

Trophic Cascades—FES/FW 550

2-3 credits, 12noon to 1:50 pm Mondays, Zoom meetings

Instructor: William J. Ripple bill.ripple@oregonstate.edu

Prerequisite:

FES/FW 550: Graduate or postbac standing, an ecology course

Zoom meeting

link: <https://oregonstate.zoom.us/j/91237917858?pwd=MVFHdWhXaTNQNzZUWHp3NWZSeXAxZz09>

Canvas website: <https://oregonstate.instructure.com>

Course website: <http://trophiccascades.forestry.oregonstate.edu/courses>

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, documentary films, class discussions, and a term paper. In addition, each student will lead two class discussions on assigned readings.

Objectives and measurable Student Learning Outcomes

Upon completion of the course, all students will be able to:

1. Communicate scientifically with others in writing and orally regarding trophic cascades
2. Cite recent applications of trophic cascades theory in ecology, wildlife, forestry, and other natural resource disciplines.
3. Synthesize, critique, and present journal articles on trophic cascades through leading class discussions.
4. 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: 60% short term paper (7-8 pages), 5% term paper proposal, 20% lecture and reading discussion participation, 15% presenting and facilitating at least one discussion.

3 credit option

Grades will be based on 100 possible points and the following percentages: 30% short term paper (7-8 pages), 40% extra term paper (10-12 pages), 5% term paper proposals

(two), 10% lecture and reading discussion participation, 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 | Total |
|--------------|---------------|
| Grade | 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 **Friday noon** before the Monday class meeting.

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:

"Accommodations are collaborative efforts between students, faculty and Services for Students with Disabilities (SSD). Students with accommodations approved through SSD are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through SSD should contact SSD immediately at 737-4098."

Statement of Expectations for Student Conduct

Please see the OSU Student Conduct website:

<https://studentlife.oregonstate.edu/studentconduct>

| Schedule | Topic (lecture) | Readings | Presenter |
|---------------------------------|---|---|-----------|
| March 29 | Class overview, Introductions, Trophic Cascades, Ripple#1 | Lafferty Ripple et al. 2016 | |
| April 5 | Predators in the web of life Dr. Luke Painter | Suraci et al. 2016 Ford et al. 2014 | _____ |
| April 12 | Trophic Cascades, Ripple #2 | Le Roux et al. 2018 | _____ |
| April 19 <u>Proposal due</u> | Wolves-elk-plants-streams Dr. Bob Beschta | Beschta & Ripple 2012 | _____ |
| April 26 | Trophic Cascades film #1 | Carpenter et al. 2010 Hebblewhite et al. 2005 | _____ |
| May 3 | Trophic Cascades, Ripple #3 | Schultz et al. 2016 | _____ |
| May 10 | Large Carnivore Conservation Dr. Chris Wolf | Myers et al. 2007 Knight et al. 2005 | _____ |
| May 17 | Trophic Cascades film #2 | Ritchie & Johnson 2009 Murray Berger et al. 2008 | _____ |
| May 24 <u>papers due</u> | Zion ecosystem dynamics Ripple #4 | Estes et al. 2011 | _____ |
| May 31 | Memorial day (no class) | | |

Required Readings-- Pdf's at <http://trophiccascades.forestry.oregonstate.edu/trophic-cascades-reading>

Beschta, R.L. and Ripple, W.J., 2012. The role of large predators in maintaining riparian plant communities and river morphology. *Geomorphology*, 157, pp.88-98.

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

Ford, A.T., Goheen, J.R., Otieno, T.O., Bidner, L., Isbell, L.A., Palmer, T.M., Ward, D., Woodroffe, R. and Pringle, R.M., 2014. Large carnivores make savanna tree communities less thorny. *Science*, 346(6207), pp.346-349.

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.

Knight, T.M., McCoy, M.W., Chase, J.M., McCoy, K.A. and Holt, R.D., 2005. Trophic cascades across ecosystems. *Nature*, 437(7060), p.880.

Lafferty, Kevin. Writing a scientific paper, step by painful step. University of California, Santa Barbara

Le Roux, E., Kerley, G.I. and Cromsigt, J.P., 2018. Megaherbivores modify trophic cascades triggered by fear of predation in an African savanna ecosystem. *Current Biology*, 28(15), pp.2493-2499.

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., Schmitz, O.J., Constant, V., Kaylor, M.J., Lenz, A., Motley, J.L., Self, K.E., Taylor, D.S. and Wolf, C., 2016. What is a Trophic Cascade? *Trends in Ecology & Evolution*, 31(11), pp.842-849.

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

Schultz, J.A., Cloutier, R.N. and Côté, I.M., 2016. Evidence for a trophic cascade on rocky reefs following sea star mass mortality in British Columbia. *PeerJ*, 4, p.e1980.

Suraci, J.P., Clinchy, M., Dill, L.M., Roberts, D. and Zanette, L.Y., 2016. Fear of large carnivores causes a trophic cascade. *Nature communications*, 7(1), pp.1-7.

Optional Reading

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.

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.

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