

SUMA K4235 Science of Urban Ecology

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Course Overview

This course facilitates learning about 1) basic principles related to ecological interactions of life on Earth, 2) the causes and consequences of biological patterns and processes in urban environments, and 3) how ecology can inform land use decisions and applied management strategies of natural resources (e.g. water, air, biodiversity), particularly in urban environments.

The first portion of this course will focus briefly on how organisms interact with one another and with the non-living environment. The second portion of this course will be an in-depth exploration of the interactions between urbanization and biodiversity and ecosystem function. This course aims to provide students with an understanding of the ways in which ecological perspectives can contribute to an interdisciplinary approach to solving environmental problems facing human society.

Towards that end, this course covers topics ranging from applied ecology and conservation biology to sustainable development. It uses a cross disciplinary approach to understand the nature of ecology and biological conservation, as well as the social, philosophical and economic dimensions of land use strategies. Although in some ways cities may seem to be isolated from what we would otherwise call "nature," they are not, and this is a major theme of this course. We will discuss ecosystem function, evolutionary processes, biodiversity, nutrient cycling, and natural resource availability in cities. Additionally, we will explore possibilities for improving ecological functioning and biodiversity in urban environments.

This course addresses the physical dimensions of sustainability management and the connections between the natural and built environments. Students will study the elements of the urban ecosystem and methods of evaluation of the ecosystem's biodiversity, health, and long-term sustainability.

Learning Objectives

In this course, students will acquire an understanding of the ecology of human-dominated landscapes, the theory and study of urban ecology, and the application of ecological principles to building sustainable urban communities. Students will also explore timely and important urban ecology issues including ecological restoration, invasive species, and biodiversity conservation.

The specific learning objectives of the course are:

- To contribute ecological perspectives to an interdisciplinary approach to address environmental problems in urban areas.
- To develop skills needed to recognize and analyze the relationships among the scientific, societal, and economic issues that shape environmental research and decision-making.
- To prepare sustainability management professionals to use ecological research and scientific knowledge to inform decisions regarding urban sustainability.

Course Schedule

***Supplemental** readings are not required, but provide additional or more in-depth information relevant to the lecture topic.*

Week 1: Intro to Urban Ecology, Evolution, Resources, and the Distribution of Life

Week 2: Population and Community Ecology

Readings:

- Spirn, A.W. 1984. *The Granite Garden*. Basic Books, New York, NY, USA. **Prologue**
- Wu, J. 2014. *Urban ecology and sustainability: The state-of-the-science and future directions*. *Landscape and Urban Planning* 125: 209-221.
- **Supplemental:** Rockström, J., *et al.* 2009. *Planetary Boundaries: Exploring the safe operating space for humanity*. *Nature* 461: 472-475.
- **Supplemental:** Tanner, C.J. *et al.* 2014. *Urban ecology: Advancing science and society*. *Frontiers in Ecology and the Environment* 12: 574-581.

Assignments Due:

- Urban Ecology Concept Map – Take 1 (see “Assignments” section below)
- Courseworks Discussion Board – Question on Week 2 Readings

Week 3: Ecosystem Ecology and Biodiversity

Readings:

- Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 1-3**
- Hooper, D.U. *et al.* 2012. *A global synthesis reveals biodiversity loss as a major driver of ecosystem change*. *Nature* 486: 105-108.
- **Supplemental:** Varga, A. 2013. *Maintaining large-scale biodiversity is critical for ecosystem health*. <http://blogs.ei.columbia.edu/2013/06/11/maintaining-large-scale-biodiversity-is-critical-for-ecosystem-health/>

Assignments Due:

- Courseworks Discussion Board – Respond to a colleague’s post from Week 2 Readings
- Choose any article from The Nature of Cities (www.thenatureofcities.com). On the Courseworks Discussion Board (Week 3 Discussion Board Question), write:
 - A brief synopsis (<250 words) of the article
 - A few sentences about why you picked this article (why did it catch your interest?)
 - Anything new you learned from it
 - Any further questions about urban ecology it made you think of.

Week 4: Urban Environments I: Anthromes

Readings:

- Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 4-6**
- Del Tredici, P. 2010. *Wild Urban Plants of the Northeast: A Field Guide*. Cornell University Press, Ithaca, NY. **Introduction Chapter**
- Ellis, E.C. and N. Ramankutty. 2008. *Putting people in the map: Anthropogenic biomes of the world*. *Frontiers in Ecology and the Environment* 6: 439-447.
- Hobbs, R.J., E. Higgs and J.A. Harris. 2009. *Novel ecosystems: Implications for conservation and restoration*. *Trends in Ecology & Evolution* 24: 599-605.
- **Supplemental:** Mannahatta2409.org

Assignments Due:

- Courseworks Discussion Board – Question on Week 4 Readings
- Response to a colleague's post from Week 3 The Nature of Cities assignment

