Spring 2024
Tue-Thu 8:30-9:50
Gould 100

URBDP 498A / 534A ENVIRONMENTAL PLANNING
Strategies for integrating complexity theory and ecology in resilience planning

Marina Alberti
malberti@uw.edu

DESCRIPTION
This course places cities and urban regions in the context of Earth's eco-evolutionary dynamics. The focus is on the integration of principles of complex systems, ecosystem dynamics, and resilience into planning and decision-making. The central theme is the critical nexus among climate change, biodiversity, and social equity in designing resilient urban systems. To bridge theory with practice, the course prompts critical inquiries such as: How can urban planners design and implement infrastructures that are resilient in the face of uncertainty and capable to adapt to a spectrum of future climate scenarios? How can we effectively coordinate the action of multiple stakeholders operating at many scales under diverse constraints? And how do we ensure a just and equitable transition towards a sustainable and resilient urban future? The course is structured around four modules: 1) theories of environmental planning, 2) methods of environmental assessment, 3) modeling and scenarios and 4) collaborative adaptive planning. These modules are used to identify and address critical transitions, and to develop strategies that promote socio-ecological resilience. Students will learn how to create scenarios, construct integrated models, assess resilience, and devise environmental management strategies through practical applications. The course incorporates a variety of approaches, such as system thinking, simulation modeling, strategic foresight, place-based analysis, life-cycle analysis, risk assessment, and adaptive management.

LEARNING OBJECTIVES

Apply complex systems theories and ecology to urban resilience planning, recognizing the interdependence of human and ecological systems.

Design adaptable blue/green infrastructure informed by strategic foresight to anticipate and thrive under various climate futures.

Utilize simulation modeling and scenario planning for resilient decision-making in the face of uncertainty.

Coordinate multi-stakeholder actions, assess tradeoffs, and address and resolve conflicts to implement equitable and sustainable urban strategies.

Promote urban designs that foster ecological and social resilience, prioritizing justice and sustainability in the transition of urban environments.

PRACTICUM

In the practicum, student teams will employ scenario planning and simulation modeling to investigate the interplay between climate change, biodiversity, and social equity within urban planning frameworks. The objective is to explore how alternative urban patterns and urban infrastructure systems impact human and ecological health and wellbeing, and to formulate hypotheses on the attributes that enhance urban resilience. Through case studies, students will evaluate system resilience and capacity for innovative solutions, gaining practical knowledge in developing future scenarios to integrate climate change, biodiversity, and social equity considerations into decision-making processes. Our goal is to formulate actionable principles to apply resilience science to environmental design and planning practices.

PARTICIPATION AND ASSIGNMENTS

This course is organized into four modules. Each module consists of 2 lectures and 2 practicum sessions over a span of two weeks. Students are required to complete the required readings, participate in class discussions and practicum exercises. Students individually will compose three memos linking theoretical concepts from each module to practical strategies and principle of environmental planning. Students will also work in teams on team scenario planning projects and will produce three team assignments that will serve as the basis for a 20-page final team report describing developed scenarios and strategic plans and give a 30-minute presentation of their findings. Students are also expected to participate in a simulation game.

PERFORMANCE

Students are expected to successfully complete all required assignments.

1. Complete all assigned readings prior to class.
2. Participate in all class discussions of reading related questions.
3. Compose three individual memos reflecting on key theoretical concepts.
4. Collaborate in writing three team assignments.

5. Participate in simulation game.
6. Participate in a 30-minute team presentation.
7. Write a twenty-page team report.

Your performance will be evaluated according to four criteria:
1. How regularly and actively you participate in team-work.
2. How appropriate and thoughtful is your approach to the problems.
3. How well informed and supported is your analysis for the report.
4. How well organized and clear is your presentation of ideas in the presentation.

Grades will be calculated based on the following criteria

Memos	30%
Team Assignments	30%
Report	30%
Presentation	10%

READINGS
This course has a series of required (→) and recommended (+) readings. The readings are available on canvas and on the library on-line system. The books are on 4-hour reserve at the library. Required readings should be completed prior to the lectures as indicated below. A few additional readings may be provided.

DISCUSSIONS
Each lecture is supported with several current articles of varied topics from ecology to modeling and political science. Is essential that everyone read the material to engage in class discussions. Each module is structured to include an in-class discussion and an individual memo to explore the key topics. In class discussion(s) will occur during the last 20-30 minutes of the lecture sessions. Memos are intended to help students link theory to practice. On-line discussions and memos should help in writing the final paper, but more importantly they should help students understand why (and be able to clearly articulate this message to decision makers) integrating uncertainty and complexity through scenario planning with adaptive management is essential to effective ecosystem management and environmental planning.

