I. Title Page

Title:	**Biodiversity response to burn intensity and post-fire restoration**
Subtheme this proposal is responding to (choose only one)	Impacts of Wildfire
Principal Investigator:	Patricia N. Manley US Forest Service, Pacific Southwest Research Station 1731 Research Park Dr., Davis, CA 95618 Phone: 530-759-1719 Fax: 530-747-0241 Email: pmanley@fs.fed.us
Co-Investigators:	Dennis D. Murphy University of Nevada Department of Biology Reno, NV 89557 Phone: 775-784-1303 Fax: 775-784-1302 Email: ddmurphy@biodiversity.unr.edu
	T. Will Richardson University of Nevada Department of Biology Reno, NV 89557 Phone: 530-412-2792 Fax: 775-784-1302 Email: trichard@unr.nevada.edu
Grants Contact Person	Bernadette Jaquint US Forest Service Albany, CA Phone: (510) 559-6309 Fax: (510) 559-6440 Email: bjaquint@fs.fed.us
Funding requested:	$ 196,400
Total cost share (value of financial and in-kind contributions):	$ 89,000

II. Proposal Narrative

a. Project abstract

A high priority of forest management in the Lake Tahoe basin, and throughout the west, is to reduce the risk of catastrophic wildfire. Despite substantial emphasis and effort by agencies and homeowners to reduce the risk of wildlfire, it is not possible to eliminate the possibility of their occurrence. Fire is a natural process in montane conifer forests, and both its presence and absence have significant ecological and social consequences. Wildfire changes many facets of forest ecosystems, including soil quality, plant composition and structure, and native species and communities. Biological diversity of native species has been shown to have significant consequences for ecosystem function and services, thus its conservation and post-fire restoration will greatly effect the restoration of forest ecosystems. Forest management and resulting fuel levels and forest structure have substantial influence on the characteristics and intensity of wildfire. Forest management, the intensity of wildfire, and post-fire restoration activities all have direct and indirect effects on habitat suitability and quality, which can be additive or ameliorative. Manley and colleagues are in a singular position to study the effects of the Angora fire and post-fire treatments on biological diversity. We have the two main ingredients necessary for a strong experimental design to address questions about effects: 1) we have pre-fire condition biological data from two other studies conducted before and continuously since before the fire; and 2) we began collecting biological data within the first year following the fire, so no data has been lost. In collaboration with California Tahoe Conservancy and US Forest Service/University of Montana, we designed and implemented a monitoring effort to evaluate birds and small mammals on sites subject to different fire intensity and post-fire treatments. This proposed study will enhance the existing effort to increase the sample size, improve the representation of various combinations of fire intensity and post-fire restoration treatments, include invertebrate sampling, and extend sampling to span a total of three years post fire. The results of the study will aid in the challenge retaining and restoring on-site biodiversity and determining how to manage future burned areas to enhance habitat and population recovery.

b. Justification statement

The Angora Fire burned approximately 3,100 acres in South Lake Tahoe, California in June and July 2007. The fire occurred in an area with high degree of private and public land intermix and adjacent to large expanses of undeveloped public land. The primary public lands burned in the fire were National Forest System (NFS; 2736 ac) and State (primarily California Tahoe Conservancy [CTC]; 163 ac) lands, which included over 300 urban parcels). Although the majority of the area within the fire perimeter experienced moderate to high burn intensity, the severity of the burns did vary within the burned area, resulting in a mosaic of post-fire conditions.

These neighborhoods experience direct interaction with a large proportion the area's native wildlife species, and this interaction is a valued part of living in these types of neighborhoods in Tahoe. One of the challenges that faces forest ecosystem restoration efforts is how to manage forests in these urban-wildland intermix areas in a manner that meets and restores multiple important management objectives, namely maintaining forest health, water quality, biodiversity, and public safety. Although post-fire treatments address immediate concerns about water quality and pubic safety, much uncertainty exists about how best to treat sites with various burns intensities to restore forest conditions that meet the full suite of forest health objectives.

