Trophic Cascades—FES/FW 550

2-3 credits, 2-3:50 pm Thursdays, Peavy Hall 276
Instructor: William J. Ripple bill.ripple@oregonstate.edu

Prerequisite:
Graduate or postbac standing, an ecology course

Course website: http://www.cof.orst.edu/leopold/courses-ttc.php

Course Content: The objective of this course is to examine carnivore effects on plants as mediated through herbivores. We will investigate the frequency and strength of trophic cascades in diverse ecosystems. Topics will range from theory, to the potential effects of predators in structuring ecosystems, to the implications for ecosystem function, management, and restoration. The course will consist of lectures, guest presentations, readings, class discussions, a field exercise, a term paper, and student presentations. Each student will write a term paper, and complete a field assignment. In addition, each student will lead at least one class discussion on assigned readings.

Objectives and measurable Student Learning Outcomes
Upon completion of the course, all students will be able to:

1. Conduct field projects analyzing top-down and bottom-up effects on forest structure.
2. Communicate scientifically with others in writing and orally regarding trophic cascades
3. Cite recent applications of trophic cascades theory in ecology, wildlife, forestry and other natural resource disciplines.
4. Synthesize, critique, and present journal articles on trophic cascades through leading class discussions.
5. Facilitate group discussions on trophic cascades.

Evaluation of Student Performance
Student performance in meeting learning outcomes in **FES/FW 550** will be evaluated as follows:
2 credit option
Grades will be based on 100 possible points and the following percentages: 50% short term paper (7-8 pages), 5% term paper proposal, 10% lecture and reading discussion participation, 20% field project, 15% presenting and facilitating at least one discussion.
3 credit option
Grades will be based on 100 possible points and the following percentages: 20% short term paper (7-8 pages), 30% extra term paper (10-12 pages), 5% term paper proposals (two), 10% lecture and reading discussion participation, 20% field project, 15% presenting and facilitating at least one discussion.

Attendance
Class attendance is mandatory: an attendance sheet will be taken; three points (3% of total grade) will be deducted for each unexcused absence.

Final Grade	**Total Points**
A	95-100
A-	93-94
B+	91-92
B	89-90
B-	87-88
C+	85-86
C	83-84
C-	81-82
D+	79-80
D	77-78
D-	75-76

Discussion Leaders: When it is your turn to lead a discussion, send an email to the class with thought-provoking questions about the article by **Wednesday noon** before the Thursday class meeting.

Field Exercise: Students will evaluate top-down and bottom-up effects in an Oregon white oak stand on OSU property. Student teams will do a field project presentation on the last day of class.

Paper requirements

Students registered for 2 credits will write a paper (7-8 double spaced pages of text plus figures and references). Potential topics for the paper include for example, investigating the developing theory, the history of thought, ideas, and work, or the frequency/strength of trophic cascades in various ecosystems. Those registered for 3 credits will write a second paper (10-12 double spaced pages of text plus figures and references) that looks deeper into some specific aspect of the trophic cascades. A paper proposal is required and should be about 400-500 words for *each* proposed paper.

Statement Regarding Students with Disabilities
OSU Policy on Students with Disabilities:
"Oregon State University is committed to student success; however, we do not require students to use accommodations nor will we provide them unless they are requested by the student. The student, as a legal adult, is responsible to request appropriate accommodations. The student must take the lead in applying to Disability Access Services (DAS) and submit requests for accommodations each term through DAS Online. OSU students apply to DAS and request accommodations at our Getting Started with DAS page."

Statement of Expectations for Student Conduct
Please see the OSU Student Conduct website:
http://oregonstate.edu/studentconduct/offenses-0.

Schedule	Topic (lecture)	Readings	Presenter
April 2	Class overview, Introductions, Trophic Cascades 1, Ripple#1	Ripple et al. 2014	
April 9	Novel Trophic Cascades Dr. Arian Wallach	Wallach et al. 2015 Letnic et al. 2012	_____
April 16 Proposal due	Trophic Cascades 2 Yellowstone, Ripple#2	Hebblewhite et al. 2005 Kay 1998	_____ _____
April 23	Wolves-elk-plants-streams, Dr. Bob Beschta	Estes et al. 2011 Springer et al. 2003	_____ _____
April 30	Trophic Cascades4 Ripple#4	Myers et al. 2007 Carpenter et al. 2010	_____ _____
May 7	Density-mediated cascades outside of parks Ripple#3	Wirsing et al. 2010 Lima 1998	_____ _____
May 14 1st paper due	Field Trip/project		
May 21	Ecosystem dynamics Other National Parks, Ripple#5	Ritchie & Johnson 2009 Berger et al 2001	_____ _____
May 28 2nd paper due	Ecosystem dynamics Cougar cascades, Ripple#6	Schmitz 2006 Murray Berger et al. 2008	_____ _____
June 4	Student Presentations on Field Projects course reaction survey		

Required Readings-- Pdf's at http://www.cof.orst.edu/leopold/ttc-required-reading.php

Berger J, Stacey PB, Bellis L, and MP Johnson. 2001. A mammalian predator-prey imbalance: grizzly bear and wolf extinction affect avian neotropical migrants. Ecological Applications 11:967-980.

Carpenter SR, Cole JJ, Kitchell JF, and ML Pace. 2010. Trophic cascades in lakes: lessons and prospects. Chapter 4, p.55-70 *in*: John Terborgh and James A. Estes (eds.) *Trophic Cascades*. Island Press, Washington, DC.

