Effects of Fire and Fuel Reduction on Stream Ecosystems in Western Forests

2003 Study Plan for
Bitterroot National Forest, Montana
and
Payette National Forest, Idaho

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Summary

This document outlines proposed research activities to be conducted in the Bitterroot and Payette National Forests in the summer of 2003. This research is part of a multi-year study (2001-2005) investigating the effects of wildland fires and broadcast prescription burning on stream ecosystems. The first goal of the study is to compare macroinvertebrate and amphibian communities and stream habitat conditions in streams flowing through watersheds that burned at varying intensities relative to unburned reference streams. The second goal is to examine the effects of broadcast prescription burning on stream biota and habitat conditions using a Before-After-Control-Impact (BACI) field experiment in conjunction with the Lesser and Greater Yellow Pine Fuel Break Project scheduled for spring and fall 2003. The work will be coordinated by David Pilliod, a post-doctoral research ecologist with the Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station, Missoula, MT. This study is part of a larger project being conducted on the Siskiyou and Umpqua National Forests in Oregon. This project involves collaborators within the Rocky Mountain Research Station and external cooperators, including USGS BRD Northern Rocky Mountain Science Center, USGS BRD Forest and Rangeland Ecosystem Science Center, USGS Water Resources Discipline, the University of Idaho, and Idaho State University.

Introduction

Prescription burning and certain lightning-ignited wildland fires (i.e., fire-use fires) are increasingly important management tools used to reduce fuel loads and restore the ecological integrity of western forests where historic fire regimes have been altered. Despite the increased use of fire as a forest restoration tool, there is inadequate information on the ecological effects of fire, particularly in aquatic ecosystems. The lack of information on the effects of fire on fish and aquatic wildlife is a major impediment to developing and evaluating fire management policies. In addition, several amphibian and salmonid species in the western U.S. are declining, and thus understanding the effects of fire on aquatic ecosystems is increasingly important.

Objectives

The first objective of this study is to examine the effects of wildland fire on stream conditions and major trophic levels of stream biota (periphyton, benthic macroinvertebrates, amphibians) in watersheds that burned within the last five years relative to watersheds that have not burned for 50-75 years. This research component is being conducted in the Bitterroot and Payette National Forests. Fish are not included in this study as they are absent or occur at low numbers in many of our streams.

The second objective of this study is to determine whether stream biota and habitat conditions in small streams are influenced by broadcast aerial-ignition prescription burning and whether these responses are similar to those observed after wildland fires of different severities. The prescribed fire component of this project is being conducted on the Krassel Ranger District of the Payette National Forest, Idaho in conjunction with the Lesser and Greater Yellow Pine Fuel Break Project in the East Fork of the South Fork Salmon River Sub-basin.

Objectives 1 and 2 are being replicated on federal lands in Oregon.

Our research addresses the following questions:

1. How do macroinvertebrate and amphibian communities respond to wildland fires of different severities?
2. Do these biotic communities respond differently to prescribed fires, which typically result in low-severity upland burns and minimal riparian burning, relative to low, mixed, or high-severity wildland fires?
3. What stream habitat characteristics are associated with abundant invertebrate and amphibian populations, and how are these habitat conditions affected by different types of fire?

Methods

Study Areas and Site Selection
This project is being conducted on the Sula Ranger District of the Bitterroot National Forest, Montana and the Krassel Ranger District of the Payette National Forest, Idaho, and several additional national forests in Oregon (Fig. 1). Study streams were selected based on size (1^{st} to 3^{rd} order), disturbance history (previous logging and roads), geology, accessibility, and proximity of appropriate streams in burned and unburned watersheds. All streams flowed through ponderosa pine, Douglas fir, or mixed pine/fir forests. Sampling reaches ranged in elevation from 1200 to 2000 m and generally occurred in the lower parts of the drainages.

In 2002, we sampled 15 streams on the Bitterroot National Forest (Table 1). Since 2001, 27 streams have been sampled on the Payette National Forest (Table 2). We plan to resample most of these streams in 2003 and 2004 (see Tables 1 & 2). Additional sampling will be conducted on streams prior to and after the prescription burn on the Payette National Forest. Figures 3-7 show the specific sampling locations.

Field Sampling
We will quantify the following components of lotic ecosystems in select watersheds in the study areas:

1. Density, biomass, and age structure of tadpoles/larvae of 1-2 species of endemic stream amphibians (Ascaphus spp., Dicamptodon spp.)
2. Composition and abundance of the aquatic invertebrate community (to family-level)
3. Autotrophic potential of streams (chlorophyll-a and AFDM of periphyton)
4. Selected stream conditions including water temperature, water chemistry, discharge, substrate, sedimentation, large woody debris, and others (see Appendix A)
5. Burn severity using field measurements and satellite-imagery.

1. Amphibian Sampling
Sampling methodology was based on the Random-X Protocols developed by R.B. Bury and D.J. Major (USGS, BRD, FRESC, Corvallis, OR) and modified to meet our needs (see Appendix A). Within each stream, we randomly selected thirty 1 m (x variable stream width) transects in a 1.0 km stream reach (Fig. 2). The starting point of each reach sampled was determined by size of stream and accessibility. Ideally, we wanted to sample each stream for 1.0 km upstream from its confluence with the next larger system (e.g., Big Creek) or for 1.0 km upstream from a road crossing. To test how location of sampling reach influenced our study, we sampled two 1-km reaches in 3 streams; 1 km at the lower part of the drainage and 1 km in the upper part of the watershed, at approximately 3 km apart.

At each transect, we sampled for amphibians using kick-sampling and recorded life history information on all captured individuals. Kick sampling involves first removing all larger rocks and logs from the stream transect, and then disturbing the substrate immediately in front of two D-frame nets. Kick sampling is an effective method for capturing many stream amphibians.

Amphibians captured during kick-sampling are placed in plastic buckets until the entire transect is sampled and all individuals can be measured. All captured individuals are measured to the nearest 1 mm (snout-vent length and total length) with a plastic ruler, weighed to the nearest 0.1 g for frog tadpoles or nearest 0.5 g for adults and juveniles with a Pesola spring scale. Each individual is identified to species, life stage (adult, juvenile, metamorph, tadpole), and sex. Captured animals are released back into the transect area. Animals that are accidentally killed during sampling (a rare event) are collected in alcohol for genetics analysis. Tailed frog tadpoles are grouped by size and developmental stage.

Amphibian data will be summarized as the total density, total biomass, and number of individuals captured by life stage and species per stream. Total density per species per stream will be calculated as an average of the number of individuals observed in each life stage divided by the total area surveyed. Total biomass per species per stream will be calculated as an average of the weight of individuals captured in each life stage divided by the total area surveyed.

2. Aquatic Invertebrates

The benthic invertebrate sampling will be conducted on a subset of streams on the Payette National Forest, Idaho (see Table 2). We will establish five transects at 50-m intervals within a 200-m stream reach. The stream reach will be selected to correspond with randomly selected, 200-m reaches used for amphibian, periphyton, and aquatic habitat sampling. We will collect benthic invertebrate samples from one location along each transect (n = 5 samples per reach) using a standard Surber sampler (0.10 m2, 250μm mesh) during summer base flow conditions. Each sample will be preserved in 75-100% ethanol for later identification (to genus where possible) and enumeration in the laboratory. Metrics derived from the invertebrate samples will include density, taxa richness and diversity, and functional feeding groups, and will be compared among years and watersheds.

