

BIOLOGY COURSE SYLLABUS

Course Number & Title: BIOL UA 390/ENVST UA 390 URBAN ECOLOGY

Instructor(s): Katie Schneider Paolantonio

Course Description:

We are currently living in a time where city residents outnumber people who live in rural areas. In addition, the projected expansion of human population growth is largely predicted to occur in urban areas. Urban Ecology is an interdisciplinary and emerging field of research focused on the consequences of urbanization on ecological processes. In addition to a physically transformed natural landscape, cities are unique from other systems in terms of hydrology, temperature, noise, air quality and many other abiotic factors. In this course we will investigate the consequences of urban constructs on ecological systems. We will discuss factors such as nutrient cycling, organismal behavior and phenology, disease, and the drivers and patterns of biodiversity in urban systems. We will also talk about green spaces, urban planning, and the future of these expanding manmade landscapes. A significant component of this course will involve discussion of current literature. This is an upper-level reasoning course designed primarily for students majoring in biology (ecology track) and environmental studies.

Pre-requisites: Fundamentals of Ecology (BIOL-UA 63/ENVST-UA 325).

Textbook(s)

Gaston, Kevin J. Urban Ecology. Cambridge University Press, Cambridge; New York, 2010.

Additional readings will be posted on NYU Classes.

Grading Information: Course grades will be based on the following:

- 40% Class participation and response papers
- 30% Student led paper discussions
- 30% Class project

Tentative Course Schedule and Readings

Week	Lecture or Discussion Topic	Assignment due
1	Course Expectations, Introduction to Urban Ecology	
	What are urban ecosystems?	Response
2	Modeling and Urbanization	Response
	Hydrology discussion	Response
3	<i>Grant Writing – Identifying Questions</i> Biogeochemistry and Ecosystem Functioning	Response
	Biogeochemistry and Ecosystem Functioning discussion	*Response
4	Plants	Response <i>Topic Due</i>
	Plants discussion	*Response
5	Evolution in Urban Environments	Response
	<i>Grant Writing: Parts of the Proposal</i> Foraging	Response
6	<i>Discussion of Proposal Ideas</i>	<i>Annotated Bibliography Part I</i>
	<i>Discussion of Proposal Ideas</i>	<i>Annotated Bibliography Part II, Outline</i>
7	Behavior and Communication	Response
	Behavior and Communication discussion	*Response
9	Physiology	Response
	Invasive Species discussion	*Response
10	Disease in Urban Ecosystems	Response
	Disease in Urban Ecosystems discussion	*Response
11	Patterns and Drivers of Urban Biodiversity discussion	*Response
	Climate change and urban ecology	Response
12	Climate change and urban ecology discussion	*Response
	Humans and Nature	<i>Papers Due</i>
13	<i>Grant Writing: Peer review</i>	<i>Peer Review Due</i>
	Green spaces and urban planning, restoration	Response

14	Future Directions and Unanswered Questions	Response
	<i>Grant Proposal Presentations</i>	<i>Final Papers Due</i>
15	<i>Grant Proposal Presentations</i>	
	<i>Grant Proposal Presentations</i>	

Weekly readings will be chosen from this list and posted the week before class.

Week 1: Introduction

Tuesday: Gaston Chapter 1: Urban Ecology (9 pages)

Holling, C. S., & Orians, G. (1971). Toward an urban ecology. *Bulletin of the ESA*, 52(2), 2-6.

Collins, J. P., Kinzig, A., Grimm, N. B., Fagan, W. F., Hope, D., Wu, J., & Borer, E. T. (2000). A New Urban Ecology Modeling human communities as integral parts of ecosystems poses special problems for the development and testing of ecological theory. *American Scientist*, 88(5), 416-425.

Thursday: Discussion Papers

Rebele, F. (1994). Urban ecology and special features of urban ecosystems. *Global ecology and biogeography letters*, 173-187.

Zipperer, W. C., Wu, J., Pouyat, R. V., & Pickett, S. T. (2000). The application of ecological principles to urban and urbanizing landscapes. *Ecological applications*, 10(3), 685-688.

