BIOL 4200 Ecological Agriculture Fall 2017

Syllabus

General Information

Professor: Dr. Kenneth Schoenly
Office: N271
Phone: 667-3949
Off. Hrs: TuTh: 9-10:30 and by appointment
Email: kschoenly@csustan.edu

Semester: Fall 2017
Credits: 3
Class: MWF 9:00-9:50 (N221)

Course Description

(Catalog Description): Analysis of ecological patterns and mechanisms of agroecosystems, with emphasis on biodiversity linkages operating between plants, pests, and natural enemies. Topics include environmental and health impacts of genetically engineered plants, pesticide resistance, and critical assessments of integrated pest management, biological control, and sustainability. Case studies from temperate, tropical, and subtropical zones are included to illustrate working examples of ecorational approaches to agriculture. Prerequisites: BIOL 1050 and BIOL 1150 (or equivalent introductory series) and CHEM 1100 and CHEM 1110 with grades of C- or higher.

One year of general biology and chemistry is a requirement for this senior-level class; any additional coursework in biology (ecology, genetics, evolution) increases your chance of succeeding in this class. As such, this course is not an introductory biology course.

Ecology is an experimental, observational, mathematical and correlative science. Interactions between organisms and their environment are at the heart of ecology and are crucial to understanding the evolution of life. Ecologists draw upon every field of biology to study organisms, notably evolution, molecular biology, physiology, behavior, and genetics. One semester is not enough time to explore all aspects of ecological agriculture. We will concentrate on **major concepts, hypotheses, and theories developed around natural ecosystems to examine their degree of application to agroecosystems.** To understand current trends and future directions, we will critique peer-reviewed studies to see if and how their findings contribute lasting impacts on the discipline.

An integral goal of this course is your continued development of critical thinking, written and verbal communication, quantitative reasoning, and experimental design skills. Lectures and assignments will guide you in the development of these skills. Readings will be drawn from the textbook and the primary literature (journal papers). The peer-reviewed literature highlights the cumulative, decentralized, self-correcting, and hypothesis-driven features of how scientific knowledge is acquired. In this class, it is **especially critical that you grasp which ecological concepts (and to what degree) have applicability to agricultural systems and sustainability**.

Required Text/Readings:

1. Connor, Loomis & Cassman (2011) Crop Ecology: Productivity and Management in Agricultural Systems, 2nd edition (chapters shown in schedule below); bring to every class period. There is no companion website for this book.

2. Readings from the primary scientific literature (identified in lecture outline below) and handouts.

Specific Learning Objectives:

1. Critically evaluate which ecological concepts and principles are useful and applicable to sustainable agricultural systems.

2. Critique ecological experiments, theories, and models to gain understanding and prediction of the relationships and interactions between organisms (i.e., crops, weeds, pests, natural enemies) and their agricultural environment.

3. Demonstrate knowledge of conservation biological control, intraguild predation, induced resistance, agroecosystem services, non-target pesticide impacts, trophic cascades (top-down, bottom-up), indirect effects, farmscaping, and other agroecological concepts.

4. Analyze community- and ecosystem-level crop field data to understand and help predict structural, dynamical, and functional properties of agroecosystems.

5. Critically evaluate current issues in agriculture through enhanced use of the refereed scientific literature, its cumulative, self-correcting, and hypothesis-testing features, and be able to distinguish it from pseudoscience.

Course Requirements:

As per university regulations, students who do not attend the first class meeting (without 24-hr prior or subsequent notice) will be instructor dropped. The rigors of this course **demand punctuality** and **regular attendance,** and **commitment** and **concentration** to the readings. **Graduate and post-baccalaureate students who are enrolled for graduate credit are expected to perform at a higher level than undergraduates (see handout); subsequently (and according to university policies), graduate and post-bac students will receive additional assignments.** Your required textbook presents a broad and unified view of crop ecology, not just as a collection of facts, but an ongoing research effort. This text and readings will constitute the bulk of the lectures; a small remainder will come from video questions, and web sites. Written exams, presentations, and homework will require students to demonstrate clear communication skills, neatness, critical thinking, problem-solving (verbal and mathematical), and biological knowledge about ecological concepts in agriculture.

