KRIS edition

CRAPO CREEK WATERSHED

Condition and Improvement Needs Inventory

USDA Forest Service

Klamath National Forest

CRAPO CREEK WATERSHED

CONDITION AND IMPROVEMENT NEEDS INVENTORY

FINAL REPORT FOR INTERAGENCY AGREEMENT # 14-48-0001-93522

U.S.D.A FOREST SERVICE

KLAMATH NATIONAL FOREST

SALMON RIVER RANGER DISTRICT

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June, 1994

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ABSTRACT

Crapo Creek is major tributary of the main stem of the Salmon River. During the summer of 1993, a Watershed Condition and Improvement Needs Inventory was conducted in the Crapo Creek watershed. The inventory included stream stability rating, channel morphology classification, aquatic habitat survey and upslope watershed condition assessment. The objectives of the inventory were to identify streams and riparian areas, assess their conditions and the processes influencing these conditions, and prescribe restoration projects where appropriate.

The terrain in this watershed is typically steep and rugged. Crapo Creek and its tributaries are predominantly high gradient streams. Many of the channels are in inner gorges with extremely steep sideslopes immediately adjacent to water courses. Throughout the watershed there are outcrops of bedrock in the channel, but much of the hillslope material is unstable and prone to landsliding. Bedrock types consist mostly of metamorphic and granitic rock. The granitic rock in the upper two thirds of the watershed is deeply weathered and dissected, exhibiting a very high erosion potential. The metamorphic rock is predominant in the lower third of the watershed and has a considerably lower erosion hazard than the granitic areas.

The inventory revealed active channelbank erosion and sedimentation. Although riparian vegetation along much of main stem Crapo has good canopy closure, there are relatively barren reaches with poor riparian condition. These problems result primarily from natural processes associated with unstable geology, and secondarily from recent disturbances in the watershed. The channels are deeply incised into granitic parent material in the mid to upper part of the watershed. There are extensive glacial deposits in the upper watershed which are being eroded as the streams incise into landscape. This is evidenced by the cobble terraces lining the main stem as this material is transported through the stream system. Floods in 1955 and 1964 appear to have severely modified many of the channels. The bulk of the watershed was heavily burned in major forest fires in 1977 and 1987. Although the hillslopes have revegetated in brush and young conifers, the channels are only marginally stable. Only a third of the 96 miles of stream inventoried in the watershed was rated as good or excellent in terms of stability.

Granitic sands being transported through the Crapo stream system can have a negative impact on beneficial uses in Crapo and downstream. Residents at the mouth of Crapo Creek utilize surface water for domestic use. There is a population of resident rainbow trout in Crapo Creek. Both anadromous and resident fish species inhabit the mainstem of the Salmon River. These anadromous species include spring and fall-run chinook salmon, summer and winter-run steelhead, Coho salmon, and sea run Pacific lamprey. The fish habitat inventory of main Crapo Creek identified little potential for anadromous fish in the stream due to natural barriers near the mouth.

No major restoration work is proposed to improve channel or aquatic habitat conditions. Acceleration of the natural recovery rate was deemed to be cost-prohibitive except for a few specific locations. Several small restoration projects are identified to address some of the localized watershed problems caused mainly by man's activities. Potential projects are categorized by objective and prioritized, with initial cost estimates. An ecosystem assessment team would need to determine whether it is appropriate or cost-effective to accelerate the rate of vegetation succession on the hillslopes.

Descriptions for more than fifty stream reaches, along with photographs of inventory sites, are given in the appendix.

INTRODUCTION

Background

In 1986, the Klamath River Basin Fishery Resources Restoration Act, P.L. 99-552 (hereinafter referred to as "the Klamath Act"), became law. The Klamath Act established the Klamath River Basin Conservation Area Restoration Program, a twenty-year fishery restoration program in the Klamath River Basin. An advisory committee, the Klamath River Basin Fisheries Task Force, was established by the Klamath Act to provide guidance in planning and implementing the Restoration Program. The Task Force formulated a restoration program work plan for Fiscal Year 1993, consisting of projects recommended for funding by the U.S. Fish and Wildlife Service.

The Klamath National Forest proposed a Watershed Improvement Needs Inventory (WINI) to determine the condition of watersheds tributary to the mainstem except for the North and South Forks. Crapo Creek the second largest tributary of the mainstem Salmon River. It is a fifth order stream. Riparian conditions in the Crapo Creek watershed have a significant influence on the health of the mainstem Salmon River, and disturbance can adversely affect water quality and fish habitat for long distances downstream. All anadromous species use the mainstem as holding, spawning and rearing habitat.

Purpose

The primary objectives of this project were threefold: to identify streams and riparian areas, to describe their conditions and dominant processes, and to develop a prioritized list of restoration projects with estimated costs. The entire watershed was inventoried. The inventory includes stream stability ratings and channel classification, upslope watershed condition, and aquatic habitat type and condition.

Location and Description

The Crapo Creek watershed drains 10,980 acres which includes 3500 acres of the Marble Mountain Wilderness Area (Figures 1 and 2). Elevations range from 1040 feet at the confluence with the mainstem Salmon River to 6870 feet at Chimney Rock. The stream flows southwest from the headwater area which is within the wilderness area boundary, just above the 6000 foot level. Crapo Creek enters the mainstem 3-3/4 miles downstream from Forks of Salmon, where the North and South Forks come together to form the main stem. The watershed is bounded on the southwest by the divide between the mainstem Salmon River watershed and the Morehouse Creek watershed. This divide includes Sauerkraut Peak to the southwest and Chimney Rock on the northwest corner of the Crapo watershed. The north-northeast boundary is the divide separating the Crapo watershed from the headwaters of the Little North Fork of the Salmon River and Devils Canyon. The south-southeastern boundary is the Hog Range and Yellow Jacket Ridge. Figures 2 and 3 show the main streams and watershed divides. For the purpose of this study, the Crapo watershed was divided into eight assessment areas. The labeling system for these subwatersheds and the streams which drain them is described under Methods.

Klamath National Forest Vicinity

Figure 1

Crapo Watershed
Klamath National Forest

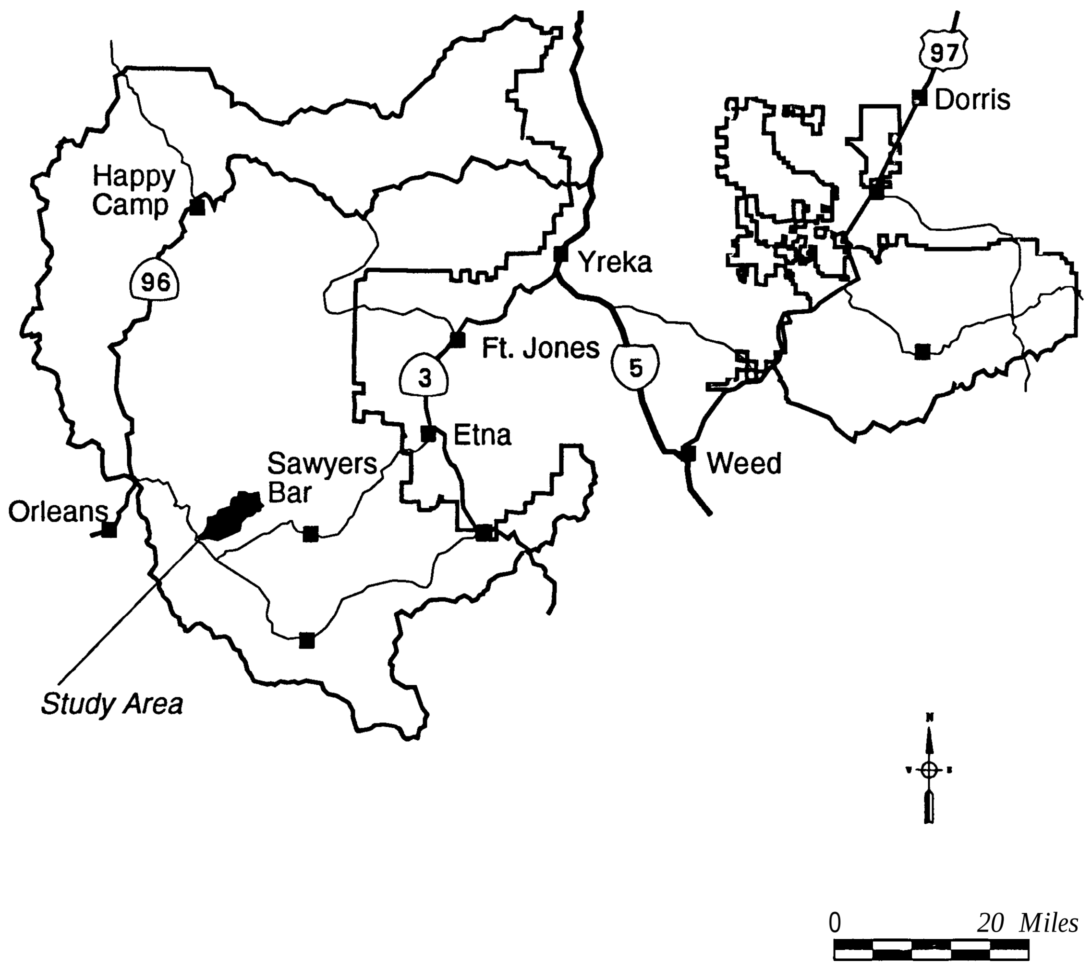

Figure 2

METHODS

The Crapo Watershed Condition study was comprised of two phases: 1) compiling existing information, and 2) gathering field data. The second phase had three parts. These were the **channel inventory**, **aquatic habitat inventory** and **watershed condition inventory**.

The aquatic habitat inventory was conducted on the mainstem of Crapo Creek from the wilderness boundary, downstream. Two attributes of this inventory, large wood and riparian condition, were also sampled for each tributary. The watershed crew concentrated its efforts on the tributaries. More frequent samples of certain attributes are taken in the main stem due to the need for higher resolution data in the higher value fish habitat.

An overall review was done of information on aerial photos, maps including fire atlas, timber stand record cards, timber sale contract folders, old and current transportation maps, and fish habitat surveys. Additional information was gathered from District specialists in hydrology, soils, wildlife and fisheries biology, archaeology and recreation, and from a geologist in the Supervisor's Office. In addition, interviews were conducted with members of the public who were knowledgeable about the history of the area. An informational letter was sent to individuals who reside on or own land in Crapo watershed, and to various interest groups and other agencies.

Channel Inventory

Stream class: This assessment of stream "significance" is based primarily on beneficial uses of the water, and influence on downstream flows. Beneficial uses include domestic and agricultural use, recreation and aesthetics, and aquatic habitat. The classification scheme, based on a Region 5 manual supplement (FSM 2536, Region 5 draft supplement), puts "Very Highly Significant" streams in Class I, followed by "Highly Significant" (II), "Moderately Significant" (III) and "Other" (IV) streams. For example, Class I is a domestic source with moderately to highly productive anadromous fish habitat, while Class IV has no beneficial uses and negligible influence on downstream flows.

Channel Stability: This numerical rating of stability follows a modified version of the protocol developed in Region 1 by Dale Pfankuch (USDA, 1978). Region 5 made slight modifications to accommodate different channel types. The rating system is the same, with "Excellent", "Good", "Fair", and "Poor" stability equating to weighted scores using over a dozen criteria. The rating was done for each stream reach. A reach is the length of stream that is relatively uniform in morphological characteristics. Stations were established at the endpoints of these reaches.

Channel Morphological Classification: This classification is based on Rosgen channel types (Rosgen, 1984). Rosgen uses the geometry of the channel and surrounding landform to classify channels. Criteria used in the classification are useful indicators of inherent sensitivity to changes in processes such as sediment delivery and runoff. These criteria include channel entrenchment, sinuosity and gradient, and dominant substrate particle size. This classification was done for each reach. For this purpose, the main stem was initially classified from aerial photos, and field verified. When describing channel type, a minimum reach length of approximately 30 times the bankfull width was used.
See Appendix B; reach summaries.

Flow Regime: Observations were made as to apparent perennial, intermittent and ephemeral flow limits of each channel, assuming a season with normal precipitation.

Watershed Condition Inventory

Upslope conditions: transects were made across each subwatershed and observations were made regarding land disturbance; fuel loading; springs, ponds and wetlands; wildlife observed, especially amphibians; and landslide presence, type and dimensions.

