**Syllabi**

**for**

**Field Courses**

**In**

**Biology at WWU:**

***Ecological Methods***

**Biol 408**

**&**

***Research in Reptile Ecology***

**Biol 409**

Summer 2018

(This is the 20th consecutive year!)

Summer Field Biology 2018

Western Washington University

**Two Courses, to be taken *simultaneously:***

 ***Ecological Methods*  Biol 408 (6 Cr)  *Research in Reptile Ecology* Biol 409 (6 Cr)**

##### Dates: Tuesday June 19, 2018 to Friday August 3, 2018

**Locations: WWU campus and Oregon Great Basin Desert (Harney Co, OR).**

### Website Information: Check Biology Department Website often for course information updates

**Targeted Students: Upper-division Biology and Environmental Science majors**

**Prerequisite: Upper-level course in Ecology, equivalent to BIOL 325 or ESCI 325 at**

 **WWU, or permission from course instructor, Roger Anderson, WWU.**

**Course Descriptions:**

 ***Biol 408, Ecological Methods:* 6 credits (A-F grading). Field research; comparative investigations and application of alternative methods and instrumentation for measuring an array of ecologically-relevant parameters, including spatiotemporal variation in microclimate, vegetation, and terrestrial invertebrate abundance and diversity. Field work will be in three meso-habitats, performed in 4 to 6 person teams, and will produce publication-quality data. *Special Course Fee* is payable at Summer Session Office by June 18. The portion of the special course fees that is for travel & expendable supplies for *Ecological Methods* in 2018 is $600, which is one-half the total travel & expendable supplies fee for both courses combined, at $1200. There is another $303 required for balancing the budget, thus the Special Course Fee total is $1503. The summer session tuition is $250 per credit for 12 credits equaling $3000. The mandatory campus fee is $141. Thus, the total cost is $4643.50 for the pair of courses. This field course is self-supporting, that is, the special course fees pay for food, travel, expendable field supplies for camping and research, whereas tuition costs tend to be applied more to purchase of field research equipment and instrumentation. This course must be taken concurrent with *Research in Reptile Ecology*. June 19 to August 3, 2018.**

 ***Biol 409, Research in Reptile Ecology:* 6 credits (A-F grading). Field research on the behavioral ecology and physiological ecology of reptiles, conducted in 4 to 6 person teams. Observational-comparative and experimental methods will be learned, and the research results will be analyzed and interpreted integratively with data collected from *Ecological Methods*. Field research by the entire class will focus on developing knowledge and understanding of the population ecology of reptiles. *Special Course Fee* is payable at Summer Session Office by June 18. The portion of the special course fees that is for travel & expendable supplies for *Research in Reptile Ecology* in 2018 is $600, which is one-half the total travel & expendable supplies fee for both courses combined, at $1200. There is another $303 required for balancing the budget, thus the Special Course Fee total is $1503. The summer session tuition is $250 per credit for 12 credits equaling $3000. The mandatory campus fee is $141. Thus, the total cost is $4643.50 for the pair of courses. This field course is self-supporting, that is, the special course fees pay for food, travel, expendable field supplies for camping and research, whereas tuition costs tend to be applied more to purchase of field research equipment and instrumentation. This course must be taken concurrent with *Ecological Methods*. June 19 to August 3, 2018.**

### Biol 408 & 409 Course Schedules

### Dates: June 19 – August 3, 2018.

**Time Commitment: Courses combined: 46 days inclusive, with about 40 work days, averaging 10 hrs per day.**

 **That is, time commitment over the approximate 6 weeks is about 6.5 class days (65 hours) per week, hence only a few afternoons and mornings are not scheduled “class time.” The total time commitment at about 390 hours per “10 week equivalent,” for 12 credits comprises about 3 hours per credit.**

**General Itinerary:**

 **June 18: 1) Pay tuition & fees ($1200 of the $1502 special course fee was prepaid); finalize living arrangements for summer.**

 **2) Complete your purchases and gather up all personal gear *before* courses begin.**

 **3) Learn insects, lizards, and plants on-line before class, if feasible.**

 **June 19: Courses begin 0815 on WWU campus, in BI 354; introduce courses and**

 **organize research teams. *See pre-trip itinerary document.***

**June 20-22 Class runs 0815-1215 and 1315-1715 or later;**

 **Three phases: 1) learning about lizards, arthropods and plants. 2) learning about past**

 **research and developing questions, hypotheses, and methods for new research,**

 **3) gathering and inspecting gear and learning to use equipment.**

 **Reserve an hour each evening for reading about the Great Basin and its biota, and for**

 **perusing the most relevant scientific papers.**

 **June 23: On campus 0815 to 1515, used for “finalizing” project proposals & constructing**

 **data sheets. At 1800-2200, picnic/barbecue at RAA’s.**

#####  June 24: Use the day to complete purchasing and packing of personal gear.

 **June 25: Class runs 0815-1215 & 1315-1915 or later:**

 **Inventory equipment and supplies, place into travel containers.**

 **Purchase supplies & food. Load gear into vehicles & field trailer.**

 **June 26: One-day travel; leave 0500 and arrive 2000; unload gear & begin set-up camp**

 **June 27: Finish immediately necessary aspects of camp set-up (and latrines) by noon,
 set up plot in the afternoon (but also carry field belt for recording PHPL sightings &**

 **captures) so that some lizard catching can happen on the 27th.**

 **June 28: Field research in morning; afternoon finish plot setup; setup abiotic measuring stations**

 **June 29-July 20: Field research days in Great Basin Sage, SE Oregon.**

 **6/29 to 7/3: focus is on capturing & marking lizards, plant mapping and developing proficiency of team research methods.**

 **4/4 to 7/20: focus is on getting excellent data for team research projects, perhaps punctuated by a few episodes to capture two other lizard species off plot.**