Estes JA, Terborgh J, Brashares JS, Power ME, Berger J, Bond WJ, Carpenter SR, Essington TE, Holt RD, Jackson JBC, Marquis RJ, Oksanen L, Oksanen T, Paine RT, Pikitch EK, Ripple WJ, Sandin SA,

Scheffer M, Schoener TW, Shurin JB, Sinclair ARE, Soulé ME, Virtanen R, Wardle DA (2011) Trophic Downgrading of Planet Earth. Science 333:301–306

Hebblewhite M, White CA, Nietvelt CG, McKenzie JA, Hurd TE, Fryxell JM, Bayley SE, and PC Paquet. 2005. Human activity mediates a trophic cascade caused by wolves. Ecology 86:2135-2144.

Kay CE. 1998. Are ecosystems structured from the top-down or bottom-up: a new look at an old debate. Wildlife Society Bulletin 26:484-498.

Letnic, M., E. G. Ritchie, and C. R. Dickman. 2012. Top predators as biodiversity regulators: The dingo Canis lupus dingo as a case study. Biological Reviews 87:390-413.

Lima SL. 1998. Nonlethal effects in the ecology and predator-prey interactions. Bioscience 48:25-34.

Murray Berger K, Gese EM, and J Berger. 2008. Indirect effects and traditional trophic cascades: A test involving wolves, coyotes, and pronghorn. Ecology 89:818-828.

Myers RA, Baum JK, Shepherd TD, Powers SP, and CH Peterson. 2007. Cascading effects of the loss of apex predatory sharks from a coastal ocean. Science 315:1846-1850.

Ripple, W.J., Estes, J.A., Beschta, R.L., Wilmers, C.C., Ritchie, E.G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M.P., Schmitz, O.J., Smith, D.W., Wallach, A.D. & Wirsing, A.J. (2014) Status and ecological effects of the world's largest carnivores. *Science*, **343**, 1241484.

Ritchie EG, and CN Johnson. 2009. Predator interactions, mesopredator release and biodiversity conservation. Ecology Letters 12:982-998.

Schmitz OJ. 2006. Predators have large effects on ecosystem properties by changing plant diversity, not plant biomass. Ecology 87:1432-1437.

Springer AM, Estes JA, van Viet GB, Williams TM, Doak DF, Danner EM, Forney KA, and B Pfister. 2003. Sequential megafaunal collapse in the North Pacific Ocean: An ongoing legacy of industrial Whaling? PNAS 100:12223-12228.

Wallach, A.D., Ripple, W.J. and S.P. Carroll. 2015. Novel trophic cascades: apex predators enable coexistence. Trends in Ecology & Evolution 30: 146-153.

Wirsing AJ, Cameron KE, and MR Heithaus. 2009. Spatial responses to predators vary with prey escape mode. Animal Behavior 79:531-537.

Optional Reading

Beyer HL, Merrill EH, Varley N, and MS Boyce. 2007. Willow on yellowstone's northern range: Evidence for a trophic cascade? Ecological Applications 17:1563-1571.

Cresswell W. 2008. Nonlethal effects of predation in birds. Ibis 150:3-17.

Crête M. 1999. The distribution of deer biomass in North America supports the hypothesis of exploitation ecosystems. Ecology Letters 2:223-227.

Dalton D. 2008. Mega-expectations. Chapter 1, p.1-26 *in*: *The Natural World of Lewis and Clark*. University of Missouri Press.

Janzen DH. 1983. The Pleistocene Hunters had Help. American Naturalist. 121:598-599.

Laliberte AS, and WJ Ripple. 2004. Range contractions of North American carnivores and ungulates. Bioscience 54:123-138.

Letnic M, and F Koch. 2010. Are dingoes a trophic regulator in arid Australia? A comparison of mammal communities on either side of the dingo fence. Austral Ecology 35:167-175.

Peterson RO, Vucetich JA, Page RE, and A Chouinard. 2003. Temporal and spatial dynamics of predator-prey dynamics. Alces 39:215-232.

Polis GA, Sears LW, Huxel DR, and JM Strong. 2000. When is a trophic cascade a trophic cascade?. Trends in Ecology and Evolution 15:473-475.

Ripple WJ, Rooney T, and R L Beschta. 2010. Large predators, deer, and trophic cascades in boreal and temperate ecosystems.Chapter 9, p.141-162 in: John Terborgh and James A. Estes (eds.) Trophic Cascades. Island Press, Washington, DC.

Ripple, W.J. and Van Valkenburgh, B. 2010. Linking Top-Down Forces to the Pleistocene Megafaunal Extinctions. BioScience. 60:516-526.

Roemer GW, Gompper ME, and BV Valkenburgh. 2009. The ecological role of the mammalian mesocarnivore. Bioscience 59:165-173.

Strong, D.R., Frank, K.T. 2010. Human Involvement in Food Webs. Annual Review of Environment and Resources 35, 1-23.

Terborgh J and Estes JA. 2010. Preface, p.xiii-xx *in*: John Terborgh and James A. Estes (eds.) *Trophic Cascades*. Island Press, Washington DC.

Van Valkenburg B, and F Hertel. 1993. Tough times at La Brea: Tooth breakage in large carnivores of the Late Pleistocene. Science 261:456-459.