Watershed Improvement Needs: The needs inventory consists of locating sites which are not up to potential in terms of productivity, or which are a source of point or nonpoint source pollution. In addition to locating them on a map, the sites are numbered and entered into a Regional database. Each site has a standard "Watershed Condition Inventory for Soil and Water Improvement" form completed if there is a feasible correction. Included is an estimated project cost, for planning purposes only. For example, savings can be considerable if multiple projects are accomplished under a single contract. The timing and level of project implementation will depend upon funding availability.

Aquatic Habitat Inventory

% Slope: This is the average water slope in the channel. The reading may extend over several habitat units. Measured from water surface to water surface.

Bankfull Channel Width: The channel width occupied at bankfull discharge by water surface. This is the channel-forming discharge represented by a recurrence interval of approximately 1.5 years.

Sample #: This is the dive unit number. This is a unique number starting with "1" and continuing throughout the survey. The sample is derived by systematic occurrence (generally 1:4 or 1:5) after an initial random start.

Habitat Type:
The USFS Region 5 key is used to determine habitat type. Twenty-five habitat types are distinguishable.

Spawning Area: The number of square feet of actual spawning area in the habitat unit. Species and size of gravel will be dependant upon criteria set by the District biologist.

Mean Length : Mean habitat unit length measured along thalweg, recorded to nearest foot.

Max Depth : The maximum depth occurring within the habitat unit to the nearest tenth of a foot.

Riffle Crest Depth : This measurement is only taken at the tail of a pool where the surface flow beaks into the riffle. This measure is used to determine residual pool depth.

Instream Cover-Total % :
The percentage of the habitat unit that has overhead cover.

The Instream cover is broken down into its component parts: undercut banks, small woody debris, large woody debris, terrestrial vegetation, aquatic vegetation, white water, boulders, bedrock ledges. The sum of these 8 components must equal 100.

Cover Complexity :
Classified as low complexity, moderate complexity, or high complexity. In general, one cover component alone will rate Low complexity, two to three components will rate Moderate complexity, and more than three components will rate High. Examples of highly complex cover may include rootwads, logjams and willow rootwads associated with it.

Coarse Woody Material: For the main stem, a continuous record was made of all wood meeting the minimum size criteria (4"x39") by dimension class occurring within the lateral bankfull margin. All pieces of wood that have any portion (meeting minimum size criteria) within bankfull. Single or aggregate pieces (3 or more). On larger tributary channels, coarse woody debris frequency was estimated as number of pieces 24" diameter or greater; for smaller tributaries, number of pieces 12-24" was recorded. The reason for the difference in size class between the main stem and larger and smaller tributaries is due not only to the difference in ranges of stable size material, but also because the function varies. For example, aquatic habitat cover and complexity are of most interest, while in the tributaries the role of coarse wood for channel structure maintenance and sediment storage are emphasized.

Biological Observations (fish counts) : Some counts are performed as two-pass or replicates, but most are single pass

Index Reach Parameters

For the remaining attributes, index reaches were selected on a random basis from within the channel stratum (channel type and size) being described. A minimum of three index sections per channel stratum or approximately two per mile are selected as a sampling baseline. Other sampling schedules (ie systematic dive unit selection) are maintained through index section.

The Index Section length is determined from the average bankfull channel width within the stratum to be described. An average bankfull width of 23 feet would produce an index reach equaling 200 feet in length.

Given the calculation of Index Section length, the crew then estimates the location of each of 10 evenly-spaced transects perpendicular to the channel within the section. Canopy closure estimates will be made at each of the 10 transects. A minimum of 3 pebble counts are necessary. Counts are done within the habitat unit type the transect falls within. These transects are chosen systematically from the 10 canopy closure transects.

Substrate Composition: The size class across the intermediate axis of 100 pebbles within sample habitat units and bankfull elevation. Record the number of total occurrences by pebble size class as fines, gravel, cobble, boulder/bedrock.

Percent Bedrock: Ocular estimate of the surface area occupied by bedrock within bankfull channel within habitat unit described by accompanying pebble count.

% Substrate Embeddedness: Taken only in pool tail outs and in low gradient riffles. Estimate of the surface area covered by fines on ten samples of the substrate to determine the degree of embeddedness. A pool tail must be less than three' in depth.

Percent Shade (Canopy Closure): Percent shade estimated from canopy closure measurements using a spherical densiometer at each of 10 transects determined as described above.

Percent Evergreen: Estimate of the percentage of the riparian vegetation that is evergreen (conifer, live oak, pacific madrone, etc.). Observations were limited to the up and downstream unit boundaries extended 200 ft up each slope from the bankfull width. Estimated by crown cover, not the number of trees.

Percent Deciduous: Estimate of the percentage of the riparian vegetation that is deciduous (alder, maple, willow, black oak, etc.). Observations were limited to the up and downstream unit boundaries extended 200 ft from the bankfull width. Estimated by crown cover, not the number of trees.

Tributary Riparian Conditions: were observed up to 250 feet slope distance on both sides of the stream for these attributes:

Prominent overstory
Prominent understory
Percent canopy cover, total and by coniferous vs. deciduous vegetation

Fines: The number of grid intersects which correspond to substrate particle diameters less than 2 mm diameter in riffle habitat and pool tail outs from a total of 49 possible intersects. The number of "fines" intersects for each of 3 random frame tosses within the wetted habitat perimeter.

LWD Recruitment (#'s): The number of trees greater than 24" recruitable to the stream channel. Tree size is estimated using a clinometer.

Percent Exposed Substrate: The percentage of the habitat unit area that has substrate that is above the existing water level within the wetted perimeter.

Mean Width, Depth: Average values. Length and width are taken to the nearest foot. Average and max depth is taken to the nearest tenth.

Analysis Areas

The Crapo Creek Watershed was divided into eight subwatersheds (A through H) and each stream reach was identified using an alpha-numeric designation. Divisions were based on topographical similarities and boundaries, such as drainage divides. Each perennial tributary and its drainage area were labeled according to the following naming convention.

Watershed and Stream Labeling Convention

The alpha-numeric label given to each subwatershed and tributary stream and reach that drains it contains the following string:

Watershed label - subwatershed letter - stream number (or main stem) - tributary letter. This string can repeat several times, depending on amount of tributary branching.

Example: CRA-A-1-B-2-A where CRA = Crapo watershed, A = subwatershed A, 1 = stream A-1, B = B tributary of stream A-1, 2 = tributary 2 of stream A-1-B, A = A tributary of stream A-1-B-2.

Watershed is Crapo Creek throughout this report.

Subwatershed is defined by tributary divides within the watershed, and usually contains only one third order or larger stream. The stream carries the same label as the subwatershed it drains.

Stream number is used to designate each stream within a subwatershed area. Numbering begins at downstream end of watershed and moves in a clockwise direction.

Tributary letter indicates smaller tributaries with alphabetical order beginning at the confluence of the tributary with the main watershed, and proceeding upstream or in a clockwise manner.

Station numbers were established along the main stem beginning at the mouth and increasing in an upstream direction. A station was established every one quarter mile or where significant change in conditions was noted. The length of channel between stations is considered a reach.

RESULTS

The following sections cover beneficial uses of Crapo Creek, and existing watershed, riparian, and channel conditions. Several subsections cover important elements and processes which set the stage for the recommendations presented later.

Beneficial Uses

Fisheries - The Crapo Creek watershed flows into the Salmon River which is a Class I, highly significant, anadromous fish stream. Downstream from the confluence with Crapo Creek, the river provides significant habitat for spring and fall-run chinook, coho salmon and fall/winter- and summer-run steelhead. The Salmon River is also designated as a Wild and Scenic River. Crapo Creek itself is a Class II stream which provides approximately six miles of resident trout habitat. Previous studies have found only limited habitat in the lower one-quarter of Crapo Creek for steelhead and salmon. This is mostly due to natural barriers near the confluence with the Salmon River. The influence of Crapo Creek on the Salmon River anadromous habitat is the main fisheries concern in this watershed. Specific concerns are the effects of granitic sands on pool habitat volume and substrate composition. Although Crapo water temperatures are significantly cooler than that of the river, any loss of riparian canopy can reduce the effectiveness of this tributary to cool the mainstem.

Wildlife - Due to the fires of 1977 and 1987 the seral stage of most of the wildlife habitat has been reduced to pioneer and early stage (grass, brush and seedlings) vegetation among snags and dead and down logs. However, diverse populations of wildlife co-exist in the watershed. Sightings of raptors, fur bearers, mountain lions, and bear have been recorded and numerous sightings and evidence were noted during the inventory. The watershed has become significant wintering range for deer as well as a migration route for a small elk population which was introduced to the Upper South Fork of the Salmon River in 1990.

Domestic water use - There are six residences near the mouth of Crapo Creek which utilize surface water for household use.

Watershed Conditions

Geology/Geomorphology

The English Peak Batholith occupies the bulk of the Crapo watershed. It is comprised of granitic rock, primarily granodiorite. Metamorphic rock occurs in the southwest portion of the watershed and constitutes less than one-third of the total area. This includes metasedimentary and metavolcanic rocks. The contact between the granitic and metamorphic rock trends in a northwesterly direction. See Figure 3.

The primary slope-forming processes in the granitic terrain consist of shallow debris slides along with a variety of surface erosion processes. Weathered granitic parent material is highly erodible. The predominance of debris sliding results from the deep channel dissection which characterizes this terrain. Past debris slides formed the steep swales at the heads of most small ephemeral channels, and also produced the steep inner gorges on the main tributaries to Crapo Creek.

In the metamorphic terrain the steep, shallow bedrock areas are relatively stable, while the deep-seated dormant landslides are prone to being reactivated. Some of the large helicopter landings are located on large dormant landslides. A good example is the landing at the end of road 11N21D.

Small active slumps are present below and on two sides of the landing.

Crapo Creek is fed by deeply incised tributaries which enter at right angles. The headwaters and side slopes of these tributaries are dissected by numerous steep swales and stream channels. Although the mainstem gradient is relatively flat (3 to 11%), the gradients of these tributaries exceed 35%. Appendix B gives details by reach.