Allow at least two weeks for exams and other assignments to be graded and returned. It is your responsibility to contact me in the event you miss an assignment (within 24 hrs) documenting your absence (e.g., doctor's note, jury summons, funeral notice); **otherwise, an unexcused absence for a gradable event will result in no score.** Makeup exams, if approved by me, must be made up before the test day or within 2 days of the exam. Assigned homework or presentations will have a **no-exceptions due date and time**. For your convenience, the syllabus, readings, and other documents will be posted online using Blackboard.

The instructor reserves the right to give unannounced quizzes if it becomes apparent that students are not keeping up with the material and/or there are an unacceptable number of absences or tardy students**.** If you happen to be absent or late that day you will receive a grade of 0 for that quiz.

Executive Order 1037 (effective August 2009) allows students to only repeat a course twice and in which they have earned less than a C grade. Students are only allowed to replace the first 16 units they repeat; those reaching the 16 unit limit may repeat an additional 12 units, but the resulting grade is averaged with all other grades. **Students repeating this class will present different journal papers than they did previously.**

Personal Responsibility:

Behavior that interferes with the instructor's ability to teach or the ability of students to benefit from instruction will not be tolerated. Examples include: audible ring tones, repeated late arrivals or early departures, irrelevant conversation, and inappropriate use of phones or computers. Inappropriate behavior will be dealt with as severely as university regulations allow. Behavior that is not consistent with the Student Conduct Code – including any form of academic dishonesty (see below) – will result in disciplinary action. **At the start of class, turn off cell phones. Check your university email daily for updates of information items.** Starting an email with "Hey" or no salutation is an inappropriate way to begin a professional conversation. Use email correspondence as an opportunity to practice your professional skills.

Cheating in any form is inappropriate conduct and will be dealt with swiftly and severely according to Sections 41301 through 41304 of Title 5 of the *California Code of Regulations*" which includes expulsion, suspension and probation.

Grading:

Two Friday midterm exams (**Oct 6, Nov 17**) will come from the lectures, readings, handouts, videos and student presentations. Exams will be mixed format (short answer essay, matching, graph interpretation, multiple choice, calculations, fill-in-the-blanks) and will test critical-thinking and problem-solving skills. I may also assign links of web sites from scientific sources that I will expect you to know on exams. The final exam (**Dec 15: starting time 8:30 am**) will be comprehensive over the entire class material. If you arrive late after other students have turned in their exams, you will be turned away, so leave early on exam days to ensure you will be on time. Traffic and/or car problems are not acceptable excuses for being late. **No extra credit will be offered beyond points earned on exams, homework, etc.**

We will devote most Fridays to student presentations, videos, and fun activities. Each student will deliver a 20-minute PowerPoint critique of a journal paper (graduate students will give two). For reasons of fairness and efficiency, topics will be assigned at random the first week of class (see schedule below) and everyone will submit their .ppt or .pptx file on the same day to the instructor (deadline announced later). Your presentation grade will be based on verbal and written delivery, and a 1-page summary (sample on Blackboard) prepared for your classmates that summarizes the paper's content. When done well, the summary makes an excellent study guide for your classmates. When I announce your name and paper, present your critique taking no more than 20 minutes (including 2-5 minutes for questions). I will use a standardized grading rubric (posted on Blackboard) to grade your verbal and written presentation. **In the event you miss (or are unready to present) your scheduled talk, you will receive an automatic '0' for the 100-pt assignment.** On the date

.ppt or .pptx files are due, you can email or bring them to me on a thumb drive so I can load and check them on my laptop.