Week 2: Modeling and Urbanization, Hydrology

Tuesday: Gaston Chapter 2: Urbanisation (25 pages)

Batty, M. (1997). Cellular automata and urban form: a primer. *Journal of the American Planning Association*, 63(2), 266-274.

Berling-Wolff, S. and J. Wu. 2004. Modeling urban landscape dynamics: A review. *Ecological Research* 19(1):119–129.

He, Chunyang, et al. (2011). Simulation of the spatial stress due to urban expansion on the wetlands in Beijing, China using a GIS-based assessment model. *Landscape and Urban Planning* 101.3: 269-277.

Seto, K.C. B. Guneralp, and L.R. Hutyrá. 2012. Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *PNAS* 109: 16083–16088.

Thursday: Hydrology

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

Vázquez-Suñé, E., X. Sánchez-Vila, J. Carrera. 2005. Introductory review of specific factors influencing urban groundwater, an emerging branch of hydrogeology, with reference to Barcelona, Spain. *Hydrogeology Journal*. 13(3): 522-533

Morée, A. L., A. H. W. Beusen, A. F. Bouwman, and W. J. Willems. 2013. Exploring global nitrogen and phosphorus flows in urban wastes during the twentieth century. *Global Biogeochemical Cycles* 27:836–846.

Limburg, K. E., & Schmidt, R. E. (1990). Patterns of fish spawning in Hudson River tributaries: response to an urban gradient?. *Ecology*, 71(4), 1238-1245.

Booth, D. B., Karr, J. R., Schauman, S., Konrad, C. P., Morley, S. A., Larson, M. G., & Burges, S. J. (2004). Reviving Urban Streams: Land use, hydrology, biology and human behavior. *Journal of the American Water Resources Association*, 40(5), 1351-1364.

Rose, S. and Peters, N. E. (2001), Effects of urbanization on streamflow in the Atlanta area (Georgia, USA): a comparative hydrological approach. *Hydrol. Process.*, 15: 1441–1457

Chadwick, M.A., D.R. Dobberfuhl, A.C. Benke, A.D. Huryn, K. Suberkropp, and J.E. Thiele 2006. Urbanization affects stream ecosystem function by altering hydrology, chemistry, and biotic richness. *Ecological Applications* 16:1796–1807.

Week 3: Biogeochemistry, Ecosystem Functioning

Tuesday: Gaston Chapter 3: Urban environments and ecosystem functions (18 pages)

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(4): 192–199.

Pataki, D.E., M.M. Carreiro, J. Cherrier, N.E. Grulke, V. Jennings, S. Pincetl, R.V. Pouyat, T.H. Whitlow, and W.C. Zipperer. 2011. Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions. *Frontiers in Ecology and the Environment* 9(1): 27-36.

Thursday: Biogeochemistry discussion (choose 2)

McDonnell, M.J., S.T.A. Pickett, P. Groffman, P. Bohlen, R.V. Pouyat, W.C. Zipperer, R.W. Parmelee, M.M. Carreiro, and K. Medley. 1997. Ecosystem processes along an urban-to-rural gradient. *Urban Ecosystems* 1(1): 21-36.

Pataki, D. E., Alig, R. J., Fung, A. S., Golubiewski, N. E., Kennedy, C. A., McPherson, E. G., ... & Romero Lankao, P. (2006). Urban ecosystems and the North American carbon cycle. *Global Change Biology*, 12(11), 2092-2102.

Pouyat, R., Groffman, P., Yesilonis, I., & Hernandez, L. (2002). Soil carbon pools and fluxes in urban ecosystems. *Environmental pollution*, 116, S107-S118.

Grimm, NB, D Foster, P Groffman, J M Grove, CS Hopkinson, KJ Nadelhoffer, DE Pataki, and DPC Peters 2008. The changing landscape: ecosystem responses to urbanization and pollution across climatic and societal gradients. *Frontiers in Ecology and the Environment* 6: 264–272.

