

**Be empowered!
Be able to get that job!
Be able to get into that grad program!**

How?

Deepen & Diversify your Research Skills & Abilities

But How?

**Summer, 2018,
enroll in
field research courses:**

Ecological Methods & Research in Reptile Ecology!
(12 total credits)

(with Dr. Anderson, Biology Department, at Western Washington University)

Roger.Anderson@wwu.edu

Radiotrack & Powdertrack



Research Teams



2 Lizard Marking Methods

Summer Field Research Courses!

Summer 2018!

Campus: WWU
Field: Fields, OR

Pit-trap insect prey



Capture-mark-measure-release



Steens Mt

Field Research: 6/26 – 7/21

Ecological Methods + Research in Reptile Ecology = **the Perfect Summer Courses!**



Ecological Methods !



Ecological cause-and-effect relationships *are ideal* for study in simple systems like desert scrub.

Study Bite Force!



Research in Reptile Ecology!

10 Species



Data-rich Research!

6 weeks:
6/19 – 8/03

Lizards are **superb** study animals for behavioral & physiological ecology.
Lizards are **excellent** subjects for population and community studies.

Two Integrated Research Projects

<http://myweb.facstaff.wwu.edu/rogera/>
<http://fire.biol.wwu.edu/anderson/description.htm>

Roger.Anderson@wwu.edu

Study Whiptail sprinting with hi-speed digital video



Track Desert Horned Lizards to study prey choice



Leopard Lizard is eating Whiptail Lizard

Study Behavior: Focal Observation & Field Experiments



Whiptails can unearth, kill & eat scorpions

Western Whiptail Lizard

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- Frame intriguing questions about organismal, population, and community ecology.
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- Develop the ability and confidence to analyze the methods and evaluate results of ecological research performed by others.
- Receive 12 credits, and have a reduced subsequent course load, with greater academic flexibility in the coming academic year.
- Have your resume strengthened by virtue of the field course experience, thereby making you more attractive to graduate programs and employers.
- Pursue follow-up research with Dr. Anderson via a senior thesis or via Biol 494 & 495, and develop results for publication, opening your career opportunities even further.
- Receive a highly credible letter of evaluation and recommendation from Dr. Anderson, who will have nonpareil knowledge of your skills and abilities.

**This page is in
paper near BI 351**

The day before we leave, all items are inventoried and packed. Dr. Anderson now rents a storage unit in Fields to house most of the camping gear & some of the field research gear, thus reducing costs & logistical challenges.



The drive to field site in Oregon includes great views like the south face of Mt Hood



**The field & research gear are hauled annually by Ford Explorer & Field Trailer.
Both are used exclusively for this field research.**



Rainbow over Prineville, OR, on the way to Fields, OR



After the first week in the field, we take a trip to Burns, OR to buy groceries, wash clothes, and shower & swim & sample restaurant food.



Horses at a BLM Corral, near Burns, OR, waiting for adoption



The diversity of color patterns among these erstwhile wild horses is delightful.



Hay field east of Burns, OR



**Lake Malheur is SW of Burns & NNW of Steens Mt.
It is famous as a bird watching destination, especially during seasonal migrations.**



Cattle & mule deer are a driving hazard, especially at night



Moving the herd



Fields Station is just a few km from the study site.



Fields Station

Frenchglen Hotel in Frenchglen, OR on the west side of Steens Mt



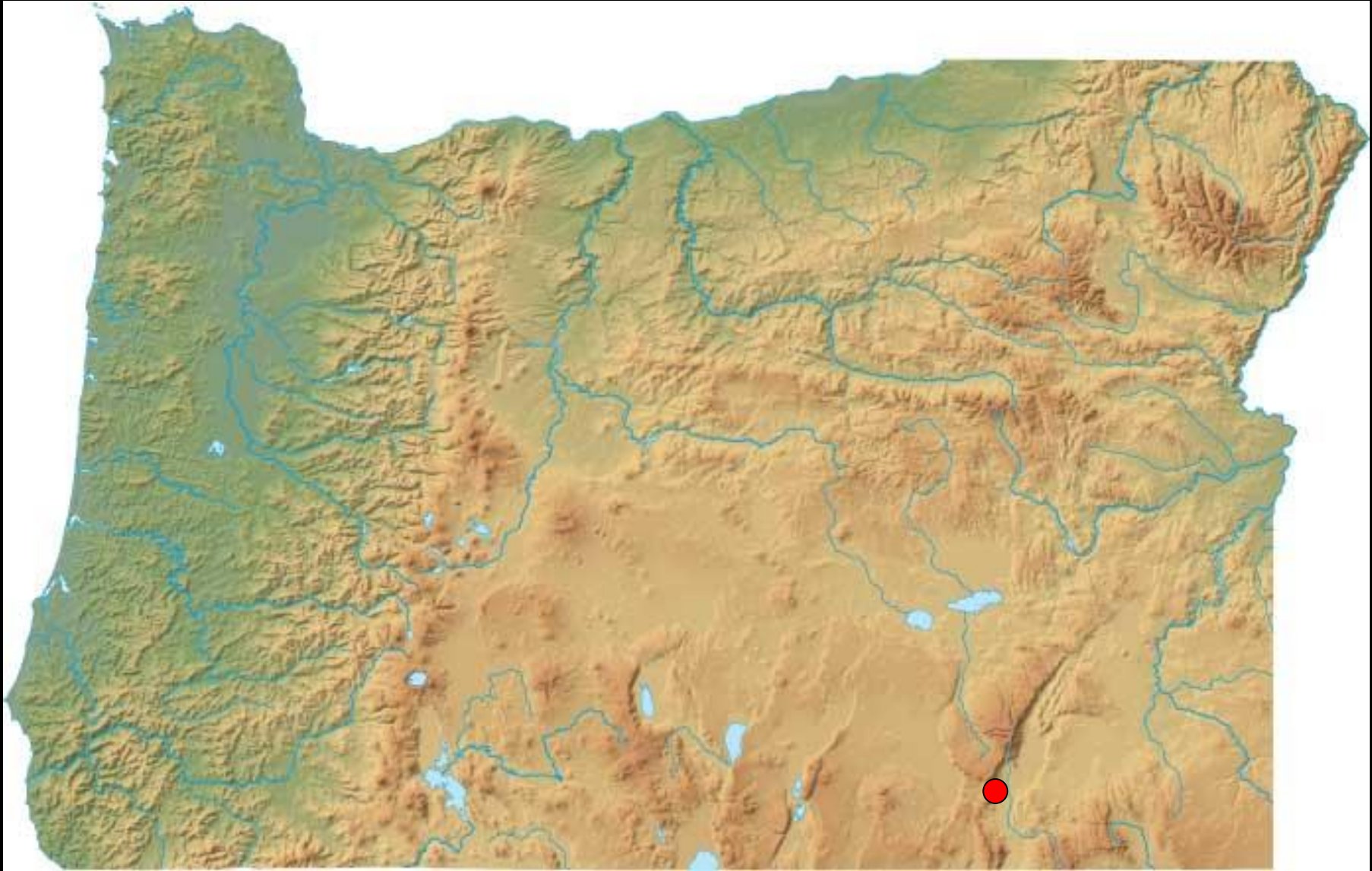
Motel,
Fields, OR



Fly-ins for breakfast or lunch are welcome at Fields Station.

