BIO 476/576 – Ecosystem Ecology **Tu/Th: 12:40-2:05 pm, CWH 104**

Instructor:
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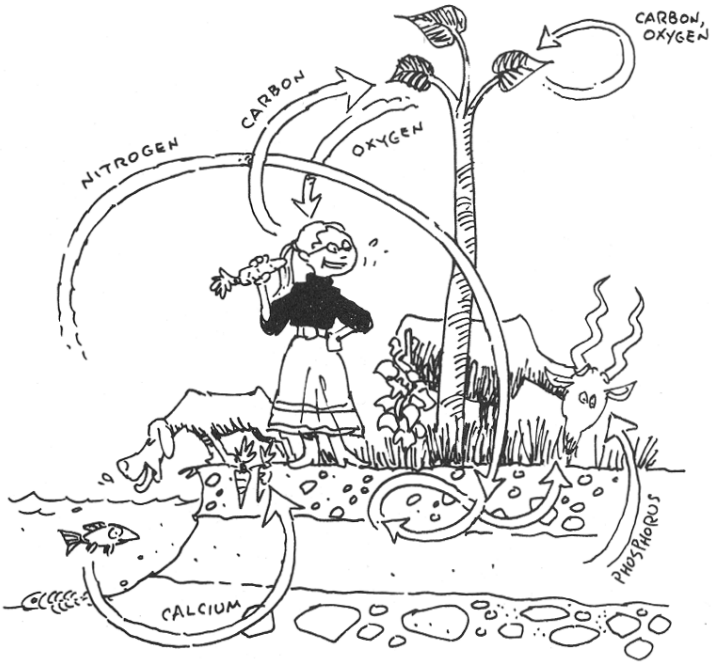
Office Hours: MWF 2:15 – 3:10 pm



Gonick & Outwater (1996)

Course Overview:
Ecosystems include the living and non-living components of an environmental system and have emergent properties that can only by understood by examining the system as a whole. This course will examine advanced ecological topics centered on the structure and function of aquatic and terrestrial ecosystems. Topics covered will include the development of the ecosystem concept, ecosystem succession, production/decomposition, energy transfer in food webs, and nutrient cycling. The course will consist of classroom lectures, problem sets, and reading/discussion of relevant primary literature.

Course Objectives:
Specific objectives/goals for this course include:

- Learn advanced ecosystem related terminology and topics used by ecologists
- Learn and integrate multidisciplinary concepts to understand how ecosystems function
- Learn how to analyze, interpret, and report ecosystem data.

Texts:
Schlesinger, W. H. and E. S. Bernhardt. 2013. Biogeochemistry: An analysis of global change. 3rd edition. Elsevier, New York. (digital version available online for free from UW-L internet at: http://www.sciencedirect.com/science/book/9780123858740)

Chapin III, F.S., H.A. Mooney, and P.A. Matson. 2012. Principles of Terrestrial Ecosystem Ecology. 2nd Ed. Springer Verlag. (digital version available online for free from UW-L internet at: http://link.springer.com/book/10.1007/978-1-4419-9504-9)

Weathers, K. C., D. L. Strayer, and G. E. Likens, editors. 2013. Fundamentals of Ecosystem Science. Academic Press. (digital version available online for free from UW-L internet at: http://www.sciencedirect.com/science/book/9780120887743)

Other reading assignments from primary literature will be provided to the class on D2L.

Website:
The website (on Desire2Learn [D2L]) is where you will find class notes, reading assignments, the most up to date copy of this syllabus, your current grade, and other important information and documents. It is vital you check the website regularly. I highly recommend you print the notes, put them in a binder, and bring them to class.

Grading:
Below is a current list of items that will be graded. The instructor reserves the right to make modifications to this list. The grading scale used in this class is also listed below.