 **July 3: Heat-of-afternoon trip to Winnemucca, NV; buy groceries, swim, shower, eat**

 **July 4: Afternoon trip to Steens Mountain (if there is too much snow, trip will be postponed)**

 **July 12: Afternoon trip to Winnemucca, NV (buy groceries, swim, shower, eat).**

 **July 11: Early afternoon placement of pitfall traps at Field Course Site.**

 **July 18: Early afternoon retrieval of pitfall traps at Field Course Site.**

 **July 20: Complete final data collection in the morning;**

 **July 20: Afternoon take down of field camp & field site**

 **(some takedown begun prior two evenings before); load vehicles & trailer.**

 **July 21: Leave field site 0700, arrive in Bellingham at 1900.**

 **July 22: WWU campus; 1400-1700, empty trailer, clean van, begin cleaning course gear.**

 **July 23: WWU campus; 0815-1215, clean & store gear; set up for pit trap samples.**

 **WWU campus; 1315-1815, finish storing gear, set up for pit trap samples, begin**

 **processing pitfall trap samples (continues into Thursday, then fecal pellet samples…)**

 **July 24–August 3: WWU campus, 0815-1815, perhaps as late as 2100 *or* later for last few days:**

**1) Process samples, 2) data entry of field notebook sightings & captures, lizard body measures, abiotic & plant measures, pitfall traps contents, ant & grasshopper counts & surveys, video focals & runways, *etc*… 3) edit data, make figures & tables, perform statistical analyses & complete research methods reports.Course Objectives of Western Field Biology**

 **Students will obtain experience in theory and practice of field research, particularly with respect to methods in terrestrial ecology that are relevant to reptile ecology. Part of the effort is as an entire class; we will measure distribution and abundance of a few focal species of reptiles in three habitats (with secondary effort on learning about distribution and abundance of local rodents). Students will also pursue small team research projects in behavioral and physiological ecology of reptiles, wherein there is a very real potential for publication. Non-trivial, scientifically useful questions and hypotheses will be generated, and reliable, ecologically useful data intended for publication in peer-reviewed scientific journals will be produced.**

 **Because knowing the environmental milieu is essential for an understanding of reptile ecology, equal effort will be placed in an Ecological Methods course. Students will learn and perform a variety of techniques used for measuring essential features of the microclimate (*e.g*., spatiotemporal patterns in temperature, humidity, wind, direct and reflected insolation), vegetation (plant form, diversity, and distribution), and terrestrial invertebrates (spatiotemporal patterns in distribution, abundance, and diversity). Comparisons of technique effectiveness and reliability will be enhanced by work in three mesohabitats. Both automated instrumentation (*e.g.*, weather station) and hand-held instruments will be utilized. Non-trivial, scientifically useful questions and hypotheses will be generated, and reliable, ecologically useful data intended for publication in peer-reviewed scientific journals will be produced.**

 **Upon completion of these courses, students will have the abilities to pursue independently both basic and applied research. Two field courses listed in their transcripts will provide these students with very noteworthy credentials, attractive to graduate programs, government agencies, and environmental assessment firms.**

 **The joint efforts of students, graduate assistant, volunteers and professor will produce a useful and valuable database and a perspective on the ecology of reptiles in the northwestern U.S.A. that has lacking heretofore. These efforts will be highly heuristic, and are likely to lead to further field courses and research efforts. Students will be encouraged to continue data analyses in the next academic year, thus permitting them to present posters and give talks at regional scientific meetings.**

 **The general learning objectives of these team research projects are to help students understand how to:**

 **(1) ask scientific questions,**

 **(2) frame those questions into testable hypotheses,**

 **(3) set up the research into well-defined procedures with an accurate knowledge of conditions intrinsic and extrinsic to the subject animals,**

1. **obtain reliable, statistically analyzable data, and**
2. **communicate results both verbally and in writing, in a scientific paper format.**

**And yes, the field experience has been designed to be *enjoyed*. Student testimonials are available upon request.**

**More detailed course “requirements” are listed beginning on page 7.General requirements for students in *Ecological Methods:***

 **1) Each student will briefly review literature on a particular instrumentation or method. This effort will provide a focused perspective that will support the research team’s comparative analysis of two techniques.**

 **2) For each of three mesohabitats, each student will be part of a research team that develops, conducts, analyzes, and provides a comparative analysis of two techniques designed to characterize the environmental or biological parameter. The team participates in the design of a research project, including all sample sizes and statistical tests anticipated, conducts the research, enters data in Excel, and—either during the course or in Biol 494 & 495 subsequently—analyzes the results with Systat, makes figures with Sigma Plot, and composes a poster in MS Word; and assuming the work integrates well with the *Research in Reptile Ecology*, then a single, integrated poster will be permitted. The plans for the poster are submitted, reviewed, and resubmitted; with the experience culminating in a team research poster, presumably integrated with the results for *Research in Reptile Ecology*. Throughout the entire process of the research course, students must document who collected which data, who scribed or recorded which data, who performed which sample analyses, data entry, data editing, graphical and statistical analyses, and who wrote which sections of the preliminary paper/poster and who edited the writing. Each student also may be individually evaluated in an oral exit interview by Dr. Anderson.**

**General requirements for students in *Research in Reptile Ecology:***

 **1) Each student will be part of a research team on the behavioral ecology and physiological ecology of lizards. The team proposes a specific research project chosen among a list of options. Fully explicated techniques that have been tried for their efficacy, including data sheets that are easily placed into Excel format are required. Students must anticipate needed sample sizes. Students perform the research with frequent consultation with the course instructor. Upon return to campus student research teams process samples, enter data in Excel—and either during the course or in Biol 494 & 495 subsequently—will analyze the results with Systat, make figures with Sigma Plot, and compose a poster in MS Word, in an integrated effort with the work for *Ecological Methods* (poster is the incipient stage for a possible paper for publication). The plans for the poster are submitted, reviewed by other research teams and the course instructor, and resubmitted; with the experience culminating in a preliminary version of the team research poster, integrated with the results for *Ecological Methods*. Throughout the entire process of the research course, students must document who collected which data, who scribed or recorded which data, who performed which sample analyses, data entry, data editing, graphical and statistical analyses, and who wrote which sections of the paper and poster and who edited the writing. Each student also may be individually evaluated in an oral exit interview by Dr. Anderson.**