Week 5: Urban Environments II: The Urban Ecosystem

Readings:

- Churkina, G. 2008. *Modeling the carbon cycle of urban systems*. *Ecological Modelling* 216: 107-113.
- Gómez-Baggethun, E. and D.N. Barton. 2013. *Classifying and valuing ecosystem services for urban planning*. *Ecological Economics* 86: 235-245.
- Luniak, M. 2004. *Synurbanization – adaptation of animal wildlife to urban development*. Pgs 50-55 in Shaw, W.W., L.K. Harris, and L. Vandruff, Eds. *Proceedings of the 4th International Urban Wildlife Symposium*. School of Natural Resources, College of Agriculture and Life Science, University of Arizona, Tucson, AZ.
- Robinson, S.L. and J.T. Lundholm. 2012. *Ecosystem services provided by urban spontaneous vegetation*. *Urban Ecosystems* 15: 545-557.
- **Supplemental:** Kaye, J.P. *et al.* 2006. *A distinct urban biogeochemistry?* *TRENDS in Ecology and Evolution* 21: 192-199.

Assignments Due:

- Courseworks Discussion Board – Question on Week 5 Readings
- Response to a colleague's post from Week 4

Week 6: Urban Environments III: The Urban Ecosystem ...continued

Readings:

- Bowen, J.L. and I. Valiela. 2001. *The ecological effects of urbanization on coastal watersheds: historical increases in nitrogen and eutrophication of Waquoit Bay estuaries*. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 1489-1500.
- Lundholm, J.T. and P.J. Richardson. 2010. *Habitat analogues for reconciliation ecology in urban and industrial environments*. *Journal of Applied Ecology* 47:966-975.
- Matteson, K.C. *et al.* 2008. *Bee richness and abundance in New York City urban gardens*. *Annals of the Entomological Society of America* 101: 140-150.
- Neil, K. and J. Wu. 2006. *Effects of urbanization on plant flowering phenology: A review*. *Urban Ecosystems* 9: 243-257.

- **Supplemental:** Bee, M.A. and E.M. Swanson. 2007. *Auditory masking of anuran advertisement calls by road traffic noise*. *Animal Behaviour* 74: 1765-1776.
- **Supplemental:** Paul, M.T. and J.L. Meyer. 2001. *Streams in the urban landscape*. *Annual Review of Ecology and Systematics* 32:333-365.

Assignments Due:

- Courseworks Discussion Board – Question on Week 6 Readings
- Response to a colleague's post from Week 5

Week 7: Urban Environments IV: Urbanization and Biodiversity

Readings:

- Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 7-8**
- Aronson, M.F.J. *et al.* 2014. *A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers*. *Proceedings of the Royal Society B* 281: 20133330.
- Chapin III, F.S. *et al.* 2000. *Consequences of changing biodiversity*. *Nature* 405: 234-242.
- McKinney, M.L. 2006. *Urbanization as a major cause of biotic homogenization*. *Biological Conservation* 127: 247-260.
- Pimm, S.L. and P. Raven. 2000. *Biodiversity: Extinction by numbers*. *Nature* 403: 843-845.
- **Supplemental:** Ellis, E.C., *et al.* 2012. *All is not loss: Plant biodiversity in the Anthropocene*. *PLoS ONE* 7: e30535.

Assignments Due:

- Courseworks Discussion Board – Question on Week 7 Readings
- Response to a colleague's post from Week 6

Week 8: Urban Environments V: Human Attitudes and Behaviors

Readings:

- Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 9-10**
- Mathey, J. and D. Rink. 2010. *Urban Wastelands – A Chance for Biodiversity in Cities? Ecological Aspects, Social Perceptions and Acceptance of Wilderness by Residents*. Pages 406-424 in *Urban Biodiversity and Design*. N. Muller, P. Werner, and J.G. Kelcey, eds. Blackwell Publishing Ltd, West Sussex, UK.
- Miller, J.R. 2005. *Biodiversity conservation and the extinction of experience*. *TRENDS in Ecology and Evolution* 20: 430-434.
- Standish, R.J., *et al.* 2013. *Improving city life: options for ecological restoration in urban landscapes and how these might influence interactions between people and nature*. *Landscape Ecology* 28: 1213-1221.
- **Supplemental:** Milbrath, L.W. 1995. *Psychological, Cultural, and Informational Barriers to Sustainability*. *Journal of Social Issues* 51: 101-120.
- **Supplemental:** Seiter, D. 2011. *Profiles of Spontaneous Urban Plants*. <http://urbanomnibus.net/2011/12/profiles-of-spontaneous-urban-plants/>

Assignments Due:

- Courseworks Discussion Board – Question on Week 8 Readings
- Response to a colleague's post from Week 7

