Conservation Biology (WFC 154)

Lecture Time: 10:00-10:50, Mon./Wed./Fri.; Giedt 1001
Section A01 Time: 8-8:50, Thurs., Robbins Hall 146, **TA:** Katie
Section A02 Time: 9-9:50, Thurs., Physics Building 140, **TA:** Shiyue
Section A03 Time: 10-10:50, Thurs., Wellman Hall 105, **TA:** Shiyue
Section A04 Time: 1:10-2, Thurs., Wellman Hall 129, **TA:** Kay
Section A05 Time: 11-11:50, Thurs., Wellman Hall 127, **TA:** Katie
Section A06 Time: 12:10-1, Thurs., Veihmeyer Hall 116, **TA:** Shiyue
Section A07 Time: 11-11:50, Fri., Wellman Hall 129, **TA:** Kay
Section A08 Time: 12:10-1, Fri., Wellman Hall 129, **TA:** Caroline
Section A09 Time: 2:10-3, Fri., Wellman Hall 129, **TA:** Caroline
Section A10 Time: 3:10-4, Fri., Wellman Hall 235, **TA:** Kay
Section A11 Time: 12:10-1, Thurs., Wellman Hall 233, **TA:** Katie
Section A12 Time: 1:10-2, Fri., Wellman Hal 129, **TA:** Caroline

Instructor: Daniel S. Karp   **Email**: dkarp@ucdavis.edu
Office: Academic Surge 1071   **Hours**: Fridays, 11-12 pm

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TA: Caroline Ristuccia   **Email**: caristuccia@ucdavis.edu
Office: Center Watershed Sciences 2101   **Hours**: Wednesday, 1-2 pm

TA: Kay Garlick-Ott   **Email**: kgarlickott@ucdavis.edu
Office: Storer 2342   **Hours**: Fridays, 2-3 pm

TA: Katie Erickson   **Email**: kerickson@ucdavis.edu
Office: Storer 2342   **Hours**: Mondays, 11-12 pm

Materials

1. **Conservation Science**, Kareiva and Marvier
2. **Conservation Biology for All**, Sodhi and Ehrlich (freely available at link below)
https://conbio.org/images/content_publications/ConservationBiologyforAll_reducedsize.pdf
3. **Academic articles**, Available through the course website

Purpose

Earth is experiencing more rapid change now than at any time in the past 10,000 years. Over the last century, innovations have resulted in improvements in human livelihoods, even as human populations increased. Yet improved livelihoods were largely achieved through widespread degradation of natural systems, causing a biodiversity crisis and severely impaired Earth's life-support systems. One of our greatest challenges will be continuing to sustain a growing population while simultaneously safeguarding Earth's biodiversity and the processes that enrich and sustain human life. WFC 154 is intended to (1) introduce students to the major threats to Earth's ecosystems, (2) explore how the global human enterprise depends on natural systems, and (3) critically evaluate forward-thinking conservation strategies to manage nature in a changing world. WFC 154 will thus be grounded in ecology but also leverage key ideas and concepts from economics, psychology, philosophy, and other disciplines as they relate to conservation science. WFC 154 will also help students understand and develop useful skills for the modern conservation scientist or practitioner. Students will learn basic science literacy (*e.g.,* by reading scientific articles), how to communicate conservation (*e.g.,* by participating in mock debates and a course blog), and how to advocate for policy (*e.g.,* by developing a policy brief).

The Classroom Environment and Student Wellness

Conservation biology suffers from cultural and gender biases that impede scientific progress and make for a less vibrant and inclusive workplace. Both for the people that lack opportunities to engage with conservation and for the sake of the discipline, I am committed to helping remove barriers and make our communities more inclusive. Conservation is particularly interwoven with issues surrounding diversity and justice. As such, we will return to these issues throughout the class. In this class, I have also tried to give more voice to those who have been excluded from conservation in the past. ***This is a work in progress***. More broadly, I strongly believe that all classrooms must be inclusive and welcoming environments. Please do not hesitate to bring to my attention (or the TA's attention) any areas for improvement or any actions or statements that made you feel uncomfortable, unsafe, or excluded.