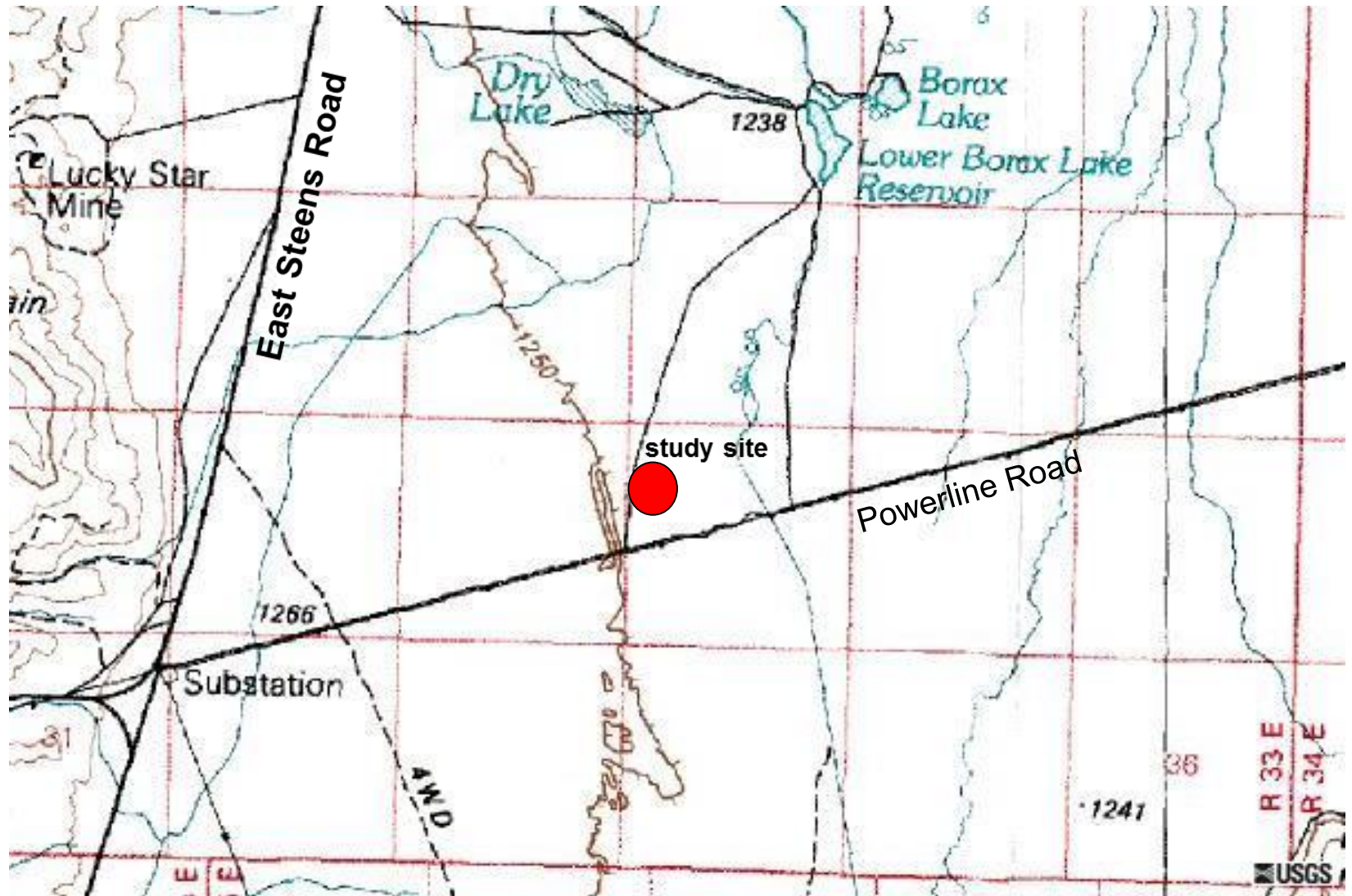


**The study area is in the Alvord Basin, Harney County, Oregon.
The site is at the northern extreme of the Great Basin Desert Scrub.**



<http://www.oregon-map.org>

The primary study site (red dot) is a few km NNE of Fields, OR, and east of the intersection of Catlow Valley Rd & East Steens Rd



View to the west from one of the tall dunes just SE of the field site

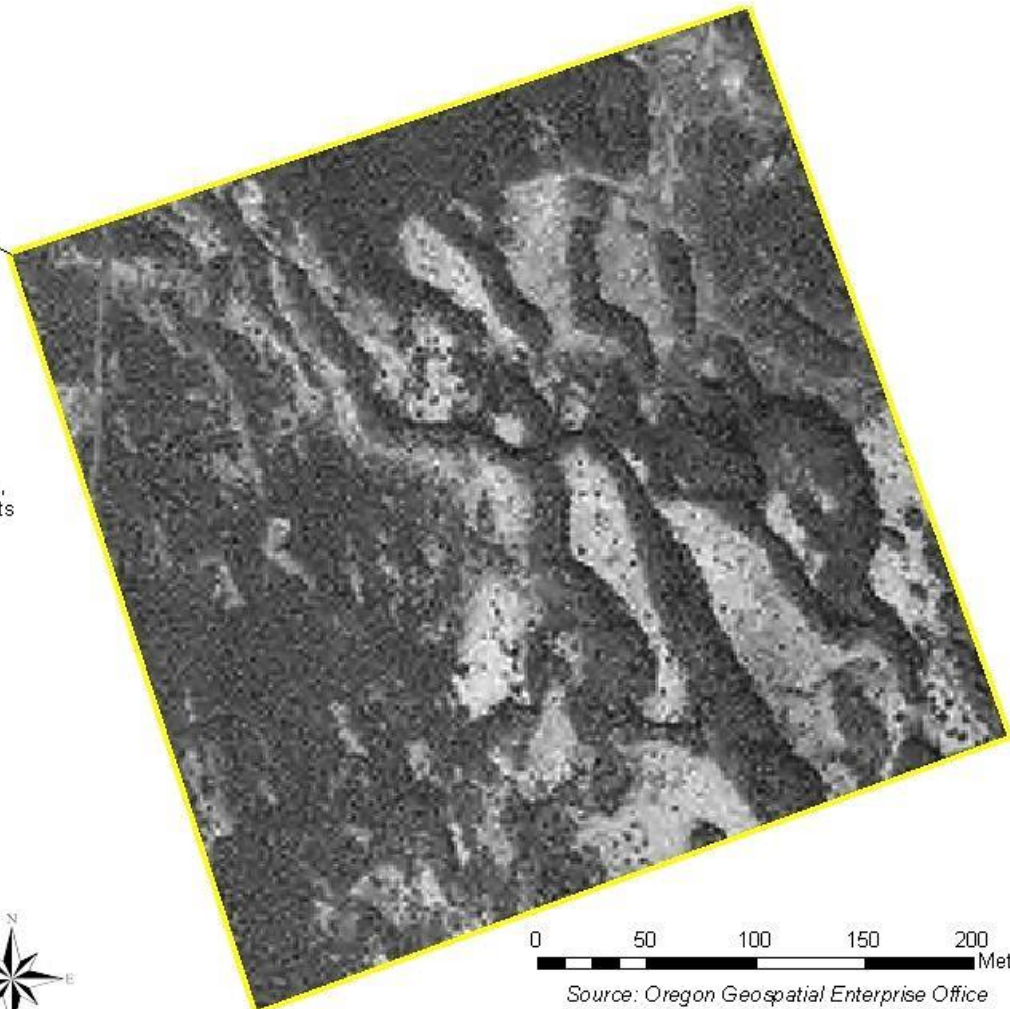





Alvord Basin Study Site, Harney County, Oregon

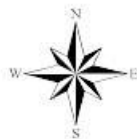


State of Oregon

The study site is approximately 6.25 hectares, and consists of three identifiable mesohabitats (dune, hardpan, sandy flat).



