Oregon TECH

2023-24
Environmental Sciences Assessment Report
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Contents

Section 1 – Program Mission and Educational Objectives

Program Mission

The Bachelor of Science program in Environmental Sciences (BES) prepares students for immediate employment and graduate studies in the assessment and monitoring of environmental conditions and problems, including research, mitigation and restoration. The BES program focuses on interdisciplinary scientific study of ecology, natural resources, and sustainability with emphases on management, research, and communication. The curriculum is comprised of four integrated core areas in ecology & natural resources; data analysis & statistics; geographic information systems (GIS); and social sciences.

Students within the Environmental Sciences program put their knowledge into practice in the best place possible—the great outdoors. Emphasis is placed on active experiential learning. The program offers numerous and diverse opportunities for students to engage in applied research and resource management projects with the support of faculty and professionals through local and regional partnerships.

Mission Statement: *Students analyze environmental conditions and problems through applied research and fieldwork, all within the stunning natural setting of the Klamath Basin.*

We believe there is a place in our program for everyone with an interest in natural resources, environmental issues, conservation and sustainability, or just being in the great outdoors! Environmental science and natural resources is a huge field that can accommodate a wide range of individual interests and skills whether it's working with wild animals, plants, people, or computers and technology. Our faculty and partners are here to help build an impressive resume of academic and work experience that will place students in the job or graduate program of their choice.

Within Environmental Sciences there are six tracks students can chose from to specialize their degree to their career goals:

- Wildlife Fisheries and Natural Resources
- Recreation and Science Ambassador
- Environmental Business and Economics
- Environmental Policy and Governance
- Water and Wetland Resources
- Environmental Chemistry

Graduates can expect to find employment in federal, state, and tribal government agencies, non-governmental organizations (NGOs), and education and research institutions. Students are also well prepared to enter graduate school. Students graduating from our program have taken positions with the U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, Oregon Department of Forestry, Oregon State Police Wildlife Enforcement, Klamath County Health Department, Klamath Irrigation District, Klamath County Soil and Water Conservation District, and the Nature Conservancy.

Mission Alignment

The BES program mission closely aligns with the Oregon Tech mission: *Oregon Institute of Technology (Oregon Tech), Oregon's public polytechnic university, offers innovative, professionally-focused undergraduate and graduate degree programs in the areas of engineering, health, business, technology, and applied arts and sciences. To foster student and graduate success, the university provides a hands-on, project-based learning environment and emphasizes innovation, scholarship, and applied research. With a commitment to diversity and leadership development, Oregon Tech offers statewide educational opportunities and technical expertise to meet current and emerging needs of Oregonians as well as other national and international constituents.*

Our students experience active and applied learning in natural environments. They develop the collaboration and communication skills necessary to work on diverse teams to address environmental issues. Many students participate in research with faculty and agency partners (Table 1). Further, BES faculty and students engage with professional communities through publications and conference presentations (Table 2). These research and scholarly activities are in direct alignment with Pillars II & III of Oregon Tech's strategic plan which state:

> Pillar II COMMITMENT TO INNOVATION: Oregon Tech strives to be entrepreneurial and on the leading edge of student engagement, innovative teaching, and collaborative research.
>
> Pillar III COMMITMENT TO COMMUNITY: Oregon Tech is an active member of the communities that it serves. Students, faculty, and staff are encouraged to contribute to their physical, professional, scholarly, and social communities via leadership and active participation through their academic and professional expertise.

Table 1: Environmental Science faculty and student research projects 2022-2023.

Project	PIs	Agency Partners	Grants or gifts in kind	Number of OT students
Carnivore Study –tracking large and meso carnivores around campus	Jherime Kellerman – NSC Nate Bickford - NSC	Forest Service	10 game cameras with new rechargeable batteries and SD cards from the Forest Service	5
Halictidae Study – monitoring native pollinators and Apis mellifera on campus. Students are curating an entomological collection and contributing to the Oregon Bee Atlas project. Students are working to develop a pollen color chart for our region.	Christy VanRooyen - NSC Terri Torres - MATH	Oregon State University Department of agriculture Klamath Basin Beekeeping Association Oregon State Beekeeping Association	Field entomological collection boxes from Oregon State Bee Packages and use of honey spinner from Klamath Basin Beekeeping Association	5
Students are working to improve our current hive monitoring equipment.	Cecily Heiner CSET Christy VanRooyen - NSC Terri Torres – MATH	Farnell/Avnet and the Planet Bee Foundation	Bee Heroes Grant $1000	6

Project	PIs	Agency Partners	Grants or gifts in kind	Number of OT students
MOU with Klamath Outdoor Science School (KOSS) Students in ENV 466 wrote educational lessons for KOSS to be taught at Outdoor School	Christy Vanrooyen - NSC	Klamath Outdoor Science school		15
Forest Fire Air Quality Research – this study is examining increased hospital burden with smoke from forest fires. Current research will be expanded from the Rouge Valley to include the Klamath Basin and examine the chemical composition of particulate matter in 2022. Additionally, this grant will fund the initial establishment of the Center for Advancing Interdisciplinary Research on the Environment and Health (AIRE Center) here at Oregon Tech.	Addie Clark - NSC Kyle Chapman - PHM Kerry Farris - NSC	U.S. Health Resources and Services Administration (HRSA) Rogue Valley Hospitals	$1,000,000 HRSA allocation of funds. Provost Creativity Grant $27,000	5
Western Yellow Rail migration using stable isotopes.	Jherime Kellerman - NSC	US Fish and Wildlife Service Bureau of Land Management	$3000	1
Klamath Falls City Parks Department- established a system of permanent vegetation monitoring plots in Moore Park. Provide the city with vegetation metrics that can help inform their management, in particular with fuels reduction.	Kerry Farris - NSC	Klamath Falls City Parks Department	Summer Creativity Grant	2-5

Project	PIs	Agency Partners	Grants or gifts in kind	Number of OT students
Avian response to riparian restoration, Cascade-Siskiyou National Monument.	Jherime Kellerman - NSC	Bureau of Land Management	4-year Cooperative agreement - $12,000 in year 1	1
Post-fire vegetation recovery in a western juniper/sagebrush/bitterbrush community - 20 years after the KAGO fire.	Kerry Farris - NSC	City of Klamath Falls; Klamath Chapter of the Oregon Native Plant Society	Time assisting in surveys by members of the Native Plant Society	2-5
Factors associated with non-native grasses and forbs in a western juniper/sagebrush/bitterbrush community.	Kerry Farris - NSC	City of Klamath Falls; Klamath Chapter of the Oregon Native Plant Society	Time assisting in surveys by members of the Native Plant Society	2-5
Sprague River water quality monitoring.	Ross Wagstaff-NSC	Klamath Soil and Water Conservation District	$6,000	3
Northern Waterthrush distribution and trends	Jherime Kellermann -NSC	Pacific Northwest Research Station, US Forest Service	$150,000	2
Ecological seed dispersal community dynamics	Jherime Kellermann -NSC			2

Table 2: Environmental Science faculty and student publications and conference proceedings.

BES Publications and Conference Proceedings
Environmental Science faculty names in bold and *identifies student name. • Johnston, N.*; VanRooyen, C. 2024. *Native Pollinator and Floral Resource Relationships at Oregon Tech.* Poster presentation at the Oregon chapter of the Wildlife Society Conference and a talk given at the Oregon Tech Environmental Research Symposium. • Harrris A.*; Sterling, D.*; **Kellermann, J.** 2024. *Thinking Inside the Box: Granivore Community Experiment Along a WUI.* Poster presentation at the Oregon chapter of the Wildlife Society Conference and the Oregon Tech Environmental Research Symposium. • Hevern, J.*; Heaney, P.*; **Farris, K.** 2024. *Feasibility of Camera Traps to Inventory Small Mammals in Moore Park.* Poster presentation at the Oregon chapter of the Wildlife Society Conference • Ore, R.*.; Woltjer, P.; **VanRooyen, C.** 2024. *Floral Resources for Native Pollinators.* Poster presentation at the Oregon chapter of the Wildlife Society Conference. • **VanRooyen, C.;** Corzatt, L.; Torres, T. 2024. *Bee School – an introduction to bee keeping.* Klamath Basin Beekeeping Association class.

Section 2 – Program Student Learning Outcomes

Upon completion of the program, students will have demonstrated the following abilities:

- **PSLO 1 - Foundational knowledge**
  Attain applicable foundational knowledge, technical skills, information literacy, and experience in several core areas of ecology, natural resources, & environmental sciences.
- **PSLO 2 - Collaboration**
  Actively collaborate with local and regional agencies, organizations, and community members that represent a diversity of perspectives.
- **PSLO 3 - Science Advocacy**
  Make and advocate for science-based and sustainable solutions to local and global environmental issues.
- **PSLO 4 - Data Analysis**
  Apply, interpret, and communicate appropriate analytical and statistical techniques to answer data driven scientific questions.
- **PSLO 5 - Geospatial Literacy**
  Demonstrate geospatial literacy through the utilization of appropriate technology to identify and address environmental problems.

PSLOs are reviewed annually to maintain relevance in a rapidly evolving job market. Our agency partners advise on essential skills and desired qualifications to ensure that our graduates are successful on the job.

Section 3 – Curriculum Map

Table 3: Mapping of ISLOs and PSLOs to the environmental science curriculum. Level of application: F – Foundational P – Practicing C - Capstone

University	ISLO 1 - Communication	ISLO 2 – Inquiry & Analysis	ISLO 3 – Ethical Reasoning	ISLO 4 – Quantitative Literacy	ISLO 5 - Teamwork	ISLO 6 – Diverse Perspectives		
Program		PSLO 4	PSLO 3	PSLO 4	PSLO 2	PSLO 2	PSLO 1	PSLO 5
COURSE								
COM 111Z	F							
SPE 321					P			
WRI 121Z	F							
WRI 122Z or 227Z	P							
WRI 345, 410, or 327	P							
ECO 201 or 202							F	
MATH 111				F				
MATH 112				F				
MATH 361		F		F				
MATH 362		P		P				
PHY 201				F			F	
BIO 211							F	
BIO 212	F	F			P			
BIO 213							F	
ENV 108					F			
ENV 111							F	
ENV 217			F				F	
ENV 224		F	P				P	

ENV 226	P	P		P			P	
ENV 314			P			P	P	
ENV 355			P			P	P	
ENV 434		C						
ENV 485			P					
GEOG 105								F
CHE 221-223		F		F				F
CHE 315		P		P				
GIS 105								F
GIS 134								F
GIS 205								P
Plant elective					C		P	
Wildlife elective		C						C
Water elective	P	P		P				
ENV 466	C							
ENV 485		C						
ENV 420	C	C			C	C	C	
ENV 495 or BIO 255, 355,455	C	C		C	C			C

Section 4 – Assessment Cycle

Table 4: BES assessment cycle 2021-2024. Level of application: F – Foundational P – Practicing C - Capstone

ISLO	PSLO	2023-2024	2024-2025	2025-2026
Communication			BIO 212 L – F ENV 226 – Final Presentations - P ENV 420 – Extern - C Research classes – C Exit Interviews – C	
Inquiry & Analysis	**PSLO 4**	ENV 226 BIO 212L CHE 315 ENV 434 Exit Interviews		

Ethical Reasoning	**PSLO 3**		ENV 111 -F ENV 355 - P ENV 375 - C ENV 484 –- P Exit Interviews	
Quantitative Literacy	PSLO 4	ENV 226 - P BIO 212L – F CHE 315 - P ENV 434 – C Research classes - C Exit Interviews		
Teamwork	**PSLO 2**		ENV 108 – F BIO 212 L – F ENV 375 – P Research Classes - C ENV 420 - C Exit Interviews	
Diverse Perspectives	**PSLO 2**			ENV 217 - F ENV 314 – P ENV 355 –P ENV 420 – C Exit Interviews
	PSLO 1	Assessed annually through curriculum completion. Exit Interviews	Assessed annually through curriculum completion. Exit Interviews	Assessed annually through curriculum completion. Exit Interviews
	PSLO 5			GEOG 105 – F GIS 205 – P Wildlife Elective - C Research Classes Exit Interviews

Section 5– Assessment Data Collection Processes

In 2023-24 data was collected on two of six ISLOs and two of five PSLOs:

- ISLO 2 – Inquiry and Analysis
- ISLO 4 – Quantitative Literacy
- PSLO 1 - Attain applicable foundational knowledge, technical skills, information literacy, and experience in several core areas of ecology, natural resources, & environmental sciences.
- PSLO 4 - Apply, interpret, and communicate appropriate analytical and statistical techniques to answer data driven scientific questions.

Performance Target:
The overall standard of success established by BES faculty members was a minimum of 80% of students assessed would score 75% or higher on the chosen artifact.