 **2) All students also will contribute effort to capture-mark-release-recapture studies, and will be able to see the results of their efforts on-line as a poster.**

**Caveats for prospective students:**

 **Field work requires tent camping in rigorous, primitive conditions. Although venomous snakes will not be studied, they do pose a field hazard, as do stinging insects, and thorns. The high elevation (4000 ft), low humidity, high midday sun, and high heat of afternoon can be problematic if one is not vigilant about avoiding dehydration and overheating. High winds can damage unsecured tents.**

**Recommended Text for *Ecological Methods*** *(photocopies of chapters can be borrowed)*:

 **Wildlife-Habitat Relationships, 2nd Ed, 1998, by Morrison, *et al.***

 Suggested Readings in *Wildlife-Habitat Relationships*:

Chapter 1. Study of Habitat: *A Historical and Philosophical Perspective*

Chapter 3, to p.59, The Vegetation and Population Perspectives

 (review Box 3.1, 3.2; Table 3.1, 3.2, 3.3; Fig 3.3)

Chapter 4. The Experimental Approach in Wildlife Science (review Fig 4.1)

Chapter 5. Measurement of Wildlife Habitat: *What to Measure and How to Measure it.*

 (review Fig 5.2, 5.3, 5.5, 5.6; Table 5.1, 5.2, 5.3)

Chapter 6, to p.180. Measurement of Wildlife Habitat: *When to Measure and How to Analyze.*

 (review Box 6.1 and Table 6.1)

Chapter 7. Measuring Behavior (review Fig 7.1)

Chapter 8, pp 248-262. Of Habitat Patches and Landscapes:

*Habitat Heterogeneity and Responses of Wildlife* (review Fig 8.4)

Chapter 10, to p. 315. Modeling Wildlife-Habitat Relationships (review Fig 10, Table 10.1, 10.2)

**Recommended Reference Texts (all can be borrowed from Dr A) for *Ecological Methods*:**

 **Ecological Methodology, 2nd Edition, 1999, by C. J. Krebs**

 **Ecological Census Techniques, 1996 by W. J. Sutherland**

 **Research Techniques in Animal Ecology, 2000, by Boitani and Fuller**

 **Surveying Natural Populations, 1997, by Hayek and Buzas**

 **Natural Vegetation of Oregon and Washington, 1973, by Franklin & Dyrness**

 **North American Terrestrial Vegetation, 1988, by Barbour and Billings**

 **Sagebrush Country, 1992, by R. J. Taylor**

 **The Sagebrush Ocean, 1989, by S. Trimble**

#####  Shrubs of the Great Basin, 1985, by H. Mozingo

 **The Desert’s Past: a natural prehistory, 1993, by D. K. Grayson**

 **Cascade-Olympic Natural History, 1998, by D. Mathews**

 **Peterson Field Guide: Ecology of Western Forests,**

 **Peterson Field Guide: Insects of North America**

**Recommended Reference Texts (all can be borrowed from Dr A) for *Research in Reptile Ecology*:**

 **Reptile Ecology & Conservation 2016, by Dodd, C.K.**

 **Reptile Biodiversity: Standard Methods 2016, By McDiarmid, R.**

 **Lizard Ecology, 2007, by Reilly, et al**

 **Lizard Ecology, 1994, by Vitt & Pianka**

 **Herpetology, 3rd Ed., 2015, by Vitt & Caldwell**

 **Reptiles of Washington & Oregon, 1995, by H. Brown, *et. al.***

 **Reptiles of the Northwest 2002, by St. John**

 **Handbook of Ethological Methods, 2nd Ed., 1996, by P. Lehner**

 **Measuring Behavior, 2nd Ed., 1993, by Martin & Bateson**

 **Sampling and Statistical Methods for Behavioral Ecologists 1998, by Bart*, et. al.***

# Biol 408 & Biol 409 Details of Field Course Requirements, 2018

**Individual Assessments:**

 **Practicums in Lab *and* in Field** (try and retry until one demonstrates *proficiency*):

 Identify and describe notable features about plants, arthropods, and lizards (on-line resources are available).

Further comments on practicum on lizards in field:

 a) Identification, based on size, form, behavior.

 b) capture technique, temperature-measuring technique, and lizard handling technique (become routine after a few days)

 c) proper scribing: each student must be observed by course instructor and initialed as satisfactory by the course instructor (or qualified surrogate) as that student scribes three “complete-sighting-and-capture” episodes, and must have correct, complete (insofar as information is reasonably available) entries in that student’s field notebook for 10 sightings each of three lizard species, *Aspidoscelis tigris, Gambelia wislizenii, and Phrynosoma platyrhinos*. These sightings can be part of the standard plot searches.

 **Lab and Field Preparation and Protocol** (*points* must be *earned* for course participation; students self-assess and are assessed by research team mates and course instructor)

 Each student will be expected to assist in procurement, inventory, inspection, and maintenance of supplies, equipment, and instrumentation. This includes work in lab, in field, and again in lab.

 **Field Notebooks** (notebook quality is critical, individual *points* must be *earned*):

 Checked for Accuracy, Completeness, Reliability (these are extremely important!)

 Each Student takes Role as Scribe Plot Surveys

 Typed in Excel and Edited

 Two Photocopies of each student’s original notes and spreadsheets; leave space for 3-hole punch.

###  Data collection, recording, entry, editing, presentation, and analysis (*points* assessed)

###  Throughout the entire process of the research course, students must document who collected which data, who scribed or recorded which data, who performed which sample analyses, data entry, data editing, graphical and statistical analyses, and who wrote which sections of the paper and poster and who edited the writing. Note that timed and dated photographs of lizard locations, with field notes in the field notebooks must be exquisitely coordinated.

