Readings & Questions 2017

Below you will find required readings and study questions for each topic. Note that these will be finalized approximately two weeks before the date of each presentation.

Questions and readings that have NOT been finalized have red text color. Black text color indicates that the questions/readings are final.

Class meets Tuesdays from 12-3 in Mackay Science room 227.

September 5

BEHAVIORAL ECOLOGY

Vladimir Pravosudov

Trivers, R. L. (1974). Parent-offspring conflict. American zoologist, 14(1), 249-264.

Zahavi, A. (1975). Mate selection—a selection for a handicap. Journal of theoretical Biology, 53(1), 205-214.

Davis, J. M., & Stamps, J. A. (2004). The effect of natal experience on habitat preferences. Trends in Ecology & Evolution, 19(8), 411-416.

❙ The study of development has often been ignored in the field of Behavioral Ecology. Explain how a developmental perspective can profitably inform our understanding of behavioral ecology and evolution.

❙ If you have never been exposed to the ideas in the 1974 paper by Robert Trivers ("Parent-offspring conflict"), then it should have affected how you think about children and parents. Specifically, how is that paper relevant to our understanding of a baby crying for its mother?

❙ Explain the perspective on communication between the sexes provided by the 1975 paper by Amotz Zahavi (“Mate selection -- a selection for a handicap”).

❙ Explain Tinbergen's four questions, and their utility for studying behavior. Should they always be addressed separately? If so, why? If not, why not?

DIVERSITY & NEUTRAL MODELS

Lee Dyer

Chave, J. (2004). Neutral theory and community ecology. Ecology letters, 7(3), 241-253.

Kraft, N.J., Comita, L.S., Chase, J.M., Sanders, N.J., Swenson, N.G., Crist, T.O., Stegen, J.C., Vellend, M., Boyle, B., Anderson, M.J. and Cornell, H.V., 2011. Disentangling the drivers of β diversity along latitudinal and elevational gradients. Science, 333(6050), pp.1755-1758.

Recommended but not required:
Schemske, D. W., Mittelbach, G. G., Cornell, H. V., Sobel, J. M., & Roy, K. (2009). Is there a latitudinal gradient in the importance of biotic interactions?. Annu. Rev. Ecol. Evol. Syst., 40, 245-269.

❙ Two part question about diversity. First, what is diversity? And, second, explain the basic issues or challenges associated with measuring diversity. In answer to the second part, mention at least a couple of the most commonly-used indices of diversity.

❙ Does the catalog of hypotheses relating to the latitudinal gradient in diversity reflect (a) our general ignorance and the fact that we have a lot more work to do; (b) the plurality of causes affecting the origins of diversity; or (c) both? Defend your choice and mention specific hypotheses for the latitudinal diversity gradient in your answer.

❙ With respect to a specific lineage of organisms, defend an hypothesis or combination of hypotheses explaining global patterns of diversity. Be specific about why a particular hypothesis (or hypotheses) is supported or rejected for the group of organisms you choose.

❙ The Unified Neutral Theory of Biodiversity is generally considered to be one of the biggest advances in biodiversity science in recent decades, but the idea of neutrality in community structure has also inspired fierce debate. In some cases, participants in the debate have given the impression that you either believe in neutral theory or you believe that species have real niche differences. Explain why this is a false dichotomy.

September 12

DISEASES OF WILD POPULATIONS (12-1pm)

Jamie Voyles

Keesing, F., Holt, R. D., & Ostfeld, R. S. (2006). Effects of species diversity on disease risk. Ecology Letters, 9(4), 485-498

Young, H. S., Dirzo, R., Helgen, K. M., McCauley, D. J., Billeter, S. A., Kosoy, M. Y., ... & Dittmar, K. (2014). Declines in large wildlife increase landscape-level prevalence of rodent-borne disease in Africa. Proceedings of the National Academy of Sciences, 111(19), 7036-7041.

❙ The Dilution Effect is an appealing hypothesis, but it is also a highly controversial topic in the fields of disease ecology and epidemiology. What are some critical characteristics of hosts, parasites and vectors that would be key for a dilution effect to occur in a disease system?

❙ Imagine a scenario in which high biodiversity could lead to an outcome that is opposite to the Dilution Effect (i.e., an amplification effect) and describe the conditions when this might occur.

SPECIALIZATION & NICHE DYNAMICS (1-2pm)

Matt Forister

Leiby, N., & Marx, C. J. (2014). Metabolic erosion primarily through mutation accumulation, and not tradeoffs, drives limited evolution of substrate specificity in Escherichia coli. PLoS biology, 12(2), e1001789.

