URBDP ENVIRONMENTAL PLANNING
Urban Resilience in a Socio-Eco-Evolutionary Perspective

Marina Alberti
malberti@u.washington.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 ecosystem dynamics and resilience into planning and decision-making. The course builds on complex systems theory and explores its application to coupled human-ecological systems through 4 modules: 1) theories of environmental planning, 2) methods of environmental assessment, 3) integrated modeling, scenarios, and strategic foresight, and 4) collaborative adaptive management and planning. Together these modules are used to frame and address critical transitions and resilience in urban ecosystems in the Puget Sound region. Students learn techniques for developing scenarios, building models, assessing resilience and devising management strategies. The course builds on a broad range of approaches including strategic environmental assessment, place-based analysis, life-cycle analysis, risk assessment, and adaptive collaborative planning.

OBJECTIVES

- Explore theories of resilience of human-natural systems in an eco-evolutionary perspective.
- Learn concepts and principles of complexity theory to address environmental issues.
- Apply eco-evolutionary principles to green/blue infrastructure design and resilience planning.
- Learn how strategic foresight and scenario planning methods help to integrate irreducible uncertainty into decision making.
- Identify strategies to implement principles of urban eco-evolutionary resilience in urban design and planning.

PRACTICUM The practicum will focus on *Urban Resilience in a Socio-Eco-Evolutionary Perspective*. We will explore dynamics of coupled human-natural systems in urbanizing regions and examine the drivers, mechanisms, and functions that regulate urban ecosystem dynamic and affect human and ecological wellbeing. Building on case studies linking urban patterns to human and ecological functions, we will develop hypotheses about what system characteristics and qualities make cities more resilient to change. We will select case examples in the Puget Sound region and test these hypotheses by exploring system resilience and innovation. Using scenario planning we will assess the effectiveness of alternative planning strategies under alternative futures. The practicum will reflect on our findings and develop principles to translate resilience science into environmental design and planning.

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 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. While it is critical to ensure comprehension of key topics there is not always time at the end of class for a full discussion. Therefore, it is essential that everyone read the material. 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

lecture. Memos are intended to help students link theory to practice. 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.

ACCOMMODATIONS

Your experience in this class is important. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course. The website for the DRS (Links to an external site.) provides other resources for students and faculty for making accommodations.

Washington state law requires that UW develop a policy for the accommodation of 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).

MODULE	WEEK	DATE	DAY		ASSIGNMENTS
INTRO	1 Overview	March 28, 2023	Lec	Ecology for an Urban Planet	
		March 30, 2023	TP	Introduction to the Practicum	**Class Exercise: Imagining the Future**
1 THEORIES	2 Complexity and Resilience in Coupled Human-Ecological Systems	April 4, 2023	Lec	Complexity of Hybrid Ecosystems	
		April 6, 2023	TP	Planning for What Future	A1: Driving Forces (In class) (Due April 13 on Canvas)
	3 Regime Shifts in Coupled Human-Natural Systems	April 11, 2023	Lec	Regime Shifts in Urban ecosystems	M1 Coupled Human Natural Systems (Due today on Canvas)
		April 13, 2023	S	Invited Speaker	A1: Driving Forces (Due today on Canvas)
2 METHODS	4 Scenarios: Imagining the possible	April 18, 2023	Lec	Scenario Planning	
		April 20, 2023	TP	Developing Resilience Hypotheses	A2 Scenario Logics (In class) (Due April 27 on Canvas)
	5 Resilience Assessment	April 25, 2023	Lec	Urban Eco-Evolutionary Dynamics	
		April 27, 2023	S	Invited Speaker	A2 Scenario Logics (Due today on Canvas)

3 MODELS	6 Predictions, Uncertainty and Surprise	May 2, 2023	Lec	Prediction in Environmental Planning	M2 Scenario Methods (Due today on Canvas)
		May 4, 2023	TP	Selecting Indicators of Resilience	A3: Resilience Indicators (In Class) (Due on Canvas May 18)
	7 Detecting Regime Shifts	May 9, 2023	Lec	Resilience Indicators	
		May 11, 2023	S	Singapore Green Plan	
4 PLANNING	8 Collaborative Resilience Planning	May 16, 2023	Lec	Managing Coupled Human-Ecological Systems	M3: Resilience principles for Planning (Due today on Canvas)
		May 18, 2023	SG	Role-Play Simulation	A3: Resilience Indicators (Due today on Canvas)
	9 Linking Science and Planning	May 23, 2023	Lec	Planning Under Uncertainty	
		May 25, 2023	TP	Team Projects Reviews	Students present status of projects
		May 30, 2023	Lec	Learning from the Future	
		June 1, 2023	TP	Prepare reports	Students work on their final reports
		10:30a.m. -12:20 p.m. Tuesday, June 6,		Students Presentations	

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: Speaker To be Finalized

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: Speaker To be Finalized

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: Describe management under uncertainty and surprise. 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. Conservation 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