-  Plot Boundary
-  Oregon Counties
-  Harney County

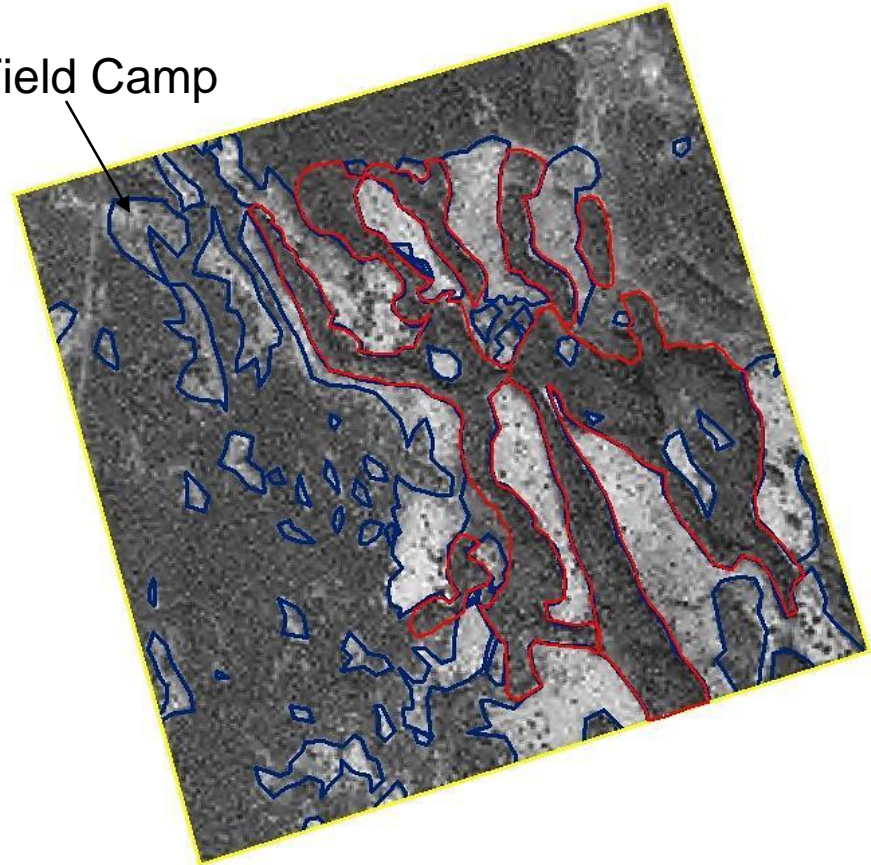


0 50 100 150 200 Meters

Source: Oregon Geospatial Enterprise Office
Projection: NAD 1983
Created by: Jennifer Korenek

Mesohabitat patterns in an area that includes the 200 x 200m study site in the Alvord Basin

Field Camp



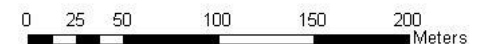
Mesohabitat Type	Percent
Dune	16
Hardpan	33
Sandy flat	51

 Plot Boundary (6.25 ha)

 Hardpan

 Dune

Sandy flat



Source: Oregon Geospatial Enterprise Office
Projection: NAD 1927
Created by: Jennifer Korenek

Overview of Central Camp & North End of Study Site



Overview of Central Camp



Van

Shade
Tarp

Field
Trailer

Kitchen

Shade
for
coolers

Hard Pan Basin

Dune

Aerial visitors over Central Camp came from Alvord Dry Lake



**Alvord Dry Lake,
better known by the
misnomer “Alvord Desert”
is a recreation destination for
wheeled , winged & balloon
vehicles.**

**ADL is in the basin just SE of
the peak of Steens Mountain, &
just S of Mickey Hot Springs**



In early years of the field course experience, a department van was used to transport students.

In recent years we have rented a van from the state motor pool.



Usually only Dr. Anderson is awake to see the beauty of dawn—about 0515 hrs



Because we arrive on site just after the summer solstice, it is fun to watch the sun rise farther south & later on each successive day during our 24 mornings



The design of Central Camp.

Note the shade tarp on near-right, field trailer with food & gear in center, and lower shade tarp, for coolers in the distance.

The cooking area is on the east side of the hardpan, near the student.



The design of Central Camp.

Note the shade tarp on near-right, field trailer with food & gear in center, and lower shade tarp, for coolers is in the distance, on the right.

Dr A is in the cooking area, on the east side of the hardpan.



The shade tarp at central camp,
where we often weigh & measure lizards
during high sun & high heat of early afternoons



The Field Course Trailer shades tool boxes below & food inside, and stores lizard noose poles on the side.



Jenny Hauer organizing some of the foodstuffs



The Kitchen



We obtain many gallons of water daily from Fields



**We buy
8-10 bags
of ice
at Fields daily**



Lunches & breakfasts are prepared individually.