Activity:

Annually, students demonstrate the attainment of foundational knowledge (PSLO 1) through the successful completion of curriculum. Data for the assessment of this PSLO includes enrollment and retention data. Each year the faculty review the curriculum to ensure that students are obtaining the skills necessary for job success.

Direct assessment data for the Inquiry and Analysis ISLO, Quantitative Literacy ISLO, and Data Analysis PSLO was collected in the following courses: ENV 226, BIO 212 L, CHE 315, ENV 434, and our research courses.

The assignments for our assessment data can be found in Appendix A.

Sample:
Here are the sample sizes for each of the courses where assessment data was collected. One challenge of doing assessment within a relatively small program like BES, is that when we collect data within courses, the sample size is not generally statistically significant.

- Inquiry and Analysis, Quantitative Literacy, and Data Analysis
    - ENV Project Symposium presentations – 16 students
    - ENV 226 – 13 students
    - BIO 212L – 52 students
    - CHE 315 – 9 students
    - ENV 434 - 7 students
- Exit Interviews – 1 of 10 graduating seniors
- First year retention rates – 12 students

Reliability: The instructor of record was responsible for assessing the artifacts for their classes. At the end of the term, each instructor recorded their data in a Qualtrics survey created for ENV Assessment. The Environmental Science assessment coordinator is responsible for gathering all other provided assessment data.

Rubric: Rubrics for the BIO 212L project, the ENV 226 Lab assignment, and the ENV 434 assignment are provided in Appendix B.

Section 6– Assessment Data

Program Enrollment:

Table 5: BES Fall term week 4 headcounts 2018-2023.

Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
42	37	36	40	42	39

Enrollment within the environmental sciences program has remained relatively stable over the last six years. Unsurprisingly, we saw a small dip in enrollment during the height of the COVID 19 pandemic, but the fall 2022 data indicates that the program has recovered from the pandemic. Enrollment and retention continue to be of great concern for the environmental program and will be further addressed in our action plans.

1st Year Retention Rates

Table 6: First year retention rates with the BES program. Based on week 4 headcounts throughout the academic year.

2016-17	2017-18	2018-19	2019-20	2020-21	2022-23	2023-24
62%	70%	45%	50%	60%	75%	62%

A first-year retention rate of 62% is less than Oregon Tech's target of 75% but still better than the national average retention rate of 59% for public undergraduate institutions as given by the National Center for Education Statistics. It should be noted that with an average incoming class of only 10 students, a one or two student decrease greatly affects our retention rates.

Employment Rates and Salaries:

100% of Oregon Tech Environmental Sciences graduates are either employed or seeking an advanced degree within six months of graduation with a median salary of **$33,436.** Employment rate and salary data is based on the 2022 graduates of the BES program, and was collected via exit surveys, career services surveys, and LinkedIn. In 2023-24, we know that **90%** of graduates were employed by graduation, however, salary data was not available as career services on campus are no longer tracking this data. Hopefully, with changes to exit interviews on campus, we will be able update this data in next year's report.

The amazing success of our graduates should be attributed to the well-designed program curriculum and the many opportunities for our students to do research or hold intern positions during their education. These experiences give our students the outstanding professional and technical skills needed in the competitive job market.

ISLO and PSLO data:

Table 7: ISLO and PSLO data for 2021-2022.

Performance Criteria	Assessment Methods	Application Level	Performance Target	Results	Met?
Inquiry and Analysis, Quantitative Literacy, and Data Analysis	ENV 226 – Final project presentations	P	80% of students scoring a 75% or higher	**100%**	Yes
Inquiry and Analysis, Quantitative Literacy, and Data Analysis	BIO 212L – Rapid Ecological Study	F	80% of students scoring a 75% or higher	**100%**	
Quantitative Literacy	CHE 315	P	80% of students scoring a 75% or higher	**88%**	
Inquiry and Analysis, Quantitative Literacy, and Data Analysis	BIO 377	C		**100%**	Yes
Inquiry and Analysis, Quantitative Literacy, and Data Analysis	ENV Project Symposium	C	80% of students scoring a 3 out of 4 on the Inquiry and Analysis and Quantitative Literacy Rubrics	**95%**	Yes

BES 4-year Graduation Rate	Equity Dashboard Data		Natural Science department goal of 50%	**42.9%**	No
BES 6-year Graduation Rate	Equity Dashboard Data		Oregon Tech goal of 50% Natural Science department goal of 75%	**71.4%**	Yes for university. No for Natural Science department although improving.
BES first year retention rate	Equity Dashboard Data		75% goal set by Oregon Tech	**75%**	Yes
DFWI rate in BES specific courses.	Equity Dashboard data		Less than the institutional average of 12%	**4.3%**	Yes

Equity Gaps:

No equity gaps were identified in the courses chosen for the 2023-24 assessment process mostly due to insufficient data. Faculty were advised by the assessment executive committee to record a response of insufficient data if the class had fewer than five students within a specific demographic subcategory. The environmental science program is proud to be connecting students from underrepresented populations to innovative hands-on learning experiences. 30% of students who participated in extern (ENV 420) or research courses BIO 255, 355, 455 in 2023-24 were from underrepresented populations. Further, 30% of the enrolled students in these classes identified as first-generation college students.

The average DFWI rate for the Natural Science Department as a whole in 2023-24 was 8.9% which is less than the Oregon Tech target of 12%. When looking at the department data, it appears that students of color and first generation students have higher DFWI rates. Of these, students who identified as African American had a 16.9% DFWI rate, Hispanic 13%, and American Indian 13.1%. In Fall of 2024, our department had a special meeting dedicated to looking at this data and to discuss possible solutions to reduce these equity gaps. This will be an area of focus for 2024-25 within our department.

History of Results:

In the last 5 years the Environmental Science program has undergone major revisions to accommodate the changing needs in industry. Each year we review the program learning outcomes with guidance from our agency partners. Further, we are continually improving our assessment processes. This means that we do not have much historical data related to these specific PSLOs.

Table 7: History of results for BES assessment data.

Performance Criteria	Previous Action Plan	2018-19	2019-20	2020-21	2021-22	2022-23	Current data	Interpretation
ISLO Quantitative Literacy	None Given			100%			**100%**	Students are successful with quantitative literacy
ISLO Inquiry and Analysis	None Given			100%			**97.6%**	Students are successful with Inquiry and Analysis

PSLO Data Analysis	None Given			100%			**100%**	Students are successful with Inquiry and Analysis
4-year BES Graduation Rate	None Given	2012-13 27.3%	2013-14 31.3%	2014-15 27.3%	2015-16 40%	2016-17 22.2%	2017-18 **42.9%**	Rates below goal but improving.
6-year BES Graduation Rate	None Given	2012-13 31.8%	2013-14 43.8%	2014-15 54.5%	2015-16 50%	2016-17 55.6%	2017-18 71.4%	Rates below department goal, but improving.
BES first year retention rate	Write a Natural Science Retention Plan	70%	45%	50%	60%	75%	**62%**	Improving retention continues to be an important focus for ENV.
DFWI rate in BES specific courses.	None Given	2%	3%	1%	3%	4.3%	**2.7%**	ENV classes have very low DFWI rates.

Student Success Stories:

We continue to have amazing students within the BES program. Below are a few selected success stories about students in the program. In Appendix C, you can view the Environmental Science Research Symposium program which highlights the diversity and complexity of extracurricular work our students have been doing.

In 2023, ENV senior Kaitlyn Baker was offered a position as an Environmental Manager for Kingsly Field Airforce Base. She began as an extern in this position and upon completion of her degree she was immediately promoted to a full time Environmental Manager on base. In summer 2024, Kaitlyn came back to OIT seeking an ENV student for a summer internship writing environmental policy. Kaitlyn is an excellent example of how highly qualified our students are even before they graduate.

Tanikwah Lang held a prestigious Midewin National Tallgrass Prairie Native American Research Assistantship over the summer of 2023. Through this work she was invited to attend the first United Nations Global Indigenous Youth Summit on Climate Change, held in Italy. After graduation, Tanikwah moved to Washington D.C. for an internship with the US Department of Agriculture Future Leaders in Public Service Internship Program. She is currently pursuing her PhD through a graduate assistantship at the University of Wisconsin-Madison titled “Connecting Cultural Values and Indigenous Research Towards Food Systems Resilience”.

Blake Loney served as a fisheries biologist intern with the USGS throughout his last few years in the Environmental Science program. During his senior year, Blake took an interest education and decided to pursue a k-12 teaching position. When he graduated, he accepted a teaching position with the Klamath County School District to teach science to junior high school students. Blake is the first ENV graduate to specialize in education through courses in our recreation and science ambassador track.

Figure 1: ENV Graduates from R to L Kaitlyn Baker, Garrett McGill, Blake Loney, Dominik Sterling, Makenzie Collier, and Alyssa Harris, with ENV faculty Jherime Kellermann, Nate Bickford, and Christy VanRooyen at graduation 2024.

Section 7– Action Plans

The BES first year retention rate was 62% which is less than the university target of 75%. This year we started interviewing students who stop out of the program to inquire about why they are leaving Oregon Tech. The reasons cited are commonly financial related or due to unforeseen family circumstances. Both the retention office and faculty in our program are meeting with their first year advisees to try to identify success barriers and connect students to support resources on campus. The low DFWI rates within BES courses indicate that our retention issues are not associated with program specific curriculum. This means that students are either facing attrition in their general educational requirements or are leaving Oregon Tech for reasons other than failing their classes. The graduation rate met the 50% Oregon Tech target with 71.4% of BES students graduating in six years. This is still lower than the Natural Science departmental goal of 75% but getting closer. We have been working diligently with students through advising to get students to graduation in a timely manner.

Our action plans for the coming year will focus on recruitment and retention of students.

Action Plans for 2023-2024

Goal 1: Increase enrollment in the program.

- Continue to improve marketing materials – including the creation of marketing materials which showcase the hands on learning opportunities in our program.
- Work with admissions to develop custom communication plans for potential BES students.
- Make visits with prospective students more impactful by focusing on interactive experiences.
- Develop or improve articulation agreements with regional community colleges to facilitate transfers.
- Increase our presence in area K-12 schools.

Goal 2: Improve retention rates

- More actively connect with first year students through events and advising.
- Create an annual schedule so that students can better plan for courses.
- Explore options to help students be successful in MATH classes. We have seen a decrease in placement test scores since COVID.

ISLO data on Teamwork, Ethics, and Communication will be collected during the 2023-24 academic year. See Table 4 for more information on the classes where assessment data will be collected.

Review of 2022-2023 Action Plans

Goal 1: Increase enrollment in the program so that the retention rates are not dramatically influenced by the loss of a few individuals.

- Continue to improve marketing materials.
- Make visits with prospective students more impactful by focusing on interactive experiences.
- Connect with visiting high schools.
- Develop or improve articulation agreements with regional community colleges to facilitate transfers.
- Increase our presence in area K-12 schools.

Goal 2: Improve the culture of community within the BES program and the Natural Science Department as a whole.

- Have departmental activities that provide opportunities to engage in fun and social ways.
- Distribute workload equitably.

Goal 3: Continue to increase opportunities for students to conduct research or connect with internships.

- Implement a biology research series of courses taught by each faculty primary investigator. This will provide a means of tracking faculty and student participation in research at various levels. Presenting research findings either in a published paper or at a professional conference will be a capstone level requirement as part of this course.
- Refine the evaluation form used by employers to capture more data about our PSLOs.
- Reach out to federal and state environmental agencies to identify opportunities for faculty and students to connect with internships and research.

Goal 4: Implement the environmental track curriculum allowing students to customize their educational experience to their profession of choice.

Goal 5: Improve the assessment process for the diverse perspectives ISLO. Students within the BES program regularly consider environmental issues from a diverse range of perspectives, but we have struggled with how to assess their ability to be culturally sensitive. This will be an agenda item in an upcoming meeting.

Goal 6: Improve student's geospatial literacy.

- Better communicate expectations for displaying geospatial data.
- Add an introductory R workshop to introduce students to R sooner in their curriculum.

Section 8– Closing the Loop: Reflection on previous work

2023-24 was a productive year for the Environmental Sciences program. We continue to expand course offerings with new tracks in the program. This year we added the Environmental Chemistry track. We have increased the number of community partnerships which provide experiential learning opportunities for our students through research and internships. For the first time, faculty within the ENV program provided a summer study abroad experience to

Scandinavia and the Baltics (Iceland, Finland, Sweden, Estonia). We had 8 students present research at the Oregon chapter of the Wildlife Society Conference in Feb. of 2024.