Relatedly, it is important to acknowledge the many physical and mental health issues that can impede student learning (*e.g.,* anxiety, alcohol/drug problems, depression, strained relationships, *etc.*). If you are suffering from any issues, or other stressful events, consider reaching out to the Counseling Center for support: https://shcs.ucdavis.edu/services/counseling-services or call 530-752-0871. An on-campus counselor or after-hours clinician is available 24/7. Finally, if you are a student who requires accommodations, please submit your SDC Letter of Accommodation to me as soon as possible, ideally within the first two weeks of this course. Anyone who is interested in learning more about the Student Disability Center (SDC) should contact them directly at sdc@ucdavis.edu or 530-752-3184.

COVID-19

I will work with you so that you can succeed in this class and stay at home if you feel sick or have been exposed to COVID-19. **Your grade will not suffer** if you stay at home after getting sick or being exposed to COVID. Contact Dr. Karp or your TA to let us know your situation. Relatedly, please consider wearing a mask in the classroom.

Land Acknowledgement

We should take a moment to acknowledge the land on which we are gathered. For thousands of years, this land has been the home of Patwin people. Today, there are three federally recognized Patwin tribes: Cachil DeHe Band of Wintun Indians of the Colusa Indian Community, Kletsel Dehe Wintun Nation, and Yocha Dehe Wintun Nation. The Patwin people have remained committed to the stewardship of this land over many centuries. It has been cherished and protected, as elders have instructed the young through generations. We are honored and grateful to be here today on their traditional lands.

Assessment (Overview)

Assessment	Value	Date
Lecture participation	5%	Ongoing
Section participation	5%	Ongoing
Weekly quizzes	5%	Ongoing (Fridays at 11:59 pm)
Online blog	15%	Due on Jan. 31 at 11:59 pm
Message box	5%	Due on Feb. 21 at 11:59 pm
Policy brief	15%	Due on Mar. 8 at 11:59 pm
Midterm exam	20%	Monday, Feb. 5, 10:00-11:00 am
Final exam	30%	Tuesday, Mar. 19, 6:00-8:00 pm

Students will lose 10% each day that an assignment is late. Any assignment that is not submitted by 11:59pm the day an assignment is due will be considered late. If canvas malfunctions and you cannot turn in an assignment, then simply email your assignment to Prof. Karp and the TA. You will still receive full credit if the email is time stamped before the due date.

The late policy does not apply to the lecture participation, section participation, and exams that occur in class. To accommodate unforeseen circumstances (i.e., COVID-19 or other illnesses, mental health challenges, family emergencies, clicker malfunctions, *etc.*), students can miss **6 lectures** (i.e., 2 weeks) and **2 sections** (i.e., 2 weeks) without harming their participation scores. However, any more lectures and sections that are missed beyond that will result in lower grades (no matter the circumstances).

The late policy also does not apply to quizzes. Quizzes must be turned in by the due date or will receive no credit. However, to accommodate unforeseen circumstances, students are allowed to miss **two** quizzes. Those quizzes will be replaced with 100% scores at the end of the quarter.

Tentative Schedule (Readings, topics, and timings subject to change)

Part I: Introduction to conservation science

WEEK 1

Lecture 1 (1/8/2024): Course introduction
- Readings: Kareiva/Marvier- Ch. 1 (Humans Are the Dominant Ecological Force)
- Learning Objectives: (I) gain a broad appreciation for how humans have influenced and are influenced by natural systems; (II) understand course structure and assignments

Lecture 2 (1/102024): Biodiversity
- Readings*:* Kareiva/Marvier- Ch. 2 (Biodiversity and Extinction)
- Learning Objectives: (I) be able to define biodiversity; (II) understand how biodiversity is measured; (III) characterize types of biodiversity loss

Lecture 3 (1/12/2024): The extinction crisis
- Readings: Sodhi/Ehrlich- Ch. 10; Ceballos et al. (2015) *Scientific Reports*
- Learning Objectives: (I) understand how extinction rates are measured; (II) argue whether or not we are experiencing a mass extinction; (III) identify attributes of at-risk species

