COLUMBIA UNIVERSITY
School of Professional Studies

Academic Program: MS in Sustainability Management

SUMA PS4238 Biodiversity, Climate Change and Sustainable Management of Natural Ecosystems
Day: TBD
3 Credits

Instructor: Ralph Schmidt, email: XXXX, telephone: XXXX
Office Hours: Date, time and location: TBD; may also be done by appointment]
Response Policy: We will generally respond within 24 hours.

Facilitator/Teaching Assistant: Gabi Ferraris, email: XXXX
Office Hours: Date, time and location: TBD; may also be done by appointment]
Response Policy: We will generally respond within 24 hours.

Course Overview

Biodiversity, a term popularized in the 1980s, refers to the variety of life at the genetic, species, and ecosystem levels. It is crucial for sustainability, as it supports ecosystems that underpin human life, economic activities, and ecological stability. The loss of biodiversity threatens essential ecosystem services like clean air, water filtration, climate regulation, and food security. This course explores how climate change, both current and projected, impacts biodiversity and how natural ecosystems influence greenhouse gas concentrations. Human survival depends on these ecosystems, yet there is uncertainty about how much biodiversity loss can be tolerated. Climate change now poses as serious a threat to biodiversity as direct development activities. Understanding the science behind these threats is essential for sustainability students, and this course aims to provide that knowledge.

Uniquely, this course is taught through collaboration among the SUMA professors who otherwise teach biodiversity classes of their own. Indeed, this course has incorporated several SUMA faculty as guest lecturers partly to ensure full compatibility and complementarity of different courses. We will study biodiversity and climate change in both terrestrial, aquatic, and marine ecosystems, including urban and agricultural landscapes. There is great biodiversity, and great threats to it, in all these ecosystems. Sustainable management of all these different ecosystems can help conserve biodiversity and reduce the rate of climate change. In fact, natural ecosystems have a very significant role in both emissions and sequestration of carbon. Over half of current emissions are absorbed by the forests and oceans rather than remaining in the atmosphere.

Simultaneously, tropical deforestation across the globe produces CO2 emissions equal to the total current emissions of the United States. Forest fires in Canada have produced emissions equal to the total fossil fuel based emissions of that country. Thawing of permafrost in the arctic north is one of the positive feedback loops, warming leading to more warming that has catastrophic potential. In studying biodiversity, we will examine ecosystems and species such as muskoxen, whales, penguins, primates, tree frogs, and monarch butterflies. We will also explore human practices like agriculture, forest management, hunting, and fishing, which affect both carbon and biodiversity and rely on climate stability. Students will learn how climate and natural ecosystems interact, a crucial first step toward actions needed to sustain life on Earth. While some readings may be challenging for those without an ecology background, support will be available. Students with prior ecology knowledge should find the course particularly informative.

Course logistics:

i. This is an Elective Course.
ii. The Course is open to cross-registrants from other fields and/or Columbia University programs.
iii. No prerequisite knowledge or course work in the discipline are required
iv. Course Modality: On Campus (In-Person)
v. Duration: Full semester

Learning Objectives

L1. Ecosystem Functionality and Dynamics

- **Objective:** By the end of this course, students will be able to identify and describe the key functions and dynamics of global natural ecosystems, including tropical, temperate, and boreal forests, grasslands, tundras, wetlands, lakes, rivers, oceans, as well as urban and agricultural ecosystems.
- **Outcome:** Students will create detailed ecosystem profiles, highlighting species interactions, nutrient cycles, and ecosystem services, supported by relevant data and case studies.

L2. Biodiversity and Climate Change Interactions

- **Objective:** Students will critically analyze the interactions between biodiversity and climate change, evaluating how climate change impacts species distribution, ecosystem health, and ecological processes in both natural and built environments.
- **Outcome:** Students will develop comprehensive reports or presentations that assess the effects of climate change on specific ecosystems and propose evidence-based solutions to mitigate these impacts.

