NRES 485 – Stream Ecosystem Management

Class: Mon, Wed, Fri 4 - 4:50 pm, Turner Hall W203

1. Instructor

Dr. Eric R. Larson, erlarson@illinois.edu
Office Hours: By appointment, Turner W421

2. Course Content

Stream and river (lotic) ecosystems are fundamentally unlike any of their freshwater, marine, or terrestrial counterparts owing to their unique dendritic structure and the dominant influence of downstream, directional water flow on their populations, communities, and abiotic processes. These features also make streams and rivers highly vulnerable to a suite of anthropogenic effects occurring in adjacent or upstream terrestrial areas, as well as to direct physical modification of lotic habitat through actions like dam building and impoundment.

This course will specifically relate the structure and function of streams and rivers to challenges and opportunities in their conservation, management, and restoration using a combination of readings, weekly discussions, student writing through a series of journal entries, and exams. Students will develop an integrative understanding of stream and river ecosystems from the site to watershed scale on issues including nutrient dynamics and pollution, the natural flow regime, and the design and implementation of freshwater protected areas. This class is distinct from *NRES 482 Aquatic Biogeochemistry* due to its emphasis on population and community ecology of freshwater organisms as related to their conservation, and from *NRES 429 Aquatic Ecosystem Conservation* by its narrower specialization on streams and rivers.

3. Learning Objectives

By the end of the course, students will:

3.1) Identify the flow regime as the fundamental force affecting stream and river structure and function, and become familiar with strategies for flow regime management

3.2) Recognize relationships between stream channels and their floodplains, and how these connections can be severed or restored through land use and management

3.3) Characterize causes of chemical, nutrient, and temperature pollution in streams and rivers and identify options for their mitigation or removal

3.4) Learn how management agencies use organisms like fish, algae, and invertebrates to measure biological integrity of streams and rivers in compliance with laws like the Clean Water Act

3.5) Understand the importance of reciprocal flows of energy and organisms between lotic and adjacent terrestrial habitats and how they can be intercepted by factors like invasive species and riparian management

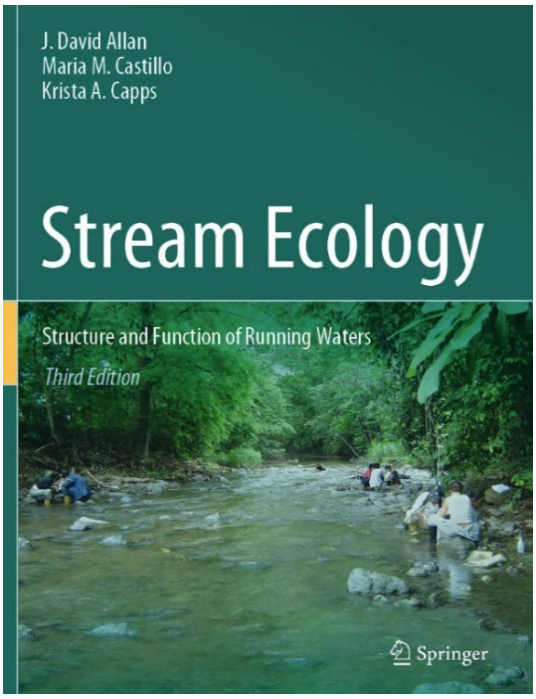
3.6) Become familiar with standard practices in stream and river restoration and understand the necessity of monitoring to evaluate restoration success

3.7) Identify differences in protected area implementation for terrestrial, marine, and lotic ecosystems and characterize major types of freshwater protected areas

3.8) Develop expertise reading, discussing, and applying scientific literature through group discussions and individual journal entries

4. Textbook (required)

Stream Ecology, 3rd Edition (2021)
J. David Allan, Maria M. Castillo, Krista A. Capps



The textbook is available as an online edition through the library website and on reserve at the Funk ACES library. Additional readings from the primary scientific literature will be provided through the class Canvas site.

5. Assessment

Grades will be calculated following:

Discussion (10 of 11, 2 each)	**-**	**20**
Journal (3 total, 10 each)	**-**	**30**
Exam 1	**-**	**15**
Exam 2	**-**	**15**
Final Exam	**-**	**20**
TOTAL		**100**

Late policy: Journal entries and exams will be penalized 10% of the possible grade for every day late where assessments are due to the instructor by 11:59 pm on the day assignment.

