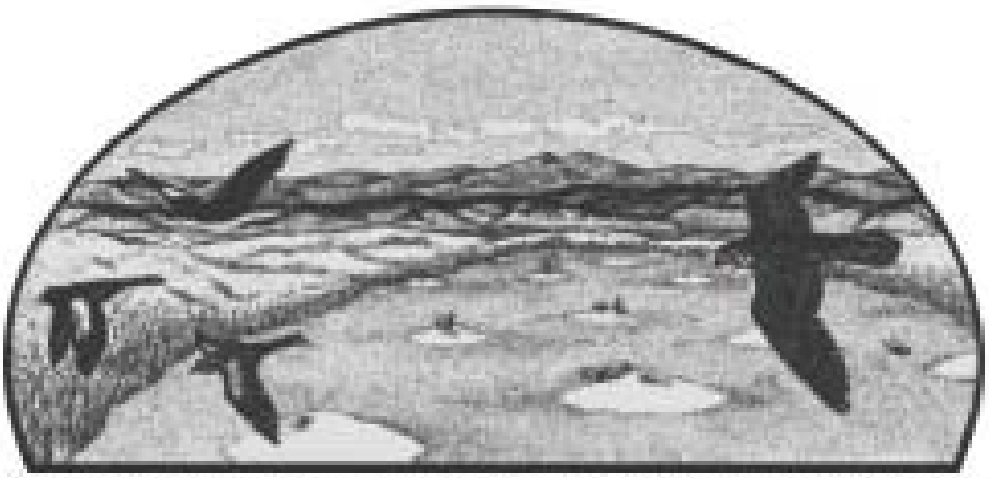
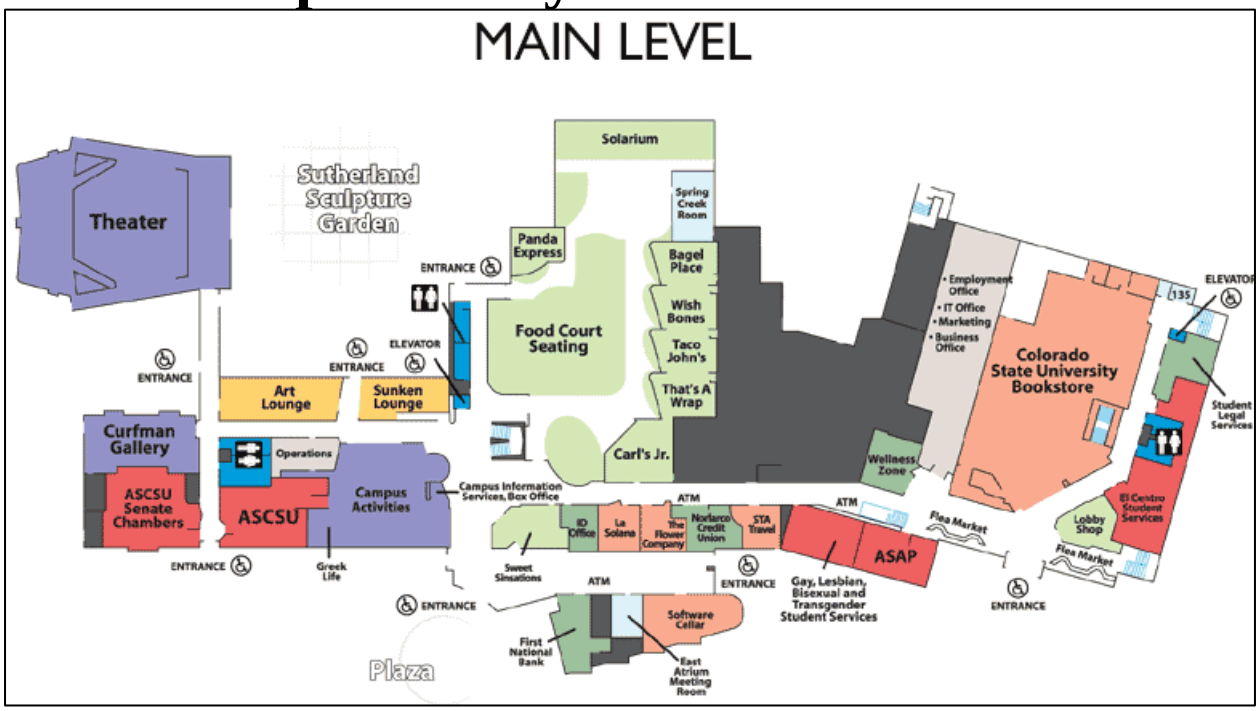


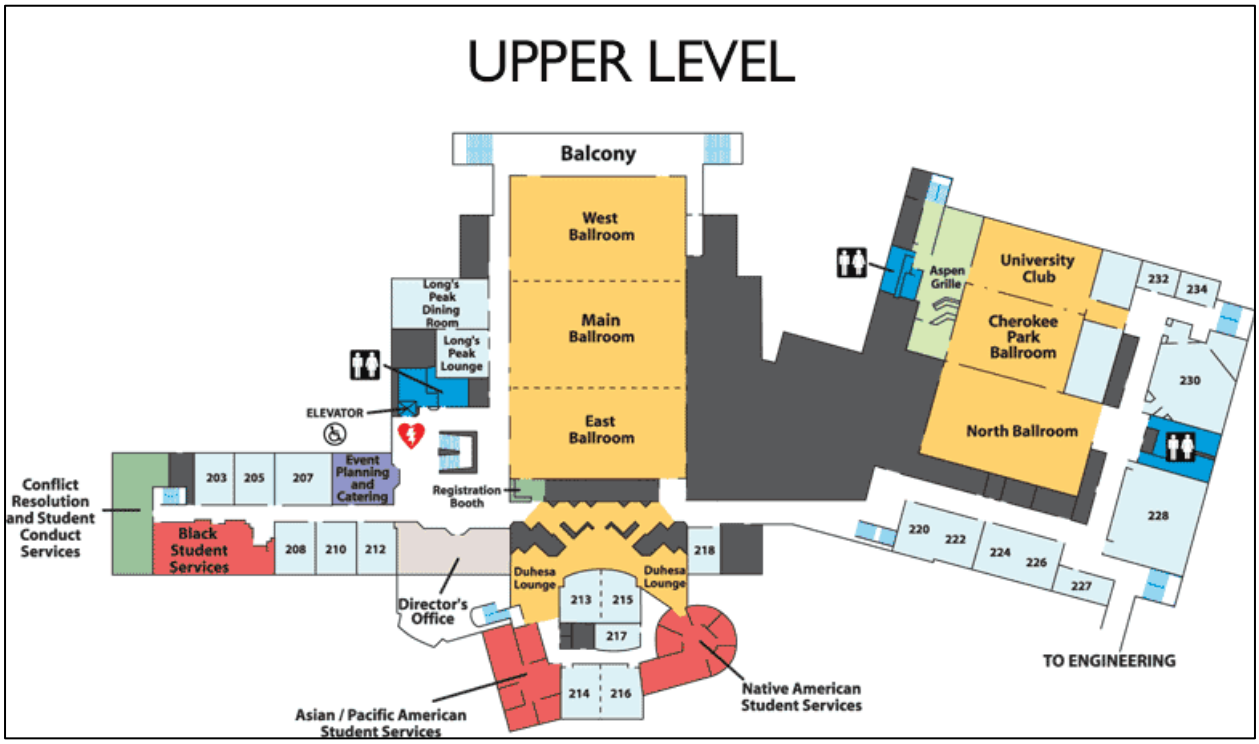
FRONT RANGE STUDENT ECOLOGY SYMPOSIUM

The 15th Annual Front Range Student Ecology Symposium

February 24 - 25, 2009
Colorado State University
Fort Collins, Colorado

Maps of Lory Student Center





Welcome!

15th Annual Front Range Student Ecology Symposium
February 24 - 25, 2009

Our Mission:

Welcome to Colorado State University for the 15th Annual Front Range Student Ecology Symposium. The Front Range Student Ecology Symposium is a showcase for outstanding ecological research done by high school, undergraduate, and graduate students from schools along the Front Range. Our entirely student-run symposium is structured like a traditional scientific meeting, but with an emphasis on creating a supportive atmosphere for discussion and critique, and providing a venue for Front Range students to interact. We welcome the participation of any Front Range student doing ecology or ecology-related research, whether the study is at the level of organisms, ecosystems, or coupled social-ecological systems. Students may present completed research, work-in-progress, research proposals, senior or course work projects, or simply ideas deserving a closer look by ecologists.

Off-Campus Participation:

This year students from University of Colorado – Boulder, University of Northern Colorado, Fort Lewis College, Metropolitan State College of Denver, Front Range Community College, Texas A&M University and University of California-Santa Cruz are joining CSU students to present research in the many diverse topics that collectively comprise the field of ecology. Additionally, we give a warm welcome to the students from Rocky Mountain High School, Riffenburgh Elementary School and Brentwood Middle School who will be participating in the symposium.

The Program:

Ecological research and results have become increasingly accessible to the general public. The need for accurate information on physical, biological, social, economic, and cultural effects has become more important. Our theme of *Science for a Society in a Changing World* reflects the growing importance of reliable research for people across all levels of understanding.

We are pleased to present our keynote speaker, Dr. Chris Field, CEO of the Carnegie Institute for Science. Dr. Field will open this year's symposium with a keynote address titled " Climate Change, Climate Change Assessments, and Climate Policy" on the afternoon of Tuesday, February 24.

This year's symposium includes 36 poster presentations and 34 oral presentations, which run in two concurrent sessions throughout the day on Wednesday, February 25. Faculty will be present to critique and provide feedback on student presentations. Prizes donated by local sponsors will be awarded for outstanding talks, posters, and photos from the photo contest.

To end the morning, we have an opportunity to see ecology and conservation at work. A member of the National Black-footed Ferret Conservation Center will discuss the ecology and recovery efforts of black-footed ferrets. During lunch, we offer an informal panel discussion on biofuels, entitled "Growing Fuel: Issues, Questions & Outlook". Panel members come from diverse backgrounds to share their experience and insights into new research about biofuels and its importance in ecology and society.

A catered reception, award ceremonies and entertainment follow. Lastly, we will be featuring live music by local band, "High Voltage". Snacks and beverages will be provided throughout the day in the North Ballroom. Please join us!

Student Presentations

Oral Presentations:

Students giving oral presentations must meet with the moderators in the break time prior to their session. Oral presentations will be limited to twelve (12) minutes. It is recommended that students adhere to this time to allow for 2-3 minutes of questions following their presentation (15 minutes total). There will be two concurrent sessions, held in rooms 220-222 and 224-226 of the Lory Student Center (see map inside cover).

Posters:

Posters will be on display in the North Ballroom from 8 am to 4 pm on Wednesday February 25. Authors will be available for discussion of their work during the poster session from 2:30 - 4:00pm. Judging will also occur during this time. Posters may be put up from 7:30 - 8:30am on February 25 and must be removed from 4:00-7:00pm.

Presentation Judging and Feedback:

Faculty and upper-level graduate students will be present during the oral and poster sessions to judge and provide feedback to presenters. Prizes donated by local sponsors will be awarded for the following categories:

Best undergraduate oral presentation
Best graduate oral presentation
Best undergraduate poster presentation
Best graduate poster presentation

All presenters have the option of getting the feedback from the judges on their work after the results have been tabulated for the prizes. CSU students may pick up their feedback from the GDPE common room (NR 218). Other students must provide an address to the FRSES organizers **(**ecosym@lamar.colostate.edu**)** so the results can be sent.

Photo Contest:

An additional competition involves photos of student work, which may be viewed and voted on by the general public during the duration of the symposium. Students may view and vote on the best photos at the registration desk (outside the North Ballroom). Pictures of study organisms, sites or systems, ecologists at work, and humorous ecological photos have been submitted. Awards will be presented for best photos!

Thanks and enjoy the program!
The 2009 FRSES Coordinating Committee

Symposium Chair: Jessica Ernakovich
Members: Aaron Berdanier, Sarah Evans, Anne Marie Casper Jim Bromberg, Kerry Byrne, , Becky Chong, , Jamie Fuller, Tom Grant, Kelly Hopping, Emily Kachergis, Kristen Kaczynski, John Lovell, Nate Mellor, John Murgel, Jessica Salo, Karen Seaver, Meg Steinweg, Charles Stone, Jonathan Straube, Patty York
Staff Advisor: Jeri Morgan
Faculty Advisor: Dr. LeRoy Poff

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Graduate Degree Program in
ECOLOGY
s = f (cl, o, r, p, t)


Associated Students of
ASCSU
Colorado State University


Natural Resource Ecology Laboratory

Schedule of Events

Tuesday, February 24, 2009
(*All events held on 2nd floor of Lory Student Center*)

2:00-3:00 pm: Keynote Speaker – **Chris Field** - *North Ballroom*
3:00-4:00 pm: Reception - *North Ballroom*

"Climate Change, Climate Change Assessments, and Climate Policy"

Dr. Chris Field is the founding director of the Carnegie Institution's Department of Global Ecology, Professor of Biology and Environmental Earth System Science at Stanford University, and Faculty Director of Stanford's Jasper Ridge Biological Preserve. Field's research emphasizes impacts of climate change, from the molecular to the global scale. In September, 2008, he was elected co-chair of working group 2 of the IPCC, and will lead the next assessment on climate change impacts, adaptation, and vulnerability. Field has testified before House and Senate committees and is a member of the US National Academy of Sciences. He received his PhD from Stanford in 1981 and has been at the Carnegie Institution for Science since 1984.

Wednesday, February 25, 2009
(*All events held on 2nd floor of Lory Student Center*)

All Day:
Registration - *outside the North Ballroom*
Photo contest: Vote for your favorite research photos! - *North Ballroom*

7:30 am: Continental breakfast - *North Ballroom*

8:15-9:15 am:
Session 1: Oral Presentations *(**Animal Behavior & Ecology**) – Room 220-222*
Session 2: Oral Presentations *(**Spatial Heterogeneity**) – Room 224-226*

9:30-10:30 am:
Session 3: Oral Presentations *(**Soil Processes & Nutrient Cycling**) – Room 220-222*
Session 4: Oral Presentations *(**Aquatic Ecology**) – Room 224-226*

10:45-11:45 am:
Black-footed Ferret Conservation Program: *– Room 230*
Paul Marinari, US Fish and Wildlife Service
Session 5: Oral Presentations *(**Human Environment Interactions**) – Room 220-222*
Session 6: Oral Presentations *(**Climate & the Biosphere**) – Room 224-226*

11:45-1:00 pm:

Panel lunch: **"Growing Fuel: Issues, Questions & Outlook"** *Longs Peak Dining Room*

Panelists: Ken Reardon, Anthony Marchese and Keith Paustian

Free pizza lunch for attendants

1:15-2:30 pm:

Session 7: Oral Presentations ***(Invasion Ecology)*** *– Room 220-222*

Session 8: Oral Presentations ***(Disease Ecology)*** *– Room 224-226*

2:30-4:00 pm:

Poster Presentations – *North Ballroom*

4:00-7:00 pm: Catered Reception, Awards and Live Music – *University Club*

5:00-5:30 pm: Awards Ceremony - *Cherokee Park Room*

Awards will be presented at 5:00, followed by music from *"High Voltage"*. Cash bar for patrons with ID.