The primary focus of this proposed study is the restoration of biological diversity. The restoration of biological diversity following a wildfire requires maintaining as much of the remaining on-site biological diversity as possible, retaining or maximizing connectivity between unburned and burned forested areas so that species pools are available to repopulate burned areas as vegetation recovers, and treating sites such that habitat recovery occurs as quickly as possible. For the Angora burn, connectivity to source species pools is high and therefore not a major concern, given the small area of the fire relative to most spatial scales relevant to wildlife dispersal/immigration, linear nature of the burn configuration, and the forested condition of the surrounding area. The primary challenges in the case of the Angora fire are the retention of remaining on-site biodiversity and determining how to manage burned areas to enhance habitat recovery.

c. Background and problem statement

Primary post-fire treatments have been conducted in many, but not all parcels in the Angora burn, with the intent of minimizing erosion through a variety of measures such as mulching, reseeding and planting native plants, removing dead and dying trees to reduce safety risks. Uncertainty exists about the effects of treatments that have already been conducted; gaining information about these effects can be used to inform future restoration efforts in the Angora burn and any future burns that may occur in the basin.

In terms of wildlife recovery, primary uncertainties lie in two arenas: 1) what is the post-fire wildlife community composition and structure associated with different fire intensities; 2) and what are the effects of various degrees of tree removal on remaining diversity in areas with different fire intensities. Other restoration treatments may also have effects on wildlife, such as hydromulching, but their application was such that their effects could not be evaluated individually. It is our opinion that hydromulching is not likely to have significant ecological effects on most wildlife because of the variability in its depth and coverage and its ephemeral nature.

Multiple state and federal agencies are involved in conducting monitoring to quickly inform restoration activities in the Angora burn area. In 2008, less than one year after the Angora fire, we began evaluating the effects of the fire and the restoration efforts that followed on bird and small mammal communities. The current effort is being conducted in collaboration with CTC and LTBMU, and its objective is to determine the status of wildlife in the area and the effects that post-fire treatments are having on the ability of habitat to support species in the short-term. In terms of restoration treatments, the removal of snags and logs has been a common practice on many parcels, but it is likely to reduce the ability of areas to support species dependent upon these features, even if the snags and logs are highly scorched. The current effort is designed as a short-term monitoring effort to establish a base-line of conditions and responses to tree removal within the burn area. We propose to build on this singular and valuable work to enhance its ability to address the following research questions:

All wildlife species are expected to be significantly affected by the burn, many negatively, but a few species may become more frequent visitors or more abundant. Songbirds, woodpeckers, and small mammals constitute the majority of vertebrate species in montane forests, and they serve an important function as the primary prey for the majority of upper trophic level species. In addition, songbirds and small mammals have been shown to be sensitive to alterations in forest structure and composition resulting from fire (e.g., Saab et al. 2007a, Converse et al. 2006), but in different ways, making for an informative combination of biota to study. Ground-dwelling invertebrates, such as ants, provide a different set of ecosystem functions, such as contributing to nutrient cycling and soil quality, and although research on invertebrates and fire is extremely limited (e.g., Neumann 1992, Koponen 1995, Bees et al. 2004), related research (e.g., Folgarait 1998) suggests that attention paid to the retention and reestablishment of ground-dwelling invertebrates could have substantial benefits toward meeting environmental protection objectives (e.g., water quality) and overall forest ecosystem restoration goals. Therefore, we propose to expand the current work to include ground-dwelling invertebrates.

d. Goals, objectives, and hypotheses to be tested

The objective of this study is to determine the relative influence of burn intensity and post-fire restoration activities on wildlife recovery in the first few years following the fire. The results can be used to guide future management of the burned area and other burn areas to enhance the conservation and restoration of biological diversity in the basin. The study will also provide a baseline of information on the status of birds, small mammals, and ground-dwelling invertebrates in the burn area that can be used as a point of reference for future monitoring efforts in the area. For example, although the USFS Lake Tahoe Basin Management Unit (LTBMU) conducted salvage logging on many of their urban parcels in 2007, the bulk of acres will not be salvaged until 2009 or later. These treatments could be informed by the results of this study by providing target conditions that will enhance the retention and recovery of wildlife and ecosystem function.

