

## **SUMA K4235 Science of Urban Ecology**

Instructor: Amy Karpati

### **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 effects of urbanization on 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.

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

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

### Week 2: Population and Community Ecology

Readings:

☐ †Alberti, M., J. Marzluff, E. Schulenberger, G. Bradley, C. Ryan, and C. Zumbunnen. 2003. *Integrating humans into ecology: Opportunities and challenges for studying urban ecosystems*. *BioScience* 53: 1169-1179.

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

### Week 3: Ecosystem Ecology and Biodiversity

Readings:

☐ Bolund, P. and S. Hunhammar. 1999. *Ecosystem services in urban areas*. *Ecological Economics* 29: 293-301.

☐ Botkin, D.B. and C.E. Beveridge. 1997. *Cities as environments*. *Urban Ecosystems* 1: 3-19.

### 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 1-3**

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.

### **Week 5: Urban Environments II: The Urban Ecosystem and Biodiversity**

Readings:

☒ †Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 4-6**

☒ Bates, A.J., J. P. Sadler, A.J. Fairbrass, S.J. Falk, J.D. Hale, and T. J. Matthews. 2011. *Changing bee and hoverfly pollinator assemblages along an urban-rural gradient*. *PLoS ONE* 6: e23459.

☒ Ellis, E.C., E.C. Antill, and H. Kreft. 2012. *All is not loss: Plant biodiversity in the Anthropocene*. *PLoS ONE* 7: e30535.

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

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

### **Week 6: Urban Environments III: Human Attitudes and Behaviors**

Readings:

☒ †Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 7-8**

☒ 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.

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

☒ Miller, J.R. 2006. *Restoration, reconciliation, and reconnecting with nature nearby*. *Biological Conservation* 127: 356-361.

☒ van den Berg, A.E., T. Hartig, and H. Staats. 2007. *Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability*. *Journal of Social Issues* 63: 79-96.

### **Week 7: Conservation in an Urbanizing World**

Readings:

☒ †Marris, E. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World*. Bloomsbury USA, New York, NY. **Chapters 9-10**

☒ Davis, A.M. And T.F. Glick. 1978. *Urban Ecosystems and Island Biogeography*. *Environmental Conservation* 5: 299-304.

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

☒ Miller, J.R., M. Groom, G.R. Hess, T. Steelman, D.L. Stokes, J. Thompson, T. Bowman, L. Fricke, B. King, and R. Marquardt. 2008. *Biodiversity conservation in local planning*. *Conservation Biology* 23: 53-63.

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

### **Week 8: Aquatic and Wetland Urban Ecosystems**

\*\* Response Paper Due

Readings:

☒ Derraik, J.G.B. 2002. *The pollution of the marine environment by plastic debris: a review*. *Marine Pollution Bulletin* 44: 842-852.

☒ 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.

☒ 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.

☒ Walters, D.M., D.S. Leigh, and A.B. Bearden. 2003. *Urbanization, sedimentation, and the homogenization of fish assemblages in the Etowah River Basin, USA*. *Hydrobiologia* 494: 5-10.

### **Week 10: Terrestrial Urban Ecosystems**

Readings:

☒ †Ditchkoff, S.S., S.T. Saalfeld, and C.J. Gibson. 2006. *Animal behavior in urban ecosystems: Modifications due to human-induced stress*. *Urban Ecosystems* 9: 5-12.

☒ Lundholm, J.T. and A. Marlin. 2006. *Habitat origins and microhabitat preferences of urban plant species*. *Urban Ecosystems* 9: 139-159.

☒ 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 4<sup>th</sup> International Urban Wildlife Symposium*. School of Natural Resources, College of Agriculture and Life Science, University of Arizona, Tucson, AZ.

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

☒ Churkina, G., D.G. Brown, and G. Keoleian. 2010. *Carbon stored in human settlements: the conterminous United States*. *Global Change Biology* 16: 135-143.

### **Week 11: Ecology and Sustainability**

Readings:

☒ †Rees, W.E., M. Wackernagel, and P. Testemale. 1998. *Our Ecological Footprint: Reducing Human Impact on Earth*. New Society Publishers, Gabriola Island, BC.

### **Week 12: Ecological Urban Design**

Readings:

☒ Fernandez-Canero, R. and P. Gonzalez-Redondo. 2010. *Green Roofs as Habitat for Birds: A Review*. *Journal of Animal and Veterinary Advances* 9: 2041-2052.

☒ Brenneisen, S. 2006. *Space for urban wildlife: Designing green roofs as habitats in Switzerland*. *Urban Habitats* 4: 27-36.

☒ Kong, F., H. Yin, N. Nakagoshi, and Y. Zong. 2010. *Urban green space network development for biodiversity conservation: Identification based on graph theory and gravity modeling*. *Landscape and Urban Planning* 95: 16-27.

☒ 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.

☒ Nowak, D. and D.E. Crane. 2002. *Carbon storage and sequestration by urban trees in the USA*. *Environmental Pollution* 116: 381-389.

☒ 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.

### **Week 13: Final Project Group Presentations**

\*\*Group Presentations

Readings: None, Prepare for Group Presentation

### **Week 14: Final Project Group Presentations**

\*\*Group Presentations

Readings: None, Prepare for Group Presentation

### **Week 15: Conclusion/More Ecological Urban Design**

Readings:

☒ Snep, R.P.H., P.F.M. Opdam, J.M. Baveco, M.F. Wallis De Vries, W. Timmermans, R.G.M. Kwak, and V. Kuypers. 2006. *How peri-urban areas can strengthen animal populations within cities: A modeling approach*. *Biological Conservation* 127: 345-355.