Poisot, T., Bever, J. D., Nemri, A., Thrall, P. H., & Hochberg, M. E. (2011). A conceptual framework for the evolution of ecological specialisation. Ecology Letters, 14(9), 841-851.

Konuma, J., Sota, T., & Chiba, S. (2013). A maladaptive intermediate form: a strong trade-off revealed by hybrids between two forms of a snail-feeding beetle. Ecology, 94(11), 2638-2644.

❙ A trade-off in performance across habitats is perhaps the most intuitive explanation for ecological specialization. With reference to whatever kind of specialization you like (diet breadth, environmental tolerances, etc.) describe the evidence that trade-offs (antagonistic pleiotropy) either are or not important for specialization in a particular group of organisms (birds, spiders, whatever).

❙ Consider species A that eats food type 1 and species B that eats food type 2. To paraphrase the classic review of ecological specialization by Futuyma and Moreno (1988), a reciprocal rearing experiment that finds that A and B both die when reared on the other resource probably tells us more about the consequences rather than the causes of specialization. Explain that statement, and describe an experiment that should be done instead, to better understand the causes of specialization.

❙ Many authors have pointed out that the history of research in specialization has been too focused on the physiology and performance of individual organisms, often under laboratory conditions, while ignoring the complexity of interactions in the wild. Considering the community context (competitors, enemies, mutualists, primary producers etc.), describe at least three distinct hypotheses to explain the evolution and persistence of specialized phenotypes.

❙ Two part question on the macroevolution of specialization: (1) What is the evidence that specialization either is or is not an evolutionary “dead end”? (2) What is the macroevolutionary relationship between diversification and specialization? Neither of these are settled issues, and for both you should explain both what is currently known (from the literature) and explain your opinion (i.e. how do you think the issue might eventually be settled, pending lots more studies of course).

September 19

POPULATION ECOLOGY (12-1pm)

Kevin Shoemaker

Turchin, P. (2001). Does population ecology have general laws?. Oikos, 94(1), 17-26.

Hanski, I. (1998). Metapopulation dynamics. Nature, 396(6706), 41-49.

Recommended but not required:

Sibly, R. M., Barker, D., Denham, M. C., Hone, J., & Pagel, M. (2005). On the regulation of populations of mammals, birds, fish, and insects. Science, 309(5734), 607-610.

Griffith, A. B., Salguero-Gómez, R., Merow, C., & McMahon, S. (2016). Demography beyond the population. Journal of Ecology, 104(2), 271-280.

❙ Ecologists have been thinking about fluctuations in populations for at least one hundred years. Given that span of time, what do you make of the fact that we are still teaching and discussing some very simple models (like the Lotka-Volterra predator-prey model) that were first created pretty early on in that history?

❙ How can populations be regulated without density-dependent mechanisms? Can you think of real-world populations that might be regulated in this manner? Can density-dependent population regulation be considered a fundamental law of nature?

❙ Given the diversity of mechanisms that can lead to population cycles, can we make any broad generalizations about population cycles in nature? Can you think of some reasons why some populations of the same species might exhibit cyclic abundance dynamics while other populations do not?

❙ With respect to metapopulations, there are skeptics that say that the theory is not useful because "real" metapopulations don't exist. Critique this position, and describe at least one example of a metapopulation from the literature that was not discussed in class.

❙ In a recent paper, Griffith et al (2016) state that “population-level processes are an ideal common currency within ecology and evolution”. Explain why you either agree or disagree with this statement?

POPULATION GENETICS (1-2pm)

Marjorie Matocq

Wang, I. J., & Bradburd, G. S. (2014). Isolation by environment. Molecular Ecology, 23(23), 5649-5662.

Marko, P. B., & Hart, M. W. (2011). The complex analytical landscape of gene flow inference. Trends in ecology & evolution, 26(9), 448-456.

❙ How have population biologists measured genetic differentiation within and among populations and what can we infer (or not) about evolutionary processes from commonly-used metrics?

❙ Think of a particular species that you are familiar with. Based on the ecology and perhaps biogeographic/evolutionary history of the species, what predictions can you make about factors which are likely to be most important in determining the distribution of genetic variation in the system?

❙ Whether we talk about a small number of microsatellites or a large number of SNPs, it is very unusual to find a wild system (population or species) without any genetic variation. Why is that and what maintains genetic variation?