3. Autotrophic Index

The autotrophic index provides a relative measure of the autotrophic potential of a stream. Autotrophic index is a ratio of periphyton biomass (ash-free weight of organic matter) to chlorophyll-a. Typically, AI values range from 50-200, with larger values indicating systems dominated by a heterotrophic community, and vice versa (APHA 1995).

To collect periphyton, we will scrape a known surface area of five randomly chosen rocks in our selected stream reaches. Removed material will be filtered and preserved in the field. Laboratory analysis of chlorophyll-a (corrected for pheophytin) and AFDM is done following methods in the current Standard Methods (APHA 1995).

4. *Habitat Measurements*

At each sampling transect, we will measure the following habitat conditions (see Appendix A for details):

- habitat type (pool, riffle, cascade)
- water depth
- survey width
- wetted width
- flow
- water temperature
- water chemistry
- dominant and subdominant substrate type and composition
- substrate embeddedness
- submerged large woody debris
- aquatic organic debris
- undercut bank
- overstory cover above water surface
- transect aspect
- gradient
- fine sediment deposition depth will be measured at five locations in 10 pools in each stream
- riparian burn within 5 m on either side of the stream transect center line
- difficulty of rubble rousing in substrate

5. *Burn Severity*
This study initially proposed to select and sample streams that fell into three burn severities classes using the following simplistic categories: unburned forests (fires absent for at least 70 yrs), low severity understory burns, and high severity stand-replacement fires. To improve our ability to understand the relationship between burn severity across a landscape and the biotic or abiotic responses measured in the streams, we have modified our design to incorporate watershed-level burn severity using field-verified normalized burn ratio values from Landsat 7 TM satellite imagery (see http://www.fire.org/firemon/LAv2_Methods.pdf). Using this method we will be able to quantify burn severity in each watershed as a continuous variable (e.g., average burn severity per pixel per watershed) or as a percentage of categorical values (e.g., percent of high severity pixels per watershed). We will also be able to look at the influence of burn severity along a stream (e.g., average burn severity in 30 m buffer along stream) relative to upland burn severity. This latter measure should also enable us to examine the buffering quality of unburned riparian forests on stream responses to upland fires.

Analysis Methods

To understand the influence of wildland fire on stream ecosystems, we will use a repeated measures design (years 2001-2004) comparing streams of similar size within the same region (e.g., Skalkaho region of the Bitterroot National Forest). Four amphibian models will be analyzed using habitat and burn severity predictor variables and the following response variables: (1) tailed frog tadpole density, (2) ratio 1 yr old tadpoles:2+ yr old tadpoles, (3) size at metamorphosis, and (4) survivorship to metamorphosis. Three invertebrate models will be analyzed using habitat and burn severity predictor variables and the following response variables: (1) species richness, (2) density of dominant taxonomic groups, and (3) biomass of dominant taxonomic groups.

To understand the influence of prescribed fire on stream ecosystems, we will use a BACI (before, after, control, impact) design for all of our biotic and abiotic variables. If assumptions of repeated measures ANOVA can be met (i.e., the covariances between all possible pairs of repeated measures are equal), then will use this analysis method. Otherwise, we will use other multivariate repeated measures calculations.

Inference
Within streams, random sampling methods (as discussed earlier) were used to maximize our ability to compare habitats, environmental conditions, and biotic communities among streams. Our within stream inference is 1 km. The random location of transect belts within streams removed the researcher bias from sampling locations allowing us to compare streams. In addition, we attempted to maintain consistency in total area sampled and the approximate location of each stream section sampled to improve among stream comparisons. In final analyses, streams of similar size within regions (e.g., Skalkaho region of the Bitterroot National Forest) will be compared. General patterns among regions will be discussed, but not compared statistically.

This study was not designed to make statistical inference for all streams across the western United States or even across entire National Forests. Several factors, such as accessibility, burn pattern, and disturbance history (e.g., roads, logging), limited our ability to randomly draw a subset of streams from the available set. Although fire perimeters, hydrologic layers, and composite landscape analyses (Robert Ahl, Forestry Sciences Lab, RMRS, Missoula, MT) in a GIS were initially used to locate potentially similar streams to sample, field crews frequently encountered problems with streams being too large or too small to sample, fire perimeters were often inaccurate, and it was our intention to compare streams in burned and unburned watersheds in close proximity.

Project Duration

The project was initiated in 2001 on the Payette National Forest and expanded to other forests in the summer of 2002. With available funding, field work will continue through 2004 and final reports will be available in 2005. Field research is conducted from late June through September.

Products and/or Tech Transfer

The results of this study should provide helpful information to managers for: (1) understanding the immediate and short-term (0-5 years post-fire) effects of fire and fuels management on stream ecosystems; (2) evaluating some of the ecological tradeoffs of prescribed fire treatments vs. potential wildland fire; and (3) identifying potential opportunities to better manage for sensitive aquatic species, endemic aquatic species, and Threatened and Endangered aquatic species.

We will meet with local District biologists and managers to present our study plan and communicate preliminary research findings in May 2003 and work closely with Fire Managers on the Payette National Forest as they implement the prescription burn in the spring and fall 2003.

We attended a regional meeting of the R1/R4 Adaptive Management and Monitoring in Couer d'Alene in January 2003 and a national meeting of the Joint Fire Science Program in March 2003. Preliminary results and progress reports were presented.

We hosted a workshop on "Sampling Methods for Stream Amphibians" in Arcata, CA at the annual meeting of the Society for Northwestern Vertebrate Biology, March 19, 2003. A paper of preliminary results was presented at this meeting in the session on "Fire and Amphibians".

Our web page will be another avenue to communicate preliminary results with the general public and other scientists and we will continue to maintain and update the project page each year.

Several manuscripts have come out of this research or are in development:

Bury, R.B., D.J. Major, and D.S. Pilliod. 2002. Responses of Amphibians to Fire Disturbance in Pacific Northwest Forests: a Review. Pages 34-42. *In*: The role of fire in nongame wildlife management and community restoration: traditional uses and new directions. Edited by W.M. Ford, K.R. Russell, and C.E. Moorman. General Technical Report NE-288. USDA Forest Service, Northeastern Research Station, Newtown Square, PA.

Pilliod, D.S., R.B. Bury, E.J. Hyde, C.A. Pearl, and P.S. Corn. 2003. Fire and amphibians in North America. *Forest Ecology and Management*. In press.

Pilliod, D.S., R.B. Bury, E.J. Hyde. Fire, disturbance history, and the distribution and abundance of stream amphibians. In preparation.

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Appendix A. Description of variables, methods used, and summary values for habitat and amphibian data recorded on stream survey transect data sheets, amphibian capture data sheets, and pool data sheets.