Week 4: Species Response to Urbanization: Plants

Tuesday: Gaston Chapter 4: Individual species and urbanization (35 pages)

K. Neil and J. Wu. 2006. Effects of urbanization on plant flowering phenology: A review. *Urban Ecosystems* 9(3): 243-257.

Gazal et al. 2008. GLOBE students, teachers, and scientists demonstrate variable differences between urban and rural leaf phenology. *Global Change Biology* 14 (1568 – 1580).

Williams, N.S.G. et al. 2009. A conceptual framework for predicting the effects of urban environments on floras. *Journal of Ecology* 97: 4-9.

Thursday: Potential Discussion Papers (choose two)

Honoura, S.L., J.B. Bellb, T.W. Ashendenc, J.N. Caped, S.A. Powera. 2009. Responses of herbaceous plants to urban air pollution: Effects on growth, phenology and leaf surface characteristics. *Environmental Pollution* 157(4): 1279–1286.

Minn, B.M. 2000. Comparison of phenological characteristics for several woody plants in urban climates. *Journal of Plant Biology* 43(1): 10-17.

Verboven, H.A.F., R. Brys, M. Hermy. 2012. Sex in the city: Reproductive success of *Digitalis purpurea* in a gradient from urban to rural sites, *Landscape and Urban Planning*. 106(2):158-164.

Gregg, J. W., Jones, C. G., & Dawson, T. E. (2003). Urbanization effects on tree growth in the vicinity of New York City. *Nature*, 424(6945), 183-187.

Hahs, A.K. et al. 2009. A global synthesis of plant extinction rates in urban areas. *Ecology Letters* 12: 1165-1173.

Imhoff, M. L., Bounoua, L., DeFries, R., Lawrence, W. T., Stutzer, D., Tucker, C. J., & Ricketts, T. (2004). The consequences of urban land transformation on net primary productivity in the United States. *Remote Sensing of Environment*, 89(4), 434-443.

Week 5: Species Response to Urbanization: Evolution and Foraging

Tuesday – Adaptation and evolution in Urban Environments

<http://www.nytimes.com/2016/07/24/opinion/sunday/evolution-is-happening-faster-than-we-thought.html>

McDonnell, MJ and AK Hahs. 2015. Adaptation and Adaptedness of Organisms to Urban Environments. *Annual Review of Ecology, Evolution and Systematics*. 46: 261-280.

Donihue, C.M. and M.R. Lambert. Adaptive Evolution in urban ecosystems. 2015. *AMBIO* 44:194-203.

Thursday – Grant Writing/Foraging: Potential Discussion Paper (choose one)

Youngsteadt, E., Henderson, R. C., Savage, A. M., Ernst, A. F., Dunn, R. R., & Frank, S. D. (2015). Habitat and species identity, not diversity, predict the extent of refuse consumption by urban arthropods. *Global change biology*, 21(3), 1103-1115.

Prange, S. and S.D. Gehrt. 2004. Changes in mesopredator-community structure in response to urbanization. *Canadian Journal of Zoology* 82:1804-1817.

Shochat, E., Lerman, S. B., Katti, M., & Lewis, D. B. (2004). Linking Optimal Foraging Behavior to Bird Community Structure in an Urban - Desert Landscape: Field Experiments with Artificial Food Patches. *The American Naturalist*, 164(2), 232-243.

Faeth, S., P.S. Warren, E. Shochat, and W.A. Marussich. 2005. Trophic Dynamics in Urban Communities. *BioScience* 55(5):399-407.

Raupp, M.J., P.M. Shrewsbury, and D.A. Herms. 2010. Ecology of Herbivorous Arthropods in Urban Landscapes. *Annual Review of Entomology* 55:19-38.

Week 6: Proposal Discussion

Week 7: Behavior and Communication

Tuesday:

Kight, C. R. and Swaddle, J. P. (2011). How and why environmental noise impacts animals: an integrative, mechanistic review. *Ecology Letters*, 14: 1052–1061.