### Research Team Assessments (*points* are *earned* as a research team)

####  Research Project Notebook

 Follow protocols as described in the RPN document, available on canvas & handed out on the first day of class. Whenever feasible, students will use data sheets printed out and 3-hole punched. At the end of the course, student teams will evaluate how well they adhered to the requirements of the RPN document.

***Two* Research Projects**

 1) *Ecological Methods*, in *two* parts:

a) Documenting Arthropod Distribution and Abundance: These data are not only critical for understanding annual patterns of abundance of lizards, they also are the basis for answering an array of other fascinating ecological questions and testing hypotheses related to those questions.

1. One team or sub-team will lead the investigation of spatiotemporal patterns of ants:

All students help locate ant colonies early in the field research.

1. One team or sub-team will lead the investigation of spatiotemporal patterns of grasshoppers.
2. The entire class will function as an integrated unit, a team, to investigate arthropod distribution and abundance via pit-fall trapping. Members of each team will lead the effort, and each other student must place and retrieve pitfall traps in the field. Back in the lab each student must assist in lab-sorting arthropods from matrix.

b) Documenting *Nanoclimate*, wherein we investigate microclimate at microhabitat level, this part includes among-team data collection. Teams will use the weather station, several sets of thermocouple arrays, i-Buttons, and every other hour during the lizards’ daily activity period (often, however, these measurements will be happening already, associated with standard ant or grasshopper searches on the 10 x 40m plots) standard weather via hand-held instruments; it is likely that one of the research teams will also study of operative environmental temperatures. Carefully chosen places and times for measuring nanoclimate data will greatly facilitate the understanding of arthropod and lizard activity time and activity behavior.

2) *Research in Reptile Ecology*, in *two* parts:

a) Investigating spatiotemporal patterns of a lizard species (class projects help in this work)

b) Performing behavioral observations and experiments on lizard interactions with “prey”

Studies on behavioral and physiological ecology of exercise in one or more lizard species

You will focus on one or two of three lizard species:

*Aspidoscelis tigris, Gambelia wislizenii, Phrynosoma platyrhinos*

**Student projects will be assessed on effort and accomplishment (assessments include by instructor, team-mates, and self)**

Before each team leaves for the field, the team must have produced a document—approved by course instructor--that functions much like a proposal:

Title, Introduction, and Methods section to the research:

It must be one inclusive document on both team research projects

Methods must include:

All supplies, equipment, and instrumentation required for the work must be listed

Data sheets must be developed

A research schedule, including expected sample sizes, must be provided

Upon your return from the field

All data must be entered into spreadsheets, and edited, and all data sets must be formally archived.

All projects must be documented by a short research paper in standard scientific paper format.

All projects must also be documented with a poster.

All *individual* contributions must be clearly denoted.

**Each Student will participate in the following Perennial Class Projects** (*points* must be *earned*)

**1) Standard Plot Searches,** using lizard sighting frequency as assiduously determined by the Person-Searching Time Technique. This standard technique on a plot of known census will allow us to estimate population densities of lizards via person-searching time on other plots in and near the Alvord Basin, specifically when we are performing comparisons of burned and unburned study plots.

An effective comparison of lizard sighting frequency with a known census of all lizards on the study area must be performed. *Each student* must participate in (and document that participation) these standard plot searches as a three- person “search team” for a minimum of three search episodes and 40 minutes minimum of full search time in each of six “phases” of the daily activity period (with a minimum of 3 separate days for each phase for the entire class):

1. Early morning, cool, emergence, basking, and approaching peak activity: 0730-0900 hrs,
2. middle morning, equable-to-warm, peak activity: 0900-1100,
3. late morning, warm, peak-to-waning activity 1100-1230,
4. midday: hot, waning activity and inactivity, 1230-1530,
5. middle afternoon, warm-to-equable, second peak of activity: 1500-1800,
6. evening, equable-to-cool, waning activity: 1800-2200 hrs.

The standard plot searches will greatly facilitate the team research projects. For example, 1) students can report sightings of particular individuals that the other team may need to observe or capture), and 2) students will be marking ant colonies and recording colony activity times, 3) other students may be needing grasshoppers for predator-prey projects or needing to observe grasshopper behavior or 4) recording other useful anecdotes or data in their field notebooks. Thus when time must be taken to perform other tasks, that time must be excluded from the search time. Note that all search time for each searcher must be carefully documented when performing these standard plot searches.

Whenever students are in their plot search trios, at least one must wear field belt with thermometer. When a lizard is captured, the rapid-registering mercury thermometers should be used for measuring deep-cloacal temperatures of lizards, but realize that these thermometers are very fragile and must be handled in a careful, safe, and standard fashion. The thermocouple thermometer may be used for body temperatures if the end wires are well covered with silicon sealant, thereby protecting the lizard from internal puncture wounds.

**2) Individual Lizard Vital Statistics**

*Each student* must participate a minimum of six times as part of the “lizard weighing-and-measuring team” that assures that all requisite data on all lizards caught that day or the day prior are properly recorded, and the lizard is returned to its capture location within 30-48 hours. Each student must be the scribe at least once. Note that many lizards will be tested for behavioral traits and physiological capacities, and their fecal material must be carefully collected and labeled prior to returning them to their capture locations.

###  3) Lizard Risk Aversion / Risk Proneness tendencies and Lizard Sprinting-and-Recovery Abilities

### Class size and time permitting, each student must assist in each of these two experiments on three separate occasions during the field course. It is expected that the efforts will require about one hour each time. One research team may be focused on this research, and their efforts will be far more extensive. It is incumbent on each student to understand the rationale for studying risk aversion and risk proneness and the lizard evasion abilities. Explication of these phenomena are available on canvas website for the course.

 **4) Plant Census, Identification, Mapping, and Measuring**

 Each student will work as a part of an entire “class-as-team” project, when weather is cool and cloudy. We must accurately and precisely map and measure at least one 40 meter-wide swath on the north side of the presently mapped study site; this effort will complete an intermittent, decade long effort to census all perennials in the core two hectares on the study plot. This work will greatly facilitate understanding of spatiotemporal patterns of arthropods and lizards in current and future student research, and will be valuable for studies of the community ecology of perennial plants. Moreover, with a census, we will be able to compare the efficacy of two plant sampling techniques, the line-intercept method and the belt-line transect method.