MODULE	WEEK	DATE	DAY	ASSIGNMENTS
INTRO	1	March 26, 2024	T	Ecology for an Urban Planet
		March 28, 2024	Th	Introduction to the Practicum
				Class Exercise: Imagining the Future
1 THEORIES	2	April 2, 2024	T	Complexity of Hybrid Ecosystems
		April 4, 2024	Th	Planning for What Future
				A1: Driving Forces (In class)
	3	April 9, 2024	T	Regime Shifts in Urban ecosystems
				M1: Coupled Human-Natural Systems (Due today on Canvas)
		April 11, 2024	Th	Interactive Session
2 METHODS	4	April 16, 2024	T	Scenario Planning
				A1: Driving Forces (Due today on Canvas)
		April 18, 2024	Th	Developing Resilience Hypotheses
				A2: Scenario Logics (In class)
	5	April 23, 2024	T	Urban Eco-Evolutionary Dynamics
		April 25, 2024	Th	Interactive Session
				M2 Scenario Methods (Due today on Canvas)
3 MODELS	6	April 30, 2024	T	Prediction in Environmental Planning
				A2: Scenario Logics (Due today on Canvas)
		May 2, 2024	Th	Selecting Indicators of Resilience
				A3: Resilience Indicators (In Class)
	7	May 7, 2024	T	Resilience Indicators
		May 9, 2024	Th	Singapore Green Plan
4 PLANNING	8	May 14, 2024	T	Managing Coupled Human-Ecological Systems
				A3: Resilience Indicators (Due today on Canvas)
		May 16, 2024	Th	Role-Play Simulation
				M3: Resilience principles for Planning (Due today on Canvas)
	9	May 21, 2024	T	Planning Under Uncertainty
		May 23, 2024	Th	Team Projects Reviews
		May 28, 2024	T	Learning from the Future
		May 30, 2024	Th	Prepare reports
PRESENTATIONS.	June 4, 2024 Reports due - June 6, 2024 @5:00 pm			

INTRO: OVERVIEW
Week 1: Ecology for an Urban Planet

Lecture 1: Environmental planning in a socio-eco-evolutionary perspective
Objective:
- Cities and urbanizing regions as hybrid ecosystems
- Eco-evolutionary dynamics and feedback
- How the questions we ask define our understand and search for solutions
- Environmental planning and management: myths and paradoxes

Readings:
→ Alberti, M., 2016 ch. 10. Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press
→ Alberti, M. 2017. "Simulation and Design of Hybrid Ecosystems." *Technology|Architecture + Design*.Volume 1, 2017 - Issue 2.
→ Folke, Carl, et al. 2021. "Our Future in the Anthropocene Biosphere: Global sustainability and resilient societies". *Ambio* 50:834-869.
\+ *IPCC AR6 Synthesis Report Climate Change 2023 https://www.ipcc.ch/report/ar6/syr/*
\+ *Fifth US National Climate Assessment (2023). https://www.globalchange.gov/nca5/*

Practicum 1: Intro to Practicum
Class exercise: Imagining the future
Readings:
→ Information packet uploaded on Canvas
Resources:
https://www.biospherefutures.net/scenarios

MODULE 1: THEORIES OF ENVIRONMENTAL PLANNING
Week 2 Complexity and Resilience in Coupled Human-Ecological Systems

Lecture 2: Complexity of Hybrid Ecosystems
Objective: Understand coupled human-natural systems as hybrid ecosystems. Examine the structure, dynamics, and evolution of hybrid ecosystems. Familiarize with principles of complex systems including: hierarchies, self-organization, emergent properties, and resilience.
Readings:
→ Holling C.S. et al. 2002. In Search of a Theory of Adaptive Change. Gunderson, L.H. and C.S. Holling (eds.) Panarchy: Understanding Transformations in Systems of Humans and Nature. Pgs 3-22. Island Press.
→ Alberti, M. 2016. Ch 2. Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press

- → Alberti, M. et al. 2020. "The Complexity of Urban Eco-Evolutionary Dynamics." BioScience. doi: 10.1093/biosci/biaa079
- + *Bai, X. 2016. Eight energy and material flow characteristics of urban ecosystems. Ambio. 2016 Nov; 45(7): 819–830. 0785-6https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5055480/*
- + *Levin, Simon, and Simon A. Levin. 2000. Chapter 1 Biodiversity and Our Lives: A Cautionary Tale. Fragile Dominion: Complexity and the Commons. Basic Books, June.*