Week 9: SPRING BREAK – NO CLASS

Week 10: Conservation in an Urbanizing World

Readings:

- Cardinale, B.J. *et al.* 2012. *Biodiversity loss and its impact on humanity*. Nature 486: 59-67.
- Kueffer, C. and C.N. Kaiser-Bunbury. 2014. *Reconciling conflicting perspectives for biodiversity conservation in the Anthropocene*. Frontiers in Ecology and the Environment 12: 131-137.
- McKinney, M.L. 2002. *Urbanization, Biodiversity, and Conservation*. BioScience 52: 883-890.
- Miller, J.R. and R.J. Hobbs. 2002. *Conservation where people live and work*. Conservation Biology 16: 330-337.
- **Supplemental:** McDonnell, M.J. and A.K. Hahs. 2013. *The future of urban biodiversity research: Moving beyond the 'low-hanging fruit.'* Urban Ecosystems 16:397-409.

Assignments Due:

- Courseworks Discussion Board – Question on Week 10 Readings
- Response Paper
- (No response to a colleague's post from Week 8 required)

Week 11: Ecological Urban Design

Readings:

- Francis, R.A. and J. Lorimer. 2011. *Urban reconciliation ecology: The potential of living roofs and walls*. Journal of Environmental Management 92: 1429-1437.
- Lovell, S.T. and J.R. Taylor. 2013. *Supplying urban ecosystem services through multifunctional green infrastructure in the United States*. Landscape Ecology 28: 1447-1463.
- NATURA Environmental Consultants and D. O'Connor. 2008. *Green City Guidelines Chapter 2: Making Space for Biodiversity in Urban Areas*. UCD Urban Institute Ireland, Dublin, Ireland.
- Ozer, E. 2014. *Mutualistic relationships versus hyper-efficiencies in the sustainable building and city*. Urban Ecosystems 17: 195-204.
- **Supplemental:** Francis, R.A. 2010. *Wall ecology: A frontier for urban biodiversity and ecological engineering*. Progress in Physical Geography 35: 43-63.
- **Supplemental:** Hamer, A.J., P.J. Smith, and M.J. McDonnell. 2012. *The importance of habitat design and aquatic connectivity in amphibian use of urban stormwater retention ponds*. Urban Ecosystems 15: 451-471.
- **Supplemental:** NATURA Environmental Consultants and D. O'Connor. 2008. *Green City Guidelines*. UCD Urban Institute Ireland, Dublin, Ireland.
- **Supplemental:** Odell, E.A., D.M. Theobald, and R.L. Knight. 2003. *Incorporating ecology into land use planning: the songbirds' case for clustered development*. Journal of the American Planning Association 69: 72-82.
- **Supplemental:** Rudd, H., J. Vala and V. Schaefer. 2002. *Importance of backyard habitat in a comprehensive biodiversity conservation strategy: A connectivity analysis of urban green spaces*. Restoration Ecology 10: 368-375.

Assignments Due:

- Courseworks Discussion Board – Question on Week 11 Readings
- Response to a colleague's post from Week 10

Week 12: More Ecological Urban Design

Readings: **PICK ANY THREE!**

- Beier et al. *Conceptual steps for designing wildlife corridors*.
<http://corridordesign.org/dl/docs/ConceptualStepsForDesigningCorridors.pdf>
- Colla, S.R., E. Willis, and I. Packer. 2009. *Can green roofs provide habitat for urban bees (Hymenoptera: Apidae)?* *Cities and the Environment* 2: 1-12.
- Hagen, K. and R. Stiles. 2010. *Contribution of Landscape Design to Changing Urban Climate Conditions*. Pages 572-592 in *Urban Biodiversity and Design*. N. Muller, P. Werner, and J.G. Kelcey, eds. Blackwell Publishing Ltd, West Sussex, UK.
- Klem Jr., D. 2009. *Avian mortality at windows: the second largest human source of bird mortality on Earth*. Proceedings of the 4th International Partners in Flight Conference, 13-16 February 2008. Ed. T. D. Rich, C. Arizmendi, D. Demarest, and C. Thompson McAllen, Texas, USA. Partners in Flight, USDA, Forest Service Technical Report, 2009.
- Lorimer, J. 2008. *Living roofs and brownfield wildlife: towards a fluid biogeography of UK nature conservation*. *Environment and Planning A* 40: 2042-2060.
- Walsh, C.J., T.D. Fletcher, and A.R. Ladson. 2005. *Stream restoration in urban catchments through redesigning stormwater systems: looking to the catchment to save the stream*. *Journal of the North American Benthological Society* 24: 690-705.
- **Supplemental:** Rosenzweig, M.L. 2003. *Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise*. Oxford University Press, Inc., New York, NY, USA.