Item	Points
Midterm Exams (2)	200
Final Exam (1)	150
Data Sets (6)	120
Talking Points (25)	100
Presentation (1)	100
Evaluations (20)	70
Total	740

OR

Item	Points
Midterm Exams (2)	200
Final Exam (0)	
Data Sets (6)	120
Talking Points (25)	100
Presentation (1)	100
Evaluations (20)	70
Total	590

Grade	%
A	92-100
AB	88-91
B	81-87
BC	77-80
C	67-76
D	55-66
F	<54

Exams:
All three exams will be take-home exams and answers must be typed. The final exam will be optional. Take the final if you want the opportunity to improve your grade or do not take the final if you are satisfied you're your grade at that time.

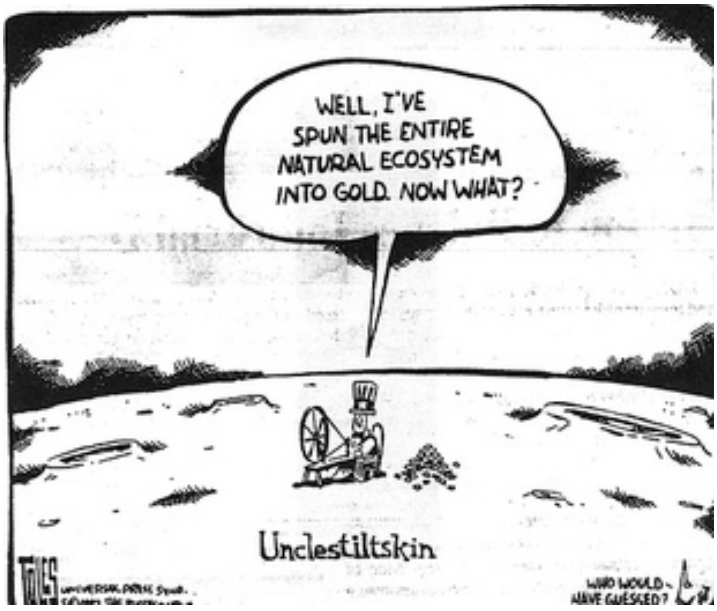
Students are encouraged to use any materials they wish to answer the questions on the take-home exams, however, students must work independently and all answers must be in your own words and references used must be cited within the answer they were used. A bibliography must also be attached to the exam. Exams are due by 11:59pm in the D2L dropbox on the due date. This should go without saying, but plagiarism will not be tolerated and will result in a zero on the exam. Word-for-word copying from references, even if cited, is still considered plagiarism. Occasional use of cited quotes is allowed. If you have questions, please ask.

Reading Assignments and Talking Points:
Almost every week students will lead classroom discussions on papers that are relevant to the topics covered in class. Each undergraduate student will only need to lead one discussion; each graduate student will need to lead at least three discussions and will lead all discussions the first couple of weeks. The papers were picked to either add extra details or to provide additional topics related to the lecture. The general ideas given in the papers are fair game on the exams. Therefore, all students should read all the papers. The student assigned to a particular paper will be expected to summarize the paper to the class in 10 minutes (it is expected that shorter papers will be more thoroughly summarized) and then lead the class in a discussion of the paper. In addition, the assigned student should write down a list of ~5 discussion questions and distribute them to me and the other students on the day of discussion (these substitute for talking points).

At the end of each class period that includes a discussion of a reading assignment, each undergraduate and graduate student shall hand in a typed "talking points" page. A talking points page should consist of 4-5 bulleted items per article. The bulleted items could be questions that arose during the reading, criticism of ideas/techniques presented in the reading, tangential thoughts related to an idea in the paper, etc. Talking points are designed to promote critical thinking and facilitate discussion among the class. Each talking point needs to be only long enough for your use in discussion, but it must be at least one (complete) sentence long and they **must be typed** (these have to be completed before you come to class). A total of 25 talking points (25 articles) will be graded (4 pts each for a total of 100 points).