September 26

MATHEMATICAL MODELS FOR EECB (12-1pm)

Paul Hurtado

Ellner, S. P., & Guckenheimer, J. (2011). Dynamic models in biology. Princeton University Press. Chapter 1 (Ch. 9 also recommended but not required).

Waddington, C. H. (1968). Towards a theoretical biology. Nature, 218(5141), 525-527.

Recommended but not required:

Chowell, G., Viboud, C., Simonsen, L., Merler, S., & Vespignani, A. (2017). Perspectives on model forecasts of the 2014–2015 Ebola epidemic in West Africa: lessons and the way forward. BMC medicine, 15(1), 42.

- What are some of the foundational mathematical models in ecology and evolutionary biology? For one of these models, discuss its purpose (e.g., what does it seek to explain?) and key mechanistic or phenomenological assumptions (including simplifying

assumptions). Is this model still useful today, or has the field advanced beyond it (or a little of both)?

- A key step in any statistical analysis is to check that the assumptions associated with your statistical model are not being egregiously violated. Discuss 2 or 3 approaches (e.g., statistical tests, graphical tools, etc.) for diagnosing possible violations of key assumptions. For each diagnostic method, discuss which assumptions they help check, and (if a violation were detected) how you might try to correct the problem.

- There has been recent controversy over p-values, including a rare statement by the American Statistical Association on their proper (and improper) use. Please discuss the proper and improper use of p-values within a broader discussion of other methods for model selection and hypothesis testing (e.g., Akaike's Information Criterion and related quantities).

LANDSCAPE ECOLOGY (1-2pm)

Peter Weisberg

Turner, Monica G. 2005. Landscape ecology: what is the state of the science? Ann. Rev. Ecol. Evol. Syst. 36: 319 – 344.

Serra-Diaz, J.M., R.M. Scheller, A.D. Syphard and J. Franklin. 2015. Disturbance and climate refugia mediate tree range shifts during climate change. Landscape Ecology 30: 1039-1053.

Recommended but not required:
Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. Annu. Rev. Ecol. Evol. Syst. 34: 487-515.

Recommended but not required:
Wiens, J.A. 1989. Spatial scaling in ecology. Functional Ecology 3: 385-397.

❙ Landscape ecology is often characterized by its focus on spatial heterogeneity, and particularly on the reciprocal relationship between landscape pattern (e.g., resource mosaic; forest age structure) and ecological process (e.g., animal movement; disturbance propagation). In her review paper describing the state of progress in the discipline, Monica Turner notes that "…the relationship between processes that create patterns and the patterns themselves still is not readily apparent." Interpret this deceptively simple statement; why is this issue an important one? How can this problem be addressed?

❙ Landscape ecologists study several kinds of fluxes, including (but not limited to) flows of genes, movements of animals, the rate and pattern of plant invasions, spread of disturbance agents, and the transfer and cycling of nutrients, energy and matter across heterogeneous landscapes. Does it seem to you that the same kinds of tools and concepts can be used (or are being used) to study these different kinds of fluxes? Or are there key differences? Please provide specific examples.

❙ How can our understanding of landscape heterogeneity be made functional, as opposed to merely structural?

❙ How might species range shifts associated with climate change be affected by landscape heterogeneity? How might such shifts also be affected by climate-disturbance interactions? Is it therefore necessary to use dynamic, ecological simulation models to forecast species range shifts, or is it sufficient to use predictions from statistical models (e.g. Maxent, Random Forest)? Justify your response to this question.

October 3

SOIL ECOLOGY (12-1pm)

Ben Sullivan

Vitousek, P. M., & Reiners, W. A. (1975). Ecosystem succession and nutrient retention: a hypothesis. BioScience, 25(6), 376-381.

McGill, W. B., & Cole, C. V. (1981). Comparative aspects of cycling of organic C, N, S and P through soil organic matter. Geoderma, 26(4), 267-286.

Recommended but not required:

Wieder, W. R., Bonan, G. B., & Allison, S. D. (2013). Global soil carbon projections are improved by modelling microbial processes. Nature Climate Change, 3(10), 909-912.

❙ Design an experiment to test how soil nutrient availability changes in response to a major disturbance event. What might this experiment be able to tell you about whether this ecosystem is at steady state?

❙ How would the theories outlined by McGill and Cole cause you to expect to see (and not expect to see) successional change in the soil microbial community as nutrient availability changes over the course of ecosystem development?

❙ Including microbial biomass and microbial growth efficiency may improve the ability of an Earth system model to predict carbon stocks and fluxes, but these coarse estimates fail to account for the tremendous variation of the microbiome. Please describe both why and why not explicitly including soil microbial community structure or functional groups would further improve Earth system model-development efforts?

