Evolutionary Ecology - PCB 4673
Fall 2018 Syllabus & Schedule

Your instructor: John Cozza
Contact: jcozza@fiu.edu (not by Canvas; include "BOTANY" in subject line)
Office hours in OE 216: **Mon 5-6+; Tues 11-12, 2-3 & 5-6+; Weds 2-3 & 5-6+** (*but not the evenings of 9/5, 10/3, and 11/7*) and **Fri 5-6+**; or by appt. Office phone: 305-348-4932

Lecture and discussion time (crucial and required): MWF 4:00 – 4:50 pm
Room: 120 Ziff Education Building

Introduction:
We will explore the interface of ecology and evolution: how the interactions of organisms with each other and with their environment shape their change over time, and how that change in turn modifies the interactions. Some of the most basic and yet most elusive questions in biology—why are there so many kinds of organisms, how do they co-exist, what is the advantage of sex, what drives the birth and death of species—will be among our topics. We will employ active and interactive learning, and you will develop skills in interpreting and communicating scientific concepts.

Prerequisites: PCB 3043 (Ecology) and PCB 3063 (Genetics)

Biology major distribution area: Ecology

Required materials:
1) **Text:** Mayhew, Peter 2006. *Discovering Evolutionary Ecology*. Oxford University Press.
2) Selections from the scientific literature and other sources, to be posted on Canvas.
3) **i-clicker** (*device only*—not the app; earlier models OK), available at the bookstore.

Individual & group learning objectives: By the end of the course, you will be able to

- Review relevant concepts from ecology and genetics, add new information, and apply to hypotheses about evolutionary ecology.
- Read a scholarly book, and from it identify, explain, and discuss advanced concepts in evolutionary ecology; work with colleagues to clarify difficulties for all.
- Interpret, apply, evaluate, and synthesize results from the scientific literature, verbally and in writing—both individually and cooperatively in groups.
- Select a relevant scientific paper, present its main results clearly, and discuss with colleagues. Formulate and ask clarifying questions about colleagues' presentations.

Structure of the course:
We will usually cover one chapter in Mayhew each week. A typical schedule would be:

- Monday we discuss the new chapter—so you must ***read it before class!***
- Wednesday we discuss related papers or do an interactive activity, with some activities spanning two classes. For most discussions or activities, you will complete a 1-3 page individual or group **written assignment (6 total)** due in 1-2 weeks, as shown on the schedule. Assignments must be handed in as a hard copy and also submitted digitally to turnitin.com. ***You must attend class prepared, and actively participate*** to get

credit for the assignment. Assignments will vary; we will discuss in advance what is expected for each one.

- Friday and some other days (starting Week 5) is our **Evolutionary Ecology Journal Club**, where we share the results of relevant papers. For your presentation, you will prepare a single Powerpoint slide about a result from a recent paper, present it to the class (5 min), and lead a short discussion (3 min). Most of you will work with a partner, but you may choose to work alone. The paper you select may be on any aspect of evolutionary ecology, but it must include *results of primary research*. This will give us all a rich and varied view of the new and exciting research in the field!

  Please show me (or send me the citation for) your paper one week before you will present it. Plan to arrive early on the day you are presenting *to load your slide onto the classroom computer.*

- There will be **two midterm exams and a cumulative final**. Half of the final will cover the new material since exam 2, and the other half will be cumulative. Exams will be all scantron Qs, and will test your grasp of the concepts and your ability to synthesize and apply them. *If you miss an exam* for a serious and urgent reason (medical emergency, death in the immediate family, jury or military duty, etc.) you must *officially document* it and let me know ASAP. If you miss a midterm and document it, the final exam grade would also become the make-up grade for the missed midterm. If you miss the final and document it, you would receive an IN grade, and then you must take a written (essay questions) make-up exam in the spring semester.
- We will use **clickers** to enable active learning, gauge your understanding, and stimulate discussion. Clicker questions might appear *in any class meeting*.

Grading splits:

Midterm exams (2@ 15%)	30%
Final exam:	20%
Written assignments (6 @ 5.8%)	35%
Journal Club slide & presentation	10%
Journal Club attendance & participation	5%
Extra credit (clickers)	up to 5% extra

Clicker extra credit will be calculated as follows. You will get 1 raw clicker point for participating in each question, and 1 additional point if you answer it correctly. At the end, your raw point total will be scaled to a maximum of 5% extra credit, with the highest total in the class scaling to the full 5%.