While Goal 1 to increase enrollment remains a priority, our numbers remained relatively stagnant in 2023-24. We have improved the program overview flyer and created a research flyer describing some of the projects are faculty are leading with students. We had excellent matriculation of students who visited campus last year. About 95% of high school seniors who visited with a BES faculty member on campus enrolled in the program. This indicates the need to invite more prospective students to campus and to increase the opportunities for personal connection. Every faculty member in the BES program visited an area high school last year as part of outreach efforts. We developed an articulation agreement with Mt. Hood Community college in hopes of increasing transfers from their to Oregon Tech.

Related to Goal 2, we have tried to more evenly distribute advisees to BES faculty as new students enroll in the program. The Natural Science department has focused on teambuilding this year through a department retreat in September, a group Halloween event in October, a holiday party in December, and an end of year BBQ in June. Such events foster belonging and inclusion for members of our team.

ENV 108 continues to be an important class for fostering connection between students and faculty. In 2023-2024, we camped at the Siskiyou Field Institute in Selma, Oregon and explored the unique serpentine ecosystems found there.

As shown in Table 1, we are continuing to increase our partnerships in the region and providing research opportunities for our students. These high impact experiences are key to professional development in BES. Our department implemented a series of research courses (BIO 255, 355, 455) where students will work on specific research projects under a faculty mentor. This provides a means to track both faculty and student participation in research endeavors and creates a way for faculty to receive teaching load for this important work. This provides a means for tracking faculty workload related to this work (Goal 3). We also expanded the ENV Research Symposium to include both a poster session and talks allowing more students to be involved.

We accomplished Goal 4 and implemented the new track curriculums. We added an additional track this year in Environmental Chemistry.

We have more clearly identified places to assess Diversity, Equity, and Inclusion in the program and have a better plan for collecting data in the future (Goal 5). We have spent more time this year exploring equity data by looking at things from the departmental level rather than just the program level. This has provided greater insight into potential equity gaps within the Natural Sciences. We have had excellent conversations about how to bridge these gaps and are excited that our program already includes many high impact practices including project based and service learning opportunities.

We added a 1 credit introductory course in R in 2023-24 to improve student geospatial literacy (Goal 6). 24 students took this class. We plan to review the GIS curriculum in 2024-25 in response to evolving geospatial software and trends within environmental literature.

The Environmental Science program is building a reputation for excellence in science regionally. Our faculty have embraced Charge 4 of the Academic Master Plan "To develop a path for progress in entrepreneurial and collaborative applied research, inclusive pedagogy, and service to the profession, that broadens access, promotes student learning and success, and enhances the intellectual life of our students, faculty, and staff." We are thrilled with the successes we have had this year and look forward to continued improvement in the future.

Appendix A– Assessment Artifacts

Rapid Ecological Study (RES)

Part I: An Introduction to the RES Project

Biology is the study of the phenomena of life, and biological scientists – researchers, teachers, and students – observe living systems, ask questions, and propose explanations for those observations. The scientific method is a way of testing proposed explanations and the primary goal of this term's project is for you to gain experience with each step of this important process. During the course of this term project, you will:

- Formulate a research question on a topic relevant to topics covered this term
- Conduct a literature search
- Develop a study design
- Perform original peer-group research in the field
- Analyze data
- Present results via a peer-group presentation AND an *individual* scientific paper

The unique aspect of this project is its intended length and scope - RAPID. While scientific research can often take months or years to complete, you will conduct your field or lab research over just a few hours, or days. Similarly, many published scientific papers in ecology are over 5,000 words. Your paper will be only 500 words – yet it will contain all the typical aspects of a scientific article including: abstract, introduction, methods, results, and discussion, plus one or two figures or tables.

In addition to your scientific paper, you will present your project via an oral presentation, which will be evaluated by both your instructor and your peers – an essential aspect of science. Finally, you will play the role of critical reviewer, providing constructive feedback to your fellow lab students.

Part II: Project Steps

This term project encompasses the 8 steps of the scientific process outlined in lab 1's exercises. You and your group will work through each step in the process over the next 8 weeks by completing in-lab exercises and a series of associated assignments.

Step 1 – Observe and Ask Questions About the Natural World			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
List of three potential research topics	end of week 2	Individual	Canvas

Any scientific inquiry begins with an observation we are trying to understand and explain. Scientists use their study of previous research or personal observations of natural phenomena as a basis for asking questions about the underlying causes. Recall from Lab 1 that for a question to be pursued by scientists, it must address phenomena in the natural world that are **well defined** and **testable**. When selecting a topic for research this quarter, it's extremely important to consider several constraints:

- *Topic* – you are free to come up with your own topic, keeping in mind that the overarching theme of this quarter is *ecology* – the branch of biology that deals with the *relations of organisms to one another and to their physical surroundings* – so your project should fit this general definition.
- *Time* - while this course is 10 weeks, if you plan your project according to the timeline provided in the RES project guidelines, then you only have 2 weeks (3 at the absolute most) to collect your observations and data. If you plan out all the details of your project very early in the quarter, it may buy you another 1 or 2 weeks for observation. Essentially, your project needs to be something that can be observed in a short period of time. Ideally, you will ***complete your observations by week 7***.

- *Group Coordination* – making sure all members of your group can adequately participate in the project is essential, so please consider the following when selecting your research topics and the logistics that may be involved with it.
    - Will your study be conducted on campus or off campus? If off campus, does everyone have transportation?
    - Will you need access to the lab? If so, will everyone in the group (including your instructor) be able to meet you in the lab at the required intervals so your group can conduct the study?
    - Does everyone's schedule allow for the time it will take to collect the data?
- *Costs and Equipment* – we don't expect you to spend significant sums of money on this project. Effective research projects can be done with little to no cost if well planned. That being said, *we may be able to help you* with the provision of equipment and some supplies, so please ask your instructor once you narrow down your questions.
- *Short List of Possible RES Projects* – the following is hardly an exhaustive list of potential topics for your RES project but are provided as examples to get you thinking.
    - Study the behavior (response to a stimulus of some sort – temperature, light, food, etc.) of small, easily managed animals like aquarium fish, hermit crabs, isopods, or annelids.
    - Study the population ecology of those same small, easily managed animals placing different densities in habitats and observing their behavior, aspects of their health, etc.
    - Study the growth of fungi to various environmental factors (light, moisture, temperature, etc.)
    - Examine whether the density and/or community composition of trees or other easily identifiable plants change in relation to some abiotic factor (e.g., aspect, elevation, soil type, snowpack, etc.).
    - Examine whether the microorganisms that live in lichen differ between habitat types (e.g., will lichen collected on rocks have a different microorganism community than lichen collected on trees).
    - Compare the survival of trees in areas of varying burn severity of a local wildfire (e.g., 2-4-2, Bootleg, Caldwell, etc.)
    - Examine the habitat use of easily observable birds during the winter (e.g., American Robin, Dark-eyed Junco, etc.).
    - Explore the variables that might affect tree well (the space around a tree under its branches that does not get the same amount of snow as the surrounding open space) formation (e.g., tree diameter, tree height, surrounding tree density, tree species).
    - Examine whether snow pack in burned areas differs with burn intensity.
    - Explore winter habitat use of burned areas by small mammals differ with burn intensity.

Step 2 – Conduct Background Research			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
Evaluation of three primary literature sources	End of week 3's lab period	Peer-group	Canvas
1st draft of introduction and literature cited sections of paper	End of week 4	Individual	Canvas
1st draft of discussion and literature cited sections of paper	End of week 7	Individual	Canvas

Conducting background research, sometimes called a "literature review", is a valuable step in any research project. Familiarizing yourself with the system of interest through the gathering of published literature provides baseline knowledge of the topic, helps refine hypotheses, and can assist in the design of an effective experiment. Week 2's lab and its associated exercises and assignments will outline effective methods for finding reliable information using OIT's library and other internet sources.

Step 3 – Develop a Hypothesis			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*

Project hypothesis	End of week 3	Peer-group	Canvas

Recall from our Lab 1 exercises that a scientifically useful hypothesis must be ***testable*** and ***falsifiable***. In order to be falsifiable, it must be possible that the test results do not support the explanation. In our example lichen study, the *test* was to compare the abundance of lichen on trees across the four primary aspects (north, south, east, and west). If the abundance of lichen was equal across all aspects, then the hypothesis was *falsified*. Conversely, if we found more lichen on the north side of our sample trees, then the hypothesis was *supported* by the data.

Step 4 – Define Variables and Generate Predictions			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
Definition of variables and generation of predictions	End of week 4's lab period	Peer-group	Canvas

In order to make predictions and design an experiment to test a hypothesis, the investigator must identify and define the ***dependent***, ***independent***, and ***controlled*** variables.

Dependent variables are those that are measured, counted, or observed in response to experimental conditions (e.g., the number of lichen on a given aspect of a tree). The *independent* variable is considered the most important variable, as it is used to test the investigator's hypothesis. It is the variable that is manipulated by the scientist (e.g., the aspect on the tree where lichen are found).

Controlled variables are alternative independent variables that might have an effect on the dependent variable but are not part of the hypothesis being tested. For example, other conditions might affect the frequency of lichen on a tree that are not related to our independent variable of interest such as: tree species, depth of bark furrows, or the amount of shade cast on the surface from neighboring trees or structures. To effectively test the effect of sun exposure on lichen abundance, these other variables must be held constant, or be *controlled*. This could be accomplished by ensuring that observations are recorded on the same tree species, with similar bark complexity, shading, etc.

Finally, an effective research hypothesis should have an associated ***prediction***. A prediction is what you expect to see in the data if your hypothesis is supported. One way to easily formulate a prediction from your hypothesis is to think of it in terms of if/then statement that predicts the outcome of your test if the hypothesis is supported. For example, "If the abundance of lichen is inversely related to sun exposure, then there will be significantly more lichen on the sides of the tree that are shaded (north aspects) than the sides of the tree that receive more sunlight (south aspects).

Step 5 – Design Tests of the Predictions			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
Study design, equipment list, project timeline	End of week 4's lab period	Peer-group	Canvas

A study design is a specific plan or protocol for *testing your predictions*. It allows the investigator to translate the conceptual hypothesis into an operational one. This step often requires some background knowledge of your topic, either through personal observations, experience, or a search of the literature – a step that your peer-group conducted during week 2's lab. While it may seem daunting at first, begin by recalling the hypothesis your group decided to test (step 3, above), then using the variables defined in step 4's assignment, think about how you will measure, observe, and/or control them. For example, to examine the effect of sun exposure on lichen abundance, we needed to:

1. Define an area or population of trees from which to draw lichen samples.

2. Ensure that the trees are the same species, of similar ages, and share similar light exposure patterns (controlled variables).
3. Determine a method of quantifying lichen on each tree.

Recall from lab 1 that drafting a data collection sheet can be helpful in organizing the required information. Be sure to think about what you are measuring and why. For example, in lab 1, we quantified lichen at predetermined heights around the entire circumference of the tree which enabled us to effectively evaluate the hypothesis that lichen abundance is inversely related to sun exposure. In addition to the core variables, is there other ancillary information that would help contextualize and organize your data? In the lichen study, we recorded information such as tree number, sample height, and tree circumference as they were useful in determining in which aspect lichen were most abundant.

Step 6 – Conduct Test by Observing or Measuring in the Field			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
Spread sheet of collected observations (raw data)	End of week 5	Peer-group	Canvas

During this step, your group will collect data in the field according to the study design created in step 5’s assignment. Observations (data) will be entered into a spreadsheet and submitted to your instructor.

Step 7 – Examine the Results			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
Tables and Figures	End of week 6	Peer-group	Canvas

Once data is collected, they must be organized and summarized so that your group can determine if the hypothesis has been supported or falsified. This step can be daunting for many, fun for others. This is where you get to examine the data your group collected and look for relationships between your variables. Scientists typically use tables and figures to achieve this goal. These tools assist in analysis and interpretation, in addition to enhancing the clarity with which results are presented to the reader or evaluator.

Tables – are useful for displaying **summarized** results (NOT RAW DATA) when the quantitative values, rather than trends, are the focus. For example, when the average number of some variable is a useful measure of the experiment’s success (e.g., the mean abundance of lichen on north aspects is greater than the mean abundance of lichen in the south, west, and east aspects).

The following guidelines will help you construct a successful *table*:

- All values of the same kind should read down the column, not across a row. Include only data that are important in presenting the results and for further discussion.
- Information and results that are *not* essential (e.g., test tube number, subject’s name, etc.) should be *omitted*.
- The heading of each column should include units of measurement, if appropriate.
- Tables are numbered consecutively throughout a lab report or scientific paper.
- The title, which is located at the top of the table should be clear and concise, with enough information to allow the table to be understandable apart from the text.

Figures – graphs, diagrams, drawings, and photographs are all called figures. They provide visual representation of the results. Often, characteristics of the data that are not apparent in a table become clear in a graph. The results of an experiment usually are presented graphically, showing the relationships among the independent and dependent variable(s).