Assignments Due:

- Courseworks Discussion Board – Question on Week 12 Readings
- Response to a colleague's post from Week 11

Week 13: Ecology and Sustainability (and time for a field trip?)

Readings:

- Jansson, A. 2013. *Reaching for a sustainable, resilient urban future using the lens of ecosystem services*. *Ecological Economics* 86: 285-291.
- Rees, W. and M. Wackernagel. 1996. *Urban Ecological Footprints: Why cities cannot be sustainable – and why they are a key to sustainability*. *Environmental Impact Assessment Review* 16: 223-248.
- **Supplemental:** Global Footprint Network <http://storymaps.esri.com//globalfootprint/>

Assignments Due:

- Courseworks Discussion Board – Question on Week 13 Readings
- Response to a colleague's post from Week 12

Week 14: Group Presentations OR Field Trip

****Group Presentations**

Readings: None, Prepare for Group Presentation

Week 15: Group Presentations OR Field Trip

****Group Presentations**

Readings: None, Prepare for Group Presentation

Assignments:

- Urban Ecology Concept Map – Take 2 (see "Assignments" section below)

Resources

All journal article readings are available through the links in Courseworks (under “Syllabus”). Power Point presentations given in lecture will be posted shortly before the start of each lecture.

Assignments and Method of Grading & Evaluation

Attendance and Class Participation/Discussion (10%)

Attendance is expected for each class session. If you have to miss class for any reason, please notify the instructor by e-mail before the start of the class session. Each unexcused absence can negatively impact your overall grade in the class. Participation in and contribution to topical class discussion is an important component of learning success in this course.

Urban Ecology Concept Map (5%)

The goal for this assignment is to try to encapsulate your thinking about urban ecology and the nature of cities both before and after completion of this course.

For your concept map:

- (a.) Complete this sentence: “Urban nature involves....”
- (b.) List the items, concepts, and ideas that come to mind as you complete this sentence. Keywords and short phrases are best. Aim for between 10-20 ideas. Don’t try to research external resources – just articulate what comes to *your* mind.
- (c.) Put each phrase or concept on a post-it note or on a small piece of paper. Be sure to create a note for the central idea of your concept map; in other words, create a central note that reads “Urban Nature.”
- (d.) Organize your post-it notes around this main idea. You can cluster your notes by similarity, hierarchy, process, or any way that makes sense to you. For example, does one concept cause another? Is one more important than others? If your ideas are equally important, then arrange your notes in a web pattern off of the central “Urban Nature.”
 - i. Optional: Use verbs to connect the concepts so that your map can be understood as sentences. For example, if you connect the central concept “Urban Nature” to another concept, describe how they are related. You might link “Urban Nature” to another concept “water resources” with the descriptor “provides.” Or, “Urban Nature” → “contains” → “rats.”
- (e.) Bring your map to class. You might end up with a sheet of paper with post-it notes stuck to it, or you might draw your concept map derived from the steps above, or you might take a photo of all your scraps of paper surrounding your central “Urban Nature.” Be prepared to explain your concept map in our next class.
- (f.) Make sure you can hand in your map to in some way – hand in the physical copy, email a photo, etc.

There is no right or wrong way to do this. The same procedure as above should be used to create your concept map that you will do at the end of the course, but you should not consult your original concept map when creating your final map. Comparing your first concept map to the one you will do at the end of the course should help you see what you have learned. For your final map, you will also be asked to briefly write about the similarities and differences, if any, between your original and final maps. Your original and final concept maps will each be worth 50 points.

Discussion Board Questions and Responses (30%)

Each week, students are expected to read all of the week's assigned readings before coming to class. Note that **Supplemental** readings are *not* required, but serve as additional resources if you're looking to expand your knowledge on the week's topic. For each week's readings, there will be an associated question posted on the Courseworks Discussion Board. Please post your response to this question each week before the start of class, and note that your response will be visible to other students. The questions will ask you to draw on information you learned in the readings, but will allow for flexibility in your responses. The goal here is to try to stimulate your thinking. There are no absolutely right answers, but I will be looking for evidence that you read the readings and also that you spent at least a little time thinking about the question. No need to write a full-length essay; a paragraph or two is perfectly sufficient.

Additionally, each week, please respond to a Discussion Board post from a colleague (classmate) from the previous week's readings. For example, in Week 3, you are to respond to a colleague's post from the Week 2 readings. Provide insightful feedback, refute a point, provide further relevant information, or otherwise expand their thinking. Please avoid simply re-phrasing your colleague's post. This assignment is meant to facilitate collaboration, promote sharing of ideas, and stimulate discussion.

Each Discussion Board Question will be graded out of 10 points, and each Response to a colleague's post will also be graded out of 10 points.

