

Poster Session

P2 Neighborhood effects of N-fixing *Morella faya* on understory plant nutrients and soil N cycling,

Nitrogen fixers significantly alter soil and foliar nutrient cycling in N limited ecosystems, but less is known about the spatial extent to which N fixers can change their environment. We measured soil N transformation rates and foliar carbon and nitrogen concentrations in 5 understory plant species along transects away from exotic, N-fixing *Morella faya* trees in a N-limited tropical forest in Hawaii Volcanoes National Park. Net N mineralization and net nitrification rates in soils directly below *M. faya* ($0.359 \text{ ug g}^{-1} \text{ day}^{-1}$ and $0.596 \text{ ug g}^{-1} \text{ day}^{-1}$, respectively) did not differ from those up to 2.5 meters from the edge of the canopy ($-0.088 \text{ ug g}^{-1} \text{ day}^{-1}$ and $0.448 \text{ ug g}^{-1} \text{ day}^{-1}$, respectively) but were significantly larger than those seven meters from the canopy edge ($-0. \text{ ug g}^{-1} \text{ day}^{-1}$ and $0.000 \text{ ug g}^{-1} \text{ day}^{-1}$). Similarly, preliminary results show that C/N ratios of understory plants within 2.5 meters from the canopy edge are significantly lower (C/N 25.4) than those that are 7 meters from the canopy edge (C/N 29.9). *M. faya* appears to alter nutrient cycling within several meters outside its canopy but has little effect at greater distances.

P4 Temperature regulation of HilA activity, measured using a *prgH* reporter, is different in *Salmonella bongori* and *S. enterica* serovar Typhimurium,

The gene *hilA*, encoding a virulence gene regulator, is found on *Salmonella* Pathogenicity Island-1. HilA directly activates *invF* and *prgH* expression by binding to HilA boxes upstream of these genes. We investigated the effects of osmolarity, temperature, pH, and growth phase on the levels of HilA activity in two species of *Salmonella*, *S. bongori* and *S. enterica* serovar Typhimurium (*S. typhimurium*). We used expression of an *prgH::lacZY* reporter gene to quantify HilA activity. We found that environmental control of HilA activity is different in *S. bongori* and *S. typhimurium*. For example, in *S. bongori*, a temperature of 37C represses HilA activity whereas a temperature of 37C induces HilA activity in *S. typhimurium*. This research leads to many new questions about environmental regulation of invasion genes.

P6 Creation and Separation of Single Point Mutations in Hil-A Using a Mutator Strain of Escherichia coli

Salmonella can infect humans as well as other animal hosts (*S. typhimurium* infects mice), but the process of infection is complex and not fully understood. Hil-A is a transcriptional regulator linked to pathogenicity in Salmonella. The functions of the domains in the 553 amino acid protein have not been fully determined. Specifically, it is not clear which individual amino acids are critical for binding or effective transcriptional activation. Targeted mutation using PCR suggested that some amino acid sequences were critical for successful binding, but random mutations had not been studied. The pBad-TOPO/hilA deletion plasmids previously cloned were transformed into a mutator strain of *E. coli*. The transformed strains were allowed to grow under different conditions: minimal media, LB, 30C and 37C. Samples were removed at six-hour intervals, and the plasmids were removed from the cells using a miniprep. The mutated plasmids were transformed into competent *E. coli* cells using electroporation. The cells containing the mutated plasmids were plated on tetrazolium plates and x-gal plates to try and isolate colonies with altered Hil-A expression. Further sequencing of chosen colonies may suggest individual amino acids critical for effective Hil-A activity.

P8 The Function of Brood Size and Prey Delivery Rates in Nestling Development of *Otus flammeolus*

The Flammulated Owl is often considered to be a large bird stuck in a small bird's body. Following this observation the Flammulated Owl has a relatively small clutch size compared to other birds of its size. Clutch size is limited by environmental factors such as resource availability and climatic variables. During the summer of 2004 we spent time observing characteristics of the small and inconspicuous Flammulated Owl (*Otus flammeolus*) in the Manitou Experimental Forest of Colorado under the guidance of Dr. Brian Linkhart. Specifically, our objective was to examine differences in prey delivery rates and growth rates in brood sizes of two versus three. Previous research has shown that as brood size increases growth rates will decrease due to parents' inability to provide maximum amount of nourishment to the young. Our original hypothesis stated that Flammulated Owl nests with broods of three versus broods of two would have comparable prey delivery rates and, thus, broods of three should have slower growth rates than nests of broods of two. Our results did not support this hypothesis and showed that growth rates of owlets were the same amongst both brood sizes. Our results also showed that there was not a significant difference in prey delivery rates. Our results do not correspond with a prominent ornithological hypothesis, known as Lack's Food Limitation Hypothesis, which states that clutch size is limited by the maximum number of young that the parents can feed and nourish.