# Biol 408, Ecological Methods, Part I

# *Describing plant distribution and abundance by census, with comparisons to two expedient techniques.*

The initial objective for studying the biotic component of the lizard habitat (i.e., plant ecology), as part of the Ecological Methods field course is to perform an actual census for a 40m x 150m area; thereby adding substantially to the area of the 100m x 100m census performed in 2001 and the added censusing in 2003. This work will probably be done from 0700 to 0800 on several days, and 2100 to 2230 on several days, and perhaps from 1600 to 2230 on a couple of days, plus whenever cool weather interferes with catching and watching lizards (thus perhaps extending the morning effort).

Once the census of the 4 ha plot is completed, students can begin to compare simulated line-intercept and belt-line transect methods on each meso-habitat (we also have some actual data from such efforts in the field). For example, we can compare these methods for three dunes, the sandy flats and for three patches of hardpan. Thus, a specific objective of this plant research is to assess the efficacy of at least two expedient methods for measuring plant distribution and abundance.

Obviously, this vegetation mapping project performed by the entire class will produce a known distribution of perennial plants (focused on shrubs) that can be used for the other objectives of Biol 408 and for Biol 409, wherein we must assess the microhabitat use of the animal species that we will be surveying (i.e., lizards and ants, especially).

***Before leaving for the field we must:***

* Prepare data sheets for measuring and mapping plants
* Learn the dominant plants of the Alvord Basin (shrubs, grasses) using the reference materials and plant collection (common and scientific name)
* Develop equipment list for survey methods
* Develop a basic understanding of how the field data will be analyzed, and what sample size will be needed

Place Additions and Changes to foregoing plans here: **Biol 408, Ecological Methods, Part II**

Document Nanoclimate & Investigate Operative Environmental Temperatures

The overall objective is to understand the levels of abiotic stress and extremes of solar radiation and environmental temperatures, insofar as they affect spatiotemporal patterns of lizards. Thus we must develop a plan to measure a range of microhabitat-microclimate (nanoclimate) conditions with thermocouples, iButtons, and solar radiation meters, and we must learn to operate thermocouple thermometers and the Campbell Scientific, Inc. (CSI) equipment used to monitor microclimate (the local weather conditions) and nanoclimate. The specific objectives related to other parts of Biol 408 and to Biol 409 are to utilize the data gathered to determine when and where lizards, ants, and grasshoppers cannot be active, and where activity is best performed with a minimum of effort thermoregulating.

The effect of nanoclimate on lizards is predicted with the use of hollow copper models of general size, shape, and color to match lizards. These models reach equilibrium temperatures similar to lizards and they reach that temperature at least as fast as live lizards. The data from these copper models allows us to predict the “operative environmental temperature” for any location that a lizard could occupy. Thus we can predict where and when a lizard can remain stationary, given that we know the range of body temperatures accepted by field-active lizards.

***Before leaving for the field, we must:***

* Design a sampling scheme for characterizing microhabitats, and for measuring a range of representative microhabitat temperatures and solar radiation levels.
* Build copper models of lizards for use in the field as ”environmental thermometers”
* Develop data sheets for manual data entry.
* Test out model response to different conditions using manually operated equipment in the lab, and record the data using your data sheets.
* Learn basic operation of the CSI datalogger and weather station.

Place Additions and Changes to foregoing plans here:

Biol 408, Ecological Methods, Part III

Develop Standardized Methods to Analyze Arthropod & Rodent Distribution & Abundance

1. **Using pitfall trapping to document distribution and abundance of ground-surface-using arthropods.** This research is especially helpful for understanding the spatial patterns of *Aspidoscelis tigris* foraging and for discerning mesohabitat patterns of ant distribution and abundance, obviously relevant to the spatiotemporal patterns of *Phrynosoma platyrhinos*. The pitfall trapping can be used to compare:
2. open ground v. under plants (mandatory)
3. under mid-to-base of large perennials (or patches of plants comprising mostly one species) v. near perimeter of large perennials
4. areas of dense litter concentration v. sparse litter concentration
5. large v. small plant patches (mandatory)
6. mesohabitats (e.g., dunes, hardpan, sandy flats; this also is mandatory).

***Before leaving for the field we must:***

* Prepare data sheets for measuring plants and documenting precise pitfall trap locations.
* Learn the dominant plants of the Alvord Basin (shrubs, grasses) using the reference materials and plant collection (common and scientific name)
* Develop equipment list for survey methods.
* Develop a basic understanding of how the field data will be analyzed, and what sample size will be needed.

Place Additions and Changes to foregoing plans here:

1. **Using sticky traps to document distribution and abundance of vegetation-using arthropods.** This research is especially helpful for understanding the spatial patterns of all lizards in their foraging and for discerning mesohabitat patterns of grasshopper nymph distribution & abundance, which is obviously relevant to the spatiotemporal patterns of *Gambelia wislizenii*. The sticky traps can be used to compare:
2. Captures in different portions of plants
3. Captures in different species of plants
4. Captures in large v. small plant patches
5. Captures in plants from different mesohabitats (e.g., dunes, hardpan, sandy flats.

***Before leaving for the field we must:***

* Prepare data sheets for measuring plants and documenting precise pitfall trap locations.
* Learn the dominant plants of the Alvord Basin (shrubs, grasses) using the reference materials and plant collection (common and scientific name)
* Develop equipment list for survey methods.
* Develop a basic understanding of how the field data will be analyzed, and what sample size will be needed.

Place Additions and Changes to foregoing plans here:

1. **Documenting spatiotemporal patterns of ant distribution and abundance.** This research is especially useful for understanding diet choice of *Phrynosoma platyrhinos*, given that ants are the principal prey items of this lizard species.