Response Paper (25%)

Students will write a 5 to 7 page (12 pt. Times New Roman, double-spaced, 1 inch margins) response paper to one of the three prompts described listed below. However, if there is another topic – relevant to urban ecology and our course content – that you would like to write your paper about, please feel free to discuss your ideas with me. The paper should include at least 5 citations from reliable sources – citing readings from this course can count towards this. Papers should be submitted electronically through email or Courseworks or as a printed hard copy by the start of class in Week 10. This assignment will be graded on a numeric scale from 0 to 100 using the breakdown of awarded points below.

Option 1: Urbanization and Biodiversity

How does urbanization affect both local and global biodiversity, from a short-term scale to a long-term scale? Should "exotic" species in cities be removed and their populations controlled, or could they play a positive role in the urban environment? Or, is the risk of their spread into surrounding areas not worth their potential benefits in cities?

(50 points will be awarded for clear and concise identification of urbanization impacts on biodiversity. 50 points will be awarded for supporting your view through discussion of the negative and/or positive roles of exotic species in the urban ecosystem.)

Option 2: Urban Ecological Restoration

What are the primary challenges to urban ecological restoration or the enhancement of ecological structure/function? Can we truly restore degraded ecosystems? What ecosystem services might we restore to urban environments, and how?

(50 points will be awarded for identification of at least 3 challenges to ecological restoration or efforts to enhance ecological structure/function and for discussion of whether degraded ecosystems can be truly restored. 50 points will be awarded for discussion of how ecosystem services might be restored in cities.)

Option 3: Human Attitudes and Urban Ecology

How might we address the conflict between urbanization and ecosystem services/biodiversity? How might we recruit people to care about the intrinsic values of species, along with the ecosystem services they provide? In other words, how do you propose we communicate to the public, land owners, and policy-makers the importance of a city's ecology as part of overall sustainability planning such that they value it, make land use decisions based on it, and manage for it?

(25 points will be awarded for discussion of the conflict between urbanization and ecosystem services/biodiversity. 25 points will be awarded for a discussion of the current state of societal attitudes towards urban ecosystems and biodiversity. 50 points will be awarded for thoughtful discussion of ways that the importance of ecology in overall sustainability planning can be communicated to the public, land owners, and policy-makers.)

Final Project (30%)

For the final course project, students will divide into teams (4-5 people per team) and follow one of the two project prompts below. Each group's project will culminate in a 20-30 minute presentation, delivered jointly by your team during Weeks 14 and 15. In addition to the joint presentation, each member of the team will submit a 3-6 page (12 pt Times New Roman, double-spaced, 1 inch margins) written brief on his or her individual research. The brief should include at least 5 citations from reliable sources. As with the Response Paper assignment, I am open to other final project ideas (for example, a social awareness/outreach project regarding urban ecology has been suggested in prior years). Let me know your ideas!

Option 1: Give a city a "green" makeover.

Your project team will select a city to view through the lens of urban ecology and sustainability. You may focus your project on any scale of analysis – i.e., a whole-city landscape scale, a neighborhood scale, or even a city block. Your task is to imagine you have an unlimited budget to restore, redesign, or otherwise improve the existing urban habitat for ecosystem services and biodiversity using the principles of urban ecology you've learned in class. What would your city look like? What are your ecological goals and targets? Might you manage for carbon sequestration, natural flood control, corridors for wildlife, habitat for plants or birds or pollinators, habitat heterogeneity, restoration of disturbance regimes, or other ecosystem services? Scale your ecological design to your target area – a whole-city scale, for example, might target connectivity among isolated green patches, while a city block scale might target alterations of buildings and the built environment to allow for greater biodiversity. Think about citing what's been done in another city as an example of what you'd want to do. It would also help others understand your plan if you show photos/depictions of the current state and your proposed improved state. Use any tools available to you through GIS, landscape architecture tools, photography, etc. Be creative!

- Each team should agree on which city to research by Week 6. You are welcome to choose any city/neighborhood, though you should do some preliminary research to find out what information is available before making your choice.
- The group presentation should give a brief overview of the current ecological state of your study city/neighborhood (in other words, why do you think it needs improvement?). Additionally, each member of the team should research and present his or her own topic related to the project. For example, you might consider a subset of the following topics: water, climate, vegetation and green space, ecosystem services, wildlife, biodiversity, habitat quality, and cultural attitudes towards the city's natural environment. Each member will prepare a brief of that topic, and summarize that work in a segment of the final presentation (approx. 4-8 slides and 4-6 minutes per person).
- Your final course project will be graded on a numeric scale from 0 to 100. The in-class presentation will account for 50 points. Presentations will be evaluated on the basis of the design and quality of the presentation visuals (15 points), the clarity and pace of the oral presentation (15 points), and the substantive discussion of your topic (20 points). The individual paper will account for 50 points and be graded on the following criteria: format, spelling, and grammar (10 points), quality of research (10 points), ecological background of your chosen city or study area (what's there now and what's wrong with it) (15 points), and how your particular ecological initiative would contribute to improving the overall sustainability of your study area (15 points).