The following guidelines will help you construct a successful *graph*:

- The independent variable is graphed on the x-axis and the dependent variable on the y-axis.
- The numerical range for each axis should be appropriate for the data being plotted. Choose your intervals and range to maximize the use of the graph space. Keep intervals spaced such that interpretation remains clear.
- Label the axes to indication the variable and units of measurement. Include a legend if colors or shading are used.
- Chose the type of graph that best presents your data. Line and bar graphs are the most frequently used. This choice of graph depends on the nature of the variable being graphed.
- Compose a title for your figure and place it below your graph. Figures should be numbered consecutively throughout lab reports or scientific papers. Each figure is given a caption or title that describes its contents, giving enough information to allow the figure to stand alone.

Step 8 – Interpret and Communicate Results			
Associated Assignments	*Due*	*Submission Type*	*Submission Location*
1st draft of introduction and literature cited sections of paper	End of week 4	Individual	Canvas
1st draft of discussion and literature cited sections of paper	End of week 7	Individual	Canvas
Peer Group Presentation	During weeks 9 & 10	Peer-group	In lab and on Canvas
Final Paper	End of the day of your assigned lab period during week 10	Individual	Canvas

The final step of your RES project is to communicate your results. There are two major ways that scientific information gets communicated among colleagues and the general public. The first is an oral presentation, often conducted during a conference gathering of scientists with similar interests (The Ecological Society of America, for example). The second is a written publication in a peer-reviewed scientific journal. For the RES project, you will synthesize everything you have done into a brief, yet informative, *oral presentation* AND a *500-word[1] scientific paper.*

<u>*Oral Presentation*</u>
Your ***peer group*** will create a concise 15-minute visual summary of your research project for presentation to your peers during the last two lab sessions of the quarter.

<u>*Scientific Paper*</u>
You will ***individually*** write a concise 500-word[1] summary of your project and include the following *seven key aspects of a successful scientific paper*:

1. <u>*Title:*</u> Strive for a concise, yet informative title that lets the reader know what the paper is about.

2. <u>*Abstract*</u>: This is a very brief summary of the entire paper. It should include a sentence that states the research question and why it is important to the larger topic being studied; a sentence describing the methods; one or two sentences about your results; and a concluding sentence. Literature is not cited in the abstract.

3. <u>*Introduction*</u>: This section establishes the context for your research and includes the following:
    a) A statement of the importance of the topic you are studying. Why should the reader care?
    b) A brief summary on the current knowledge on your topic by citing at least 3 peer reviewed papers.
    c) Justification for your hypothesis and/or an explanation of how your specific research question will fill an

[1] Note that the 500-word count only applies to narrative sections. It does not include the paper's title, the abstract, references, figure captions, etc.

existing gap in or contribute to the overall body of knowledge on your topic.

d) A clear statement of your research question and hypothesis.

e) A clear statement of at least one prediction based on your research hypothesis.

In essence, an introduction starts “big” introducing your general field of research and works down to how your specific study fits into that large picture. This is the opposite of your discussion (see hourglass figure below). A primary element of the introduction is a review of the current scientific literature that builds justification for your hypothesis; thus, you will be citing the primary literature frequently throughout this section of your paper. Essentially, any statement of fact needs to include a citation. For example, the following sentence asserts how and why lichen are important and backs up the statement by citing published research.

Lichen are key components of terrestrial ecosystems due to both their pioneering and engineering capabilities (Asplund et al. 2017).

When the source paper is authored by only one researcher (as above) simply include the author’s last name and the year of publication. If the paper has two authors, list both, followed by the year (Sheard and Jonescu 1974). A paper with more than two authors only lists the first author’s name followed by et al. and the year (Schoustra et al. 2005). A statement that is supported by more than one source separates *each source* with a comma (Barrow 2000, Leu and Murray 2006, Dettman et al. 2007).

4. *Methods*: Describe where and how you set up your study design, exactly how you collected your observations, and the materials and supplies used. *It should have enough detail to allow a reader to replicate your study.*

5. *Results*: This section *narratively summarizes* your results from the analysis of your data. It reports the facts of what you found. Your description of results will refer to your tables and/or figures that also *summarize* your data. For example, “Lichen abundance was greatest on north aspects with a mean of 5.7, and lowest on south aspects with a mean of 0 (Table 1 and Figure 1).” This lets the reader know they should refer to both Table 1 and Figure 1 in your paper for a visual representation of your findings. This section presents summarized, *not raw* data. This section does not interpret your results in any way. That is saved for the discussion section. Raw data is *NOT* reported – only summaries of data.

   a) *Figures and/or Tables*: You must include at least one figure or table in your paper. Figures and tables should *summarize* your data and emphasize your key results. They should not show raw (the full set of unanalyzed data) data. Figures and tables also *require a caption*. Captions must be numbered and should completely describe the figure or table such that they could stand alone, independent of your paper, and the reader would still have an idea of the question your study examined. Placement of captions differs between tables and figures. Table captions are placed above the table, while figure captions are placed below (see example below).

Table 1. Mean lichen abundance across four directional aspects sampled from three trees on the Oregon Tech campus, Klamath Falls, Oregon.

Tree	Aspect			
	North	East	South	West
1	5	0	0	3
2	3	2	0	0
3	9	1	0	2
Mean	5.7	1.0	0.0	1.7

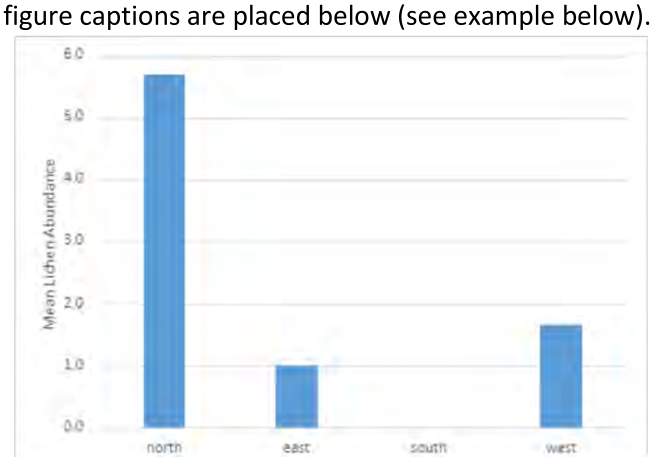


Figure 1. Mean lichen abundance across four directional aspects sampled from three trees on the Oregon Tech campus, Klamath Falls, Oregon.

6. *Discussion/Conclusion*: This section reiterates your key results using brief, summarizing statements. It does ***not*** report hard numbers or statistics. Did your observations support or refute your original hypothesis and prediction? How do your results compare with other studies examining similar questions (this is where you will cite other studies)? If your results were not as you expected speculate and discuss why. Was it your methods? Study sites? The time of year? What would you do differently if you repeated this study?

7. *References*: Here you will list, in alphabetical order by author, all the papers you cited within your RES report. We will use the official format and style of the Ecological Society of America (ESA) which publishes numerous professional journals in the field of ecology. ESA style formatting is as follows and needs to be followed EXACTLY:

Journal article with one author:

FORMAT: Last name, First initial. Second initial. Date. Title. Italicized journal title volume number(issue- if applicable): inclusive page numbers.

EXAMPLE: Smith, V. H. 1986. Light and nutrient effects on the relative biomass of blue-green algae in lake phytoplankton. *Canadian Journal of Fisheries and Aquatic Sciences* 43:148–153.

Journal article with two or more authors:

FORMAT: Last name and initial(s) of author, followed by initials and then Last name of additional authors. Year of publication. Title of article. Italicized journal title Volume number(issue – if applicable): Inclusive page numbers.

EXAMPLE: Elser, J. J., and K. Urabe. 1999. The stoichiometry of consumer-driven nutrient recycling: theory, observations, and consequences. *Ecology* 80:735–751.

EXAMPLE: Elser, J.J., K. Urabe, and D.B. Cooper. 1999. The stoichiometry of consumer-driven nutrient recycling: theory, observations, and consequences. *Ecology* 80:735–751.

Online journals that don't have volume, issue, or page numbers

FORMAT: Last Name, First Initial. Second Initial. Year of publication. Title of article. Italicized Title of Journal. DOI number.

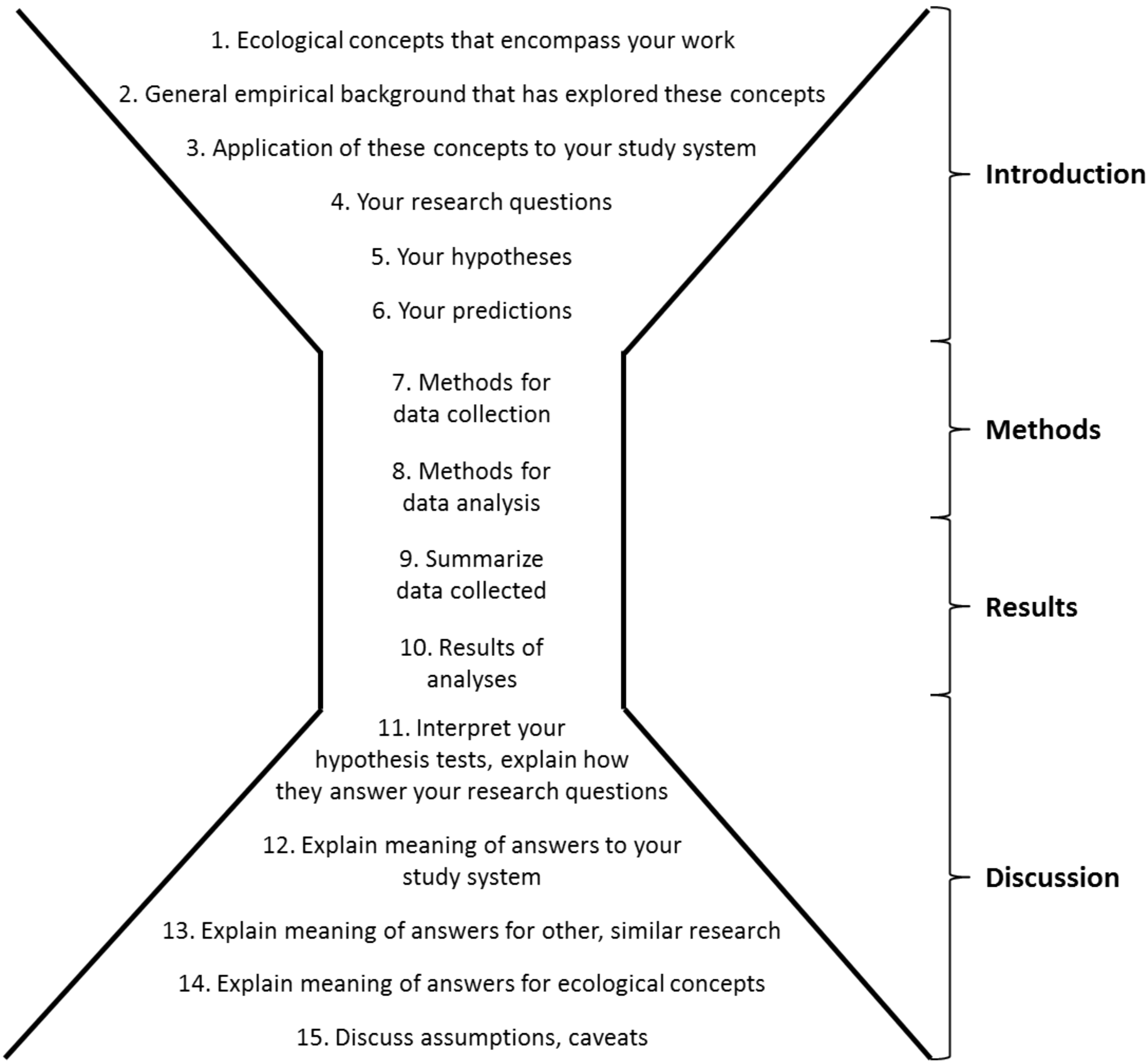
EXAMPLE: London, J. M., J. M. Ver Hoef, S. J. Jeffries, M. M. Lance, and P. L. Boveng. 2012. Haul-out behavior of harbor seals (*Phoca vitulina*) in Hood Canal, Washington. PLoS ONE 7:e38180. doi:10.1371/journal.pone.0118883.

Notes on ESA Style

- Always list the author names in the order in which they appear on the paper. Researchers carefully determine the order of authorship on a paper, and you need to preserve it to ensure that the article is recognizable, findable, and fairly credited.
- Note that all author names are listed as first initials and last names. Even if you know the whole first name, the Ecology format dictates that using initials only in the Literature Cited list. Note also that the first name is given last name first, then initials and any additional authors are listed initials first, then last name.
- Note that there are spaces between the initials.
- Note that the journal name is written out completely. In older issues of Ecology, citations included bold font for volume number of journal articles. In recent issues, the volume number has not been bolded. Note that issue numbers for journal articles are not listed.