L3. Biodiversity's Role in Sustainability

- **Objective:** Students will articulate the importance of biodiversity in sustaining ecological balance, human health, and economic stability, and analyze how biodiversity loss undermines these systems.
- **Outcome:** Students will write bi-weekly assignments and create presentations that illustrate the interdependence between biodiversity and human well-being, incorporating case studies and current research.

L4. Biodiversity in Climate Change Mitigation and Adaptation

- **Objective:** Students will investigate the role of biodiversity and natural ecosystems in climate change mitigation and adaptation, focusing on carbon sequestration, ecosystem resilience, and adaptation strategies.
- **Outcome:** Students will analyze case studies or produce short papers that analyze successful examples of biodiversity-based climate solutions and propose new strategies based on course learnings.

L5. Impact of Climate Change on Ecosystems

- **Objective:** Students will gain in-depth knowledge of how climate change affects various natural ecosystems and biodiversity, including the identification of key threats and vulnerabilities.
- **Outcome:** Students will write their final research papers to explore climate change effects on specific ecosystems, supported by empirical data and case studies.

L6. Sustainability and Ecosystem Management

- **Objective:** Students will critically evaluate concepts of sustainability as applied to different ecosystems, and assess the implications of achieving or failing to achieve sustainability goals.
- **Outcome:** Students will develop strategic management plans or sustainability frameworks that address the specific needs and challenges of various ecosystems, incorporating both theoretical and practical considerations.

Readings

Books (Readings will be provided on CourseWorks):

Thomas Lovejoy and Lee Hannah. (2005). *Climate Change and Biodiversity.* Yale University Press.

Thomas E. Lovejoy and Lee Hannah. (2019). *Biodiversity and Climate Change*. Yale University Press.

Josep G. Canadell and Robert B. Jackson. (2021). *Ecosystem Collapse and Climate Change*. Springer.

Gaia Vince. (2022). *Nomad Century*. Flatiron Books.

Articles

Aponte et. al. (2020). "Structural diversity underpins carbon storage in Australian temperate forests". *Global Ecology and Biogeography*. Vol. 29, Issue 5.
https://doi.org/10.1111/geb.13038

Brodie & Watson. (2023). "Human responses to climate change will likely determine the fate of biodiversity". PNAS. https://doi.org/10.1073/pnas.2205512120

Churkina, G. (2008). "Modeling the carbon cycle of urban systems". *ElSevier Journal*. Vol: 216. 107-113.
https://doi.org/10.1016/j.ecolmodel.2008.03.006

Dirzo, R. and Raven, P. (2003). "Global State Of Biodiversity And Loss". Annual Review of Environment and Resources. Vol 28: 137-167. https://doi.org/10.1146/annurev.energy.28.050302.105532

Esperon Rodriguez, M., et al. (2022). "Climate change increases global risk to urban forests". *Nature Climate Change*, Vol: 12. 950-955.
https://vibrantcitieslab.com/wp-content/uploads/2023/08/climate-change-increases-global-risk-to-urban-forests.pdf

Ferreira, et. al. (2024). "Mangrove Biodiversity and Conservation: Setting Key Functional Groups and Risks of Climate-Induced Functional Disruption". *Diversity*. 16, no. 7: 423. https://doi.org/10.3390/d16070423

McPhearson, T., et al. (2018). "Urban ecosystems and biodiversity". *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*. Cambridge University Press. New York. 257–318.
https://uccrn.ei.columbia.edu/sites/default/files/content/pubs/ARC3.2-PDF-Chapter-8-Ecosystems-and-Biodiversity-wecompress.com_.pdf

Parmesan, et al. (2023). "The case for prioritizing ecology/behavior and hybridization over genomics/taxonomy and species' integrity in conservation under climate change". *Biological Conservation*. Vol. 281.
https://doi.org/10.1016/j.biocon.2023.109967

Recommended/Optional Resources:

Sudhir Chandra Das, Pullaiah Thammineni, and Elizabeth Ashton. (2022). *Mangroves: Biodiversity, Livelihoods and Conservation*. Springer.