Detailed Presentation Schedule

Oral Presentations

Session 1: Animal Behavior and Ecology

8:15-9:15AM (*Room 220-222*)

(A) EFFECTS OF MULTI-USE PATHWAY CONSTRUCTION ON UNGULATES IN GRAND TETON NATIONAL PARK
- Amanda Hardy, Colorado State University, Graduate Student

(B) PRELIMINARY RESEARCH ON EPAULETTED FRUIT BATS IN KRUGER NATIONAL PARK, SOUTH AFRICA AND THEIR EFFECTS ON SYCAMORE FIG SEED GERMINATION
- Emily Snode, University of Nothern Colorado, Graduate Student

(C) ROADS REDUCE SURVIVAL FOR NAÏVE ISLAND FOXES
- Nathan Snow, Colorado State University, Graduate Student

(D) DEVELOPMENT OF MANEUVERABILITY IN TWO NEW WORLD FRUIT BATS IN RELATION TO RESROUCE PARTITIONING
-Jason Shaw, University of Nothern Colorado, Graduate Student

Session 2: Spatial Heterogeneity

8:15-9:15AM (*Room 224-226*)

(A) INVENTORY AND MONITORING OF NATURAL RESOURCES IN LARGE HETEROGENEOUS LANDSCAPES
- Jennifer Jones, Colorado State University, Graduate Student

(B) DISTINGUISHING FENS AND WET MEADOWS IN THE ROCKY MOUNTAINS: VARIATION IN SOILS, WATER TABLE, VEGETATION, AND POTENTIAL SENSITIVITY TO CLIMATE CHANGE
- Katharine Driver, Colorado State University, Graduate Student

(C) WOODY COVER AND HETEROGENEITY IN THE SAVANNA OF KRUGER NATIONAL PARK, SOUTH AFRICA
- Gabriela Bucini, Colorado State University, Graduate Student

(D) REGIONAL SYNCHRONY OF MOUNTAIN PINE BEETLE POPULATION IN THE SOUTHERN ROCKY MOUNTAINS
- Teresa Chapman, University of Colorado - Boulder, Graduate Student

Oral Presentations

Session 3: Soil Processes & Nutrient Cycling

9:30-10:30AM (*Room 220-222*)

(A) IMPLICATIONS OF METHANOTROPH COMMUNITY COMPOSITION FOR METHANE UPTAKE IN UPLAND SOILS
- Craig Judd, Colorado State University, Graduate Student

(B) SOIL MOISTURE LIMITATION OF HIGH-ELEVATION PRIMARY PRODUCTIVITY MEDIATED BY NITROGEN AVAILABILITY
- Aaron Berdanier, Colorado State University, Graduate Student

(C) ANALYSIS OF SOIL PROCESSES IN THE ARCTIC DURING FALL FREEZE-THAW CYCLES
- Jessica Ernakovich, Colorado State University, Graduate Student

(D) DIFFERENCES IN THE ORGANIC LAYER AND MINERAL SOIL PRIOR TO AND FOLLOWING DECOMPOSITION
- Nathan Mellor, Colorado State University, Graduate Student

Session 4: Aquatic Ecology

9:30-10:30AM (*Room 224-226*)

(A) THE IMPACT OF BED DISTURBANCE ON THE GROWTH OF THE NUISANCE DIATOM *DIDYMOSPHENIA GEMINATA* IN RIVERS
- James Cullis, University of Colorado - Boulder, Graduate Student

(B) FLOW DISTURBANCE AND AQUATIC ECOSYSTEMS – A QUESTION OF SCALE
- Thomas Wilding, Colorado State University, Graduate Student

(C) USE OF A BAYESIAN HIERARCHICAL REGRESSION MODEL TO PREDICT SPECIES TRAIT DISTRIBUTIONS OF AQUATIC INSECTS IN STREAMS
-Matthew Pyne, Colorado State University, Graduate Student

(D) FLOW REGIME, HABITAT CONFIGURATION AND FUNCTIONAL TRAITS INFLUENCE DISTRIBUTION PATTERNS IN DYNAMIC RIVER NETWORKS
- Daniel Auerbach, Colorado State University, Graduate Student

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Oral Presentations

Session 5: Human Enviroment Interactions

10:45-11:45AM (Room 220-222)

(A) EVALUATING THE EFFECTIVENESS OF CARBON AND ZEOLITE TREATMENTS TO REDUCE NITROGEN IN SEWAGE SLUDGE TREATED LANDS
- Kirstin Holfelder, Colorado State University, Graduate Student

(B) AN OUTSIDE PERSPECTIVE ON COASTER BROOK TROUT:THEIR MANAGEMENT AND THEIR FUTURE
- Nate Cathcart, Colorado State University, Undergraduate Student

(C) USING HUMAN MODIFIED LAND COVER TO CHARACTERIZE LAND USE PATTERNS IN THE SOUTHERN ROCKY MOUNTAINS
- Ian Leinwand, Colorado State University, Graduate Student

(D) CULTIVATION AS A QUICK PASTORAL RECOVERY MECHANISM: THE CASE OF MAASAI IN SIMANJIRO, TANZANIA
- Stacy Lynn, Colorado State University, Graduate Student

Session 6: Climate & the Biosphere

10:45-11:45AM (*Room 224-226*)

(A) FIRE REGIME OF A MIXED CONIFER FOREST IN SOUTHWESTERN COLORAOD
- Carissa Aoki, Colorado State University, Graduate Student

(B) POTENTIAL AFFECTS OF CLIMATE CHANGE ON BAT POPULATIONS IN THE SOUTHERN ROCKY MOUNTAINS
- Mark Hayes, University of Northern Colorado, Graduate Student

(C) STABLE CARBON ISOTOPES AS INDICATORS OF GROSS PRIMARY PRODUCTION AND GROWING CONDITIONS IN AN EXPERIMENTAL EUCALYPTUS PLANTATION
- Toby Gass, Colorado State University, Graduate Student

(D) BIOPHYSICS OF THE AMAZON BASIN
- Ian Baker, Colorado State University, Graduate Student

Oral Presentations

Session 7: Invasion Ecology
1:15-2:30PM (Room 220-222)

(A) GROWTH AND DEFENSE CHARACTERISTICS OF THE INTRODUCED WEED *VERBASCUM THAPSUS* (COMMON MULLEIN)
- Christina Alba-Lynn, Colorado State University, Graduate Student

(B) ALLEE EFFECTS AND INVATION SUCCESS THROUGH COUPLED EVOLUTIONARY AND ECOLOGICAL DYNAMICS
- Andrew Kanarek, Colorado State University, Graduate Student

(C) CAN ONE INVASION LEAD TO ANOTHER? MECHANISMS OF OLD AND NEW EXOTIC PLANT INVASION ALONG WESTERN RIVERS
- Lindsay Reynolds, Colorado State University, Graduate Student

(D) THE RANGE EXPANSION OF CHEATGRASS IN ROCY MOUNTAIN NATIONAL PARK
- James Bromberg, Colorado State University, Graduate Student

(E) PLANT NEIGHBOR IDENTITY INFLUENCES INDIVIDUAL PLANT BIOCHEMISTRY AND PHYSIOLOGY
- Amanda Broz, Colorado State University, Graduate Student

Session 8: Disease Ecology
1:15-2:30PM (*Room 224-226*)

(A) DEGREE DISTRIBUTION IS INSUFFICIENT TO CHARACTERIZE A DIESEASE CONTACT NETWORK
-Gregory Ames, Colorado State University, Graduate Student

(B) THE ROLE OF WILDFIRE ON PREVALENCE IN SIN NOMBRE VIRUS IN DEER MICE SIX YEARS POST BURN
- Megan Hayes, Fort Lewis College – Durango, Undergraduate Student

(C) ENERGETIC STRESS IN THE HONEYBEE *APIS MELLIFERA* FROM *NOSEMA CERANAE* INFECTION
- Christopher Mayack, Colorado State University, Graduate Student

(D) *YERSINIA PESTIS* INFECTION IN PRAIRIE DOGS AND GROUND SQUIRRELS; THE RELATIVE IMPORTANCE OF EARLY-PHASE TRANSMISSION IN EXPLAINING PLAGUE OUTBREAK
- Michael Buhnerkempe, Colorado State University, Graduate Student

(D) THE INFLUENCE OF HUNGER ON DIESEASE TRANSMISSION IN A HONEYBEE COLONY
- Craig Feigenbaum, Colorado State University, Graduate Student

Poster Presentations

2:30-4:00PM *(North Ballroom)*

(1) RANGELAND MANAGERS' KNOWLEDGE, ATTITUDES, AND MANAGEMENT PRACTICES REGARDING *BROMUS TECTORUM* (CHEATGRASS)
Windy Kelley, Colorado State University, Graduate

(2) AUTO-INHIBITION OF SEED GERMINATION BY INVASIVE *ACROPTILON REPENS* (RUSSIAN KNAPWEED)
Thomas A. Grant, Colorado State University, Graduate

(3) LANDSCAPE SCALE CONSTRAINTS ON CONVERSION OF A SAGEBRUSH STEPPE ECOSYSTEM TO AN ANNUAL GRASS DOMINATED STABLE STATE IN SOUTHEASTERN WYOMING
Marques Munis, Colorado State University, Graduate

(4) USING NATIVE ANNUAL PLANT SPECIES TO SUPPRESS WEEDY INVASIVE SPECIES IN POST-FIRE HABITATS
Christopher Herron, Colorado State University, Graduate

(5) AN ECOLOGICAL ASSESSMENT OF CORE AND EDGE POPULATIONS OF TWO DOMINANT GREAT PLANS GRASSES: IMPLICATION FOR CLIMATE CHANGE
Amanda Lease, Colorado State University, Graduate

(6) CLIMATE CHANGE AND GRAZING EFFECTS ON THE TIBETAN PLATEAU
Kelly Hopping, Colorado State University, Graduate

(7) RESPONSE OF NATIVE PHREATOPHYTES TO CHANGING HYDROCLIMATE IN THE SAN LUIS VALLEY, COLORADO
Julie Kray, Colorado State University, Graduate

(8) IMPACTS OF CLIMATE ON PHENOLOGY AND DEMOGRAPHY OF A WHITE-TAILED PTARMIGAN POPULATION IN COLORADO, USA
Greg Wann, Colorado State University, Graduate

(9) DESCRIBING ECOSYSTEM SHIFTS IN RANGELANDS USING DATA-DRIVEN STATE AND TRANSITION MODELS
Emily Kachergis, Colorado State University, Graduate

(10) ESTABLISHING NATIVE PLANTS ON ABANDONED FARMLAND AT RABBIT MOUNTAIN OPEN SPACE
Richard Lancaster, Colorado State University, Graduate

(11) COMMUNITY-BASED URBAN RESTORATION IN RIPARIAN CORRIDORS:AN EXAMINATION OF SOCIAL CAPITAL AND COMMUNICATION PROCESSES
Cara DiEnno, Colorado State University, Graduate

(12) SEEDLDING ESTABLISHMENT FOLLOWING MOUNTAIN PINE BEETLE INFESTATION AND FOREST HARVESTING
Byron Collins, Colorado State University, Graduate

Poster Presentations

(13) POST-DISPERSAL SEED FATE OF TROPICAL MONTANE TREES IN AN AGRICULTURAL LANDSCAPE, SOUTHERN COSTA RICA
Rebecca Cole, University of California – Santa Cruz, Graduate

(14) LONG-TERM PLANT SUCCESSION FOLLOWING A SEVERE DISTURBANCE IN RESPONSE TO SEEDING, SOIL FUMIGATION, NITROGEN IMMOBILIZATION, AND NUTRIENT ADDITION
Tim Hoelzle, Colorado State University, Graduate

(15) PINGREE TO THE PLATTE
Robert Faris, Riffenburgh Elementary School, Sixth Grade

(16) HETEROSPECIFIC RESPONSE TO CHEMICAL ALARM CUES IN GUPPIES
Benjamin Pauls, Colorado State University, Undergraduate

(17) MORPHOLOGICAL RESONSE TO DECREASED PREDATION RISK IN TRINIDADIAN MORPHOLOGY
Sarah Fitzpatrick, Colorado State University, Undergraduate

(18) PHENOTYPIC PLASTICITY IN THE COLOR PATTERN OF MALE FUPPIES IN RESPONSE TO PREDATOR CUES
Robert Wildermuth, Colorado State University, Undergraduate

(19) PREDATOR INDUCED PLASTICITY IN HABITAT USE BY GUPPIES
Kyle Lenling, Colorado State University, Undergraduate

(20) PREDATOR MEDIATED SELECTION ON ESCAPE PERFORMANCE OF TRINIDADIAN GUPPIES
Daniel Ozzello, Colorado State University, Undergraduate

(21) VARIATION IN BODY-MASS INDEX IN A COLORADO POPULATION OF ORNATE BOX TURTLES (*TERRAPENE ORNATA ORNATA*)
Eric Gangloff, Colorado State University, Undergraduate

(22) LOOKING FOR HOTSPOTS OF NITROGEN CYCLING IN AN ALPINE-SUBALPINE WATERSHED
Anthony Darrouzet-Nardi, University of Colorado - Boulder, Graduate

(23) SOIL MICROORGANISMS ALTER SELENIUM ACCUMULATION IN A TOXIC LOCOWEED
Elan Alford, Colorado State University, Graduate

(24) PERFORMANCE OF SPECIES RICHNESS ESTIMATORS ACROSS VARIATIONS IN COMMUNITY PARAMETERS
Gordon Reese, Colorado State University, Graduate

(25) ECONOMIC INCENTIVES FOR CONSERVATION IN MERU, KENYA
Andrew Tredennick, Colorado State University, Graduate

(26) COMMUNICATION, CONFLICT, AND SCIENCE IN NATURAL RESOURCE COLLABORATION: A CASE STUDY OF AN INACTIVE COLLABORATIVE GROUP
Aleta Rudeen, Colorado State University, Graduate

(27) SURVIVAL AND RESOURCE SELECTION OF BLACK-FOOTED FERRETS BASED ON PREDATOR EXPOSURE IN SOUTH DAKOTA
Sharon Poessel, Colorado State University, Graduate

Poster Presentations

(28) THE EFFECTS OF SNTHROPOGENIC MOISE ON UNGULATE BEHAVIOR IN THE GRAND TETON CORRIDOR
Casey Brown, Colorado State University, Graduate

(29) AVIAN RESPONSE TO MANAGED BURNS AND GRAZING TIMING IN HIGH ELEVATION SAGEBRUSH
Heidi Erickson, Colorado State University, Graduate

(30) SWIFT FOX (*VULPES VELOX*) ECOLOGY IN RELATION TO BUBONIC PLAGUE
Amariah Anderson, Colorado State University, Graduate

(31) RELATIONSHIPS BETWEEN SITE TYPE, PLANTS, AND ARTHROPODS IN A GRASSLAND ECOSYSTEM
Michael Habel, Rocky Mountain High School

(32) RESPONSE OF SHORTGRASS ECOSYSTEMS TO CLMATE CHANGE: DOES SEVERE DROUGHT INCREASE INVASIBILITY
Karie Cherwin, Colorado State University, Graduate

(33) RECYCLING IN OUR CLASSROOM: INVESTIGATIONS INTO EARTH SYSTEMS ON A MIDDLE SCHOOL CAMPUS
Katie Boisen, Brentwood Middle School

(34) INVESTIGATIONS INTO EARTH SYSTEMS ON A MIDDLE SCHOOL CAMPUS
Steve Swenson, Brentwood Middle School

(35) EXOTIC SPECIES ELIMINATION PROJECT
Colleen Sinclair, Front Range Community College, Undergraduate

(36) ORGANIZATIONAL STRUCTURE & WILDLIFE REINTRODUCTION PROGRAMS: A CASE STUDY OF THE SEA EAGLE RECOVERY PROJECT
Alexandra Sutton, Texas A&M University, Graduate

Full Abstracts Index

Keynote Address

Dr. Chris Fields
CLIMATE CHANGE, CLIMATE CHANGE ASSESSMENTS AND CLIMATE POLICY
Carnegie Institution for Science, Stanford University

Over the last 20 years, the Intergovernmental Panel on Climate Change (IPCC) has conducted a series of assessments on the science and impacts of climate change, and on strategies for managing it. The reports of the IPCC have played a central role in communicating the scientific consensus on climate change to governments and the public. Still, much of the public has an incomplete or incorrect view of the status of the science and of the messages in the IPCC assessments. Insight into the goals and processes of the IPCC, as well as of other entities that have conducted assessments of the scientific literature, can help both scientists and non-scientists appreciate the nature of the scientific knowledge on climate change, including the uncertainties and their implications. As the evidence on the nature and consequences of climate change becomes clearer and clearer, the need for accurate information on physical, biological, social, economic, and cultural effects becomes greater and greater. IPCC can contribute some, but not all of the necessary knowledge.