Stream Survey Transect Data Sheet

Site Location and Habitat Description

Stream: Stream name from topographic map.
Drainage: List the major drainage in the area (e.g., Big Creek, SF Salmon).
State: Use the two-letter abbreviation.
Date: Use MM/DD/YYYY format (e.g., 05/12/2002 for May 12, 2002).
Trans #: Every 1 m transect has a unique number. Use a unique five digit code YY### (e.g., 01251 is transect 251 in year 2001). This number is generally provided on the form. If the transect does not have a number ahead of time, record the transect number as YY999.
Trans Dist: This is the distance from the starting point of the stream section surveyed. This is a random number and is provided ahead of time. For example, "0" is used to indicate where the stream section survey starts. Using a tape measure, find the next transact by walking upstream from the upstream edge of the transect and measure to the downstream edge of the next transect. Units are in meters, but the nylon tape measure is usually in feet so use conversion table from notebook.
Adjusted Distance: If the random distance places the next transect in an unsurveyable part of the stream or if sample point is deemed unsafe by surveyors (e.g., waterfall, major log jam), then move upstream or downstream to the closest surveyable portion. Try to follow the scenarios: if large log across stream, survey immediately below log; if waterfall, survey at base of waterfall; if deep plunge pool, survey downstream shallows. Report the direction (up or down) and distance adjusted in meters. Start measuring the next distance from the upstream edge of the original transect.
UTM: Universal Transverse Mercator recorded as easting and northing from the GPS unit in meters. The map datum used by the GPS receiver will be NAD27 and zone 11.
EPE: Report the Estimated Positional Error from the GPS unit in meters. This is a rough estimate to evaluate unusually located points later.
Observers: Record the first, middle, and last initials of all individuals involved with the survey of this particular site. The person holding the nets is watching and should be included as an observer.
Recorder: Record the first, middle, and last initials of the recorder.
Weather: Record the weather at the start of each transect survey. Weather codes are: CL = clear, PC = partly cloudy, CO = cloudy. Precipitation codes are: D = dry, F = fog, M = mist, LR = light rain, HR = heavy rain. Wind codes are: C = calm, LB = light breeze, MB = moderate breeze, W = strong wind, G = gusty.
Aspect: Record the direction of water flow using a magnetic compass, reporting aspect in relation to true north (not magnetic north). Be sure to use a compass with appropriately adjusted declination (see topomap) or compute adjustment before recording. In Appendix B, average aspect is reported.
Water Temp: Record water temperature and report in °C = (°F – 32)/1.8. Thermometers should be placed in the water below the transect at the start of the survey and remain in the water for 3-5 minutes. Onset Tidbit temperature data loggers will monitor stream temperatures every hour until September 2004.
Air Temp: Record air temperature at chest height in the shade in °C. You should record air temperature before water temperature to avoid evaporative cooling on the bulb.
Gradient: Stream gradient will be measured with digital elevation models in a GIS.
Burn: Using the centerline of the stream, estimate 5 m on either side of the stream. Describe if the riparian forest is burned using the following categories: 0 = unburned or at least no overstory cover vegetation was burned, 1 = partially burned with riparian foliage from trees and shrubs still alive and providing cover, 2 = burned with no living trees or shrubs providing cover.
Survey Width: The width of the survey area in centimeters. Usually this is the wetted width, but occasionally you will not survey a part of the transect because of thick deadfall or extensive braiding. We record survey width, because we use this measure to estimate the density and biomass of amphibians.

Wet Depth: Record the depth of the stream at three locations across the transect from left to right while facing upstream: left third (measured halfway between center and left bank), center, right third (measured halfway between center and right bank). Depth is recorded from marks on net handles to the nearest 2 cm. In Appendix B, depth is reported as a stream average of transect depths, which are calculated as an average of these 3 measurements taken per transect.

Flow: Using a submersible fishing bobber and line, fill the bobber with water so that it is neutrally buoyant and record the time it takes to travel 1 m downstream using a stopwatch. Repeat the measurement 3 times, recording each in seconds to the nearest 2 decimal places. In Appendix B, flow is calculated by dividing the flow measured in seconds by the distance the bobber traveled and then averaging across the 3 measurements.

Flow Dist: The distance the bobber was floated in meters. This is usually 1 m, but occasionally the current is such that it is easier to float the bobber along a 0.5 m section of stream.

Substrate: Substrate is visually classified into 2 categories (Dominant and Sub-dominant) based on substrate sizes modified from Platts et al. (1983) [from Lane 1947]. Size classes are as follows: 1 = silt, 2 = <1 mm, 3 = 1-2 mm, 4 = 2-4 mm, 5 = 4-8 mm, 6 = 8-16 mm, 7 = 16-32 mm, 8 = 32-64 mm, 9 = 64-160 mm, 10 = 160-256 mm, 11 = >256 mm. Non-rock materials are given the following classes: 12 = wood, 13 = bark, 14 = soil, 15 = vegetation, 16 = leaf litter. Visual categorization of the dominant and sub-dominant substrates is first recorded for the entire transect area. Then, record the number of times the dominant and sub-dominant substrate appear in a 10 cm x 30 cm view box moving along the downstream edge of the 1 m transect from left to right facing upstream. Finally record the total number of viewing areas (or calculate from stream width/30 cm). Appendix B reports the dominant and sub-dominant substrates as percentages by dividing the number of times each appeared in the viewing area by the total number of viewing areas, and then averaging these values for each stream.

Pebble Counts: In addition to the above method of substrate classification, we performed a Wolman Pebble Count (Wolman 1954) using a modified Platts et al. (1983) [from Lane 1947] substrate size classes. For our purposes, “pebbles” are any coarse substrate >9 mm measured along the intermediate axis (not the longest side and not the shortest side). Visually divide the stream into three equally sized sections from left to right; 10 pebbles will be measured from each of these three sections. Using the downstream edge of the 1 m transect and moving from left to right facing upstream, move your finger along the substrate and measure the size of each pebble your finger touches using a plastic ruler. Report the size of the first 10 pebbles encountered starting from the left bank, the first 10 encountered from the start of the next section, and the first 10 encountered from the start of the last section. In Appendix B, pebble counts are reported as the frequency of each particle size by dividing the number of pebbles in each size divided by the total number of pebbles counted; these are then reported as percentages.

Embeddedness: Embeddedness rates the degree that the larger particles (boulder, cobble, gravel) are surrounded or covered by fine sediment (<2 mm). Embeddedness estimation is conducted at the same time as the Pebble Count. For each pebble measured during the pebble count, report the degree of embeddedness as the percent of the “pebble” covered by fine sediment <2 mm. Use the following categories to describe the percent of the surface of each particle > 9 mm covered by fine sediment: 0-5%, 5-25%, 25-50%, 50-75%, 75-100%. In Appendix B, embeddedness is reported as the frequency of substrate particles in each embeddeness category by dividing the number of pebbles in each category by the total number of pebbles counted; these are then reported as percentages.

Anchor: This measure attempts to describe how “cemented” are the larger substrate particles. While conducting the Pebble Count, estimate (across the entire transect area) how hard it was to remove particles >9 mm. Use the following categories: 1 = no resistance, 2 = slight pull dislodges particles, 3 = particles unmovable or move with significant effort. The anchor may vary across the transect. If so, record an average. Sometimes the anchor will be “3” initially, but once you start removing larger objects the rests comes out easily. In this case, record the initial anchor value before disturbance.