Judith Weis and Carol Butler. (2009). *Salt Marshes – A Natural and Unnatural History*. Rutgers University Press.

Miguel Montoro Girona, Hubert Morin, Sylvie Gauthier, Yves Bergeron. (2023). *Boreal Forests in the Face of Climate Change.* Springer.

Assignments and Assessments

- **In-Class Presentation (15%)**
  Students will be asked to form groups of two to six students depending on class size, and make 20-minute presentations (with slides) on one of the reading assignments for the week. Professors will be available to advise students on these presentations.
  (Addresses the following learning objectives: L1, L2, L3, L4, L5, L6)

- **Bi-Weekly Assignments (20%)**
  To support ongoing learning and engagement, students will complete four (4) short bi-weekly assignments over the course of the semester. Students will have to submit reflection papers, summarizing key insights from the readings and course materials and their relevance to current sustainability and biodiversity problems experienced today (maximum 2 pages)
  (Addresses the following learning objectives: L1, L2, L5)

- **Midterm Project - Case Study Analysis (15%)**
  Overview: Students will conduct a comprehensive case study analysis (5-6 pages in length) of a real-world scenario or problem related to the course material. This project aims to apply theoretical knowledge to practical situations, enhancing critical thinking and analytical skills. Students will select a case study of their choice. Case study needs to be approved by the instructor before continuing. The case study should include the following components:
  - **Background Information**
    Provide context for the case study, including geographical location, timeframe, and key stakeholders involved. Summarize the main environmental, social, and economic factors at play.
  - **Problem Identification**
    Clearly state the central issue or challenge presented in the case study.
    Identify any secondary problems or contributing factors.
  - **Analysis**
    Apply relevant course concepts and theories to analyze the situation.
    Evaluate the causes and consequences of the identified problems.
    Consider multiple perspectives (e.g., ecological, economic, social, political).
  - **Proposed Solutions**
    Develop at least two potential solutions to address the main problem.
    Discuss the pros and cons of each proposed solution.
    Recommend the most viable solution and justify your choice.

  (Addresses the following learning objectives: L2, L3, L4)

- **Final Project (40%)**
  Overview: Students will choose to present their final deliverable either as a written, comprehensive research paper (15 pages in length) or as a final 20-minute presentation that critically examines an ecosystem studied in class. The final project should include the following components:
  - **Ecosystem Selection** (15% of final grade)

Select an ecosystem from those covered in the course (e.g., tropical rainforest, temperate forest, tundra, wetland, marine ecosystem, urban environment). Justify your choice based on its significance, biodiversity, or relevance to current environmental issues.

- **Biodiversity Assessment** (25% of final grade)
  Provide a detailed description of the biodiversity within your chosen ecosystem. Include information on species richness, species diversity, and genetic diversity. Highlight key species within the ecosystem, including any endemic, threatened, or keystone species. Discuss their roles and contributions to ecosystem functioning.
- **Ecosystem Traits and Services** (20% of final grade)
  Describe the fundamental ecological traits of the ecosystem, such as its structure, function, and dynamics. Include information on habitat types, food webs, and ecological interactions. Identify and elaborate on the ecosystem services provided by this ecosystem, such as provisioning (e.g., food, water), regulating (e.g., climate regulation, water purification), supporting (e.g., nutrient cycling), and cultural services (e.g., recreational, aesthetic).
- **Impacts from Climate Change and Human Activities** (25% of final grade)
  Analyze how climate change is impacting the chosen ecosystem. Discuss specific climate-related factors such as temperature changes, altered precipitation patterns, sea-level rise, or increased frequency of extreme weather events. Examine other human-related impacts on the ecosystem, such as deforestation, pollution, habitat fragmentation, invasive species, or land-use changes.
- **Management and Conservation Strategies** (15% of final grade)
  Review existing management and conservation strategies employed to protect and sustain the ecosystem. Propose a management technique or conservation strategy tailored to the ecosystem's needs. Outline steps for implementing the proposed technique, including potential challenges and necessary resources. Suggest methods for monitoring and evaluating the effectiveness of the management strategy.