Oral Presentations

Abstracts listed alphabetically by author
Numbers refer to presentation session and order as shown in schedule above

Christina Alba-Lynn (7A)
GROWTH AND DEFENSE CHARACTERISTICS OF THE INTRODUCED WEED *VERBASCUM THAPSUS* (COMMON MULLEIN)
Colorado State University, Graduate
with Ruth Hufbauer (CSU), Deane Bowers (CU-Boulder), and Dana Blumenthal (USDA-ARS)

Introduced plants often sustain less damage from herbivores than their native counterparts. This phenomenon of "enemy escape" could contribute to the successful expansion of introduced plants in their new range. In addition to an overall loss of herbivores in the new range, introduced plants may experience a shift in herbivore community composition from specialist-generalist dominated to generalist dominated. If such a shift occurs, plant investment in costly structural defenses against specialists should decrease, while investment in less costly chemical defenses against generalists should increase. This change in allocation to defense could create a net energy gain, freeing introduced populations to invest in growth, thereby bolstering their competitive abilities. We conducted a greenhouse experiment with *Verbascum thapsus* (common mullein) in which plant size, trichome length and leaf toughness (structural defenses), and iridoid glycoside concentrations (chemical defense) were measured in native and introduced populations. We predicted that introduced populations would be larger, invest less in trichomes and leaf toughness, and more in chemical defense. As predicted, introduced populations were larger than natives ($P = 0.004$). However, none of the defense traits differed as a result of native or introduced status (trichomes, $P = 0.93$; leaf toughness, $P = 0.96$; iridoid glycosides, $P = 0.96$), suggesting that enemy release does not promote mullein's

invasive status. Instead, there was significant variation in the defense traits among populations (regardless of native or introduced status), indicating that disjunct populations are adapted to local conditions.

Gregory Ames (8A)
DEGREE DISTRIBUTION IS INSUFFICIENT TO CHARACTERIZE A DISEASE CONTACT NETWORK
Colorado State University, Graduate
with Dylan George, Christian Hampson, Andrew Kanarek, Cayla McBee, Dale Lockwood, Jeff Achter, and Colleen Webb (CSU)

Recent outbreaks of infectious diseases such as SARS and avian influenza have illustrated the need for tools that allow public health officials to accurately predict the dynamics of diseases. Mathematical models offer such a tool, provided that they account for all of the key elements of population structure and disease behavior that control disease dynamics. Differential equation based models, such as the ubiquitous SIR model, assume that populations are homogeneously mixed, where every person is equally likely to contact every other person. This ignores the fact that people interact with a small subset of the population and so have a non-uniform probability of contracting a disease. Recently, disease ecologists have shown that contact structure between individuals can have profound impacts on the spread of disease that cannot be predicted by traditional SIR models. This has led to the use of approaches based on graph theory, which allows contacts between all individuals to be modeled explicitly. These approaches have largely ignored the finer scale structure of these networks and focused instead on the degree distribution as the explanatory variable for the spread of disease on the network. Here we show how network structure other than degree distribution affects disease processes. To examine the effect, we compare the outcomes of disease processes on pairs of graphs that have the same degree distribution but differ in other elements of structure. We show that fine scale structure profoundly impacts the dynamics of a disease process on the graph for certain types of diseases. This implies that models that fail to account for this structure may produce inaccurate predictions about disease behavior.

Carrisa Aoki (6A)
FIRE REGIME OF A MIXED CONIFER FOREST IN SOUTHWESTERN COLORADO
Colorado State University, Graduate
with Peter M. Brown (Rocky Mountain Tree-Ring Research) and William H. Romme (CSU)

Mixed conifer forests in the western U.S. have typically been difficult to quantify in terms of their historical fire regime. In particular, few studies have been conducted in the mesic mixed conifer type found in Colorado. We used dendrochronological methods to analyze fire scar and age structure data from the mesic mixed conifer forest on Banded Peak Ranch in the San Juan Mountains. We found few fire scars, indicating a lack of the low-severity/high-frequency fire regime. Age structure data proved difficult to analyze due to the large number of highly decomposed samples. We therefore devised a system that combined qualitative and quantitative assessments to define whether each plot was of high severity, mixed severity, or not initiated by fire. Overall, 45% were high severity, 25% mixed severity, 25% not fire initiated, and 5% not dateable. The 1879 fire year, widespread throughout the southwestern U.S., was particularly prevalent. Our sampling method included small variable radius plots of 30 trees each, placed within a 500 meter square area. Patches of high severity fire ranged from smaller than a single variable radius plot to larger than the 500 meter square, suggesting that mesic mixed conifer forests experience both the large, severe fires common in higher elevation forests, as well as small, severe fires. From the standpoint of ecological restoration, low-severity prescribed burning will not likely “restore” these systems to historical conditions.

Daniel Auerbach (4D)
FLOW REGIME, HABITAT CONFIGURATION AND FUNCTIONAL TRAITS INFLUENCE DISTRIBUTION PATTERNS IN DYNAMIC RIVER NETWORKS
Colorado State University, Graduate
with N.L Poff (CSU)

Metacommunity theory is an effort to explain how and why species are distributed at multiple scales, and is a potentially valuable tool for addressing such pressing issues as how species extinctions or invasions will influence lotic ecosystems. We assume that patterns in the linked local communities of a river network emerge from interactions between the topology of its habitat template, as determined by flow regime and fluvial geomorphology, and the range of functional traits found in its species pool. To test predictions concerning these potentially complex

interactions we are developing a simple theoretical simulation framework in which physical habitat structure is captured as directed graphs composed of categorically classified nodes (reach and junction habitat), species are characterized in terms of their dispersal and reproductive capacities, and a flow/disturbance regime modifies these life history components by altering habitat quality. Within this framework, we predict greater overall (gamma) diversity when 1) increased drainage density (as node degree) corresponds to a more divided network, 2) increased autocorrelation in flow sequence over both monthly and yearly cycles corresponds to reduced variance in site suitability, and 3) dispersal ranges are small relative to network dimensions and reproductive cycles are faster than flow-mediated disturbance cycles.

Ian Baker (6D)
BIOPHYSICS OF THE AMAZON BASIN
Colorado State University, Graduate
with Lara Prihodko (CSU), A. Scott Denning (CSU)

The Amazon Basin, approximately 8 million square kilometers, is home to the largest rain forest in the world. By some estimates, the Amazon Basin contains up to 10% of terrestrial biomass. Small changes in the large gross fluxes of carbon between the atmosphere and biosphere can have far-reaching implications in global distribution of atmospheric CO2. However, the ecophysiology of the region is poorly understood. Model studies that characterize the region as water-limited are inconsistent with recent satellite-based research that suggests that the region is light-limited, and may actually show an increase in photosynthesis during periods of drought. Furthermore, it has been postulated that the Amazon is an “ecosystem on the edge” that will undergo massive conversion from forest to grassland under climate change. In this study we use a synthesis of observational and model data to construct a conceptual model of ecophysiological function across gradients of vegetation and precipitation in tropical South America. We find that predictions of imminent conversion of forest to grassland are likely premature; the mechanisms that sustain forest function through annual drought are more robust than previously thought. Additionally, large-scale vegetation conversion to grassland is unlikely. The mechanisms that sustain the forest protect the basin interior, with the edges, or “transition forest”, acting as a buffer. Our results sound a rare note of optimism in an increasingly dire field of climatic predictions: Tropical forests may be able to survive as humans reconcile their dependence on fossil fuels.

Aaron Berdanier (3B)
SOIL MOISTURE LIMITATION OF HIGH-ELEVATION PRIMARY PRODUCTIVITY MEDIATED BY NITROGEN AVAILABILITY
Colorado State University, Graduate
with Julia Klein (CSU)

Moisture availability is highly variable in high-elevation ecosystems, and is recognized as an influential factor in their structure and function. But, moisture constraints on high-elevation primary productivity have never been demonstrated. To address this issue, we compiled data from a global set of seven high-elevation studies to examine if and when aboveground primary productivity is limited by soil moisture. Our results show that soil moisture limits aboveground primary productivity and that there is a high probability (88%) that this relationship is represented best with a nonlinear, asymptotic Michaelis-Menten function. A linear regression also fit the data and was highly significant ($P < 0.001$), but had a much lower probability of being the best model (12%). We estimated that soil moisture becomes strongly limiting in high-elevation ecosystems below 47% gravimetric soil moisture. At Niwot Ridge, CO, we measured soil nitrogen availability and found that it increased significantly with soil moisture ($P = 0.028$). This suggests that soil moisture limits high-elevation aboveground primary productivity indirectly through its influence on nitrogen cycling. These findings have consequences for ecosystem responses to interannual climate variability and directional climate change. Predicted decreases in soil moisture are likely to substantially decrease the aboveground primary productivity of high-elevation ecosystems.

James Bromberg (7D)
THE RANGE EXPANSION OF CHEATGRASS IN ROCKY MOUNTAIN NATIONAL PARK
Colorado State University, Graduate
with Cynthia Brown (CSU)

The range of cheatgrass, a prolific invasive weed of the western United States, has been thought to be expanding its range to higher elevations in recent decades. However, limited data are available to track high elevation trends with this species. Two data sets in Rocky Mountain National Park were resampled to document the changes in cheatgrass in more recent years. Both the occurrence of cheatgrass within plots and percent cover of cheatgrass over plots were analyzed to determine how the species' distribution is changing. The data give some indication that cheatgrass may in fact be spreading within this high elevation study region.

Amanda Broz (7E)
PLANT NEIGHBOR IDENTITY INFLUENCES INDIVIDUAL PLANT BIOCHEMISTRY AND PHYSIOLOGY
Colorado State University, Graduate
with Corey Broeckling and Matthew Lewis (CSU Metabolomics Facility), Clelia De-la-Peña and Jorge Vivanco (CSU), Eric Greene and Ragan Callaway (Univ. Montana, Missoula), and Lloyd Sumner (Noble Foundation, OK)

Many species of exotic invasive plants can establish very high population densities over time, resulting in a near monoculture of conspecific neighbors; however, at the invasion front or at new sites of introduction these weeds exist at much lower relative densities within a matrix of heterospecific neighbors. This ecological phenomenon makes invasive weeds a useful system in which to study the impact of plant community composition on individual plant biochemistry and physiology. Here, using a non-targeted metabolomics analysis, we show that individuals of the invasive weed, *Centaurea maculosa* Lam., accumulate increased levels of defense related secondary metabolites and reduced levels of primary metabolite when growing in conspecific versus heterospecific field stands. In a greenhouse experiment designed to further investigate these results, we found that *C. maculosa* plants accumulated less biomass and had higher amounts of total phenolics when grown with a conspecific versus a heterospecific plant neighbor, but only when the plants were elicited with jasmonic acid to mimic herbivory. These results indicate that an individual *C. maculosa* plant can differentially modify its defense response strategy based on the composition of the plant community in which it grows: conspecific plant neighbors result in increased accumulation of defense related secondary metabolites, whereas heterospecific neighbors lead to increases in primary metabolism and biomass production. Our results suggest that plant neighbor identity, although generally unaccounted for in biological studies, is an important factor in individual plant biochemistry and physiology that necessitates further study.

Gabriela Bucini (2C)
WOODY COVER AND HETEROGENEITY IN THE SAVANNA OF KRUGER NATIONAL PARK, SOUTH AFRICA
Colorado State University, Graduate
with Niall Hanan (CSU), Randall Boone (CSU), Michael Lefsky (CSU), Sassan Saatchi

The coverage of woody plants and their spatial distribution create a complexity of vegetation patterns that characterizes savannas ecosystems. Kruger National Park (KNP) covers almost two millions hectares of savanna with an impressive biodiversity. The resilience of this system is dependent on its biodiversity, which can be decomposed in species, structure and function diversity. In this work, we focused our attention on the structure of woody vegetation in the KNP savanna. We first assessed and mapped structure attributes and then modeled them as a response to biotic and abiotic factors at the regional scale. Specifically, we combined field measurements, optical and radar imagery and generated two wall-to-wall maps of woody cover and woody spatial heterogeneity at medium resolution (90 m). We created statistical models to explain the mapped woody vegetation patterns in relation to climate, soil and perturbation factors such as fire and herbivory and we established variables' relative importance in the ecological processes. The two maps along with the ecological insights derived from the models were made available to KNP for both for scientific and management purposes. KNP has in fact a long experience of integrating science in management planning and it recognizes structure and biotic heterogeneity as a goal for maintenance of biodiversity and ecosystem resilience.

Michael Buhnerkempe (8D)
YERSINIA PESTIS INFECTION IN PRAIRIE DOGS AND GROUND SQUIRRELS: THE RELATIVE IMPORTANCE OF EARLY-PHASE TRANSMISSION IN EXPLAINING PLAGUE OUTBREAKS.
Colorado State University, Graduate
with Colleen Webb (CSU), Rebecca Eisen (CDC)

Determining how the causative agent of plague (*Yersinia pestis*) spreads through a population is important in understanding plague dynamics in both amplifying (epizootic) and maintenance (enzootic) hosts. Previously, flea-borne transmission was assumed to be through repeated feeding attempts after plague bacteria produced a blockage in the digestive tract of the flea. This route of transmission has been shown to be less important in North American mammals like the prairie dog and their fleas, and recently, early-phase (unblocked) transmission of plague by fleas and contact with infected host tissue (i.e. infected carcasses) have been proposed as alternatives to the blocked flea paradigm. However, the role of early-phase transmission versus infected tissue contact in driving plague outbreaks is not known. To determine the importance of early-phase transmission in plague epizootics, we develop a model that explicitly incorporates plague infection in hosts and their fleas as well as both early-phase and direct contact transmission. We parameterize the model for both prairie dogs and ground squirrels and their fleas using field data and the literature. Using multi-parameter sensitivity analysis, we hope to determine the relative importance of early-phase transmission versus contact with infected host tissue in driving plague epizootics. We also hope to identify host and flea characteristics that control whether plague reaches epizootic levels or remains in an enzootic state.