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(1): 5 - 12

Thursday: Potential Discussion Papers (choose two)

Parker, T. S., & Nilon, C. H. (2008). Gray squirrel density, habitat suitability, and behavior in urban parks. *Urban Ecosystems*, 11(3), 243-255.

Pohl, N.U., E. Leadbeater, H. Slabbekoorn, G.M. Klump, U. Langemann. 2012. Great tits in urban noise benefit from high frequencies in song detection and discrimination. *Animal Behaviour*. 83(3):711-721.

Bee, M. A., & Swanson, E. M. (2007). Auditory masking of anuran advertisement calls by road traffic noise. *Animal Behaviour*, 74(6), 1765-1776.

Atwell, J.W., G.C. Cardoso, D.J. Whittaker, S. Campbell-Nelson, K.W. Robertson, and E.D. Ketterson. 2012. Boldness behavior and stress physiology in a novel urban environment suggest rapid correlated evolutionary adaptation. *Behavioral Ecology* 23 (5): 960-969

Nemeth, Erwin, et al. "Bird song and anthropogenic noise: vocal constraints may explain why birds sing higher-frequency songs in cities." *Proceedings of the Royal Society B: Biological Sciences* 280.1754 (2013): 20122798.

Week 9:

Tuesday: Physiology and Organismal Ecology: Potential Discussion Papers (choose two)

Angilletta Jr, M. J., Wilson, R. S., Niehaus, A. C., Sears, M. W., Navas, C. A., & Ribeiro, P. L. (2007). Urban physiology: city ants possess high heat tolerance. *PLoS One*, 2(2), e258.

Kleist, N.J., Guralnick, R.P., Cruz, A., Lowry, C.A. & C. D. Francis (2018). Chronic anthropogenic noise disrupts glucocorticoid signaling and has multiple effects on fitness in an avian community *PNAS* 2018 ; published ahead of print January 8, 2018, doi:10.1073/pnas.1709200115.

Partecke, Jesko, Ingrid Schwabl, and Eberhard Gwinner. "Stress and the city: urbanization and its effects on the stress physiology in European blackbirds." *Ecology* 87.8 (2006): 1945-1952.

Wandeler, P., Funk, S. M., Lurgiader, C. R., Gloor, S., & Breitenmoser, U. (2003). The city - fox phenomenon: genetic consequences of a recent colonization of urban habitat. *Molecular Ecology*, 12(3), 647-656.

Thursday: Invasion - Background Chapter and Discussion (two discussion papers):

Gaston Chapter 6: Urbanisation and alien invasion (14 pages)

Shochat, E., S.B. Lerman, J.M. Anderies, P.S. Warren, S.H. Faeth, and C.H. Nilon. 2010. Invasion, Competition, and Biodiversity Loss in Urban Ecosystems. *BioScience* 2010 60 (3), 199-208.

Adams AL, Dickinson KJM, Robertson BC, van Heezik Y (2013) Predicting Summer Site Occupancy for an Invasive Species, the Common Brushtail Possum (*Trichosurus vulpecula*), in an Urban Environment. *PLoS ONE* 8(3): e58422

Tonini, F., H. Hartwig, R. Hochmair , H. Scheffrahn ,1 and D.L. Deangelis. 2013. Simulating the Spread of an Invasive Termite in an Urban Environment using a Stochastic Individual-Based Model *Environmental Entomology* 42(3):412-423.

Week 10: Disease in Urban Landscapes

Tuesday:

Bradley, C. A., & Altizer, S. (2007). Urbanization and the ecology of wildlife diseases. *Trends in ecology & evolution*, 22(2), 95-102.

Himsworth, C.G., K.L. Parsons, C. Jardine, and D.M. Patrick. Rats, Cities, People, and Pathogens: A Systematic Review and Narrative Synthesis of Literature Regarding the Ecology of Rat-Associated Zoonoses in Urban Centers. *Vector-Borne and Zoonotic Diseases*. June 2013, 13(6): 349-359

Thursday: Potential Discussion Papers (choose two):

Silvina Fenoglio, M., M. Videla, A. Salvo, G. Valladares, Beneficial insects in urban environments: Parasitism rates increase in large and less isolated plant patches via enhanced parasitoid species richness, *Biological Conservation*, Volume 164, August 2013, Pages 82-89.

