Conservation Biology

Course Objectives: The goal of this course is for students to develop a basic understanding in conservation biology with an emphasis on global change biology. In this course, we will cover topics such as biodiversity, ecosystem services, habitat fragmentation, human-wildlife interactions, anthropogenic climate change, and how to communicate climate change and conservation to the public. It is said that humans are currently experiencing an environmental crisis; that we have initiated a new geological era – the Holocene; that we are in the midst of a sixth extinction. The aim of this course is to train students on proper conservation techniques and understandings. We will meet every Monday and Wednesday from 11:30a - 1:00p.

Resources:

- Kareiva, P., Marvier, M., & Silliman, B. *Effective Conservation Science: Data not Dogma*. 2018. Oxford University Press, Oxford, UK. (ECS)
- Van Dyke, F. *Conservation Biology: Foundations, Concepts, Application*. 2008. Springer Science+Business Media, New York, NY. (CB) (**There are many copies available at the library.**)

Additional Reading: Additional primary literature articles will be available for students on the website and are listed in the '*Reading*' column of the schedule below. Full citations are also listed.

Schedule:

Class	Topic	Reading
M: 10 Sept	History of Conservation	**CB (1-26)** & Ludwig *et al.* (1993)
W: 12 Sept	Biodiversity Defined	**CB (83-117)** & Myers *et al.* (2000) & Monastersky (2014)
M: 17 Sept	Measuring Diversity	Gotelli & Colwell (2001) & Sakschewski *et al.* (2016)
W: 19 Sept	Stability and Resilience	Lehman & Tilman (2000) & Isbell *et al.* (2015)
M: 24 Sept	Extinction	Barnosky *et al.* (2015) & Berger *et al.* (2001) & Doughty *et al.* (2015) & *Bringing them back to life* (Zimmer, 2013)
W: 26 Sept	Genetic Diversity	**CB: 153-181** & Daru *et al.* (2017) & DeSalle & Amato (2004)
M: 1 Oct	Populations & Baselines	**CB: 213-240** & Pinnegar & Engelhard (2007)
W: 2 Oct	Habitat Fragmentation	**CB: 279-309** & Tewksbury *et al.* (2002) & Fischer & Lindenmayer (2007)
M: 8 Oct	Restoration & Rehabilitation	Ruiz-Jaen & Aide (2005) & Kaiser-Bunbury *et al.* (2017) & Hiers *et al.* (2016)
W: 10 Oct	Natural Restoration & Fire	Cromsigt & te Beest (2014) & Donaldson *et al.* (2017) & Pellegrini *et al.* (2017)
M: 15 Oct	Ecosystem Services	Dee *et al.* (2017) & **ECS: 19-24** & Worm *et al.* (2006)
W: 17 Oct	Conservation Economics	Forum (2010) & **CB: 383-411** & Costanza *et al.* (1997)
M: 22 Oct	Conservation Management	**CB:349-378** & **ECS: 58-63**
W: 24 Oct	Ethics	**CB: 29-53** & Cohen (2014)
M: 29 Oct	Anthropogenic Climate Change	**CB:121-150** & Runting *et al.* (2016) & Bonachela *et al.* (2015)
W: 31 Oct	Climate Change: Phenology	Parmesan & Yohe (2003) & Pau *et al.* (2011) & Edwards & Richardson (2004)
M: 5 Nov	Climate Change: Range Shifts	Chen *et al.* (2011) & Parmesan *et al.* (1999)
W: 7 Nov	Invasive Species Debate	Wolkovich *et al.* (2014) & **ECS: 39-44** & McLACHLAN *et al.* (2007)

Class	Topic	Reading
M: 12 Nov	Human-Wildlife Interactions	Blom *et al.* (2010) & Zimmerman *et al.* & Ogra & Badola (2008)
W: 14 Nov	Objectivity in Conservation	**ECS: 1-15** & Marvier *et al.* (2016)
M & W: 19 & 21 Nov	Thanksgiving Break!	
M: 26 Nov	Food Systems & Agriculture	**ECS: 73-79** & **ECS: 104-109** & Tscharntke *et al.* (2012)
W: 28 Nov	Plant-Pollinator Interactions	Genung *et al.* (2017) & Marvier *et al.* (2016)
M: 3 Dec	Citizen Science & the Public	**CB: 415-440** & Wiggins & Crowston (2011)
W: 5 Dec	Communicating Conservation	Knowlton (2017) & Webb (2005) & *Uninhabitable Earth* (Wallace-Wells, 2017)

Grading Rubric:

Type	Percent of Grade
Participation & Discussion	25
Midterm	30
Final Exam and Project	45

References

Barnosky, A.D., Lindsey, E.L., Villavicencio, N.A., Bostelmann, E., Hadly, E.A., Wanket, J. & Marshall, C.R. (2015) Variable impact of late-quaternary megafaunal extinction in causing ecological state shifts in north and south america. *Proceedings of the National Academy of Sciences* **113**, 856–861.