P10 Scaling biogenic trace gas emissions from plot to regional level: Effects of *Morella faya* stand size on soil N₂O and NO_x fluxes in Hawai'i Volcanoes National Park.

My research quantifies soil-to-atmosphere nitrogen-oxide gas emissions from the exotic nitrogen-fixing *Morella faya* tree in Hawaii Volcanoes National Park. We found that *M. faya* significantly increases nitrogen gas emissions from young, volcanic substrates in which atmospheric nitrogen limits plant productivity. To determine the effect of the *M. faya* invasion on regional nitrogen gas fluxes, we sampled *M. faya* soil gas emissions from small plots under variably sized tree canopies within the wet and dry forests of Hawaii Volcanoes National Park. In wet forest sites, soil N circulation and N-oxide gas fluxes were significantly higher under large, contiguous *M. faya* stands (2.2 ng N₂O -N cm⁻² h⁻¹) compared to isolated *M. faya* trees (0.1 ng N₂O -N cm⁻² h⁻¹). Nitrogen-oxide fluxes from soils beneath isolated *M. faya* trees in wet forests did not differ from native, non-nitrogen fixing Ohia tree stands (0.2 ng N₂O -N cm⁻² h⁻¹). In dry forest plots, the presence of *M. faya* patches, independent of canopy size, significantly increased NO soil-to-atmosphere fluxes, but did not significantly increase soil N₂O emissions relative to the native Ohia tree. We may now apply these plot-level fluxes to a regional map of the *M. faya* invasion to extrapolate annual nitrogen-oxide emissions on a landscape scale.

P12 3-Bromoisoxazoles and 3-Bromoisoxazolines in the Synthesis of Tetracycline Antibiotics.

One of the synthetic paths for tetracycline antibiotics involves 3-oxygenated isoxazoles. The synthesis of 3-oxygenated isoxazoles, however, can be difficult. 3-bromo-4,5-dihydroisoxazoles (3-bromoisoxazolines) and 3-bromoisoxasoles are readily available, and studies of their conversion to 3-oxygenated compounds were undertaken. No successful reaction with methoxide or hydroxide was found that did not affect the rest of the molecule.

P14 Catamount Biological Field Station 2004 Bat Survey.

A comprehensive survey of all bat species inhabiting the upper-montane forest at the Catamount Biological Field Station was conducted to determine the species present and the importance of tree cavities, especially in aspen, to the conservation of bats throughout the region. An Anabat II detector was used to conduct an acoustic inventory of bats on June 23, 2004 confirming the likely presence of six species: *Myotis evotis*, *M. volans*, *M. ciliolabrum*, *M. lucifigus*, *Lasionycteris noctivagans*, and *Lasiurus cinereus*). *Tadarida brasiliensis* may also be present but its identification from acoustic analysis is problematical. Additional live trapping along flyways was conducted over a two month period using a harp trap and two 16-meter mist nets. Live trapping resulted in the capture of only two species, *M. ciliolabrum* and *M. lucifigus*. Further research is needed to quantify and qualify the importance of tree cavities to forest roosting bats in the upper-montane, mixed-conifer forest.

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Oral Presentations

pH Regulation of HilA Activity, Measured Using an *invF* Reporter, is Different in *Salmonella* Bongori and *S. Enterica* Serovar Typhimurium

The gene *hilA*, encoding a virulence gene regulator, is found on *Salmonella* Pathogenicity Island-1. HilA directly activates *invF* and *prgH* expression by binding to HilA boxes upstream of these genes. My professor Phoebe Lostroh, my lab partner Jeff Carson and I investigated the effects of osmolarity, temperature, pH, and growth phase on the levels of HilA activity in two species of *Salmonella*, *S. bongori* and *S. enterica* serovar Typhimurium (*S. typhimurium*). We used expression of an *invF*::*lacZY* reporter gene to quantify HilA activity. We found that environmental control of HilA activity is different in *S. bongori* and *S. typhimurium*. For example, in *S. bongori*, a pH of 8 represses HilA activity whereas a pH of 8 activates HilA in *S. typhimurium*. This research leads to many new questions about environmental regulation of invasion genes.