Grades will be weighted as follows**:**

Exams (2 @ 100 pts each)	200 pts (33%)
Comprehensive Final (Friday, December. 15 @ 8:30 am)	150 pts (25%)
Paper Presentation (100 pts, grad students: 2 @ 50 pts each)	100 pts (17%)
Homework	125 pts (21%)
Miscellaneous (punctuality, attendance, participation, conduct)	25 pts (4%)
Total	600 pts (100%)

A = 540-600, B = 480-539, C = 420-479, D = 360-419, F < 360 points. No +/- grading will be used.

Some Important Dates:

Aug 23: First class day
Sep 4: Labor Day (No Class)
Sep 20: Census Date: Last add/drop day
Sep 22: Presentation (pptx) files due
Oct 6 (F): Exam 1
Oct 11 (No Class)
Nov 10: Veteran's Day (No Class)
Nov 17 (F): Exam 2
Nov 23-24 (Thanksgiving) (No Class)
Dec 11 (Last Class Day)
Dec 12 (Reading Day)
Dec 15 Final Exam (start time: 8:30)

Recording Policy:

Audio or video recording of classes (tape and digital format) is not permitted under any circumstances. If you do not intend to comply with this policy, please discuss this with the instructor or take another class. An exception is made for students registered with Disability Resource Services, who are approved for this accommodation. In such exceptions, DRS students will be asked to sign a "Recording Agreement" which disallows them from sharing recordings with other individuals unless approved by the DRS program.

Tips for Success:

If you are not prepared to dedicate the time and effort needed for this course, you should reconsider your enrollment. However, if you heed the following advice, the class can be made easier, and more enjoyable:

- Be punctual and attend every class meeting
- To refresh memory, review past biology, math and chemistry notes
- Review upcoming material ahead of lecture
- Take good notes & revisit/rewrite often (1:3 rule)
- Seek help from university tutors (Library, CVMSA "Commons")
- Ensure neatness & legibility on exams & homework; make sure you turn them in on time
- Review terminology & concepts using the book's index, and end-of-chapter summaries
- If you need clarification or have questions, come to my office hours

Punctuality and regular attendance, correct spelling and grammar, and good penmanship are all necessary for succeeding in a professional career. Consequently, poor spelling, grammar or penmanship will result in lost points on exams and homework; illegible answers on exams and late homework will receive no credit (i.e., if I can't read it, it's wrong).

