

Livestock Grazing and Yosemite Toads

UC, PSW, and R5 Cooperative Study Unit study

Dr. Barbara Allen-Diaz presented details of a recently initiated five-year project under a National program that fosters cooperation between universities and federal agencies; in this case the USDA Pacific Southwest Research Station, Region 5 of the Forest Service, UC Davis and UC Berkeley. The purpose of the study is to determine the effects of livestock grazing on Yosemite Toads, *Bufo canorus*, and their habitat. It is being funded by the R5 Forest Service, and will run from 2005-2010.

The Yosemite toad is found at elevations ranging from 6,500 to 11,500 feet between South Lake Tahoe at Ebbets Pass to Kings Canyon National Park at Evolution Valley. The toads are active from about April through October depending on the snowpack, and are di-urnal (only active during the day). They exhibit sexual dimorphism, the female being more brilliantly colored than the male, a rare feature amongst toads. The toads tend to be long-lived having a life span exceeding ten years and the longest known lived for fifteen years. Adult female Yosemite toads may only breed once every other year, and have a lower fecundity (1,500-2,000 eggs) compared to the closely related Western toad, which usually has more than 15,000 eggs. The tadpoles metamorphose in six to eight weeks. Yosemite toads have several predators such as Mountain yellow-legged frogs, birds, and garter snakes. Potential causes for their decline are numerous and include: disease, pesticides, dams and water diversion, livestock grazing, vegetation and fire management, timber harvest, climate change, roads, and recreation. This study aims to examine the interaction between livestock grazing and Yosemite toads given that there are many other important contributing factors.

Research on the Yosemite toad is especially important because they are characterized as a California State species of concern, a Forest Service sensitive species, and a Federal endangered species candidate. The suspected link between Yosemite toad decline and livestock grazing led to changes in forest management grazing regulations that restricted grazing by including limited operating periods during Yosemite toad breeding and rearing as part of the 2001/2004 Sierra Nevada Forest Plan amendments. This study will be very meaningful since there is a lack of quantitative data on the connection between livestock grazing and Yosemite toads. This is an adaptive management study intended to guide management decisions. The purpose is to investigate whether livestock grazing under SNFP Amendment Riparian Standards and Guidelines has a measurable effect on Yosemite toad populations, and to discover what effects livestock grazing may have on the habitat components that affect survival and recruitment of Yosemite toad populations.

The study design consists of two components; the first is a correlative, multivariate study based on all sampling done on toads. The data includes more than fifty meadows that are potentially range wide. The goal is to relate grazing history and other environmental characteristics to toad occupancy, and to capitalize on existing toad occupancy data. The second component looks at

experimental grazing treatments and is the focus of Barbara's talk. This component is utilizing three distinct treatments lasting four to five years to analyze treatments relative to toad population and habitat/vegetation outcomes. The experimental treatments are: no grazing within the meadow, exclusion of livestock in wet areas within a meadow where toads actually breed, and grazing in accordance with FS Riparian Standards and Guidelines across the entire meadow.

Scientists from the Pacific Southwest Research Station are quantifying toad populations utilizing counts and population estimates by lifestage (adults, subadults, or tadpoles). They are also measuring local microhabitat conditions and relationships by measuring habitat conditions at rearing, subadult, and adult locations and by relating used habitats to available habitat data.

University of California scientists are describing and quantifying meadow habitats in terms of plant community types, meadow productivity, water table dynamics, water quality (both temperature and chemistry), and grazing. Grazing is being investigated based on timing as determined from both records and cameras, and intensity based on utilization and stubble height.

Researchers from both the PSW and UC will then integrate their research efforts by quantifying toad population status in meadows with different livestock grazing characteristics. They will also collaborate to identify habitat features that are important to toads at several spatial scales from the allotment, down to the meadow, and finally the individual breeding pools. Finally they will utilize the data to describe the effects of livestock on habitat for Yosemite toads as well as other relevant meadow characteristics.

To investigate toad populations, researchers are completing meadow surveys for toads as well as other amphibians and reptiles, and quantifying breeding area size and the abundance of tadpoles. They are also marking metamorphs, subadults, and adults for mark/recapture studies.

Toad microhabitat is being investigated by measuring habitat conditions at tadpole and toad locations as well as in a 2.5-meter radius of around the toad locations. Measurements are also being taken at randomly selected unoccupied locations. Recorded habitat characteristics include: water depth, flow, temperature, substrate types, detritus depth, vegetation composition, slope, evidence of livestock use, and the presence or absence of fish. Field data collection is being obtained using vegetation transects through toad pools from tree edge through the pool to the opposite tree edge. Piezometer pipes are being installed to measure the water table depth and water quality. Standard cages are being utilized to exclude grazing and quantify the grazing intensity and biomass removal. Vegetation was quantified utilizing vegetation transects in "toad-centric" plots and cages to exclude grazing. Stubble height was also recorded, as well as the species composition surrounding each piezometer. The intention is to characterize the entire meadow. Water parameters for the study include: water table dynamics, water temperature sensors, and water chemistry monitoring. Camera data is also being utilized.

In 2005 researchers accomplished the assembly of the study plan, the laborious internal and peer review processes, and site selection. They also sampled toads and toad microhabitat, as well as

vegetation. They have also installed piezometers, and pilot sampled water temperature and chemistry. Researchers also piloted three time-scaled field cameras.

The study area consists of five grazing allotments randomly chosen out of a pool of possible allotments based on toad survey data. Potential meadows had to have Yosemite toads, cattle grazing, and accessibility. The meadows are in experimental blocks of three and are one to six hectares in size and 2,000-3,000 meters in elevation. Two allotments were selected in Stanislaus National Forest and three were chosen in the Sierra National Forest.

A brief overview of the data gathered in 2005 was presented. Data has been collected for mark/recapture studies on toads. Data pertaining to the water temperature in stagnant pools occupied by Yosemite toads and flowing pools occupied by the toads has been collected. The air-temperature was also recorded and a comparison of the three has demonstrated diurnal fluctuations on a daily basis for all three. The flowing pools are cooler while the stagnant ones are warmer and exhibit more fluctuation in temperature. Nutrient levels such as phosphate, ammonia, nitrate, total phosphorous, and total nitrogen has been recorded in the warmer stagnant and cooler flowing occupied pools. These nutrients as well as *E. coli* concentrations have already demonstrated significant differences between warm and cool pools. Researchers have identified approximately 160 different plant species in the meadows. Data pertaining to utilization has been obtained from cages. Average water table depth in the meadows was collected in 2005 and demonstrates variation between seasons and meadows.

A lack of quantitative data regarding livestock numbers in the meadows under study has prompted the utilization of digital time-lapse cameras. Allotment-scale data exists, but with camera data researchers can investigate where the cows are actually grazing and at what density, how long cattle are staying in the meadows, what time of day cattle primarily graze, and how this data can be utilized to guide management decisions. To quantify this multifaceted set of information an IT specialist is developing a set of algorithms to go through the countless frames. The date, time, and temperature are recorded on each picture.