The following questions will be addressed as part of the study:

1. How does the structure and composition of bird, small mammal, and ground-dwelling invertebrates vary by burn intensity?
2. What effect does tree removal and remaining tree density have on the remaining birds, small mammals, and ground-dwelling invertebrates?
3. What habitat value do burned trees and logs have for birds, small mammals, and ground dwelling invertebrates?
4. How can habitat conditions be improved through restoration treatments to enhance the retention and restoration of native biodiversity?
5. Are there combinations of conditions that together support a greater diversity of species and either condition alone?

e. Approach, methodology and location of research

Ideally, we would have sampled the entire area prior to the burn so that we had comparable before and after data. Wildfires pose a challenge in terms of experimental design in that comparable pre-treatment data are rarely available. Most studies must rely upon the post-fire comparison of burned sites to ecologically equivalent unburned sites. Initially, unburned sites provide the basis for reconstructing the pre-fire characteristics of burned sites. Over time, they serve as a barometer of change in unburned sites compared to changes observed in burned sites. Animal populations and communities provide a special challenge in that they can and do fluctuate between years, even without extreme environmental change. Fortunately, some pre-treatment wildlife data are available through previous research designed and implemented by Dr. Manley and colleagues. The Urban Biodiversity study (Manley et al. 2006) had approximately 10 sample sites within or in the vicinity of the Angora fire. These sites were sampled in 2003-2005 for birds, small mammals, and invertebrates using techniques appropriate and effective for this project. We also have comparable data from the Upland Fuels Treatment study, which has continuously sampled the same 12 sample sites on the west shore (Tahoma to Tahoe City) since 2006 and is scheduled to continue until 2010. These sites provide an unbiased description of species composition, relative abundance, and annual variability associated with ecologically equivalent forest conditions before and after the fire for all the three species groups targeted in this study.

The funding requested by this proposal will be used to expand the scope, sample size, and duration of the existing project (Table 1) to broaden and strengthen the information that it will provide on how to conduct post-fire site management and restoration activities in a manner that enhances the retention and restoration of biological diversity. Specifically, the study will increase the sample size from 42 to a minimum of 72 sample sites by sampling additional USFS/UMT vegetation response sites, it will add invertebrate sampling to the animal sampling effort (including processing samples collected pro-bono in 2008), collect data on post-fire tree use by wildlife species, and it will extend the study for one additional year for a total of three years of post-fire sampling. The specifics on the original design and sampling and the proposed additions are described in detail below.

Table 1. Existing and proposed expansion of existing project to address post-fire biodiversity in the Angora fire area.

	Existing	Expanded	
Study component	2008-09	2009	2010
Total sample sites	42	72	72
Bird sampling	42	72	72
Small mammal sampling	30	50	50
Invertebrate sampling	0*	72	72
Tree use by wildlife	0	72	72

* Field data collected in 2008 as an in-kind contribution, but identification and analysis not yet funded.

Sample Site Selection

The study is designed to maximize the information gained through collaboration and consistency with other research and monitoring efforts in the burn area and elsewhere in the basin. Site selection was conducted in a stratified random manner. To the extent possible, sites were co-located with USFS/UMT vegetation response monitoring sample sites established on a 200x200-m systematic grid established across the burn area (~ 100 grid points, Fig. 1). To gain efficiencies, the USFS/UMT project did not sample all of the grid points in the high intensity burn areas, given that there were so many in that dominant condition. They chose to distribution the sampling effort throughout the burn area and across the gradient of burn intensity, sampling a total of 75 of the 100 grid points. Candidate sites for the existing study included the following: all USFS/UMT vegetation grid points being sampled, all public land urban parcels in or near the burn, and study sites associated with the urban biodiversity or upland fuels projects located in or near the burn.