Option 2. Evaluate a city's actual "greening" efforts as they relate to urban ecology.

Your project team will select a city and research its past and/or ongoing efforts to become more ecologically sustainable. Has the city developed a sustainability plan and has its implementation been successful? What aspects of the urban ecosystem is the city focusing on – climate, biodiversity, ecosystem services, terrestrial or aquatic habitat? Taking into consideration what you've learned in the course, how would you evaluate the importance and effectiveness of these efforts? From an urban ecology standpoint, what additional efforts do you think the city should focus on to advance its sustainability agenda?

- Each team should agree on which city to research by Week 6. You are welcome to choose any city, though you should do some preliminary research to find out what information is available before making your choice. All cities are facing a range of ecological issues, but not all cities are well characterized. Choosing a city with an accessible base of research will simplify your project.
- The group presentation should give an overview of the past and current ecological state of your study city. Additionally, each member of the team should research his or her own topic related to the project. For example, you might consider a subset of the following topics as it relates to your study city: water, climate, ecosystem services, vegetation and green space, wildlife, biodiversity, habitat quality, and cultural attitudes towards the city's natural environment. Each member will prepare a brief of that topic, and summarize that work in a segment of the final presentation (approx. 4-8 slides and 4-6 minutes per person).

- Your final course project will be graded on a numeric scale from 0 to 100. The in-class presentation will account for 50 points. Presentations will be evaluated on the basis of the design and quality of the presentation visuals (15 points), the clarity and pace of the oral presentation (15 points), and the substantive discussion of your topic (20 points). The individual paper will account for 50 points and be graded on the following criteria: format, spelling, and grammar (10 points), quality of research (10 points), ecological background of your chosen city or study area (its past and current condition) (15 points), and your evaluation of the city's sustainability initiatives as they relate to urban ecology (15 points).

Grading Policy

Late Assignment Policy

Assignments are due at the start of the class session on the dates/times identified. Ten percent of the assignment's worth will be deducted from any assignment submitted after the due date/time. Assignments not received by the time final grades must be submitted will receive zero points for the assignment. Extensions may be granted in especially warranted situations as per the instructor's discretion.

Incompletes

As outlined in the School's grading and academic standards policy, "A grade of 'I' (incomplete) is a temporary grade indicating failure to complete assigned work. The mark is given only upon the request of the student and at the discretion of the instructor. The student and faculty member must sign a completed 'Request for Grade of Incomplete Form' before the final class session. The 'I' must be removed within one year after the end of the semester in which the student received the grade. Students seeking an extension of this time limit must have the approval of the instructor and successfully petition of the director of their program. If no petition is made, or if the petition is unsuccessful, the grade is changed to an N-Permanent Incomplete- which remains on the student's permanent record."

Academic Integrity

The School of Continuing Education does not tolerate cheating and/or plagiarism in any form. Those students who violate the Code of Academic and Professional Conduct will be subject to the Dean's Disciplinary Procedures. The Code of Academic and Professional Conduct can be viewed online at: <http://ce.columbia.edu/node/217>

Please familiarize yourself with the proper methods of citation and attribution. The School provides some useful resources online; you are strongly encouraged to familiarize yourself with these various styles before conducting your research.

Violations of the Code of Academic and Professional Conduct will be reported to the Associate Dean for Student Affairs.

Accessibility Statement

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: <http://health.columbia.edu/services/ods/support>