MICROBIAL ECOLOGY (1-2pm)

David Vuono

Pace, N. R. (2009). Mapping the tree of life: progress and prospects. Microbiology and Molecular Biology Reviews, 73(4), 565-576.

Thompson, J. R., Pacocha, S., Pharino, C., Klepac-Ceraj, V., Hunt, D. E., Benoit, J., ... & Polz, M. F. (2005). Genotypic diversity within a natural coastal bacterioplankton population. Science, 307(5713), 1311-1313.

Recommended but not required:

Pepe-Ranney, C., Campbell, A. N., Koechli, C. N., Berthrong, S., & Buckley, D. H. (2016). Unearthing the ecology of soil microorganisms using a high resolution DNA-SIP approach to explore cellulose and xylose metabolism in soil. Frontiers in microbiology, 7.

- Molecular phylogenetics has helped to pave the path forward for microbial ecology, why? What are the limitations of microbial community survey studies based on rRNA gene sequences from the environment? What factors need to be taken into account when interpreting these data?
- What role does the "rare' biosphere play in maintaining microbial diversity in environmental samples?
- In Thompson et al, why was the 16S rRNA gene not able to resolve the tremendous amount of microdiversity with populations of Vibrio splendidus? Despite the <1% divergence of the 16S sequences from the strains isolated, how were the authors able to define these populations as ecologically differentiated groups and why is this important in the context of microbial ecology?
- Microbiologist traditionally needed to isolate and grow microorganisms in the lab in order to understand an organisms potential role in the environment. How can traditional microbiology approaches (i.e., culture dependent techniques) be used in parallel with modern DNA and RNA sequencing to better understand the wealth of diversity, both taxonomic and functional, in the environment?

October 10

ECOIMMUNOLOGY (12-1pm)

Angela Smilanich

Schulenburg, H., Kurtz, J., Moret, Y., & Siva-Jothy, M. T. (2009). Introduction. ecological immunology. Philosophical Transactions of the Royal Society of London B: Biological Sciences, 364(1513), 3-14

Pamminger, T., Treanor, D., & Hughes, W. O. (2016, January). Pleiotropic effects of juvenile hormone in ant queens and the escape from the reproduction–immunocompetence trade-off. In Proc. R. Soc. B (Vol. 283, No. 1822, p. 20152409). The Royal Society.

❙ Trade-offs in life-history traits are a large part of the literature in ecological immunology. What does it mean to have a trade-off? What sort of trade-offs would you expect to occur between immunity and life-history traits? How would you demonstrate that such a trade-off exists?

❙ Understanding the causes of variation in the immune response is an important component of ecological immunology. First, explain why understanding factors leading to variation in a trait is important, then describe at least two possible ecological factors that could cause variation in the immune response.

APPLIED EVOLUTION (1-2pm)

Beth Leger

Schoener, T. W. (2011). The newest synthesis: understanding the interplay of evolutionary and ecological dynamics. science, 331(6016), 426-429.

Oduor, A. M. (2013). Evolutionary responses of native plant species to invasive plants: a review. New Phytologist, 200(4), 986-992.

❙ How is natural selection measured in the wild? and describe some examples of recent evolutionary change that have been documented.

❙ Why is the idea of a historical reference community central to the intellectual content of biological restoration? What do you think about the "novel ecosystem" concept: helpful new way to look at restoration, or muddying the waters with imprecise terminology?

❙ What does the idea of evolutionary potential mean in the context of restoration?

October 17

COMMUNITY ECOLOGY (12-1pm)

Beth Pringle

Vellend, M. 2016. Chapter 3: A brief history of ideas in community ecology. pp 20-35 in The Theory of Ecological Communities, Princeton University Press: Princeton.

Gotelli, N. J., G.R. Graves, C. Rahbek. 2010. Macroecological signals of species interactions in the Danish avifauna. PNAS 107: 5030-5035

Recommended but not required:
Sandel, B. 2015. Towards a taxonomy of spatial scale-dependence. Ecography 38: 358-369.

❙ Clements described an ecological community as an integrative whole, a superorganism. Gleason declared that communities could not be defined because species overlap is merely coincidental—species end up where they do independently of all others. Vellend says that ecologists currently define a community as "a set of species in sometimes arbitrary units of space." How to define a community has remained a central dilemma in the field of ecology. How do you think a community is best defined? Explain your reasoning and why you think your definition will be useful to the field moving forward.