Lecture Outline and Reading Assignments*

Week Beginning	Ecological Concept(s) & Applications to Agriculture	Journal Paper(s) & Video(s)	Book Chapter(s)** & Presentations
Wed, Aug 23	Course Introduction, Global Ecology & the Evolutionary Backdrop; Impact of Humankind on Geological Processes, the Biosphere & Evolutionary Trajectories	A1, A2	1
Mon, Aug 28	Natural Selection, Phylogeography & Group Selection; Long-Term Crop-Pest Dynamics, Crop & Livestock Origins & Domestication, Reducing Livestock Conflict via Genetic Selection	A3, A4, A5 V1a, V1b	
Wed, Sep 6	Population Growth & Carrying Capacity; Human Population, Food Supply & Intensive Agriculture/Fisheries	A6, A7, A8	17, 18
Mon, Sep 11	Biogeochemical Cycles (H_2O, C, N, P); Impacts of Future Climate Change on Global & CA Agriculture	A9, A10	6, 8, 9
Mon, Sep 18	Nature's Services; Agroecosystem Services (Dis-Services, Tradeoffs & Synergies), Farmers' Perceptions; **Ppt Files Due Friday (Sept 22 @ 10 am)**	A11, A12, A13	
Mon, Sep 25	Terrestrial Biomes & Restoration Ecology; "The Dust Bowl", Erosion Control, Soil Fauna Restoration	A14, A15 V2	7, 12 P1, P2
Mon, Oct 2	Photosynthesis, Nutrient Enrichment & Biomagnification; C3, C4 & CAM Crops, Fertilizer Management, Impact of Agrochemical Inputs (H_2O, fertilizer), Review for Exam	A16, A17	10, 12, 14 **Test 1, Friday**
Mon, Oct 9	Species-Area Effects, Habitat Islands & Community Equilibria; Monoculture Expansion & Pest Accrual, Specialist & Generalist Crop Pests	A18, A19	P3, P4
Mon, Oct 16	Habitat Modification, Self-Thinning & Competition in Plants; Manipulating Crop Communities to Manage Pests & Optimize Yields	A20, A21	3 P5, P6
Mon, Oct 23	Plant-Herbivore Interactions; Constitutive and Induced Crop Defenses, Compensation & Overcompensation	A22, A23	P7, P8
Mon, Oct 30	Ecology of Invasive Species; Invasive Pest Species in NA, Established vs. Reintroduced Pest Populations in CA	A24, A25 Handouts	P9a, P9b (debate)
Mon, Nov 6	Integrated Pest Management; Harmonization of Tactics: Biological Control, Host-Plant Resistance, Cultural Practices, Impact of Pesticides	A26, A27, A28 V3	2
Mon, Nov 13	Predator-Prey Interactions; Biological Pest Control: Insecticidal Check Method; Riskiness, Successes & Failures, Review for Exam	A29, A30a, A30b	**Test 2, Friday**
Mon, Nov 20	Food Web Processes: Intraguild Predation, Bottom-Up & Top-Down Effects, Contrasting Trophic Cascades	A31, A32	P10, P11
Mon, Nov 27	Ecological Resilience & Directional Selection; Insecticide-Induced Pest Outbreaks, Non-Target Impacts, Pesticide Resistance	A33, A34, A35	P12, P13
Mon, Dec 4	Landscape Modification, Habitat Fragmentation & Wildlife Conservation; Farmscaping, Conservation Biological Control & Post-Harvest Agriculture	A36, A37, A38 V4, V5	P14, P15 (if needed)
Mon, Dec 11	Catch-Up Lecture, Review for Final	A39 (if time permits)	**Final, Friday**

*The instructor reserves the right to change the length or content of lecture topics, textbook and journal readings in the event of extenuating circumstances.

**Readings in Connor, Loomis & Cassman (2011)

Primary Literature (Listed in Chronological Order)

Reading List (Everyone)

A1: Waters, C.N. et al. 2016. The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science* 351: aad2622.1 – aad2622.10.

A2: Palumbi, S.R. 2001. Humans as the world's greatest evolutionary force. *Science* 293: 1786-1790.

A3: Bearchell, S.J. et al. 2005. Wheat archive links long-term fungal pathogen population dynamics to air pollution. *PNAS* 102 (15): 5438-5442.

A4: Larson, G. et al. 2005. Worldwide phylogeography of wild boar reveals multiple centers of pig domestication. *Science* 307: 1618-1621.

A5: Muir, W. 1996. Group selection for adaptation to multiple-hen cages: selection program and direct responses. *Poultry Science* 75: 447-458.

A6: Cohen, J.E. 1995. Population growth and Earth's human carrying capacity. *Science* 269: 341-346.

A7: Conway, G. & G. Toenniessen. 1999. Feeding the world in the twenty-first century. *Nature (Supplement)* 402: C55-C58.

A8: Pauly, D. et al. 2000. Fishing down aquatic food webs. *American Scientist* 88: 46-51.

A9: Vitousek, P.M. et al. 1997. Human domination of Earth's ecosystems. *Science* 277: 494-499.

A10: Lobell, D. et al. 2006. Impacts of future climate change on California perennial crop yields: model projections with climate and crop uncertainties. *Agricultural and Forest Meteorology* 141: 208-218.

A11: Trewavas, A. 2001. Urban myths of organic farming. *Nature* 410: 409-410.

A12: Ricketts, T. et al. 2004. Economic value of tropical forest to coffee production. *Proceedings of the National Academy of Sciences* 101: 12579-12582.