Grade scale: A = 93-100%, A− = 90-92%, B+ = 87-89%, B = 83-86%, B− = 80-82%, C+ = 77-79%, C = 70-76%, D = 60-69, F = 0-59%.

A grade of "C" or better is required to earn credit in the biology major. Grades are rounded up or down to the nearest 1%. There will be no curving, and no unearned points will be added to anyone's grade. The only extra credit available will be that earned by using your clicker, or by participating in and writing about selected enrichment activities announced in class.

How to use turn-it-in:

Turn-it-in is a tool to help you make sure that all of your written work is original. Consider each highlight on the "originality report" that turn-it-in provides. If it's coincidental (something anyone could say, e.g. "hypotheses for the evolution of sex") then it's OK. But if it's the specific wording of your author or website, or another student, then you have to remove it. And you can't just change a few words—turn-it-in will still detect this—you must completely rewrite the highlighted sentence(s) in your own words. *If in doubt—rewrite! The best way to avoid plagiarism is simply not to have the source in front of you (or up on the screen) while you are writing! And you can never cut-and-paste an author's text into your document--ever!*

Honor policies:

As scientists and scholars, we hold ourselves to the highest standards of integrity. The FIU honor policy will apply fully to our work in this class. Any *cheating* on exams or *plagiarism* on written work will result in a grade of F for the assignment and, if warranted, the course. *Signing someone else's name* on a class attendance sheet or poll will result in loss of participation points for both people. Using *more than one clicker* will result in temporary confiscation of both clickers, and permanent loss of clicker points for the owner and perpetrator. All course materials are for your use only—do not share, post, or sell (it's stealing). *Serious dishonor or cheating* will result in academic misconduct charges.

As a progressive learning community, we respect and protect the civil rights of everyone, regardless of gender, race, ethnicity, culture, place of origin, or disability.

Academic misconduct definitions and procedures are detailed at: http://integrity.fiu.edu/misconducts.html, and in the FIU Student Handbook.

FIU's student code of conduct, and policies on discrimination and sexual harassment, are available at: http://regulations.fiu.edu/regulation.

Accommodations for disabilities are arranged through the Disability Resources Center. See: http://studentaffairs.fiu.edu/get-support/disability-resource-center/index.php.

General expectations and how to succeed:

- **Read and outline the text and assigned papers** thoughtfully, *before* the relevant class. The material is challenging-- you will need to read much of it more than once!
- **Attend every class** and *actively* participate in discussions, interactive questions, and activities. Studies show that active, social engagement with the material produces meaningful, enduring learning.
- **Ask questions**; ask for clarification. There are no stupid questions!
- **Help your neighbor** and contribute to the group. If you help each other, everyone will do better including you!
- **Review concepts** ASAP after class, using the book and other resources.
- **Come to office hours** with any questions you are still unsure about.
- **Read all course emails** and announcements on Canvas! You are responsible for all information in them, as well as anything announced or posted in class.
- **Take care of yourself**: Eat well, drink water, sleep, exercise, go outside!