5. Assessment (continued)

Students will be assessed using a combination of three exams, participation in class discussions, and weekly journal entries evaluated at three due dates throughout the semester, which relate discussion readings to a river or watershed of their choice. Exams will use short answer and essay questions and require synthesis across material from lectures and readings. Weekly discussion of primary literature will be assessed by attendance and participation. Grades will follow the scale:

A+	**97 - 100%**	**C**	**73 - 76.9%**
A	**93 - 96.9%**	**C-**	**70 - 72.9%**
A-	**90 - 92.9%**	**D+**	**67 - 69.9%**
B+	**87 - 89.9%**	**D**	**63 - 66.9%**
B	**83 - 86.9%**	**D-**	**60 - 62.9%**
B-	**80 - 82.9%**	**F**	**< 59.9%**
C+	**77 - 79.9**		

6. Generative AI policy

This class does not allow the use of generative AI tools in the completion of journals and exams. All written products are expected to represent the exclusive work of the student using only their notes, the class text book, assigned readings, and approved resources like peer-reviewed journal articles and government reports. Use of generative AI for a class assessment may result in loss of all points associated with the assessment. The instructor will not use AI for any class purposes.

7. Class schedule

Week	Day	Topic	*Reading*	**Assessment**
1	Mon Jan 19	No class		
	Wed Jan 21	Introduction, syllabus, journal		**Choose a river for journal**
	Fri Jan 23	What's special about streams?	*Allan et al. Ch. 1*	
2	Mon Jan 26	Biodiversity declines in lotic systems		
	Wed Jan 28	Freshwater biodiversity declines	*Strayer and Dungeon 2010 (1)*	**Discussion 1**
	Fri Jan 30	Are we succeeding at stream restoration?	*Bernhardt et al. 2005 (2)*	
3	Mon Feb 2	Streamflow and the hydrograph	*Allan et al. Ch. 2*	
	Wed Feb 4	The natural flow regime	*Poff et al. 1997 (3)*	**Discussion 2**
	Fri Feb 6	Managing flow regimes		
4	Mon Feb 9	Fluvial geomorphology	*Allan et al. Ch. 3*	
	Wed Feb 11	Process-based restoration	*Beechie et al. 2010 (4)*	**Discussion 3**
	Fri Feb 13	Conserving and restoring floodplains		
5	Mon Feb 16	Stream water chemistry	*Allan et al. Ch. 4*	
	Wed Feb 18	Salting our streams	*Wallace and Biastoch 2016 (5)*	**Discussion 4**
	Fri Feb 20	Managing stream water chemistry		
6	Mon Feb 23	Exam 1 review		
	Wed Feb 25	Journal discussion		**Journal 1 due**
	Fri Feb 27	Exam 1		**Exam 1**

7. Class schedule (continued)

Week	Day	Topic	Reading	Assessment
7	Mon Mar 2	Reach-scale habitat	*Allan et al. Ch. 5*	
	Wed Mar 4	Riverscape ecology	*Fausch et al. 2002 (6)*	**Discussion 5**
	Fri Mar 6	Protecting in-stream habitat		
8	Mon Mar 9	Autochthony and allochthony	*Allan et al. Ch. 6 & 7*	
	Wed Mar 11	The River Continuum Concept	*Vannote et al. 1980 (7)*	**Discussion 6**
	Fri Mar 13	RCC critiques and alternative models		
9	Mon Mar 16	Spring Break		
	Wed Mar 18	Spring Break		
	Fri Mar 20	Spring Break		
10	Mon Mar 23	Trophic relationships	*Allan et al. Ch. 9*	
	Wed Mar 25	The Index of Biotic Integrity	*Karr 1991 (8)*	**Discussion 7**
	Fri Mar 26	Bioassessment for streams and rivers		
11	Mon Mar 30	Species interactions	*Allan et al. Ch. 10*	
	Wed Apr 1	Food webs and invasive species	*Baxter et al. 2004 (9)*	**Discussion 8**
	Fri Apr 3	Consequences of extinctions and invasions		
12	Mon Apr 6	Exam 2 review		
	Wed Apr 8	Journal discussion		**Journal 2 due**
	Fri Apr 10	Exam 2		**Exam 2**

7. Class schedule (continued)

Week	Day	Topic	Reading	Assessment
13	Mon Apr 13	Community ecology and food webs	*Allan et al. Ch. 11 & 12*	
	Wed Apr 15	Freshwater protected areas	*Abell et al. 2007 (10)*	**Discussion 9**
	Fri Apr 17	Implementing freshwater protected areas		
14	Mon Apr 20	Nutrient dynamics	*Allan et al. Ch. 13*	
	Wed Apr 22	Stream restoration for nitrogen management	*Craig et al. 2008 (11)*	**Discussion 10**
	Fri Apr 24	Reducing nutrient runoff to streams		
15	Mon Apr 27	Carbon and stream ecosystem metabolism	*Allan et al. Ch. 14*	
	Wed Apr 29	Urban streams	*Blaszczak et al. 2019 (12)*	**Discussion 11**
	Fri May 1	Restoration revisited: theory and practice	*Palmer et al. 2019 (13)*	
16	Mon May 4	Class synthesis and future directions	*Allan et al. Ch. 15*	
	Wed May 6	Final exam review		**Journal 3 due**
	Thur May 7	Reading Day		
17	May 8 -14	Final exam TBD		**Final exam**