Selection of Songpost Trees by Flammulated Owls (*Otus flammeolus*) in Colorado.

To better understand habitat selection in Flammulated Owls (*Otus flammeolus*), which are listed as a sensitive species in the United States and Canada, I compared characteristics of trees used for singing (songposts) by breeding owls during 2003 and 2004 to available trees on the Manitou Experimental Forest in central Colorado. Compared to available trees, trees used for songposts had greater diameter (at breast height; 46.2 ± 1.8 cm vs. 19.7 ± 1.8 cm), height (18.8 ± 0.5 m vs. 10.2 ± 0.6 m), and crown volume (301.1 ± 31.1 m³ vs. 73.4 ± 15.6 m³). Such trees were likely chosen to provide maximum cover from potential predators during singing episodes. Comparisons songpost trees and nearest neighbors showed that owls typically sang from the largest and tallest trees in a particular area. Songpost trees were approximately twice as likely to be located on a ridgetop compared to available trees, suggesting that these trees may also have been selected to provide maximum sound projection across territories in a heavily forested landscape. Finally, Flammulated Owls were more likely to sing from ponderosa pines (*Pinus ponderosa*) than the generally more abundant Douglas firs (*Pseudotsuga menziesii*). My results underscore the importance of old-growth ponderosa pine and Douglas fir to the reproductive ecology of Flammulated Owls in Colorado, adding to previous studies' findings that such trees also provide important foraging and roosting sites for these owls.

Genetic diversity among *Xanthomonas oryzae* pv. *oryzae* strains from Taiwan and Asia

Xanthomonas oryzae pv. *oryzae* is the causal agent of bacterial blight of rice, a serious disease that occurs throughout Asia. Taiwanese strains have not been included in past studies of the diversity of *X. oryzae* pv. *oryzae* in Asia and rep-PCR fingerprinting has not been used previously to evaluate strains throughout Asia. This study examines strains from a wider geographic range than any previous study. We analyzed 32 *X. oryzae* pv. *oryzae* strains, of which five were from Taiwan, from 13 countries and *Stenotrophomonas maltophilia* strain BP1 (as an outgroup) using rep-PCR and 16S-23S rDNA internal transcribed spacer (ITS) sequencing. Fingerprints were generated by amplifying regions between the repetitive extragenic palindromic (REP) sequence, the enterobacterial repetitive intergenic consensus (ERIC) sequence, the BOX element, and the insertion sequence IS1112. Fingerprints from each strain were compared visually and scored. Two phylogenetic trees were generated: one using parsimony optimality criterion and heuristic searching, the other using distance optimality criterion and unweighted-pair group method with arithmetic means (UPGMA) clustering. Branch support for both trees was estimated by bootstrap analysis with 2,000 replications. Taiwanese strains XM36, XH49 and XB14 formed a well-supported clade. These strains may cluster with Taiwan XG17, but this cluster was poorly supported. Taiwanese strain XF10 consistently clustered with the Indonesian strain XOO8. In addition, the data suggested that the Thai strain XOO10 is not closely related to any of the *X. oryzae* pv. *oryzae* strains analyzed. Thirty of the 32 *X. oryzae* pv. *oryzae* strains had identical 16S-23S rDNA ITS sequences, including the five Taiwanese strains. The Nepalese strain NXO263 sequence differed by a single nucleotide substitution and the Thai strain XOO10 differed by 7 substitutions and an insertion.

The mating behavior and "stratagem" of *Taeniopoda reticulata* (Orthoptera: Romaleidae) in Boca del Drago, Panama,

Animals that have either long insemination durations or perform mate-guarding behavior gain reproductive benefits by reducing rival male sperm competition. Romaleinae (common name: lubber grasshopper) is an ideal subfamily for examinations into these two sexual strategies since both morphological and behavioral mechanisms appear to be utilized within this taxon. However, very few species of Romaleinae have been studied, so in order to better understand romaleine reproductive strategies I described and examined the mating behavior of *Taeniopoda reticulata* (Fabricius). This research was primarily conducted in the field, but to augment my field observations I took mating pairs into captivity to document any evidence of continuous sperm transfer that would support a long insemination duration. In order to address copulatory mate-guarding, I hypothesized that a male that invested more time in his mate would reap reproductive benefits by lowering (ideally eliminating) her number of subsequent partners. I found evidence of continuous sperm transfer, and I also discovered that captivity significantly increased mating duration, but the copulation times did not stabilize in the isolated environment. Shorter copulations still occurred, which would not be expected in a species where long insemination durations were prerequisite for any fertilization whatsoever. There was a trend for a female's number of subsequent partners to decrease as the initial male's copulation time investment increased, but it was not significant. These results suggest that *T. reticulata* uses a complex form of variable insemination duration that grants benefits similar to those seen in mate-guarding populations.