Nate Cathcart (5B)
AN OUTSIDE PERSPECTIVE ON COASTER BROOK TROUT: THEIR MANAGEMENT AND THEIR FUTURE
Colorado State University, Undergraduate
with Dr. Casey Huckins (MTU)

Brook trout *Salvelinus fontinalis* that utilize the open waters of Lake Superior, presumably for better growth conditions, have been termed coasters. Coaster brook trout are only found within the Lake Superior Basin where their populations have crashed drastically since the 1900s due to habitat degradation, over harvest, species introductions, and other factors. Currently, the United States Fish and Wildlife Service is investigating whether to list the coaster brook trout as a threatened or endangered species. Populations of coaster brook trout are found in Canada, Minnesota, and Michigan. Canada contains the healthiest populations but Michigan's populations are perhaps the most remote, leading to unique research possibilities involving the ecological traits of coasters. The Salmon-Trout River population of coaster brook trout in the upper peninsula of Michigan has been studied for decades. For six months in 2008 on the Salmon-Trout River, we investigated spawning activity, sampled the fish community, took genetic samples of brook trout, studied young-of-year fish growth and habitat use, began mapping hydrology within spawning sites, and maintained a camera weir to track seasonal fish passage. Presently, the coaster brook trout faces many issues in and out of the water. Continuous and modern research will allow the coaster brook trout to, optimistically, persist in an ever changing world. While a decision has yet to be made whether to list it as a threatened or endangered species, the current research is a step toward finding and enacting proper management practices to conserve this fish.

Teresa Chapman (2D)
REGIONAL SYNCHRONY OF MOUNTAIN PINE BEETLE POPULATIONS IN THE SOUTHERN ROCKY MOUNTAINS
University of Colorado - Boulder, Graduate
with Thomas Veblen, Tania Schoennagel

Regional spatial synchrony, defined as the correlated fluctuations of disjunct population abundances, of insect species can indicate the role of climate in contributing to eruptive outbreaks. The theoretical mechanism of wide-geographic synchrony due to climatic stochcasticity (the "Moran" effect) assumes that distant populations have similar local density-dependent factors, such as host suitability. We analyzed regional synchrony in Mountain Pine Beetle (MPB) populations of the southern Rocky Mountains. The spatial distribution of the two main host species

varies considerably and potentially violates the assumptions of the Moran effect if this difference in host species is not considered. Using percentage of tree mortality detected with aerial surveys from 1996 to 2007 and aggregated to an 8km X 8km grid format as a proxy for MPB population density, we calculated the average correlation of MPB densities with a smoothed spline nonparametric covariance function. We investigated the difference in region wide synchrony compared to synchrony in lodgepole pine and ponderosa pine stands. We found that there was significant regional synchrony across the southern Rockies (0.17). The mean correlation was higher in lodgepole stands (0.29) and decayed at greater distances (>400 kms) than in Ponderosa stands (.06; ~270 kms). Results suggest that climate may synchronize MPB populations within similar forest covertypes in the southern Rockies.

James Cullis (4A)
THE IMPACT OF BED DISTURBANCE ON THE GROWTH OF THE NUISANCE DIATOM: *DIDYMOSPHENIA GEMINATA* IN RIVERS
University of Colorado - Boulder. Graduate
with Matthew Miller (CU) and Diane McKnight (CU)

Didymosphenia geminata, or "rock-snot", is a nuisance diatom species that can form large amounts of stalk material that covers the streambed. These blooms impact the aesthetic value and biodiversity of mountain streams across many parts of North America and Europe and threaten both valuable fish species such as trout and the sustainability of water supply infrastructure. The objective of this study is to investigate the hydrologic factors affecting the growth of *D. geminata*, and in particular the impact of floods and bed disturbance. Developing a quantitative understanding of the impact of flood events on the growth of *D. geminata* is crucial in understanding the impact of flow regulation on the increasing risk of nuisance blooms and if environmental flood releases from reservoirs are to be considered as a possible mitigation option. This paper will present the initial results from the analysis of the impact of a flood event on the growth of *D. geminata* in Boulder Creek, CO during the summer of 2006. This flood event resulted in significant decrease in coverage of *D. geminata*. Analysis of the hydrologic properties of the flood event suggest that there is a critical level of shear stress that is possibility related to bed disturbance that is a significant factor in reducing the coverage of *D. geminata*. This has implications for the possible consideration of managed flood releases for the control of future growth of *D. geminata* in regulated mountain rivers.

Katharine Driver (2B)
DISTINGUISHING FENS AND WET MEADOWS IN THE ROCKY MOUNTAINS:VARIATION IN SOILS, WATER TABLE, VEGETATION, AND POTENTIAL SENSITIVITY TO CLIMATE CHANGE.
Colorado State University, Graduate
with Dr. David Cooper (CSU)

Fens and wet meadows are two of the most abundant montane and subalpine wetlands in the Rocky Mountains. Fens are ground water fed peat accumulating ecosystems. They are characterized as having organic and perennially saturated soils. Due to limited nutrient availability and perennial saturation, fen vegetation consists of highly specialized wetland species. In contrast, wet meadows have mineral soils and only seasonally have water tables near the soil surface. Lack of continuous saturation limits peat accumulation but these soils typically have redoximorphic features characteristic of seasonally anoxic soils. Higher nutrient availability and lower water tables support a broader range of plant species in wet meadows. Data from fens and wet meadows throughout Rocky Mountain National Park has been used to better characterize the hydrologic regimes and vegetation that distinguish these wetland types and to identify features that may be used as indicators of climate change impacts. Water table and precipitation data suggests that climate change may affect fens and wet meadows differently. Fens depend upon perennial soil saturation and thus reduced ground water flow due to lower snowpack, earlier melt dates, or reduced summer precipitation could result in lower water tables in fens, altered peat accumulation rates and threatening vegetation. Wet meadows would be affected more by changes in the timing, duration, or amount of summer monsoonal precipitation, which historically has come from mid July through August, at the height of the growing season. If mid-summer aquifer recharge is inadequate, wet meadows will experience extreme drying, vegetation change, and could come to resemble dry or upland meadows. Establishing "thresholds" that distinguish fens from wet meadows and uplands is important for long term monitoring of wetland condition.

Jessica Ernakovich (3C)
ANALYSIS OF SOIL PROCESSES IN THE ARCTIC DURING FALL FREEZE-THAW CYCLES
Colorado State University, Graduate
with Matthew Wallenstein (CSU), Sarah Berg (CSU) and Alisa Challenger (CSU)

In the Arctic, fall freeze-up has major biogeochemical consequences. It is the transition between a time of minimal soil nitrogen at the height of summer and increasing soil N during the winter. These transitions are thought to decrease microbial biomass drastically, ushering in a new community responsible for nutrient cycling in the upcoming season. Soil processes during fall freeze in the Arctic have not been analyzed in depth. In order to gain an understanding of arctic soil processes, I propose to (1) analyze the microbial community response to the thaw by monitoring shifts in the active community and total community through rRNA and rDNA amplification, (2) track soil nutrient dynamics, and (3) monitor soil respiration. Understanding the response of microorganisms to the fall freeze at the molecular level will give insight into their overall role in biogeochemical cycling. Monitoring soil nutrients, such as dissolved organic carbon (DOC), dissolved organic nitrogen (DON), ammonium, and nitrate will highlight changes in nutrient dynamics over a freeze period. Soil respiration measurements will complete the understanding of the effect of the fall freeze on nutrient cycling. A closer look at the nutrient dynamics of the fall freeze with a microbial perspective will add to our knowledge of biogeochemical cycles in the Arctic.

Craig Feigenbaum (2E)
THE INFLUENCE OF HUNGER ON DISEASE TRANSMISSION IN A HONEYBEE COLONY
Colorado State University, Graduate
with Dhruba Naug (CSU)

Transmission patterns within a social group are likely to be shaped by the amount of available resources if the primary driver of social interactions is food exchange. The honeybee colony was used as a model to study how the amount of food stored in a colony influences the distribution of pathogens. Using a radioactive pulse, we explicitly mapped the spatial and temporal spread of an ‘infection’ that results from direct food transfer among individuals in a starved and a satiated colony. We show that the spread of an ‘infection’ is significantly influenced by the amount of stored food, with individuals from a starved colony having a higher exposure. This suggests that colonies with small food stores are more susceptible to epidemics. More generally, we also show that the social structure of the colony provides some amount of shielding to the queen and the youngest workers who are the most valuable members of the colony.

Toby Gass (6C)
STABLE CARBON ISOTOPES AS INDICATORS OF GROSS PRIMARY PRODUCTION AND GROWING CONDITIONS IN AN EXPERIMENTAL EUCALYPTUS PLANTATION
Colorado State University, Graduate
with Michael G. Ryan and Nate G. McDowell

Biosphere-atmosphere models of terrestrial carbon accumulation increasingly include the stable carbon isotope ratios (delta13C) generated by photosynthesis and ecosystem respiration as parameters. Environmentally driven changes in the delta13C of photosynthetic products have been implicated as the source of the variable delta13C of ecosystem respiration. Delta13C is also used to infer historical growth processes and environmental conditions. Structural or physiological adjustments that maintain constant leaf-level gas-exchange in changing environments may limit the inference that should be drawn from the delta13C of plant tissues and the associated carbon fluxes. We found that carbon isotope discrimination did not reflect changes in the gross primary production of *Eucalyptus saligna* in well-watered conditions. Although this phenomenon is sufficiently common to have been documented repeatedly, we do not know how predominant invariant discrimination is at global scales or in specific bioregions. We suggest that the relationship between atmospheric delta13C and gross primary production might not be as predictable as assumed in some integrated biosphere-atmosphere models. Research to date has focused on delta13C levels as recorders, rather than predictors. Insufficient evidence exists for us to conclude that delta13C incorporates the sensitivity and consistency needed to predict carbon fluxes across spatial scales.

Amanda Hardy (1A)
EFFECTS OF MULTI-USE PATHWAY CONSTRUCTION ON UNGULATES IN GRAND TETON NATIONAL PARK
Colorado State University, Graduate
with Kevin Crooks

Transportation systems in national parks affect how visitors experience parks and how park resources are affected by visitors. Grand Teton National Park (GTNP) recently constructed a paved, multi-use pathway for non-motorized travel adjacent to park roads that traverse through habitats where park visitors can view ungulates, including elk (*Cervus elaphus*), pronghorn antelope (*Antilocapra americana*), moose (*Alces alces*) and mule deer (*Odocoileus hemoinus*). Given concerns that activities on pathways may change ungulate behavior and distribution, this study was initiated to quantify potential effects of pathway construction and use on ungulates, visitors' ability to see ungulates, and interactions between wildlife and humans. We are characterizing and quantifying the activity of ungulates and visitors before, during and after the construction of 12.5 km of pathway (treatment area) and along 6.9 km of road corridor with no pathway construction (control area). We will present preliminary results comparing ungulate densities, distance from road and behaviors in the control and treatment areas in 2007 (before pathway construction) and 2008 (during pathway construction). Data collection will continue after the pathway is opened (2009 & 2010). Results from this effort will offer insights regarding how multi-use pathways along park roads may affect the management of park transportation corridors in terms of visitor experience and safety, protection of park wildlife, and maintaining the character of park landscapes.

Mark Hayes (6B)
POTENTIAL AFFECTS OF CLIMATE CHANGE ON BAT POPULATIONS IN THE SOUTHERN ROCKY MOUNTAINS
University of Northern Colorado, Graduate
with Rick A. Adams (UNC)

The Southern Rocky Mountains may be experiencing rapid climate changes resulting in environmental modification with potentially significant influences on species of conservation concern. Bats represent a significant contribution to mammalian species diversity in the Southern Rocky Mountains. However, the precise affects of climate changes on local bat populations and the potential affects on food-web dynamics and trophic interactions are unknown. Here, we present preliminary results suggesting that the proportion of reproductively active female bats in our study area over 12 years is significantly related to mean summer temperatures and availability of water resources. We scaled these reproductive rate relationships with projected increasing regional temperatures and incorporated this information into a preliminary age-structured stochastic population dynamics model. In this model, bat populations declined to extinction regularly within 2 centuries. This preliminary modeling provides insights into how some bat populations may respond to increasing temperatures and reduced water resource availability associated with climate change in the Southern Rocky Mountains. We anticipate that this model will provide a framework for more sophisticated species-specific mathematical approached to modeling the affects of regional climate changes on bat populations, and that this approach can be extended to investigations of forest and riparian food-web dynamics.

Megan Hayes (8B)
THE ROLE OF WILDFIRE ON PREVALENCE OF SIN NOMBRE VIRUS IN DEER MICE SIX YEARS POST-BURN
Fort Lewis College, Undergraduate

With newly emerging diseases, much attention has focused on human disturbance of wildlife habitat, which may increase prevalence of zoonotic diseases. Sin Nombre Virus (SNV) is a hantavirus carried by deer mice (*Peromyscus maniculatus*) and is highly lethal to humans. In this study, I examined the relationship between prevalence of SNV in deer mice and intensity of burn six years following a wildfire. The study site was within the Missionary Ridge Fire perimeter in southwest Colorado, where SNV is common. From June 9th through July 25th, 2008, I compared SNV patterns in four habitat types: gambel oak (*Quercus gambelii*), ponderosa pine (*Pinus ponderosa*), aspen (*Populus tremuloides*), and mixed conifer, in low and high burn intensity areas. Three replicates were used for each of the eight site types. One hundred Sherman traps were baited and set at each site, for a total of 2,400 traps. On all captured deer mice, a small blood sample was drawn from the retro-orbital sinus by using a capillary tube. Blood samples were screened for antibodies to SNV using a field-based protein assay-A/G horseradish peroxidase enzyme-

linked immunosorbent assay (PAGEIA). Significantly more mice tested positive for antibodies in low burn intensity areas than high burn intensity areas (P = 0.035). Deer mice with antibodies to SNV were also heavier and sexually mature compared with mice without SNV.

Kirstin Holfelder (5A)
EVALUATING THE EFFECTIVENESS OF CARBON AND ZEOLITE TREATMENTS TO REDUCE NITROGEN IN SEWAGE SLUDGE TREATED LANDS
Colorado State University, Graduate
with Indy Burke (CSU)

The disposal of sewage sludge is a global problem. In the 1980's, the US disposed of 70 million dry tons of sewage sludge yearly at a cost of $844 million. Since then, population has grown 13.2%. The City of Aurora is currently feeling the pressures of such rapid development. From 1969 to 1986, the city of Aurora had a land disposal policy for municipal sewage sludge. Around 233,000 dry tons of biosolids were incorporated into 2 square miles of land. The area is now managed by Aurora Parks and Open Space, who want to put a trail in the site. Unfortunately, the land is covered by spiny lettuce (*Lactuca serriola*), kochia (*Kochia scoparia*), cheat grass (*Bromus tectorum*), and other exotic grasses and forbs.
My objectives are to understand why weedy plants characterize the sludge disposal site and to develop effective management strategies. In a pilot study, I found nitrogen (N) levels in the sewage sludge treated area were three orders of magnitude higher than the N levels in neighboring shortgrass steppe sites. Having established that high N levels could be contributing to weed dominance, I applied two treatments I hypothesized would reduce plant available N: sawdust and zeolite. I measured N in treatment and reference plots and found that N was significantly reduced by the sawdust treatment. My results indicate that sawdust used to stimulate microbial N immobilization can reduce plant available N, and may be a useful management technique for sludge contaminated areas.