(Addresses the following learning objectives: L1, L2, L3, L4, L5)

- **Class participation (10%)** - Class participation will be evaluated on a scale of 0-100. All students are expected to contribute to the classroom discussion throughout the course, including the in-class presentations and discussions with guest speakers. While classes will generally feature lectures on the specified topics each week, active discussion is encouraged to bring in students' experiences and knowledge. Students should probe concepts introduced in the class and in readings and look for innovative solutions to challenges identified in the materials.

    - On-time attendance at each class meeting is expected. Partial attendance, i.e. lateness or early departure, if not excused in advance, will impact the "Participation" component of the course grade. If you need to miss a class for any reason, please email the instructors in advance.

Grading

The final grade will be calculated as described below:

FINAL GRADING SCALE

Grade	Percentage
A+	98–100 %
A	93–97.9 %
A-	90–92.9 %

B+	87–89.9 %
B	83–86.9 %
B-	80–82.9 %
C+	77–79.9 %
C	73–76.9 %
C-	70–72.9 %
D	60–69.9 %
F	59.9% and below

Assignment/Assessment	% Weight	Individual or Group/Team Grade
In-Class Presentation	15%	Team Grade
Bi-Weekly Assignments (4 Assignments - 5% each)	20%	Individual Grade
Midterm Project - Case Study Analysis	15%	Team Grade
Final Project	40%	Individual Grade
In-Class Participation	10%	Individual Grade

Assignments Evaluation Criteria

- Depth of understanding of course concepts (25%)
- Quality of analysis and critical thinking (25%)
- Clarity and coherence of arguments (20%)
- Feasibility and creativity of proposed solutions (20%)
- Writing quality and proper citation (10%)

Course Policies

Participation and Attendance
You are expected to do all assigned readings, attend all class sessions, and engage with others in class discussions. If you need to miss a class for any reason, please discuss the absence with the instructors in advance.

Late work
Papers and projects are due by the beginning of class on the date that they are due. All assignments must be handed in on time. Any late submissions, unless pre-approved by the professor, will receive an automatic reduction of one letter grade.

Citation & Submission
All written assignments must use a standard citation format of your choice (e.g., MLA, APA, Chicago), cite sources, and be submitted to the course website (not via email).

School and University Policies and Resources

Copyright Policy

Please note—Due to copyright restrictions, online access to this material is limited to instructors and students currently registered for this course. Please be advised that by clicking the link to the electronic materials in this course, you have read and accept the following:

> The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials. Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

Use of Artificial Intelligence (AI)

Students are expected to adhere to the principles of honesty and authenticity. While using generative AI tools to assist in class work is allowed, students must clearly indicate which portions of their work were generated by AI, giving proper credit to the tool.

The use of generative AI tools should not compromise the originality of the work. Assignments, projects, and assessments should primarily reflect the student's own understanding, research, and creativity. The use of generative AI tools should align with the learning objectives of the course. Students are encouraged to engage with the technology to enhance their understanding and explore new avenues of learning, rather than as a means to bypass critical thinking and research.

Students are responsible for adhering to intellectual property rights. The use of copyrighted materials in AI-generated work should comply with fair use policies and properly attribute the source.

Academic Integrity

Columbia University expects its students to act with honesty and propriety at all times and to respect the rights of others. It is fundamental University policy that academic dishonesty in any guise or personal conduct of any sort that disrupts the life of the University or denigrates or endangers members of the University community is unacceptable and will be dealt with severely. It is essential to the academic integrity and vitality of this community that individuals do their own work and properly acknowledge the circumstances, ideas, sources, and assistance upon which that work is based. Academic honesty in class assignments and exams is expected of all students at all times.