Dinners are a group affair





Moonrise

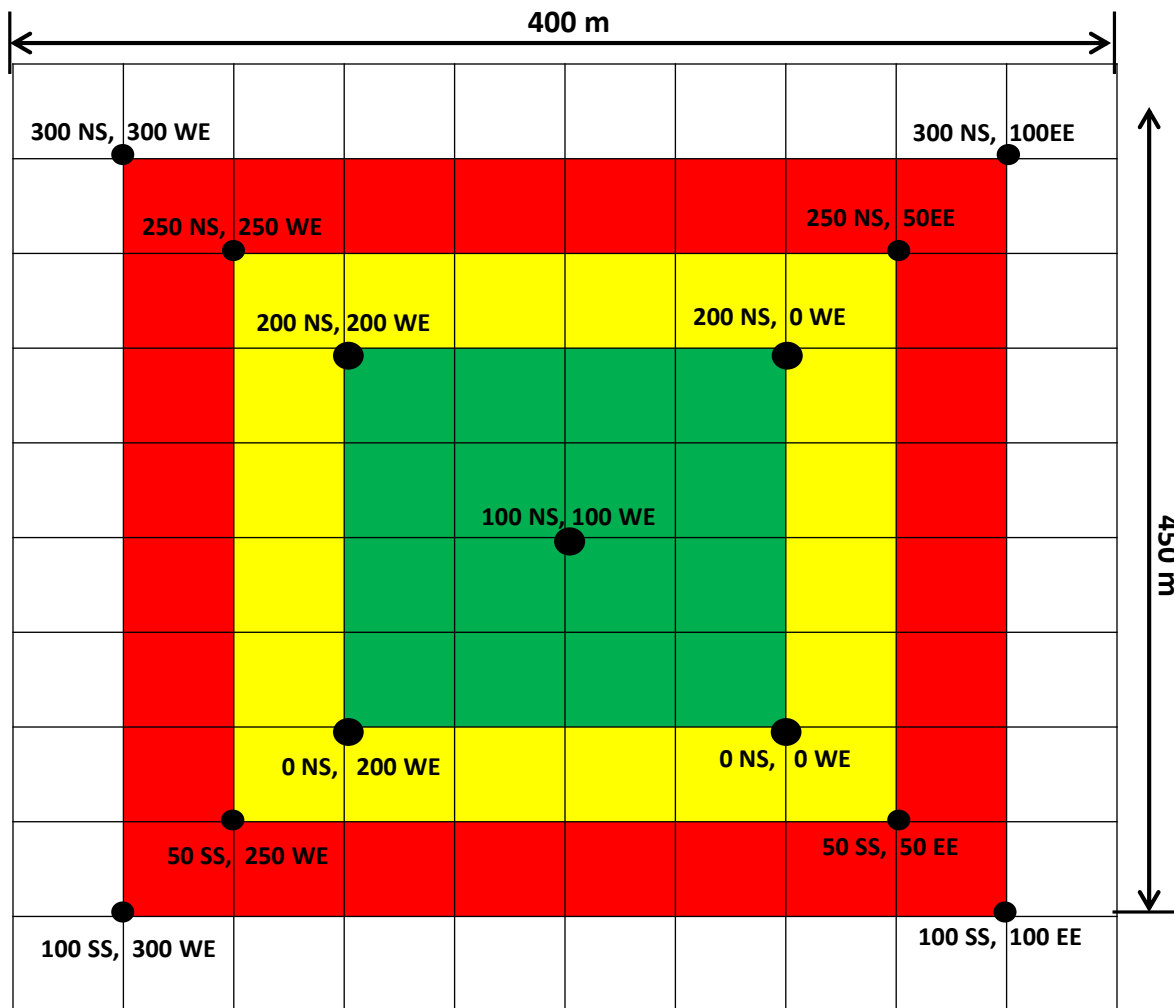
Sunrise over “the notch”



Standard plot search for lizards



Alvord Basin Study Site



Green = 200 m x 200 m core plot (4 ha) for lizard census (each square = 50 m x 50 m)

Yellow = 50 m perimeter (5 ha) for larger lizard sample sizes & home range data for core lizards

Red = External 50 m perimeter (7 ha) for *Phrynosoma* captures & unusual lizard movements

There are **90 posts** (1 at each 50 m node) for 400 x 450 m plot.

There are **912 yellow pin flags** (1 at each 10 m node) for the 300 x 300 m plot

(24 flags x 7 of the 50 m lines plus 24 flags x 31 other lines)

On the west side of the study site & upslope is the plant community dominated by *Artemisia tridentata*, Basin Big Sage.

Because the study site is an area of interdigitating and ecotonal communities, the sage-dominated areas are called “sandy flats” *mesohabitat*.



The ecotone between sage & greasewood communities



In 2003 & again in 2005, as Miku showed here, we performed major efforts at mapping & measuring the perennials.

Plans for 2018 & later will include use of aerial cameras for updating the plant ecology research.



Dr. Anderson's colleagues pursue whiptail lizard in basin big sage, *Artemisia tridentata*



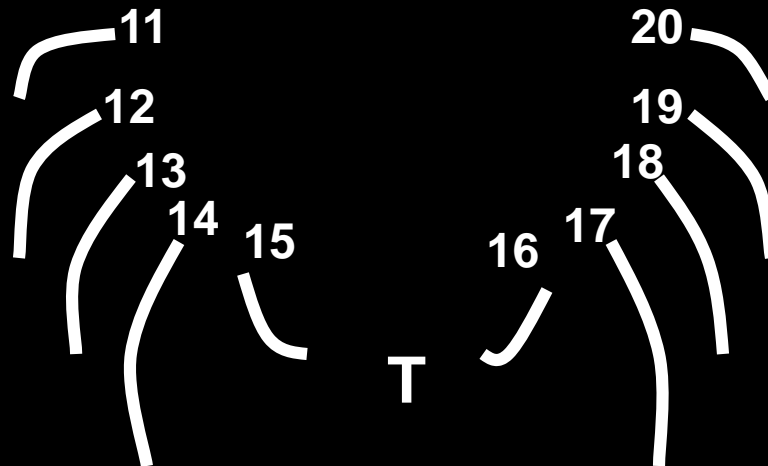
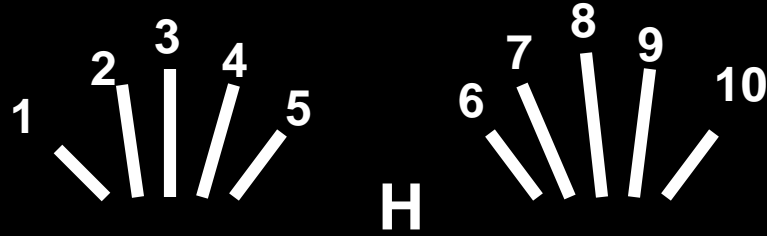
Seeking the Elusive Lizard



2005 students in the midst of a successful morning's lizard catching



**Schematic
of the
sequence
of
toe clips,
when
viewing the
dorsal
surface
(from
above).**



This slide is an example of the field-training slide show presented to students in the first few days, when students are still on campus:

Toes are counted from above.

The front feet toes are counted in a clockwise, left-to-right arc (arcing anteriorly) from left foot to right foot; the toe nearest the body on the left foot is 5 and the toe nearest the body on the right foot is 6.