In addition to burn intensity and restoration treatment, we also considered the level of urbanization in site selection, with sites being classified as urban or wildland for the purposes of selection. Recent research findings from a study conducted in the Lake Tahoe basin demonstrated that bird, mammal, and invertebrate communities were affected by various urban stressors, including habitat loss, habitat change, human disturbance, and dogs (Manley et al. 2006). As a result, we believed it was important to account for the potential of urban influences across all treatment combinations to the extent possible.

To determine the effects of each source of effects – fire intensity and post-fire treatment – we selected replicate sample sites from each combination of treatments (Table 2). We used the fire intensity map, developed through a collaborative agency endeavor, and treatment histories by parcel to identify potential sample sites in each category of treatment combinations. Sites were then selected randomly from the pool of candidate sites in each category.

In 2008, 42 sites were selected and sampled, with sites in each combination of burn intensity and post-fire treatment (Table 2). Of the 42 sites sampled, 26 were located on the USFS grid, 14 were located on state lands, and 2 were control sites from the Urban Biodiversity study. In 2009, the sample will be increased to 72, with the majority being co-located with the USFS/UMT vegetation response sample points, with a few additions from the Urban Biodiversity study sites in the vicinity of the fire (~ 8 more sites). Sites will be selected to meet the target sample sizes in each combination of conditions (Table 2).

Table 2. Target minimum number of core sites in each combination of fire intensity (percent tree mortality) and post-fire tree removal.

	Fire intensity					
Post-fire treatment	None	Low (<40%)	High (>90%)	Moderate (40-90%)	Target	Existing
None	6	6	6	6	24	23
Partial tree retention	6	6	6	6	24	12
No tree retention	6	6	6	6	24	7
Target	18	18	18	18	72	
Existing	13	6	17	11		42

Field Methods

Animal Data

Sites are defined by a single central point around which sampling is conducted. Birds, small mammals, and invertebrates will be sampled with standard techniques (Table 3). These techniques have no environmental impact and minimal disruption of wildlife activities. We will use data collection techniques that are consistent with our other research studies on the effects of urban development on biological diversity (Urban biodiversity study; Manley et al. 2006, 2007) and the effects of fuels treatments on biological diversity (Upland Fuels Treatment study; Murphy et al. 2008). The compatible designs of these studies provide pre-burn plant and animal data for the study, and will facilitate a meta-analysis of biodiversity responses to tree removal with and without fire.

Bird species composition and abundance will be characterized with point counts conducted at each site (Ralph et al. 1993). During each of three visits conducted in the spring, all birds seen or heard will be recorded. Their distance from the observer (10-m distance bands up to 60m, 60-75m, 75-100m, and >100m) will also be recorded. Distance intervals facilitate constraining the characterization of bird populations and communities to the treatment area. Sites are visited three times each year during the spring (late May to early July).

Small mammal species composition and abundance will be characterized with Sherman live trapping (Jones et al. 1996). Trapping grids are designed to work in small urban parcels so that results will be comparable in urban and wildland conditions. Trapping grids will be 40 x 130 m, with alternating extra-long and extra-large traps on a 10-m spacing for a total of 70 traps. Traps will be pre-baited for three nights prior to a 4-night sample trapping session. Trapping will be conducted between June and August, with a mix of site conditions sampled during each session throughout the summer to avoid confounding breeding chronology with site conditions. Traps will be baited with oats, seeds, and peanut butter, and checked twice per day throughout the trap session. Captured animals will be individually marked using uniquely numbered ear tags.

Invertebrate composition and relative abundance will be characterized with a grid of pitfall traps with the same response design used in our previous studies. We will use a standard pitfall trapping method to quantify invertebrate community characteristics because it provides rapid and repeatable results and unbiased samples of ground-dwelling invertebrates within a survey area (Anderson 1990, Agosti et al. 2000). At each site, we will array 12 traps in a 40 x 40-m grid. We will place four traps, spaced 10 m apart, along each of three 40-m transects that are oriented north-south and centered on the center point of each plot; the three transects are separated by 20 m (Bestelmeyer and Wiens 1996, Anderson 1997). Pitfall traps will consist of 6.5-cm diameter (120 ml) plastic cups with approximately 25 ml of propylene glycol. Traps will be left open for 7 days and then contents will be collected. Ants will be identified to species and the remaining invertebrates will be identified to morphospecies and placed in functional groups.