Behavior Patterns Associated with Pregnancy and Infant Presence in Two Groups of Captive Lowland Gorillas (*Gorilla gorilla gorilla*).

Pregnancy and changes in group composition have been shown to affect the behavior patterns of individuals in captive groups of Western Lowland Gorillas. To assess social change, this study considered two gorilla groups in regard to specific behaviors of aggression, self-grooming and regurgitation and reingestion as well as patterns of association. Group one contained a pregnant female during Period I of the study and during Period II the infant born remained with her multiparous mother. In period II this group had a reduction in aggressive behavior by the silverback and significant changes in association patterns. The silverback spent more time with both the mother of the infant and another non-pregnant female, and the two non-pregnant females spent more time together after the infant was born into the group. The pregnant female was also significantly less responsible for maintaining contact with another female in the group after giving birth. In the second group, the same female was pregnant during Period I and Period II. Approximately four months before Period II began, this primiparous mother had her baby removed. During Period II the non-pregnant female in this group showed an increase in regurgitation and reingestion. In addition, proximity changed, with the silverback male spending more time with both females, and the two females spending less time with each other. Lastly, the non-pregnant female approached the pregnant female less in Period II. These findings lend support to the importance of group composition and reproductive status in affecting behavioral and social patterns for captive lowland gorillas, and suggest trends that should be further investigated to provide the best possible environment for these animals.

Effects of the Hayman Fire after one and two years on water quality and benthic macroinvertebrates of the South Platte River, Colorado.

Indirect effects of fire, such as erosion and runoff, tend to have the greatest impacts on aquatic ecosystems and benthic macroinvertebrates. Macroinvertebrates are good water quality indicators and few studies have been conducted on local populations. In October of 2003 and 2004, in eight points in an area affected by the Hayman Fire and at eight points in a control site, I measured water quality, leaf litter cover, silt deposition, macroinvertebrate density, and composition. In both years there was a decrease in pH, dissolved oxygen, and silt deposition in the burned area. Leaf litter cover was lower in the burned site in 2003 only. In both years, the density, morphological richness, and Ephemeroptera density were substantially lower in the burned area of the river. There was also a nonsignificant trend both years of fewer individuals in the burned areas of other groups, such as Diptera, Hemiptera, Amphipoda, etc. These results indicate that fire negatively affected both biotic and abiotic factors one and two years after disturbance. However, the changes in 2004 indicate that the two sites are equalizing. Flooding in the summer of 2004 possibly reduced the water quality and leaf litter in the unburned area, while the dissolved oxygen increased in the burned area aided macroinvertebrate recovery. The results also illustrated that benthic should be monitored over an extended period of time to better understand how aquatic environments respond to fire.

The Pregnancy Strategy of the Common Marmoset (*Callithrix jacchus*)

Pregnancy serves as a necessary, yet costly, aspect of many females' life cycles. Different species deal with these costs by employing various pregnancy strategies. Previous studies asserted that common marmosets (*Callithrix jacchus*) reduce their activity level during pregnancy, but do not alter their intake. However, little is known about this species' digestive efficiency and specific nutrient retention during pregnancy. Therefore, this study sought to broaden the knowledge of common marmosets' pregnancy strategy by measuring intake (dry matter and caloric), digestible energy, digestive efficiency, calcium and phosphorus retention, and activity level of pregnant and other reproductively mature common marmosets. Contrary to previous findings, the females in this study had a significantly higher digestible energy and intake even early in pregnancy. The females in the third trimester of pregnancy also had a significantly lower activity level than other reproductively mature individuals. Overall, variation seems to typify common marmoset digestion, so discrepancies seem reasonable. In conjunction with common marmoset diversity, pregnancy's intricacy and individualism warrant idiosyncratic pregnancy strategies in *C. jacchus*.

