

**Conservation Biology**  
FW 8452, Fall 2016, 3 credits  
Tuesday and Thursday 8:45 – 10:00  
Skok Hall 100

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**Course Description:**

Conservation biology is a mission-oriented science that focuses on how to protect and restore biological diversity. In this course, we will study the ecological concepts constituting the scientific basis for biological conservation, from genetics to species to ecosystems. However, since most of the threats to biodiversity originate from human actions, understanding human behavior and the social, political and economic systems in which people act is an essential component for those interested in conserving biodiversity. In turn, understanding how conservation can affect human well-being through provision of ecosystem services is also an important component of modern conservation biology. We will study ideas and methods from both the biological and social sciences relevant for biological conservation.

**Course Goals:**

The overall goal for this course is to provide you with an introduction to the current biological, ecological, economic, social, and policy underpinnings of conservation biology and the application of these principles to conservation challenges.

By taking this course, you will:

- Develop understanding of the fundamental biological/ecological principles underlying conservation biology;
- Develop understanding of the fundamental principles underlying economic, political, and social systems that affect the conservation of biological diversity and in turn are affected by conservation;
- Develop an understanding of the interdisciplinary challenges of implementing conservation practices;
- Develop an appreciation for the diverse perspectives regarding conservation among conservation practitioners, scientists, decision-makers, and the public at large.

**Course Outline:**

After spending a session introducing conservation themes using the book *Encounters with the Archdruid* by science writer John McPhee, we will spend four weeks covering some of the core biological concepts important for understanding the conservation of biological diversity, moving from the genetic level, up through populations and species, to ecosystems. For the next three weeks we cover some of the core economic, political, and social concepts important for understanding both the drivers of threats to biodiversity and potential policy responses to conserve biodiversity. Following these two core sections, we will apply natural and social science methods to address approaches to biodiversity conservation including conservation planning, protected areas, ecosystem management, provision of ecosystem services, and ecosystem restoration. Following Thanksgiving Break, we will spend one week on climate change and conservation, and one week of student led sessions on conservation frontiers: emerging issues, cutting edge tools and methods. The last day of class we will provide a summary of major themes, lessons learned, and emerging issues.

**Class Format:**

Class material is presented through a combination of lecture and discussion in two 75-minute class periods per week, with each class period typically structured around 1-2 reading assignments, which everyone is expected to read before class. Electronic copies of readings are available on the UMN Moodle web site ([www.moodle.umn.edu](http://www.moodle.umn.edu)).

**Recommended books:**

Most readings in the course will be journal articles that we will make available on the Moodle web site and there is no assigned textbook. Depending upon your background you may find the following books helpful as references on particular topics:

Groom, M.J., G.K. Meffe, and C. R. Carroll. 2006. *Principles of Conservation Biology* (3<sup>rd</sup> Edition). Sinauer Associates.

Kareiva, P. and M. Marvier. 2014. *Conservation Science: Balancing the Needs of People and Nature*. Roberts and Company Publishers.

Sodhi, N.S. and P.R. Ehrlich (eds.). *Conservation Biology For All*. Oxford University Press.

Hunter, M.L. Jr. and J.P. Gibbs. 2006. *Fundamentals of Conservation Biology*, 3<sup>rd</sup> Edition. Wiley-Blackwell.

Borgerhoff Mulder, M. and P. Coppolillo. 2005. *Conservation: Linking Ecology, Economics, and Culture*. Princeton University Press.

Groves, C.R. and E.T. Game. 2016. *Conservation Planning: Informed Decisions for a Healthier Planet*. Roberts and Company.

Fisher, B., R. Naidoo, and T. Ricketts. 2014. *A Field Guide to Economics for Conservationists*. Roberts and Company.

Goodstein, E. and S. Polasky. 2014. *Economics and the Environment* (7<sup>th</sup> edition). Wiley.

**Attendance:** Because this course depends on in-class participation, attendance at all schedule class meetings is expected. Please contact us in advance if you must miss a class session.