Crapo Watershed

Geomorphic Terrane Types

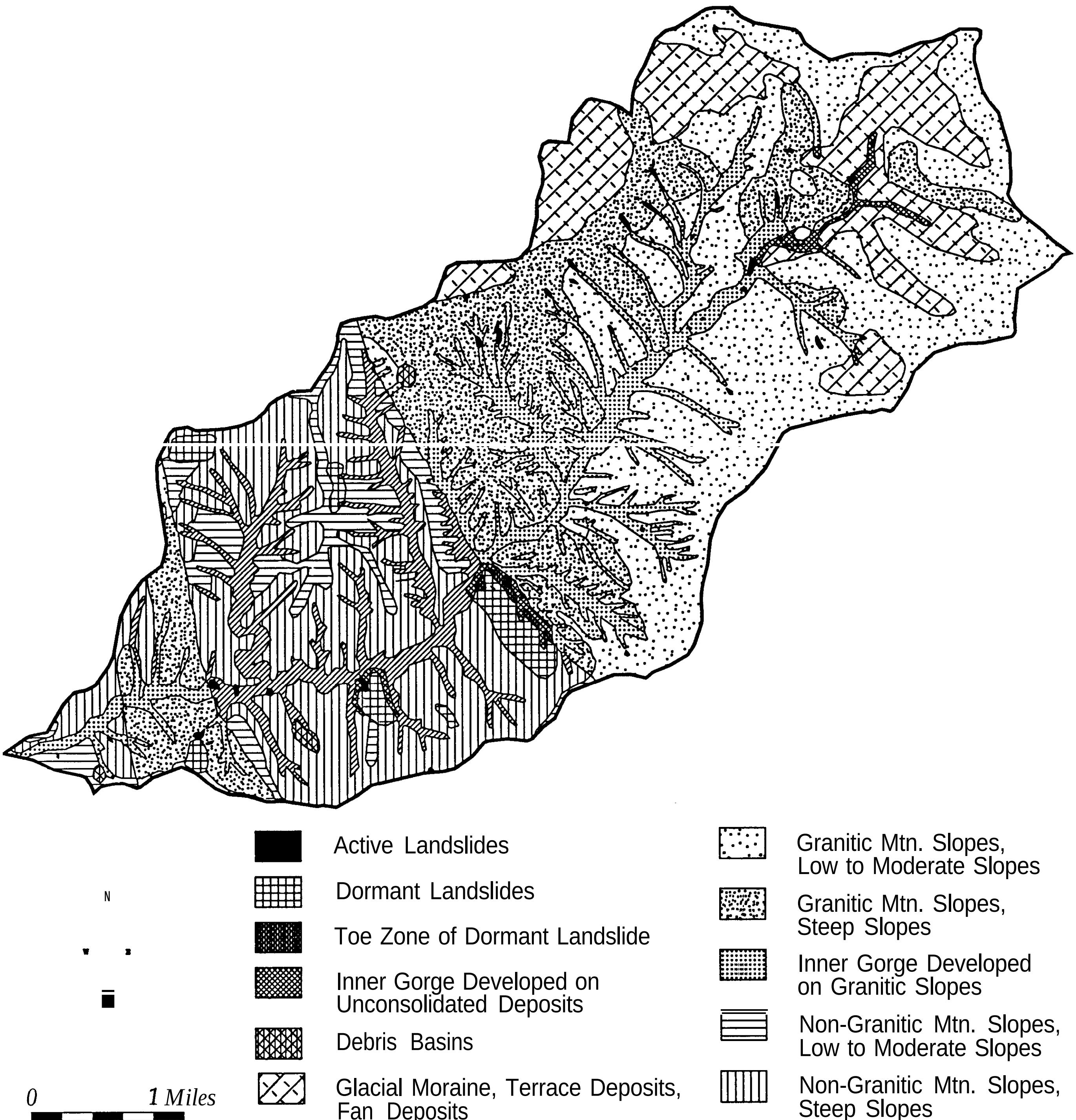

Figure 3

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The majority of the hillslopes are steep, in excess of 50% slope gradient. Upper streambank slopes exceed 65% in many reaches. These steep slopes are immediately adjacent to stream channels, and are classified as inner gorge. Inner gorge is one of the least stable geomorphic terranes in the Klamath Mountains. Gentle terrain limited to the crest of Yellow Jacket Ridge, Crapo Meadows, the divide between Morehouse and Crapo watersheds, Box Camp basin, dormant landslide benches, and stream terraces along Crapo Creek. Most of this flatter terrane is comprised of extensive glacial deposits, which dominate the headwaters. These deposits are being eroded by fluvial action, as the surrounding mountains are uplifted. The transport of this material dominates the channel-forming processes of Crapo Creek.

The resultant stream terraces are as thick as 50 feet along much of the middle reach of main Crapo. In addition to these alluvial terraces, smaller alluvial fan and debris flow deposits exist at the mouths of tributaries. These angular deposits are up to 15 or 20 feet thick, and are often perched on top of the alluvium. These features indicate active ravel in the recent geologic past, suggesting watershed disturbance cycles such as drought, wildfire, intense rain and landsliding.

Channel morphology is further discussed under Stream Channel Morphology and Stability.

Soils

The soils in the Crapo watershed area have been mapped and described in the Order 3 Soil Resource Inventory of the Klamath National Forest (U.S.D.A., 1983). See Appendix E for a list and location of soil mapping units. The soils are moderately deep to deep (24 to 60 inches deep) sandy loams with shallow (less than 20 inches deep) soils associated with ridge tops and rock outcrops. These soils have been mapped at an Order 3 Soil Survey intensity. The soil associations are Pilliken Variant and Nisqually Taxajunct with inclusions of Chaqanakee, Spana and Bonneville Taxajunct series. They vary from Entic to Pachic Xerumbrepts with very gravelly sandy loam textures. Soil productivity is moderately high to moderate (Forest Survey Site Class 3 to 4). Conifer regeneration potential is mostly moderate, with 51 to 70 percent seedling survival. Erosion hazard ratings are very high for bare soil (FSM R5-2500-14, Issued 4/76; Alexander 1981; and Swearingen 1988). See Appendix E for a brief description of the above-mentioned soil associations.

Climate

The current climate of the Crapo Creek watershed is seasonal, with about eighty-five percent of precipitation occurring between November and March. There is no precipitation data specific to Crapo Creek, however, records for the area indicate that annual precipitation ranges from 40 to 70 inches depending upon elevation (Rantz, 1967). The nearest records are for Orleans to the west, with an average of 50 inches, and Sawyers Bar to the east, with an average of 38 inches per year. Figure 17 gives nearby monthly rainfall amounts for a 4 1/2 year period, from 1989-1993.

Snow accumulation can exceed twenty feet in the upland areas and be limited to one or two feet in the lower basin, mainly accumulating above 4,500 feet elevation. Below this elevation, precipitation falls largely as rain. Snowpacks in higher elevations and protected areas were observed as late as June in 1993, a year with slightly above-normal snowpack for the Klamath basin. The majority of precipitation comes from cyclonic storms, however summer thunderstorms can occur with frequency and can be severe enough to trigger debris torrents. These events can cause long term damage to riparian resources and create high suspended sediment load and bedload.

De la Fuente and Baldwin (1986) looked at precipitation records in northwestern California for the past century. They found that there have been alternating wet and dry conditions, each lasting a few decades. 1870 to 1910 was a relatively wet period, 1911-1937 a dry one, 1938-1975 wet, and 1976 to present, dry.

Hydrography and Streamflow

Since a good portion of the watershed is above 4500 feet elevation, snowmelt plays a significant role in stream hydrology. This is evident in the discharge records for 1989-1993, even though snowpacks were below normal most of those years. See Figure 18.

The Crapo stream network is 96 miles long, not including ditchlines. The primary tributaries of Crapo Creek are located within the wilderness area and are fed by a complex system of springs and meadows. The most dominant system is CRA-D-8-A through L, which has the Crapo Meadow complex as its headwater source. The remaining dominant tributaries include CRA-E-6,7,8,9,11, and 13. Sixty-four miles of additional streams were added to the existing database (thirty-two miles) as a result of this inventory. This length includes intermittent as well as perennial streams. A geographic information system first generated a stream map from the topography. These stream locations were then ground-truthed. See Figure 4 to compare the inventory streams with the original U.S.G.S. data. Streamflow regime is best depicted on an overlay (Appendix F) at the Salmon River District Office. Figure 7a distinguishes between perennial and intermittent streams.

There are no prominent lakes in the Crapo watershed. Bodies of standing water are limited to small ponds in the headwater meadow areas. The largest of these is located in the headwaters of the Box Camp basin, in subwatershed CRA-E-7-J. This particular pond and associated wetland area exhibits the characteristics of a onetime substantial lake which has been silted in.

Streamflow data is very limited for Crapo Creek itself. U.S. Geological Survey data indicate that the average annual discharge for the Salmon River at Somes Bar is 1,285 thousand acre feet. Based on drainage area alone, Crapo Creek's portion of this yield would be approximately 30 thousand acre feet. During the previous five seasons, water years 1989 to 1993, winter streamflow was measured near the mouth of Crapo Creek as part of a water monitoring project. The highest measured peak flow during this relatively dry period was 664 cubic feet per second on January 8, 1990.

According to U.S.G.S. records, exceptionally high flows occurred throughout northwestern California during the winters of 1952-53, 1955-56, 1964-66, 1969-70, 1971-72, and 1973-74. Historic accounts describe floods in 1861-62 and 1889-90 (de la Fuente and Haessig). For the Salmon River at Somes, the record peak was 133,000 cfs on December 22, 1964. If prorated to Crapo Creek, this extreme event would have been an estimated 3000 cfs. In contrast, lowest flow during the monitoring period for Crapo Creek was 1.5 cfs in October, 1991.

Vegetation

The Crapo watershed supports diverse riparian communities, with its broad range in elevations and channel types. The majority of the watershed, including much of the riparian zone, was burned with varying intensities during the 1977 Hog Fire and the 1987 Yellow Fire. However, the lower main stem has good riparian conditions, with a broad mix of species of different age classes and sizes. The canopy closure equals or exceeds ninety percent along much of this reach, which was unaffected by the fires.

The fires resulted in a mixture of intermingled vegetative conditions ranging from no live riparian or upslope vegetation, with fire killed conifers, to areas of healthy riparian vegetation and live conifers. The fire-killed conifer stands also consist of an understory of crown-scorched chinquapin, madrone, and live oak.

A good portion of the burned over areas were reforested following the 1977 fire and again following the 1987 fire. In 1988 a riparian willow planting project was completed in the mid-reach area of the mainstem of Crapo Creek, between station #2 and #5, and along several tributaries.

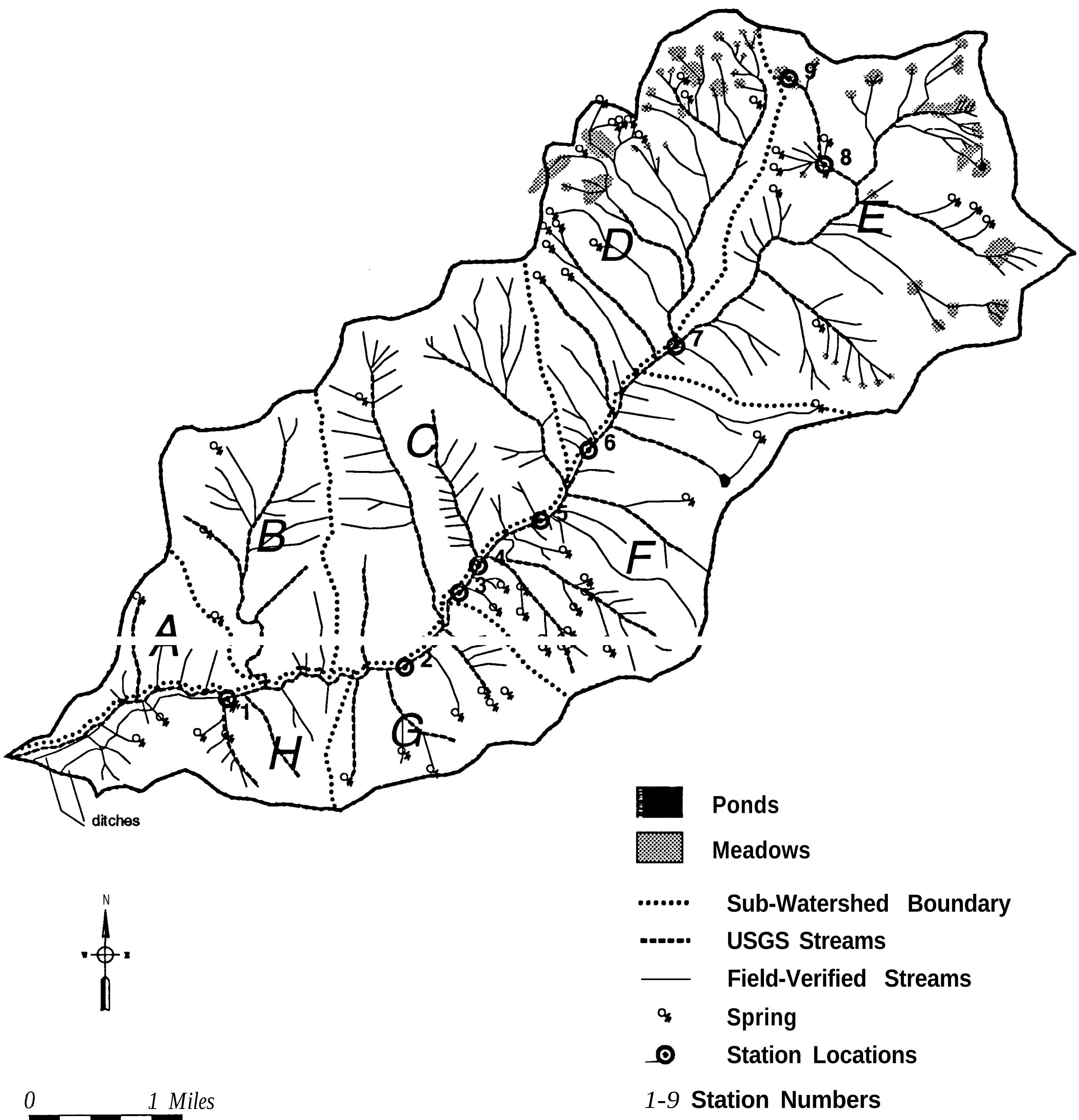
See Figure 5.

