# BIO 101 / EARTHSYS 101C – Science for Conservation Policy: Meeting California's Pledge to Protect 30% by 2030

**Brief course description**

California has set the ambitious goal of conserving 30% of its lands and waters by the year 2030. In this course, students will develop science-based recommendations to help policymakers reach this "30 by 30" goal. Through lectures, labs, and field trips, students will gain practical skills in ecology, protected area design in the face of climate change, and science communication. Students will apply these skills to analyze real-world data, formulate conservation recommendations, and communicate their findings in mock verbal and written testimony to policymakers.

## Logistics

Course listing: BIO 101 / EARTHSYS 101C
Winter 2022
Weekly schedule: Tues / Thurs 9:45 – 11:15 am
4 credits
Pre-requisites: BIO 81 or BIO/EARTHSYS 105 or BIO 117/EARTHSYS 111 or Instructor Approval
Enrollment cap: 25
Room: STLC 119

Instructor:

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Teaching Assistant

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Office Hours:

Tyler: Mondays 1:00 - 2:00 pm, Bass Biology 203 and Zoom (Link to Tyler's Zoom room) or by appointment
Maria: By appointment

This course fulfills:

- WAYS-AQR (Applied Quantitative Reasoning)
- Elective, Biology Ecology & Evolution track

**Full Course Description**
California recently pledged to conserve 30% of its land and waters by the year 2030. This "30 by 30" pledge is part of a global initiative to set aside space for nature, but how do we ensure that protected areas contribute to biodiversity conservation goals?

This course will explore the connections between conservation science and policy. Our goal is to develop and communicate science-based recommendations to guide California's ambitious 30 by 30 pledge. We will focus in particular on terrestrial conservation planning and the challenge of designing protected areas that work for wildlife.

In the first half of the course, students will develop the knowledge and skills needed to apply ecological concepts to the design of natural protected areas. Weekly labs will give students the opportunity to analyze real-world data and form conservation recommendations. In the second half of the course, students will apply their new analytical skills towards informing the implementation of 30 x 30. Students will work in groups to conduct an original quantitative research project with the goal of advancing three 30 x 30 priorities: biodiversity conservation, climate resilience, and equitable access to the benefits of nature. Students will present their original analyses and recommendations in the form of a policy brief and verbal testimony to natural resource decisionmakers.

**Learning Outcomes**
1. Apply concepts and theory from ecology to the design of natural protected areas.
2. Synthesize theory and empirical data on biodiversity, human dimensions, and spatial ecology to critically evaluate conservation and management actions.
3. Conduct and interpret spatial and ecological analyses in R.
4. Develop an original data-driven proposal addressing a current conservation challenge in California.
5. Communicate scientific data and policy recommendations (verbally and in writing) to stakeholders and policymakers.

**Breadth Requirement (WAY-AQR) Learning Outcomes**
By the end of the course, students should be able to:
- Transform and analyze data or apply estimation methods to solve relevant problems, guide decision-making, or answer questions of specific or wide concern
- Choose appropriate probabilistic or empirical models to solve a given problem, using information from observed data and knowledge of the system being studied
- Quantitatively model or visualize the behavior or evolution of a system, network or dataset in the social sciences, humanities, sciences, or engineering

**Guiding Values**

1. Conservation is ultimately about the people who interact with, depend on, and draw inspiration from nature.
2. A diversity of perspectives, skills, approaches, and lived experiences strengthens our class and our work as conservation scientists and practitioners.
3. There are no irrelevant questions or calls for help: no one's experience is too large or too small
4. We will use coding and statistics to apply and deepen our understanding of the concepts covered in class. No prior experience is needed, and coding abilities should not be a barrier to student success.

**Grading**

Grades will be weighted according to the following categories:

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| R labs (x4) | 40% |
| Guest speaker / field trip reflections (x5) | 25% |
| Project Proposal (group grade) | 5% |
| Policy Brief (group grade) | 10% |
| Verbal Testimony (group grade) | 10% |
| Project Reflection (individual grade) | 10% |

**Late work policy**

Please do not hesitate to reach out to Tyler and/or Maria if you need accommodations or if there are extenuating circumstances that will prevent you from turning work in on time. We are generally flexible and able to offer reasonable extensions. We will accept late work for most* assignments, with a slight penalty. If we have spoken and agreed on granting an extension, this policy applies the new agreed upon due date. Assignments are always due by the start of class because we want you to be ready for new material and discussions.

- Work turned in on same day as due date – no penalty
- Work turned in within 1 week of due date – 10% penalty
- Work turned in >1 week after due date – 25% penalty

*We will not accept late work for the Policy Brief, Verbal Testimony, or Project Reflection

**Course materials, readings, and resources**

Required materials

- There is no required textbook. All required readings will be provided.
- **Student will need a working laptop computer** for labs and the group project. Please contact me ASAP if you need help getting a laptop. I can connect you with resources on campus, and I have one extra laptop I could lend someone.