A13: Ehler, L. & D. Bottrell. 2000. The illusion of integrated pest management. *Issues in Science and Technology* 16: 61-64.

A14: Pimentel, D. et al. 1987. World agriculture and soil erosion. BioScience 37 (4): 277-283.

A15: De Deyn, G.B. et al. 2003. Soil invertebrate fauna enhances grassland succession and diversity. Nature 422: 711-713.

A16: Matson, P.A. et al. 1998. Integration of environmental, agronomic, and economic aspects of fertilizer management. *Science* 280: 112-115.

A17: Kelly, B.C. et al. 2007. Food web-specific biomagnification of persistent organic pollutants. *Science* 317: 236-239.

A18: Southwood, T. 1961. The number of species of insect associated with various trees. *Journal of Animal Ecology* 30: 1-8.

A19: Strong, D. 1974. Rapid asymptotic species accumulation in phytophagous insect communities: the pests of cacao. *Science* 185: 1064-1066.

A20: Gorham, E. 1979. Shoot height, weight and standing crop in relation to density of monospecific plant stands. *Nature* 279: 148-150.

A21: Risch, S. et al. 1983. Agroecosystem diversity and pest control: data, tentative conclusions, and new research directions. *Environmental Entomology* 12: 625-629.

A22: Agrawal, A. 1998. Induced responses to herbivory and increased plant performance. *Science* 279: 1201-1202.

A23: Paige, K. & T. Whitham. 1987. Overcompensation in response to herbivory: the advantage of being eaten. *American Naturalist* 129: 407-416.

A24: Pimentel, D. et al. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52: 273-288.

A25: Capinera, J. 2002. North American vegetable pests: the pattern of invasion. *American Entomologist* (Spring): 20-39.

A26: Reganold, J. et al. 2001. Sustainability of three apple production systems. *Nature* 410: 926-929.

A27: Fagan, W.F. et al. 1998. Interactions between biological control efforts and insecticide applications in tropical rice agroecosystems: the potential role of intraguild predation. *Biological Control* 13: 121-126.

A28: Zhu, Y. et al. 2000. Genetic diversity and disease control in rice. *Nature* 406: 718-722.

A29. DeBach, P. et al. 1951. A biological check method for evaluating the effectiveness of entomophagous insects. *Journal of Economic Entomology* 44: 763-766.

A30a: Simberloff, D. & P. Stiling. 1996. How risky is biological control? *Ecology* 77: 1965-1974.

A30b: Frank, J. 1998. How risky is biological control? Comment. *Ecology* 79: 1829-1834.

A31: Eubanks, M. et al. 2002. Intraguild predation of beneficial arthropods by red imported fire ants in cotton. *Environmental Entomology* 31: 1168-1174.

A32: Snyder, W. & D. Wise. 2001. Contrasting trophic cascades generated by a community of generalist predators. *Ecology* 82: 1571-1583.

A33: Gould, F. 1991. The evolutionary potential of crop pests. *American Scientist* 79: 496-507.

A34: Lu. Y. et al. 2010. Mirid bug outbreaks in multiple crops correlated with wide-scale adoption of *Bt* cotton in China. *Science* 328: 1151-1154.

A35: Relyea, R. 2005. The impact of insecticides and herbicides on the biodiversity and productivity of aquatic communities. *Ecological Applications* 15: 618-627.

A36: Kruess, A. & T. Tscharntke. 1994. Habitat fragmentation, species loss, and biological control. *Science* 264: 1581-1584.

A37: Philips, C. et al. 2014. Understanding farmscapes and their potential for improving IPM programs. *Journal of Integrated Pest Management* 5: 1-9.

A38: Elphick, C. 2004. Assessing conservation trade-offs: identifying the effects of flooding rice fields for waterbirds on non-target bird species. *Biological Conservation* 117: 105-110.

A39: Bainbridge, D.A. 1986. High performance low cost buildings of straw. *Agriculture, Ecosystems, and Environment* 16: 281-284.