- Always italicize species names.
- Please DO NOT follow your citation with a weblink to the article! DOI numbers are permitted, but not full weblinks.

Putting It All Together. Illustrated in the figure below is a helpful way to organize your thoughts when writing your paper. The scientific process goes from a broad concept about your topic and narrows when we formulate our hypothesis. Our focus then becomes very specific while we collect and analyze our data but begins to expand back out as we draw conclusions and relate our findings to the broader body of knowledge on the topic. One of the most helpful things you can do while writing your own paper is to examine published literature. Strive to pattern your writing after the articles you have read and cited in support of your paper. How do those authors organize their introduction? What aspects of their methods do they describe? How do they describe their results?



Part III: Overview of RES Project Requirements and Due Dates

The following table provides an overview of all the activities and assignments required of you and your peer group in order to successfully complete the RES project this term. Specific details of each assignment are posted on canvas.

Week	In Lab RES Activity	In Lab RES Assignment	Submission Type	Due Date	Homework Due Before Next Lab	Submission Type	Due Date
2	Basics of Scientific Investigation	Skills Inventory	*Individual* Hardcopy	Before Leaving Lab	Step 1. Observe and Ask Questions About Natural World	*Individual* Canvas	End of week 2
3	Step 2. Background Research	Evaluation of Three Primary Sources	*Group* Hardcopy	Before Leaving Lab	Step 3**.** Develop a Hypothesis	*Group* Canvas	End of week 3
4	Step 4. Define Variables and Generate Predictions	Defined Variables and Predictions	*Group* Canvas	Before Leaving Lab	Step 8. Interpret and Communicate Results – *Introduction*	*Individual* Canvas	End of week 4
	Step 5. Design Tests of the Predictions	Study Design					
5	Step 6. Conduct Test by Observing of Measuring in the Field	Collect Data **NO LAB THIS WEEK**	None	None	Step 6. Conduct Test – *Raw Data*	*Group* Canvas	End of week 5
6	Step 7. Examine the Results – *Data Organization and Analysis*	None	None	None	Step 7. Examine the Results – *Tables and Figures*	*Group* Canvas	End of week 6
7	Step 8. Interpret and Communicate Results – *Discussion*	None	None	None	Step 8. Interpret and Communicate Results – *Discussion*	*Individual* Canvas	End of week 7
8	Step 8. Interpret and Communicate Results – *Presentation*	None	None	None	Step 8. Interpret and Communicate Results – *Presentation*	*Group* Canvas	End if week 8
9	Step 8. Interpret and Communicate Results – *Final Paper*	*Group* Presentation (half the class)	*Group* Canvas	Before Leaving Lab	Final Paper	*Individual* Canvas	End of your assigned lab day during week 10
10	Step 8. Interpret and Communicate Results	*Group* Presentation (half the class)	*Group* Canvas	Before Leaving Lab	Final Paper	*Individual* Canvas	End of your assigned lab day during week 10

BIO377 – Wildlife Ecology

Lab – Giving Up Density (GUD) analysis

Download the GUD data from Google Sheets https://docs.google.com/spreadsheets/d/10bRj_exu1qQynEiFJjyjexHYPRxCuGv95lMTbZQSDRI/edit?usp=sharingLinks to an external site.

Your assignment is to determine if GUD is associated with the habitat variables we collected. You could assess habitat as simply open and forest (categorical) or as a quantitative continuous measure (e.g. % shrub cover). You can do this in excel, but ***I challenge you to use R*** to do some analysis as we did in the Jay lab. Below is some R code to get you started. You can run generalized linear models and AIC to select the best models.

What to turn in (submit as a word document - include the names in your group):

- A short paragraph or two summarizing your results. Make sure to start off clearly stating the question.
- At least 1-2 figures and table supporting your conclusions.
- Your R code.

getwd() #This will tell you your current working directory - in the files tab (lower right) you can navigate to a new file, click **more**, and click **Set as working directory**

```
gud<-read.csv("GUD data_2023.csv")
names(gud)
```

```
install.packages("ggplot2")  #a great package for data visualization
library(ggplot2)
```

#it helps to start off with some data visualization, below is a boxplot which shows mean and median

```
bp1<-ggplot(gud,aes(x=Habitat, y=GUD, fill=Habitat)) +
 geom_boxplot(notch=TRUE) + stat_summary(fun.y=mean, geom="point", shape=23, size=4)
bp1
```

#this will create a scatterplot with the best fit regression line

```
sp1<-ggplot(gud, aes(x=Shrub_cov, y=GUD)) + geom_point() +
 geom_smooth(method=lm)
sp1
```

#now you can run some generalized linear models - you can include categorical and quantitative variables

```
m1<-glm(GUD~Habitat,data=gud)
anova(m1,test="Chisq")  #this will tell you if the variable is significant
```

```
m2<-glm(GUD~Shrub_cov,data=gud)
anova(m2,test="Chisq")

aic<-AIC(m1,m2)
ord.aic<-order(aic$AIC)
aic[ord.aic,]

#you can take your best model and graph the variables using method above
```

BIO377 Quantitative Literacy

Quiz/Exam questions

I assigned a paper by Strickland et al 2011 that found the following results for nesting Gray Jays (now called Canada Jays). What is the mechanism associated with habitat quality that may be driving this pattern?

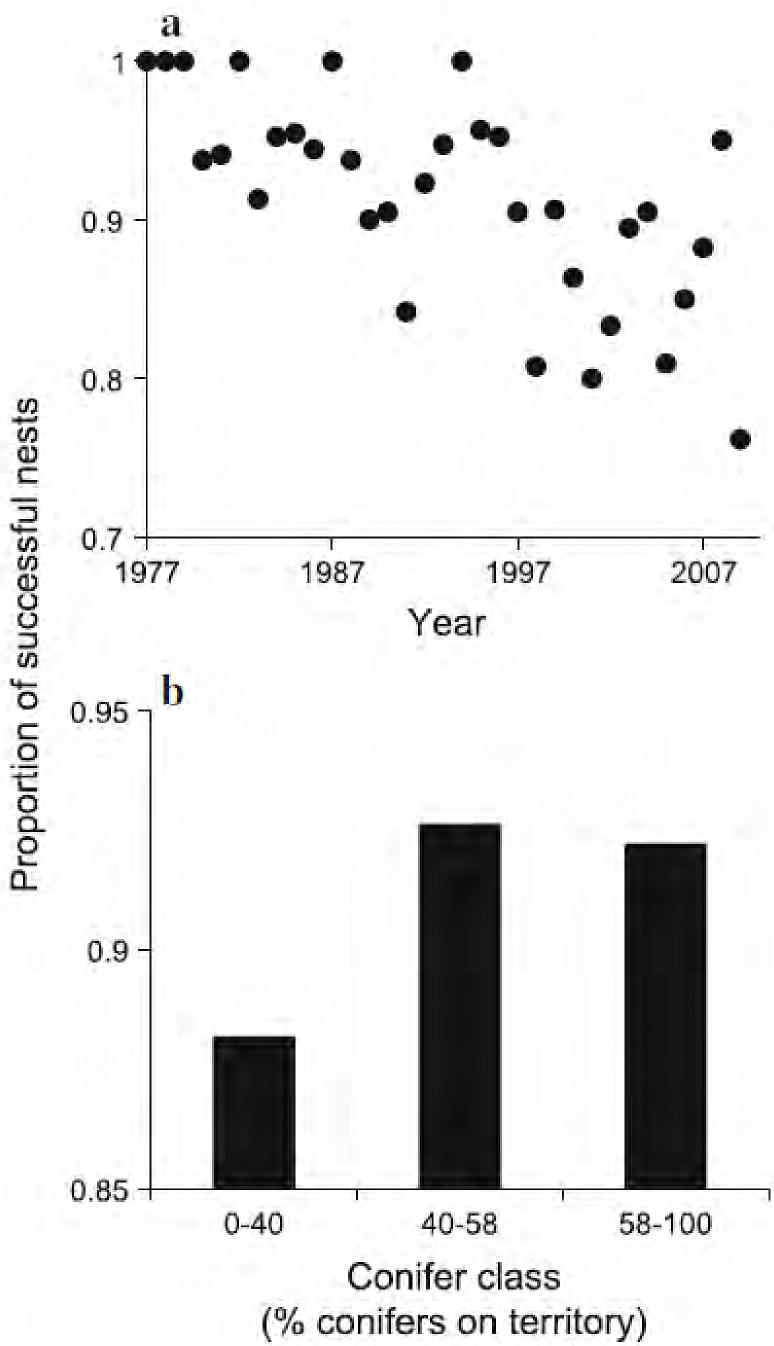
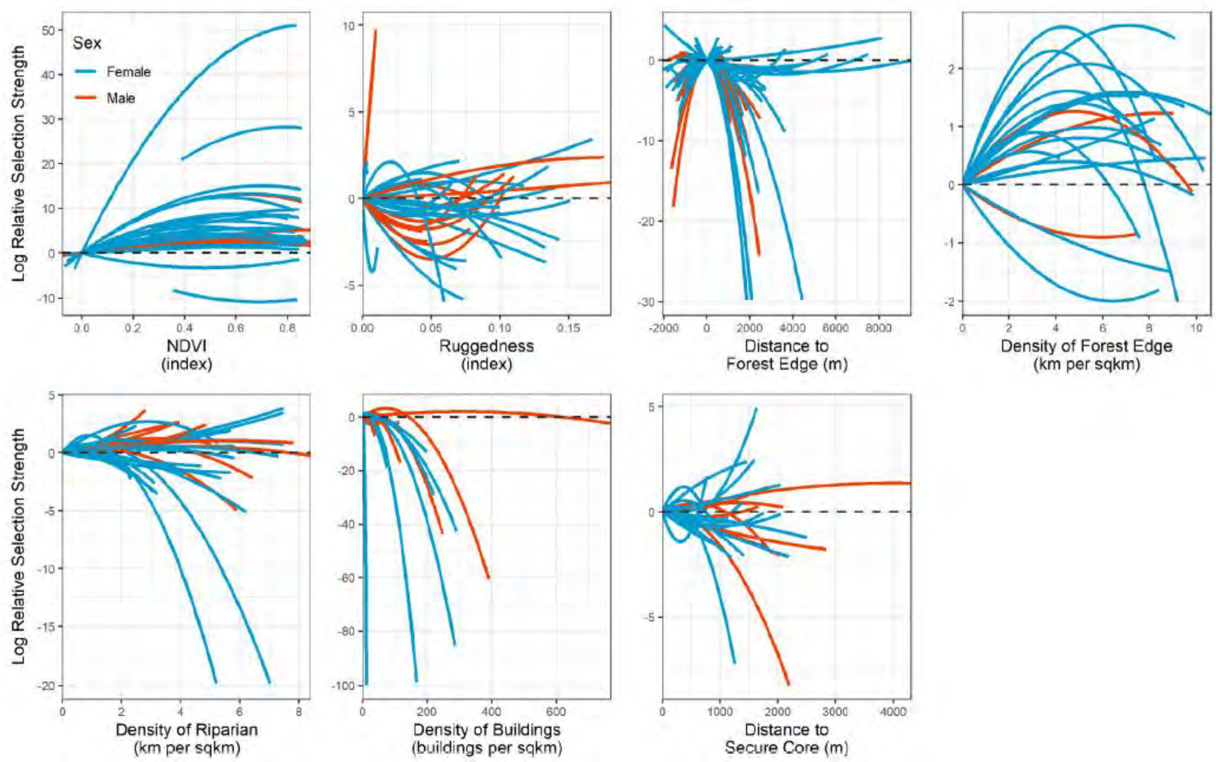
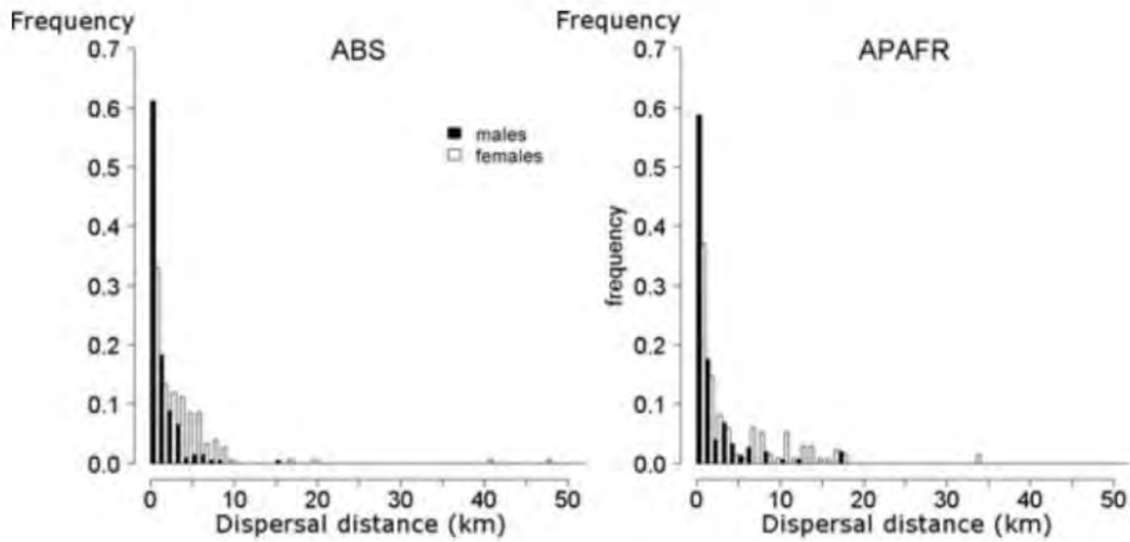