SPS holds each member of its community responsible for understanding and abiding by the SPS Academic Integrity and Community Standards posted at https://sps.columbia.edu/students/student-support/academic-integrity-community-standards. You are required to read these standards within the first few days of class. Ignorance of the School's policy concerning academic dishonesty shall not be a defense in any disciplinary proceedings.

Diversity Statement

It is our intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture.

Accessibility
Columbia is committed to providing equal access to qualified students with documented disabilities. A student's disability status and reasonable accommodations are individually determined based upon disability documentation and related information gathered through the intake process. For more information regarding this service, please visit the University's Health Services website: https://health.columbia.edu/content/disability-services.

Class Recordings
All or portions of the class may be recorded at the discretion of the Instructor to support your learning. At any point, the Instructor has the right to discontinue the recording if it is deemed to be obstructive to the learning process. If the recording is posted, it is confidential and it is prohibited to share the recording outside of the class.

SPS Academic Resources
The Division of Student Affairs provides students with academic counseling and support services such as online tutoring and career coaching: https://sps.columbia.edu/students/student-support/student-support-resources.

Columbia University Information Technology
Columbia University Information Technology (CUIT) provides Columbia University students, faculty and staff with central computing and communications services. Students, faculty and staff may access University-provided and discounted software downloads.

Columbia University Library
Columbia's extensive library system ranks in the top five academic libraries in the nation, with many of its services and resources available online.

The Writing Center
The Writing Center provides writing support to undergraduate and graduate students through one-on-one consultations and workshops. They provide support at every stage of your writing, from brainstorming to final drafts. If you would like writing support, please visit the following site to learn about services offered and steps for scheduling an appointment. This resource is open to Columbia graduate students at no additional charge. Visit http://www.college.columbia.edu/core/uwp/writing-center.

Career Design Lab
The Career Design Lab supports current students and alumni with individualized career coaching including career assessment, resume & cover letter writing, agile internship job search strategy, personal branding, interview skills, career transitions, salary negotiations, and much more. Wherever you are in your career journey, the Career Design Lab team is here to support you. Link to https://careerdesignlab.sps.columbia.edu/

General Course Housekeeping:
- Avoid using offensive language or language that is not appropriate for a professional setting.
- Do not criticize or mock someone's abilities or skills.
- Communicate in a way that is clear, accurate and easy for others to understand.
- Balance collegiality with academic honesty.
- Keep an open-mind and be willing to express your opinion.
- Reflect on your statements and how they might impact others.
- Do not hesitate to ask for feedback.
- When in doubt, always check with your instructor for clarification.

Weekly Readings and Course Calendar

Week (Date) & Instructor	Topic	Readings (due on this day)	Assignments (due on this day)
Week 1 Instructor: Ralph Schmidt	Introduction. Recent history of global climate. Physical dynamics of climate.	N/A	Come prepared to introduce yourself
Week 2 Instructor: Ralph Schmidt	Tropical forest ecology, biodiversity, and carbon cycles. History of land use.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Thomas Lovejoy and Lee Hannah. Changing the Biosphere. Pp. 3-11; 2. Michael MacCraken. What is Climate Change? Pp. 12– 22; 3. John Williams and Kevin Burke. Past Abrupt Changes in Climate and Terrestrial Ecosystems. Pp. 128-141. 4. Mark Bush. A Neotropical Perspective on Past Human-Climate Interactions and Biodiversity. Pp. 142-153; 5. James Watson et. al. Tropical Forests in a Changing Climate. Pp. 196-207; 6. Daniel Nepstad. Postponing the Amazon Tipping Point. Pp. 208-210. **Articles**: Dirzo, R. and Raven, P. (2003). "Global State Of Biodiversity And Loss". Annual Review of Environment and Resources. Vol 28: 137-167. https://doi.org/10.1146/annurev.energy.28.050302.105532 **Total pages: 77** **Optional Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Jeffrey Park. A Paleoecological Perspective on Sudden Climate Change and Biodiversity Crises. Pp. 97-108.	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 1**