A monitoring station was established near the lower landing to monitor the recovery of the riparian community between 1988 and 1992. An unplanted control station was established in Kanaka Gulch, on the other side of Yellow Jacket Ridge. The amount of unshaded sky above a fixed point was measured, and species composition was recorded once a year for four years. The recovery trend at both sites was positive until 1991, when canopy was reduced from apparent grazing of both riparian areas. Observations made during this inventory (1993) indicate that vegetation at the Crapo site was only set back temporarily. The riparian vegetation along this particular tributary is essentially impenetrable by cattle.

The unburned areas exhibit healthy stands of mixed conifer and deciduous trees. The unburned riparian areas additionally support various species of grasses, forbs, willows, and snow brush. The conifer component ranges from white and Douglas fir to ponderosa and sugar pine, and incense cedar. Madrone, alder, big leaf maple, dogwood, live oak, chinquapin, white and black oak comprise the majority of deciduous trees. The madrone and oak, mixed with brush, make up the majority of vegetation found below the 4000 foot level. The evergreen components occupy the majority of the areas above 4000 ft. in elevation. See Figure 6 for a map showing vegetation types inventoried in 1976, with plantation updates.

Crapo Watershed

Hydrography



Ponds

Meadows

Sub-Watershed Boundary

USGS Streams

Field-Verified Streams

Spring

Station Locations

1-9 Station Numbers

Figure 4

January 13.1994

Crapo Watershed

1988 Riparian Planting

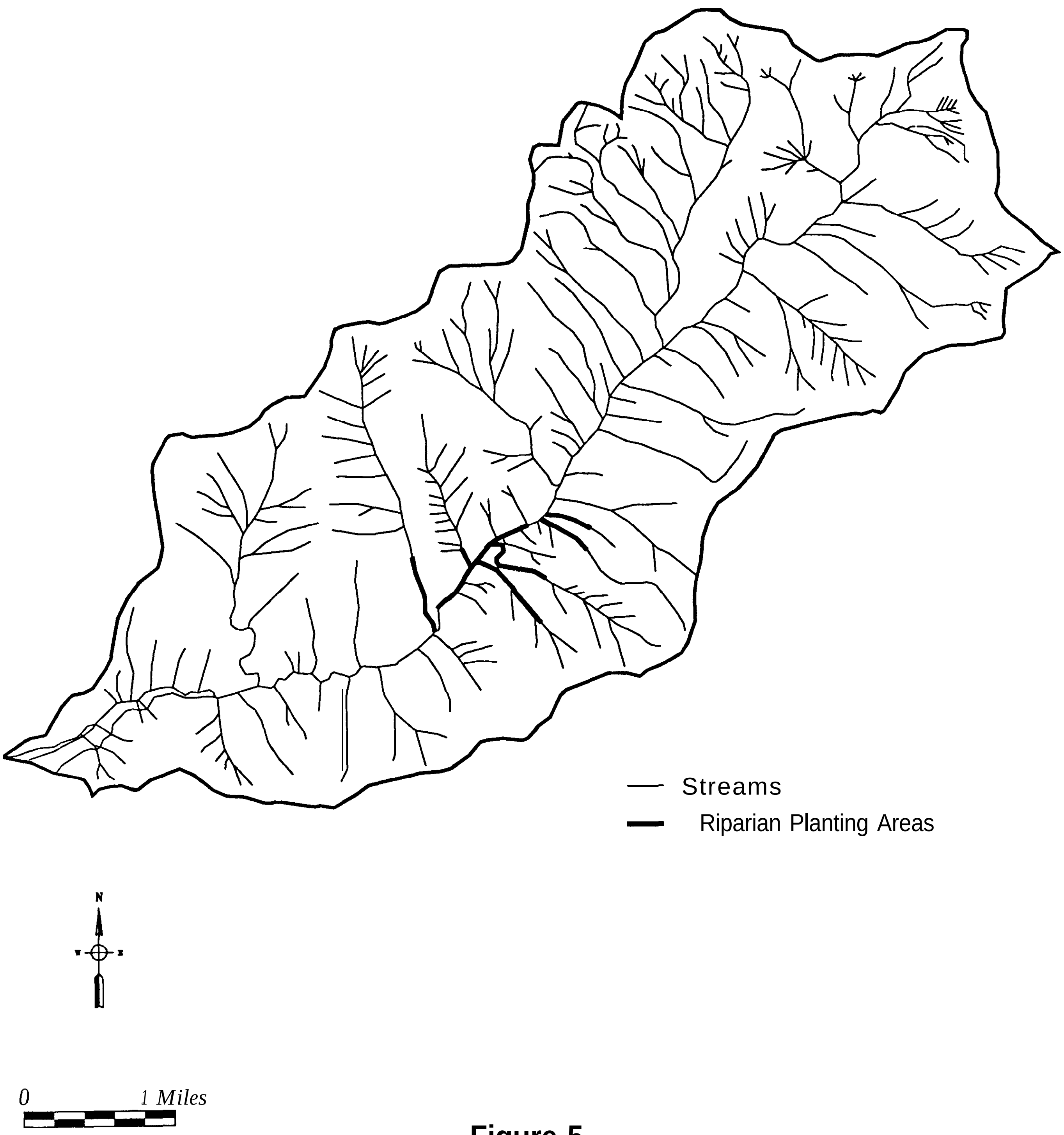


Figure 5

January 13, 1994

Past and Present Watershed Disturbance

Fire

Evidence of catastrophic fire in this century during the decades prior to 1977 is minimal in the Crapo watershed. However, frequency of smaller fires in similar parts of the Klamath Mountains has been demonstrated to occur as frequently as every ten to twenty-five years (Carl Skinner, personal communication). With the exception of an occasional small lightning fire, the only major fire activity was in the Sauerkraut Peak area between 1911 and 1920. In 1977 the lower two-thirds of the watershed was burned in the Hog Fire with mostly medium and high intensities. In 1987, the entire Crapo watershed, with the exception of the extreme south end, was burned over by the 1987 Yellow Fire.

The fire, which occurred during a dry lightning storm, burned with high intensities in the majority of the middle reaches of the watershed. As a result, the lack of stabilizing surface vegetation led to increased surface erosion and sediment delivery to the channel system. There are also many areas still remaining which exhibit hydrophobic soils up to 2" thick.Low and medium intensities occurred in the upper reaches and headwaters of the watershed which also included the Marble Mountain Wilderness area. The 1987 fire largely reburned the portion of the watershed which burned in the Hog Fire. Exceptions to this include subbasins A, G and H, and portions of plantations on Yellow Jacket Ridge. See Figures 7a through 7d for the extent and intensity of the various fires.

Cultural History, Resource Development and Current Use

The earliest known people to inhabit the area around the Crapo watershed were the Konomihu. Later, the Karok people used this territory. Both tribes used certain parts of the landscape depending on the season. They inhabited the river corridor and mouths of tributaries when the salmon were running, and for winter village sites. In late summer they moved to oak stands to collect acorns and other nuts. They hunted deer for winter stores, using fire on the north slopes to drive the deer into snares. There have been several prehistoric sites located and recorded in the Crapo Watershed. The records are maintained at the Salmon River District office.

The first European-Americans to explore the area that is now the Klamath National Forest arrived in the 1820's. They were members of the Hudson Bay Company and were explorers and trappers. The gold rush of the 1850's stimulated more interest in the area. The area experienced some early extensive mining in and around the mouth of Crapo Creek. The only sustained mining activity which is still current today is at the Evergreen Mine near Sauerkraut Peak. The mining has been mostly hard rock type and there is no evidence of hydraulic mining within the watershed. The mining that has occurred is limited to the lower reach area.