Practicum 2: Mapping Complex Systems Dynamics
Readings:
- → Meadows, D.H. 1999. Chicken Little, Cassandra, and the Real Wolf. Whole Earth Spring.
- → Kremen, C. 2005. Managing ecosystem services: What do we need to know about their ecology? Ecology Letters 8: 468-479.
- → Liu et al. 2007. Complexity of Coupled Human and Natural Systems. Science Vol. 317. no. 5844, pp. 1513 – 1516

MODULE 1: THEORIES OF ENVIRONMENTAL PLANNING
Week 3 Resilience in Coupled Human Natural Systems

Lecture 3: Resilience and Regime Shifts in Urban Ecosystems
Objective: Understand regime shifts, slow and fast variable, adaptation to change.
Readings:
- → Scheffer, M., S. Carpenter, J. Foley, C. Folke, and B. Walker. 2001. Catastrophic shifts in ecosystems. Nature 413: 591-596.
- → Holling, C.S. 1973. Resilience and stability of ecological systems. Annual Review of Ecology and Systematics 4: 1-23.
- → Alberti, M., 2016 ch. 4. Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press
- → Biggs, R., G. D. Peterson, and J. C. Rocha. 2018. The Regime Shifts Database: a framework for analyzing regime shifts in social-ecological systems. Ecology and Society 23(3):9. https://www.ecologyandsociety.org/vol23/iss3/art9/
- + *Anderson, E. , N. B. Gtimm, J. A. Lewis, C. L. Redman, S. Barthel, J. Colding, and T. Elmqvist. 2022. Urban climate resilience through hybrid infrastructure. Current Opinion in Environmental Sustainability 55:101158.*

https://www.researchgate.net/publication/358817498_Urban_climate_resilience_through_hybrid_infrastructure

- + *Biggs R, Blenckner T, Folke C, Gordon L, Norström A, Nyström M & Peterson GD. 2011. Regime Shifts. In: Sourcebook in Theoretical Ecology. Hastings A & Gross L (eds). University of California Press, Berkeley.*

Practicum 3: Interactive Session

MODULE 2: METHODS OF ENVIRONMENTAL ASSESSMENT
Week 4 Scenarios: Imagining the Possible

Lecture 4: Scenario Planning
Objectives: Learn how strategic foresight and scenario planning methods help to integrate irreducible uncertainty into decision making.

Reading:
- → Peterson, G.D., Graeme S. Cumming, and Stephen R. Carpenter. 2003. Scenario Planning: a Tool for Conservation in an Uncertain World. Conservation Biology 17(2):358-366.
- → Alberti, M. 2016. Ch 9. Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press.
- → Mansur, A. V., R. I. McDonald, B. Güneralp, H. Kim, J. A. Puppim de Oliveira, C. T. Callaghan, P. Hamel, J. J. Kuiper, M. Wolff, V. Liebelt, I. S. Martins, T. Elmqvist, and H. M. Pereira. 2022. Nature futures for the urban century: Integrating multiple values into urban management. Environmental Science and Policy 131:46-56. https://www.sciencedirect.com/science/article/pii/S1462901122000193?via%3Dihub
- → Oteros-Rozas, E., B. Martín-López, T. Daw, E. L. Bohensky, J. Butler, R. Hill, J. Martin-Ortega, A. Quinlan, F. Ravera, I. Ruiz-Mallén, M. Thyresson, J. Mistry, I. Palomo, G. D. Peterson, T. Plieninger, K. A. Waylen, D. Beach, I. C. Bohnet, M. Hamann, J. Hanspach, K. Hubacek, S. Lavorel and S. Vilardy 2015. Participatory scenario planning in place-based social-ecological research: insights and experiences from 23 case studies. Ecology and Society 20(4):32. http://dx.doi.org/10.5751/ES-07985-200432

Practicum 4: Developing Resilience Hypotheses
Readings:
- → Scheffer, M., Carpenter, S.R., Lenton, T.M., Bascompte, J., Brock, W., Dakos, V., van de Koppel, J. van de Leemput, I. A., Levin, S. A., van Nes, E. H., Pascual, M., Vandermeer, J. (2012). Anticipating Critical Transitions. Science, 338, 344–348.
- → Cumming G. S., Olsson P., Chapin III F. S. and C.S. Holling. Resilience, experimentation, and scale mismatches in social-ecological landscapes. Landscape Ecol DOI 10.1007/s10980-012-9725-4.
- → Spotswood EN, Beller EE, Grossinger R, et al. 2021. The biological deserts fallacy: cities in their landscapes contribute more than we think to regional biodiversity. *Bioscience* 71: 148–60.
- \+ *van der Heijden, K. 1996. Scenarios: the art of strategic conversation. John Wiley, New York.*

MODULE 2: METHODS OF ENVIRONMENTAL ASSESSMENT
Week 5 Resilience Assessment

Lecture 5: Urban Eco-Evolutionary Dynamics
Objective: Understand adaptive change in coupled human-natural systems. By focusing on green and blue infrastructure, explore mechanisms linking urbanization to eco-evolutionary

dynamics and the potential feedbacks on ecosystem function that support human communities.