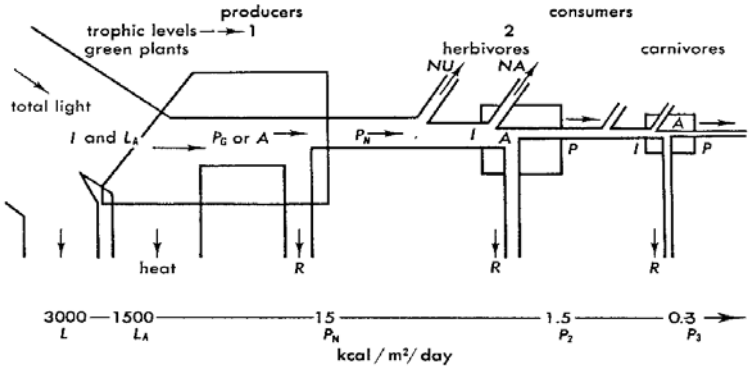
Data Sets:
Throughout the semester students will individually work with data collected during actual ecosystem related studies. The data sets will be related to the concepts presented in lecture (i.e., an application of the concepts). The purpose of these exercises are to: a) see how ecosystem concepts have been applied to actual ecological questions; and b) gain practice in processing, graphing, and analyzing ecosystem data. For each data set assignment students will upload into the D2L dropbox: 1) a MS Word file containing answers to questions and required graphs; and 2) MS Excel file containing all calculations. Assignments are due by 11:59pm on the due date. Six data sets will be analyzed (6 @ 20 points each for a total of 120 points).

Student Presentations:
The presentations will consist of the student choosing a recent journal article of their choice that describes original research (i.e., it cannot be a review article) in the field of ecosystem ecology, claiming it as their own for a day, and presenting the research to the class. The article cannot be one that was already discussed in class. The presentation must be done in PowerPoint and the student should include adequate introductory material in addition to the research findings and implications. Presentations will be scored by classmates and by the instructor. Grades will be assigned using the classmate (25% weight) and instructor (75% weight) scores. Each student will be expected to evaluate 20 presentations (3 points each, the 20th presentation will be worth 13 points) for a total of 70 points. Additional details will be provided later.



Tentative Class/Lecture Schedule:

Date	Day	Topic	Data Sets (DS)	Exams
1/26	T	Course Intro and What's an Ecosystem?		
1/28	U	History of the Ecosystem Concept		
2/2	T	Snow Day		
2/4	U	Student led literature discussion		
2/9	T	Ecosystem Classification, Atmosphere, Lithosphere		
2/11	U	Student led literature discussion	*Lake Ice DS due*	
2/16	T	Production, decomposition		
2/18	U	Energy transfer in ecosystems	*Stream Metabolism DS due*	
2/23	T	Student led literature discussion		
2/25	U	Introduction to nutrient cycles and redox	*Fish Energetics DS due*	*Exam 1 handed out*
3/1	T	Terrestrial nutrient cycling		
3/3	U	Terrestrial nutrient cycling		*Exam 1 due*
3/8	T	Student led literature discussion		
3/10	U	Aquatic nutrient cycling		
3/15	T	Spring Break – No Class		
3/17	U	Spring Break – No Class		
3/22	T	Student led literature discussion	*Hubbard Brook DS due*	
3/24	U	Aquatic nutrient cycling		
3/29	T	Student led literature discussion		
3/31	U	Ecosystem succession	*Stream P Loading DS due*	*Exam 2 handed out*
4/5	T	Student led literature discussion		
4/7	U	Ecosystem succession		*Exam 2 due*
4/12	T	Student led literature discussion		
4/14	U	Global nutrient cycles and issues	*Forest N Loading DS due*	
4/19	T	Presentations (Barbour, Bohrman, Leisz, Schloesser)		
4/21	U	Presentations (Burkhart, Montoure, Rogers, Schneider)		
4/26	T	~~Roundtable discussion with Dr. Strayer~~ Nutrient Cycling in Stream Ecosystems of the Driftless Area		
4/28	U	No Class – MRRC Conference		
5/3	T	Presentations (Clavette, McHenry, Ziegler, Specht, Giebink)		*Final handed out*
5/5	U	Presentations (Greenup, Erickson, Moser, Kahl, Bartelme)		
5/9	M(4:45pm)	Presentations (Reda, Lyons, Hlina, Warner, McGrane)		
5/11 (11 :59pm)	W	*Final Exam Due*		