Crapo Watershed

Vegetation Types

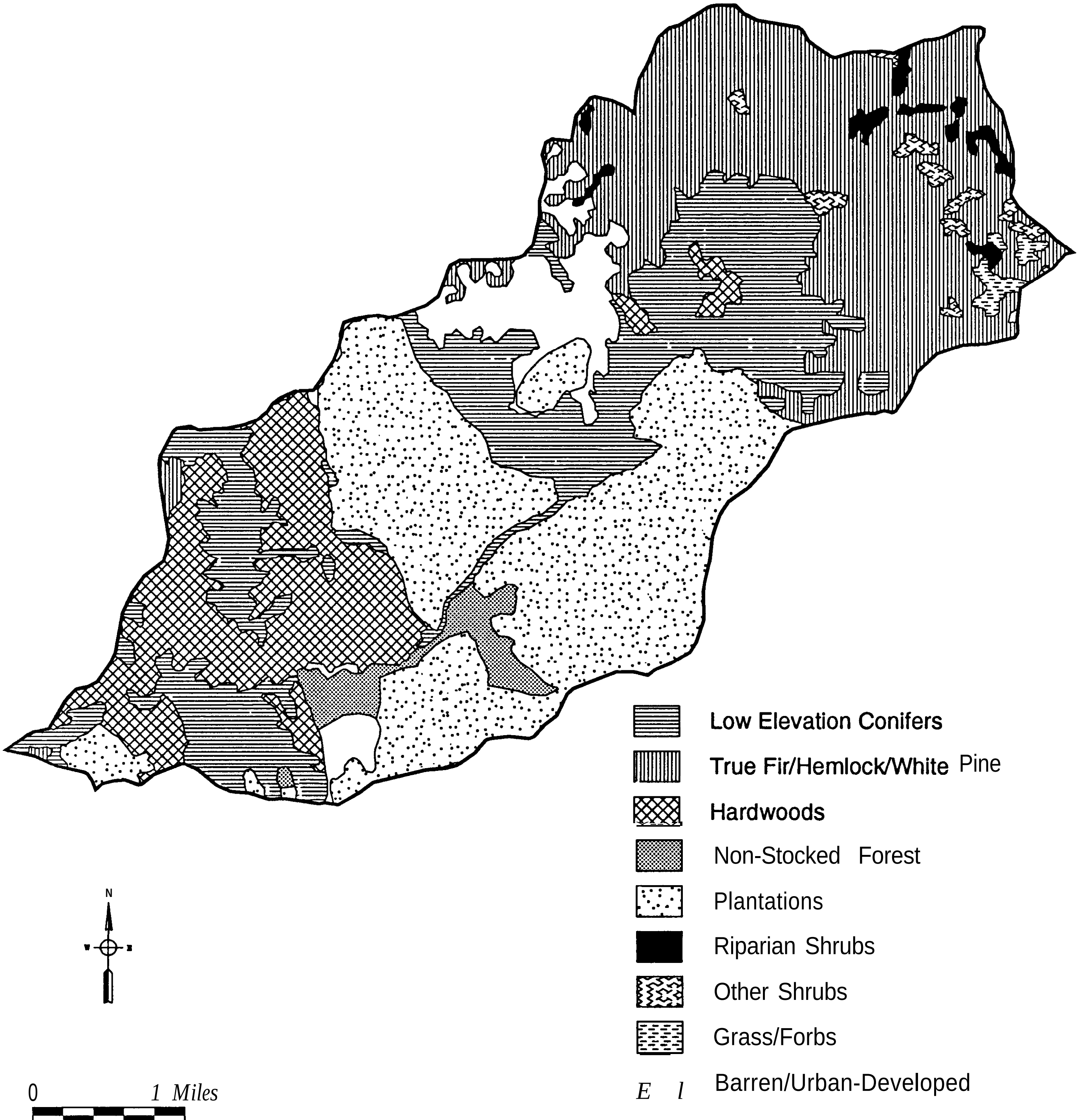


Figure 6

January 13, 1994

Crapo Watershed

Fire History

1911-1976

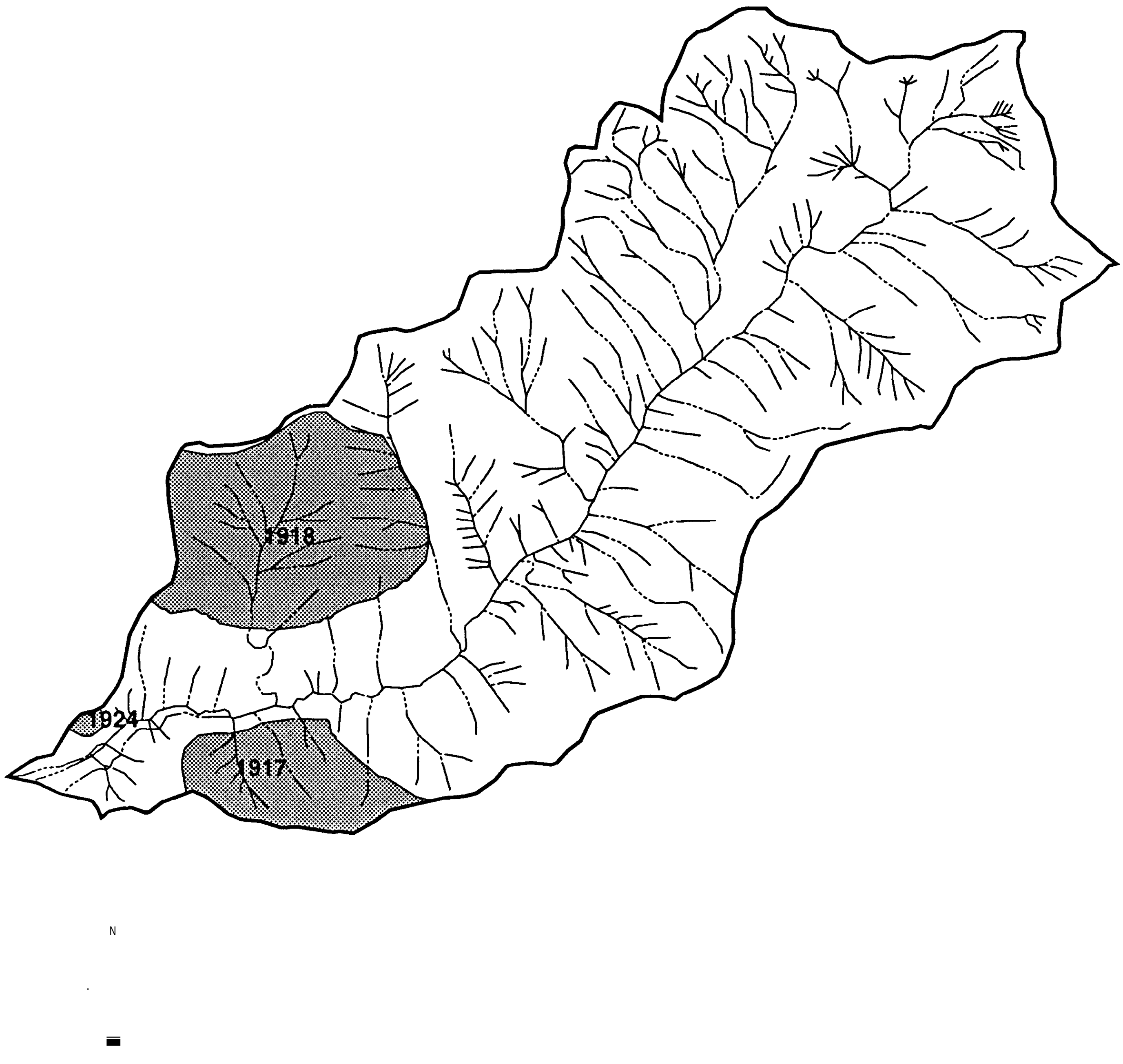


Figure 7a

January 13, 1994

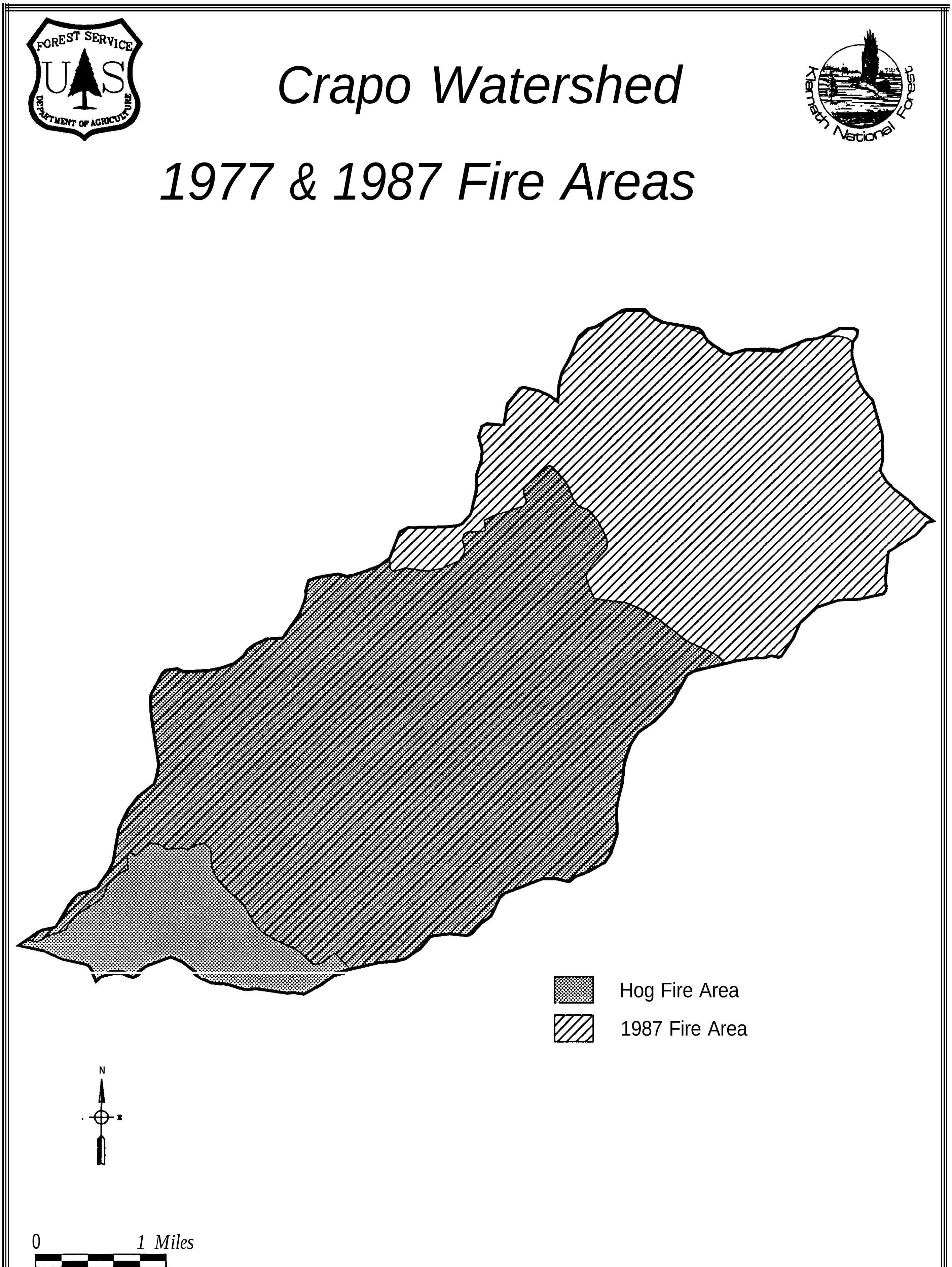

Crapo Watershed
1977 & 1987 Fire Areas
Hog Fire Area
1987 Fire Area
N
0
1 Miles
January 13, 1994