❙ In the Gotelli et al. 2010 paper, they report that biotic interactions, including Allee effects within species and competition between species, may affect species distributions at regional spatial scales. With reference to any system you like, describe how another species interaction (e.g., mutualism, parasitism, predation, herbivory, etc.) may produce patterns that "scale up" in space well beyond the spatial scale of the community or territory of any particular individual.

PHYSIOLOGICAL ECOLOGY (1-2pm)

Jack Hayes

Huey, R. B., Kearney, M. R., Krockenberger, A., Holtum, J. A., Jess, M., & Williams, S. E. (2012). Predicting organismal vulnerability to climate warming: roles of behaviour, physiology and adaptation. Phil. Trans. R. Soc. B, 367(1596), 1665-1679.

Kearney, M., & Porter, W. (2009). Mechanistic niche modelling: combining physiological and spatial data to predict species' ranges. Ecology letters, 12(4), 334-350.

❙ A fundamental goal in physiological ecology has been to establish mechanistic connections between physiological traits and fitness. In your opinion, have we already learned what we need to know (more or less), or should that remain an important goal moving forward? Be specific with respect to areas of ecology and evolutionary biology for which that physiology and fitness connection is (or has been) most important.

❙ A distinction can be made between statistical and physiological (or mechanistic) approaches to niche modeling. What is the distinction? and why might the two approaches produce very different results? Illustrate with a real example from the literature.

❙ Explain what type I, type 2, and type 3 statistical errors are. Which of these types of statistical errors do you think is the most important to avoid or minimize?

October 24

PHENOTYPIC PLASTICITY (noon to 1pm)

Jenny Ouyang

Pigliucci M. 2005. Evolution of phenotypic plasticity: where are we going now? Trends in Ecology & Evolution, 20, 481-486.

Pigliucci M. "Phenotypic Plasticity." In. Evolution: The Extended Synthesis. Eds. Pigliucci and Mueller. 2010. Massachusetts Institute of Technology Press. pgs 355-378.

Charmantier A, Mccleery RH, Cole LR, Perrins C, Kruuk LEB, Sheldon BC (2008) Adaptive phenotypic plasticity in response to climate change in a wild bird population. Science, 320, 800-803.

If interested in the topic of modern evolution, highly recommend the following two books:

Pigliucci, M. & Mueller, G.B. Evolution The Extended Synthesis. 2010. Massachusetts Institute of Technology Press.

West-Eberhard MJ. 2003. Developmental Plasticity and Evolution. New York: Oxford University Press.

If interested in the topic of mechanisms of plasticity, highly recommend:

Badyaev AV 2005. Stress-induced variation in evolution: From behaviour plasticity to genetic assimilation. Proceedings of the Royal Society B 272: 877-886.

❙ What is a reaction norm? How do we quantify plasticity? What is the difference between phenotypic and genetic accomodation? What are possible mechanisms of plasticity?

❙ What is the role of plasticity in niche construction and speciation?

❙ Can there be selection on plasticity? How? Which ecological conditions would favor stabilizing or directional selection on reaction norms? How would you test which life-history traits would respond to such selection pressures?

CHEMICAL ECOLOGY (1 to 2pm)

Lora Robinson

Salazar, D., Jaramillo, A. & Marquis, R. J. 2016. The impact of plant chemical diversity on plant–herbivore interactions at the community level. Oecologia 181, 1199-1208

Raguso, R. A. et al. The raison d'être of chemical ecology. 2015. Ecology 96, 617-630

❙ Explain the potential trade-offs between an organisms investment in producing primary metabolites and secondary metabolites. How can changes in the abiotic and biotic conditions affect these trade-offs?

❙ Why do organisms produce a diverse array of secondary metabolites? How does chemical diversity contribute to species diversity?

October 31

SPECIES & SPECIATION (12-1pm)

Matt Forister

Orr, H. A., & Presgraves, D. C. (2000). Speciation by postzygotic isolation: forces, genes and molecules. BioEssays, 22(12), 1085-1094.

Rabosky, D.L. (2016). Reproductive isolation and the causes of speciation rate variation in nature. Biological Journal of the Linnean Society, 118(1), pp.13-25.

Recommended but not required:

Mallet, J. (2008). Hybridization, ecological races and the nature of species: empirical evidence for the ease of speciation. Philosophical Transactions of the Royal Society of London B: Biological Sciences, 363(1506), 2971-2986.

Feder, J. L., Flaxman, S. M., Egan, S. P., Comeault, A. A., & Nosil, P. (2013). Geographic mode of speciation and genomic divergence. Annual Review of Ecology, Evolution, and Systematics, 44, 73-97.