Source: Odum, E.P. (1971)

Reading Assignments

Date	Reading Assignments	Responsible Student
2/4	Forbes (1887)	Strauss
	Lindeman (1942) and Cook (1977)	Burkhart
	Schindler (1998)	Bohrman
	O'Neill (2001)	Barbour
2/11	Knapp and Smith (2001)	Leisz
	Worm et al. (2006)	Schloesser
	Rice and Herman (2012)	Burkhart
	Hoellein et al. (2013)	Bohrman
2/23	Takimoto et al. (2008)	Schneider
	Pace et al. (1999)	Kahl
	Sitters et al. (2015)	Clavette
3/8	Schlesinger (2004)	Specht
	Chadwick et al (1999)	Giebink
	Likens (2004)	Reda
	Doughty et al. (2015)	Greenup
3/22	Post and Palkovacs (2009)	McHenry
	Frisch et al. (2014)	Moser
	Rosemond et al. (2015)	Leisz
3/29	Azam and Malfatti (2007)	McGrane
	Hilderbrand et al (1999)	Erickson
	Capone and Knapp (2007) + Deutsch et al. (2007)	Barbour
4/5	Odum (1969)	Ziegler
	Rogers et al. (2008)	Montoure
	Richardson et al. (2009)	Lyons
	Romme et al. (2011)	Bartelme
4/12	Chapin et al (1997)	Hlina
	Gruber and Galloway (2008)	Rogers
	Galloway et al. (2008)	Warner
	Grimm et al. (2013)	Schloesser

Reading Assignment Citations

Azam, F. and F. Malfatti. 2007. Microbial structuring of marine ecosystems. Nature Reviews Microbiology 5: 782-791.

Capone, D. G. and A. N. Knapp. 2007. Oceanography: A marine nitrogen cycle fix? Nature 445: 159-160.

Chadwick, O. A., L. A. Derry, P. M. Vitousek, B. J. Huebert, and L. O. Hedin. 1999. Changing sources of nutrients during four million years of ecosystem development. Nature 397:491-497.

Chapin, F. S., B. H. Walker, R. J. Hobbs, D. U. Hooper, J. H. Lawton, O. E. Sala, and D. Tilman. 1997. Biotic control over the functioning of ecosystems. Science 277: 500-504.

Cook, R. E. 1977. Raymond Lindeman and the trophic-dynamic concept in ecology. Science 198: 22-26.

Deutsch, C., J. L. Sarmiento, D. M. Sigman, N. Gruber, and J. P. Dunne. 2007. Spatial coupling of nitrogen inputs and losses in the ocean. Nature 445: 163-167.

Doughty, C. E., J. Roman, S. Faurby, A. Wolf, A. Haque, E. S. Bakker, Y. Malhi, J. B. Dunning, and J.-C. Svenning. 2015. Global nutrient transport in a world of giants. Proceedings of the National Academy of Sciences. doi: 10.1073/pnas.1502549112.

Forbes, S. A. 1887. The lake as a microcosm. Bulletin of the Peoria Scientific Association:77-87.

Frisch, D., P. K. Morton, P. R. Chowdhury, B. W. Culver, J. K. Colbourne, L. J. Weider, and P. D. Jeyasingh. 2014. A millennial-scale chronicle of evolutionary responses to cultural eutrophication in Daphnia. Ecology Letters. doi: 10.1111/ele.12237.

Galloway, J. N., A. R. Townsend, J. W. Erisman, M. Bekunda, Z. Cai, J. R. Freney, L. A. Martinelli, S. P. Seitzinger, and M. A. Sutton. 2008. Transformation of the nitrogen cycle: Recent trends, questions, and potential solutions. Science 320: 889-892.

Grimm, N. B., F. S. Chapin, B. Bierwagen, P. Gonzalez, P. M. Groffman, Y. Luo, F. Melton, K. Nadelhoffer, A. Pairis, P. A. Raymond, J. Schimel, and C. E. Williamson. 2013. The impacts of climate change on ecosystem structure and function. Frontiers in Ecology and the Environment 11:474-482.