**Grades:** The grades in this course will be based on the following:

<b>Component of Grade</b>	<b>%</b>
ASSIGNMENTS (10% each)	40
TAKE-HOME EXAM	30
DISCUSSION LEADER	10
CLASS SESSION	10
CLASS PARTICIPATION	10
<b>Total Points</b>	<b>100</b>

Incompletes will only be assigned in the case of extraordinary circumstances arising late in the semester that prevent normal completion of course requirements. If you enroll with S/N grading, you must complete all course requirements and earn a C- or better to receive a grade of S (Satisfactory).

**Assignments:** There are four major assignments in this course. In general you will be given one week to complete them. Assignments will be submitted to the instructor via email following the specific instructions provided in class (also posted on Moodle).

**Take-home Exam:**

There will be one take-home exam that will be completed outside of class. This exam will be available on November 22 and due December 1. The purpose of the exam is to allow you to demonstrate your understanding of course material.

**Discussion Leader:**

You will be asked to lead class discussion(s) 2 times during the semester. You may want to prepare some study guide questions for the class, to help everyone prepare for the discussion. You may choose how much to emphasize the suggested readings or may, in consultation with instructors, choose alternate readings to those indicated in the syllabus. Course guides and alternate readings must be available at the start of the class session prior to the discussion. We will grade this course component as: 1=you did not effectively prepare and lead the discussion; 2=the session generated an adequate level of discussion, as a result of your leadership; 3=you effectively prepared students and led the session, resulting in an excellent discussion of key ideas in the readings.

**Class session:**

During the last section of the course, students will form groups to develop presentations on conservation issues. It is up to the group to decide what issues to emphasize, cover, or ignore. Each group will be responsible for organizing one class period including assigning readings. The group can decide how to divide class time between lecture and discussion of relevant articles. Or your group might decide to create a video or podcast. Be creative! You will have the opportunity to evaluate the participation of your group members for their final grades.

**Class participation:**

Class participation will be assessed over the course of the semester and participation grades will be assigned based on your contributions to discussions in class. We will grade participation as 1=poor if you rarely ask questions or participate in discussions, 2=good if you ask questions and participate in discussion, 3=excellent if you ask questions and bring an informed perspective to class discussion frequently providing insights or unique perspectives. The thoughtfulness of comments matters more than the volume of comments in class participation.

**This course follows all University of Minnesota policies.** Details are available, as follows. Let us know if you have questions—we are happy to discuss specifics with you.

Credit & workload expectations	<a href="http://policy.umn.edu/education/studentwork">http://policy.umn.edu/education/studentwork</a>
Grading	<a href="http://policy.umn.edu/education/gradingtranscripts">http://policy.umn.edu/education/gradingtranscripts</a>
Student Conduct/Academic Dishonesty	<a href="http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf">http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf</a>
Class Absences	<a href="http://policy.umn.edu/education/makeupwork">http://policy.umn.edu/education/makeupwork</a>
Disability Accommodations	<a href="https://diversity.umn.edu/disability/?q=accommodations">https://diversity.umn.edu/disability/?q=accommodations</a>

## **Student Mental Health and Stress Management**

Mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. University of Minnesota services are available to assist you with addressing these and other concerns you may be experiencing. More information on confidential mental health services available on campus is available: <http://www.mentalhealth.umn.edu/>.

## **Readings**

### **Introduction to Conservation Biology**

Tuesday September 6 – Contrasting views of conservation (Polasky)

McPhee, J. 1971. *Encounters with the Archdruid*. Farrar, Straus and Giroux.

### **I. Biological Concepts for Sustaining Populations**

Thursday September 8 – What is biodiversity? (Galatowitsch)

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, J. Kent. 2000. Biodiversity hot spots for conservation priorities. *Nature* 403: 853-858.

Bickford, D. et al. 2007. Cryptic species as a window on diversity and conservation. *Trends in Ecology and Evolution* 22: 148-155.

Marris, E. Linnaeus at 300. 2007. The species and the specious. *Nature* 446: 250-253.

Tuesday September 13 – Genetic diversity (Galatowitsch) Guest: Ken Kozak

Frankham, R. 2010. Challenges and opportunities of genetic approaches to biological conservation. *Biological Conservation* 143: 1919-1927.