❙ Explain the following terms and ideas that have been important in the history of speciation research: 1) the Dobzhansky-Muller model of speciation, 2) reinforcement, 3) Haldane's rule.

❙ The history of research into speciation has moved from a focus on the geography of speciation (allopatry, parapatry and sympatry) to a focus on the ecology of speciation. Define "ecological speciation" and explain the shift in emphasis from the previous geographical framework.

❙ Consider the following proposition: "The real controversy with respect to 'species' is not about the definition of species, the real issue is whether or not you believe species are entities that can be characterized by differences that are biologically more important than differences among other levels of organization and diversification, such as differences among individuals, populations or communities." Explain your own position regarding the priority or importance of species as a unit of study.

PALAEOECOLOGY (1-2pm)

Scott Mensing and Adam Csank

Mensing, S. A., Tunno, I., Sagnotti, L., Florindo, F., Noble, P., Archer, C., ... & Piovesan, G. (2015). 2700 years of Mediterranean environmental change in central Italy: a synthesis of sedimentary and cultural records to interpret past impacts of climate on society. Quaternary Science Reviews, 116, 72-94.

Roberts, N. (2013). The Holocene: an environmental history. John Wiley & Sons. Ch. 2.

Recommended but not required:

Flower, Aquila; Gavin, Daniel G.; Heyerdahl, Emily K.; Parsons, Russell A.; and Cohn, Gregory M., "Western Spruce Budworm Outbreaks Did Not Increase Fire Risk over the Last Three Centuries: A Dendrochronological Analysis of Inter-Disturbance Synergism" (2014). Environmental Studies. 26. http://cedar.wwu.edu/envs_facpubs/26

❙ Considering the ecosystem or organisms that you work on in your own research, how might the environment of your system or organism have been different during the Little Ice Age? Middle Holocene? Late Pleistocene? How might this past history be reflected in the modern populations/distribution patterns/communities that you find today?

❙ If you were to add a paleoecological component to your analysis, what tools would be best suited to answer your questions? What temporal resolution of analysis would you need? What evidence would you need to collect? Explain your reasoning.

November 7

PHILOSOPHY OF BIOLOGY (12-1pm)

Carlos Mariscal

What is a Species?
Ereshefsky, M. (1992). Eliminative pluralism. Philosophy of Science, 59(4), 671-690.
Optional: Mishler, B. D., & Brandon, R. N. (1987). Individuality, pluralism, and the phylogenetic species concept. Biology and Philosophy, 2(4), 397-414.

The Extended Evolutionary Synthesis
Laland, K., Wray, G. A., & Hoekstra, H. E. (2014). Does evolutionary theory need a rethink?. Nature, 514(7521), 161.
Optional: Laland, K. N., Uller, T., Feldman, M. W., Sterelny, K., Müller, G. B., Moczek, A., ... & Odling-Smee, J. (2015, August). The extended evolutionary synthesis: its structure, assumptions and predictions. In Proc. R. Soc. B (Vol. 282, No. 1813, p. 20151019). The Royal Society.
Optional: Booth, A., Mariscal, C., & Doolittle, W. F. (2016). The modern synthesis in the light of microbial genomics. Annual review of microbiology, 70, 279-297.

Understanding Function in DNA
Graur, D., Zheng, Y., Price, N., Azevedo, R. B., Zufall, R. A., & Elhaik, E. (2013). On the immortality of television sets:"function" in the human genome according to the evolution-free gospel of ENCODE. Genome biology and evolution, 5(3), 578-590.
Optional: Doolittle, W. F., Brunet, T. D., Linquist, S., & Gregory, T. R. (2014). Distinguishing between "function" and "effect" in genome biology. Genome biology and evolution, 6(5), 1234-1237.
Optional: Graur, D., Zheng, Y., & Azevedo, R. B. (2015). An evolutionary classification of genomic function. Genome biology and evolution, 7(3), 642-645.

❙ Should we expect species concepts to be consistent across the tree of life? What impact might this sort of thinking have? For example, with respect to the units of evolution, understanding biological theory, or the politics of species conservation.

❙ Advocates of the EES view it as theoretically on par with the Modern Synthesis. Is there anything important the EES account leaves out? Is there anything trivial it includes? Is the EES necessary, important, irrelevant, or harmful to contemporary biological thinking?

❙ What is the difference between selected effect and causal role functions? Are they exhaustive of all options? Are they exclusive? How are they relevant to biology?