% LWD: Estimate the percent of the entire transect area that is covered by in-stream large woody debris (>5 cm diameter) using the following categories: 0 %, 0-5%, 5-25%, 25-50%, 50-75%, 75-99%, or 100%.

% OD: Estimate the percent of the entire transect area that is covered by in-stream organic debris (wood <5 cm diameter, leaf litter) using the following categories: 0 %, 0-5%, 5-25%, 25-50%, 50-75%, 75-99%, or 100%.

% UB: Estimate the percent of the entire transect area that extends into and is covered by an undercut bank using the following categories: 0 %, 0-5%, 5-25%, 25-50%, 50-75%, 75-99%, or 100%.
% Cover <1 m: Estimate the percent of the entire transect area that has overhanging vegetation or other shading cover (such as a large log) <1 m from the water surface using the following categories: 0 %, 0-5%, 5-25%, 25-50%, 50-75%, 75-99%, or 100%.
% Cover >1 m: Estimate the percent of the entire transect area that has overhanging vegetation or other shading cover (such as a large log) >1 m from the water surface using the following categories: 0 %, 0-5%, 5-25%, 25-50%, 50-75%, 75-99%, or 100%.
Environment: Describe the dominant habitat type (Overton et al. 1997) for the transect using the following categories: C = cascade, composed of turbulent water coming over the top of rocks and forming white water or falls, HGR = high gradient riffle, composed of turbulent water moving around rocks and forming some white water, LGR = low gradient riffle, composed of slightly turbulent water moving around rocks and not forming any white water and may include some runs and glides, PP = plunge pool, composed of scoured turbulent pool at base of falls, P = pool, composed of slow non-turbulent water. In Appendix B, we report the frequency of different habitat types in each stream by dividing the total number of transects in each habitat type by the total number of transects; these are reported as percentages.
Debris Vol: This measurement is recorded after the amphibian survey has been completed. Record the total volume of debris that accumulates in the amphibian nets during kick-sampling. In Appendix B, debris volume is reported as a stream average.
Debris Comp: Record the dominant and sub-dominant debris type found in the amphibian nets after kick-sampling using the categories described under *Substrate*. This helps describe the fine sediment, vegetation, and debris that may be filling interstitial spaces the substratum or coating the surface of the rocks. In Appendix B, we report this measurement as a stream average.
Amphibian Surveys
Begin Time: List the time the survey began in 24 hour format.
End Time: List the time the survey ended in 24 hour format.
Amphibian Date: For each species, record the species (TF = tailed frog, GS = giant salamander). Record the total number of individuals observed (not just captured) for each life stage.
Fish: Record whether fish were observed in the net or visually.
Fish Species: Record what fish species were observed or captured as trout (includes char), sculpin, or other.
Camera Number: If photo taken, record the equipment identification number on the camera.
Photo Frame Number(s) / Descriptions: If photo taken, record the number of the photo as viewed on the camera's view screen. Briefly describe the photo subject in the comments field.
Comments: Comment on anything noteworthy about the weather, location, animals captured, or survey.
Field Check: Record the initials of the person checking the field form. This person should be someone other than the recorder.

<u>Amphibian Capture Data Sheet</u>
Stream: Stream name from topographic map.
Dates: Record the start and end dates for the stream survey period. Use MM/DD/YYYY format.
Trans#: Record the transect number. This number MUST match the number on the Stream Survey Transect Data Sheet.
Animal ID: Use the 5-digit transect number and add a two digit number to identify the individual starting with 01 for the first capture of that transect. The first animal captured in each new transect should start with YY###01.
Species: Record the species captured. TF = tailed frog, GS = giant salamander.
Life stage: Record the life stage of the individual captured: A = adult, J = juvenile, M = metamorph (for tailed frogs - may have tail, but no longer has suctorial mouth parts), T/L = tadpole or larvae (for tailed frogs – must have suctorial mouth parts), E = eggs.
Sex: Record the sex of the animal as male, female, unknown.
 # Legs: Record the number of legs present as 0, 2, or 4. Limb buds are not recorded as legs. The limb must be functional (animal can move it) and have digits.

SVL: Record the length of the animal from snout to vent using a plastic ruler to the nearest mm. The best way to do this is to put the animal in a plastic bag first (also used to weigh the animal).
TL: Record the total length of the animal from snout to the tip of the tail using a plastic ruler to the nearest mm.
Wt: Record the weight of the animal by placing in a plastic bag and hanging from a Pesola spring scale. Try to avoid putting excess water in the bag. The only water should come off the skin of the animal. Record tailed frog tadpoles and metamorphs to the nearest 0.1 g and adult tailed frogs and giant salamanders to the nearest 0.5 g.
Tare: Record the weight of the plastic bag after removing the animal. Be careful not to drain any water from the bag when removing the animal for release. The bag weight should include this small amount of water.
Comments: Record any comments about the animal that are unusual. Use the following short-hand: 1 = Non-functional hind leg nubbins, 2 = Escaped, 3 = Dead, 4 = Collected, 5 = Collected toe tissue, 6 = Other. Note: all individuals should be recorded on this form even if they escaped before processing or were observed but not captured (this would only be the case if no animals were captured but one was observed or if one was observed but not captured on the last netting). If tissue is collected, record the animal #, date, and stream on the sample vial and on a tag placed inside the vial.

Pool Data Sheet
Stream: Stream name from topographic map.
Dates: Record the start and end dates for the stream survey period. Use MM/DD/YYYY format.
Pool#: Record the pool number starting with YY##. For example, pool two in 2001 would be 0202. As surveyors walk upstream, choose one pool every 100 m or so and record the following measurements.
UTM: Record the Universal Transverse Mercator Easting and Northing from the GPS unit in meters. The map datum used by the GPS receiver will be NAD27 and zone 11.
EPE: Report the Estimated Positional Error from the GPS unit in meters. This is a rough estimate to evaluate unusually located points later.
Sediment Depth: Measure the depth of sediment at 5 locations relative to the thalwag: the upstream edge of the pool, the center of the pool, the downstream edge of the pool, between the thalwag and left side of the pool, between the thalwag and right side of the pool. If the thalwag is not evident, use the midline of the stream. At these 5 locations in the pool, push a stake into the sediment until it stops. Slide your hand down the stake to the substrate surface and remove the stake. Measure the depth of sediment in mm.
Pool Size: Approximate the width and length of the pool to the nearest 0.5 m. This rough estimate provides a way of distinguishing major differences between pools of varying size.
Pool Depth: Measure the maximum depth of the pool to the nearst cm.

Water Chemistry

In 2003, water samples will be collected before and after prescribed fires in treatment and control and sent to Don Campbell at USGS Water Resources Division, Ft. Collins, CO for complete water chemistry analysis.

Table 1. Stream sampling locations for the Stream Ecology Fire Project on the Bitterroot National Forest, MT.