Gruber, N. and J. N. Galloway. 2008. An Earth-system perspective of the global nitrogen cycle. Nature 451: 293-296.

Hilderbrand, G. V., T. A. Hanley, C. T. Robbins, and C. C. Schwartz. 1999. Role of brown bears (Ursus arctos) in the flow of marine nitrogen into a terrestrial ecosystem. Oecologia 121: 546-550.

Hoellein, T. J., D. A. Bruesewitz, and D. C. Richardson. 2013. Revisiting Odum. 1956. A synthesis of aquatic ecosystem metabolism. Limnology and Oceanography 58:2089-2100.

Knapp, A. K. and M. D. Smith. 2001. Variation among biomes in temporal dynamics of aboveground primary production. Science 291: 481-484.

Likens, G. E. 2004. Some perspectives on long-term biogeochemical research from the Hubbard Brook Ecosystem Study. Ecology 85: 2355–2362.

Lindeman, R. L. 1942. The trophic-dynamic aspect of ecology. Ecology 23: 399-418.

Odum, E. P. 1969. The strategy of ecosystem development. Science 164: 262-270.

O'Neill, R. V. 2001. Is it time to bury the ecosystem concept? (with full military honors, of course!). Ecology 82: 3275-3284.

Pace, M. L., J. J. Cole, S. R. Carpenter, and J. F. Kitchell. 1999. Trophic cascades revealed in diverse ecosystems. Trends in Ecology & Evolution 14: 483-488.

Post, D. M. and E. P. Palkovacs. 2009. Eco-evolutionary feedbacks in community and ecosystem ecology: interactions between the ecological theatre and the evolutionary play. Philosophical Transactions of the Royal Society B: Biological Sciences 364: 1629-1640.

Rice, K. C. and J. S. Herman. 2012. Acidification of Earth: An assessment across mechanisms and scales. Applied Geochemistry 27: 1-14.

Richardson, A. J., A. Bakun, G. C. Hays, and M. J. Gibbons. 2009. The jellyfish joyride: causes, consequences and management responses to a more gelatinous future. Trends in Ecology & Evolution 24:312-322.

Rogers, D. A., T. P. Rooney, D. Olson, and D. M. Waller. 2008. Shifts in Southern Wisconsin forest canopy and understory richness, composition and heterogeneity. Ecology 89: 2482-2492.

Romme, W., M. Boyce, R. Gresswell, E. Merrill, G. Minshall, C. Whitlock, and M. Turner. 2011. Twenty years after the 1988 Yellowstone fires: Lessons about disturbance and ecosystems. Ecosystems 14: 1196-1215.

Rosemond, A. D., J. P. Benstead, P. M. Bumpers, V. Gulis, J. S. Kominoski, D. W. P. Manning, K. Suberkropp, and J. B. Wallace. 2015. Experimental nutrient additions accelerate terrestrial carbon loss from stream ecosystems. Science 347:1142-1145.

Schindler, D. W. 1998. Replication versus realism: The need for ecosystem-scale experiments. Ecosystems 1:323-334.

Schlesinger, W. H. 2004. Better living through biogeochemistry. Ecology 85: 2402–2407.

Sitters, J., C. L. Atkinson, N. Guelzow, P. Kelly, and L. L. Sullivan. 2015. Spatial stoichiometry: cross-ecosystem material flows and their impact on recipient ecosystems and organisms. Oikos 124:920-930.

Takimoto, G., D. A. Spiller, and D. M. Post. 2008. Ecosystem size, but not disturbance, determines food-chain length on islands of the Bahamas. Ecology 89: 3001-3007.

Worm, B., E. B. Barbier, N. Beaumont, J. E. Duffy, C. Folke, B. S. Halpern, J. B. Jackson, H. K. Lotze, F. Micheli, S. R. Palumbi, E. Sala, K. A. Selkoe, J. J. Stachowicz, and R. Watson. 2006. Impacts of biodiversity loss on ocean ecosystem services. Science 314:787-790.