- Students will need to download QGIS, R, and RStudio for labs. These are all free open-source computer programs that work on Mac and Windows.
    - Instructions for installing R and RStudio: http://web.cs.ucla.edu/~gulzar/rstudio/
    - Download QGIS here: https://qgis.org/en/site/forusers/download.html

Additional helpful free resources:

- Spatial Ecology and Conservation Modeling: Applications with R, by Robert Fletcher and Marie-Josée Fortin. Springer 2018. PDF available on Canvas and copy on reserve at Science Library.
- R spatial cheat sheet available on Canvas.
- Spatial Data Science with R https://rspatial.org/raster/index.html
- Stanford Geospatial Library offers resources, workshops, and consultation for students doing spatial research. Additional information on resources they provide here: https://guides.library.stanford.edu/remotesgc
- R resources at Stanford (https://library.stanford.edu/projects/r), including workshops and weekly office hours for troubleshooting code.

**Communication**

Course announcements will be communicated in person and through Canvas Announcements. Please do not be shy about asking questions during class – if you have a question, most likely someone else does too! Please feel free to stay after class, reach out via email, or come to office hours if you would like to chat or if you have personal questions. For emails, please use the subject line "BIO 101: specific subject" to ensure I see it. I will do my best to respond in a timely manner (within 1-2 business days). I do not generally check my email on evenings or weekends and I do not expect you to either.

**R Labs and Coding Assignments**

Weeks 2-5 will consist of paired Tuesday lectures and Thursday labs. Labs are designed to help students take the concepts covered in lectures and apply them in a conservation decision-making context. We will use the R coding language, which has become the standard coding language for ecological statistics. No prior coding or R experience is required. We will also use QGIS (a graphical user interface program) for visualizing maps and spatial data. All labs will be during the Thursday class time and students should be able to complete most of the work in class. Each lab activity and associated reflection will make up 10% of the student's grade and will be due the Tuesday after lab. Students are encouraged to attend office hours if they need additional help.

**Field Trips and Guest Speakers**

We will have two field trips and three guest speakers. There will be a full day field trip to Coyote Valley on February 8. We will leave from campus at 8 am and return at 3 pm. Lunch will be

provided. There will also be a shorter local field trip to Cooley Landing, East Palo Alto, focused on climate resilience, ecosystem restoration, and community engagement. This will be on February 10 (8:30 am – 12:00 pm). Transportation will be via carpooling which the instructors will help arrange. Students will be expected to turn in a brief ~½ page reflection following each field trip or guest speaker, each of which will make up 5% of the student's grade. Reflection prompts will be provided after each activity.

**COVID-19**

We are continuing to monitor the situation and follow the University's guidance regarding COVID-19 precautions. As of now, **the first two weeks of the course will be online-only via Zoom**. We are doing our best to make the remote learning environment engaging and accessible and we appreciate your enthusiastic participation. This syllabus provides an outline of the course, however some activities may change depending on changing University policies. We understand that online learning, isolation requirements, changes in student living situations, and the uncertainty surrounding the entire situation may affect your learning and your ability to access course materials. Please let us know immediately if you are having any difficulties accessing course materials or if there is anything we or the University can do to better support you.

**Access and Accommodations**

Stanford is committed to providing equal educational opportunities for disabled students. Disabled students are a valued and essential part of the Stanford community. We welcome you to our class.

If you experience disability, please register with the Office of Accessible Education (OAE). Professional staff will evaluate your needs, support appropriate and reasonable accommodations, and prepare an Academic Accommodation Letter for faculty. To get started, or to re-initiate services, please visit http://oae.stanford.edu

If you already have an Academic Accommodation Letter, we invite you to share your letter with us. Academic Accommodation Letters should be shared at the earliest possible opportunity so we may partner with you and OAE to identify any barriers to access and inclusion that might be encountered in your experience of this course.

## Course Schedule

**Please note that calendar is subject to change and readings may be added as the course progresses.**

** Indicates class held online via Zoom.*

| Date | | Topic | Readings due | Assignments due |
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| Jan. 4* | T | Introduction and course logistics | | |
| Jan. 6* | Th | Protected areas (Tyler) | TNC 30 x 30 Story Map (Overview and 30% by 2030 sections) | |
| Jan. 11* | T | Habitat and Biodiversity Data (Tyler) | Pathways to 30x30 draft: Conservation in CA section (pg. 24-33) | -Student Survey due 9:45 am<br>-Download iNaturalist app to phone |
| Jan. 13* | Th | **Lab 1:** Intro to Spatial Ecological Data | | Install QGIS, R, and RStudio on computer (see Lab 1 'Before Class' section for instructions) |
| Jan. 18* | T | **Guest speaker**: Species distributions (Avery Hill, Stanford) | Geographical Ecology (Chap. 6) pg. 127-135 & 142-149. | Lab 1 due 9:45 am |
| Jan. 20 | Th | **Lab 2:** Species Distribution Modeling | | |
| Jan. 25 | T | Connectivity (Tyler) | | Lab 2 due 9:45 am |
| Jan. 27 | Th | **Lab 3:** Corridor Identification | Connectivity_reading (posted on Canvas) Chap. 2 | |