Week 3 Instructor: Ralph Schmidt	Temperate forest ecology, biodiversity and carbon cycles. History of land use.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. David Breshears et. al. Rapid Broad-Scale Ecosystem Changes and Their Consequences for Biodiversity. Pp. 80-90; 2. Camille Parmesan. Range and Abundance Changes. Pp. 31-38 (pp. 25-31 should be read first); 3. Antoine Guisan et. al. Climate Change Impacts on Mountain Biodiversity. Pp. 221-233; 4. David Inouye. Climate Change and Frost Effects in Rocky Mountain Plant Communities. Pp. 234-236. **From:** Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 6 - 2016 Tasmanian Wilderness Fires. Pp. 133-153. **Articles**: Aponte et. al. (2020). "Structural diversity underpins carbon storage in Australian temperate forests". *Global Ecology and Biogeography*. Vol. 29, Issue 5. https://doi.org/10.1111/geb.13038 **Total pages: 68** **Optional Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Eric Post and Michael Avery. Phenological Dynamics in Pollinator-Plant Associations Related to Climate Change. Pp. 42-54.	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 2** **Bi-Weekly Assignment #1 Due**
Week 4 Instructor: Ralph Schmidt	Boreal forest ecology, biodiversity and carbon cycles.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. David Breshears et. al. Rapid Broad-Scale Ecosystem Changes and Their Consequences for Biodiversity. Pp. 83-84. (Also assigned for temperate forests.)	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 3**

		2. Lauren Buckley and Janneke Hillerislambers. Temperate and Boreal Responses to Climate Change. Pp. 211-220; **From**: Thomas E. Lovejoy and Lee Hannah. *Climate Change and Biodiversity.* Yale University Press, 2005: 1. Brian Huntley. North Temperate Responses. Pp.109-124; 2. Bert Drake et. al. Synergistic Effects. Pp. 307-308; 3. Daniel Scott. Integrating Climate Change into Canada's National Park System. Pp. 342-345. **From**: Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 3 - Permafrost Thaw in Northern Peatlands. Pp. 27-67. **Total pages: 75** **Optional Readings:** **From**: Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 4 - Post-Fire Recruitment Failure as a Driver of Forest to Non-Forest Ecosystem Shifts in Boreal Regions. Pp. 69-100.	**Submit Midterm Project Case Study for Approval.**
Week 5 Instructor: Ralph Schmidt	Mangrove ecology, biodiversity and carbon cycles. Effects of Climate Change on Small Islands.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Celine Bellard et. al. The Effects of Sea-Level Rise on Habitats and Species. Pp. 125-127; **From**: Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 9 - Processes and Factors Driving Change in Mangrove Forests. Pp. 221-264. **Articles**: Ferreira, et. al. 2024. "Mangrove Biodiversity and Conservation: Setting Key Functional Groups and Risks of Climate-Induced Functional Disruption". *Diversity*. 16, no. 7: 423. https://doi.org/10.3390/d16070423 **Total pages: 57** **Optional Readings:**	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 4** **Bi-Weekly Assignment #2 Due**

		From: Sudhir Chandra Das, Pullaiah Thammineni, and Elizabeth Ashton. *Mangroves: Biodiversity, Livelihoods and Conservation.* Springer, 2022. 1. Sudhir Chandra Das et. al. Mangroves: A Unique Ecosystem and Its Significance. Pp. 3-11; 2. Daniel Alongi. Climate Change and Mangroves. Pp. 175-198.	
Week 6 Instructor: Wendy Hapgood	Grasslands ecology, biodiversity and carbon cycles. History of land use.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Oswald Schmitz. Enlisting Ecological Interactions among Animals to Balance the Carbon Budget. Pp. 332-335. **From**: Thomas E. Lovejoy and Lee Hannah. *Climate Change and Biodiversity.* Yale University Press, 2005: 1. Diana Wall. Climate Change Impacts on Soil Biodiversity in a grassland ecosystem. Pp. 291-295. **From**: Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 7 - Climate-Induced Global Forest Shifts due to Heatwave-Drought. Pp. 155-186. **Total pages: 41** Additional readings to be identified by guest lecturer.	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 5**
Week 7 Instructor: Roberto Lenton	Fresh water, biodiversity and climate change.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Les Kaufman. Climate Change: Final Arbiter of the Mass Extinction of Freshwater Fishes. Pp. 237-245. 2. P. 228 (also assigned within temperate forests). **From**: Thomas E. Lovejoy and Lee Hannah. *Climate Change and Biodiversity.* Yale University Press, 2005: 1. David Allan. Climate Change and Freshwater Ecosystems. Pp. 274-290. **Total pages: 26** Additional readings to be identified by guest faculty.	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 6** **Midterm Report/Case Study Analysis DUE**