Week	Date	Topic or graded activity/discussion	Reading due
1	20 Aug 22 24	Course information and introduction What is evolutionary ecology? Forming hypotheses in evolutionary ecology	 Mayhew ch. 1 Fox 2014
2	27 29 31	Major evolutionary transitions Major evolutionary transitions continued 1) Discussion: How did sex originate?	Mayhew ch. 2 8/27: drop/add 8/28: $$ due Hurst 2016, Lenski 1999, Otto 2008, Scudallari 2014, Zimmer 2009
3	3 Sept 5 7	*Labor Day holiday—no class* How did sex originate? continued (due 9/17) *+ How to do Journal Club & example* Major ecological transitions	 *Find, read, bring, and discuss a relevant paper on sex evolution.* Mayhew ch. 3
4	10 12 14	Climate change discussion *Sign up for JC by today* Life history evolution 2) Discussion: suicidal trees (due 9/24)	AAS 2010, Gillis 2015 Mayhew ch. 4 Poorter 2005, J Read 2008
5	17 19 21	Sex allocation Sex change discussion Journal club (#1-5)	Mayhew ch. 5 Vitt 2003, Kline 2011
6	24 26 28	Dispersal EXAM #1 on weeks 1-5 Journal club (#6-10)	Mayhew ch. 6
7	1 Oct 3 5	Behavior and plasticity 3) Activity: Invasive species assessment Invasive species continued (due 10/15)	Mayhew ch. 7 Pheloung 1999 *Bring your article or computer*
8	8 10 12	Population dynamics Journal club (#11-15) Journal club (#16-20)	Mayhew ch. 8
9	15 17 19	Generalization vs. specialization 4) Discussion: Specialization in *Nepenthes* Specialization in *Nepenthes* continued (due 11/14)	Mayhew ch. 9 ALL: Moran 2010 + divided among group: 3-4 papers *you* signed up to read (posted on Canvas)
10	22 24 26	Antagonism vs. cooperation 5) Activity: Antbirds and army ants Antbirds and army ants continued (due 11/5)	Mayhew ch. 10 Angier 2012, Kuhlmann 2006
11	29 31 2 Nov	Coevolution EXAM #2 on weeks 6-10 Journal club (#21-25)	Mayhew ch. 11 10/29: last DR
12	5 7 9	Speciation Journal club (#26-30) Extinction	Mayhew ch. 12 Mayhew ch. 13
13	12 14 16	*Veterans' Day holiday—no class* 6) Discussion: How will we become sustainable? Sustainability continued (due 11/30)	 P Read 2009, Caldeira 2013, Burger 2012
14	19 21 23	Macroecology Journal club (#31-35) *Thanksgiving holiday—no class*	Mayhew **ch. 15** (←**note!**)
15	26 28 30	Macroevolution Journal club (#36-40) Course wrap-up *+ evaluations (online)*	Mayhew **ch. 14**, Hallinan 2011 Mayhew ch. 16 (short)
Finals	3 Dec	FINAL EXAM on weeks 11-15 + cumulative; **2:15-4:15 PM in ZEB 120**	

This syllabus and schedule, particularly the time devoted to each topic, may change at any time *to better meet the needs of the group, or due to unforeseen circumstances.* All changes will be announced in class or via Canvas. The most current version will be kept updated on Canvas, so check there if in doubt.

Course readings and resources:

AAS (Australian Academy of Science) 2010. The science of climate change: questions and answers. Canberra. https://www.science.org.au/climatechange. Accessed 9/8/14.

Adam, J. (1997). Prey spectra of Bornean *Nepenthes* species (Nepenthaceae) in relation to their habitat. *Pertanika Journal of Tropical Agricultural Science*, *20*(2/3), 121-134.

Amagase, S., Mori, M., & Nakayama, S. (1972). Digestive enzymes in insectivorous plants IV. Enzymatic digestion of insects by *Nepenthes* secretion and *Drosera peltata* extract: proteolytic and chitinolytic activities. *Journal of biochemistry*, *72*(3), 765-767.

Angier, N. (2012). Feathered freeloaders at the ant parade. *New York Times*, September 24, Science section: D1. http://www.nytimes.com/2012/09/25/science/spotted-antbirds-feathered-freeloaders-at-the-ant-parade.html?pagewanted=all&_r=0. Accessed Fall 2013.

Bauer, U., Di Giusto, B., Skepper, J., Grafe, T., & Federle, W. (2012). With a flick of the lid: a novel trapping mechanism in *Nepenthes gracilis* pitcher plants. *PloS one*, *7*(6), e38951.

Bauer, U., Clemente, C., Renner, T., & Federle, W. (2011). Form follows function: morphological diversification and alternative trapping strategies in carnivorous *Nepenthes* pitcher plants. *Journal of Evolutionary Biology*, *25*(1), 90-102.

Bauer, U., Grafe, T., & Federle, W. (2011). Evidence for alternative trapping strategies in two forms of the pitcher plant, *Nepenthes rafflesiana*. *Journal of Experimental Botany*, *62*(10), 3683-3692.

Bauer, U., Willmes, C., & Federle, W. (2009). Effect of pitcher age on trapping efficiency and natural prey capture in carnivorous *Nepenthes rafflesiana* plants. *Annals of Botany*, *103*(8), 1219-1226.