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| Feb. 1 | T | Conservation Prioritization (Tyler). **Guest:** Kelley Chauvin | | Lab 3 due 9:45 am |
| Feb. 3 | Th | **Lab 4:** Systematic Conservation Prioritization | 1) Wyborn and Evans 2021; 2) Response to Wyborn and Evans (PDFs of readings are on Canvas) | Field trip and group project survey due |
| Feb. 8 | T | **Field trip:** Coyote Valley. Tour with Santa Clara Valley Open Space Authority (8 am – 3 pm) | 1) Bay Nature article for background on conservation in Coyote Valley; 2) Forward, Highlights, and Introduction (through pg. 12) from Coyote Valley Landscape Linkage Report | Lab 4 due 9:45 am |
| Feb. 10 | Th | **Field trip:** Cooley Landing. Tour and restoration work party with Grassroots Ecology (8:30 am – 12:00 pm) | Read this KQED article on sea level rise and EJ in East Palo Alto | Register individually and sign waiver here. |
| Feb. 15 | T | Group Project details and work time | Pathways to 30x30 pg. 1-17 | |
| Feb. 17* | Th | **Guest speaker:** Modeling climate impacts to wildlife communities (Dr. Brooke Bateman, National Audubon Society) | | |
| Feb. 22 | T | Conservation Baselines: Insights from the fossil record (Maria) | Barnosky et al. 2017 | Project Proposal due 9:45 am |
| Feb. 24 | Th | Discussion: Traditional Ecological Knowledge/ Stewardship (Maria) | Asters and Goldenrods chapter from *Braiding Sweetgrass*; Chap. 12 and Coda from *Tending the Wild* | |

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| Mar. 1 | T | **Guest speaker:** Connecting Science and Policy (Dr. Liz Hadly, Stanford) | Further reading: blog post on prescriptive vs. informative advocacy | |
| Mar. 3* | Th | **Guest speaker:** 30x30 planning behind the scenes (Millie Chapman, UC Berkeley) | Read from Pathways to 30x30 Appendix A: the section on the Bay Area and two other regions of your choice | |
| Mar. 8 | T | Careers in conservation; work time | | |
| Mar. 10 | Th | Work time | | -Individual Reflection due 9:45 am<br>-Policy brief due 9:45 am |
| Finals week | W | **Student group presentations** (Wednesday March 16, 9:00 – 11:30 am, STLC 119) | | |

# Group Project: Providing guidance for 30 x 30 policymakers

**Required background reading:** Pathways to 30x30 document (on Canvas), pg. 1-23

**Summary**

Students will work in groups of 3-4 to develop data-driven policy recommendations regarding the implementation of 30x30 in California. Students will design and carry out an original analysis with the goal of advancing one or more of these priorities:

- **Effectiveness at conserving biodiversity**: Biodiversity conservation is a central goal of 30x30. A key question, is which areas to protect? Existing protected areas in California occur disproportionately in species poor regions, such as the high Sierra and the eastern deserts (though many interesting, endemic, and/or threatened species do occur here!). Many of these places were protected for their remoteness and scenic beauty, rather than for their biodiversity *per se*. Future protected areas must explicitly consider their contributions to biodiversity conservation.
- **Resilience to climate change**: Most existing protected areas were designed to protect biodiversity and natural features where they are today. However, climate change is already causing dramatic range shifts for many species. Given the rapidly changing climate, many protected areas may no longer be able to support the species they were designed to protect. This raises a critical question: how do we design a protected area system that accounts for and facilitates climate-induced range shifts?
- **Equity in nature access, protection, and benefits**: Biodiversity provides immense societal benefits, yet opportunities for interacting with nature are highly unequal. For example, low-income communities and communities of color in the U.S. have less access to high quality parks and are more likely to live in areas that are deprived of nature. These disparities have profound implications for mental and physical health. The 30x30 initiative provides an opportunity to make conservation and access to the benefits provided by nature more equitable.

Throughout the course, we will provide students with background on these issues, and we will teach them how to access relevant ecological and geospatial datasets. Students will apply the skills they learned in the labs (weeks 2-5) to analyze these data and formulate conservation recommendations. The three priorities presented to students are broad and open-ended, so students will have ample flexibility to pose their own research questions and choose which analyses to perform.

The project has four graded components:

1. **Project Proposal**; one per group, 5% of course grade. Due Tuesday Feb. 22
2. **Policy Brief (two pages)**; one per group, 10% of course grade. Due Thursday March 10
3. **Individual Reflection**; one per individual, 10% of course grade. Due Thursday March 10
4. **Verbal Testimony** (group grade; 10% of course grade). Wednesday March 16, 9-11 am