	Stream Name	Tributary	Treatment	Sampling Location NAD27 Zone 11 UTM Easting	UTM Northing	Sampling Length km upstream	2002 Data Collected Amphibian & Habitat Surveys	Water Temperature Recorder	Water Chemistry Analysis	Samples Planned for 2003
1	Gilbert	Laird, E Fk Bitterroot R	Burned	726121	5082151	1	X	X	X	Yes
2	Laird	E Fk Bitterroot R	Burned	726715	5080731	1	X	X	X	Yes
3	Moon	Laird, E Fk Bitterroot R	Burned	726709	5080707	1	X	X	X	Yes
4	Crazy	Warm Springs, E Fk Bitterroot R	Burned	726933	5075555	1	X	X	X	Yes
5	Smoke	Warm Springs, E Fk Bitterroot R	Unburned	726972	5075063	1	X	X		Yes
6	Camp W Fk	Camp Creek, E Fk Bitterroot R	Unburned	736407	5069048	1	X	X	X	Yes
7	Weasel	Skalkaho Creek, Bitterroot R	Unburned	743798	5113214	0.5	X	X		Yes
8	Railroad	Skalkaho Creek, Bitterroot R	Unburned	742547	5116514	1	X	X		Yes
9	Skalkaho S Fk	Skalkaho Creek, Bitterroot R	Burned	742743	5110964	1	X	X		Yes
10	Skalkaho E Br 22.4 Lower	Skalkaho Creek, Bitterroot R	Burned	746693	5111278	1	X	X		No
11	Skalkaho E Br 22.4 Upper	Skalkaho Creek, Bitterroot R	Burned	747526	5111861	1	X			No
12	Hog Trough	Skalkaho Creek, Bitterroot R	Unburned	742028	5114548	1	X			Yes
13	Little Blue Joint	W Fk Bitterroot R	Burned	705325	5062283	1	X	X		Yes
14	Coal	W Fk Bitterroot R	Burned	707130	5058358	1	X	X		Yes
15	West	W Fk Bitterroot R	Unburned	709672	5056280	1	X			Yes

Table 2. Stream sampling locations for the Stream Ecology Fire Project on the Payette National Forest, ID.

	Stream Name	Tributary	Treatment	Location NAD27 Zone 11 UTM Easting	UTM Northing	Sampling Length km upstream	2001 Data Amphibian & Habitat Surveys	2002 Data Collected Amphibian & Habitat Surveys	Benthic Macro-invertebrates	Water Temperature Recorder	Water Chemistry Analysis	Samples Planned for 2003
1	Beaver	Big Creek	Burned	638113	5002345				X			Yes
2	Big Ramey	Big Creek	Burned	644575	5004251				X	X		Yes
3	Cabin - Lower	Big Creek	Burned	662303	4999140	1	X	X	X	X	X	Yes
4	Cabin - Middle	Big Creek	Burned	662762	5000760	1	X					No
5	Cabin - Upper	Big Creek	Burned	663236	5004427	1	X	X		X	X	Yes
6	Canyon	Big Creek	Burned	662401	4998701	1	X	X	X	X	X	Yes
7	Cave - Lower	Big Creek	Burned	660863	5001059	1	X	X	X[1]	X		Yes
8	Cave - Upper	Big Creek	Burned	660067	5003765	1		X				Yes
9	Clark	Big Creek via Beaver Crk	Unburned	634557	5006766	1		X				Yes
10	Cliff	Big Creek	Burned	669229	4996550	1	X	X	X[1]	X	X	Yes
11	Cougar	Big Creek	Burned	671563	4996578	1	X	X	X[1]	X	X	Yes
12	Cow	Big Creek via Cabin Crk	Burned	663144	5001050	1	X	X	X	X		Yes
13	Crooked E Fk	Big Creek	Burned	654637	5006251	1		X	X			No
14	Crooked W Fk	Big Creek	Burned	654637	5006251	1		X	X			No
15	Mulligan	Big Creek via Beaver Crk	Burned	636493	5004963	1		X				Yes
16	Pioneer-Lower	Big Creek	Burned	669285	4995905	1	X	X	X[1]	X	X	Yes
17	Pioneer-Upper	Big Creek	Burned	669200	4993723	1		X				Yes
18	Wild Horse	Big Crk via Monumental C	Burned	644027	4999380				X			Yes
19	Dead Man	E Fk of S Fk Salmon R	Rx Burn F2003	605526	4979878	1		X		X	X	Yes
20	Parks	E Fk of S Fk Salmon R	Rx Burn S2003	615632	4979001	1	X	X	X	X	X	Yes
21	Reegan	E Fk of S Fk Salmon R	Unburned	611568	4978043	1	X	X	X	X	X	Yes
22	Williams	E Fk of S Fk Salmon R	Uburned	602950	4984071	1		X		X	X	Yes
23	Blackmare	S Fork Salmon River	Unburned	599096	4962290	1	X	X	X	X	X	Yes
24	Buckhorn N Fk	S Fork Salmon River	Unburned	596791	4975509	1	X	X	X	X	X	Yes
25	Camp	S Fork Salmon River	Unburned	602125	4971353	1		X				Yes
26	Fitsum	S Fork Salmon River	Rx Burn F2003	597594	4983441	1	X	X	X	X	X	Yes
27	Four Mile	S Fork Salmon River	Unburned	603473	4968380	1	X	X	X	X	X	Yes
28	Indian	S Fork Salmon River	Unburned	600108	4980214	1		X				No
29	Phoebe	S Fork Salmon River	Unburned	601779	4972383	1		X				Yes
30	Tailholt	S Fork Salmon River	Unburned	603915	4988522	1		X				Yes

[1]Data collected by Wayne Minshall, Idaho State University, Pocatello, ID

Figure 1. Map of project study areas.