The work on ants, as related to *Phrynosoma*, requires us to

1. Map and identify the “species” of each ant colony on nine10x 40m plots and one 60 x 60 m plot.
2. Determine relative levels of activity within each “species” through at least three “phases” and perhaps up to six “phases” of the day (this requires video-recorded counts of ants near the nest).
3. Develop a reliable method for determining relative abundance among colonies, both within and among species (this requires video-recorded counts near the nest).
4. Develop a reliable means of determining the typical foraging distance and relatively reliable limits to foraging distance for the “typical” colony of each “species” of ant.
5. Develop reliable methods for comparing abundance of ants among mesohabitats and microhabitats (pitfall trapping in each mesohabitat and among microhabitats is one method)

***Before we leave for the field we must:***

* Prepare data sheets for mapping ant colonies and measuring abundances.
* Develop equipment list for your survey methods.
* Develop a basic understanding of how the field data will be analyzed, and what sample size will be needed.

Place Additions and Changes to foregoing plans here:

##### Document spatiotemporal distribution and abundance of grasshoppers. This work (and sticky traps) is especially useful for understanding how grasshoppers affect the diet choice and foraging patterns of *Gambelia wislizenii*. The data on grasshoppers may also enable us to interpret foraging patterns of *Aspidoscelis tigris*, and thus, the saurophagy (lizard-eating) of *Gambelia*.

#####  The general objectives for investigating grasshopper spatiotemporal patterns will be to determine,

##### within each readily identifiable mesohabitat:

##### how many and when each “species” of grasshopper and life stage of grasshopper can be found on the most common plant species and on the ground, and

##### precisely where each type of grasshopper is, and precisely what each type of grasshopper is doing when it can be found, particularly when it is most vulnerable to lizards.

# *Before leaving for the field we must:*

* Prepare data sheets for documenting the grasshopper surveys.
* Learn to identify the common grasshopper “species” and their nymphs and adults of both sexes.
* Learn the dominant plants of the Alvord Basin (shrubs, grasses) using the reference materials and plant collection (common and scientific name).
* Develop equipment list for your survey methods.
* Develop a basic understanding of how the field data will be analyzed, and what sample sizes will be needed.

Place Additions and Changes to foregoing plans here:

1. **Malaise Traps** may be used, with and without blacklights, to learn more about the more volant insects and to improve our knowledge and understanding of the species diversity of arthropods that may be available to the lizards. Because the immature stages of insects are not volant, some of these insects may be available to the lizards, yet may be unlikely to fall into pitfall traps or be caught on sticky traps. Thus, the malaise trap may prove a valuable addition to our array of techniques to document arthropod diversity in the Alvord Basin.

# *Before leaving for the field we must:*

* Prepare data sheets for documenting the malaise trapping.
* Develop equipment list for your survey methods.
* Develop a basic understanding of how the field data will be analyzed, and what sample sizes will be needed.

Place Additions and Changes to foregoing plans here:

1. **Developing Field Methods to Document distribution and abundance of rodents:**

Comparing strategic use of **Game Cameras**, **Field surveys** with Red LED Spotlights and IR Night Vision Scopes, and **Sherman Traps** to document rodent species richness and productivity from the sage-dominated sandy flats mesohabitat into the greasewood-dominated dune mesohabitat. Field methods may support an M.S. student’s research.

### Biol 409, Research in Reptile Ecology

Student research teams will focus on one of three lizard species, and in 2018 will focus on most of the research topics listed below for that species:

1. *Phrynosoma platyrhinos*: We will document microhabitat, nanohabitat, and substratum use by desert horned lizards throughout the daily activity period and investigate how the lizards’ spatiotemporal patterns relate to environmental temperatures (and perhaps to operative environmental temperatures of copper models of lizards) and to the distribution and abundance of their prey (principally ants). Frequent standard plot searches by the entire class to find lizards, ant nest entrances and document ant activity will be necessary. Moreover, we will have telemetry equipment to aid us in locating and observing lizards. Lizards will be recaptured daily or every other day at dawn to inspect the transmitter and also to express fecal pellets from lizards. These fecal pellets contain the heads of each ant eaten, thus we can document how many ants of each available species is eaten. If *P. platyrhinos* are post-reproductive, we will use powder tracking that will enable precise knowledge of microhabitat, nanohabitat, and substratum use. If *P. platyrhinos* are still in the midst of reproduction in early July, we will focus our radiotelemetry efforts on females, with the intent of a) documenting their long-distance movements to lay their eggs far off of their home range, and b) document the weight loss and level of debilitation in females brought on by reproduction and stomach worm infestation. We also may embark on a study comparing the effects of nematode parasites on foraging and energetics, with grad student involvement.
2. *Aspidoscelis tigris*: We will try to investigate microhabitat use while foraging, along with assessments of risk aversion / risk proneness tendencies at first sighting and while foraging (we have to document our own movements and behaviors in this process as well). We will try to document behavioral performance patterns of wariness, avoidance and evasion of predators {e.g., a) rapidly dragged fake lizard, b) a pursuing human} under natural field conditions. We will study sprinting-and-recovery abilities by experiments involving repeated chases in enclosed raceways on natural substratum, and we may compare full-tail v. broken-short tail whiptails on agility-turns and survivorship . Operative environmental temperatures may be documented if either TA or course instructor are also integrally involved.
3. *Gambelia wislizenii*: We will document microhabitat, nanohabitat, and substratum use by leopard lizards throughout the daily activity period and investigate their spatiotemporal patterns with environmental temperatures and the distribution and abundance of their prey (lizards and grasshoppers). We also will correlate actual lizard body temperatures (measured with a rapid-registering cloacal thermometer), environmental temperatures, and operative environmental temperatures of *G. wislizenii* models. We will use high-speed digital video to document detection and pursuit of grasshoppers, small snakes & lizards, shiny rolling-and-bouncing objects, and fly-fishing lures without hooks. We may use snake models and bird models to simulate approach of a predatory snake toward a *G. wislizenii*. We will examine sprinting-and-recovery abilities by repeated chases in enclosed raceways on natural substratum and relate those patterns to field experiments on prey pursuit and capture by *G. wislizenii*.
4. *Crotaphytus bicinctores*: We will document microhabitat, nanohabitat, and substratum use by collared lizards throughout the daily activity period and investigate their spatiotemporal patterns with environmental temperatures and the distribution and abundance of their prey (lizards and grasshoppers). We also will correlate actual lizard body temperatures (measured with a rapid-registering cloacal thermometer), environmental temperatures, and operative environmental temperatures of *Crotaphytus bicinctores* models. We will use high-speed digital video to document detection and pursuit of grasshoppers, small snakes & lizards, shiny rolling-and-bouncing objects, and fly-fishing lures without hooks. We may use snake models to simulate approach of a predatory snake toward a *C. bicintores*. We may examine sprinting-and-recovery abilities by repeated chases in enclosed raceways on natural substratum and relate those patterns to field experiments on prey pursuit and capture by *C. bicinctores.*
5. *Sceloporus occidentalis*: We will document microhabitat, nanohabitat, and substratum use by these lizards throughout the daily activity period and investigate their spatiotemporal patterns with environmental temperatures and the distribution and abundance of their potential predator, *Crotaphytus bicinctores.*
6. *Sceloporus graciosus*: We will compare antipredator behavior and locomotory abilities of two populations of *S. graciosus*; those sympatric with *G. wislizenii* versus those that are allopatric with *G. wislizenii.*