Figure 7b

Crapo Watershed

Hog (1977) Fire Intensity

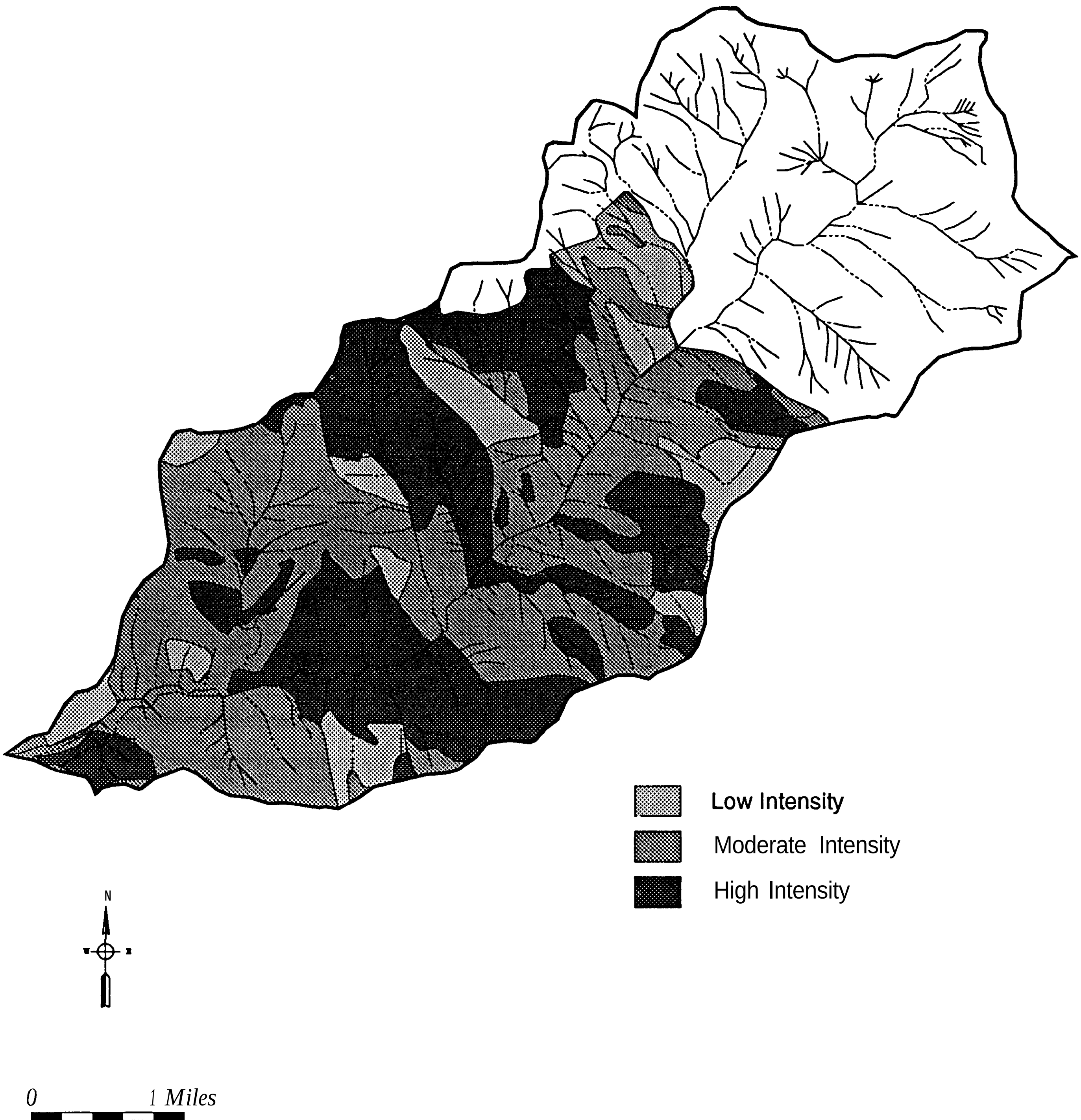


Figure 7c

January 13, 1994

Crapo Watershed

Yellow (1987) Fire Intensity

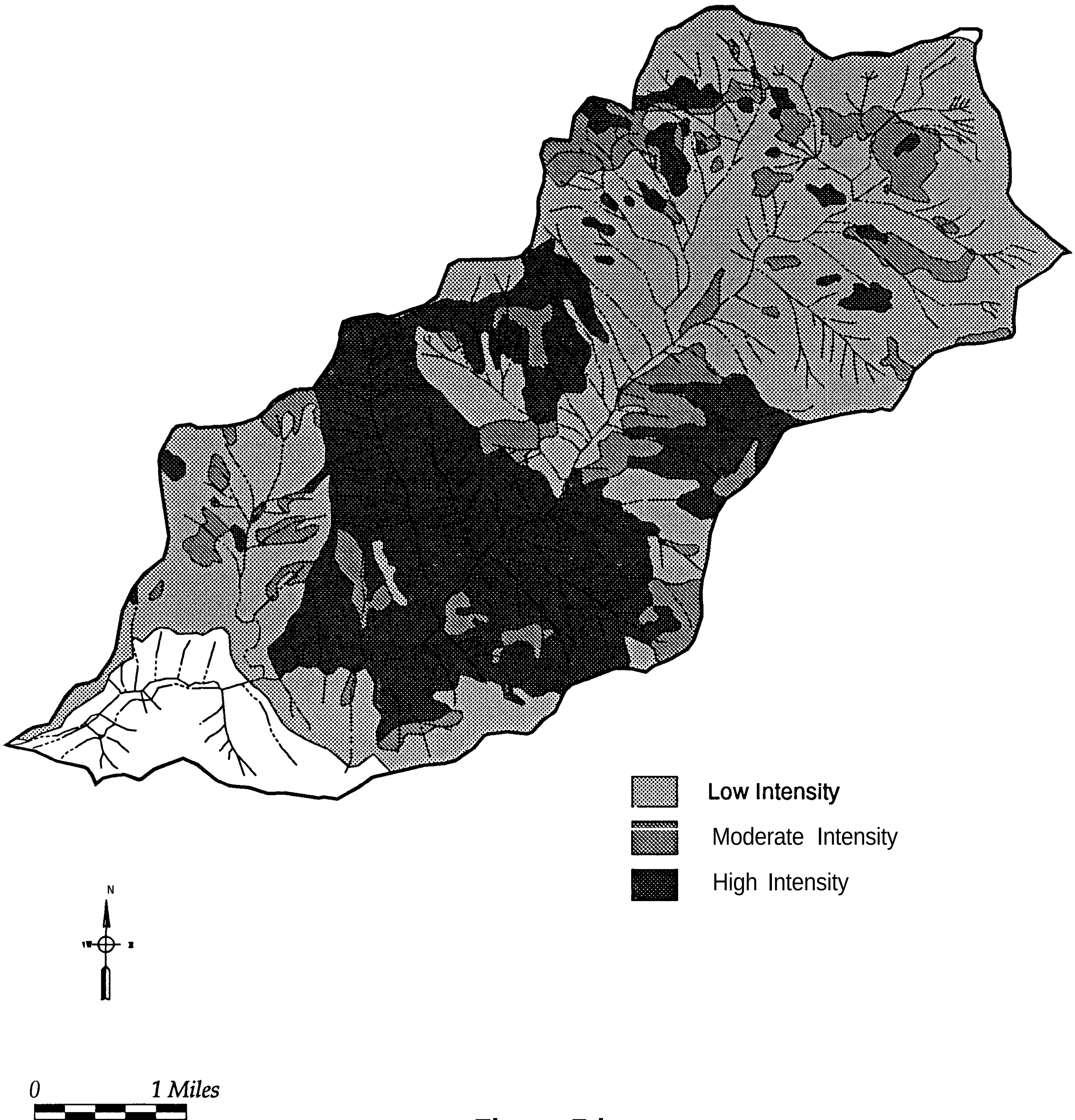


Figure 7d

January 13, 1994

There is an old diversion ditch in the lower reach which carried water to a hydraulic mining operation in the Quail Gulch area. There is also a dam and water diversion in the lower reach approximately one mile upstream from the confluence with the Salmon River. This diversion dam is used for domestic water supply near the mouth of Crapo Creek.

The transportation system in the Crapo watershed is very limited, with an average road density of 0.04 acres of road per acre of watershed. Prior to the 1940s, access was by foot and stock only. The only major road system today is the Yellow Jacket Ridge transportation system (11N21) which was constructed after the 1977 fire for access to fire salvage operations. There are several small spurs off the main system. Spur 11N21D offers the only access near the main stem of Crapo Creek and terminates in a large log landing referred to as "lower landing". The only other road into the watershed is the mining access road into Evergreen Mine which was constructed in the early 1940's as access to the mine. This road originates at the mouth of Crapo Creek and follows the old Crapo Trail route up to the Evergreen Mine located just under Sauerkraut Peak. In 1978 and 1979 the road was reconstructed and widened to accommodate larger size trucks to haul mining ore. This road is currently closed except for access to the Evergreen Mine. See Figure 8 for location of roads and trails.

The Crapo watershed has received very little impact from recreation. Recreation is limited mainly by access. Most of the utilization in the area is associated with hunting along Yellow Jacket Ridge and entry by backpackers or pack strings into the Marble Mountain Wilderness area. There are several trail systems into the Crapo Watershed. The Crapo Trail enters the watershed at the mouth of Crapo Creek and is the Evergreen Mine road for the first two miles after which it climbs to the ridge. The trail continues along the northern watershed divide, into the Marble Mountain Wilderness. Garden Gulch Trail is the main trail entering the watershed from the east. It originates just below Mud Lake. This trail connects to Box Camp and continues to Chimney Rock A secondary trail enters the watershed from the Yellow Jacket Ridge road and contours in a northerly direction to intersect with the Garden Gulch Trail. One other trail contours midslope across the watershed from Box Camp to an intersection with the Crapo Trail approximately one mile southwest of Chimney Rock. This trail is used primarily by the grazing allotment permitees.

Cattle grazing in the Crapo watershed began in 1901. The range was utilized by several families, including Ahlgren, Jenner, McBroom, and McBride, with herds as large as 200 head. Until the U.S. Forest Service instituted the allotment system in about 1910 there was considerable confusion about range use and distribution, with each stockman driving cattle where and when he pleased to the various meadows.

The entire watershed is part of a much larger grazing allotment for cattle. The grazing permit allows for up to 200 head of stock from mid July to October. The current allotment has been held by the Hayden family since 1935.

The cattle are usually brought in from the Little North Fork watershed to the headwaters of the Crapo watershed. The cattle usually work their way down through the meadow systems and mainstem as low as mid-reach and the lower landing area. Localized impacts of grazing in the meadows and along the riparian corridors were observed in the form of trailing and reduced vegetation. With heavy, wet winters these grazed areas seem to recover each year. Experts on range condition assessed several areas in the middle of the 1993 grazing season, and found that range conditions were good, at least in the lower meadows. Indicators included lack of invader species, and presence of species vulnerable to cattle grazing. However, the upper dry meadows along the divide appear to be very fragile, and lacking adequate ground cover. The cause of cover reduction is unknown, but may be due to cattle, horse, or human traffic, since it is adjacent to trails. There was no sign of grazing for any extended period. Riparian plantings, shown in Figure 5, were in healthy condition, indicating that use of these willows by cattle in the past one or two years has been greatly reduced.

From 1978 to 1990 there was extensive timber management activity in the south and southeast areas of the watershed for the salvage and reforestation of fire-damaged areas. The Hog Fire burned the south and southeast portion of the watershed, predominately the Yellow Jacket Ridge area, and except for a few small stands the entire area outside of wilderness was salvage logged. This was accomplished by helicopter logging from 1978 through 1981. Site preparation burning and reforestation planting was accomplished throughout most of the area. Planting of units began in 1978 and continued through 1981. Herbicide spraying for release was done in 1982 and 1983. Reforestation evaluations done in 1984 indicated good survival and growth. The Yellow Fire of 1987 reburned the entire area and consumed most of the new plantations. A very limited reforested area survived the 1987 fire. Mature trees that were left from the Hog Fire of 1977, but damaged in 1987, were logged by helicopter. Most of the timber management activity has taken place along the Yellow Jacket Ridge side of the watershed. This salvage logging necessitated the Yellow Jacket road system (11N21) which includes several spurs and large size landing areas. These landings, several of which are located on landslide terrane, were the most significant management-caused disturbance identified in the watershed.

Finally, some of the firelines made in the suppression of the 1987 fire have not completely healed and have resulted in some additional erosive areas. This is primarily limited to the Crapo Meadows and Box Camp areas in the upper reaches of the watershed.

Crapo Watershed

Roads, Trails & Plantations

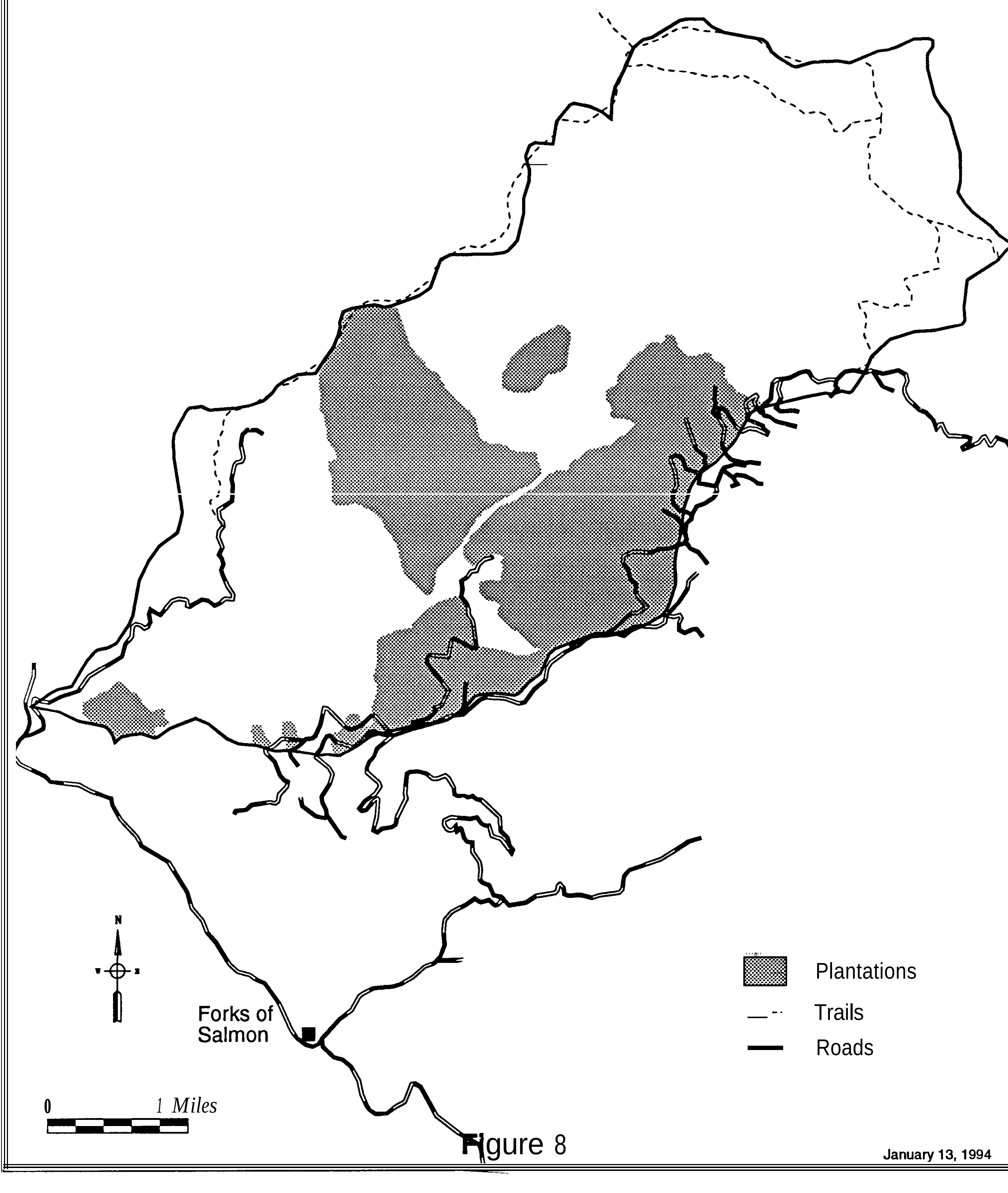


Figure 8

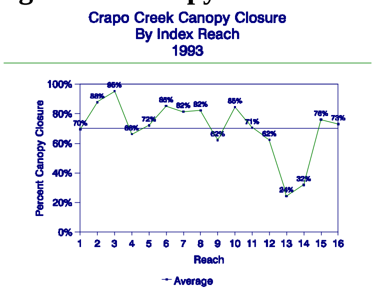
Channel and Riparian Conditions

Completion of field inventories revealed the following conditions regarding vegetative shading, channel stability and morphology, water quality, large woody debris and fish habitat:

Vegetative Shading

The aquatic inventory measured canopy closure within 16 randomly selected index reaches (see Methods) along mainstem Crapo Creek from the confluence with the Salmon River to the wilderness boundary. Figure 9 displays the canopy closure data. Canopy closure averaged 70% for this entire survey area. However, two indexes (#13 and #14) located between stations 3 and 5 had canopy closures of less than 40%. Figure 4 shows the locations of stations. Water temperatures probably do not increase dramatically over this reach (See the discussion under the water quality section of this report). The average canopy closure below station 3 nears 80%.