Salant H., K.Y. Mumcuoglu and G. Baneth. 2013, Ectoparasites in urban stray cats in Jerusalem, Israel: differences in infestation patterns of fleas, ticks and permanent ectoparasites. *Medical and Veterinary Entomology*. doi: 10.1111/mve.12032.

Delgado-V. C.A., K. French. 2012. Parasite–bird interactions in urban areas: Current evidence and emerging questions, *Landscape and Urban Planning* 105(1–2): 5-14.

Suárez-Rodríguez, M., I. López-Rull, and C. Macías García. 2013. Incorporation of cigarette butts into nests reduces nest ectoparasite load in urban birds: new ingredients for an old recipe? *Biology Letters* 9 1 20120931; doi:10.1098/rsbl.2012.0931 1744-957X

Bradley, C. A., Gibbs, S. E., & Altizer, S. (2008). Urban land use predicts West Nile virus exposure in songbirds. *Ecological Applications*, 18(5), 1083-1092.

Reisen, W. K., Takahashi, R. M., Carroll, B. D., & Quiring, R. (2008). Delinquent mortgages, neglected swimming pools, and West Nile virus, California. *Emerging infectious diseases*, 14(11), 1747.

Week 11

Tuesday: Urban Biodiversity

Gaston: Chapter 5 (32 pages)

One review paper

McKinney, M. L. (2002). Urbanization, Biodiversity, and Conservation: The impacts of urbanization on native species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems. *BioScience*, 52(10), 883-890.

Faeth, S. H., C. Bang, and S. Saari. 2011. Urban biodiversity: patterns and mechanisms. *Annals of the New York Academy of Sciences*, 1223: 69–81.

McKinney, M.L. 2008. Effects of urbanization on species richness: A review of plants and animals. *Urban Ecosystems* 11(2): 161-176.

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 Academy B*.

and One experimental paper:

Price, S. J., Browne, R. A., & Dorcas, M. E. (2012). Evaluating the effects of urbanisation on salamander abundances using a before - after control - impact design. *Freshwater Biology*, 57(1), 193-203.

Gomes, V., R. Ribeiro, M.A. Carretero 2011. Effects of urban habitat fragmentation on common small mammals: species versus communities. *Biodiversity and Conservation* 20(14): 3577-3590.

Parris, K. M., & Hazell, D. L. (2005). Biotic effects of climate change in urban environments: The case of the grey-headed flying-fox (*Pteropus poliocephalus*) in Melbourne, Australia. *Biological conservation*, 124(2), 267-276.

Niemelä, J., & Kotze, D. J. (2009). Carabid beetle assemblages along urban to rural gradients: a review. *Landscape and Urban Planning*, 92(2), 65-71.

Helden, A.J., G.C. Stamp, S.R. Leather. 2012. Urban biodiversity: comparison of insect assemblages on native and non-native trees. *Urban Ecosystems* 15(3):611-624.

Donnelly, R., & Marzluff, J. M. (2006). Relative importance of habitat quantity, structure, and spatial pattern to birds in urbanizing environments. *Urban Ecosystems*, 9(2), 99-117.

Shochat, E. (2004). Credit or debit? Resource input changes population dynamics of city - slicker birds. *Oikos*, 106(3), 622-626.

Evans, K.L. et al. (2010) What makes an urban bird? *Global Change Biology* 17:1365-2486.

Hope, D., Gries, C., Zhu, W., Fagan, W. F., Redman, C. L., Grimm, N. B., ... & Kinzig, A. (2003). Socioeconomics drive urban plant diversity. *Proceedings of the National Academy of Sciences*, 100(15), 8788-8792.