Readings:

→ Chambers, J. C., Allen, C. R., and Cushman, S. A. 2019. Operationalizing Ecological Resilience Concepts for Managing Species and Ecosystems at Risk. Frontiers in Ecology and Evolution 7. https://www.frontiersin.org/articles/10.3389/fevo.2019.00241/full

→ Sgrò CM, Lowe AJ, Hoffmann AA. Building evolutionary resilience for conserving biodiversity under climate change. Evol Appl. 2011 Mar;4(2):326-37. doi: 10.1111/j.1752-4571.2010.00157.x. Epub 2010 Oct 18. PMID: 25567976; PMCID: PMC3352557. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3352557/

+ *Smith, T. B., M. T. Kinnison, S. Y. Strauss, T. L. Fuller, S. P. Carroll. 2014. Prescriptive Evolution to Conserve and Manage Biodiversity. Annual Review of Ecology, Evolution, and Systematics 45(1):1-22. https://www.annualreviews.org/doi/10.1146/annurev-ecolsys-120213-091747*

+ *Alberti, M., 2016. Ch 5, Ch 7. Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press*

Practicum 5: Interactive Session

Module 3: Models of human-environmental interaction
Week 6 Predictions, Uncertainty and Surprise

Lecture 6: Prediction in Environmental Planning
Objective: Explore the role of prediction and predictive models. Learn principles of system modeling. Understand limitations of predictions and learn approaches to dealing with uncertainty and surprise in modeling coupled human-natural systems.

Readings:

→ Carpenter, S. R., B. H. Walker, J. M. Anderies, and N. Abel. 2001. From metaphor to measurement: resilience of what to what? Ecosystems 4: 765-781.

→ Carpenter, S. R., and L. H. Gunderson. 2001. Coping with collapse: ecological and social dynamics in ecosystem management. BioScience 51: 451–457.

→ Schindler and Horn, 2015. Prediction, precaution, and policy under global change. Science, Vol 347, Issue 6225 p953-954

→ Alberti, M., 2008. Ch 9. Futures of Urban Ecosystems, in Advances in Urban Ecology: Integrating Humans and Ecological Processes in Urban Ecosystems, pp. 225-242, Springer, New York, NY.

Practicum 6: Selecting Indicators of Resilience
Readings

→ Puget Sound Action Team. 2015. State of the Sound Report

- Layzor, J. 2008. Chapter 6 Averting Ecological Collapse in California's Bay Delta. Natural Experiments: Ecosystem-Based Management and the Environment. MIT Press.

Module 3: Models of human-environmental interaction
Week 7 Detecting Regime Shifts

Lecture 7: Resilience Indicators
Objective: Explore adaptive cycles in the context of coupled human systems. Discuss indicators to monitor resilience. Understand thresholds and criticality. Understand adaptive change.

Readings:
- Reynolds, H. L., S. K. Mincey, R. D. Montoya, S. Hamlin, A. Sullivan, B. Thapa, J. Wilson, H. Rosing, J. Jarzen, and J. M. Grove. 2022. Green infrastructure for urban resilience: a trait-based framework. Frontiers in Ecology and the Environment. 20(4):231-239.
- Scheffer M, Bascompte J, Brock WA, Brovkin V, Carpenter SR, et al. (2009) Early-warning signals for critical transitions. Nature 461: 53–59. doi: 10.1038/nature08227. https://www.nature.com/articles/nature08227
- Heather L Reynolds, Sarah K Mincey, Robert D Montoya, Samantha Hamlin, Abigail Sullivan, Bhuwan Thapa, Jeffrey Wilson, Howard Rosing, Joseph Jarzen, J Morgan Grove. 2022. Green infrastructure for urban resilience: a trait-based framework. Front Ecol Environ 20(4): 231– 239, doi:10.1002/fee.2446

https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.2446
- Kate A. Brauman et al, Global trends in nature's contributions to people, Proceedings of the National Academy of Sciences (2020). DOI: 10.1073/pnas.2010473117

Practicum 7: Singapore Green Plan https://www.greenplan.gov.sg/

Module 4: Management of Complex Coupled HumAn-Natural Systems
Week 8 Collaborative Resilience Planning

Lecture 8: Managing Coupled Human Natural Systems
Objective: Management under uncertainty. Understand heterogeneity and redundancy. Explore concepts of criticality and adaptation. Learn strategies to build resilience
Readings:
- Holling, C.S. 1996. Surprise for Science, Resilience for Ecosystems, and Incentives for People. Ecological Applications 6(3): 733-735.
- Schultz, C. 2008. Responding to scientific uncertainty in U.S. forest policy. 2008. Environmental Science and Policy 11: 253-271.
- Kinzig, A., et al. 2003. Coping with uncertainty: A call for a new science-policy forum. Ambio 32(5): 330-335.