Section 1: Developing familiarity with academic articles
- Learning Objectives: (I) understand how academic articles are structured; (II) differentiate between academic literature and advocacy material; (III) learn to search for pertinent articles

WEEK 2

MARTIN LUTHER KING HOLIDAY (1/16/2023): No class

Lecture 4 (1/17/2024): What are ecosystem services?
- Readings: Kareiva/Marvier- Ch. 3 (Ecosystem Services, read from the beginning up to but not including '*Assigning Monetary Value to Ecosystem Services*')
- Learning Objectives**:** (I) understand and communicate the concept of ecosystem services; (II) articulate connections between ecosystem services and biodiversity; (III) identify strategies for measuring and monitoring ecosystem services

Lecture 5 (1/19/2024): Valuing and managing ecosystem services
- Readings: Tallis et al (2014) *Nature.;* Karieva/Marvier- Ch. 3 (Ecosystem Services, read from '*Assigning Monetary Value to Ecosystem Services*' to the end of the chapter)
- Learning Objectives: (I) articulate the philosophical underpinnings of modern conservation;

(II) differentiate alternative strategies for valuing benefits from ecosystems; (III) evaluate pros and cons associated with current ecosystem service management strategies

Section 2: Summarizing conservation for lay-audiences—online blogging

- Learning Objectives: (I) distill the take-away messages from an academic article; (II) learn to effectively communicate the implications and limitations of a scientific study; (III) understand parameters for online blogging assignment.

WEEK 3

Part II: Threats to Earth's ecosystems

Lecture 6 (1/22/2024): Deforestation and fragmentation
- Readings: Kareiva/Marvier- Ch. 13 (Reversing Global Deforestation & Forest Degradation)
- Learning Objectives: (I) understand the extent and drivers of deforestation and fragmentation; (II) evaluate and compare the relative impacts of habitat loss versus fragmentation on biodiversity; (III) enumerate multiple strategies for mitigating deforestation and articulate pros and cons associated with each approach

Lecture 7 (1/24/2024): Overhunting
Readings: Sodhi/Ehrlich- Ch. 6; Dirzo *et al.* (2014) *Science*.
- Learning Objectives: (I) understand why people hunt; (II) articulate the cascading impacts of overhunting on ecosystems; (III) learn management strategies

Lecture 8 (1/26/2024): Climate change— evidence and solutions
- Readings: Kareiva/Marvier- Ch. 18 (Climate Change on a Global Scale, read from the beginning up to but not including *'How Global Climate Change Affects Biodiversity'*)
- Learning Objectives**:** (I) understand why climate change is occurring; (II) articulate the scientific evidence for anthropogenic climate change; (III) be able to discuss strategies for both reducing the magnitude of climate change and mitigating its impact

Section 3: Intrinsic and instrumental values and 'New Conservation' (Debate)
- Readings (In Order): Soule (2013) *Con Bio*; Kareiva (2014) *Con Bio*; Soule (2014) *Con Bio.*
- Learning Objectives: (I) articulate arguments for why nature should be valued; (II) critically evaluate the concept of 'New Conservation'

WEEK 4

Lecture 9 (1/29/2024): Climate change— impacts
- Readings: Urban (2015) *Science.*; Kareiva/Marvier- Ch. 18 (Climate Change on a Global Scale, read from *'How Global Climate Change Affects Biodiversity'* to the end of the chapter)
- Learning Objectives: (I) articulate risks of climate change to people; (II) understand how species can respond to changing climates; (III) identify fingerprints of climate change in natural ecosystems

Lecture 10 (1/31/2024): Fisheries and aquaculture
- Readings: Kareiva/Marvier- Ch. 15 (Building Sustainable Marine Fisheries)
- **Blog due.**
- Learning Objectives: (I) understand the causes and consequences of fisheries collapse; (II) differentiate alternative strategies for managing common pool resources; (III) compare relative benefits and costs of wild fisheries and aquaculture.