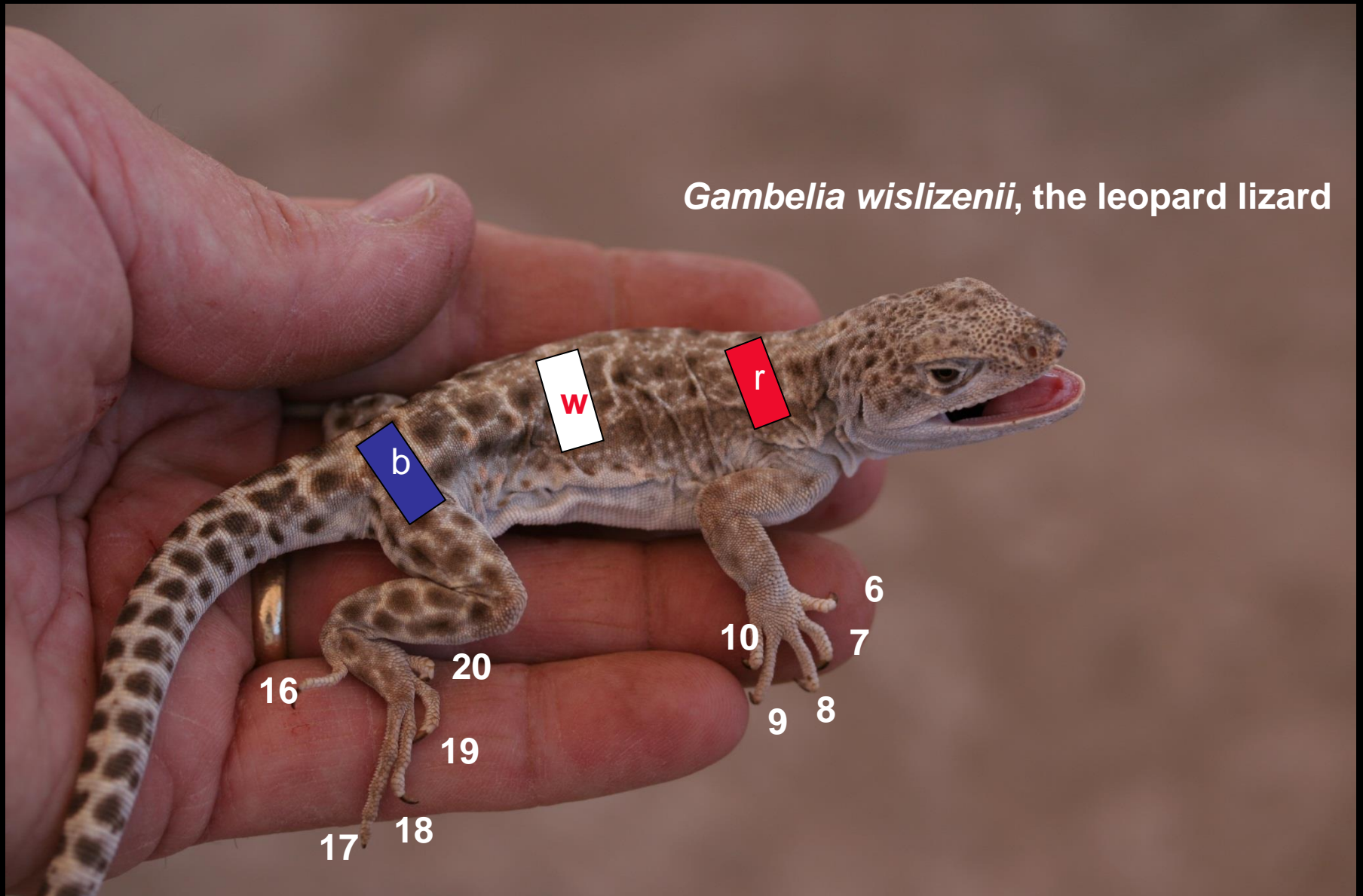
Similarly, the toes on the rear feet are counted in a left-to-right arc from left foot to right foot, but anticlockwise (arcing posteriorly), so that the toe nearest the body on the left rear foot is 15 and the toe nearest the body on the right rear foot is 16.

Thus, the longest toes are 14 and 17; these two toes are *never* to be clipped.



Paintmark ID is RWB

Note that toes 6-10 and toes 16-20 on this lizard were not clipped



Paint-code marking





Dr Anderson was a little grumpy about students paint-marking themselves with non-toxic lizard marking pens until they asked him to take a photo, in which they demonstrated two field marking methods: toe-clipping & paint-code-marking.

Radiotrack & Powdertrack



Research Teams



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Dr. Anderson's Ford Explorer & new 2011 portable toilet at NE end of base camp



View to E, just S of the portable toilet; note entrance to base camp at bottom right.



View to west, at center plot, when the 10 students were conducting a standard plot search for lizards, summer 2011.

View of the main field course camp to SSW of the center of hardpan, from where photo was taken.



SSE view of the main field course camp; photo taken to from entrance to the hardpan, and E of the road to Borax Lake, N of the powerlines.



Each field season as shown here in 2013, we catch thousands of arthropods in hundreds of pitfall traps.

We place the traps in the open and under three sizes of two species of perennials in two mesohabitats.



In years with a large class, as in 2006, we add pitfall traps to the hardpan mesohabitat in addition to the dune and sandy flats mesohabitats.



**Pitfall trap “under”
Greasewood,
Sarcobatus vermiculatus,
one of two
dominant perennials
in this
Great Basin Desert
Community**



**Each vial comprises the arthropods
that fell into a single pitfall trap**



**We radio-track
two species of lizards.**

**We study
habitat use,
foraging pathways,
activity period patterns,
burrow use,
egg-laying forays,
and more!**

**We answer important
ecological questions
via tests of hypotheses.**



The radiotransmitter was glued on the side of the tail of this female leopard lizard. She is in orange breeding coloration



Standing above the Alvord Basin west of field site, with a view of Steens Mt



Moonrise above the purple glow of mountains lit by the setting sun



After the moon descends the skies darken & the combination of dry desert air at 4000 ft elevation & the absence of light pollution reveals a spectacular show of stars.



**Scorpions on site
are not very venomous.**

**They are abundant
& easy to find at night
with a blacklight.**



The Desert Horned Lizard, *Phrynosoma platyrhinos* is very cryptic, so paint-code marks are helpful.

Remarkably, we usually see the lizard by its movement or by recognizing its body form, rather than by seeing the colors.



Horned lizards, about to be released with radio-transmitters.



The antenna and receiver



Desert Horned Lizard with Radiotransmitter



**Hairy-chested lizard,
being readied for a
powder-tracking
session.**

**We use rabbit fur,
usually obtained from
road-killed jackrabbits.**



**This attempt was in 2005, the first time we tried powder-tracking;
we applied way too much powder**



Students with black-light wands are tracking the UV-reflective powder trail left by a foraging horned lizard. That morning we had glued a fur patch to its ventral surface, applied fluorescent powder to the fur, then released the lizard.



**Adult *Hadurus* scorpion in ambush mode.
We first saw this animal glowing green, detected by blacklight wand.**



Horned lizards have large clutches

(this female died underground before she could oviposit;
her death may have been related to a heavy nematode infestation)



Each summer we discover recently desiccated remains of Desert Horned Lizards.

The combined stressors of reproductive effort & infestation by nematode parasites may contribute to their demise.

The life phases of the nematode include hatching & growing to small size in the ant, then emerging from the ant when it is eaten by the lizard, and growing to reproductive size in the lizard's stomach.



The harvester ant, *Pogonomyrmex californicus* is a large, abundant ant on site.

The ant is the intermediate host of the nematode parasite.

It is the primary prey of the Desert Horned Lizard , *Phrynosoma platyrhinos*.

Photographed by Cortney Bunch, using Dr. Peterson's amazing computer-camera



**Harvester Ants
are the primary prey
of the
desert horned lizard**



**A flagged *Pogonomyrmex* nest entrance
(we observe & video-record colony surface activity)**



These honeypot ants, *Myrmecocystus kennedyi* are common prey of horned lizards





Flag marks the GPS location of a horned lizard that was also powder-tracked



At every opportunity, we collected the ant-laden fecal pellets from *Phrynosoma platyrhinos*



Flagged powder-track trail of *Phrynosoma platyrhinos*



The beginning segment of a powder-track trail



Powder-tracked pathway of a radio-tracked desert horned lizard



**Juvenile human,
Adult horned lizard**



Hunter Steen Anderson, 2006

Hatchling Desert Horned Lizard



Hatchling horned lizard



Hatchling horned lizard





View from the east rim, with Borax Lake & Alvord Peak in the upper right of photo



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Learn by Direct Experience!

Students in
*Biology, Ecology,
Environmental Science,
Wildlife Science,
Conservation Biology*

Immerse yourself in the natural world!

Develop skills & abilities essential for conservation biology.

12 Qtr Credits

Set yourself apart from the average student!