GENOMIC VARIATION AND ARCHITECTURE (1-2pm)

Tom Parchman

Ellegren, H., Smeds, L., Burri, R., Olason, P. I., Backström, N., Kawakami, T., ... & Uebbing, S. (2012). The genomic landscape of species divergence in Ficedula flycatchers. Nature, 491(7426), 756-760.

Chapter 2 from: Lynch, M., & Walsh, B. (2007). The origins of genome architecture (Vol. 98). Sunderland: Sinauer Associates. *(PDF will be made available)*

Recommended but not required:
Kawakami, T., Smeds, L., Backström, N., Husby, A., Qvarnström, A., Mugal, C. F., ... & Ellegren, H. (2014). A high-density linkage map enables a second-generation collared flycatcher genome assembly and reveals the patterns of avian recombination rate variation and chromosomal evolution. Molecular ecology, 23(16), 4035-4058.

❙ Years ago, non-coding DNA was thought to represent “junk”. Now we know that is not the case. What are some of the functions of non-coding DNA, and what are some of the consequences of non-coding DNA that does not have an apparent function?

❙ Recombination rates vary across the genome, across species, and across populations. What are some evolutionary consequences of variation in recombination rate? How does this relate to the idea of ‘divergence’ islands mentioned in the Ellegren et al. 2012 paper?

❙ What is the population genetic mechanism(s) that Lynch argues best explain genome size expansion?

November 14

COMPARATIVE GENOMICS AND GENE EVOLUTION (12 -1pm)

David Alvarez-Ponce

Cork, J. M., & Purugganan, M. D. (2004). The evolution of molecular genetic pathways and networks. Bioessays, 26(5), 479-484.

Alvarez-Ponce, D., & McInerney, J. O. (2011). The human genome retains relics of its prokaryotic ancestry: human genes of archaebacterial and eubacterial origin exhibit remarkable differences. Genome biology and evolution, 3, 782-790.

❙ Can you find any parallels or areas of overlap between the study of genetic networks and the study of ecological networks (food webs)? Put another way, are there any questions that might be pursued in both areas using similar approaches and techniques.

❙ Evolutionary biologists have often conceptualized selection and drift acting on genes in isolation, i.e. abstracted from the genomic context in which they interact with other genes. How do you see our understanding of evolution being affected by a knowledge of the structure and function of genetic networks?

ECOLOGICAL AND EVOLUTIONARY EPIGENETICS (1-2pm)

David Zeh

Bonilla MM, Zeh JA, Zeh DW. 2016. An epigenetic resolution of the lek paradox. BioEssays 38, 355-366.

Zeh DW, Zeh JA, Ishida Y. 2009. Transposable elements and an epigenetic basis for punctuated equilibria. Bioessays, 31, 715-726.

Recommended but not required:

Klironomos FD, Berg J, Collins S. 2013. How epigenetic mutations can affect genetic evolution: Model and mechanism. BioEssays 35, 571-578.

❙ Explain why the classic view of the co-adapted genome is an incomplete representation of eukaryotic genomes, using the human genome as an example.

❙ What is the Lek Paradox and how might discoveries in epigenetics help resolve this paradox?

❙ The parasite hypothesis views transposable elements as genomic parasites that replicate within the host genome purely in their own interests, even at the cost of reducing host fitness. By contrast, the helpful transposon hypothesis argues that transposons enhance host evolvability by elevating the rate of large-scale alterations of the genome. Which hypothesis is correct? Explain your answer.

❙ How might transgenerational epigenetic effects be important for organisms adapting to new environments or responding to changing biotic and abiotic conditions (including toxins in the environment)?

❙ Discuss the evidence from comparative genomics that the domestication of retrotransposon genes and DNA transposon sequences has been critical in the origin and elaboration of the mammalian placenta and the physiology of pregnancy. Explain how the transposon-driven origin of the placenta differs from conventional view of live birth as an adaptation to enhance maternal fitness.