***Rationales for the research, including the questions asked, hypotheses proposed and methods to be used will be developed prior to leaving for the field.*** Methods will be further modified when in the field so as to optimize research productivity for both *Ecological Methods* and *Research in Reptile Ecology*. It will be imperative to balance work between both courses.

**Pre-trip Itinerary for Biol 408 & 409 in Summer 2018**

**Tuesday, 19 June 2018, 0815-1215 hrs and 1315-1715 or later (*e.g*., 1815)**

 **Course Introduction**

 Student Introductions

 The course objectives (desert lizards as model systems in a model field system)

 Safety

 Individual Gear

 Choosing Teams & projects

 **Reviewing course procedures**

 The Study Site

 Camp set-up

 Plot set-up

 Capture-Measure-Mark-Release-Resight-Recapture

 Field Notebooks

 Capture Notebook

 Lizard Body Data Notebook

 Location & Release Notebook

 Pitfall Trapping Notebooks

 Microclimate & Nanoclimate Notebook or Datasheets

 Plant Census & Mapping Datasheets

 P**ast Student Research**

 Team Research Projects

 Questions & Hypotheses

 Data collection objectives

 Equipment & Supplies Used

 Field Data Sheets

 Lab Excel Files

 Grasshopper Survey Notebooks

 Ant Survey & Activity Notebooks

 Lizard Radiotelemetry Notebooks

**Wednesday, 20 June 0815-1215**

 Detailed Introduction to Alvord Basin Lizards & Introduction to Alvord Basin Plants

**Wednesday Afternoon, 20 June, 1315-1715**

 Study lizard specimens

 Review Plant Specimens

 Put together field belts & begin some inventory

 Learn how to use GPS units & hand-held anemometers

 Van Safety Learning, on-line, perhaps

Lab Safety Learning, on-line

**Thursday Morning, 21 June, 0815-1215**

 Deoxidize & repair thermocouple wires and plugs

 Learn how to use thermocouple thermometers & junction boxes, calibrate them

 Informal, within-team quiz on Lizards

Introduction to Terrestrial Arthropods

 Review Posters and literature relevant to Team projects

 Review Plant specimens

**Thursday Afternoon, 21 June, 1315-1715 or later**

 Learn how to use non-contact infra-red thermometers and light meters

 Informal within team learning and quiz on plant identification

 **Examine Ants**, review Arthropods

 Develop Team Research Plans, develop research rationale (intro to proposal)

**Friday Morning, 22 June, 0815-1215**

 (Dr Anderson & Field Assistant Matt McTernan pick up WA state van in Olympia)

Review past work, develop team research plans, develop research protocol (methods)

 Build equipment & supplies list for team research

 Become proficient at identifying ants & arthropods

**Friday Afternoon, 22 June, 1315-1715**

 Review Team Research Plans with Dr A (further develop methods)

 Begin Inventory Inspection & Repair for Team Research

 Learn how to use hand-held light meters, weather stations

 Student pairs quiz on Ant & Arthropod Identification

**Saturday, 23 June, 0815-1615 (bring bag lunch)**

Develop Methods with descriptions of what data are to be collected, how data are to be

 collected, develop & complete preparation of field data sheets.

 Complete list of Instrumentation & Equipment for Team Research

 Inspection & Repair of Team Research Inventory

 Practice using field notebooks and practice **lizard catching** on WA coast near Marysville

**Saturday Evening, 23 June, 1830-2130**

 Field Course Barbecue at the Anderson home

**Sunday, 24 June**

Review checklist of personal tasks to attend to before you leave, begin tasks

Final review list of items to take along or share on field trip, and make your last purchases

Pack your personal gear, and try getting to bed early (before 2300 hrs)

**Monday morning, 25 June, 0815-1215**

 Complete inventory and perform final inspection of all Field Course Supplies & Equipment

 Refer to more precise instructions on next page; develop to-purchase list for supplies

All team members finalize your goal of proficient use of research instrumentation

 Go retrieve personal gear (use van at midday, if needed) to campus by 1300 (or earlier, by 0800)

**Monday Afternoon & early Evening, 25 June, 1315-1915 or later**

 Review Food Purchase-and-Inventory Lists

Carefully Pack all gear into appropriate containers

 Buy Food

 Pack vehicles, get to bed early.

**Tuesday Morning, 26 June, 0500 hrs, yes, 0500 hrs!**

 We Leave!