Woodpeckers, sapsuckers, and nuthatches are primary cavity nesters, creating their own nest cavities in trees and snags. It is well established that primary cavity nesters perform a keystone ecological function by creating cavities that are needed for nesting and shelter for many species of birds and small mammals (Bull 1997, 2002). Their persistence in an area and use of sites depends on the availability of suitable foraging and nesting substrates (e.g., Zack et al. 2002, Koivula and Schmiegelow 2007, Russel et al. 2007), which can be great affected by wildfire. The persistence of many small mammal species also depends on the number and character of trees and snags (e.g., Saab et al. 2004, Vierling et al. 2008). Tree use by wildlife will be characterized with two sampling efforts. The first involves recording sign of tree use by wildlife within the ¼ ac vegetation sampling plot located at each site (see vegetation section below). Wildlife use sign includes cavity-nester nest holes, woodpecker/sapsucker feeding excavations, bird nests (cavity, cup, stick), squirrel nests, and observed use by small mammals or birds during vegetation sampling. Each tree within the ¼ ac plot is individually numbered and characterized (species, height, diameter at breast height, decadence features, vigor, and decay [snags only]). Evidence of wildlife use will be recorded in association with individually identified trees.

The second sampling effort focuses on the characteristics of active nest trees of cavity nesters and trees used for foraging by cavity nesters. Within 60 m of each sample site, observers will search for active cavity nests (Martin and Geupel 1993) and foraging cavity nesters (Robinson and Holmes 1982, Nappi et al. 2003, Covert-Bratland et al. 2006). Substrates used for foraging will be recorded for any cavity nester observed foraging with a focal animal sampling observational techniques. When a foraging cavity nester is located, observers will watch the individual for 5 seconds, and then record the following information: bird species, foraging height, foraging technique, and foraging substrate characteristics (species, vigor, scorch). When nests are located, the bird species, location of the nest (height and aspect), and stage of nest development will be recorded. The nest tree will be characterized as per vegetation plots, with the addition of the percent of the tree that is scorched. In addition, habitat characteristics around the tree will be described. Tree clustering will be characterized with a point-center quarter approach: the nearest tree in each 90 degree quadrant from the center point is characterized, including distance from the center point. In addition, a 20-factor prism will be used to describe tree species composition, density by diameter class, vigor, decay class (snags only), and basal area, as per the sample site protocol.

Vegetation Data

Vegetation sampling methods implemented in 2008 were derived through a collaborative process with USFS/UMT and CTC such that all parties are collecting data in the same manner and the resulting variables meet the full range of information needs (vegetation response and habitat conditions). Vegetation data will consist of a detailed description of understory and overstory vegetation composition, cover, and structure, fuels, and ground cover. The majority of data will be collected within ¼ ac (17.8-m radius) plots. The following information is collected for each tree: species, diameter at breast height, height, height to live crown base, live crown ratio, crown position, vigor (stress, disease, death), and scorch. In addition, a 20-factor prism will be used to describe tree species composition, density by diameter class, and basal area. Within a 3.57-m (11.7 ft) fixed radius subplot of 0.01 ac (0.004 ha) nested at the plot center, the number and height of all seedlings less than of 1.4-m tall will be recorded for each species. Each mature tree and snag will be permanently marked with an aluminum tree tag and nail. Canopy cover will be measured at 25 points using a 5x5-m grid using a GRS site-tube densitometer.

Surface and ground fuels will be sampled on all four transects in each inventory plot using the line-intercept method (Brown 1974). One-hour (0-0.64 cm) and 10-hour (0.64-2.54 cm) fuels are tallied from 15-17 meters, 100-hour (2.54-7.62 cm) fuels from 12-17 m, and 1000-hr (>7.62 cm) fuels are sampled along the entire length (17.58 m) of each transect. The larger fuels (1000-hr) represent coarse woody debris (CWD) that has high value for many wildlife species, and will be described as follows: species, diameter at the tape, diameter at each end, length, and decay class. Duff and litter depth (cm) will be measured at the 8-m and 16-m marks. Measurements will be conducted towards the distal ends of transects to minimize disturbance at plot center.