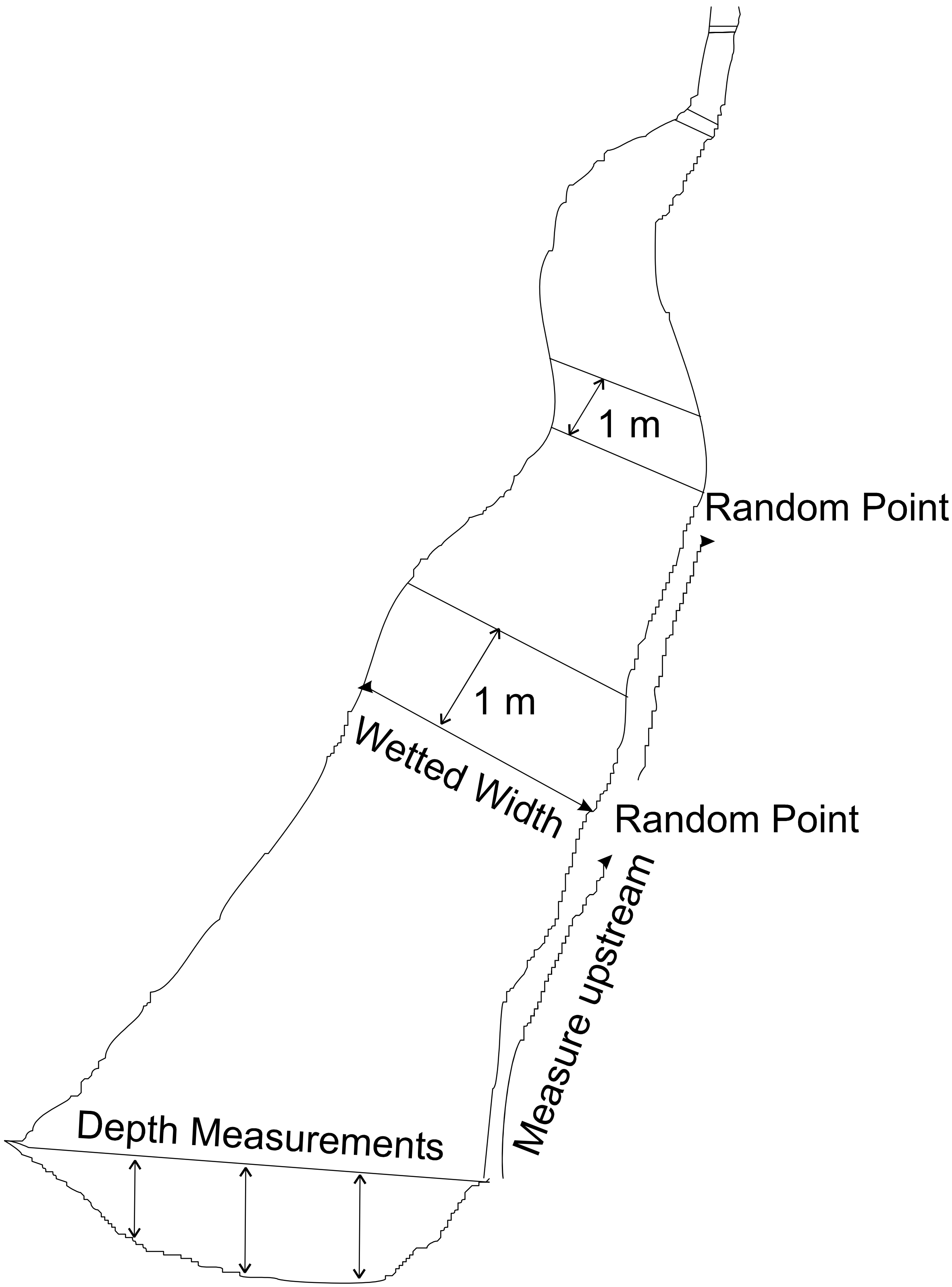

Figure 2. Diagram of sampling design and transect “belt” orientation.

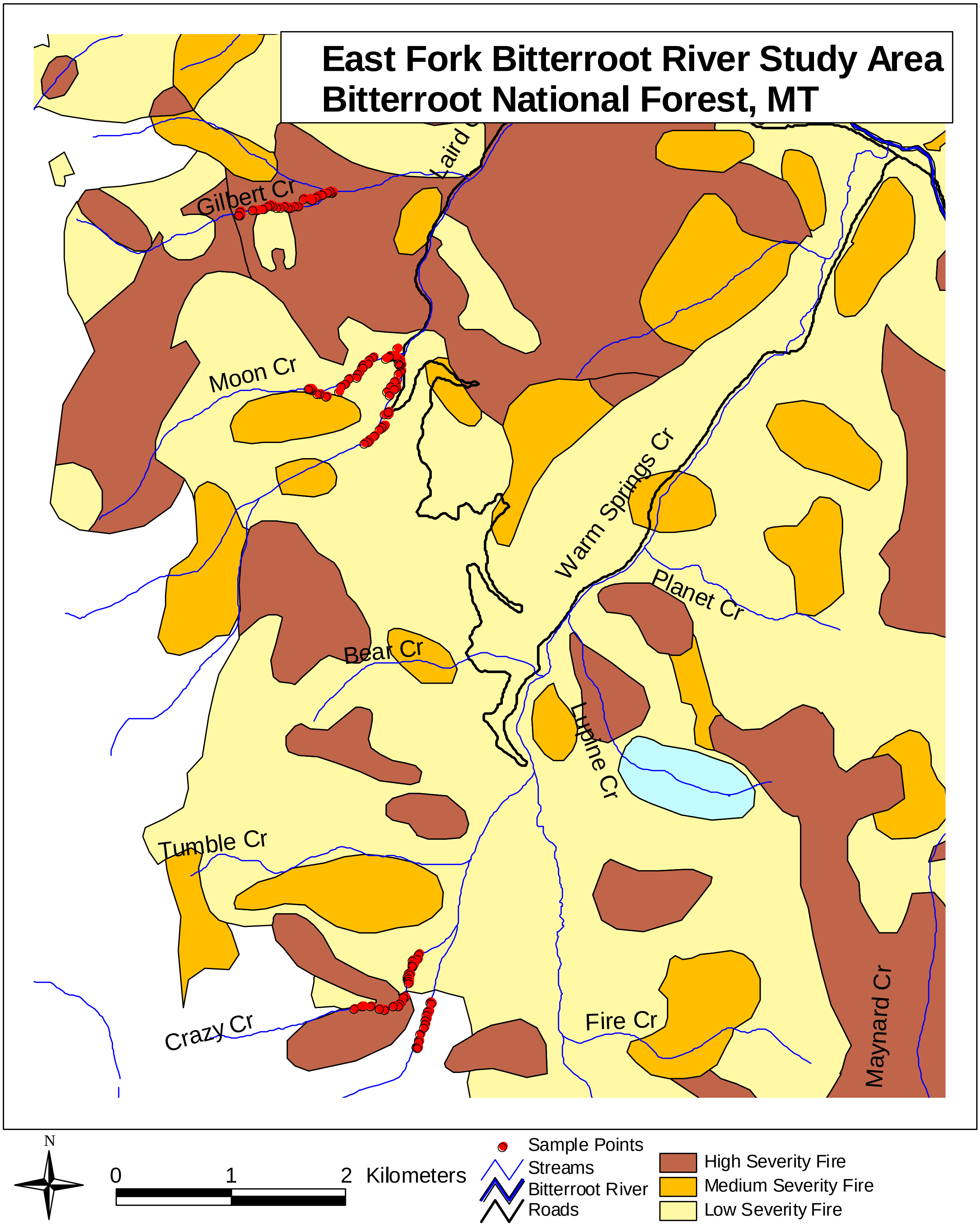

Figure 3. Sample locations for stream fire ecology project, 2002.