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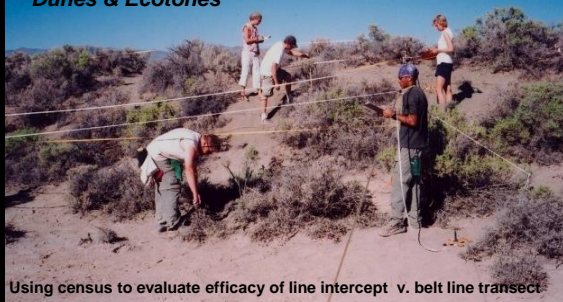
These are like no other courses you have ever taken!

- Weather station, i-buttons, & portable electronic thermometry
- Radiotracking, powder tracking, GPS & GIS
- Experiments on lizard predation & antipredation
- Pitfall trapping of arthropods
- Field surveys of ants & grasshoppers
- Methods compared for plant distribution & abundance
- Capture-mark-release-recapture methods for vertebrates

-Focal sampling of animal behavior

Ecological Methods, Biol 408

Dunes & Ecotones



**Fun & Rewarding:
Data-rich Research**

**Reptile Ecology Research,
10 Species, Biol 409**



Summer 2018

**Concurrent courses,
WWU Biol 408 & 409:
June 19 to Aug 3.**

Fieldwork: 6/26-7/21

Contact:
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**Focal Observations &
Behavioral Experiments**



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**This page is in
paper near
BI 311 & BI 351**

We use a great variety of field-useful electronic devices, such as i-Buttons for nanoclimate measures and high speed digital cameras for documenting lizard sprinting & prey capture



We chase lizards on natural sand substratum in a 20 meter raceway



**Raceway for measuring acceleration and velocity over short and long distances
In Whiptail Lizards (the prey) & Leopard Lizards (the predators)**



**Checking the camera view
at the lizard raceway**



**Clint Collins was a
volunteer researcher
in 2009.**

**He proved his mettle
chasing lizards.**

**Clint performed his
master's research on
site in 2010.**



Run Lizard, Run!



**The raceway is 20 meters long.
Lizards run on natural sand surface.**

**The raceway set-up
in 2015.**



Fields, Oregon

Hi-speed digital video of lizard predation

Field Trip 6/26 to 7/21

Leopard Lizard

Ants are horned lizard prey

Desert Horned Lizard

Western Whiptail Lizard

Research in Reptile Ecology!

Run, Lizard, Run!

Radiotracking

Ecological Methods!

Capture Measure Mark Release Methods

Research in Teams

Steens Mt

Plant & Animal Ecology

Concurrent courses:

Biol 408, Ecological Methods

Biol 409, Research in Reptile Ecology

Western Washington University

<http://myweb.facstaff.wvu.edu/rogers/>
<http://fire.biol.wvu.edu/anderson/description.htm>

June 19 to Aug 3
includes field & lab time

Summer Field Research Courses!

24 field days, 46 days total, team-research.

WWU, 2018

Summer 2018

Measure Prey Availability

Roger.Anderson@wwu.edu

Great Basin Desert, near Fields, OR

In the cape region of Baja California, this lizard is known as “The Hunter”

It forages like gleaning birds: it has excellent vision & detects small, stationary insects. Its forceps-like jaws pluck them off of vegetation and out of the leaf litter.

It has excellent chemoreception like mammals & can detect hidden, buried prey. It digs like a badger to unearth prey & dispatches scorpions as does a mongoose with cobras.

***Aspidoscelis tigris*, the western whiptail lizard**



The western whiptail lizard, *Aspidoscelis tigris* is a widely foraging lizard.





Whiptail Lizard momentarily halts foraging to increase its body temperature above 40°C.

The western whiptail lizard, *Aspidoscelis tigris*, is a wide foraging lizard seen often in the open, and can sprint at 6m/sec to evade the ambush of the leopard lizard. Note, however that the whiptail can be very cryptic in the shadows,





Whiptail on the move in open, between shrubs



This male western whiptail lizard was mate-guarding the female as she dug for prey



**The blunt-nose leopard lizard,
Gambelia wislizenii,
eats large insects & lizards.**

It is an ambush predator.

It often leaps like a cat into mid-air to capture insect prey.

It can match the speed of its lizard prey, even the fast-sprinting whiptail lizards.

Jessica Self was a student in the field courses in 2009, and was a volunteer field researcher the next year; in 2011 she performed her graduate research at the study site.

As of 2013, 10 master's thesis projects had been conducted on site. Jessica Self, K. Claire Hilsinger, Clint Collins & Phil Dugger are the most recent M.S. students.





Grasshoppers in the open



Grasshoppers on foliage

Prey of the leopard lizard, *Gambelia wislizenii*



Western whiptail lizard
Aspidoscelis tigris



Desert horned lizard
Phrynosoma platyrhinos



Predator and its prey

Grasshopper may be cryptic, but if it moves, the leopard lizard will see it



This male leopard lizard, with the warming sunlight on his back, was visually searching for movement of potential prey



BROS HU (body resting on substratum, head up) body position

**Note the toes
lifted off the
super-hot
sunlit
substratum**



This adult female leopard lizard was visually searching for movement of potential prey



FLEPOS (front legs extended, pelvis on substratum) body position



Dappled lighting on this spotted reptile reveals why it is called the leopard lizard





Female Leopard Lizard eating female Whiptail Lizard

Although western whiptail lizards can run 6m/sec to evade predators, the leopard lizard is able to catch them.



This adult male leopard lizard was captured with a semi-digested, adult whiptail lizard in its gut.

We gently extracted the prey, checked the prey for its identity, and measured it as best we could.

We slid the prey into his mouth and down his throat and he readily re-swallowed the prey.



This adult leopard lizard had laid a clutch of eggs less than a week earlier.

Earlier on this day she captured, killed, and swallowed most of an adult whiptail lizard.

The leopard lizard was caught while basking, with the tail of the lizard not yet swallowed.



Cannibalism!

This male leopard lizard ate a young female who would have been large enough to be his mate the following year.





If it were not for the orange spots, this lizard predator would be like the prey on site: cryptic (camouflaged & escaping notice by being still)



**Female Leopard Lizard, just a few days after egg-laying.
Note her regrown tail**



**Female on left, is in post-breeding coloration
The male is on the right.**



Male leopard lizard has a firm grip on this receptive female.

As happens with other females, her orange did not reach full, bright peak until several days after mating, when she was no longer receptive (warning coloration?)



Mating pair of Leopard Lizards



Gravid female leopard lizard digging a burrow deep for egg-laying



**Hatchling
leopard
lizard!**



**Juvenile human,
Juvenile leopard lizard**



**Hunter Steen Anderson
2006**

Subadult *Gambelia wislizenii*



This young leopard lizard is demonstrating an enormous mouth gape



Adult side-blotch lizard.

This species is not easily found on site, because it is furtive.

This diminutive species is a snack for both leopard lizards & whiptail lizards, both of which are abundant.



***Sceloporus graciosus*, the Sagebrush Lizard is furtive & rare, perhaps due to effective predation by the abundant leopard lizards.**





Male leopard lizard, *Gambelia wislizenii* in classic ambush predation pose.

It eats large arthropods, especially grasshoppers, and other lizards.