Bibliography of Readings

- Aronson, M.F.J., F.A. La Sorte, C.H. Nilon, M. Katti, M.A. Goddard, C.A. Lepczyk, P.S. Warren, N.S.G. Williams, S. Cilliers, B. Clarkson, C. Dobbs, R. Dolan, M. Hedblom, S. Klotz, J. L. Kooijmans, I. Kuhn, I. MacGregor-Fors, M. McDonnell, U. Mörtberg, P. Pysek, S. Siebert, J. Sushinsky, P. Werner, and M. Winter. 2014. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. *Proceedings of the Royal Society B* 281: 20133330.
- Bee, M.A. and E.M. Swanson. 2007. Auditory masking of anuran advertisement calls by road traffic noise. *Animal Behaviour* 74: 1765-1776.
- Beier et al. 2007. Conceptual steps for designing wildlife corridors. *CorridorDesign*.
<http://corridordesign.org/dl/docs/ConceptualStepsForDesigningCorridors.pdf>
- Bowen, J.L. and I. Valiela. 2001. The ecological effects of urbanization on coastal watersheds: historical increases in nitrogen and eutrophication of Waquoit Bay estuaries. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 1489-1500.
- Cardinale, B.J., J.E. Duffy, A. Gonzalez, D.U. Hooper, C. Perrings, P. Venail, A. Narwani, G.M. Mace, D. Tilman, D.A. Wardle, A.P. Kinzig, G.C. Daily, M. Loreau, J.B. Grace, A. Larigauderie, D.S. Srivastava and S. Naeem. 2012. Biodiversity loss and its impact on humanity. *Nature* 486: 59-67.
- Chapin III, F.S., E.S. Zavaleta, V.T. Eviner, R.L. Naylor, P.M. Vitousek, H.L. Reynolds, D.U. Hooper, S. Lavorel, O.E. Sala, S.E. Hobbie, M.C. Mack, and S. Diaz. 2000. Consequences of changing biodiversity. *Nature* 405: 234-242.
- Churkina, G. 2008. Modeling the carbon cycle of urban systems. *Ecological Modelling* 216: 107-113.
- Colla, S.R., E. Willis, and I. Packer. 2009. Can green roofs provide habitat for urban bees (Hymenoptera: Apidae)? *Cities and the Environment* 2: 1-12.
- Del Tredici, P. 2010. *Wild Urban Plants of the Northeast: A Field Guide*. Cornell University Press, Ithaca, NY.
- Ellis, E.C., E.C. Antill, and H. Kreft. 2012. All is not loss: Plant biodiversity in the Anthropocene. *PLoS ONE* 7: e30535.
- Ellis, E.C. and N. Ramankutty. 2008. Putting people in the map: anthropogenic biomes of the world. *Frontiers in Ecology and the Environment* 6: 439-447.
- Francis, R.A. 2010. Wall ecology: A frontier for urban biodiversity and ecological engineering. *Progress in Physical Geography* 35: 43-63.
- Francis, R.A. and J. Lorimer. 2011. Urban reconciliation ecology: The potential of living roofs and walls. *Journal of Environmental Management* 92: 1429-1437.
- Gómez-Baggethun, E. and D.N. Barton. 2013. Classifying and valuing ecosystem services for urban planning.

Ecological Economics 86: 235-245.

- Hagen, K. and R. Stiles. 2010. Contribution of Landscape Design to Changing Urban Climate Conditions. Pages 572-592 in *Urban Biodiversity and Design*. N. Muller, P. Werner, and J.G. Kelcey, eds. Blackwell Publishing Ltd, West Sussex, UK.
- Hamer, A.J., P.J. Smith, and M.J. McDonnell. 2012. The importance of habitat design and aquatic connectivity in amphibian use of urban stormwater retention ponds. *Urban Ecosystems* 15: 451-471.
- Hobbs, R.J., E. Higgs and J.A. Harris. 2009. Novel ecosystems: implications for conservation and restoration. *Trends in Ecology & Evolution* 24: 599-605.
- Hooper, D.U., E.C. Adair, B.J. Cardinale, J.E.K. Byrnes, B.A. Hungate, K.L. Matulich, A. Gonzalez, J.E. Duffy, L. Gamfeldt, and M.I. O'Connor. 2012. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature* 486: 105-108.
- Jansson, A. 2013. Reaching for a sustainable, resilient urban future using the lens of ecosystem services. *Ecological Economics* 86: 285-291.
- Kaye, J.P., P.M. Groffman, N.B. Grimm, L.A. Baker and R.V. Pouyat. 2006. A distinct urban biogeochemistry? *TRENDS in Ecology and Evolution*. 21: 192-199.
- Klem Jr., D. 2009. Avian mortality at windows: the second largest human source of bird mortality on Earth. *Proceedings of the 4th International Partners in Flight Conference*, 13-16 February 2008. Ed. T. D. Rich, C. Arizmendi, D. Demarest, and C. Thompson McAllen, Texas, USA. Partners in Flight, USDA, Forest Service Technical Report, 2009.
- Kueffer, C. and C.N. Kaiser-Bunbury. 2014. Reconciling conflicting perspectives for biodiversity conservation in the Anthropocene. *Frontiers in Ecology and the Environment* 12: 131-137.
- Lorimer, J. 2008. Living roofs and brownfield wildlife: towards a fluid biogeography of UK nature conservation. *Environment and Planning A* 40: 2042-2060.
- Lovell, S.T. and J.R. Taylor. 2013. Supplying urban ecosystem services through multifunctional green infrastructure in the United States. *Landscape Ecology* 28: 1447-1463.
- Lundholm, J.T. and P.J. Richardson. 2010. Habitat analogues for reconciliation ecology in urban and industrial environments. *Journal of Applied Ecology* 47:966-975.
- Luniak, M. 2004. Synurbanization – adaptation of animal wildlife to urban development. Pgs 50-55 in Shaw, W.W., L.K. Harris, and L. Vandruff, Eds. *Proceedings of the 4th International Urban Wildlife Symposium*. School of Natural Resources, College of Agriculture and Life Science, University of Arizona, Tucson, AZ.
- Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY.
- Mathey, J. and D. Rink. 2010. Urban Wastelands – A Chance for Biodiversity in Cities? *Ecological*

Aspects, Social Perceptions and Acceptance of Wilderness by Residents. Pages 406-424 in *Urban Biodiversity and Design*. N. Muller, P. Werner, and J.G. Kelcey, eds. Blackwell Publishing Ltd, West Sussex, UK.