Shafer, A. et al. 2015. Genomics and the challenging translation into conservation practice. *Trends in Ecology and Evolution* 30: 78-87.

Thursday September 15 – Assessing threats to biodiversity (Galatowitsch)

Assignment 1—Due Thursday September 22

Papworth et al. Evidence for shifting baseline syndrome conservation. *Conservation Letters* 2: 93-100.

Mace G. et al. 2008. Quantification of extinction risk: IUCN's system for classifying threatened species. *Conservation Biology* 22: 1424-1442

Wake, D. and V. Vredenburg. 2008. Are we in the midst of the sixth mass extinction? A view from the world of amphibians. *Proceedings of the National Academy of Sciences* 105: 11466-11473.

Tuesday September 20 – Conservation challenges for long-distant migrants (Galatowitsch) Guest: Holly Holt

Thursday September 22 – Assessing the viability of small populations (Galatowitsch)

Flather, C. et al. 2011. Minimum viable populations: is there a ‘magic number’ for conservation practitioners? *Trends in Ecology and Evolution* 26: 307-316.

Zabel et al. 2006. The interplay between climate variability and density dependence in the population viability of Chinook salmon. *Conservation Biology* 20: 190-200.

Robinson, O.J., J.L. Lockwood, O.C. Stringham, and N.H. Fefferman. 2015. A novel tool for making policy recommendations based on PVA: helping theory become practice. *Conservation Letters* 8: 190-198

Tuesday September 27 – Conservation challenges for sustaining metapopulations (Galatowitsch)

Metapopulation simulation

Harrison, S. 1991. Local extinction in a metapopulation context: an empirical evaluation. *Biological Journal of the Linnean Society* 42: 73-88.

Johansson et al. 2013. Epiphytic metapopulation persistence after drastic habitat decline and low tree regeneration: time-lags and effects of conservation actions. *Journal of Applied Ecology* 50: 414-422.

Thursday September 29 – Establishing new populations (Galatowitsch)

Meek, M. et al. 2015. Fear of failure in conservation: the problem and potential solutions to add conservation of extremely small populations. *Biological Conservation* 184: 209-217.

Armstrong, D.P. and P.J. Seddon. 2007. Directions in reintroduction biology. *Trends in Ecology and Evolution* 23: 20-25.

Perez, I, J.D., M. Diaz, G.G. Nicola, J.L. Tella, and A. Gimenez. 2012. What is wrong with current translocations? A review and a decision-making proposal. *Frontiers in Ecology and the Environment* 10: 494-501.

## **II. Economic, Political and Social Concepts to Understand Drivers of Biodiversity Loss and Potential Policy Responses to Conserve Biodiversity**

Tuesday October 4 – Conservation in a crowded world: Understanding direct and indirect drivers of biodiversity loss (Polasky)

Millennium Ecosystem Assessment. 2005. Summary for policy-makers. *Ecosystems and Human Well-being: Synthesis*. Island Press.

Thursday October 6 – Economics 101: How markets function (Polasky)

Polasky, S. 2013. Conservation economics. Sections 1, 2, 4 A-C.

Heal, G. 2001. Basic economics. Chapter 2 in *Nature and the Marketplace: Capturing the Value of Ecosystem Services*. Island Press

Tuesday October 11 – Valuing the environment (Polasky)

Polasky, S. 2013. Conservation economics. Section 3.

Fisher, B., R. Naidoo, and T. Ricketts. 2014. Valuing the environment. Chapter 5 in *A Field Guide to Economics for Conservationists*. Roberts and Company.

-or-

Heal, G. 2001. Valuation. Chapter 7 in *Nature and the Marketplace: Capturing the Value of Ecosystem Services*. Island Press.

Thursday October 13 – Market failure and policy: externalities, public goods, and common property resources (Polasky)

Assignment 2 – Due Thursday October 20

Polasky, S. 2013. Conservation economics. Section 4 D-E.

Fisher, B., R. Naidoo, and T. Ricketts. 2014. Institutions: Capturing and securing the value of nature. Chapter 6 in *A Field Guide to Economics for Conservationists*. Roberts and Company.