The collared lizard, *Crotaphytus bicinctores*
is common on the rim on the E side of the Alvord Basin



**Great Basin Collared Lizard,
*Crotaphytus bicinctores***



**The Tule Rim, on the east side of the Alvord Basin,
where the Great Basin Collared Lizard resides**



**The Tule Rim, on the east side of the Alvord Basin,
where the Great Basin Collared Lizard resides**



**The Great Basin Collared Lizard, *Crotaphytus bicinctores*
kills lizard prey by crushing their skulls.
We measure bite forces in lizards during the field research courses.**





Radiotrack & Powdertrack



Research Teams



2 Lizard Marking Methods

Summer Field Research Courses!

Summer 2018!

Campus: WWU
Field: Fields, OR

Pit-trap insect prey



Capture-mark-measure-release



Steens Mt



Field Research: 6/26 – 7/21

Ecological Methods + Research in Reptile Ecology = **the Perfect Summer Courses!**



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Study Bite Force!



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10 Species



Data-rich Research!

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Study Whiptail sprinting with hi-speed digital video



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Leopard Lizard is eating Whiptail Lizard

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Enter & edit data,
Write integrated research paper/poster.

Friday August 3, 2018

Classes End

Be Empowered. Get that job! Get into that Grad Program!

At WWU, in summer 2018, take:
Biol 408 = Ecological Methods
Biol 409 = Research In Reptile Ecology

You will experience theory & practice of field research in a team-research setting.

- Frame intriguing questions about organismal, population, and community ecology.
- Reframe questions into testable hypotheses.
- Develop clever methods to unambiguously test the hypotheses.
- Work with a variety of instruments.
- Obtain data worthy of publication.
- Perform graphical & statistical analyses to allow you to confidently answer your research questions.
- Learn how to think productively about the abiotic and biotic challenges that animals face, and how the animals meet those challenges.
- Develop the ability and confidence to analyze the methods and evaluate results of ecological research performed by others.
- Receive 12 credits, and have a reduced subsequent course load, with greater academic flexibility in the coming academic year.
- Have your resume strengthened by virtue of the field course experience, thereby making you more attractive to graduate programs and employers.
- Pursue follow-up research with Dr. Anderson via a senior thesis or via Biol 494 & 495, and develop results for publication, opening your career opportunities even further.
- Receive a highly credible letter of evaluation and recommendation from Dr. Anderson, who will have nonpareil knowledge of your skills and abilities.

**This page is in
paper near BI 351**

**The Western Fence Lizard *Sceloporus occidentalis*
is common on boulders upslope on either side of the basin & also in Fields, OR**



Adult male Western Fence Lizard



An aggregate of basking *Sceloporus occidentalis*



**Jessica eyes the
Western Fence Lizard,
out of focus, in foreground.
It perches on boulders
on all slopes above the basin.**





The sagebrush lizard, *Sceloporus graciosus*

Striped Whip Snake, *Masticophis taeniatus*, eats lizards



This snake seems to glide effortlessly across the desert floor



**Average size adult *Masticophis taeniatus*, the striped whip snake
(this one had just eaten an adult male *Phrynosoma*)**





Masticophis taeniatus* eating *Sceloporus graciosus



Rattlesnakes are small & uncommon on site



The Great Basin rattlesnakes (Crotalus lutosus)
are not commonly seen on the study site.
Are they rare or cryptic?



**This
Great Basin
rattlesnake
may have been
the largest
individual
we have seen on
the
study site**









These rattlesnakes are shy & do not hesitate to warn us before we step on them



**Gopher Snakes
eat
small mammals**



***Pituophis catenifer* moving across hardpan**



**Jackrabbits
are
common on site**



Some jackrabbits become very wary if you approach quickly & in numbers



**Common Nighthawks
forage for flying insects
between dusk & dawn,
& rest daily near camp.**



This nocturnally active, bat-like Common Nighthawk is resting in camp



Common Nighthawk at nest



Nighthawks “nest” on sand in the north side of shrubs



Scorpions in courtship
The male has a grip
on the female



We used UV light to reveal green glow of the scorpion & to attract insects for it to eat



Note the exit holes from cicadas



**Cicada exit hole near cheat grass seeds.
We think one cicada species emerges once per 5 years.**



**Cicadas
shortly
after
emerging
from soil**



Cicada on Greasewood





Greasewood can survive the harsh conditions of hardpan and is salt tolerant.

2010 & 2011 were rare years because cool, moist springs allowed recruitment (germination & survival) of young perennials into the community



**Basin Wild Rye Grass,
Leymus cinereus
can be nearly
two meters tall.**



We are often “greeted” by a show of spring wildflowers when we first arrive on site.









Tiny, spiny “annuals” bedeck the desert floor in spring & early summer



Another tiny, spiny annual flower on site



Grasshoppers, despite their camouflage, are primary prey of leopard lizards



Robber flies are aerobic, but are caught by leopard lizards as the flies perch



The inimitable robber fly



A sample of sun-bleached, weathered ungulate bones



The Alvord Basin was a lake-filled basin not all that long ago...



Yes, there are lizards up there.



Downpours do happen from time-to-time



It is not always warm in the desert; cool, cloudy, breezy days cause huddling



Students place their tents just upslope from the study site



**On rare occasions, rainwater pools in the hardpan at central camp.
Fortunately, the site is dry later in the day.**



Rain caused the hardpan of central camp to be flooded, but the students' tents were high and dry in the sandy, sagebrush community, upslope.





Water flows in tiny, narrow washes after rains, and pools in small basins.

We see crickets moving into the water to die & then we see horsehair worms emerge from the crickets, swim about and mate.



In pooled water, horsehair worms emerge from large Jerusalem crickets



**Sometimes rains are voluminous enough to cause pooling in basins.
Basins have clay substratum.
As the clay dries, it cracks into pentagonal & hexagonal patterns.**