Berger, J., Stacey, P., Bellis, L. & Johnson, M. (2001) A mammalian predator-prey imbalance: grizzly bear and wolf extinction affect avian neotropical migrants. *Ecological Applications* **11**, 947–960.

Blom, B., Sunderland, T. & Murdiyarso, D. (2010) Getting redd to work locally: lessons learned from integrated conservation and development projects. *Environmental Science & Policy* **13**, 164–172.

Bonachela, J., Pringle, R., Sheffer, E., Coverdale, T., Guyton, J., Caylor, K., Levin, S. & Tarnita, C. (2015) Termite mounds can increase the robustness of dryland ecosystems to climatic change. *Science* **347**, 651–655.

Chen, I., Hill, J., Ohlemuller, R., Roy, D. & Thomas, C. (2011) Rapid range shifts of species associated with high levels of climate warming. *Science* **333**, 1024–1026.

Cohen, S. (2014) The ethics of de-extinction. *NanoEthics* **8**, 165–178.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neil, R., Paruelo, J., Raskin, R., Sutton, P. & van den Belt, M. (1997) The value of the world's ecosystem services and natural capital. *Nature* **387**, 253–260.

Cromsigt, J. & te Beest, M. (2014) Restoration of a megaherbivore: landscape-level impacts of white rhinoceros in kruger national park, south africa. *Journal of Ecology* **102**, 566–575.

Daru, B., Elliot, T., Park, D. & Davies, T. (2017) Understanding the processes underpinning patterns of phylogenetic regionalization. *Trends in Ecology and Evolution* **32**, 845–860.

Dee, L.E., De Lara, M., Costello, C. & Gaines, S.D. (2017) To what extent can ecosystem services motivate protecting biodiversity? *Ecology Letters* **20**, 935–946.

DeSalle, R. & Amato, G. (2004) The expansion of conservation genetics. *Nature Reviews Genetics* **5**, 702–712.

Donaldson, J.E., Archibald, S., Govender, N., Pollard, D., Luhdo, Z. & Parr, C.L. (2017) Ecological engineering through fire-herbivory feedbacks drives the formation of savanna grazing lawns. *Journal of Applied Ecology* **55**, 225–235.

Doughty, C.E., Roman, J., Faurby, S., Wolf, A., Haque, A., Bakker, E.S., Malhi, Y., Dunning, J.B. & Svenning, J.C. (2015) Global nutrient transport in a world of giants. *Proceedings of the National Academy of Sciences* **113**, 868–873.

Edwards, M. & Richardson, A. (2004) Impact of climate change on marine phenology and trophic mismatch. *Nature* **430**, 881–884.

Fischer, J. & Lindenmayer, D. (2007) Landscape modification and habitat fragmentation: a synthesis. *Global Ecology and Biogeography* **16**, 265–280.

Forum, W.E. (2010) Biodiversity and business risk. Tech. rep.

Genung, M., Fox, J., Williams, N., Kremen, C., Ascher, J., Gibbs, J. & Winfree, R. (2017) The relative importance of pollinator abundance and species richness for the temporal variance of pollination services. *Ecology* **98**, 1807–1816.

Gotelli, N. & Colwell, R. (2001) Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecology Letters* **4**, 379–391.

Hiers, J., Jackson, S., Hobbs, R., Bernhardt, E. & Valentine, L. (2016) The precision problem in conservation and restoration. *Trends in Ecology and Evolution* **31**, 820–830.

Isbell, F., Craven, D., Connolly, J., Loreau, M., Schmid, B., Beierkuhnlein, C., Bezemer, T.M., Bonin, C., Bruelheide, H., de Luca, E. & et al. (2015) Biodiversity increases the resistance of ecosystem productivity to climate extremes. *Nature* **526**, 574–577.

Kaiser-Bunbury, C.N., Mougal, J., Whittington, A.E., Valentin, T., Gabriel, R., Olesen, J.M. & Blüthgen, N. (2017) Ecosystem restoration strengthens pollination network resilience and function. *Nature* **542**, 223–227.

Knowlton, N. (2017) Doom and gloom won't save the world. *Nature* **544**, 271.