Figure 9: Canopy Closure



The overall watershed condition inventory revealed the following vegetative shading conditions. The lower one-third of the watershed, from the confluence with the River to station 3, is mostly vegetatively lush. It exhibits 70% or greater canopy closure on the mainstem and associated tributaries.

The middle one-third of the watershed, from stations 3 to 6, was totally denuded by the fires of 1977 and 1987. The tributaries and upslope areas are virtually choked with brush and underlying grass and forbs. There is currently little or no large tree over-story in these upslope areas. The canopy closure along this reach of the mainstem is also minimal, being as low as 24%. See Figure 9 index reach 13 and 14. This portion of the mainstem is one of the areas that was burned by both of these fires. Almost the entire overstory was consumed. This reach of the mainstem also has very sparse vegetative cover on the lower and upper banks. The channel itself has undergone extensive erosion, a process initiated by the 1964 flood. See Channel Stability and Morphology discussion.

The upper one-third of the watershed, above the wilderness boundary and off the above chart (station 6 to headwaters), is a contrast to the middle reach. It has healthy stands of conifers, well vegetated riparian areas, and meadow complexes. There was underburn throughout most of this upper area with patchy areas of hot canopy burns. A good portion of the northwest side of the watershed above the wilderness boundary also underwent a hot burn, which has resulted in large stands of charred snags with new vegetation beginning to appear. A good portion of this area also has good lower and upper streambank cover. This upper reach was burned in 1987, but at a low intensity, resulting in an underburn with very little crown fire, especially along the mainstem riparian corridor.

For the most part them mainstem tributaries exhibit the same profiles as the main stem, with streams in the middle portion of the watershed burned over, and the lower and upper third of the watershed having tributaries that are well shaded.

Stream Channel Morphology and Stability

The upper half of the Crapo watershed is in a granitic soil type. Where this soil type is associated with steep gradients, in excess of 55% in the side tributaries, channels are typically unstable with numerous landslides and slumps. See Figure 10. This upper half contributes large amounts of granitic sands downstream through the system. This appears to be a part of the natural landforming process for this area which has been occurring since ancient time. The transport of glacial deposit from the headwaters, occurring since at least the end of the last ice age, has contributed to the extensive sand and cobble deposits between stations 2 and 7. The more recent natural events, floods of 1955 and 1964 and the fires of 1977 and 1987, may have accelerated both channel and surface erosion. The lower half of the watershed is primarily metamorphic in soil type and does not exhibit the acute erosion that is evident in the upper half of the watershed. There is much evidence of granitic sands having been transported, past and present, through the system. The mainstem Salmon River pools contain granitic sand and there are many areas in the riparian corridor which have large sandy deposits, granitic cobbles and boulders deposited on top of the metamorphic soil.

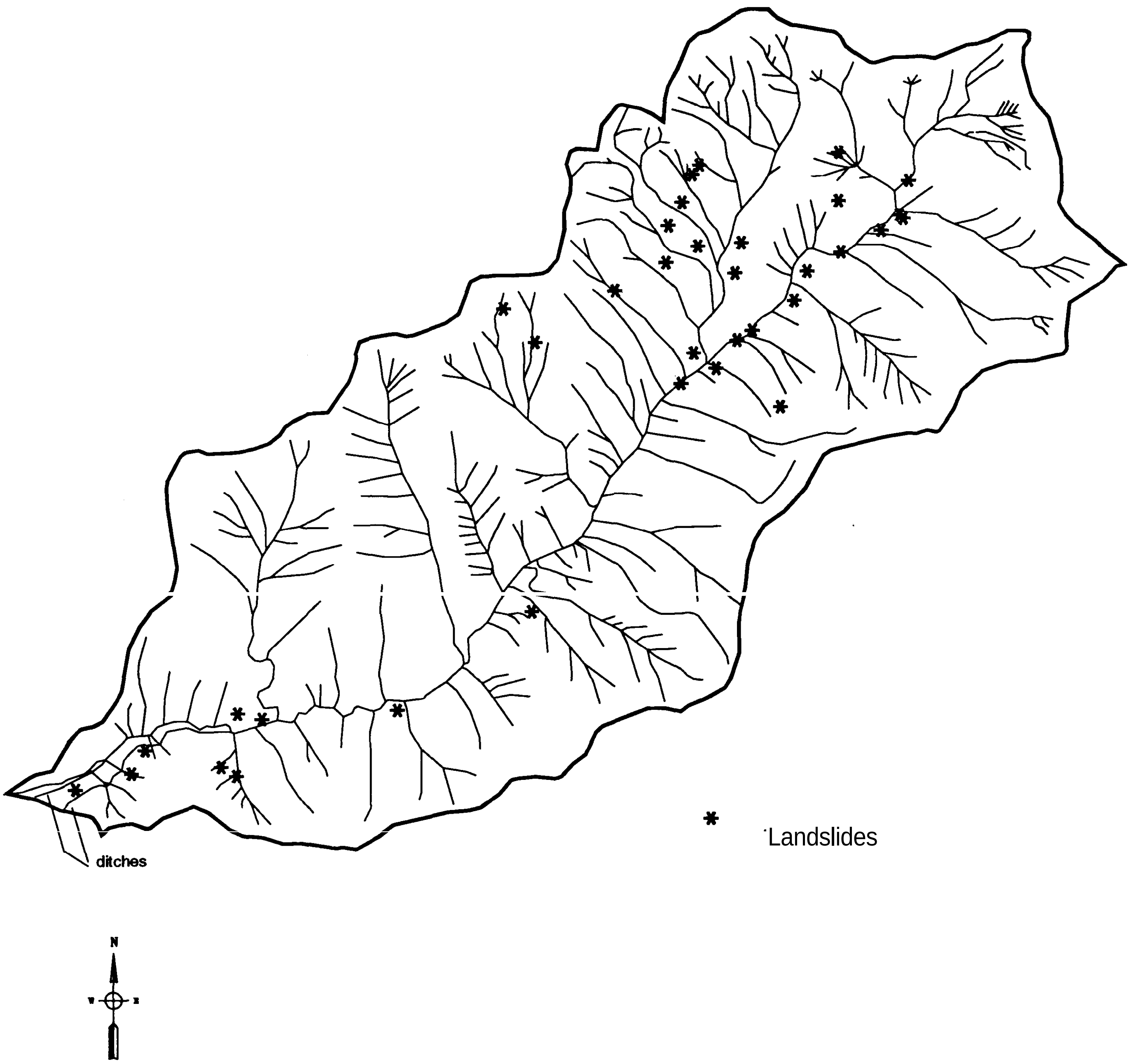
The stability rating for nearly two thirds of the channel system is "fair", followed by nearly a quarter of the length in "good" condition. See Table 1. The third largest class is "excellent", occurring where stable banks and streambed have influence over other factors. The areas of excellent stability are found predominantly in the headwater meadow areas of subwatersheds D and E. The bulk of the "good" rated streams reaches are found in the tributaries. The only reach of the main stem with good stability is between the confluence and Station 1. Figure 12 shows the distribution of stability ratings. For a more detailed description of channel conditions, see Appendix B, Field Note Summaries by Reach.

The predominant channel type is Rosgen A, which includes subtypes A-1, -2, -3 and -4. The A type channels have steep gradients, over 4 %, have a 1:1 sinuosity, and are well entrenched. A-2 channels are the most predominant in Crapo watershed. It is characterized by a mostly large boulder substrate with large cobbles. Intermingled throughout the system are sections with various particle sizes from sands to bedrock. Generally, the larger the particle size, the smaller the width depth ratio, while smaller particle size reaches tend to be more shallow. See Table 2 for a summary distribution of basic channel types. The subtype distribution is shown on a large scale map (Appendix F) and detailed on inventory forms.

A fully attributed map is available at the District office.