-or-

Heal, G. 2001. Policies and institutions. Chapter 8 in *Nature and the Marketplace: Capturing the Value of Ecosystem Services*. Island Press.

Tuesday October 18 – Overcoming the tragedy of the commons and the role of governance (Polasky)

Hardin, G. 1968. The tragedy of the commons. *Science* 162: 1243-48.

Dietz, T., E. Ostrom, and P.C. Stern. 2003. The struggle to govern the commons. *Science* 302: 1907-1912.

Thursday October 20 – Participatory processes Guest speaker: Kristen Nelson

Rauschmayer, F. and H. Wittmer. 2006. Evaluating deliberative and analytical methods for the resolution of environmental conflicts. *Land Use Policy* 23:108-122.

Bingham, L. B., T. Nabachi, and R. O’Leary. 2005. The new governance: Practices and processes for stakeholder and citizen participation in the work of government. *Public Administration Review* 65(5): 547-558.

De Vente, J., M.S. Reed, L.C. Stringer, S. Valente and J. Newig. 2016. How does the context and design of participatory decision making processes affect their outcomes? Evidence from sustainable land management in global drylands. *Ecology and Society* 21(2): 24.

### **III. Approaches to Conservation: Protected Areas, Conservation Planning, Ecosystem Services, and Ecosystem Restoration**

Tuesday October 25 – Protected areas (Galatowitsch)

Laurence, W.F., D.C. Useche, J. Rendeiro, M. Kalka, C.J. Bradshaw et al. 2012. Averting biodiversity collapse in tropical protected areas. *Nature* 489: 290-294.

Fuller, R. et al. 2010. Replacing underperforming protected areas achieves better conservation outcomes. *Nature* 466: 365-367.

Thursday October 27 – Protected areas (Galatowitsch) Guest—Anup Joshi

Case: Assessment of proposed rail and road alignments through Chitwan National Park  
Assignment 3 - Due Thursday November 3

Coetzee BWT, Gaston KJ, Chown SL (2014) Local Scale Comparisons of Biodiversity as a Test for Global Protected Area Ecological Performance: A Meta-Analysis. *PLoS ONE* 9(8): e105824. doi:10.1371/journal.pone.0105824

Tuesday November 1 – Conservation planning (Galatowitsch)

Margules, C. and R. Pressey. 2000. Systematic conservation planning. *Nature* 405: 243-253.

Thursday November 3 – Conservation planning (Polasky)

Ando, A., J. Camm, S. Polasky and A. Solow. 1998. Species distributions, land values, and efficient conservation. *Science* 279: 2126-2128.

Polasky, S., E. Nelson, J. Camm, B. Csuti, P. Fackler, E. Lonsdorf, C. Montgomery, D. White, J. Arthur, B. Garber-Yonts, R. Haight, J. Kagan, A. Starfield, and C. Tobalske. 2008. Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biological Conservation* 141(6): 1505-1524.

Tuesday November 8 – Ecosystem services (Polasky)

Assignment 4 – Due Tuesday November 15

Fisher, Naidoo & Ricketts. 2014. Ecosystem services: The economic-ecological sandwich  
Chapter 4 in *A Field Guide to Economics for Conservationists*. Roberts and Company.

Goulder, L.H. and D. Kennedy. 1997. Valuing ecological services: philosophical bases and empirical methods. In *Nature's Services: Societal Dependence on Natural Ecosystems*, G. Daily (ed.). Island Press.

McCauley, D. 2006. Selling out on nature. *Nature* 443: 27-28.

Thursday November 10 – Ecosystem services (Polasky)

Nelson, E., G. Mendoza, J. Regetz, S. Polasky, H. Tallis, D.R. Cameron, K.M.A. Chan, G. Daily, J. Goldstein, P. Kareiva, E. Lonsdorf, R. Naidoo, T.H. Ricketts and M. R. Shaw. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7(1): 4–11.

Polasky, S., E. Nelson, D. Pennington, and K. Johnson. 2011. The impact of land-use change on ecosystem services, biodiversity and returns to landowners: a case study in the State of Minnesota. *Environmental and Resource Economics* 48(2): 219-242.