**Spadefoot Toads
appear on the
surface in summer
evenings following
the day's rain**





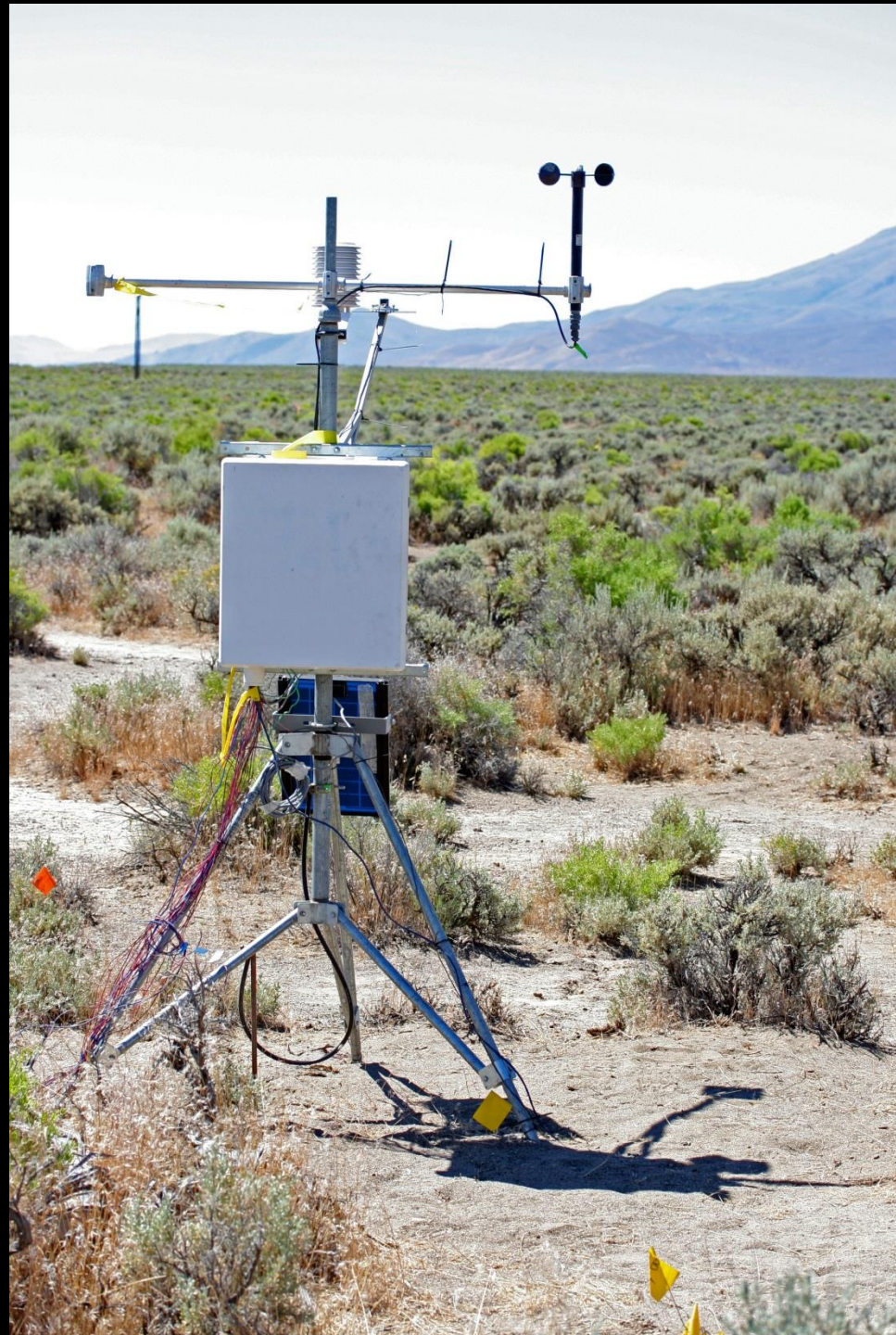
**Spadefoot
tadpoles &
toadlets
& shrimp
in drying ponds**



Rare sighting of a kangaroo rat during daylight hours



Portable weather stations provide important ecological context for research in biophysical ecology of lizards.



Rainy cool, spring & early summer produces abundant greenery.

Note the dense stand of invasive grass in the foreground.

During this summer trip the Steens Mt road loop was closed due to snow.



**This rain
did not
reach the ground.**



Sometimes the rain over the heated desert floor does reach the ground





In July & August 2006 there were major fires on the western slopes above the Alvord Basin.

Two weeks after we left the site, a wildfire burned eastward into the basin, reaching the road just 2 km N of camp.



Wildfire on the mountain



Much of this sagebrush community west & upslope of the study site has been destroyed by wildfire & replaced by the invasive annual grass, *Bromus tectorum*.



In this region, the sagebrush community is poorly adapted to wildfires, hence the invasive plants dominate after fire, as seen on left.



Much of the lower elevations of the Steens Mt massif are grazed by cattle.



In contrast, our study area is “low-use, winter range” & remains “pristine.”

Horses are denizens of ranch and open range in eastern Oregon & Nevada



**It is not unlikely that
this calm horse was
once wild.**

**Many formerly wild,
feral horses from
Nevada & Oregon are
available for adoption.**



For a few summers, horses were routine passersby



Burros on Sheldon Wildlife Refuge, not far from Bog Hot River



Hunter Steen Anderson swimming in Bog Hot River



**Early July, at Mickey Hot Springs at the N end of the Alvord Basin,
with the Steens massif in the background. (study site is near the S end of Alvord Basin)**



Lance McBrayer, research colleague from Georgia Southern University

Just a short hike north of the study site is the famous hot spring known as Borax Lake & the lower outflow lake



**The lighter, calm center is the upwelling of the hot spring of Borax Lake.
A fish, the endangered Borax Lake chub lives only in this little lake.**



One of a number of hot springs just N of Borax Lake



One of a number of hot springs just N of Borax Lake



One of a number of hot springs just N of Borax Lake



Sunset beyond Alvord Peak



Measuring a horned lizard in central camp, under the shade tarp.



The shade tarp provides retreat from the heat of the day



In some afternoons we go portable to weigh & measure lizards at Fields Station.



The dust devils hit central camp on some afternoons



The camp shower



Each summer we dig & fill 2 latrines about 0.5 km west of the study site



Long-limbed, WWU Basketball Great Getting Ready to Show the guys “How to Dig Deep”



Best Latrine... Ever!

In the evenings, as we wait for dark so that we can powder-track the day's pathway taken by horned lizards, we sometimes play croquet, horseshoe, wiffle ball & toss footballs and frisbees.







Denio Junction is in Nevada, not far from the Bog Hot Valley study site



**Students are dedicated researchers all day,
& sometimes well into the night, but not every night.**



Jamming



**Field course student
Sophie Wilhoit, in an
impromptu demonstration
of her musical talents at
Denio Junction .**



**John Wayne wall clock
& taxidermy mounts
are emblematic
of many social
establishments in
much of the rural,
intermountain west.**



**Be empowered!
Be able to get that job!
Be able to get into that grad program!**

How?

Deepen & Diversify your Research Skills & Abilities

But How?

**Summer, 2018,
enroll in
field research courses:**

Ecological Methods & Research in Reptile Ecology!
(12 total credits)

(with Dr. Anderson, Biology Department, at Western Washington University)

Roger.Anderson@wwu.edu

Radiotrack & Powdertrack



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Two Profs, two grad students & two undergrads, 2011





**Dr A and
son,
Hunter
2016**



In past years the
Diamond Bar was
open in Denio.



White Horse Hot Springs





**If the spring is cooler & moister than average,
pronghorn may linger in the basin before migrating upslope.
(This location is south of the study site, on the power line road looking W)**





Mustangs on Steens Mountain



**Cool
mountain
stream
on
Steens
Mountain**



Hunter Steen Anderson on Donner-and-Blitzen River, Steens Mt



El Cazador, The Hunter

Afternoon dip on our way up Steens Mountain



**Sunset beneath rain clouds
viewed from atop Steens Mountain**

Perching precariously at the edge in an effort to take a photo is unwise.



**Humans staring
into the abyss**



Lichen landscape on Steens Mt



We drive on Steens Mt in a large loop, entering on the SW & exiting to the NW



The top of the Steens uplift is above treeline



Trees in a protected swale on Steens Mt



Students appreciating the views



**In early July of most years, the snow has melted
& the annual plants are in flower on Steens**







Some snow fields do not disappear during summer atop Steens Mountain







We can see great distances to the east from atop Steens



View from atop Steens, looking south toward the Alvord Basin & the study site



Wildhorse Canyon drops from this glacial cirque where Wildhorse Lake resides—just below the peak on Steens Mt—all the way down to the Alvord Basin below.



**View from atop Steens. Pueblo Mts are in the far left.
Alvord Peak is in the center, at the far end of the Steens uplift**



This valley on Steens Mt was carved by a glacier







Above treeline on Steens Mountain









Large grasshopper high on Steens Mt







The 2013 field course students were the subject of a TV documentary