Phylogenetic Relationships within *Primula* section *Parryi*: an AFLP Analysis,

Primula sect. *Parryi* represents eight closely related taxa endemic to western North America. We investigated the phylogenetic relationships of these taxa using AFLP analysis of whole genome DNA. *Primula angustifolia*, *P. parryi*, and *P. rusbyi* were confirmed as being clearly separate and distinct species, while *P. cusickiana* var. *cusickiana*, var. *domensis*, and var. *nevadensis* were confirmed as belonging to a single clade with var. *domensis* and var. *nevadensis* forming their own subclade. Several taxa showed close affinities related to geographic location of populations, but this was not seen in *P. cusickiana* var. *cusickiana*. Members of the *cusickiana* clade showed great genetic distances between individuals while members of the separate species showed surprisingly small genetic distances, even when widespread geographically. These results support and amplify previous studies using cpDNA and suggest patterns of allopatric speciation occurring in the Great Basin. Small populations and isolated habitats mark these taxa for conservation concern.

The relationship between wildland fire and salmonid habitat quality: influence of riparian vegetation on post-fire accumulations of sediment and large woody debris.

Wildland fire is a natural disturbance in aquatic ecosystems. For decades, fire was maligned as detrimental to salmonid health because post-fire sedimentation may negatively impact spawning and rearing conditions, suffocate adult fish, and reduce macroinvertebrate abundance. However, recent research indicates that these detriments are short-lived and may be eclipsed by the long-term benefits of fire. Wildfire creates large woody debris (LWD), which can positively affect salmonid habitat by creating deep water habitat, overhead cover, and entraining nutrients. LWD has been directly linked to salmonid abundance and theoretical modeling suggests that up to 50% of LWD in a system may be recruited after wildfire. Despite these important relationships, little is known about the influence of riparian zone burn on post-fire accumulations of LWD or sediment. My project examined the differences in sediment percentages and LWD volumes in ten burned watersheds in the Upper Columbia River Basin, home to multiple threatened and endangered salmonids. Five of these study sites had burned riparian zones (RB streams). I explored the differences in habitat quality between RB streams and streams with burned watersheds, but unburned riparian buffers (B streams). I hypothesized that RB streams would have higher percentages of fine sediment, smaller average particle size, and more LWD than B streams. Using multivariate analyses, I found no significant differences in sediment percentages or mean particle size between B and RB streams. I did find significantly more pieces of LWD in RB streams. I also observed a greater volume of LWD in RB streams, although this finding was not significant. These results suggest that even one year after a fire, the potential benefits of forest fire may be apparent in streams that experience riparian burn. These findings also suggest that the presence or absence of burn in the riparian zone is an important variable that should be considered in the development of salmonid conservation strategies.

Effects of Fire on Selected Rare Plants of the Siskiyou Mountains, Oregon.

Rare plant species in areas with frequent fire regimes may depend on fire for recruitment and survival. Various rare plant species in the Siskiyou Mountains, southern Oregon are present in plant communities with frequent fire regimes. The fire response of populations of selected rare species, *Sedum oblancoelatum*, *Festuca elmeri*, *Rafinesquia californica*, *Solanum parishii*, *Fritillaria gentneri*, *Cypripedium fasciculatum*, *Eucephalus vialis*, *Isopyrum stipitatum*, *Camissonia graciliflora*, and *Cirsium ciliolatum*, were analyzed with respect to fire severity and management history in the 2002 Squires Fire area. Visual soil characteristics and remaining fuel size were used to quantify soil burn severity. *Solanum parishii* and *Rafinesquia californica* populations appeared to increase in response to fire at low and moderate soil burn severity regimes. The data on *Festuca elmeri* are mixed with respect to fire and soil burn severity. *Eucephalus vialis* and *Fritillaria gentneri* appear to increase in response to fire but the sample was too small to quantify response to soil burn severity. *Sedum oblancoelatum* and *Cypripedium fasciculatum* were relatively unaffected by the fire, but appeared to tolerate low severity fire. No data were gathered on the early flowering *Isopyrum stipitatum* and *Camissonia graciliflora*. The increased recruitment of some of these species after the 2002 Squires Fire indicates that these species respond positively to fire. Knowledge of the effects of fire on rare species might inform management decisions such as the use of prescribed fire in plant communities with frequent fire to encourage rare plants in the Siskiyou Mountains.