Herb and shrub percent cover, height, and nested frequency will be measured in five $0.25 m^2$ quadrats located at 3 meter intervals (3,6,9,12,15) along all four transects, for a total sample area of $1.25 m^2$. Frequency describes the abundance and distribution of species and is very useful for comparing significant differences between two plant communities or detecting significant change in a single community over time. Plant cover will be measured within each quadrat as per 12 cover classes (0-1, 1-5, 5-15, 15-25, 25-35, 35-45, 45-55, 55-65, 65-75, 75-85, 85-95, 95-100).

Data Analysis

Factors affecting biological diversity and abundance individual species of interest and concern will be assessed using multiple linear regression techniques. Biodiversity measures will include measures of richness, abundance, and evenness for entire taxonomic groups (birds, small mammals, ants, invertebrates), for ecological groups within taxonomic groups (e.g., cavity nesters, ground nesters), and across taxonomic groups to address questions related to species of special interest (e.g., prey species for top carnivores). These measures of biological diversity all will be based on count data.

The majority of explanatory variables are continuous, including the treatments. Burn intensity based on remote sensing is represented as percent tree mortality. Ground-based data will provide a more accurate and detailed assessment of burn intensity at sample sites, reflected in continuous variables such as the density of trees by vigor class and by degree of scorch. Post-fire treatments consist of count data in terms of varying numbers and proportions of remaining trees removed from and remaining on the site. Habitat variables will consist of measures of canopy cover, ground cover, and snag and log densities by size and decay class. Tree data includes species, trees ha^{-1}, basal area ha^{-1}, height to live crown base, canopy cover, and crown bulk density. Fuel load parameters include fuel depth, litter and duff load, 1-hour, 10-hour, 100-hour, 1000-hour sound and rotten timelag fuel loads, and total fuel load.

The characteristics of trees used by wildlife to meet various needs will also be analyzed using multiple logistic regression techniques. The characteristics of trees used and not used by various species, species groups, or for particular kinds of use (e.g., foraging, nesting, resting) will be analyzed.

We will use Akaike's Information Criterion (AIC) to develop models of the association between sampled species and forest conditions at each capture site. We will use model selection based on corrected AIC (AIC_c) for model selection, since sample sizes may be small relative to the number of model parameters (Burnham and Anderson 2002). Models with a change of AIC_c of <2 relative to the top model (lowest AIC_c) will be considered competitive in their influence on the measure of diversity being analyzed. We will also calculate the sum of weights for individual variables in top models to evaluate their individual influence.

f. Relationship of the research to previous relevant research and monitoring

One of the greatest strengths of this project is that, as described in section e above, it is intimately associated and coordinated with multiple completed or ongoing, extant research studies. First, the scientists involved have the unique ability to integrate pre-fire data from the Urban Biodiversity study and the Upland Fuels Treatment study into an investigation of the effects of the Angora wildfire on biological diversity. Second, we were able to capture the first year of post-fire response with the support of other funds, making this expanded research possible. We collaborated with the primary vegetation response research and monitoring projects being conducted by CTC and USFS/UMT, such that data can be shared among the projects, thus making for a highly efficient data collection system. Collaboration among these entities will extend beyond data collection to include analysis and interpretation of animal and plant responses, thereby providing even greater insights into post-fire recovery dynamics. For example, although data on animal populations and communities may only be collected at a subset of all established monitoring sites, the relationships established by this study at our sample sites can be used to make inferences about any or all of the sites in the vegetation response grid.