Lehman, C. & Tilman, D. (2000) Biodiversity, stability, and productivity in competitive communities. *The American Naturalist* **156**, 534–552.

Ludwig, D., Hilborn, R. & Waters, C. (1993) Uncertainty, Resource Exploitation, and Conservation: Lessons from History. *Science* **260**, 17+36.

Marvier, M., Kareiva, P. & Fuller, E. (2016) Mark plummer's legacy: Leave no orthodoxy unquestioned. *Coastal Management* **44**, 1–17.

McLACHLAN, J.S., HELLMANN, J.J. & SCHWARTZ, M.W. (2007) A framework for debate of assisted migration in an era of climate change. *Conservation Biology* **21**, 297–302.

Monastersky, M. (2014) Life - a status report. *Nature* **516**, 159–162.

Myers, N., Mittermeier, R., Mittemeier, C., da Fonseca, G. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* **403**, 853–858.

Ogra, M. & Badola, R. (2008) Compensating human–wildlife conflict in protected area communities: Ground-level perspectives from uttarakhand, india. *Human Ecology* **36**, 717–729.

Parmesan, C., Ryrholm, N., Stefanescu, C., Hill, J., Thomas, C., Descimon, H., Huntley, B., Kaila, L., Kullberg, J., Tammaru, T., Tennett, W., Thomas, J. & Warren, M. (1999) Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature* **399**, 579–583.

Parmesan, C. & Yohe, G. (2003) A globally coherent fingerprint of climate change impacts across natural systems. *Nature* **421**, 37–42.

Pau, S., Wolkovich, E.M., Cook, B.I., Davies, T.J., Kraft, N.J.B., Bolmgren, K., Betancourt, J.L. & Cleland, E.E. (2011) Predicting phenology by integrating ecology, evolution and climate science. *Global Change Biology* **17**, 3633–3643.

Pellegrini, A.F.A., Ahlström, A., Hobbie, S.E., Reich, P.B., Nieradzik, L.P., Staver, A.C., Scharenbroch, B.C., Jumpponen, A., Anderegg, W.R.L., Randerson, J.T. & et al. (2017) Fire frequency drives decadal changes in soil carbon and nitrogen and ecosystem productivity. *Nature* .

Pinnegar, J.K. & Engelhard, G.H. (2007) The "shifting baseline" phenomenon: a global perspective. *Reviews in Fish Biology and Fisheries* **18**, 1–16.

Ruiz-Jaen, M. & Aide, T. (2005) Restoration success: how is it being measured? *Restoration Ecology* **13**, 569–577.

Runting, R.K., Bryan, B.A., Dee, L.E., Maseyk, F.J.F., Mandle, L., Hamel, P., Wilson, K.A., Yetka, K., Possingham, H.P. & Rhodes, J.R. (2016) Incorporating climate change into ecosystem service assessments and decisions: a review. *Global Change Biology* **23**, 28–41.

Sakschewski, B., von Bloh, W., Boit, A., Poorter, L., Peña-Claros, M., Heinke, J., Joshi, J. & Thonicke, K. (2016) Resilience of amazon forests emerges from plant trait diversity. *Nature Climate Change* **6**, 1032–1036.

Tewksbury, J.J., Levey, D.J., Haddad, N.M., Sargent, S., Orrock, J.L., Weldon, A., Danielson, B.J., Brinkerhoff, J., Damschen, E.I. & Townsend, P. (2002) Corridors affect plants, animals, and their interactions in fragmented landscapes. *Proceedings of the National Academy of Sciences* **99**, 12923–12926.

Tscharntke, T., Clough, Y., Wanger, T.C., Jackson, L., Motzke, I., Perfecto, I., Vandermeer, J. & Whitbread, A. (2012) Global food security, biodiversity conservation and the future of agricultural intensification. *Biological Conservation* **151**, 53–59.

Wallace-Wells, D. (2017) Uninhabitable earth. *New York Magazine* .

Webb, C. (2005) Engineering hope. *Conservation Biology* **19**, 275–277.

Wiggins, A. & Crowston, K. (2011) From conservation to crowdsourcing: a typology of citizen science.

Wolkovich, E.M., Cook, B.I., McLauchlan, K.K. & Davies, T.J. (2014) Temporal ecology in the anthropocene. *Ecology Letters* **17**, 1365–1379.

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

Zimmer, C. (2013) Bringing them back to life.

Zimmerman, B., Peres, C., Malcolm, J. & Turner, T. (????) Conservation and development alliances with the kayapo of south-eastern amazonia, a tropical forest indigeous people .