Fig. 3 The proportion of successful gray jay nests in Algonquin Park (ON, Canada) in relation to **a** year (1977–2009) and **b** conifer class (the percentage of conifer trees in a territory). Both predictor variables had a significant effect on nest success in a generalized linear model (see "Results" for details)

This figure from Sells et al Grizzley bear study is an example of

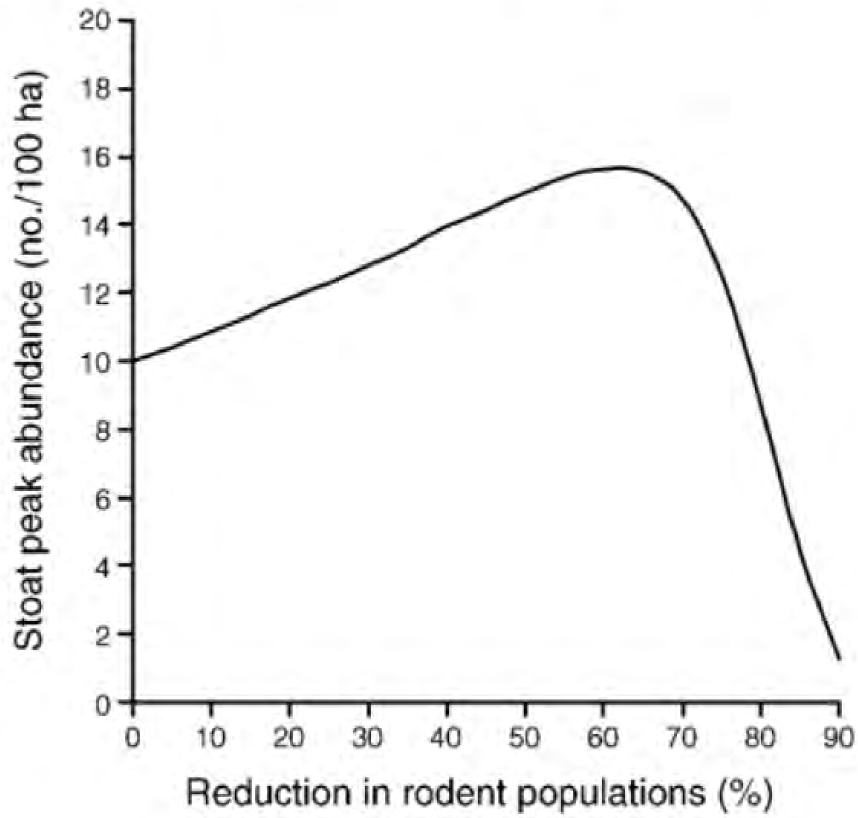


This figure from Coulon et al (2009) shows dispersal distances of male and female Florida Scrub-Jays based on observational data at two areas (ABS & APAFR), resighting banded (individually marked) birds. Having taken Wildlife Ecology, your concerns with this data when informing the dispersal ecology of this species would be that

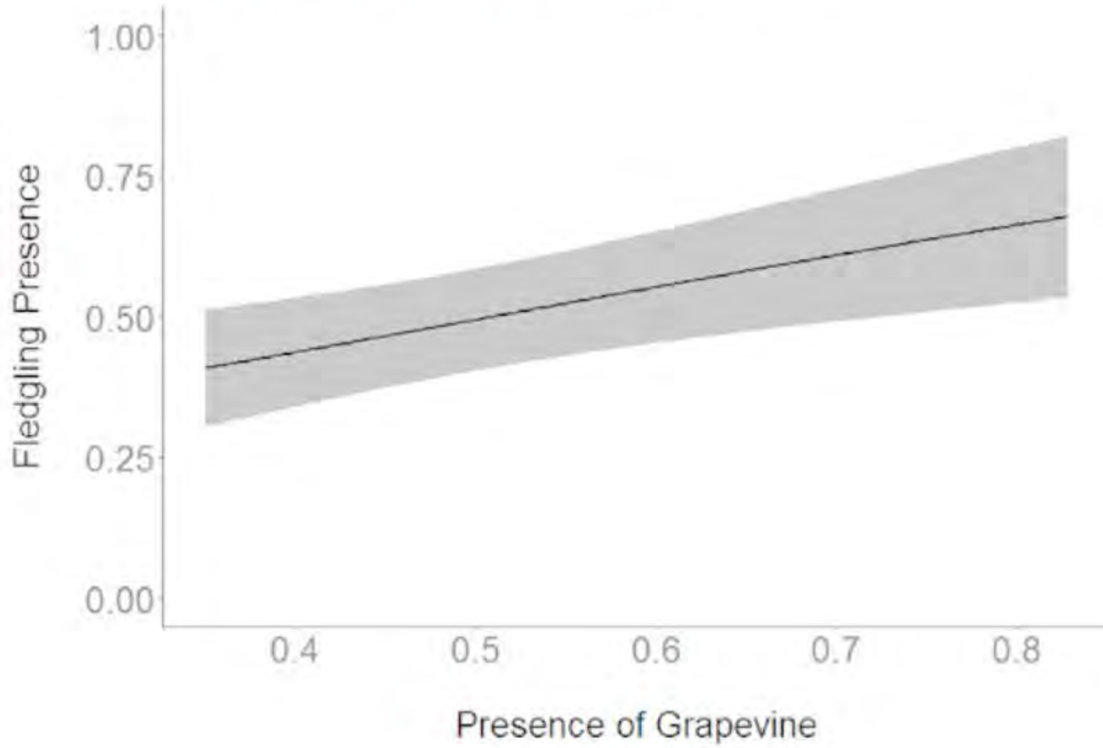


- ○ it doesn't consider habitat quality
- ○ there is psuedoreplication
- ○ distances would be biased due to size of study areas
- ○ it doesn't consider species interactions

This figure shows the relationship between stoat (a type of weasel) abundance and reduction in rodent populations (their prey). This is an example of



These results from a study on Cerulean Warblers suggests that grapevines



- ○ decrease available habitat
- ○ increase habitat quality
- ○ decrease habitat quality
- ○ increase available habitat

ENV 226 Practical 3 Designing a Project

- ✓ LO 9.1 Combine the principals you have learned in this class about data analysis and presentation to design your own research project based on available data.
- ✓ LO 9.2 Present your findings in a PowerPoint presentation.
- ✓ LO 9.3 Critically evaluate the analysis done by your peers.

Part 3 – Results and Conclusions

Once data is collected, they must be organized and summarized so that you can determine if the hypothesis has been supported or falsified. This is where you get to examine the data and look for relationships between your variables. Scientists typically use tables, figures, and statistical tests to achieve this goal. These tools assist in analysis and interpretation, in addition to enhancing the clarity with which results are presented to the reader or evaluator.

Tables – are useful for displaying summarized results (NOT RAW DATA) when the quantitative values, rather than trends, are the focus. For example, when the average number of some variable is a useful measure of the experiment's success (e.g., the mean abundance of lichen on north aspects is greater than the mean abundance of lichen in the south, west, and east aspects).

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- All values of the same kind should read down the column, not across a row. Include only data that are important in presenting the results and for further discussion.
- Information and results that are not essential (e.g., test tube number, subject's name, etc.) should be omitted.
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- The following guidelines will help you construct a successful graph:
- The independent variable is graphed on the x-axis and the dependent variable on the y-axis.
- The numerical range for each axis should be appropriate for the data being plotted. Choose your intervals and range to maximize the use of the graph space. Keep intervals spaced such that interpretation remains clear.

- Label the axes to indication the variable and units of measurement. Include a legend if colors or shading are used.
- Chose the type of graph that best presents your data. Line and bar graphs are the most frequently used. This choice of graph depends on the nature of the variable being graphed.
- Compose a stand-alone caption. Figures should be numbered consecutively throughout lab reports or scientific papers. Each figure is given a caption describes its contents, giving enough information to allow the figure to stand alone. Captions should include an in text citation for the data.

Tests – We have learned about a variety of statistical tests this term including Chi Square, Fisher's Exact, T-tests, f-tests, and correlation coefficients. You should run the statistical test that best answers your question given the type of data you have. Present your results from your analysis in APA format.

Turn it in: We are continuing to add to your Final Project PowerPoint presentation.

Add a Results 1 slide after your methods and present a table with appropriate summary data related to your analysis. This could include descriptive statistics or might be a contingency table.

Add a Results 2 Slide which has a graph which best displays the data in your analysis.

Add a Results 3 Slide which presents the results of the test you used in APA format.

Finally, add a Discussion slide: This section reiterates your key results using brief, summarizing statements. It does not report hard numbers or statistics. Identify the limitations of the data if any. Did your observations support or refute your original hypothesis and prediction? How do your results compare with other studies examining similar questions (this is where you will cite other studies)? If your results were not as you expected speculate and discuss why. What would you do differently if you repeated this study?

Upload a completed draft of your PowerPoint on Canvas.

Term Project Guidelines

The main goal of the final project is to help you become confident using the statistical tools covered during this quarter in a real-world data analysis setting. You may draw from any existing environmental data set of your choice, but *your selected data must contain at least 2 explanatory (independent) variables*. Datasets and research hypotheses are due by **Friday, February 23rd @ 5:00pm**. You will present your completed analysis to your peers during our final exam session which is on **Thursday, March 21st from 8-10am**.

*Successful presentations will address **all** the sections outlined below justification for conclusions that cite the appropriate statistics, tables, or plots. See Canvas for example projects to get a clear idea of project expectations.*

1. (20pts) Introduction of the Dataset
    a. (10pts) Provide background and context for the data you are analyzing being sure to address the following.
        i. What is the source of the data (e.g., downloaded from USGS website, data from another course)?
        ii. What system is being studied?
        iii. What species?
        iv. Where and when was this data collected?
        v. If the researchers providing this data published their research, be sure to provide the citation.
        vi. What is the ecological importance of this dataset (e.g., why should we care about this analysis)?

    b. (10pts) Describe the data frame
        i. How many observations are in the data frame?
        ii. How many variables are in the data frame?
        iii. What does each variable measure? Is the variable nominal, continuous, discrete, binomial?
        iv. What is the response variable?
        v. What is/are the explanatory variable(s)?
        vi. Is there potential pseudoreplication in the study design? If not, state how you know. If so, which variables are fixed and which are random?

        For ease and clarity, items i. – iv. could be summarized in a table like the one shown below.

Variable Name	Explanatory or Response	Type	Description
nest	response	binary	0 = no nest detected; 1 = nest detected
age	explanatory	integer	time in years since tree died and became a snag
dbh	explanatory	continuous	diameter of snag in centimeters
bark	explanatory	continuous	visual estimate of the percentage of bark remaining on the bole of snag

2. (5pts) Hypotheses
    a. What is the research hypothesis being examined with this dataset?

3. (10pts) Initial Data Exploration
    a. (5pts) Are there outliers in the dataset? Provide plots and discuss.
    b. (5pts) What is the distribution of each variable? Provide plots and discuss.

4. (25pts) Selection of Statistical Analysis Technique (20pts)
    a. (5pts) Explain why your selected analysis technique is appropriate for your *data* and your *question*.
    b. (5pts) Clearly write out the model you created and ran in R (e.g., provide the code for the model statement).
    c. (5pts) What is the *statistical* hypothesis being examined with your selected analysis technique?
    d. (10pts) Describe any exploratory/precautionary steps that are *appropriate for your question and choice of test*. Be sure to provide the appropriate R output (including plots) and thoroughly discuss your process.

5. (10pts) Conduct Analysis
    a. Provide the R code used and resulting output, including plots.

When cutting and pasting from R into Word or other programs (e.g., MS Word or PowerPoint), fonts such as **`CourierNew`** or **`Lucida Console`** (both at **`9pt`**) will preserve the formatting and make your output easier to read.