g. Strategy for engaging with managers

Managers are already an integral part of the existing study, and the expanded version will provide even more useful information. Staff at CTC and USFS/UMT helped design and collect the vegetation data. Results from each year's data collection will be provided to agencies in a manner that allows them to incorporate the material into individual agency reports on the status of forest recovery and restoration efforts on their lands. This means providing a composite report on the study, as well as providing summary data broken down by land ownership. In addition to providing data and results in the most useful format possible, we will continue to work closely with the primary agencies – CTC and USFS/UMT - engaged in restoration efforts in the burn area to discuss the progress and findings of our research, discuss and interpret composite results across the full suite of monitoring and research efforts in which they are involved, and identify additional information needs as they arise and how best to meet them. We have and will continue to call or meet at least quarterly to achieve the outcomes stated above.

h. Description of deliverables/products

Deliverables will be in the form of quarterly reports tracking progress in the primary project activities, annual reports that describe progress and findings to date, a final report with a full analysis of plant-animal-burn-management interactions, a minimum of one peer-reviewed publication, and multiple presentations at local and regional agency, public, and scientific forums, and at least one national scientific meeting. Data analysis and interpretation will identify facets of biodiversity and species that appear to be most affected by the fire and/or the post-fire treatments. Habitat characteristics that could be modified to enhance conditions for species negatively affected by the fire and subsequent treatments will be identified. The management implications will be described in terms of the ecological effects of each condition and how future post-fire treatments could be designed to maximize the positive benefits and minimize the negative impacts to birds, small mammals, invertebrates, species of concern, and overall biodiversity.

Papers in peer-reviewed scientific journals:

- Post-fire forest management to enhance biological diversity: burn intensity, post-fire treatment and biodiversity restoration
- Post-fire tree use by cavity-dependent species

Symposia, conference, workshop presentations:

- Lake Tahoe Science Symposium
- The Society for American Forestry
- Society for Conservation Biology

Progress and completion reports and presentations:

- Quarterly, annual progress and final completion reports
- Quarterly discussions and annual presentations to staff and leadership at U.S. Forest Service, California Tahoe Conservancy, and Tahoe Regional Planning Agency
- Presentations at local public meetings as requested

Data and maps:

- Description of species composition at sample sites
- Description of conditions by land ownership

Website:

- Information on the study background, objectives, study area, methods, results and conclusions available on PSW-supported public web site for the project

III. Schedule of major milestones/deliverables

Milestone/Deliverables	Start Date	End Date	Description
Submit quarterly progress reports			Submit brief progress report to Tahoe Science Program coordinator by the 1st of July, October, January, and April.
2009:			
Site selection	April 1	May 1	Work with USFS/UMT researchers and existing data layers to select additional sites to meet target sample sizes
Data collection	June 1	Sept 15	Collect all animal and habitat data as described in methods (vegetation data at grid sites collected by USFS/UMT during the same time period)
Data entry and analysis	Oct 1	Dec 15	Enter animal and habitat data, identify invertebrates from 2008 and 2009, and conduct preliminary analysis of relationships between burn intensity, treatment, and biodiversity responses
2010:			
Prepare interim report of findings	Jan 15	Mar 15	Compile results in an agency report that partitions results as needed to be most useful to individual agencies.
Present findings to agencies and local scientific venues	Mar 15	May 15	Offer to present progress and results to date to interested parties and local symposium opportunities
Data collection	June 1	Sept 15	Collect all animal and habitat data as described in methods (vegetation data at grid sites collected by USFS/UMT during the same time period)
Data entry and analysis	Oct 1	Dec 15	Enter animal and habitat data, identify invertebrates from 2010, and being final analysis of relationships between burn intensity, treatment, and biodiversity responses
2011:			
Continue data analysis	Jan 15	May 15	Conduct final analysis of relationships between burn intensity, treatment, and biodiversity responses
Present and discuss findings with agencies and to local scientific and interested public groups	May 15	July 15	Offer to present research results to interested parties and local symposium opportunities
Prepare final report of findings	May 15	July 15	Final report with all results will be provided and made available to all interested parties.
Submit manuscripts to peer reviewed journal	July 15	Sept 15	Prepare and submit manuscripts for publication