Bonhomme, V., Gounand, I., Alaux, C., Jousselin, E., Barthélémy, D., & Gaume, L. (2011). The plant-ant *Camponotus schmitzi* helps its carnivorous host-plant *Nepenthes bicalcarata* to catch its prey. *Journal of Tropical Ecology*, *27*(01), 15-24.

Bonhomme, V., Pelloux-Prayer, H., Jousselin, E., Forterre, Y., Labat, J., & Gaume, L. (2011). Slippery or sticky? Functional diversity in the trapping strategy of *Nepenthes* carnivorous plants. *New Phytologist*, *191*(2), 545-554.

Buch, F., Rott, M., Rottloff, S., Paetz, C., Hilke, I., Raessler, M., & Mithöfer, A. (2012). Secreted pitfall-trap fluid of carnivorous *Nepenthes* plants is unsuitable for microbial growth. *Annals of Botany,* 111(3), 375-383.

Burger, Joseph R., et al. (2012). The macroecology of sustainability. *PLoS Biology,* 10(6), e1001345.

Caldeira, K., Bala, G., and Cao, L. (2013). The science of geoengineering. *Annual Review of Earth and Planetary Sciences,* 41, 231–56.

Clarke, C., Bauer, U., Ch'ien, C., Tuen, A., Rembold, K., & Moran, J. (2009). Tree shrew lavatories: a novel nitrogen sequestration strategy in a tropical pitcher plant. *Biology Letters*, *5*(5), 632-635.

Dieckmann, U., & Ferrière, R. (2004). Adaptive dynamics and evolving biodiversity. *Evolutionary Conservation Biology*, 188-224.

Di Giusto, B., Bessière, J., Gueroult, M., Lim, L., Marshall, D., Hossaert-McKey, M., & Gaume, L. (2010). Flower-scent mimicry masks a deadly trap in the carnivorous plant *Nepenthes rafflesiana*. *Journal of Ecology*, *98*(4), 845-856.

Ferriere, R., & Legendre, S. (2013). Eco-evolutionary feedbacks, adaptive dynamics and evolutionary rescue theory. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1610), 20120081.

Fox, L. 2014. How to ask research questions (or frame hypotheses). Bioe 147/247 course website, University of California at Santa Cruz. http://courses.pbsci.ucsc.edu/eeb/bioe147/Assignments_files/Questions%20and%20Hypotheses_How%20they%20should%20be%20framed.pdf. Accessed 8/16/2014 and modified by JC.

Gordon, D., Onderdonk, D., Fox, A., Stocker, R., & Gantz, C. (2008). Predicting invasive plants in Florida using the Australian weed risk assessment. *Invasive Plant Science and Management*, *1*(2), 178-195.

Gorelick, R., & Heng, H. H. (2011). Sex reduces genetic variation: a multidisciplinary review. *Evolution*, *65*(4), 1088-1098.

Grafe, T., Schöner, C., Kerth, G., Junaidi, A., & Schöner, M. (2011). A novel resource–service mutualism between bats and pitcher plants. *Biology Letters*, rsbl20101141.

Hickey, D. (1993). Molecular symbionts and the evolution of sex. *Journal of Heredity*, *84*(5), 410-414.

Hurst, L. (2016). Why did sex evolve? Researchers edge closer to solving longstanding mystery. *The Conversation*. http://theconversation.com/why-did-sex-evolve-researchers-edge-closer-to-solving-longstanding-mystery-55407. Accessed 8/20/2017.

Hurst, L. (1995). Selfish genetic elements and their role in evolution: The evolution of sex and some of what that entails. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *349*(1329), 321-332.

Kline, R., Khan, I., & Holt, G. (2011). Behavior, color change and time for sexual inversion in the protogynous grouper (*Epinephelus adscensionis*). *PloS One*, *6*(5), e19576.

Kuhlmann, M. (2006). Do antbirds help or hinder army ants? *Teaching Issues and Experiments in Ecology, 4*. Ecological Society of America.

Lenski, R. 1999. A distinction between the origin and maintenance of sex. *Journal of Evolutionary Biology, 12*, 1034-1035.

Mallet, J. (2007). Hybrid speciation. *Nature 446*(7133), 279-283.

Mayhew, Peter (2006). *Discovering Evolutionary Ecology*. Oxford University Press. 215 pp.

Maynard Smith, J. & Szathmáry, E. (1995). Chapter 9: The origin of sex and the nature of species, in *The Major Transitions in Evolution*. Oxford University Press. pp. 149-167.