		Optional Readings: **From**: Judith Weis and Carol Butler. *Salt Marshes: A Natural and Unnatural History.* Rutgers University Press, 2009: 1. Pp. 3-88; 109-116.	
Week 8 Instructor: Jenna Lawrence	Ocean ecology, biodiversity, and carbon cycles. Human impacts. Polar and Temperate Oceans.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Lee Cooper. The Bering Sea and Climate Change Pp. 39-41; 2. Donald Noakes. Climate Change and Salmon Populations. Pp.77-79; 3. William Cheung and Miranda Jones. Climate Change and Marine Biodiversity. Pp.168-182; 4. Joan Kleypas. Impacts of Ocean Acidification on Marine Biodiversity. Pp. 185-195; 5. Lauren Jarvis et. al. The Asymmetrical Impacts of Climate Change on Food Webs. Pp 246-254. **From**: Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 12 - Marine Heatwave Drives Collapse of Kelp Forests in Western Australia. Pp. 325-343. **Total pages: 59** **Optional Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Richard Aronson. Climate Change, Conservation, and the Metaphor of Deep Time. Pp. 114-122; 2. Camille Parmesan. Range and Abundance Changes. Pp. 25-31.	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 7**
Week 9 Instructor: Jenna Lawrence	Ocean ecology, biodiversity, and carbon cycles. Human impacts. Tropical Oceans.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Jason Hartog and Alistair Hobday. Dynamic Spatial Management in an Australian Tuna Fishery. Pp. 255-257;	Complete Readings Weekly 20-minute Presentation on one of the Readings:

		2. Ove Hoegh-Guldberg. Coral Reefs: Megadiversity Meets Unprecedented Environmental Change. Pp. 55-65. **From**: Josep G. Canadell and Robert B. Jackson. *Ecosystem Collapse and Climate Change.* Springer, 2021: 1. Chapter 10 - Recurrent Mass-Bleaching and the Potential for Ecosystem Collapse on Australia's Great Barrier Reef. Pp. 265-289. 2. Chapter 13 - Impact of Marine Heatwaves on Seagrass Ecosystems. Pp. 345-364. **Total pages: 59** **Optional Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Richard Aronson. Climate Change, Conservation, and the Metaphor of Deep Time. Pp. 114-122; 2. Camille Parmesan. Range and Abundance Changes. Pp. 25-31.	**Group 8** **Bi-Weekly Assignment #3 Due**
Week 10 Instructor: Amy Karpati	Urban and suburban ecology, biodiversity, and carbon cycles. Human health and well-being.	**Required Readings:** **Articles**: Churkina, G. (2008). "Modeling the carbon cycle of urban systems". *ElSevier Journal*. Vol: 216. 107-113. https://doi.org/10.1016/j.ecolmodel.2008.03.006 Esperon Rodriguez, M., et al. (2022). "Climate change increases global risk to urban forests". *Nature Climate Change*, Vol: 12. 950-955. https://vibrantcitieslab.com/wp-content/uploads/2023/08/climate-change-increases-global-risk-to-urban-forests.pdf McPhearson, T., et al. (2018). "Urban ecosystems and biodiversity". *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*. Cambridge University Press. New York. 257–318. https://uccrn.ei.columbia.edu/sites/default/files/content/pubs/ARC3.2-PDF-Chapter-8-Ecosystems-and-Biodiversity-wecompress.com_.pdf **Total pages: 75** **Optional Readings:**	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 9**