Jennifer Rains Jones (2A)
INVENTORY AND MONITORING OF NATURAL RESOURCES IN LARGE, HETEROGENEOUS LANDSCAPES
Colorado State University, Graduate
with David Cooper (CSU)

Understanding the status and trends of natural resources is an important component of resource management. The National Park Service has developed an Inventory and Monitoring Program to provide a scientific foundation for natural resource management. Park networks have chosen to target specific resources as 'vital signs' that will characterize status and inform trends of physical and biological processes. Wetlands have been chosen in both Sierra and Rocky Mountain Network Parks as an ecologically important habitat targeted for inventory and monitoring. Sampling wetland resources at the park scale presents many challenges including logistical issues and time constraints. The National Park Service has developed a unique approach to sampling wetland resources at large scales that provides a both spatially balanced sample and sufficient flexibility to change with project needs. The sampling design being used by the Rocky Mountain and Sierra Networks Parks involves a three stage generalized random tessellation stratified (GRTS) selection. The first stage involves a discrete, stratified watershed selection, the second stage, an unequal probability selection based on wetland type, and the third stage, plot placement within selected wetlands. Power analysis of data collected during the 2007 and 2008 field seasons in Yosemite, Sequoia, and Kings Canyon is being used to validate the use of this complex sampling design.

Craig Judd (3A)
IMPLICATIONS OF METHANOTROPH COMMUNITY COMPOSITION FOR METHANE UPTAKE IN UPLAND SOILS
Colorado State University, Graduate
with Joe von Fischer, Noah Fierer

Methane is an important greenhouse gas, and the uptake of methane by methanotrophic bacteria in upland (i.e., well-drained, oxic) soils is the primary biological sink. Rates of methane consumption by upland soils differ in space and time, but we have only a weak understanding of the importance of differences among methanotrophic bacteria in driving differences in uptake rates. To investigate the effect of community composition differences on methane uptake, we used enzyme kinetic assays and DNA sequencing techniques to investigate if methanotrophic community composition could explain differences in methane consumption we see at three Long Term Ecological Research (LTER) sites that fall along a precipitation gradient. Our findings reveal that communities differ in rates of methane uptake, and that their biochemical differences correspond with variation in community composition. A remaining uncertainty is what environmental factors are most important for shaping the biogeographic patterns that we observe.

Andrew Kanarek (7B)
ALLEE EFFECTS AND INVASION SUCCESS THROUGH COUPLED EVOLUTIONARY AND ECOLOGICAL DYNAMICS
Colorado State University, Graduate
with Colleen Webb (CSU)

The mechanisms that facilitate success of an invasive species include both ecological and evolutionary processes. Investigating the evolutionary dynamics of founder populations can enhance our understanding of patterns of invasiveness and provide insight on management strategies for controlling further establishment of introduced populations. Our aim is to analyze the evolutionary consequences of ecological processes (i.e. propagule pressure and threshold effects) that impact successful colonization. We address our questions using a spatially-explicit modeling approach that incorporates dispersal, density dependent population growth, and selection. Our results show that adaptive evolution may occur in small or sparse populations, providing a means of mitigating or avoiding inverse density dependent effects (i.e. Allee effects). The rate at which this adaptation occurs is proportional to the amount of genetic variance and is a crucial component in assessing whether natural selection can rescue a population from extinction. We show that rapid evolution can occur given sufficient genetic diversity due to sampling effects from single or multiple source populations. Our results are consistent with empirical evidence and other theoretical work, and underscore the importance of evolution in predicting invasions.

Ian Leinwand (5C)
USING HUMAN MODIFIED LAND COVER TO CHARACTERIZE LAND USE PATTERNS IN THE SOUTHERN ROCKY MOUNTAINS
Colorado State University, Graduate
with David M. Theobald, Richard L. Knight, John E. Mitchell

The Rocky Mountain west is experiencing rapid land use change in the form of rural and exurban residential development. Public land managers from the USFS, BLM, and NPS are becoming increasingly concerned with ecological impacts and management implications of private land use adjacent to public lands. Using a human modification framework, we quantified the composition and patterns of human land use at the interface of public and private land within the Southern Rocky Mountain Ecoregion (SRME). We also examined the relationship between residential housing density and human modified land cover, allowing us to model the ecological footprint of land use along a rural to urban gradient. Our methods demonstrate how detailed land cover data collected from aerial photographs can be used to quantitatively define and characterize general land use types. Within the SRME, the total shared edge between public and private land is approximately 44,690 km. Overall the dominant land uses were Residential (18%) and transportation (18%) followed by Agriculture (10%) and Resource Extraction (3%). We found that the area of human modified land cover per residential unit decreases as housing density increases, while the total area modified increases non-linearly as residential

housing density increases. Our research provides quantitative estimates of land use impacts that can be used to model the ecological consequences of future land use scenarios.

Stacy Lynn (5D)
CULTIVATION AS A QUICK PASTORAL RECOVERY MECHANISM: THE CASE OF MAASAI IN SIMANJIRO, TANZANIA
Colorado State University, Graduate

In northern Tanzania, large areas of high-potential land have been taken out of the hands of Maasai livestock herders to create national parks to reduce wildlife vulnerability to land use change and consumptive use. These parks had the additional effect of eliminating seasonal movement mechanisms from the traditional Maasai repertoire. Despite the high temporal and spatial variability of rainfall in East Africa that makes cultivation a risky venture, over the past thirty years most Maasai in the area have diversified from pure pastoralism to a mixed pastoral-agricultural land use system. Every year a crop is planted there is a risk of complete loss. An important question arose as to whether cultivation was a financial sink, or whether this diversification was truly helping people to survive.
Household interview data collected during one average (2002) and one dry rainfall (2003) year indicate that while median cultivation-related income did decrease significantly in 2003 ($80 vs. $451 in 2002), when the two years were averaged only 12% of households were at a net loss, 80% of households showed a net gain, if small, and 8% of households effectively broke even. This demonstrates that despite poor years, cultivation is not a financial sink for these households. Rather, cultivation now increases resilience by 1) providing a mechanism for simultaneously coping with short-term food and cash needs through intermittent good harvests, and 2) presenting an opportunity to cultivate and harvest with the very first rainy season following a drought, allowing a quick rebound while livestock populations recover over the course of years.

Christopher Mayack (8C)
ENERGETIC STRESS IN THE HONEYBEE *APIS MELLIFERA* FROM *NOSEMA CERANAE* INFECTION
Colorado State University, Graduate
with Dhruba Naug (CSU)

Parasites are dependent on their hosts for energy to reproduce and can exert a significant nutritional stress on them. Energetic demand placed on the host is especially high in cases where the parasite-host complex is less coevolved. The higher virulence of the newly discovered honeybee pathogen, *Nosema ceranae*, which causes a higher mortality in its new host *Apis mellifera*, might be based on a similar mechanism. Using Proboscis Extension Response and feeding experiments, we show that bees infected with *N. ceranae* have a higher hunger level that leads to a lower survival. Significantly, we also demonstrate that the survival of infected bees fed ad libitum is not different from that of uninfected bees. These results demonstrate that energetic stress is the probable cause of the shortened life span observed in infected bees. We argue that energetic stress can lead to the precocious and risky foraging observed in infected bees and discuss its relevance to colony collapse syndrome. The significance of energetic stress as a general mechanism by which infectious diseases influence host behavior and physiology is discussed.

Nate Mellor (3D)
DIFFERENCES IN THE ORGANIC LAYER AND MINERAL SOIL PRIOR TO AND FOLLOWING DECOMPOSITION
Colorado State University, Graduate
with M. Haddix, S.J. Morris, R.T. Conant, E.A. Paul

The fate of litter compounds during decomposition is currently in debate. Soils appear to be both similar throughout the world and a product of the plant materials that are decomposed to form the mineral soil. The Nebraska National Forest consists of cedar and pine plantations planted on native prairie. The organic layer (litter) and mineral soil under all three vegetation types was sampled in 2007. Pyrolysis molecular beam mass spectrometry (Py-MBMS)

was done to determine the differences in chemical compounds in the litter and mineral soil prior to and following decomposition. This work should help to determine the extent to which litter chemistry dictates the chemical composition of mineral soil.

Matt Pyne (4C)
USE OF BAYESIAN HIERARCHICAL REGRESSION MODEL TO PREDICT SPECIES TRAIT DISTRIBUTIONS OF AQUATIC INSECTS IN STREAMS
Colorado State University, Graduate
with Hongyu Tan

Prediction of species abundance and distribution has long been a major goal of ecology. But, it can be difficult to understand the ecological link between species and their environments. Additionally, the relationship between taxa distributions and environmental covariates are often complex. Many habitat models, from simple linear regression models to multivariate methods and neural networks, have been used in attempts to capture this complexity. A Bayesian hierarchical regression model can incorporate multiple species and environmental variables and explicitly model the relationship between the environment and each species. We used a Bayesian model for multivariate compositional data to predict the abundance of species traits for aquatic insects in streams located in Washington, Oregon and Colorado. We found that the species trait distributions were correlated with environmental variables associated with environmental degradation (e.g. percent forest, sand and fine stream substrates) and stream temperature.

Lindsay Reynolds (7C)
CAN ONE INVASION LEAD TO ANOTHER? MECHANISMS OF OLD AND NEW EXOTIC PLANT INVASION ALONG WESTERN RIVERS
Colorado State University, Graduate
with David J. Cooper

In the southwestern United States, the exotic woody plant species tamarisk (*Tamarix ramosissima Ledebour, T. chinensis Loureiro*, and their hybrids) and Russian olive (*Elaeagnus angustifolia* L.) are invaders of riparian habitats. These plants were introduced by humans throughout the southwest around 1900 however Russian olive invasion has increased more recently compared to tamarisk. Both tamarisk and Russian olive have invaded the ephemeral stream system in Canyon de Chelly National Monument, Arizona. We worked in sites within Canyon de Chelly and throughout the region to address the following question: can Russian olive establish in shadier and drier habitat than tamarisk and the native cottonwood? To address this question we analyzed exotic and native riparian tree seedling establishment in a controlled experiment, at sites in Canyon de Chelly, and at sites throughout the central Colorado River Basin. Our results indicate that Russian olive can establish in the shade of cottonwood, tamarisk and other plants. Russian olive can also establish on high terraces where seedlings do not have access to the water table. These are habitats where tamarisk and native riparian plant species cannot establish. In the future, Russian olive will likely increase in abundance while tamarisk will decrease along rivers in the southwestern US.

Jason Shaw (1D)
DEVELOPMENT OF MANEUVERABILITY IN TWO NEW WORLD FRUIT BATS IN RELATION TO RESOURCE PARTITIONING
University of Northern Colorado, Graduate
with Rick Adams

Resource partitioning allows for competing species to coexist within a habitat by exploiting different foraging methods or locations. Coexistence among closely related, taxonomically and/or ecologically related species, is afforded by variation in traits allowing for resource partitioning. Field studies have shown that there exist ontogenetic shifts throughout the age-spectrum of young insectivorous bat leading to significantly different, size-specific ecomorphologies. These studies indicate that niche space differs among different aged juveniles and between juveniles and adults of the same species. We are using laboratory tests of age-dependent juvenile flight abilities of two species of fruit bats (*Carollia perspicillata* and *Artibeus jamaicensis*) by flying young bats of difference age through a 3D maze. We tested flight ability by adjusting the maneuverability course relative to full wingspan, 75% wingspan and 50% wingspan. Preliminary results comparing the data of the juveniles with

that of adults suggests that *A. jamaicensis* maneuvers through the three maze configurations like an adult at 45 days after achieving first flight (t-test, $p>0.05$) whereas, *C. perspicillata* achieved adult-like agility at 40 days after achieving first flight (t-test, $p>0.05$). This suggests that juveniles cannot initially exploit the resources in the same manner and location as the adults, suggesting resource partitioning within the same species.

Emily Snode (1B)
PRELIMINARY RESEARCH ON EPAULETTED FRUIT BATS IN KRUGER NATIONAL PARK, SOUTH AFRICA AND THEIR EFFECTS ON SYCAMORE FIG SEED GERMINATION
University of Northern Colorado, Graduate
with Rick Adams

Recently there has been a notable decline of sycamore fig trees (*Ficus sycomorus*) in Kruger National Park (KNP), South Africa. KNP is inhabited by two species of epauletted fruit bats, *Epomophorus wahlbergi* and *E. crypturus*, both of which eat figs from sycamore trees. This study quantifies the effects of fig seed manipulations by these fruit bats. I hypothesize that manipulation by epauletted fruit bats does have an effect on fig seed germination success. I predict both oral processing (spats) and passing of seeds through the digestive tract of these fruit bats causes increases in germination rate and percentage. Fecal and spat samples were collected from feeding roosts in KNP throughout June 2008. Controls included seeds taken directly from fruit and cleaned, and seeds taken from fruit with pulp attached. All seeds were germinated under similar conditions. Fecal seeds were germinated for 11 days, spat seeds 18 days, and control seeds 15 days. Results showed 96.8% of *E. crypturus* fecal seeds germinating within an average of seven days, whereas 26% of cleaned control seeds germinated in 10 days, and 12% of pulp control seeds germinated in 15 days. None of the seeds from the spat samples germinated. Preliminary results of scanning electron microscopy imaging of experimental and control groups show fig seed surface differences. These results may indicate seeds digested by epauletted fruit bats become scarified, opening up the seed coat for nutrients that expedite seed germination.

Nathan P. Snow (1C)
ROADS REDUCE SURVIVAL FOR NAÏVE ISLAND FOXES
Colorado State University, Graduate
with William F. Andelt (CSU) and Thomas R. Stanley (USGS)

Island foxes (*Urocyon littoralis*) have experienced severe reductions in populations on 4 of 6 California Channel Islands. Meanwhile, numbers of foxes on San Clemente Island (SCLI) have remained relatively stable, but are suffering frequent mortalities from collisions with vehicles. Through isolation, many endemic species have lost their instincts to avoid threats (i.e., predator naïveté) and therefore suffered declines. We examined if the extensive road network on SCLI contributed a negative impact on annual rates of survival of SCLI foxes (*U. l. clementae*). We examined the annual survival of 3 samples of foxes on SCLI; a random sample from the entire northern 2/3 of the island, a sample that lived near roads, and a sample that lived away from roads. We found that foxes on SCLI generally have a high annual survival rate (0.92), however foxes near roads had significantly lower annual survival rates (0.72) than foxes living away from roads (0.96). We ascertained the reduced survival of foxes along roads was likely related to the naïveté of foxes juxtaposed with the road network and human influences, particularly in urban habitats.