**Instructions for Inventory Day, June 25**

On Monday morning, 25 June 2018, please be sure you have completely developed the list of field research items you need for your research projects, both for Biol 408 & 409 (re-read the syllabus).  Download useful files to one of the external hard drives and to one of the laptop computers. You should be building your binder for your team’s Research Project Notebook. Please include useful documents from the Canvas Course website, and develop a suitable Introduction (*i.e.,* rationale and background to your specific research questions and then the questions presented in hypothesis-testing format) and Methods (include your list of research materials). You will need to develop these ideas well enough to articulate them on camera…

Please have your yellow field notebook labeled and insert the field course version of the sighting & capture data instructions.

You will need to make all of the many necessary copies of your data sheets for grasshopper surveys, ant surveys and the prompts for the lizard focal observations and the data sheets for your field experiments.

Recall for Biol 408 that we will be pitfall trapping, plant mapping, and measuring arthropod abundance and activity and using a variety of means to document microclimate and nanoclimate (portable weather station and hand held units for wind speed & direction, insolation, humidity, air and soil temperatures (thermocouples & i-buttons), rainfall, and more.

Be sure you know whether you will be able to coordinate the logistics in the field for video data retrieval & storage (consider video documentation of ant activity, lizard behavior in focal observations, and documenting lizard locomotion in field and raceway experiments). That is, you will need to consider recording time requirements (GB of memory card, how long batteries support video-recording, how many GB you will need for all projects when in the field, consider sample sizes, *etc*…).

We will need to test all equipment, learn how to use it (be sure we have paper and scanned pdf copies of all manuals), and be sure we have all the electronic power sources and connectors (for ac & dc) inventoried.

All rechargeable batteries (AA to large 12 volt batteries) must be fully charged before we leave.

We need to be sure we have all of the parts and accessories for the HOBO weather station; we need to check my lab to be sure to see if any the pieces of the Campbell Scientific Weather station are here (they may be in storage in Fields).

Be sure we inventory all the accessories for the high speed digital video cameras and that we understand what is needed for the process of downloading (e.g., connectors and disk space needs). Note that we need to have the ac plug carefully and completely screwed in.

We need to be sure all of the handy cams have adequate supply of batteries (1.5 batteries per handy cam).  Note that there are several models of handy cams and they could require different cards, batteries, and chargers.

The inventory of items must become more detailed than it is currently, and pre-existing errors clearly need correcting. Inventory must be satisfactorily completed by 1300 on Monday (this includes an excel list of the name/id for all lizard bags and any other special instructions listed on canvas).

Before 1300 on Monday we will need to be sure all thermocouples are de-oxidized. All thermocouple thermometers must have been tested against mercury thermometers for 0-70 C.   Before 1300 on Monday we must have learned how to use the i-buttons, set up an inventory of all i-buttons in an excel spread sheet to permit us to categorize them.

At 1400 we will need to discuss food & beverage for the trip. We will need to begin purchasing food at 1500. We will begin loading at 1700-1730 with the intent of being done by 1930. We will need to work until the Van, the Ford Explorer, and the Field Course Trailer are packed. Note that I have not seen either the bag of ropes or the bag of bungee cords. We also need a couple of tarps. If they did not get packed for the return trip last year, then we will need to get such items so that the trailer can be secured. I’ll return with van at 11:30. Call me if you have questions.

**Most of the tasks in Biol 408 & 409 Laboratory after return from the field:**

1. Unload equipment, clean van, clean equipment & return equipment BI 351 or Loading Dock cage.
2. Photocopy & pdf-scan (increase contrast/darken all copies & slightly reduce page size on full pages; be sure to leave space for 3-hole punch) all notebooks and data sheets, place originals and photocopy in separate white, 3-ringed binders, and label binders.
3. Download weather station data and transfer data to excel.
4. Download i-button data and transfer data to excel.
5. Transfer digital videos to a hard drive on a lab computer or the large external drive in BI 351.
6. Dry & weigh all *P. platyrhinos* fecal pellets, and measure intact *P. platyrhinos* fecal pellets; enter data in excel.
7. Select up to 3 fecal pellets per every P.p. sampled (thus identifying and counting prey in 1, 2, or 3 fecal pellets, comprising a total of 100 to 200 ants; be sure to weigh also the rocks, urates, and other materials in the pellet, then enter those data so those weights can be subtracted from the “pellet” weight ); the *Pp & the ants* team must complete the analysis of a *minimum* of 3 pellets per individual and must analyze all fecal pellets for radio-tracked individuals; data must be entered into excel & carefully edited.
8. Enter into excel all lizard sightings and search data, and careful edit the data; be sure to calculate person search time per each hour or time period of the day.
9. Enter into excel all lizard body-measure data and carefully edit.
10. Enter into excel all grasshopper sightings data from the nine 10 x 40 plots, and carefully edit data.
11. Enter into excel all ant sightings data from the nine 10 x 40 plots, and carefully edit data.
12. Compile all abiotic, weather-related measures into a single excel file.
13. Dry & weigh all fecal pellets of the other lizard species; enter data into excel; carefully edit data.
14. Transduce videos of focal observations of lizards into data which then can be transcribed into excel files.
15. Transduce videos of prey and faux-prey encounters with lizards into data which then can be transcribed into excel files.
16. Transduce videos of emergence of lizards into data, so later we can transcribe into excel files.
17. Transduce videos of ant colony activity, then transcribe data into excel files.
18. Develop powder track data sets for distances, directions, mesohabitat, microhabitat, nanohabitat, substratum, lighting conditions, and more and enter data into excel.
19. Label and derive data from all digital photographs taken of lizard locations & pathways.
20. Download GPS waypoints & make home range maps of radio-tracked *Phrynosoma platyrhinos*.
21. Develop basic graphs to visualize patterns in our data sets.
22. Try some preliminary statistical analyses.
23. Thoroughly document research methods, and re-state research rationale (e.g., Introduction).
24. Offer suggestions for research by students in next year’s field courses.
25. Be sure each person taking samples, entering data, and editing data is identified on the data sheet and on the excel spread sheet, along with the data and time the task is completed.
26. Archive all video and data files on a lab computer & external hard drives.