Tuesday November 15 – Restoration as a conservation strategy (Galatowitsch)

Perring, M. et al. 2015. Advances in restoration ecology: rising to the challenges of the coming decades. *Ecosphere* 6: 1-25.

Suding et al. 2015. Committing to ecological restoration. *Science* 348: 638-640.

Thursday November 17 – Resilience assessments for restoration (Galatowitsch)

Suding, K et al. 2004. Alternative stable states and positive feedbacks in restoration ecology. *Trends in Ecology and Evolution* 19: 46-53.

Tuesday November 22 – Uncertainty, resilience, and adaptive management (Galatowitsch and Polasky)

Ludwig, D. et al. 1993. Uncertainty, resource exploitation, and conservation: lessons from history. *Science* 260: 17, 36.

Folke, C. 2006. Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change* 16(3): 253-267.

Polasky, S., S. Carpenter, C. Folke and B. Keeler. 2011. Decision-making under great uncertainty: environmental management in an era of global change. *Trends in Ecology & Evolution* 26(8): 398-404.

Optional: Lee, K. N. 1999. Appraising adaptive management. *Conservation Ecology* 3(2): 3.

Thursday, November 24 – Thanksgiving – No Class

#### **IV. Frontiers in conservation science: Climate change and emerging issues**

Tuesday November 29 – Climate change and conservation (Polasky)

Bellard, C., C. Bertelsmeier, P. Leadley, W. Thuiller, and F. Courchamp. 2012. Impacts of climate change on the future of biodiversity. *Ecology Letters* 15: 365–377.

Thomas, C.D., A. Cameron, R.E. Green, M. Bakkenes, L.J. Beaumont, Y.C. Collingham, B.F.N. Erasmus, M. Ferreira de Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A.S. van Jaarsveld, G.F. Midgley, L. Miles, M.A. Ortega-Huerta, A.T. Peterson, O.L. Phillips, and S.E. Williams. 2004. Extinction risk from climate change. *Nature* 427: 145–148.



Lawler, J.J., T.H. Tear, C. Pyke, M.R. Shaw, P. Gonzalez, P. Kareiva, L. Hansen, L Hannah, A. Aldous, C Beinz, and S. Pearsall. 2010. Resource management in a changing and uncertain climate. *Frontiers in Ecology and the Environment* 8(1): 35-43.

Thursday, December 1 – Frontiers of conservation science: emerging issues, cutting edge tools and methods (Student Session)

Tuesday, December 6 – Frontiers of conservation science: emerging issues, cutting edge tools and methods (Student Session)

Thursday December 8 – Climate change and assisted migration Guest Speaker: Jessica Hellman

Straudinger, M. D., S. L. Carter, M. S. Cross, N. S. Dubois, J. M. Duffy, C. Enquist, R. Griffis, J. J. Hellmann, J. J. Lawler, J. O’Leary, S. A. Morrison, L. Sneddon, B. A. Stein, L. M. Thompson, and W. Turner. 2013. Biodiversity in a changing climate: a synthesis of current and projected trends in the US. *Frontiers in Ecology and the Environment* 11: 465-473.

Schwartz, M., J. Hellmann, J. McLachlan, D. Sax, J. Borevitz, J. Brennan, A. Camacho, G. Ceballos, J. Rappaport Clark, H. Doremus, R. Early, J. Etterson, D. Fielder, J. Gill, P. Gonzalez, N. Green, L. Hannah, D. Jamieson, D. Javeline, B. Minter, J. Odenbaugh, S. Polasky, D. Richardson, T. Root, and H. Safford. 2012. Managed relocation: integrating the scientific, regulatory and ethical challenges. *BioScience* 62: 732-743.

Hellmann, J. J., V. J. Meretsky, and J. S. McLachlan. 2011. Strategies for conserving biodiversity under a changing climate. Pages 363-288 In: Hannah, L., ed. *Saving a Million Species: Extinction Risk from Climate Change*. Island Press, Washington, DC.

Tuesday, December 13 – Course Wrap Up and Discussion (Galatowitsch and Polasky)