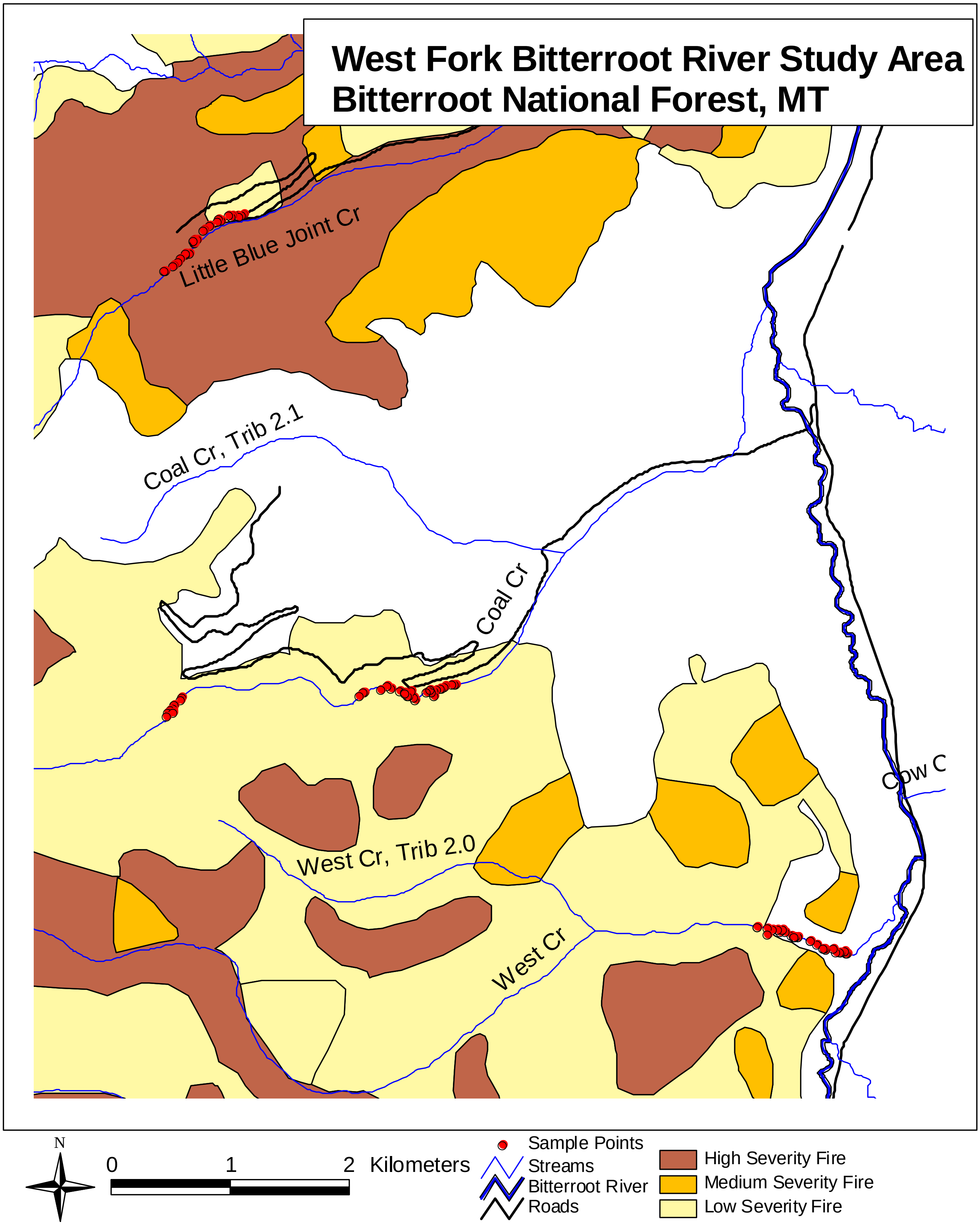

Figure 4. Sample locations for stream fire ecology project, 2002.

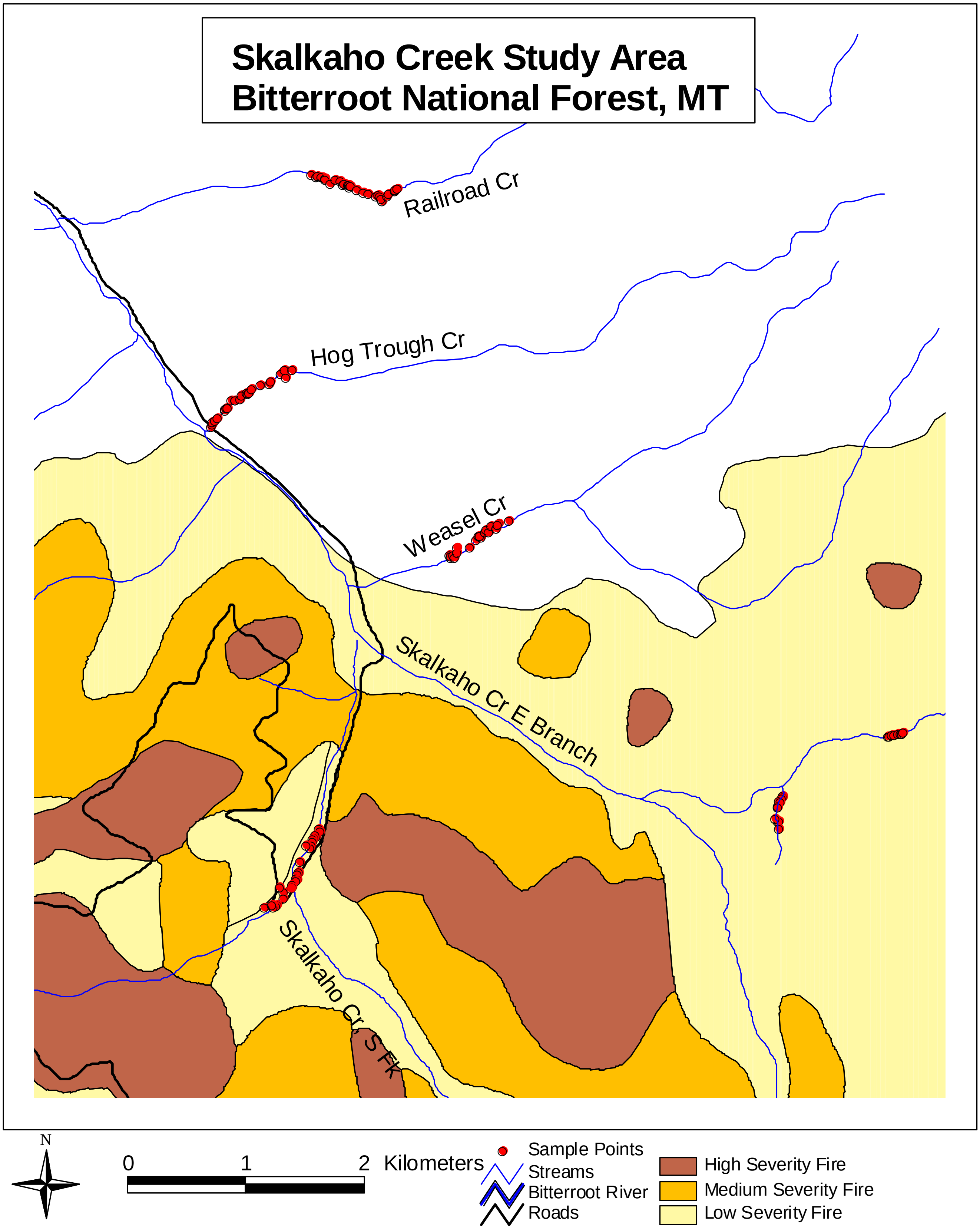

Figure 5. Sample location for stream fire ecology project, 2002.