8. Readings

(1) Strayer, D.L. and Dudgeon, D. 2010. Freshwater biodiversity conservation: recent progress and future challenges. *Journal of the North American Benthological Society* 29:344-358.

(2) Bernhardt, E.S., Palmer, M.A., Allan, J.D., Alexander, G., Barnas, K., Broos, S., Carr, J., Clayton, S., Dahm, C., Follstad-Shah, J., and Galat, D. 2005. Synthesizing US river restoration efforts. *Science* 5722:636-7.

(3) Poff, N.L., Allan, J.D., Bain, M.B., Karr, J.R., Prestegaard, K.L., Richter, B.D., Sparks, R.E. and Stromberg, J.C. 1997. The natural flow regime. *BioScience* 47:769-784.

(4) Beechie, T.J., Sear, D.A., Olden, J.D., Pess, G.R., Buffington, J.M., Moir, H., Roni, P. and Pollock, M.M. 2010. Process-based principles for restoring river ecosystems. *BioScience* 60:209-222.

(5) Wallace, A.M. and Biastoch, R.G. 2016. Detecting changes in the benthic invertebrate community in response to increasing chloride in streams in Toronto, Canada. *Freshwater Science* 35:353-363.

(6) Fausch, K.D., Torgersen, C.E., Baxter, C.V. and Li, H.W. 2002. Landscapes to riverscapes: Bridging the gap between research and conservation of stream fishes. *BioScience* 52:483-498.

(7) Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R. and Cushing, C.E. 1980. The river continuum concept. *Canadian Journal of Fisheries and Aquatic Sciences* 37:130-137.

(8) Karr, J.R. 1991. Biological integrity: a long-neglected aspect of water resource management. *Ecological Applications 1:66-84.*

(9) Baxter, V.C., Fausch, K.D., Murakami, M. and Chapman, P.L. 2004. Fish invasion restructures stream and forest food webs by interrupting reciprocal prey subsidies. *Ecology* 85:2656-2663.

(10) Abell, R., Allan, J.D. and Lehner, B. 2007. Unlocking the potential of protected areas for freshwaters. *Biological Conservation* 134:48-63.

(11) Craig, L.S., Palmer, M.A., Richardson, D.C., Filoso, S., Bernhardt, E., Bledsoe, B.P., Doyle, M.W., Groffman, P.M., Hassett, B.A., Kaushal, S.S., Mayer, P.M., Smith, S.M. and Wilcock, P.R. 2008. Stream restoration strategies for reducing river nitrogen loads. *Frontiers in Ecology and the Environment* 6:529-538.

(12) Blaszczak, J.R., J.M. Delesantro, D.L. Urban, M.W. Doyle and Bernhardt, E.S. 2019. Scoured or suffocated: Urban stream ecosystems oscillate between hydrologic and dissolved oxygen extremes. *Limnology and Oceanography* 64:877-894.

(13) Palmer, M.A., Menninger, H.L. and Bernhardt, E. 2010. River restoration, habitat heterogeneity, and biodiversity: a failure of theory or practice? *Freshwater Biology* 55:205-222.

9. Academic Integrity Statement

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/. Academic dishonesty may result in a failing grade. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

10. Students with Disabilities Statement

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@illinois.edu. Visit https://www.disability.illinois.edu/ for more information.

11. Family Educational Rights and Privacy Act (FERPA) Statement.

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.

12. Sexual Misconduct Policy and Reporting

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found at https://wecare.illinois.edu/resources/students/#confidential

Other information about resources and reporting is available at https://wecare.illinois.edu/.

13. Inclusivity Statement

The effectiveness of this course is dependent upon the creation of an encouraging and safe classroom environment. Exclusionary, offensive or harmful speech (such as racism, sexism, homophobia, transphobia, etc.) will not be tolerated and in some cases is subject to University harassment procedures. We are all responsible for creating a positive and safe environment that allows all students equal respect and comfort. I expect each of you to help establish and maintain an environment where you and your peers can contribute without fear of ridicule or intolerant or offensive language.

14. Emergency Response Recommendations

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency-preparedness/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/.