Student Presentation Papers:

P1: Drinkwater, L.E. et al. 1995. Fundamental differences between conventional and organic tomato agroecosystems in California. *Ecological Applications* 5(4): 1098-1112.

P2: Peng, S. et al. 1996. Increased N-use efficiency using a chlorophyll meter on high-yielding irrigated rice. *Field Crops Research* 47: 243-252.

P3: Strong, D. et al. 1977. Time and the number of herbivore species: the pests of sugarcane. *Ecology* 58: 167-175.

P4: Agrawal, A. 2000. Specificity of induced resistance in wild radish: causes and consequences for two specialist and two generalist caterpillars. *Oikos* 89: 493-500.

P5: Kays, S. & J. Harper. 1974. The regulation of plant and tiller density in a grass sward. *Journal of Ecology* 62: 97-105.

P6: Shapiro, A. & C. Wortmann. 2006. Corn response to nitrogen rate, row spacing, and plant density in eastern Nebraska. *Agronomy Journal* 98: 529-535.

P7: Karban, R. 1988. Resistance to beet armyworms (*Spodoptera exigua*) induced by exposure to spider mites (*Tetranychus turkestani*) in cotton. *The American Midland Naturalist* 119(1): 77-82.

P8: Thomson, V. et al. 2003. Compensation for herbivory by *Cucumis sativus* through increased photosynthetic capacity and efficiency. *Oecologia* 134: 167-175.

P9a: McInnins, D. et al. 2017. Can polyphagous invasive tephritid pest populations escape detection for years under favorable climatic and host conditions? *American Entomologist* 63(2): 89-99 (Issues in Entomology).

P9b: Carey, J. et al. 2017. The 30-year debate on a multi-billion-dollar threat: Tephritid fruit fly establishment in California. *American Entomologist* 63(2): 100-113 (Issues in Entomology).

P10: Carter, P. & A. Rypstra. 1995. Top-down effects in soybean agroecosystems: spider density affects herbivore damage. *Oikos* 72: 433-439.

P11: Wimp, G. et al. 2010. Increased primary production shifts the structure and composition of a terrestrial arthropod community. *Ecology* 91: 3303-3311.

P12: Eveleens, K. et al. 1973. Secondary outbreak induction of beet armyworm by experimental insecticide applications in cotton in California. *Environmental Entomology* 2: 497-503.

P13: Powles, S.B. et al. 1998. Evolved resistance to glyphosate in rigid ryegrass (*Lolium rigidum*) in Australia. *Weed Science* 46: 604-607.

P14: Holzschuh, A. et al. 2010. How do landscape composition and configuration, organic farming and fallow strips affect the diversity of bees, wasps and their parasitoids? *Journal of Animal Ecology* 79: 491-500.

P15: Maas, B. et al. 2013. Bats and birds increase crop yield in tropical agroforesty landscapes. *Ecology Letters* 16: 1480-1487.

Videos Shown in Class (listed in chronological order)

V1a. Guns, Germs & Steel ("Animal Domestication, "Types of Farmed Animals" by Jared Diamond: Nat'l Geogr. Soc.). Weblink: https://www.youtube.com/watch?v=tx_PcorChSU

V1b. Dmitry Belyaev & Silver Fox Experiments. Weblink: https://www.youtube.com/watch?v=0jFGNQScRNY

V2. The Dust Bowl ("Introduction", "New Deal" by K. Burns, PBS). Website: http://www.pbs.org/kenburns/dustbowl/

V3. Integrated Pest Management in Agriculture (San Luis Video Publishing). Website: http://www.horticulturevideos.com/ipm.html#agriculture

V4. Farmscaping: Advanced Tactics for Achieving Sustainable Agriculture (San Luis Video Publishing). Website: http://horticulturevideos.bizvision.com/product/farmscapingadvancedtacticsforachievingsustainableagriculture%2812490%29

V5. The Straw Bale Solution (by Athena & Bill Steen, Networks Productions, Inc.)