Lecture 11 (2/2/2024): Invasive species
- Readings: Kareiva/Marvier- Ch. 17 (Getting Practical about Introduced Species)
- Learning Objectives: (I) understand how and why species invasions occur; (II) predict when

species are likely to become invasive; (III) discuss potential impacts of species invasions; (IV) identify how management strategies for each stage of the invasion process

Section 4: Midterm Review Session
- Learning Objectives: (I) solidify understanding of the major threats to Earth's ecosystems; (II) solidify understanding of the many ways that nature supports human wellbeing

WEEK 5

Midterm 1 (2/5/2024): Covers all materials discussed in Parts I and II of the course.

Part III: How ecosystems support and enrich human life

Lecture 12 (2/7/2024): Biodiversity and infectious diseases
- Readings: Keesing *et al.* (2010) *Nature*; Wood *et al.* (2014) *Ecology.*
- Learning Objectives: (I) learn how zoonotic diseases are propagated; (II) understand contexts under which biodiversity would be expected to increase or decrease disease risk

Lecture 13 (2/9/2024): Biological control
- Readings: Karp *et al.* (2013) *Ecol. Lett*.
- Learning Objectives: (I) understand the basic process of integrated pest management; (II) compare classical versus conservation biological control; (III) identify some strategies for bolstering control of crop pests by their natural enemies

Section 5: Dilution effect activity
- Learning Objectives: (I) learn to interpret scientific data and figures; (II) solidify understanding of the relationships between habitat, biodiversity, and disease; (III) understand how multiple analyses can be combined into a broader scientific 'story'

WEEK 6

Lecture 14 (2/12/2024): Pollination
- Readings: Potts *et al.* (2010) *Trends in Ecology and Evolution*.
- Learning Objectives: (I) understand the reliance of our global food system on pollinators; (II) characterize the extent and drivers of pollinator decline; (III) weigh the evidence that conserving nature may bolster pollination and improve crop yields

Lecture 15 (2/14/2024): Cultural ecosystem services
- Readings: Bratman *et al.* (2012) *Annals NY Acad. Sci.*; Chan *et al.* (2012) *BioScience*.
- Learning Objectives: (I) understand why cultural services are critical for motivating conservation but often overlooked; (II) appreciate the many ways in which ecosystems enrich human lives; (III) learn how qualitative analysis can help us assess cultural services

Lecture 16 (2/16/2024): Water quality and quantity (Guest lecture: TA Caroline Gengo)
- Readings: Kareiva/Marvier- Ch. 16 (Managing Fresh Water for People and Nature)
- Learning Objectives: (I) articulate the state of Earth's freshwater resources; (II) differentiate between threats to global water quantity and quality; (III) learn solutions for sustainability

Section 6: Delivering an elevator pitch
- Pre-section assignment: choose a conservation-relevant scientific finding, policy, or concept that you would like to communicate to a lay-audience
- Learning Objectives: (I) learn to communicate a scientific finding, policy, or concept to multiple audiences; (II) learn to use the message box to hone and deliver an argument; (III) message box completed in class as an assessment.

Part IV: Conservation strategies, opportunities, and science

WEEK 7

PRESIDENTS' DAY HOLIDAY (2/19/2024): No class

Lecture 17 (2/21/2024): Protected areas
- Readings: Kareiva/Marvier- Ch 5 (Conservation in Protected Areas and on Private Land)
- **Message box due.**
- Learning Objectives: identify recent trends in global protected area coverage; (II) understand key challenges to effective protected area creation and implementation; (III) learn how protected areas could be managed to improve outcomes for wildlife and local people.

Lecture 18 (2/23/2024): Reserve design and conservation planning
- Readings: Kareiva/Marvier- Ch. 6 (Conservation Planning and Priorities)
- Learning Objectives: (I) articulate principles of reserve design, (II) understand zoning strategies for reserves, (III) learn about strategies for setting global conservation priorities.

Section 7: Policy briefs
- Learning Objectives: (I) learn about the purpose and structure of an effective policy brief; (II) understand parameters for policy brief assignment.