6. (20pts) Interpret and Discuss Results
    a. (5pts) Did the analysis support or refute the statistical null hypothesis(es)?
    b. (5pts) Did the analysis support or refute your research hypothesis?
    c. (5pts) What was the effect of your explanatory variable(s) on your response variable?
    d. (5pts) What conclusions can you draw from your results that addresses the real-world question at hand?

7. (10pts) Quality of Presentation
    a. Well organized
    b. Effective graphics used to illustrate points
    c. Delivery was conversational in style, not reading from slides

When describing your results, *all statements must be supported with the appropriate statistical evidence* in the form of F-, t-, z-, or p-values, plots and/or tables. All described effects and/or probabilities must be accompanied by estimates of precision (e.g., SE or 95% CI).

For example, "Tree condition accounted for a significant amount of the deviance observed in cavity presence (X^2 = 6.0354, p = 0.0140, Table 1). This refuted the statistical null hypothesis but supported my research hypothesis that dead trees would be more likely to contain woodpecker nest cavities. The log of the odds ratio between dead and live trees was -0.7610 (p = 0.0153, Table 2), meaning that the odds of a live tree having a cavity are 53.28% (95% CI = 75.01-14.16%) lower than the odds of a dead tree having a cavity (Table 2; Figure 1). The probability of a live tree having a nest cavity was 0.23 (SE = 0.042; Table 3), while the probability of a dead tree having a nest cavity was 0.39 (SE = 0.049; Table 3)."

Online Data Sources

This is hardly an exhaustive list, but the following federal government sites provide a tremendously wide range of environmental data that is easy to search by topic and download with adequate supporting materials.

Source	Web Link	Description
Environmental Protection Agency (EPA)	https://edg.epa.gov/metadata/catalog/main/home.page	Houses a vast selection of EPA data sources, organized into topics such as air and water that are in easily downloaded formats.
National Oceanic and Atmospheric Administration (NOAA)	https://data.noaa.gov/onestop/	Explore data from across scientific disciplines, formats, time periods, and locations. The wide range of filtering options can pinpoint specific collections that may not be discoverable in other searches.
United States Forest Service (USFS)	https://www.fs.usda.gov/rds/archive/catalog	Data associated with USFS research publications. Wide range of topics and easily searchable.
United States Geological Survey (USGS)	https://www.usgs.gov/products/data	Browse real-time data, data releases, provisional data, and more.
	https://www.sciencebase.gov/catalog/	Digital repository providing access to scientific data products and resources.

Appendix B– Project Rubrics

ENV 226 Final Project Presentations

Student:

Topic:

	pts possible	pts earned
All 5 sections of a scientific presentation were present: Intro, methods, Results, Discussion, References	0	
Nicely formatted title slide with author and affilation shown.	1	
Question was clearly stated.	1	
Introduction included a reference to at least three scientific papers with citations for this research.	3	
Variables examined appropriately address the question.	2	
Accurately stated null hypothesis.	2	
Alternative hypothesis clearly identifies the expected trend in the data beyond just that the data is different.	1	
Student provided acceptable reasoning for their analysis methods.	3	
Student addressed the uncertainty of the data	2	
Student clearly stated the results of their analysis using APA formating as appropriate.	2	
Student correctly interpreted the results of any tests used.	3	
Relevant figures/tables were provided to support the analysis and each included the following things:	3	
Appropriate title and axis labels for graphs	1	
Captions that were detailed enough that if the figure were taken out of context it could easily be interpreted.	2	
Captions included sources for the data.	1	
No grammerical mistakes on slides.	2	
Numbers shown on slides were expressed to an appropriate significance.	1	
Student used a professional looking design for their slides.	1	
Presentation was engaging and well delivered	4	
Presentation was between 7-9 minutes (failure to do this results in a 3pt deduction)	0	
Reference page was included. (failure to do this results in a zero score on the assignment).	0	
Average Evaluation Score from Peers	5	
Total	**40**	**0**

Feedback to Student:

Oregon TECH

Institutional Student Learning Outcome Rubric – Inquiry & Analysis

ISLO 2 Inquiry & Analysis:
Oregon Tech students will engage in a process of inquiry and analysis.

Definition
Inquiry and analysis consists of posing meaningful questions about situations and systems, gathering and evaluating relevant evidence, and articulating how that evidence justifies decisions and contributes to students' understanding of how the world works.

PERFORMANCE CRITERIA	**High Proficiency (4)** The work *meets listed requirements* for this criterion; little to no development needed.	**Proficiency (3)** The work *meets most requirements*; minor development would improve the work.	**Some Proficiency (2)** The work needs moderate development in *multiple requirements.*	**Limited Proficiency (1)** The work does not meet this criterion: it needs substantial development in *most requirements.*
IDENTIFY	Identifies a creative, focused, and manageable topic that addresses potentially significant yet previously less-explored aspects of the subject.	Identifies a focused and manageable topic that appropriately addresses relevant aspects of the subject.	Identifies a topic that, while manageable, is too narrowly focused and leaves out relevant aspects of the subject.	Identifies a topic that is too general and wide-ranging to be manageable.
INVESTIGATE	Clearly states, comprehensively describes, and synthesizes in-depth information from relevant high-quality sources representing various approaches and points of view.	States, comprehensively describes, and presents in-depth information from relevant high-quality sources representing various approaches and points of view.	Presents information from relevant sources representing a limited set of approaches or points of view, but descriptions leave some terms undefined or ambiguities unexplored.	Presents information from irrelevant sources representing a limited set of approaches or points of view, or states information without clarification or description.
SUPPORT	All elements of the methodology or theoretical framework are skillfully developed. (Appropriate methodology or theoretical frameworks may be synthesized from across disciplines.)	Critical elements of the methodology of theoretical framework are appropriately developed. However, more subtle elements are ignored.	Critical elements of the methodology of theoretical framework are missing, incorrectly developed, or unfocused.	Inquiry design demonstrates a misunderstanding of the methodology or theoretical framework.
EVALUATE	Organizes and synthesizes evidence to reveal insightful patterns, differences, or similarities related to subject focus.	Organizes evidence to reveal important patterns, differences, or similarities related to subject focus.	Organizes evidence, but the organization is not effective in revealing important patterns, differences, or similarities.	Lists evidence, the evidence presented is not organized or it is unrelated to the subject focus.
CONCLUDE	States an eloquently supported conclusion that is a logical extrapolation of the inquiry, reflecting the student's informed evaluation and ability to place substantial evidence and perspectives in priority order.	States a conclusion focused solely on the inquiry findings, arising specifically from and responding specifically to the inquiry findings.	States a general conclusion beyond the scope of the inquiry, the support for which is inadequate, or information was chosen to fit the conclusion.	States an ambiguous, illogical, or fallacious conclusion that is inconsistently tied to the inquiry findings.

Developed by the ESLO Inquiry & Analysis Committee, Approved by the Assessment Executive Committee, January 2017. Edited 2023.

Oregon TECH

Institutional Student Learning Outcome Rubric – Quantitative Literacy

ISLO 5 Quantitative Literacy:
Students will demonstrate quantitative literacy.

Definition
Quantitative literacy comprises the ability to appropriately extract, interpret, evaluate, construct, communicate, and apply quantitative information and methods to solve problems, evaluate claims, and support decisions in students' everyday professional, civic, and personal lives.

Performance Criteria	High Proficiency (4) The work meets listed requirements for this criterion; little to no development needed	Proficiency (3) The work meets most requirements; minor development would improve the work	Some Proficiency (2) The work needs moderate development in multiple requirements	Limited Proficiency (1) The work does not meet this criterion; it needs substantial development in most requirements
Calculate	Perform challenging computations and sequences of computations, knowing the tools needed.	Perform longer and more complicated computations, or solve problems involving sequences of linked computations selecting from a list of possible tools.	Correctly perform short single computations with tools provided.	Unable to correctly perform computations even when tools are provided.
Interpret	Give holistic interpretations of methods, tools used, and results, with little to no instructor prompting or guidance.	In response to broad instructor prompting, interpret equations or expressions in a general sense, interpret overall patterns and trends in graphical information. When appropriate, interpret differences in computational results.	When prompted, identify specific parts of equations or expressions, interpret specific data points on graphs, interpret results of computations literally.	Unable to correctly interpret results of computations, equations, expressions or graphs.
Construct Representations	Construct appropriate, complex, and clearly labeled analytical and/or graphical models with little to no instructor prompting or guidance.	Construct analytical and/or graphical models of mathematical relationships in response to broad instructor prompting.	Construct graphical models of information in response to specific instructor prompting.	Unable to correctly construct graphical models of information in response to specific instructor prompting.
Apply in Context	Solve relevant complex, multifaceted problems, with little to no instructor prompting, or guidance. Acknowledge and justify assumptions used in solving problem(s).	Choose correct formulas, set up correct equations (or systems of equations), and/or choose correct frameworks to solve problems in response to broad instructor prompting. Acknowledge assumptions used in solving problem(s).	Can set up and solve applied problems (i.e. word problems) when provided specific formulas or frameworks.	Unable to apply given formulas or frameworks to set up or solve applied problems.
Communicate	Accurately integrate quantitative evidence into complex arguments with little to no prompting or guidance. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.	Accurately integrate quantitative evidence into an extended argument in response to a broad prompt. While instructor provides guidance, student uses quantitative evidence to identify, explain, and/or solve a problem. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.	Accurately integrate quantitative evidence into basic arguments in response to specific prompts. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.	Unable to explain quantitative evidence so that a competent non-expert reader can follow along, and/or unable to accurately include quantitative evidence in writing in response to specific prompts.

Instructions: 1) enter student names beginning in cell D1; 2) use the green columns to decide whether the student met the requirement listed in each row (1 for yes, 0 for no). Their score will automatically sum and be entered in row 2.	Possible Points																				
Total Score	**30.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Title (3%) 1.0pts		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Title concisely , yet effectively describes the project	**1.00**																				
Abstract (5%) 1.5pts																					
Concise review of all parts of paper	**1.50**																				
Introduction (20%) 6.0pts																					
Should cover general field of biology that their study addresses	**1.00**																				
Summarize relevant literature	**1.00**																				
Proper use of citations	**1.00**																				
Statement of research question and hypotheses	**1.00**																				
Well organized	**1.00**																				
Well written	**1.00**																				
Methods (10%) 3.0pts																					
Past tense	**1.00**																				
Clear and concise – could replicate the study from reading	**1.00**																				
Includes all steps of methods used	**1.00**																				
Results (20%) 6.0pts																					
Reports summarized data, not raw data	**1.00**																				
Describe findings in terms of total numbers, means, etc.	**1.00**																				
Includes tables and figures	**1.00**																				
Figure is clear with title	**1.00**																				
Figure axis are labeled	**1.00**																				
Appropriate units defined (e.g., mm, cm, g, etc)	**1.00**																				
Discussion (20%) 6.0pts																					
Clearly state key findings	**2.00**																				
Discuss their implications in light of other research	**2.00**																				
Properly cite other work	**1.00**																				
Draws reasonable conclusions	**1.00**																				
Literature Cited (5%) 1.5pts																					
Contains at least 3 peer-reviewed sources	**1.00**																				
Consistent formatting	**0.50**																				
Overall presentation (17%) 5.0pts																					
Proper length – not well over or under 500 words	**1.00**																				
Proper grammar & spelling	**1.00**																				
Good flow (e.g., doesn’t feel like it was written carelessly and without review)	**2.00**																				
Ideas clearly communicated	**1.00**																				

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Appendix C– ENV Research Symposium Program

OREGON TECH

ENVIRONMENTAL RESEARCH & EXTERNSHIP SYMPOSIUM

Thursday, Dec 7th 2023
6-8 p.m.

CEET

AGENDA

6:00 PM - 6:50PM	POSTER PRESENTATIONS AND REFRESHMENTS - CEET BISTRO AREA
7:00 PM - 8:00 PM	RESEARCH AND INTERNSHIP TALKS - CEET AUDITORIUM

To attend the talks remotely use the QR or Link

HTTPS://BIT.LY/ENVSYMPOSIUM2023

bitly

FOR ADDITIONAL CONFERENCE INFORMATION, PLEASE CONTACT :
CHRISTY VANROOYEN, ENVIRONMENTAL SCIENCES DIRECTOR
CHRISTY.VANROOYEN@OIT.EDU

https://www.oit.edu/academics/degrees/environmental-sciences

POSTERS

ENVIRONMENTAL MANAGING AT KINGSLEY FIELD EXTERNSHIP

KATLYN BAKER

EMPLOYER: US AIRFORCE

At Kingsley Field 173rd FW, environmental managers help maintain compliance for a multitude of highly regulated, technical, and complex environmental programs and permits including: Air Quality; Contaminated Media; Cultural Resources; Environmental Management Systems; Energy Conservation; EPCRA; Hazardous Materials; Hazardous Waste; Natural Resources; NEPA; Pest Management; Planning, Programming, Budgeting and Execution; Restoration; Solid Waste/Recycling; Storage Tanks; and Water Quality. As environmental managers, our main goal is to protect the community and environment by practicing best management practices at the base.