Marzluff, J. M. (2005). Island biogeography for an urbanizing world: how extinction and colonization may determine biological diversity in human-dominated landscapes. *Urban Ecosystems*, 8(2), 157-177.

Davies, T.W., J. Bennie, and K.J. Gaston. 2012. Street lighting changes the composition of invertebrate communities. *Biology Letters* 8:764-767.

Thursday: Climate Change and Urban Landscapes

Dodman, David. "Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories." *Environment and Urbanization* 21.1 (2009): 185-201.

McDonald, Robert I., et al. "Urban growth, climate change, and freshwater availability." *Proceedings of the National Academy of Sciences* 108.15 (2011): 6312-6317.

Stone Jr, B. (2005). Urban heat and air pollution: An emerging role for planners in the climate change debate. *Journal of the American planning association*, 71(1), 13-25.

Solecki, W., & Marcotullio, P. J. (2013). Climate change and urban biodiversity vulnerability. In *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities* (pp. 485-504). Springer Netherlands.

Week 12: Climate continued, humans and nature

Tuesday: Climate Potential Discussion Papers (choose two):

Hallegatte, S., Ranger, N., Mestre, O., Dumas, P., Corfee-Morlot, J., Herweijer, C., & Wood, R. M. (2011). Assessing climate change impacts, sea level rise and storm surge risk in port cities: a case study on Copenhagen. *Climatic change*, 104(1), 113-137.

Nelson, K. C., Palmer, M. A., Pizzuto, J. E., Moglen, G. E., Angermeier, P. L., Hilderbrand, R. H., ... & Hayhoe, K. (2009). Forecasting the combined effects of urbanization and climate change on

stream ecosystems: from impacts to management options. *Journal of Applied Ecology*, 46(1), 154-163.

Castán Broto, Vanesa, and Harriet Bulkeley. "A survey of urban climate change experiments in 100 cities." *Global Environmental Change* 23.1 (2013): 92-102.

Thursday: Humans and Nature

Gaston Chapters 7, 9 and 12 (66 pages)

Turner, W. R., Nakamura, T., & Dinetti, M. (2004). Global urbanization and the separation of humans from nature. *Bioscience*, 54(6), 585-590.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using green infrastructure: a literature review. *Landscape and urban planning*, 81(3), 167-178.

Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology letters*, 3(4), 390-394.

Week 13:

Tuesday – Grant writing, peer review

Thursday: Green spaces and Urban Planning

Gaston: Chapter 10 and 11(57 pages)

Goddard, M. A., Dougill, A. J., & Benton, T. G. (2010). Scaling up from gardens: biodiversity conservation in urban environments. *Trends in Ecology & Evolution*, 25(2), 90-98.

Georgi, J. N., & Dimitriou, D. (2010). The contribution of urban green spaces to the improvement of environment in cities: case study of Chania, Greece. *Building and Environment*, 45(6), 1401-1414.

Bryant, M. M. (2006). Urban landscape conservation and the role of ecological greenways at local and metropolitan scales. *Landscape and urban planning*, 76(1), 23-44.

Handel, S. N., Saito, O., & Takeuchi, K. (2013). Restoration ecology in an urbanizing world. In *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities* (pp. 665-698). Springer Netherlands.

Week 14: Future directions and unanswered questions

Tuesday: Gaston Chapter 12 (22 pages)

Montgomery, M. R. (2008). The urban transformation of the developing world. *Science*, 319(5864), 761-764.

Alig, R.J., J.D. Kline and M. Lichtenstein. 2004. Urbanization on the US landscape: looking ahead in the 21st century. *Landscape and Urban Planning* 69(2-3): 219–234

Eigenbrod, F., Bell, V. A., Davies, H. N., Heinemeyer, A., Armsworth, P. R., & Gaston, K. J. (2011). The impact of projected increases in urbanization on ecosystem services. *Proceedings of the Royal Society B: Biological Sciences*, 278(1722), 3201-3208.

Thursday: Finals papers due, Presentations begin

Week 15: Finish Presentations of Grant Proposals