		From: Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Caitlin Littlefield et. al. Ecosystem- Based Adaptation. Pp. 297-309; 2. Andrew Gonzalez et. al. Connectivity by Design: A Multiobjective Ecological Network for Biodiversity. Pp. 323-325. **From:** Gaia Vince. *Nomad Century.* Flatiron Books, 2022: 1. Chapter 2: The Four Horsemen of the Anthropocene. Pp. 10-30. 2. Chapter 5: Wealth of Migrants. Pp. 70-89. 3. Chapter 8: Migrant Homes. Pp. 125-140. 4. Chapter 9: Anthropocene Habitats. Pp. 141-153.	
Week 11 Instructor: Bruce Kahn	Agriculture, biodiversity and climate change.	**Required Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Monika Bertzky et. al. Climate Change Mitigation Using Terrestrial Ecosystems: Options and Biodiversity Impacts. Pp. 310-322; 2. Cary Fowler and Ola Westengen. Climate Change, Food, and Biodiversity. 347-355; 3. David Tilman et. al. Saving Biodiversity in the Era of Human- Dominated Ecosystems. Pp. 356-365. **Articles**: Brodie & Watson. (2023). Human responses to climate change will likely determine the fate of biodiversity. *PNAS*. https://doi.org/10.1073/pnas.2205512120 **Total pages: 45** **Optional Readings:** **From:** Gaia Vince. *Nomad Century.* Flatiron Books, 2022: 1. Chapter 10: Food. Pp. 154-169. Additional readings to be identified by the instructor.	Complete Readings Weekly 20-minute Presentation on one of the Readings: **Group 10** **Bi-Weekly Assignment #4 Due**
Week 12	All ecosystems – the biosphere.	**Required Readings:**	Complete Readings

Instructors: Amy Karpati, Jenna Lawrence, Ralph Schmidt		**From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Elizabeth Hiroyasu and Jessica Hellmann. Invasive Species and Climate Change. Pp. 258-269. 2. Pablo Marquet et. al. Protected Area Management and Climate Change. Pp. 283-293. 3. Guy Midgley and Lee Hannah. Extinction Risk from Climate Change. Pp. 294-296. 4. Edward Maibach. Increasing Public Awareness and Facilitating Behavior Change: Two Guiding Heuristics. Pp. 336-346. 5. Thomas Lovejoy. Regreening the Emerald Planet: The Role of Ecosystem Restoration in Reducing Climate Change. Pp. 326-331. **Articles**: Parmesan, et al. (2023). The case for prioritizing ecology/behavior and hybridization over genomics/taxonomy and species' integrity in conservation under climate change. *Biological Conservation*, Vol. 281. https://doi.org/10.1016/j.biocon.2023.109967 **Total pages: 64** **Optional Readings:** **From:** Thomas E. Lovejoy and Lee Hannah. *Biodiversity and Climate Change.* Yale University Press, 2019: 1. Brett Riddle. Genetic Signatures of Historical and Contemporary Responses to Climate Change. Pp. 66-76. 2. Pablo Imbach et. al. Modeling Species and Vegetation Distribution under Climate Change. Pp. 157-167. 3. Lauren Jarvis et. al. The Asymmetrical Impacts of Climate Change on Food Webs. Pp. 247-257. 4. Lindsay Campbell et. al. Climate Change and Disease. Pp 270-280. **From:** Gaia Vince. *Nomad Century.* Flatiron Books, 2022: 1. Chapter 12 - Restoration. Pp. 188-205.	Weekly 20-minute Presentation on one of the Readings: **Group 11**
Week 13 Instructors:	Final Presentations	**No required readings for this week.**	**Final Research Papers Due**

Ralph Schmidt			
Week 14 Instructors: Ralph Schmidt	Final Presentations	**No required readings for this week.**	