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V. Figures

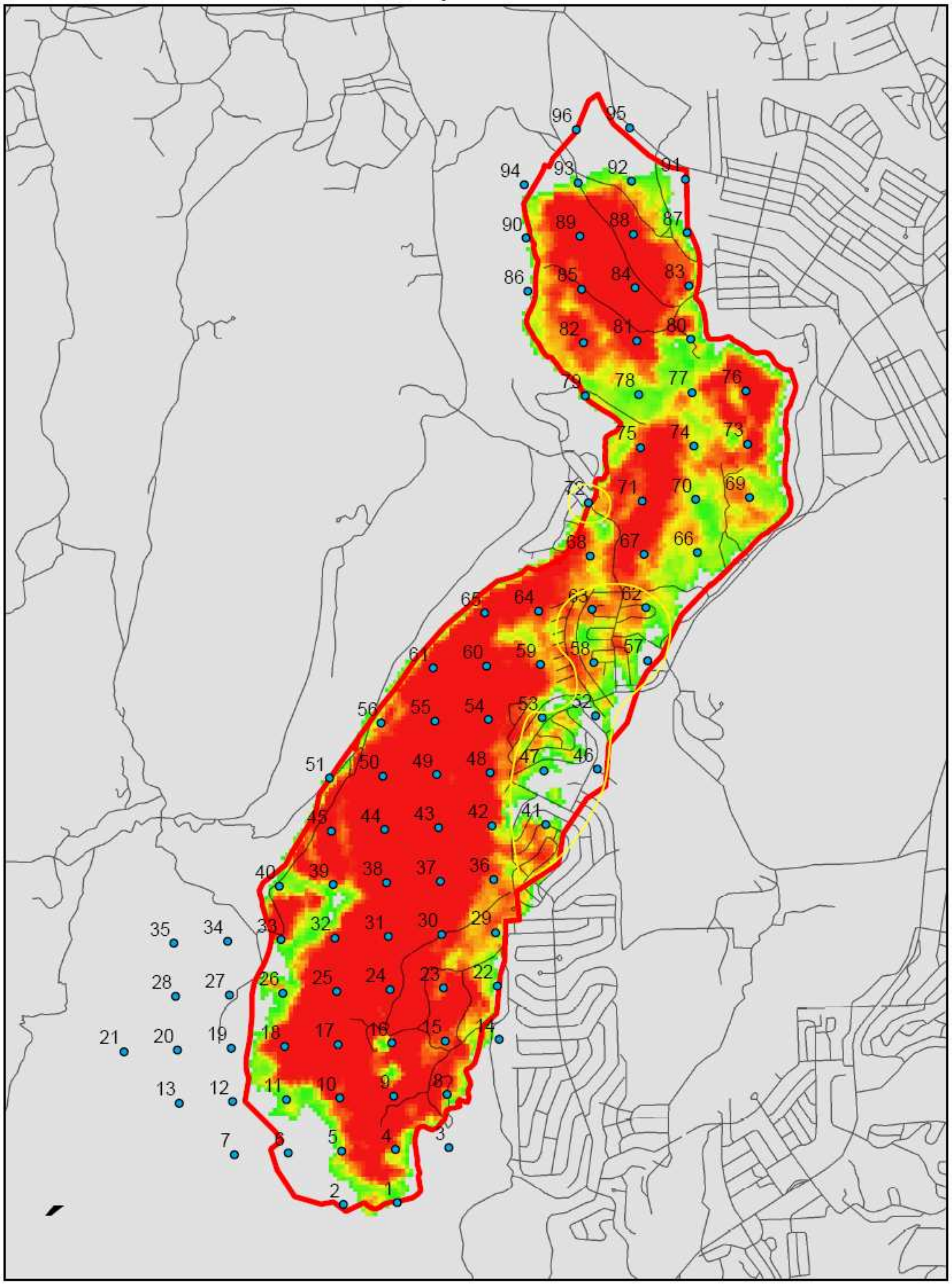

Figure 1. U.S. Forest Service and University of Montana vegetation monitoring sites; sampling design and data collection are a product of the University of Montana.