Merbach, M., Zizka, G., Fiala, B., Merbach, D., Booth, W., & Maschwitz, U. (2007). Why a carnivorous plant cooperates with an ant-selective defense against pitcher-destroying weevils in the myrmecophytic pitcher plant *Nepenthes bicalcarata* Hook. *Ecotropica*, *13*, 45-56.

Moran, J., & Clarke, C. (2010). The carnivorous syndrome in *Nepenthes* pitcher plants. *Plant signaling & behavior*, *5*(6), 644-648.

Moran, J. (2006). Life and death in a pitcher. *Natural History* magazine, October issue, *115*(8), 56-62.

Moran, J., Clarke, C., & Hawkins, B. (2003). From carnivore to detritivore? Isotopic evidence for leaf litter utilization by the tropical pitcher plant *Nepenthes ampullaria*. *International Journal of Plant Sciences*, *164*(4), 635-639.

Moran, J., Merbach, M., Livingston, N., Clarke, C., & Booth, W. (2001). Termite prey specialization in the pitcher plant *Nepenthes albomarginata*—evidence from stable isotope analysis. *Annals of Botany*, *88*(2), 307-311.

Moran, J. (1996). Pitcher dimorphism, prey composition and the mechanisms of prey attraction in the pitcher plant *Nepenthes rafflesiana* in Borneo. *Journal of Ecology*, 515-525.

Ornstein, L. (2009). Replacing coal with wood: sustainable, eco-neutral, conservation harvest of natural tree-fall in old-growth forests. *Climatic Change*, *97*(3), 439-447.

Ornstein, L., Aleinov, I., & Rind, D. (2009). Irrigated afforestation of the Sahara and Australian Outback to end global warming. Climatic Change, 97(3-4), 409-437.

Otto, S. (2008). Sexual reproduction and the evolution of sex. *Nature Education, 1*(1), 182. https://www.nature.com/scitable/topicpage/sexual-reproduction-and-the-evolution-of-sex-824. Accessed 8/19/2017.

Pheloung, P., Williams, P., & Halloy, S. (1999). A weed risk assessment model for use as a biosecurity tool evaluating plant introductions. *Journal of Environmental Management*, *57*(4), 239-251.

Poorter, L., Zuidema, P. A., Peña-Claros, M., & Boot, R. (2005). A monocarpic tree species in a polycarpic world: How can *Tachigali vasquezii* maintain itself so successfully in a tropical rain forest community?. *Journal of Ecology*, 268-278.

Read, J., Sanson, G., Burd, M. and Jaffré, T., 2008. Mass flowering and parental death in the regeneration of *Cerberiopsis candelabra* (Apocynaceae), a long-lived monocarpic tree in New Caledonia. American Journal of Botany, 95(5), 558-567

Read, P. (2009). Reducing CO_2 levels—so many ways, so few being taken. *Climatic Change*, *97*(3), 449-458.

Scudellari, M. (2014). The sex paradox. *The Scientist, 28*(7, July issue). http://www.the-scientist.com/?articles.view/articleNo/40333/title/The-Sex-Paradox/. Accessed 8/20/2017.

Thornham, D., Smith, J., Ulmar Grafe, T., & Federle, W. (2012). Setting the trap: cleaning behaviour of *Camponotus schmitzi* ants increases long-term capture efficiency of their pitcher plant host, *Nepenthes bicalcarata*. *Functional Ecology*, *26*(1), 11-19.

Vitt, P., Holsinger, K., & Jones, C. (2003). Local differentiation and plasticity in size and sex expression in jack-in-the-pulpit, *Arisaema triphyllum* (Araceae). *American Journal of Botany*, *90*(12), 1729-1735.

Waxman, D., & Gavrilets, S. (2005). 20 questions on adaptive dynamics. *Journal of Evolutionary Biology*, *18*(5), 1139-1154.

Wells, K., Lakim, M., Schulz, S., & Ayasse, M. (2011). Pitchers of *Nepenthes rajah* collect faecal droppings from both diurnal and nocturnal small mammals and emit fruity odour. *Journal of Tropical Ecology*, *27*(04), 347-353.

Zimmer, C. (2009). On the origin of sexual reproduction. *Science, 24*(5932, Jun. 5), 1254-1256.