☒ 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.

☒ 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.

☒ 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.

**†Not assigned as a student presentation, but will be discussed in lecture.**

### **Readings**

Alberti, M., J. Marzluff, E. Schulenberger, G. Bradley, C. Ryan, and C. Zumbunnen. 2003. Integrating humans into ecology: Opportunities and challenges for studying urban ecosystems. *BioScience* 53: 1169-1179.

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Klem Jr., D. 2009. Avian mortality at windows: the second largest human source of bird mortality on 7

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.

Kong, F., H. Yin, N. Nakagoshi, and Y. Zong. 2010. Urban green space network development for biodiversity conservation: Identification based on graph theory and gravity modeling. *Landscape and Urban Planning* 95: 16-27.

Lundholm, J.T. and A. Marlin. 2006. Habitat origins and microhabitat preferences of urban plant species. *Urban Ecosystems* 9: 139-159.

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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.

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Nowak, D. and D.E. Crane. 2002. Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution* 116: 381-389. 8



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.

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

Rees, W.E., M. Wackernagel, and P. Testemale. 1998. *Our Ecological Footprint: Reducing Human Impact on Earth*. New Society Publishers, Gabriola Island, BC.

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

Snep, R.P.H., P.F.M. Opdam, J.M. Baveco, M.F. Wallis De Vries, W. Timmermans, R.G.M. Kwak, and V. Kuypers. 2006. How peri-urban areas can strengthen animal populations within cities: A modeling approach. *Biological Conservation* 127: 345-355.

van den Berg, A.E., T. Hartig, and H. Staats. 2007. Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. *Journal of Social Issues* 63: 79-96.

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.

Walters, D.M., D.S. Leigh, and A.B. Bearden. 2003. Urbanization, sedimentation, and the homogenization of fish assemblages in the Etowah River Basin, USA. *Hydrobiologia* 494: 5-10.

## **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. Books used in the course have been placed on reserve at Lehman Library.

## **Assignments and Method of Grading & Evaluation**

### **Attendance and Class Participation/Discussion (25%)**

Attendance is mandatory for each class session. If you have to miss class for any reason, you must notify the instructor by e-mail before the start of the class session. Each unexcused absence will negatively impact your overall grade in the class. Two or more unexcused absences could result in failure to pass the course. Participation in and contribution to topical class discussion is an important component of learning success in this course.

### **Journal Article Presentations (20%)**

Each student will be assigned one to three journal articles from the class readings, depending on class size. While all students should read all articles and come prepared to discuss the material, one student will be responsible for presenting to the class a summary of their assigned article and open up discussion about how the article relates to the course and to sustainability management. Students will be graded 9

based on their understanding of the material, the quality of their presentation, and their leadership in discussion. Presentations may be as informal or formal as the presenter decides (i.e. from a simple verbal overview to a Power Point presentation), and the student's grade is not affected by the chosen presentation format. Presentations should be from 5-10 minutes in duration.

### **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 two prompts listed below. The paper should include at least 5 citations from reliable sources. Papers should be submitted electronically or as a printed hard copy by the start of class in Week 8. 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 ecological restoration or the enhancement of ecological stability/function? Can we truly restore degraded ecosystems? How does the urban context affect these challenges?

*(50 points will be awarded for identification of 3 challenges to ecological restoration or efforts to enhance ecological stability/function and for discussion of whether degraded ecosystems can be truly restored. 50 points will be awarded for identification of one way per challenge in which the urban context affects the challenge.)*

### **Final Project (30%)**

For the final course project, students will divide into teams and study a city through the lens of urban ecology. This project will culminate in a 20-30 minute presentation, delivered jointly by your team during Weeks 13 and 14. In addition to the joint presentation, each member of the team will submit a 3-5 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 8 citations from reliable sources.

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 studied. Choosing a city with an accessible base of research will simplify your project considerably. 10

Each member of the team should research his or her topic, prepare a brief of that topic, and summarize that research in a segment of the final presentation (approx. 4-8 slides and 4-8 minutes per person). You should consider a subset of the following topics: water, climate, energy, vegetation, wildlife, biodiversity, habitat quality, human health, physical infrastructure, and socioeconomic structure. You should read several sources on your theme (government reports from NGOs, scientific papers, etc), summarize your key points to your team, then decide how to structure your group presentation. Your goal is to explain several dimensions of your chosen city in a way that illustrates the complexity and interdependence of urban human and ecological systems.

Your final course project will be graded on a numeric scale from 0 to 100. The group presentation will account for 50 points (each member of the presentation team will receive the same point total). Presentations will be evaluated on the basis of the design and quality of the presentation visuals (10 points), the clarity and pace of the oral presentation (10 points), the clear identification of at least 3 important ecological issues (15 points) and the clear identification of at least 3 sustainability initiatives undertaken (or which *should* be undertaken) within your selected city related to urban ecology (15 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), demographic and ecological background of your chosen city (10 points), the clear identification of 1 important ecological issue (10 points) and the clear identification of 1 sustainability initiative undertaken (or which *should* be undertaken) within your selected city related to urban ecology (10 points).

### **Grading Policy**

#### **Late Assignment Policy**

Assignments are due at the start of the class session on the dates/times identified. Ten points 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 starts 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> 11

Please familiarize yourself with the proper methods of citation and attribution. The School provides some useful resources online; we strongly encourage you 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>