Thomas Wilding (4B)
FLOW DISTURBANCE AND AQUATIC ECOSYSTEMS – A QUESTION OF SCALE
Colorado State University, Graduate

In choosing a topic for graduate research we must implicitly select a scale at which to work. Experimental research typically operates at a fine scale because manipulation of variables over large areas is not practical. Landscape scale studies often rely on observational data more practically measured over large areas. My aim is to predict the right scale for evaluating the effects of dams and altered disturbance regimes on aquatic ecosystems.
The effect of flow disturbance operates at a point scale. For example, extreme velocities will displace or injure individual fish and mobilize individual cobbles. Moving up in scale, the number and severity of floods that occur each year will constrain the population that persists to exploit baseflow habitat. It is the additive effect of repeated disturbances that exclude some species and favour others, and hence drive long-term biotic patterns

and spatial differences between hydroclimatic regions.
Applying these concepts to measuring the effect of dams, small-scale studies are expected to highlight only the deleterious effects of floods on individual growth and survival. This is important for examining specific mechanisms of altered disturbance regimes, but not the net effect. Larger scale studies will be necessary to observe the community level result of disturbance. Dams alter flow regimes at the reach scale, reducing the spatial scale at which distinct flow regimes are observed. I propose that long-term data collected at the reach scale is required to understand the effect of altered disturbance regimes and guide successful management for stream ecosystems.

Poster Presentations

Abstracts listed alphabetically by author
Numbers refer to poster order as shown in schedule above

Elan Alford (23)
SOIL MICROORGANISMS ALTER SELENIUM ACCUMULATION IN A TOXIC LOCOWEED
Colorado State University, Graduate
with Mark Paschke

Many poisonous plants grow in the western United States. *Astragalus bisulcatus* is a widespread plant that causes livestock poisoning. This locoweed can cause toxicity because it hyperaccumulates soil selenium (Se). Here we describe the influence of soil microorganisms on Se accumulation in *A. bisulcatus* and a co-occurring, non-hyperaccumulating congener, *A. drummondii*. We found that soil microorganisms affect Se concentration in the hyperaccumulator differently than the non-hyperaccumulator. Specifically, inoculation and root nodulation influence shoot Se concentration in *A. bisulcatus* but have no effect on *A. drummondii*. Further research is required to unravel the mechanisms at work in this interesting initial result.

Amariah Anderson (30)
SWIFT FOX (*VULPES VELOX*) ECOLOGY IN RELATION TO BUBONIC PLAGUE EVENTS IN NORTHEASTERN
Colorado State University, Graduate
with Michael Antolin (CSU) and Kevin Crooks (CSU)

An analysis of the relationships between swift fox (*Vulpes velox*) home range distribution and prairie dog colonies (*Cynomys ludovicianus*) on the Central Plains Experimental Range (CPER) in northeastern Colorado is presented. Data from the years 2004 – 2007 is used in conjunction with home range kernel density estimates illustrating swift fox home range distribution and overlap onto prairie dog colonies. The intent of the study is to determine swift fox dependence on prairie dogs for their burrows and food resources. The bubonic plague (*Yersinia pestis*) epizootics that occurred in 2005 and again in 2007 dramatically altered the distribution of prairie dog colonies on the CPER. These events offer a unique opportunity to compare swift fox distribution from the pre- and post- plague time periods. Fleas were collected off of trapped swift foxes and later individually identified to species and PCR was performed to determine potential *Y. pestis* infection. Future work will entail a second round of PCR (a re-PCR of the same fragment) to ensure that there are no false negative results.

Katie Boisen (33)
RECYCLING IN OUR CLASSROOM: INVESTIGATIONS INTO EARTH SYSTEMS ON A MIDDLE SCHOOL CAMPUS
Brentwood Middle School
with Steve Swenson and Ann Dickenson

The school recycles paper and cardboard and we want to recycle plastic bottles but do not know how we can clean them. Our Advisement class helps out our school and community recycle. There are several activities that revolve around the importance of recycling that we do in our school. We communicate with other classrooms to make sure they have a recycling container. We supply and decorate recycling containers for those classrooms that need a receptacle. Students in our class also create meaningful recycling posters for our building. Every other Friday, we pick up the recycling in our building and take it to the recycling bins for pick-up. Lastly, we give public service announcements over the school intercom on a weekly basis. These announcements give recycling tips and facts to our school population. Our Advisement class does quite a bit to help the recycling cause, but we are always searching for new and exciting ways to help even more!

Casey Brown (28)
THE EFFECTS OF ANTHROPOGENIC NOISE ON UNGULATE BEHAVIOR IN THE GRAND TETON TRAVEL CORRIDOR
Colorado State University, Graduate
with Lisa Angeloni (CSU), Kevin Crooks (CSU), Kurt Fristrup (CSU)

The effects of anthropogenic noise on terrestrial wildlife are a relatively new area of study with broad ranging management implications. Human activities such as wildlife viewing may increase the levels of noise within protected areas, including U.S. National Parks. Grand Teton National Park draws nearly 4 million visitors per year to recreate along park roads, trails, and campgrounds. As visitors travel through the park, and congregate around wildlife viewing locations, increased levels of noise are one of the many disturbance stimuli introduced into the environment. This study investigated the potential effects of human induced noise on ungulate behavior along the Teton travel corridor; elk and pronghorn were the focal species for the project. We utilized acoustic monitoring equipment to measure sound levels associated with recreational activities at stationary points throughout our study area. We also conducted roadside surveys observing human activities and ungulate behaviors while concurrently recording anthropogenic noise. The information from this study can provide insights to managers into the types of human activities associated with noise disturbance and to what levels ungulates respond to levels of noise stimuli.

Karie Cherwin (32)
RESPONSE OF SHORTGRASS ECOSYSTEMS TO CLIMATE CHANGE: DOES SEVERE DROUGHT INCREASE INVASIBILITY?
Colorado State University, Graduate
with Alan Knapp (CSU)

According to the latest IPCC report, global climate change models are predicting an increase in the variability and intensity of extreme weather events, such as drought, in semi-arid regions. Semi- arid grasslands, or shortgrass-steppe, are among the most responsive ecosystems to global climate change. Therefore it is critical to determine the underlying mechanisms of their responses to scenarios like drought and how these mechanisms vary across space and time. Annual net primary productivity (ANPP) is heavily influenced by precipitation and increases along spatial precipitation gradients; however, time series analyses of grasslands have revealed temporal lags in recovery following drought. These time lags may create a "window of opportunity" for invasive species to colonize these ecosystems because of the reduction in plant cover and meristem density, and the accumulation of soil nitrogen. I have completed two years of a three-year field experiment to examine the consequences of drought on semi-arid grassland productivity and invasibility. My presentation will cover my questions, methods, preliminary results & conclusions, and future research directions.

Rebecca J. Cole (13)
POST-DISPERSAL SEED FATE OF TROPICAL MONTANE TREES IN AN AGRICULTURAL LANDSCAPE, SOUTHERN COSTA RICA
University of California- Santa Cruz, Graduate

Variation in post-dispersal seed fate is an important factor driving patterns of forest regeneration. Because most previous studies have not tracked final seed fate and have commonly equated seed removal with predation without considering the possibility of secondary dispersal, little is known about individual seed mortality factors in degraded habitats. This study tracked the post-dispersal fate of large-seeded tropical montane trees in abandoned pasture, secondary forests, and forest fragments during two consecutive years. The incidence of secondary dispersal by animals, scatterhoarding in particular, and the effects of seed burial on germination were measured. Overall, seeds survived through germination more often in secondary forests than in abandoned pastures or forest fragments. The majority of seed mortality was caused by rodent predation in forest fragments, insects and fungal pathogens in secondary forests, and a combination of desiccation, insects, and fungal pathogens in pastures. Seeds were frequently secondarily dispersed in larger forest fragments, whereas they were only rarely moved in other habitats. Burial improved germination in pastures and was important for an often scatterhoarded species, *Otoba novogranatensis*, in all habitats. These results suggest that (1) seed mortality factors differ in response to the type of habitat degradation, (2) large-seeded species have high potential for survival when dispersed to secondary forests, and 3) seed removal is not a reliable proxy for seed predation, particularly in less degraded forest fragments.

Byron Collins (12)
SEEDLING ESTABLISHMENT FOLLOWING MOUNTAIN PINE BEETLE INFESTATION AND FOREST HARVESTING
Colorado State University, Graduate
with Charles Rhoades (CSU), William Romme (CSU)

The forests of Colorado and across much of the Mountain West are changing rapidly due to the effects of severe mountain pine beetle infestation. The widespread mortality of many lodgepole pine forests is certain, but the future trajectory of these ecosystems is not. As an initial step in characterizing ecosystem recovery after mountain pine beetle outbreak, this study will compare tree seedling density and herbaceous plant cover between areas that have been harvested to reduce crown fuels and adjacent untreated stands. Our research compares various salvage logging practices employed by the US Forest Service in response to insect infestations with a no-action alternative. Sampling was conducted at the USFS Fraser Experimental Forest on ten treated and ten untreated stands. Treatment units range from 5 to 60 hectares and vary in the amount of overstory removed as well as the quantity of harvest residue left on site. Of seedlings established prior to harvest, 18% fewer were found in treated areas as compared with untreated. Lower numbers of advanced regeneration seedlings may be due to mechanical damage associated with harvest operations and burial under harvest residue. On-going work, focused on seedlings established since harvest, will aim to identify relationships between management practices, site conditions and forest regeneration that will inform future responses to mountain pine beetle outbreak and associated forest management.

Anthony Darrouzet-Nardi (22)
LOOKING FOR HOTSPOTS OF NITROGEN CYCLING IN AN ALPINE-SUBALPINE WATERSHED
Colorado State University, Graduate
with William D. Bowman

Landscape heterogeneity is one of the major obstacles to understanding the terrestrial N cycle. This project was designed to identify hotspots of N cycling and develop testable hypotheses about hotspot function. Using soil core composites, buried bags, and resin bags, I measured percent N and N isotope ratios in heavy, light, and total soil fractions; net mineralization and net nitrification; and inorganic N availability across a 0.89 km2 alpine-subalpine catchment within the Niwot Ridge LTER site, Colorado, USA. The well-defined gradients in the percent N data from the heavy soil fraction suggest that N moves more slowly through the dry meadows of the alpine tundra above tree line. However, the lack of pattern in the d15N data suggest that rates of N cycling in the open areas may still depend on plant species identity. This hypothesis is supported by the fact that there are more visible gradients in the d15N data under the species-poor patches of trees. The anomalous d15N values in the wetlands as well as net nitrification rates at the base of the steep sideslope suggest that these may be hotspots of denitrification.

Mineralization hotspots in the alpine appear to be associated with patches of N-fixing forbs. Resin bags show the clearest patterns of N cycling, suggesting that rates are elevated under all types of tree cover and that plant size and species identity are important determinants of landscape-level N cycling rates.

Cara DiEnno (11)
COMMUNITY-BASED URBAN RESTORATION IN RIPARIAN CORRIDORS: AN EXAMINATION OF SOCIAL CAPITAL AND COMMUNICATION PROCESSES
Colorado State University, Graduate

Though some may see people as a challenge to conservation, they are also always at the root of the solution (McCormack, 2005). The non-profit sector has increasingly become a force in encouraging environmental engagement, yet very little is known about the success of their communication efforts aimed at involving people in local ecological issues and gaining support for conservation initiatives. This case study describes the role of social capital and communication processes in shaping successful community outreach efforts of an urban non-profit organization in Denver, Colorado; specifically, the Partners for Colorado Native Plants (PCNP) group, a grant funded project of the Denver Botanic Gardens. The focus of the local outreach effort was the involvement of urban communities in riparian plant restoration projects in local Denver natural areas. Social capital was examined for its role in encouraging citizens to get involved initially in projects as well as the ability for social capital to be built through participation in restoration projects. Small group communication within the PCNP project was examined using the Bona Fide Group Collaboration Model developed by Walker, Craig, & Stohl (1998).

Heidi Erickson (29)
AVIAN RESPONSE TO MANAGED BURNS AND GRAZING TIMING IN HIGH ELEVATION SAGEBRUSH
Colorado State University, Graduate
with Cameron Aldridge (CSU) and N. Hobbs (CSU)

Understanding how management practices affect wildlife populations is fundamental to wise conservation of public lands. Prescribed fire and grazing timing are two management tools frequently used within publicly owned sagebrush ecosystems. We conducted surveys and avian nest monitoring in order to assess the impacts of grazing timing strategies (early summer before peak green-up, mid-summer at peak green-up, and late summer after peak green-up) in conjunction with prescribed fire on avian populations in a high-elevation sagebrush ecosystem. Three bird species were common during avian surveys: Brewer's sparrow (*Spizella breweri*), horned lark (*Eremophila alpestris*), and vesper sparrow (*Pooecetes gramineus*). Brewer's sparrows had a lower detection frequency within the mid-summer grazing treatment compared to early and late summer grazing treatments, while horned larks and vesper sparrows had a higher detection frequency within the late summer grazing treatment. We monitored 50 avian nests in 2007 and 103 nests in 2008. Apparent success for shrub-obligate nesting species was 58 percent in 2007 and 63 percent in 2008. Sage-grouse (*Centrocercus urophasianus*) pellet counts revealed greatest sage-grouse habitat use within the early grazing treatment and minimal use of burn treatment areas across all grazing treatments. This research will support management of sagebrush ecosystems by providing land managers with direct comparisons of wildlife response to management regimes.

Robert Faris (15)
PINGREE TO THE PLATTE
Riffenburgh Elementary School
with Casey Brown (CSU)

We at Riffenburgh are near the Cache la Poudre River and are concerned about the pollution levels of the river and they may affect macro invertebrates in the river. We have been a part of an ongoing study of the river in our sixth grade class. To get our results we tested phosphate, nitrate, and pH levels of the soil near the river and the water in the river. We also conducted macro invertebrate surveys. We did this at three different sites along the Poudre River. We are studying macro invertebrates because they are an important part of the food web. If macro invertebrates are affected by water quality, other larger organisms including human populations may be impacted.

Sarah Fitzpatrick (17)
MORPHOLOGICAL RESPONSE TO DECREASED PREDATION RISK IN TRINIDADIAN GUPPIES
Colorado State University, Graduate
with Corey Handelsman, Julian Torres Dowdall, Lisa Angeloni, and Cameron Ghalambor

Spatial and temporal variation in predatory regimes is thought to be a mechanism of adaptive evolution and has been shown to yield predictable and repeatable phenotypes among populations. We hypothesized that local adaptation to either a low or high predation habitat would drive morphological divergence in the Trinidadian Guppy (*Poecilia reticulata*), representing fitness trade-offs between the respective environments. Thus, if the predator regime were altered, we would expect a phenotypic response based on a priori predictions of guppy morphology observed in wild populations that differ in predatory environments. We tested this hypothesis by marking and introducing the offspring of wild *P. reticulata* from high predation streams into two low predation streams in the Guanapo drainage in the Northern Range Mountains of Trinidad. Mark-recapture sampling was conducted monthly to assess changes in morphology, juvenile recruitment, and survivorship. Recaptured fish from the introduction sites were photographed each month and digitized at 14 homologous landmarks (tpsDig software) to quantify lateral body morphology. Superimposed landmark configurations were used to calculate geometric shape variables and depict the source of shape variation among individuals. Compared to the founding population, subsequent recruits exhibited an increase in overall and head size, a shortened caudal peduncle, eye shift dorsally, and mouth shift ventrally. These results largely match our a priori predictions of body morphology that have been observed in low-predation fish, and suggest the predatory regime mediates divergent natural selection in *P. reticulata*.