Big Creek Study Area
Payette National Forest, ID

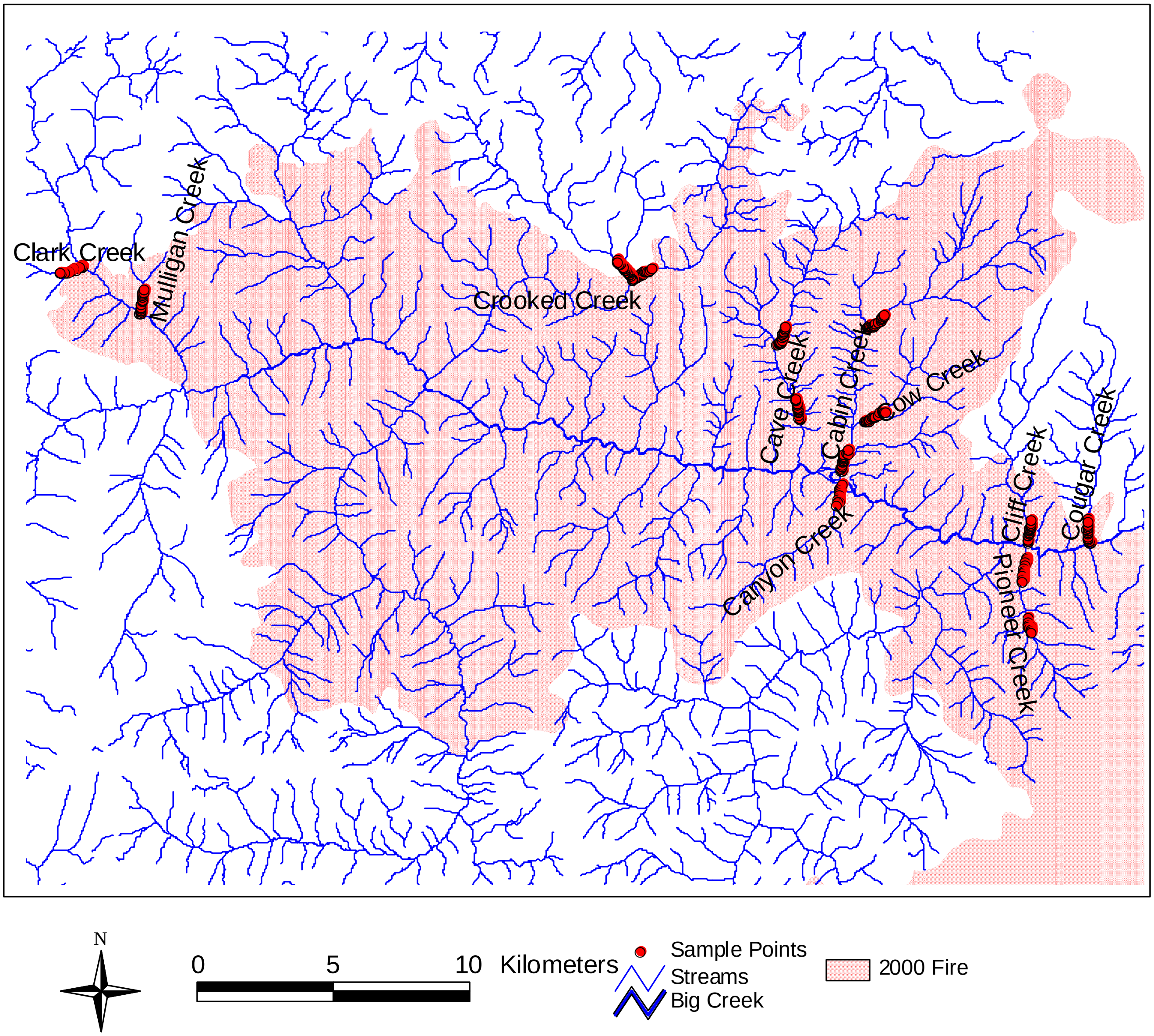

Figure 6. Sample locations for stream fire ecology project, 2002.

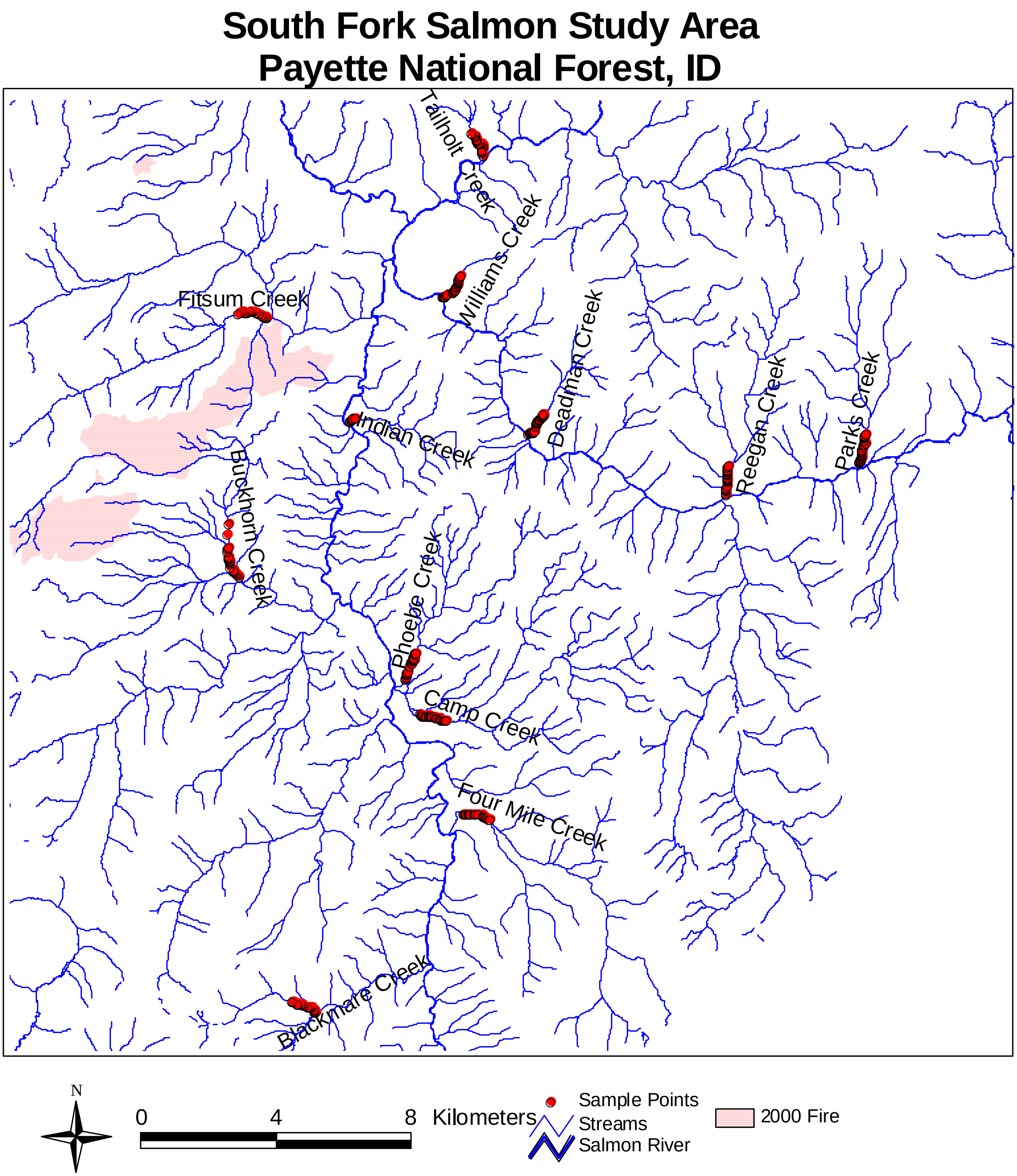

Figure 7. Sample locations for stream fire ecology project, 2002.