[NEW QUESTIONS FROM DAVID ZEH:]

❙ *What is the difference between intergenerational and transgenerational epigenetic effects? Can intergenerational epigenetic effects have evolutionary implications?*

❙ *Ecologists and evolutionary biologists typically view epigenetic mechanisms as facilitators of adaptive phenotypic plasticity and accelerated evolutionary response. By contrast, biomedical researchers often focus on the negative fitness consequences of environmentally-induced epigenetic disruption. Can both views be correct? Which view is more accurate? Why did epigenetic mechanisms evolve and how might this insight address the question of whether epigenetic effects are adaptive or maladaptive?*

❙ *According to Zeh et al.'s (2009) epi-transposon hypothesis, physiological stress shifts the balance of power in favor of parasitic sequences in their struggle with the epigenetic defense mechanisms of the host genome. How is this significant for Sewall Wright's shifting balance theory, Stuart Kauffman's complexity catastrophe hypothesis, and punctuated equilibria?*

November 21

ECOSYSTEM MANAGEMENT AND FAITH BASED CONSERVATION

Sudeep Chandra

Strongly recommended:

Biodiversity, Scientists, and Religious Communities: Conservation Through Collaboration (AAAS news article)

Schaefer, J. (2017). New Hope for the Oceans: Engaging Faith-Based Communities in Marine Conservation. Frontiers in Marine Science, 4, 62.

Bhagwat, S., & Palmer, M. (2009). Conservation: the world's religions can help. Nature, 461(7260), 37-37.

Additional recommended reading:

Rolston III, H. (2010). Saving Creation: Faith Shaping Environmental Policy. Harv. L. & Pol'y Rev., 4, 121.

Preamble to study question: Ecologists employ scientific approaches (populations modeling, habitat conservation models, etc.) to conserve ecosystems and biodiversity. Yet there continues to be larger scale, global environmental degradation, due to local (e.g. habitat loss, invasive species introductions), regional, and global disturbances (e.g. climate change, atmospheric pollution). In the last decades, an emerged field of combining conservation science studies with partnerships with religious and faith organization has emerged to facilitate environmental conservation efforts. Some researchers and scholars in policy and social science suggest these partnerships are required to make significant and meaningful change that lends itself to conservation.

❙ Pick one of the dominant religions from eastern and western world, compare and contrast the environmental philosophies of these two religions and how they may contribute to conserving a natural resource. What are the limitations of using a faith based approach to developing natural resource conservation plans?

PHYLOGENETICS

Guy Hoelzer

Degnan, J. H., & Rosenberg, N. A. (2009). Gene tree discordance, phylogenetic inference and the multispecies coalescent. Trends in ecology & evolution, 24(6), 332-340.

Felsenstein, J. (1988). Phylogenies from molecular sequences: inference and reliability. Annual review of genetics, 22(1), 521-565.

Optional:
Huelsenbeck, J. P., & Rannala, B. (1997). Phylogenetic methods come of age: testing hypotheses in an evolutionary context. Science, 276(5310), 227-232.

❙ Compare and contrast taxonomy with phylogeny. Considering the ambiguity in some phylogenetic relationships caused by lineage sorting of ancestral polymorphisms and hybridization, discuss ways you think evolutionary taxonomies could reflect discordant associations among taxa for different genomic loci. You should ignore homoplasy and other sources of error in phylogenetic inferences in your answer.

❙ Discuss the advantages and disadvantages of model-based approaches to phylogenetics, such as Maximum Likelihood and Bayesian methods, with non-model-based approaches, such as Cladistics based on the Maximum Parsimony criterion. Under what conditions would you choose to assume or avoid assuming a detailed model of the evolutionary process in your phylogenetic analysis? Consider using a variety of data sources (e.g., DNA sequences, amino acid sequences, morphology, …) in your answer.

November 28

GLOBAL CHANGE AND CONSERVATION (12-1pm)

Ken Nussear

Araújo, M. B., & New, M. (2007). Ensemble forecasting of species distributions. Trends in ecology & evolution, 22(1), 42-47.

Kearney, M. (2006). Habitat, environment and niche: what are we modelling?. Oikos, 115(1), 186-191.

Buckley, L. B., Urban, M. C., Angilletta, M. J., Crozier, L. G., Rissler, L. J., & Sears, M. W. (2010). Can mechanism inform species' distribution models?. Ecology letters, 13(8), 1041-1054.

❙ Given the uncertainty involved in species distribution modeling how can we use these models to inform conservation efforts now and into the future?

❙ Do mechanistic (vs. correlative) "niche" models provide better distribution models since they are based on real limiting interactions of a species and environmental limitations?

❙ What does it mean for an ecological relationship to be "mechanistic" versus "correlative"? How would you justify (or test experimentally) that a putative "mechanistic" relationship of environment and performance (e.g., sprint speed as a function of ambient temperature) is not just a correlation?

❙ Each of the statistical relationships for mechanical for both mechanical and correlational variables that are used to define habitat or niche relationships imparts error into the modeling process. Should mechanistic model error be accounted for differently than that of correlational models? How would one best account for these sources of error?