Eric Gangloff (21)
VARIATION IN BODY-MASS INDEX IN A COLORADO POPULATION OF ORNATE BOX TURTLES (*TERRAPENE ORNATA ORNATA*)
Metropolitan State College of Denver, Undergraduate
with J.L. Gagliardi-Seeley (MSCD)

The demographics and life history of the ornate box turtle (*T. o. ornata*) has yet to be studied in Colorado. To provide a comparison with other populations so that land management questions can be better informed, morphometric data were collected for two seasons in a population of ornate box turtles on the sandhills of eastern Colorado (n = 84). Ratios of mass to calculated volume, or body mass index, were compared between males and females and between years. A significant difference was found between mean body mass index for females in 2007 and females in 2008, while males did not demonstrate such a difference. This difference is most likely due to variation in egg development and reproductive output in females.

Thomas A. Grant (2)
AUTO-INHIBITION OF SEED GERMINATION BY THE INVASIVE *ACROPTILON REPENS* (RUSSIAN KNAPWEED)
Colorado State University, Graduate
with Mark Paschke (CSU)

In order to increase our understanding of Russian knapweed's (*Acroptilon repens* (L.) DC) chemical effects on the germination and establishment of its own species (auto-inhibition), seeds of *A. repens* were sown inside and outside of knapweed infestations at a CSU property in Waverly, CO. Using activated carbon and the addition or removal of *A. repens* litter as treatments in a split plot design, the research attempts to isolate the intra-specific chemical interactions of this highly invasive and potentially allelopathic species. The preliminary analysis of the first year data uses an ordination method (Non-metric Multi-dimensional Scaling - NMS) to isolate relationships and patterns between the plant community composition, experimental treatments, and germination of *A. repens* seeds. More traditional statistics will utilize a split-plot Anova to determine if treatment effects influence the germination of Russian knapweed seeds. The NMS ordination has isolated a positive relationship (R squared > 0.3) between species richness and the presence of *A. repens* seedlings. A cursory analysis of treatments using an Anova-like test within the ordination software (Multi-Response Permutation Procedures) found no significant treatment effects. Additional research will incorporate a second year of data and more in-depth analysis of the data using both ordination and parametric statistical tests.

Michael Habel (31)
RELATIONSHIPS BETWEEN SITE TYPE, PLANTS AND ARTHROPODS IN A GRASSLAND ECOSYSTEM
Rocky Mountain High School
with Jordyn Zuniga, Ryan Kane, Marion Annis, Miriam Galeas (CSU)

Grassland ecosystems are important systems which cover approximately one quarter of the Earth's surface. Hazaleus Natural Area is a 212 acre parcel of land in Southwest Fort Collins, Colorado. At Hazaleus Natural Area there are several different habitat types including prairie dog towns and riparian areas. In this study we looked at the relationship between site type, plants, and arthropods at Hazaleus. We collected data at four different habitat types: roadside, on prairie dog town, riparian, and off prairie dog town. At these sites, we assessed arthropod diversity, plant cover and plant canopy height. This gives information on the effect of habitat and inhabitant relationships in a grassland ecosystem.

Christopher Herron (4)
USING NATIVE ANNUAL PLANT SPECIES TO SUPPRESS WEEDY INVASIVE SPECIES IN POST-FIRE HABITATS
Colorado State University, Graduate
with Mark Paschke (CSU)

Increasing rangeland fire frequencies and uncharacteristic fires are creating a need for improved restoration methods across the west. Traditional seed mixtures of perennial plant species may not be suitable for intensely burned sites. A devastating fire has the potential to return a site to early seral conditions where native annuals have the potential to be the most suitable species for competing with invasive plant species such as cheatgrass (*Bromus tectorum*). In addition, native perennial plant establishment may be increased by providing a means for a more natural succession toward a later-seral community. We are testing the idea that native annual plant species are better suited to post-fire restoration efforts, compared to perennial plant species that are commonly used in traditional seed mixtures, with four treatments (native annual seed mixture, standard perennial seed mixture, combination of annual and perennial, and a control). Results after one growing season suggest that the response of cheatgrass cover was decreased in plots seeded with the native annual plant species. However, this was only observed at two of four sites, possibly due to differences in precipitation between regions.

Tim Hoelzle (14)
LONG-TERM PLANT SUCCESSION FOLLOWING A SEVERE DISTURBANCE IN RESPONSE TO SEEDING, SOIL FUMIGATION, NITROGEN IMMOBILIZATION AND NUTRIENT ADDITION
Colorado State University, Graduate
with Mark Paschke (CSU)

Due to recent legislation, oil shale research and development has increased throughout the western US. The aim of this study is to investigate the long-term effects of various reclamation practices on ecosystem development associated with disturbed oil shale lands in the Piceance Basin of northwestern Colorado. In 1984, a series of experiments were established to examine the response and interaction of seeding mixes, nitrogen (N) and phosphorus (P) addition, N immobilization, and importance of the soil microbial community to plant recovery and succession following a severe disturbance associated with energy development. Here, we revisit these experiments 24 years after the initial disturbance to assess plant successional dynamics.

Kelly Hopping (6)
CLIMATE CHANGE AND GRAZING EFFECTS ON THE TIBETAN PLATEAU
Colorado State University, Graduate
with Julia Klein and Joseph Bump (CSU)

The Tibetan Plateau is experiencing novel ecological and social changes that affect rangeland condition and, in turn, the pastoralists who depend upon the grasslands for their livelihoods. Widespread rangeland degradation has been attributed to numerous factors, including overgrazing by herders' yaks and sheep, disturbance by Plateau pikas

(*Ochotona curzoniae*), and climate change, but few studies have rigorously tested their actual effects. In addition, increasingly frequent and severe snowstorms contribute to herders' vulnerability in the short-term by preventing access to forage for their livestock, but the longer-term consequences of prolonged snow cover in this system are unknown. To better understand the independent and interactive effects of these variables, we will set up a fully factorial experiment at Nam Tso, Tibet Autonomous Region (4820 m) with two climate and two grazing factors. Combinations of the following treatments will be performed on 64 four-meter-diameter plots: year-round warming by ITEX chambers, spring snow addition, controlled summer grazing by yaks, and exclosure of natural pika activity. We will measure vegetation cover and composition, productivity, and soil carbon and nitrogen availability to monitor the treatments' ecological effects and their implications for pastoralists throughout the region.

Emily Kachergis (9)
DESCRIBING ECOSYSTEM SHIFTS IN RANGELANDS USING DATA-DRIVEN STATE AND TRANSITION MODELS
Colorado State University, Graduate
with Maria Fernandez-Gimenez, Monique Rocca

State and transition models are useful tools for describing non-linear ecosystem dynamics and assisting in land management decision-making. While many state and transition models are based on expert knowledge, we are interested in developing data-driven models and standardizing field and statistical methods. We created two state and transition models to describe ecosystem response to rangeland management practices and disturbances in a Northwestern Colorado watershed. These models focus on the Claypan and Mountain Loam Ecological Sites, an NRCS land classification that includes soils, climate, and vegetation. Species cover, aboveground production, and percent utilization were estimated on 75 plots stratified by management history. Management history factors included historic grazing intensity (high, medium and low) and shrub treatment (mechanical, aerial spraying or none). Measured environmental variables included slope, aspect, and soil depth. States and transitions were determined using cluster analysis and non-metric multidimensional scaling of cover data together with herbivory, management history, and environmental variables. Preliminary results describe alternate states that are characterized by dominant vegetation as well as particular ecological processes. Removal of shrubs by aerial spraying of herbicide was associated with a Grassland state in both Mountain Loam and Claypan. Less than half of Grassland sites were associated with aerial herbicide spraying, suggesting that other factors must also lead to increased grass and decreased shrub cover within these ecological sites. Some states were associated with unique slope positions, suggesting that current Ecological Site definitions for these sites may obscure ecologically meaningful differences among sites based on hillslope position.

Windy Kelley (1)
RANGELAND MANAGERS' KNOWLEDGE, ATTITUDES, AND MANAGEMENT PRACTICES REGARDING *BROMUS TECTORUM* (CHEATGRASS)
Colorado State University, Graduate

Bromus tectorum (cheatgrass) is a non-native annual grass that has encroached on much of the native grasslands of the western United States. Significant research has been conducted regarding ecological effects of the plant, but less is known about what land managers know about this species, their attitudes towards it, and how they are trying either to prevent its establishment or manage its presence. The purpose of this research is to understand the ranchers and natural resource professionals existing knowledge, attitudes, and management practices of *Bromus tectorum* in southeastern Wyoming and northeastern Colorado. This information will provide a baseline assessment of knowledge, attitudes, and management practices in several target populations, which will be compared with these populations' attributes at the conclusion of the overall project (2012). I facilitated four sets of two focus groups, one comprised of natural resource professionals and the other by ranchers. The data was analyzed using content analysis. This poster reports preliminary results from the focus groups.

Julie Kray (7)
RESPONSE OF NATIVE PHREATOPHYTES TO CHANGING HYDROCLIMATE IN THE SAN LUIS VALLEY, COLORADO
Colorado State University, Graduate
with David Cooper (CSU), Alan Knapp (CSU), John Sanderson (TNC), and Stephanie Kampf (CSU)

Accurate estimates of groundwater outflow from evapotranspiration are critical to managing water resources in semiarid and arid basins with shallow water tables. Phreatophytes, or plants that use shallow groundwater, can contribute significantly to total groundwater outflow on a watershed scale. Some phreatophytes also acquire soil water recharged by precipitation to reduce or supplement their groundwater use. Consequently, groundwater use by phreatophyte communities may vary, both spatially and temporally, in response to seasonal or long-term changes in growing season precipitation. I will use stable oxygen isotope signatures and plant physiological measurements to investigate the response of four common native phreatophyte species to: (1) the present summer monsoon rainfall regime, and (2) increased and decreased total summer rainfall in the San Luis Valley, Colorado. Results of this work will be incorporated into the Rio Grande Decision Support System regional groundwater model, and may have implications for water-limited regions worldwide.

Richard Lancaster (10)
ESTABLISHING NATIVE PLANTS ON ABANDONED FARMLAND AT RABBIT MOUNTAIN OPEN SPACE
Colorado State University, Graduate
with Cini Brown (CSU), Claire DeLeo (Boulder County Open Space)

This project addressed the priority research need to evaluate restoration techniques for former agricultural lands, particularly the establishment of diverse, stable native plant communities. We (1) evaluated the species richness and abundance of native species planted in different proportions and compositions during the first 3 years after seeding, (2) examined factors associated with success and failure of native plant establishment including weedy, non-native species, and first year soil nitrogen (N) and carbon (C) levels, (3) tested the effectiveness of broadleaf specific herbicides in controlling non-native forbs in established grasses and (4) assessed changes in species diversity over the three year period. It appears that including forbs and shrubs in higher proportions in seed mixtures may result in greater representation in the aboveground plant community for only a limited time. However forb and shrub establishment was too low in this study to draw meaningful conclusions about the effects of altered representation in seed mixtures. As the plant community develops, grasses gained dominance. However, this is the natural successional pattern, and we may see that once forbs and shrubs have established a seedbank, they will become more abundant for some period after disturbance such as fire.

Amanda Lease (5)
AN ECOLOGICAL ASSESSMENT OF CORE AND EDGE POPULATIONS OF TWO DOMINANT GREAT PLAINS GRASSES: IMPLICATIONS FOR CLIMATE CHANGE
Colorado State University, Graduate
with Alan Knapp (CSU) and Gene Kelly (CSU)

Due to fragmentation, where there were once contiguous populations of grasslands, core and edge populations remain, often times separated by large distances and located in different climates. Previous research has focused primarily on dominant species in core populations, with the edge populations overlooked. The purpose of this study is to compare core and edge populations of two dominant C4 grasses, *Bouteloua gracilis* and *Andropogon gerardii*, in a reciprocal transplant experiment. Core and edge populations of both species have been transplanted to gardens located at Shortgrass Steppe LTER and Konza Prairie LTER. Differences in population responses to both ambient conditions and predicted climate extremes will be assessed. Preliminary results suggest that generalizations across species cannot be made when comparing core and edge populations in ambient conditions both within the same environment and between mesic and dry sites. This preliminary data warrants further research. Understanding the differences between core and edge populations will inform future management practices in grassland ecosystems of North America.

Kyle Lenling (19)
PREDATOR INDUCED PLASTICITY IN HABITAT USE BY GUPPIES
Colorado State University, Graduate
with K. Aree Kongmuang, Corey Handelsman, Julian Torres Dowdall, Lisa Angeloni, Cameron Ghalambor

Phenotypic plasticity in behavior can increase fitness across an environmental gradient. If plasticity in foraging behavior corresponds to the presence or absence of predators, it could promote local adaptation. In the wild, Trinidadian guppies (*Poecilia reticulata*) from high predation locales are found at the surface and along shorelines of tropical streams, while low predation occupants exploit the entire water column. If this observed behavior is a plastic response to the presence of predators, it may be a fitness parameter. Here, we incorporated a split brood design to quantify predator-induced plasticity in habitat use by Trinidadian guppies. At birth, broods were split between tanks containing plain water or water from tanks containing pike cichlids (*Crenicichla alta*), a natural predator of guppies. The water column in the tanks was equally divided into three sections. Weekly observations were conducted to quantify the position of the fish in the water column during the first five weeks of life. The addition of predatory cues to the water caused a plastic response that was independent of whether the fish were descendents of high or low predation populations. Guppies in the control treatment moved freely throughout the water column and showed a preference for the substrate, while guppies in the predator treatment remained at the surface of the water level almost exclusively. Presumably, this behavioral response enhances foraging success in low predation habitats and increases survival in high predation environments. Thus, Trinidadian guppies seem to show adaptive phenotypic plasticity in habitat use.

Marques Munis (3)
LANDSCAPE SCALE CONSTRAINTS ON CONVERSION OF SAGEBRUSH STEPPE ECOSYSTEM TO AN ANNUAL GRASS DOMINATED STABLE STATE IN SOUTHEASTERN WYOMING
Colorado State University, Graduate
with K. Aree Kongmuang, Corey Handelsman, Julian Torres Dowdall, Lisa Angeloni, Cameron Ghalambor

Cheatgrass (*Bromus tectorum*) is one of the most prolific invaders of western rangelands, increasing fire frequency, decreasing wildlife and livestock habitat value and limiting the use of prescribed fire as a management tool. Once cheatgrass becomes established, it modifies the environment to create an ecologically stable state that is resilient to both successional processes and management intervention. The objective of the study reported here is to evaluate landscape scale constraints on conversion of perennial grass/shrublands to cheatgrass dominated stable states. Study sites were located in southeastern Wyoming and stratified by aspect and slope position along a fire chronosequence. Circular nested plots (CNP's) were randomly located within these strata to measure effects on plant community. Field observations and preliminary analysis indicate that cheatgrass is more likely to persist on south facing aspects at low to mid elevations than on other aspects and at higher elevations. Additional CNP's were established in areas prone to persistent infestation to test plant community and ecosystem process response to cheatgrass invasion, fire history, chemical control, seeding, and grazing. Future field work will assess the effectiveness of treatments to reduce the rate of N turnover and rate of soil moisture depletion. Researchers have identified these factors as key processes that promote alternative stable states dominated by cheatgrass.