Matteson, K.C., J.S. Ascher and G.A. Langellotto. 2008. Bee richness and abundance in New York City urban gardens. *Annals of the Entomological Society of America* 101: 140-150.

McDonnell, M.J. and A.K. Hahs. 2013. The future of urban biodiversity research: Moving beyond the 'low-hanging fruit.' *Urban Ecosystems* 16:397-409.

McKinney, M.L. 2002. Urbanization, Biodiversity, and Conservation. *BioScience* 52: 883-890.

McKinney, M.L. 2006. Urbanization as a major cause of biotic homogenization. *Biological Conservation* 127: 247-260.

Milbrath, L.W. 1995. Psychological, Cultural, and Informational Barriers to Sustainability. *Journal of Social Issues* 51: 101-120.

Miller, J.R. 2005. Biodiversity conservation and the extinction of experience. *TRENDS in Ecology and Evolution* 20: 430-434.

Miller, J.R. and R.J. Hobbs. 2002. Conservation where people live and work. *Conservation Biology* 16: 330-337.

NATURA Environmental Consultants and D. O'Connor. 2008. *Green City Guidelines*. UCD Urban Institute Ireland, Dublin, Ireland.

Neil, K. and J. Wu. 2006. Effects of urbanization on plant flowering phenology: A review. *Urban Ecosystems* 9: 243-257.

Odell, E.A., D.M. Theobald, and R.L. Knight. 2003. Incorporating ecology into land use planning: the songbirds' case for clustered development. *Journal of the American Planning Association* 69: 72-82.

Ozer, E. 2014. Mutualistic relationships versus hyper-efficiencies in the sustainable building and city. *Urban Ecosystems* 17: 195-204.

Paul, M.T. and J.L. Meyer. 2001. Streams in the urban landscape. *Annual Review of Ecology and Systematics* 32:333-365.

Pimm, S.L. and P. Raven. 2000. Biodiversity: Extinction by numbers. *Nature* 403: 843-845.

Rees, W. and M. Wackernagel. 1996. Urban Ecological Footprints: Why cities cannot be sustainable – and why they are a key to sustainability. *Environmental Impact Assessment Review* 16: 223-248.

Robinson, S.L. and J.T. Lundholm. 2012. Ecosystem services provided by urban spontaneous vegetation. *Urban Ecosystems* 15: 545-557.

Rockström, J., W. Steffen, K. Noone, Å. Persson, F.S. Chapin, III, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke,

H.J. Schellnhuber, B. Nykvist, C.A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J.A. Foley. 2009. Planetary Boundaries: Exploring the safe operating space for humanity. *Nature* 461: 472-475.

Rosenzweig, M.L. 2003. *Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise*. Oxford University Press, Inc., New York, NY, USA.

Rudd, H., J. Vala and V. Schaefer. 2002. Importance of backyard habitat in a comprehensive biodiversity conservation strategy: A connectivity analysis of urban green spaces. *Restoration Ecology* 10: 368-375.

Spirn, A.W. 1984. *The Granite Garden*. Basic Books, New York, NY, USA.

Standish, R.J., R.J. Hobbs and J.R. Miller. 2013. Improving city life: options for ecological restoration in urban landscapes and how these might influence interactions between people and nature. *Landscape Ecology* 28: 1213-1221.

Tanner, C.J., F.R. Adler, N.B. Grimm, P.M. Groffman, S.A. Levin, J. Munshi-South, D.E. Pataki, M. Pavao-Zuckerman, and W.G. Wilson. 2014. Urban ecology: Advancing science and society. *Frontiers in Ecology and the Environment* 12: 574-581.

Varga, A. 2013. Maintaining large-scale biodiversity is critical for ecosystem health. *State of the Planet – Blogs from the Earth Institute, Columbia University*. <http://blogs.ei.columbia.edu/2013/06/11/maintaining-large-scale-biodiversity-is-critical-for-ecosystem-health/>

Walsh, C.J., T.D. Fletcher, and A.R. Ladson. 2005. Stream restoration in urban catchments through redesigning stormwater systems: looking to the catchment to save the stream. *Journal of the North American Benthological Society* 24: 690-705.

Wu, J. 2014. Urban ecology and sustainability: The state-of-the-science and future directions. *Landscape and Urban Planning* 125: 209-221.