WEEK 8

Lecture 19 (2/26/2024): Conservation in working landscapes
- Readings: Sodhi/Ehrlich- Ch. 13
- Learning Objectives: (I) appreciate the challenges and opportunities for conserving wildlife in farming landscapes; (II) understand how alternative farming practices influence farmland biodiversity; (III) articulate how farming policy and certification programs can influence on-farm conservation practices

Lecture 20 (2/28/2024): Conservation policy: The Endangered Species Act
- Readings: Sodhi/Ehrlich- Ch. 12
- Learning Objectives: (I) articulate key policies that have shaped conservation; (II) understand when and how species are listed, (III) learn how listed species are managed

Lecture 21 (3/1/2024): International Conservation Policy
- Readings: Kareiva/Marvier- Ch. 4 (Policy Responses to Biodiversity Loss and Ecosystem Degradation, only read from *'Laws for Biodiversity Protection in Other Nations'* to the end of the chapter).
- Learning Objectives: (I) understand how biodiversity is protected in other countries; (II) articulate key conservation problems that span political borders; (III) discuss pros and cons associated with scientists engaging in advocacy

Section 8: Indigenous Land Management and Traditional Ecological Knowledge (TEK)
- Learning Objectives: (I) articulate differences and similarities between TEK and western sciences; (2) understand how TEK can be leveraged to guide land management; (3) explore conservation benefits of working with indigenous people on lands important to you

WEEK 9

Lecture 22 (3/4/2025): Conservation genetics (Guest Lecture: TA Katie Erickson)
- Readings: Nair (2014) *PNAS;* Kareiva/Marvier- Ch. 7 (The Perils of Small Populations, read the middle section '*The Genetic Problems of Small Populations: Inbreeding & Genetic Drift'*).
- Learning Objectives: (I) differentiate between the causes and consequences of inbreeding depression, (II) understand how population genetics can be used to define and manage populations, (III) learn about DNA barcoding as a tool for conservation

Lecture 23 (3/6/2024): Restoration and reintroduction
- Readings: Kareiva/Marvier- Ch. 11 (Restoration and Reintroduction: Fixing Problems After the Fact)
- Learning Objectives**:** (I) identify alternative strategies for defining restoration goals; (II) learn about tradeoffs involved with managing novel ecosystems; (III) understand advantages and limitations associated with reintroduction, rehabilitation, and captive breeding

Lecture 23 (3/8/2024): Problems with small populations
- Readings: Kareiva/Marvier- Ch. 7 (The Perils of Small Populations, read entire chapter EXCEPT the middle section entitled '*The Genetic Problems of Small Populations: Inbreeding and Genetic Drift'*).
- **Policy brief due.**
- Learning Objectives: (1) understand how stochasticity threatens small population, (2) define and explain the Allee effect, (3) articulate the concept of a minimum viable population

Section 9: Adaptive Management
- Learning Objectives: (I) articulate the key components of adaptive management; (II) practice creating an adaptive management plan from case studies

WEEK 10

Lecture 25 (3/11/2024): Quantifying population sizes and simple population trends
- Readings: Kareiva/Marvier- Ch. 8 (Population Size, Trend, and Viability, read from beginning until but not including *'Demographic Matrix Models'*).
- Learning Objectives: (I) articulate alternative methods for conducting wildlife censuses, (II) use mark-recapture models to estimate population size, (III) implement a population model

Lecture 26 (3/13/2024): Population viability analysis
- Readings: Kareiva/Marvier- Ch. 8 (Population Size, Trend, and Viability, read from *'Demographic Matrix Models'* until the end of the chapter).
- Learning Objectives: (I) implement a stage-structure population model, (II) articulate the components of PVA and how it can be used in conservation management

Lecture 27 (3/15/2024): Adaptive management and monitoring
- Readings: Kareiva/Marvier- Ch. 12 (Adaptive Management and Evidence-based Conservation)
- Learning Objectives: (I) understand basic principles of adaptive management, (II) articulate costs and benefits of monitoring

Section 10: Course review— focus on conservation strategies and science
- Learning Objectives**:** (I) solidify understanding of the major strategies leveraged to practice modern conservation; (II) understand the conservation scientist's toolkit

Assessment Description

Note: These descriptions constitute broad overviews of the assignments. Refer to the actual assignment descriptions when preparing your assignments.