THINKING INSIDE THE BOX: A LOOK INSIDE SEED PREDATOR COMMUNITIES IN KLAMATH

ALYSSA HARRIS & DOMINIK STERLING

PI: DR. JHERIME KELLERMANN

This research project is an observational study looking at the relationships and communities of seed predators. We are setting up boxes containing sunflowers seeds, observed by trail cameras, to study the community of various seed predators and species relationships around Klamath Falls. We want to quantify the difference of behaviors in seed predators in relation to the Wildland Urban Interface (WUI) and different habitat types. We are also measuring the individual animals' time spent and time of day at seed boxes to understand the species temporal distribution and perceived predation risk. This study is still within the pilot stage, and we plan to launch a full-sized stratified study as soon as possible.

SPECIES RICHNESS IN MOORE PARK

JORDAN HEVERN & PATRICK HEANEY

PI: PROF. KERRY FARRIS

The lack of ponderosa pine regeneration in Moore Park has been highlighted as a key concern by the city of Klamath Falls Parks Division (KFPD). There are several possible factors that may be contributing to this decline including drought, lack of cone production, high seed predation, or lack of adequate germination sites. The aim of this research was to investigate the efficacy of camera traps as a tool for inventorying the community of vertebrates known to predate ponderosa pine seeds. Our specific objectives were to: 1) determine the most beneficial camera placement technique, and 2) determine the number of trap nights required to capture the greatest number of seed predator species. Between 14 July and 8 November 2023, we monitored 12 pairs of camera traps placed throughout Moore Park using a random sampling regime stratified by habitat type. At each location, we placed 2 cameras separated by at least 20 meters. The “large mammal” camera was set at knee height and aimed in a direction meant to capture as much of the established plot as possible. The “small mammal” trap was set 10-20 cm in height and aimed at a sherman live trap that was locked open and baited with standard bird seed. During the total 1,783 trap days, our cameras recorded 24 different species. Species richness significantly differed by camera type ($t = 2.2$; $p = 0.00$), with small mammal cameras capturing an average of 8.3 species, as compared to 2.0 species by the large mammal cameras. Of the 24 species recorded during the study period, all were detected at least once by small mammal cameras. Fifteen of the 24 are considered consumers of ponderosa pine seeds. The number of trap nights required to capture the maximum species diversity was calculated to be an average of 53.25 days on the small mammal cameras. This information will be instrumental in designing future camera trap studies in Moore Park in understanding how to effectively carry out camera trap studies that show variability in biodiversity in an area that houses ponderosa pine and how long you need to keep the cameras up to get an understanding of species richness.

PONDEROSA PINE DEMOGRAPHY

THEO ROGERS, PETER WOLTJER, JORDAN HEVERN

PI: PROF. KERRY FARRIS

The lack of ponderosa pine regeneration in Moore Park has been highlighted as a key concern by the city of Klamath Falls Parks Division (KFPD), as the maintenance of native vegetation is the primary goal of the KFPD and a shift from fire-resilient ponderosa pine to fire-susceptible western juniper can have profound effects on the park's fire management objectives. There are several possible factors that may be contributing to this decline including drought, lack of cone production, high seed predation, or lack of adequate germination sites. To investigate this issue, our team set up plots in Moore Park and extracted Ponderosa Pine tree core samples, performed cone counts, and examined the abundance of Ponderosa Pine and Juniper seedlings. The aim of this project is to provide the city with current information on the demography and reproduction of ponderosa pine within Moore Park. Using this data, we hope to identify what conditions successfully promoted Ponderosa Pine seedling germination and what we can do in Moore Park to increase seedling abundance.

POST-FIRE VEGETATION RECOVERY IN MOORE PARK

ISRAEL ORNELAS, JAIME BIGBY, MARIO GRAMAJO, ANGELINA SETKA

PI: PROF. KERRY FARRIS

In an effort to assist the city of Klamath Falls manage the natural habitat of Moore Park, Oregon Tech has initiated a series of interrelated projects investigating management questions critical to the effective stewardship of the park's resources. The 2003 KAGO fire burned through southeast corner of Moore Park, an area comprised primarily of Artemisia tridentata, Purshia tridentata, and native bunch grasses. This project aims to examine vegetation community differences 20 years post-fire. During June of 2023 we established 10 paired vegetation plots that consisted of 30-meter transects to estimate species richness and vegetative cover and 5 x 30-meter rectangular plots to estimate shrub density. All data has been entered and proofed and analysis is currently underway. Our goals are to compare data from burned and unburned sites to examine differences in vegetation cover; especially that of non-native plant species and to help better inform Moore Park managers on how this shrub community responds to disturbances such as fire.

EXTERNSHIP AS A BOTANY TECHNICIAN

ANGELINA SETKA

EMPLOYER: US FOREST SERVICE

I will be presenting on my time this summer working as a botany technician for the forest service as part of my environmental science externship course. This will include things like my roles and responsibilities, what I accomplished, key skills learned, and more. I want to stress the importance of the hands-on fieldwork and general overall experience gained during this opportunity.

POLLEN COLLECTION AND ANALYSIS OF LOCAL FLORA IN KLAMATH FALLS, OREGON

MAKENZIE COLLIER & FILIP TRIER

PI: PROF. CHRISTY VANROOYEN

Honeybees are an important livestock that provide pollination services to agricultural crops and the local community. At Oregon Tech, we have been studying floral resource use by Apis mellifera through pollen trapping in our apiary. Pollen traps were set weekly throughout the summer months and then samples were locally identified and sent for analysis through Johnah Ventures to verify the specific floral resources from which our bees are taking pollen. Using this pollen data along with Broodminder hive monitor data we are able to get a nuanced picture of which flora is preferred by the different colonies in our apiary. As we accrue data from different pollination seasons, we can also compare changes in prevalence of specific floral resources from year to year.

TALKS

CORRELATING WATER QUALITY MEASURES WITH ALGAL POPULATIONS IN UPPER KLAMATH LAKE
MONTE SCHELL & JAYMES KODAK
PI: DR. KEN USHER & DR. KAMAL GANDHI

This last summer 2023, our research focused on collecting water quality measures in Upper Klamath Lake, and examining their correlation with varying algal concentrations. Regular sampling provided critical data on factors influencing algal growth, including chemical levels, temperature, and other environmental parameters. Our study aimed to elucidate the complex relationship between water quality dynamics and algal concentrations, ideally contributing valuable insights into the lake's ecological balance. This research not only expands our understanding of local ecosystems but also underscores the importance of comprehensive water quality assessments for effective environmental management.

INVASIVE WEED SURVEYS & TREATMENT
JAIME BIGBY

Jamie Bigby is a senior this year. He is an Environmental Science major, aspiring for a career in ecological related work. Over the summer he was an intern with the Middle Fork Ranger Station in the Willamette National Forest. He will be discussing the Forest Service’s use of Herbicides to maintain forest roads for logging operations.

NATIVE POLLINATOR AND FLORAL RESOURCE RELATIONSHIPS AT OREGON TECH
NICKI JOHNSTON
PI: PROF. CHRISTY VANROOYEN

Native pollinators serve a crucial role in the environment. Animal pollination services also contribute to 30% of global food production (Khalifa et al 2021). Unfortunately, native pollinator populations are on the decline due to factors such as climate change, environmental toxins, and habitat loss. Our multi-year initiative involves collecting baseline data to identify the native pollinator species present near Oregon Tech and connecting specific species to the floral resource they were sampled on. In the future, we hope to be able to make recommendations for the construction of native pollinator gardens in the Klamath Basin. This baseline data will also be useful in determining how populations are being impacted phenologically by climate change and other factors.

MY NARA SUMMER
TANIKWAH LANG

The Wildlife Society Native American Research Assistantship program allowed me to gain so much experience this last summer. I moved 2,038 miles to Illinois where I participated in Grassland bird research concerning bison reintroduction on the Midewin National Tallgrass Prairie. The work that I did included bird nest searching and monitoring, vegetation surveys, and raw data entry. I was also able to gain experience communicating with many professionals and developing long-lasting relationships. This experience helped me develop both hard and soft skills that will enhance my abilities to move further along in the natural sciences career field

PRESENTERS

KATLYN BAKER

JAIME BIGBY

MAKENZIE COLLIER

MARIO GRMAJO

ALYSSA HARRIS

PATRICK HEANEY

JORDAN HEVERN

NICKI JOHNSTON

JAYMES KODAK

TANIKWAH LANG

ISRAEL ORNELAS

THEO ROGERS

ANGELINA SETKA

MONTE SCHELL

DOMINIK STERLING

PETER WOLTJER

Appendix D – Track Curriculum for Chemistry Track

Environmental Science with Tracks

Communication Requirements	Credit Hours: 18
COM 111Z	
SPE 321	
WRI 121	
WRI 227 or 122	
Elective: WRI 345 – Science writing or WRI 410 – Grant and proposal writing	
Social Science Requirements	Credit Hours: 12
ECO 201 or 202	
9 additional credits	
Humanities Requirements	Credit Hours: 9
9 credits only 1 class of performance based.	
Math Requirements	Credit Hours: 12
MATH 111 – College Algebra	Credit Hours: 4
MATH 112 – Trigonometry	Credit Hours: 4
MATH 361 – Statistical Methods I	Credit Hours: 4
MATH 362 – Statistical Methods II	Credit Hours: 4
PHY - Science bachelor requirements	
201 – Algebra Based Physics	Credit Hours: 4

Program Requirements for all tracks

BIO 211-213	Credit Hours: 12
CHE 221-223	Credit Hours: 15
ENV 108 (once as new student and once as upper classman)	Credit Hours: 2
ENV 111 Intro to environmental sciences	Credit Hours: 4
ENV 217 - Intro to Natural Resources Management	Credit Hours: 4
ENV 224 - Scientific Reason & Method	Credit Hours: 3
ENV 226 - Environmental Data Analysis	Credit Hours: 3
ENV 314 – Policy and Management	Credit Hours: 3
ENV 355 – Careers in environmental Sciences	Credit Hours: 3
ENV 434 – Advanced Data Analysis	Credit Hours: 4
ENV 484 - Sustainable Human Ecology	Credit Hours: 4
ENV 485 – Habitat Management	Credit Hours: 3
GEOG 105- physical geography	Credit Hours 4
GIS 103 - Digital Earth	Credit Hours: 3
GIS 134 - Geographic Info Systems	Credit Hours: 3
GIS 205 - Mobile and Web GIS	Credit Hours: 2

Credit hours: 127

Environmental Chemistry

Required within track	**Credit Hours: 28**
CHE 315 (environmental analytical chem)	Credit Hours:4
CHE 465 (chem fate and transport) 4 credits	Credit Hours: 4
CHE 331 organic chemistry I	Credit Hours: 4
CHE 451 biochemistry II	Credit Hours: 4
Toxicology	Credit Hours: 4
GEOG 335 - Soils	Credit Hours: 4
BIO 4xx Toxicology	Credit Hours: 4

Track electives	**Credit Hours: 25**
BIO 255– Research	Credit Hours: 1
BIO 355 – Research	Credit Hours: 1
BIO 455– Research	Credit Hours: 1
BIO 377 – Wildlife Ecology	Credit Hours: 4
BIO 386 - Ornithology	Credit Hours: 4
BIO 428 – Fisheries	Credit Hours: 4
BIO 495 – Environmental Health	Credit Hours: 3
CHE 265 -electrochemistry	Credit Hours: 4
CHE 332 organic chemistry II	Credit Hours: 4
CHE 333 organic chemistry III	Credit Hours: 4
CHE 450 biochemistry I	Credit Hours: 4
CHE 452 biochemistry III	Credit Hours: 4
ENV 485 – Habitat Management	Credit Hours: 3
ENV 495 or ENV 420 - Research in Env. Sciences or Internship	Credit Hours: varies
GEOG 335 - Soils	Credit Hours: 4
ENV 321 – Water Resources	Credit Hours: 4
REE 331 - Fuel Cells	Credit Hours: 3
REE 335 - Hydrogen	Credit Hours: 3
REE 333 - Batteries	Credit Hours: 3
REE 337 - Materials for Renewable Energy Applications	Credit Hours: 3
REE 346 - Biofuel and Biomass	Credit Hours: 3
CE 374 - Hydrology	Credit Hours: 4
PHY 305 Nanoscience & Nanotechnology	Credit Hours: 4