Daniel Ozzello (20)
PREDATOR INDUCED PLASTICITY IN HABITAT USE BY GUPPIES
Colorado State University, Undergraduate
with Corey Handelsman, Cameron Ghalambor

Predation is one of the principal, if not the most important, selection pressures affecting guppies (*Poecilia reticulata*) in the wild. Several studies have demonstrated that guppies living in high predation environments have different life history, behavioral, and morphological characteristics than guppies in low predation areas. For instance, high predation females tend to mature at an earlier age and smaller size and produce more, smaller offspring per brood. High predation males tend to be dully colored, presumably to avoid predator attention. Conversely, females in low predation environments mature at a later age and larger size and produce fewer, larger offspring per brood, while males in these environments are more brightly colored, likely the result of sexual selection by females. Additionally, high predation populations have been found to accelerate faster when

startled in a simulated predator attack. All of these traits are largely or completely the result of predation as a selection pressure. The goal of this experiment was to analyze the differences in response time from the onset of a simulated predator strike to the initiation of the escape response between wild-caught high predation and low predation male guppies. Of greatest interest was the difference in reaction time, maximum velocity, and maximum acceleration between the two populations.

Benjamin Pauls (16)
HETEROSPECIFIC RESPONSE TO CHEMICAL ALARM CUES IN GUPPIES
Colorado State University, Undergraduate
with Julian Torres-Dowdall and Cameron Ghalambor

The presences of subcutaneous structures containing chemical cues that induce anti-predator behavior in conspecifics have been described in several fish species. When a predator damages a fish, these structures are ruptured and the chemical cues released, enhancing predator detection in nearby conspecifics. The alerted fish then respond with anti-predator behaviors to potentially avoid predation. If, however, sympatric heterospecific fish were capable of sensing and reacting to these chemicals, they too would benefit from increased predator detection. Our study focuses on two closely related species of guppies - *Poecilia picta* and *P. reticulata*. In their natural habitats throughout the tropics, these species are often found inhabiting the same areas and even schooling together. Therefore, we predict that both species will react to its heterospecific alarm cues. To test this prediction, we exposed females of both species to the chemical alarm cues of *P. reticulata*. After a period of acclimatization, conspecific groups consisting of four female fish of either *P. picta* or *P. reticulata* were observed for a period of thirty minutes, wherein their baseline behavior, along with their reactions to distilled water (the placebo) and the extracted alarm chemicals of *P. reticulata* were recorded. Both species showed a strong reaction to the chemical, with *P. picta* characterized by sudden inactivity and a quick descent to the aquarium's bottom, while *P. reticulata* grouped together in a tighter school and dramatically reduced their movement. These results are in agreement to studies in other groups of fish. Further research is necessary to determine whether the chemical cues of *P. picta* also influence the behavior of *P. reticulata* in a reciprocal manner.

Sharon Poessel (27)
SURVIVAL AND RESOURCE SELECTION OF BLACK-FOOTED FERRETS
BASED ON PREDATOR EXPOSURE IN SOUTH DAKOTA
Colorado State University, Graduate
with Kevin Crooks (CSU), Lisa Angeloni (CSU), Dean Biggins (USGS), Stewart Breck (USDA), and Travis Livieri (Prairie Wildlife Research)

The black-footed ferret (*Mustela nigripes*) is a highly endangered species that has been reintroduced into natural habitat areas since 1991. One of the most successful reintroduction sites is the Conata Basin/Badlands area in South Dakota. This location contains the only self-sustaining black-footed ferret population, and its continued success is vital to the future of the species. However, predation is considered to be the primary cause of mortality in these animals, especially by great horned owls (*Bubo virginianus*) and coyotes (*Canis latrans*). We examined the exposure of black-footed ferrets to landscape features utilized by these predators and whether predator features affected survival of ferrets. We also calculated resource selection functions based on ferret use of habitat versus availability at two different spatial scales, within the home-range and across the entire study area. Exposure to great horned owl perches reduced ferret survival, but movement corridors used by coyotes had no effect on survival. At both the within-home-range and study area scales, ferrets in sites with great horned owl mortality selected areas closer to owl perches than would be expected at random. We conclude that considering the location and distribution of great horned owl perches in potential reintroduction sites is critical to the continued survival of this endangered species.

Gordon Reese (24)
PERFORMANCE OF SPECIES RICHNESS ESTIMATORS ACROSS VARIATIONS IN COMMUNITY PARAMETERS
Colorado State University, Graduate
with Kenneth Wilson (CSU) and Curtis Flather (USFS)

Species richness, the number of species in a defined area, is a frequently used measure of biological diversity. Despite the simplicity of the concept, species richness is difficult to accurately quantify as surveys rarely result in a census. Numerous estimators are available for estimating species richness based on a sample, but the performance of these estimators can be affected to varying degrees by parameters that reflect the form of the species-abundance distribution, the spatial autocorrelation in individual occurrences, and species detection probabilities. To study the performance of popular estimators across a wide range of community parameters, we created a program that simulates communities, samples the landscape, and estimates species richness for a number of estimators based on a 'capture-recapture' of species. Some of these estimators include the nth-order jackknife estimators, Chao's bias-corrected abundance-based and incidence-based estimators, and a mixture model. We used the Monte Carlo simulation program to vary factors such as survey design, e.g., linear transect versus random placement of survey locations, and community parameters that included number of species; relative abundance of species following distributions such as the discrete uniform, log-normal, and log-series; degree of spatial aggregation, e.g., clumped, random, and uniform; and detection probability of species. We then evaluated the performance of the species richness estimators as a function of factors by comparing estimator bias and precision.

Aleta Rudeen (26)
COMMUNICATION, CONFLICT AND SCIENCE IN NATURAL RESOURCE COLLABORATION: A CASE STUDY OF AN INACTIVE COLLABORATIVE GROUP
Colorado State University, Graduate
with Maria Fernandez-Gimenez, Jessica Thompson, Paul Meiman

Collaboration is emerging as a potential solution to contentious natural resource management issues, but there is a need for more information on the causes of success and failure in these processes, and specifically the roles of science, conflict and communication in collaboration. Knowledge gaps remain about the role of science in collaboration, and studies of collaborative groups that did not reach their goals are lacking. To address these gaps, we investigated the roles of communication, conflict and science in a case study of the Northwest Colorado Stewardship (NWCOS), an inactive collaborative group that did not reach its goals. Our objectives were to assess participants' perceptions of the group's success, and explore the roles of conflict, communication and science in relation to the group's process and outcome. We hypothesized that miscommunication and specifically, poor communication of science, contributed to conflict within the group, and that clearly communicated science contributed positively to reaching agreement. We conducted semi-structured, in-depth interviews with key participants of NWCOS, and analyzed the data using qualitative data analysis software to evaluate evidence in relation to our hypotheses. We found that although NWCOS did not reach its primary goal, participants perceived benefits from the collaborative process, and most participants felt that there were some positive outcomes despite the lack of consensus decisions. Our research also provides insight on the communication, use and effectiveness of scientific information in collaborative natural resource planning.

Colleen Sinclair (35)
EXOTIC SPECIES ELMINATION PROJECT
Front Range Community College, Undergraduate
with Vicki Rockwell (FRCC), Angie Moore (FRCC), and Steve Zagel (FRCC)

The intent of the Exotic Species Elimination Project is to eradicate Russian Olives from riparian areas. Although the project is more of a conservation effort than a research project, data collection is necessary to ensure success. The main goal of this project is to determine which methods and herbicides are most successful at controlling these trees. It was originally hypothesized that eradication at individual sites would take upwards of five years. Although the numbers have decreased greatly, additional time is necessary. After mapping, numbering, and collection of size and

height data, removal begins by using the cut/stump method. Biannually, each site is revisited, assessed, and treated for re-growth. Preliminary findings have shown that the longer re-growth is treated in this way, the greater success we have controlling the population. Over the past five years there has been a sixty-seven to ninety-three percent decline in population and re-growth based on original numbers from each site. Other research is underway to determine which season is best for cutting to produce the smallest amount of re-growth as well as whether tree size has an effect on re-growth from stumps or root systems. With ongoing fieldwork and research this project is hoping to see a continued decline in populations of this invasive species.

Alexandra Sutton (36)
ORGANIZATIONAL STRUCTURE & WILDLIFE REINTRODUCTION PROGRAMS: A CASE STUDY OF THE SEA EAGLE RECOVERY PROJECT
Texas A&M University, Graduate

Wildlife reintroduction programs are complex conservation initiatives that have historically been met with limited success. Although biological variables may greatly influence the success of a reintroduction, management features may also have a consequential impact. Literature in the field of management suggests that the organizational structure of a program, in particular, may affect its outcome. To explore the feasibility of applying this theory to wildlife reintroductions, this case study sought to examine in-depth the organizational structure of the Sea Eagle Recovery Project, a plan to reintroduce the white-tailed sea eagle *(Haliaeetus albicilla)* throughout Ireland & the United Kingdom. The researcher collected data from interviews, documents, and media items in order to gain insight into the type of organizational structure employed throughout the ontogeny of the project. Preliminary analysis of data has suggested several potential effects of organizational structure on the outcome of the reintroduction process.

Steve Swenson (34)
INVESTIGATIONS INTO EARTH SYSTEMS ON A MIDDLE SCHOOL CAMPUS
Brentwood Middle School
with Katie Boisen and Ann Dickenson

Stream table (10 meters)-there are a lot of rock in the shape of a stream like thing that we push water down to show erosion
•Colorado map (5 meters by 4 meters)-Last year the 6th grade made a map out of soil and rocks near our door. This year we are putting in the rivers and they will be the right length
•Archeological dig The dig is a mock-up of an archeological dig that is set-up on Brentwood's school grounds. First, we will gather up supplies and objects (done). Then we will measure, map, and slowly dig finding ancient objects! A part of our group is burying some artifacts at different levels of dirt. Then the other part of our group will dig up the objects and examine them and question placement and condition.
•Rock gardens-This is where we studied all kinds of rocks and got to climb on them
•Well testing on campus-Our group put this sensor down the well that beeps and tells us how far it is to the water, then we put down a thermometer to see the temperature of the water. Then we put the data on a big table sheet of paper—the water level moves some, the temperature, not very much.

Andrew Tredennick (25)
ECONOMIC INCENTIVES FOR CONSERVATION IN MERU, KENYA
Colorado State University, Graduate
with Michael Coughenour (CSU)

The transformation of landscapes for basic human needs is the main driver of biodiversity loss worldwide, which can encumber the provisioning of critical ecosystem services. In developing countries, there is a direct link between local economies and the environment, suggesting the benefits of ecosystem conservation are not only aesthetic and bio-ethical, but economic as well. We propose research that will examine the ecological and economic drivers of land-use in and around the Meru Conservation Area in central Kenya. Rapid land-use change and economic activity surrounding the Meru Conservation Area is degrading the very land on which the local people and wildlife depend. An integrated, spatially explicit ecological and socio-economic model, SAVANNA-PHEWS, will be used to investigate if maximum economic returns coincide with conservation of ecosystem services and biodiversity in the long-term. We will compare scenarios designed to maximize ecological and/or socioeconomic outcomes in 50-year simulations. Establishing the links among long-term

economic stability, ecosystem services, and biodiversity will provide a clear economic incentive for conservation, and a blueprint for work in other areas.

Greg Wann (8)
IMPACTS OF CLIMATE ON THE PHENOLOGY AND DEMOGRAPHY OF A WHITE-TAILED PTARMIGAN POPULATION IN COLORADO, USA.
Colorado State University, Graduate
with Cameron Aldridge (CSU), Clait Braun (DOW) and Tom Hobbs (CSU)

The population dynamics of avian species are heavily influenced by weather, and research over the past two decades has provided evidence that birds have been affected by recent changes in climate. The 2007 IPCC predicts a global temperature increase by as much as 1.1-6.4 C by 2100, in addition to increases in the frequency of extreme weather events and changes in the timing and amount of precipitation. These changes are expected to have continuing impacts on birds and other organisms. I propose exploiting an existing 43-year demographic dataset to investigate the influence of past climate on the phenology and demography of a white-tailed ptarmigan population at Mt. Evans, Colorado, and to predict likely responses to future climate scenarios. Past studies have demonstrated advances in the laying date of many bird species as a consequence of increasing spring temperatures. Increasing spring temperatures have also been noted in the Colorado alpine, and a similar trend in advancing hatch dates in ptarmigan is predicted. Studies on demographic responses of birds to climate change are less frequent than phonological studies due to a paucity of long-term datasets, especially for alpine species. I predict years with increased spring and winter temperatures and reduced snow cover in late summer during the brood-rearing period will have detectable effects on the survival, breeding success and age-class structure of white-tailed ptarmigan in Colorado.

Robert Wildermuth (18)
PHENOTYPIC PLASTICITY IN THE COLOR PATTERN OF MALE GUPPIES IN RESPONSE TO PREDATOR CUES
Colorado State University, Graduate
with Willow Hibbs, Corey Handelsman, Julian Torres Dowdall, Lisa Angeloni, Cameron Ghalambor

Predation and sexual selection are known mechanisms in the adaptive evolution of color patterns in male Trinidadian guppies (*Poecilia reticulata*). In the absence of predation, male guppies tend to exhibit more coloration than conspecifics from high predation habitats. This is hypothesized to be the result of sexual selection, where females show mating preferences for males with increased coloration. To test for phenotypic plasticity in male color pattern, guppies from high and low predation populations were reared in the presence or absence of the piscivorous pike cichlid (*Crenicichla alta*). Plasticity was measured by quantifying the prevalence and size of orange and black spots on guppy siblings reared with or without a predator. This split brood model allowed us to partition the genetic and environmental variance components of the phenotype. After maturation, each male was anesthetized and photographed. Using NIH image, the area of orange and black spots on each male, total body area, and standard length were quantified. Males descending from high predation populations exhibited more phenotypic plasticity than descendents from low predation populations. Further, guppies reared in the absence of a predator cue showed an increase in coloration compared to those reared in the presence of a predator.

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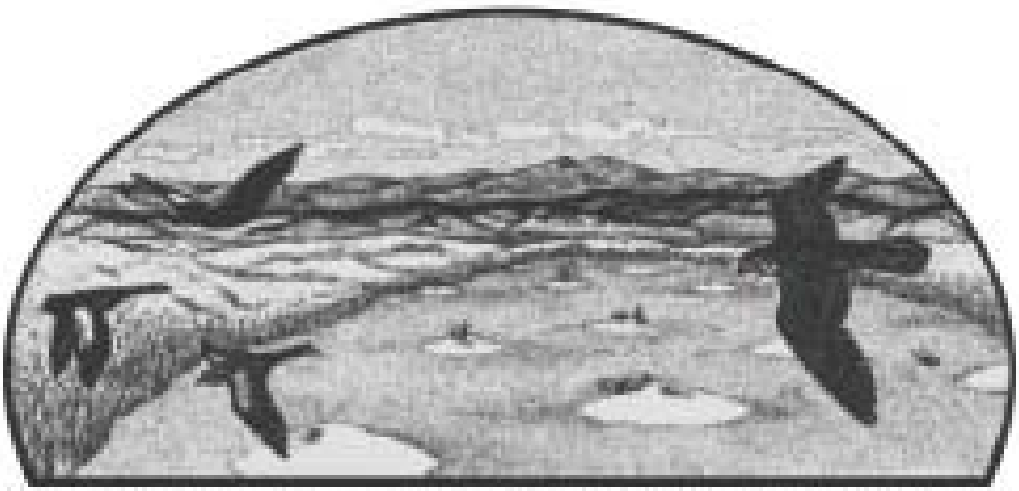

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