Lecture Participation (5%)
At least one clicker question will be implemented in each lecture and used to record attendance. Importantly, scores are purely determined by participation: 'correct' answers receive no extra points. Students will receive full credit for a lecture if they respond to 1 clicker question. To accommodate all unforeseen circumstances (i.e., COVID-19 or other illnesses, mental health challenges, family emergencies, clicker malfunctions, *etc.*), students may miss a total of 6 lectures (i.e., 2 weeks) with no penalty. However, without any exception, any lectures missed beyond that will result in a grade reduction according to the following formula:

- 21-27 lectures: 100 out of 100 points
- 17-20 lectures: 75 out of 100 points
- 13-16 lectures: 50 out of 100 points
- 9-12 lectures: 25 out of 100 points
- <9 lectures: 0 out of 100 points

Section Participation (5%)
Students will get points for participating in sections, including the figure of the week activity associated with an ongoing pedagogy study. For the figure of the week activity, students will turn in a piece of paper with their name on it which will be used to track attendance. To accommodate all unforeseen circumstances (i.e., COVID-19 or other illnesses, mental health challenges, family emergencies, *etc.*), students may miss a total of 2 sections (i.e., 2 weeks) with no penalty. However, without any exception, any sections missed beyond that will result in a grade reduction according to the following formula:

- 8-10 sections: 80 out of 80 points
- 6-7 sections: 60 out of 80 points
- 4-5 sections: 40 out of 80 points
- 2-3 sections: 20 out of 80 points
- 0-1 sections: 0 out of 80 points

In addition, students will receive 20 points for taking the two surveys associated with the pedagogy study (10 points per survey). The surveys will be administered in section in weeks 1 and 9.

Quizzes (5%)
Online quizzes will be administered via Gradescope and due by Friday at 11:59pm each week. Quizzes will draw from the week's lectures and will be untimed. No late quizzes will be accepted; however, the two lowest quiz scores will be replaced with 100% scores.

Online blog (15%)
One learning objective of this course is to teach students how to communicate with lay-audiences about conservation issues. Each student will be required to summarize the insights, implications, and limitations of a recent academic article (relevant to conservation) for an online course blog. Academic articles must be recent (from 2022, 2023, or 2024) and cannot be the subject of prior a course blog. Blog entries will be 750-1000 words, targeted for a lay-audience, and modeled after The Nature Conservancy's *Cool Green Science* (http://blog.nature.org/science/). Be sure to spice up your blog entry with some photos. The top scoring blogs will be posted on an outward-facing website (https://medium.com/student-conservation-corner). Students that do not wish to make their blog entries public will not be

required to do so or will be allowed to post anonymously. ***A full assignment description is posted on canvas— failure to read the description will likely result in a lower grade.***

Message box (5%)

Students will learn how to use the message box to effectively communicate a conservation policy, a conservation issue in the news, or recent conservation-relevant research. Students will be tasked with choosing a conservation-relevant scientific finding, policy, or concept that they would like to communicate to a lay-audience before section 6. In section 6, students will be introduced to the concept of the message box and how it can be used to communicate with multiple target audiences. Students will then be asked to write a message box targeted to specific audience and then deliver it in class to a different student. Grades will be assigned for both the written message boxes (graded by course instructors; due the following Monday) and the orally delivered message boxes (full credit for all participants).

Policy brief (15%)

Another course theme is the crucial need to transfer knowledge from experts to decision-makers. Academic papers are often hard to obtain, written in technical language, and difficult to relate to concrete policy recommendations. Translating academic writing to a format that could potentially influence policy requires: (I) grabbing and holding the attention of the target audience and (II) summarizing complex information into easily digestible, jargon-free language. Students will distill from a recent academic article or conservation topic in the news a 1 page policy brief. As policy briefs must be both informative and attention grabbing, figures and/or photos are required. ***A full assignment description is posted on canvas— failure to read the assignment description will likely result in a lower grade.***

Midterm exam (20%)

The midterm will cover all course lectures and assigned readings in the first two sections of the course (introduction to conservation science and threats to Earth's ecosystems).

Final exam (25%)

A final exam will cover all course lectures and readings.