- → Walker, B., S. Carpenter, J. Anderies, N. Abel, G. Cumming, M. Janssen, L. Lebel, J. Norberg, G. D. Peterson, and R. Pritchard. 2002. Resilience management in social-ecological systems: a working hypothesis for a participatory approach. Conservat. Ecology 6(1): 14.
- + *Rammel, C., Stagl, S. and Wilfing, H. 2007. Managing complex adaptive systems: a co-evolutionary perspective on natural research management. Ecological Economics, 63 (1). pp. 9-21. ISSN 0921-8009*

Practicum 8: Role Play Simulation

Readings:

- → Packet sent by email

Module 4: Management of Complex Coupled Human-Natural Systems

Week 9: Linking Science and Planning

Objective: Explore the diversity of perceptions and interests in coupled human-natural systems. Learn how to manage conflicts in decision making. Understand the role of science in policy-making. Explore adaptive management and planning strategies.

Lecture 9: Planning Under Uncertainty

Readings:

- → Alberti 2016 ch 8. *Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press*

Practicum 9: Team Projects Reviews

Lecture 10: Learning from the Future

Objective: What does the future can teach us about planning in the present? This lecture will synthesize the lessons learned by exploring the city as a coupled human-natural system, evolutionary resilience, and scenario planning.

- → Knapp et al 2021. A Research Agenda for Urban Biodiversity in the Global Extinction Crisis *BioScience*, Volume 71, Issue 3, March 2021, Pages 268–279, https://doi.org/10.1093/biosci/biaa141
- → Department of Interior. Technical Guide for Adaptive Management. http://www.doi.gov/initiatives/AdaptiveManagement/
- + *M. Lindgren and H. Bandhold (2003). Scenario Planning: the link between future and strategy. New York, Palgrave, Macmillan*

Readings:

→Alberti 2016 ch 10. Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems. UW Press

CLASS POLICIES

1. Religious Accommodation

Washington State law requires that UW develop a policy for accommodating student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request Form (https://registrar.washington.edu/students/religious-accommodations-request/).

2. Diversity, Equity And Inclusion

The University of Washington supports an inclusive learning environment in which diverse perspectives are recognized, respected, and seen as a source of strength. In this course, I will strive to create welcoming spaces where everyone feels included and engaged regardless of their social and cultural backgrounds.

DISABILITY ACCESS AND ACCOMMODATION

It is the policy and practice of the University of Washington to create accessible learning environments consistent with federal and state law, including establishing reasonable accommodations for all students. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so that we can discuss how they will be implemented in this course.

If you have not yet established services through DRS, and you have a temporary health condition or permanent disability that requires accommodations, contact DRS directly (disability.uw.edu) to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Conditions requiring accommodation include but are not limited to: mental health, attention-related, learning, vision, hearing, physical or health impacts.

In assessing whether you require reasonable accommodations through DRS, please note that full participation in this course requires the following types of engagement: [to be described by the instructor. See example here.

3. Academic Integrity

The University of Washington Student Conduct Code (WAC 478-121) defines prohibited academic and behavioral conduct and describes how the University holds students accountable. I expect that you will know and follow university policies regarding all forms of academic and other misconduct.

4. Artificial Intelligence

Artificial Intelligence (AI) has rapidly become an integral part of various fields, offering opportunities to enhance both scientific and communicative tasks also pose significant practical and ethical challenges. In this course, AI is viewed as a natural progression in the evolution of tools available to augment our academic endeavors. It can serve as a valuable assistant for a range of activities, including brainstorming ideas, structuring arguments, troubleshooting code, searching for information, analyzing literature, and enhancing written communication by checking for grammatical accuracy. Students opting to utilize AI in their coursework are required to transparently acknowledge its use. Responsibility for the final submission lies with the student, which means you must critically evaluate the AI-generated content for accuracy, authenticity, and potential biases. It is imperative to ensure that AI assistance does not lead to the dissemination of false information, perpetuate biases, or result in plagiarism or copyright infringement. Proper use of AI tools, coupled with diligent oversight, can contribute to the integrity and excellence of your academic work.