Crapo Watershed

Landslides



0 1 Miles

Figure 10

June 23, 1994

Figure 11: Channel Type Distribution

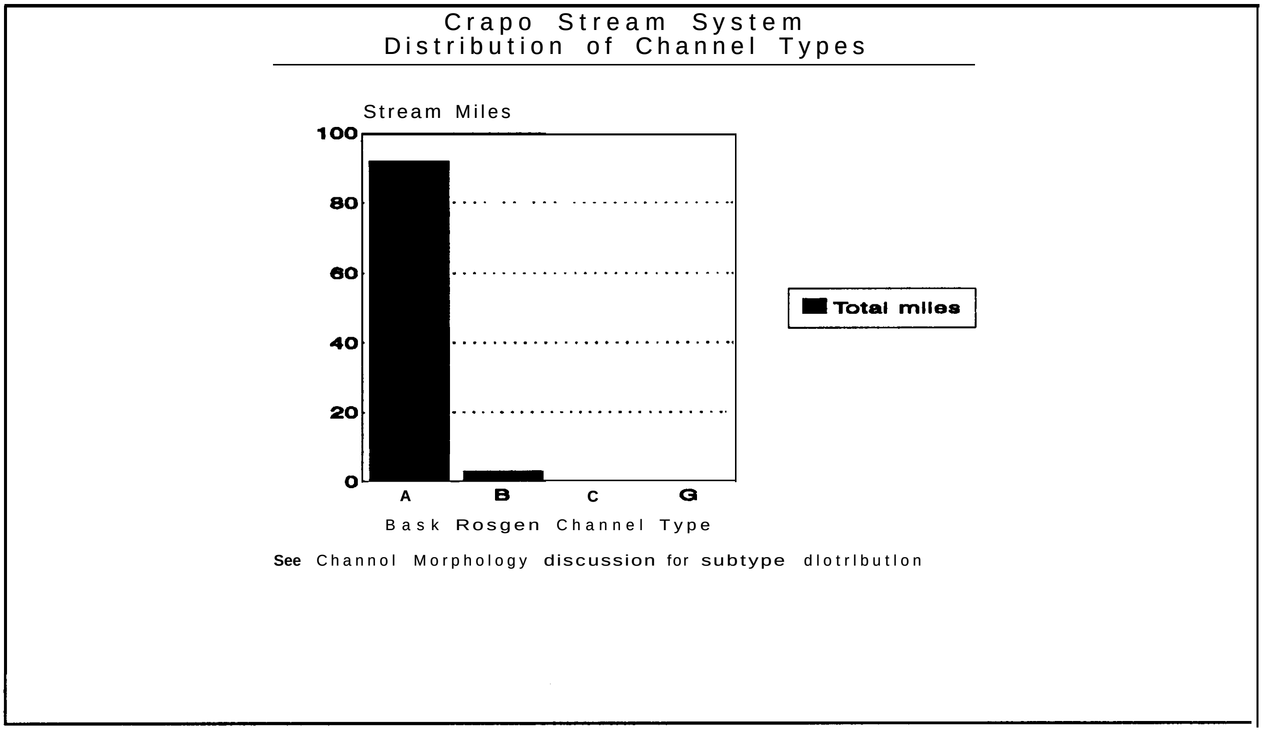


Figure 12: Channel Stability Distribution

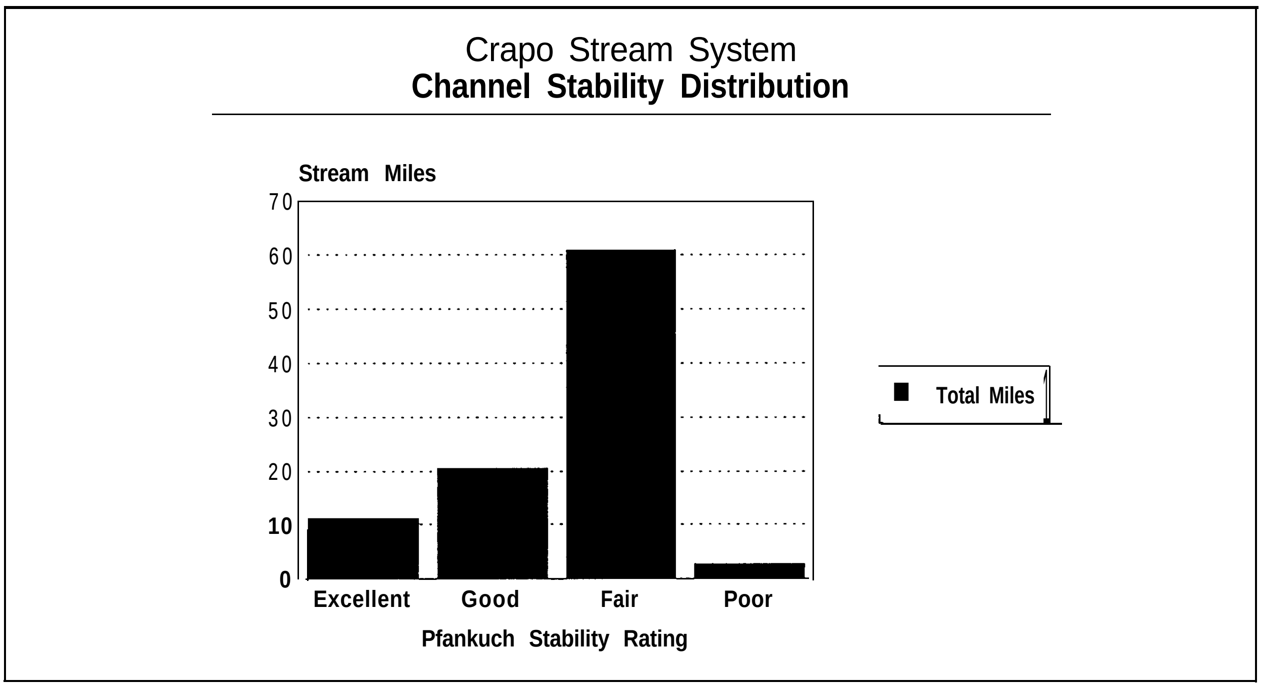
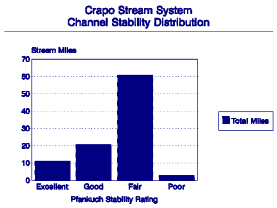
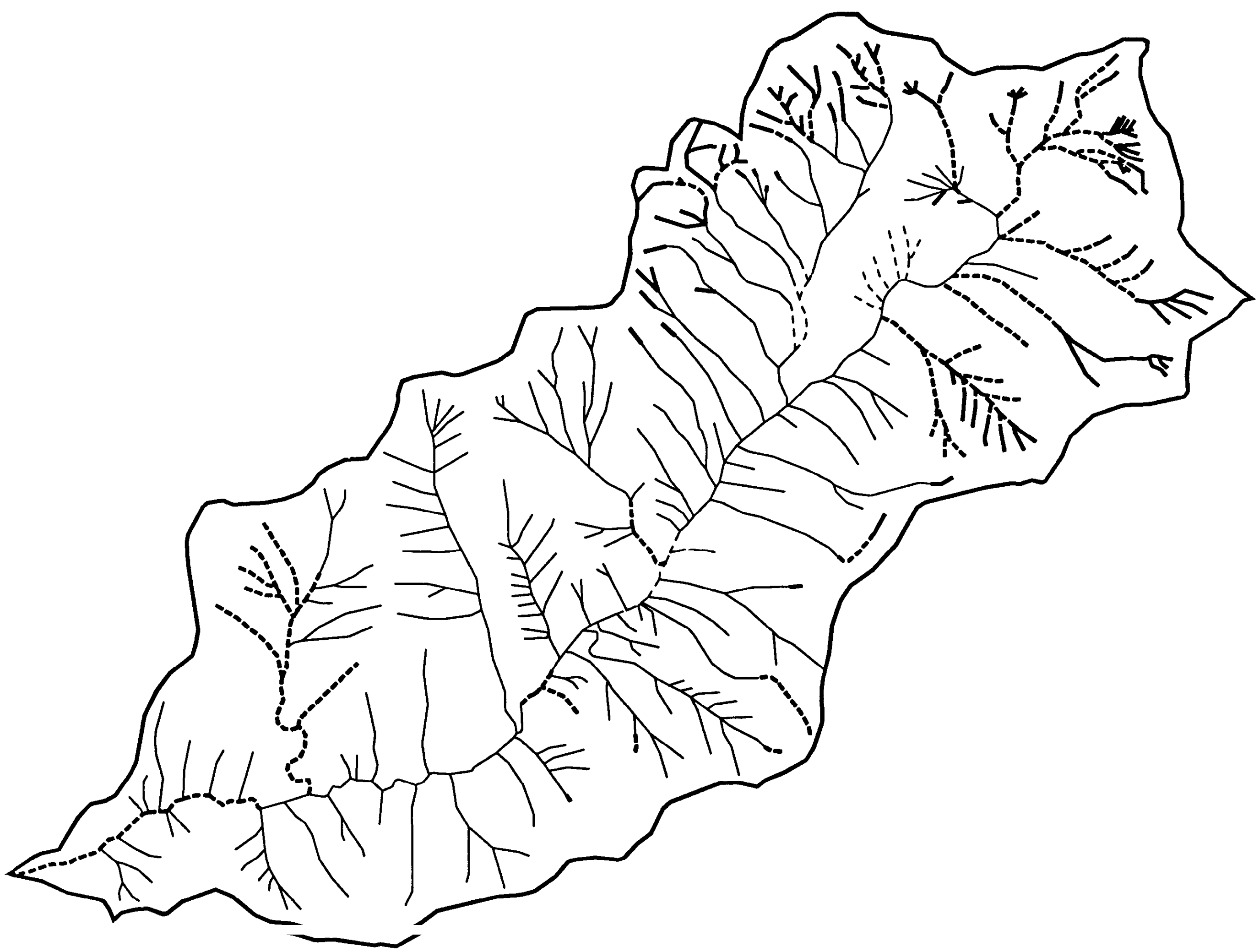


Figure 12: Channel Stability Distribution



Crapo Watershed

Pfankuch Stability Ratings



━━ (heavy solid line)	Excellent
▪▪▪▪ (heavy dashed line)	Good
—— (thin solid line)	Fair
- - - (thin dashed line)	Poor

N

0 1 Miles

Figure 13

January 13, 1994

Water Quality

Two recent studies by the Klamath National Forest characterize the sediment load of Crapo Creek, while a third looks at summer water temperature. The first sediment study is the Salmon Sub-basin Sediment Analysis (de la Fuente and Haessig, 1993). The second is a five year post-fire turbidity monitoring project with sediment data for four of the five years.

The sediment analysis was for the entire Salmon River basin, with aerial photo interpreted landslides, and surface erosion estimated using a modified Universal Soil Loss Equation model. Historic landslide sediment production from 1944-1988 was estimated at 5-10 cubic yards per acre in the Crapo watershed, delivered during an event like the floods of 1972-74. With post-fire (1989) disturbance conditions, this rate is projected to be 10-19.9 cubic yards per acre of landslide sediment, with an additional 1-2 cubic yards per acre of surface erosion. For comparison, the projected landslide delivery rate for like terrane in an undisturbed condition would be 2.5 to 2.9 cubic yards per acre. Of the existing sediment, it is estimated that 68 percent of the total comes from natural landsliding, 1 percent from roads, and 31 percent from wildfires.

The sediment study also identified and mapped scoured channels during different photo periods. In the 1994 photos, only a few tributaries on the north side of Crapo drainage show up as scoured. In 1955, an additional scoured tributary near the mouth was mapped, and 7 more tributaries in the upper 2/3 of the watershed are evident in the 1964 photo. However, in 1965 the change is dramatic. Virtually the entire main stem was scoured in the '64 flood. Subsequent photos show that the scoured area is slowly healing, however, as many actively eroding reaches of channel still exist.

The extensive channel scour which occurred during the 1964 flood is still evident. The main stem between stations 5 and 9 shows the most evidence of scour. Tributaries CRA-D-7-A through L have areas of residual active scour. On the main stem between stations 5 and 7 the channel recovery from this scour event appears to be very slow. Further upstream, between stations 7 and 9 are many other areas exhibiting the effects of 1964 channel scour. However, with the exception of several landslides, the major scoured areas along this reach appears to be healing, with robust riparian vegetation. See also Assessment of Channel Conditions section.

Crapo Watershed

Channels Scoured Prior to 1944

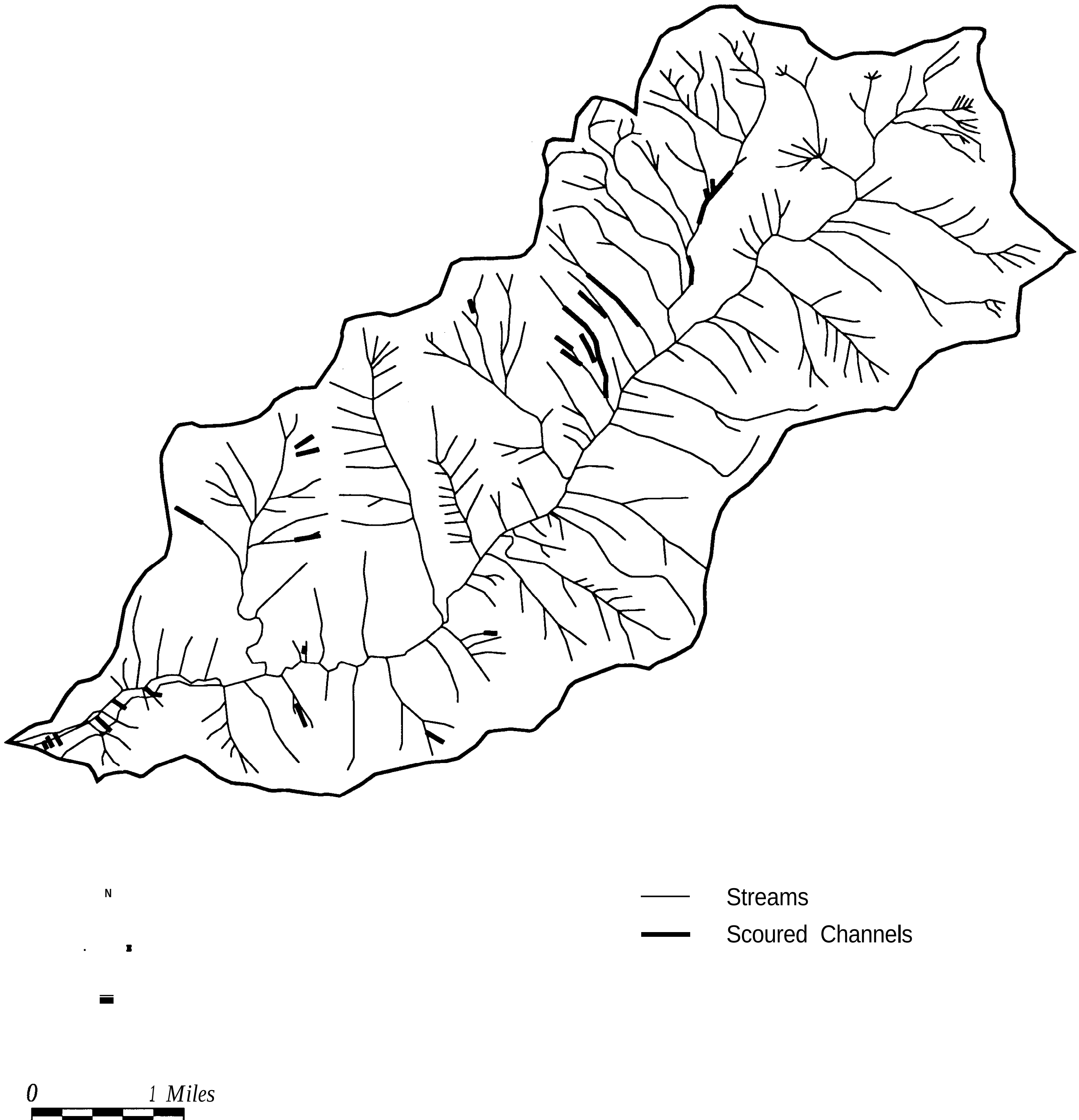


Figure 14

June 23, 1994

Crapo Watershed

Channels Scoured in 1964 Flood

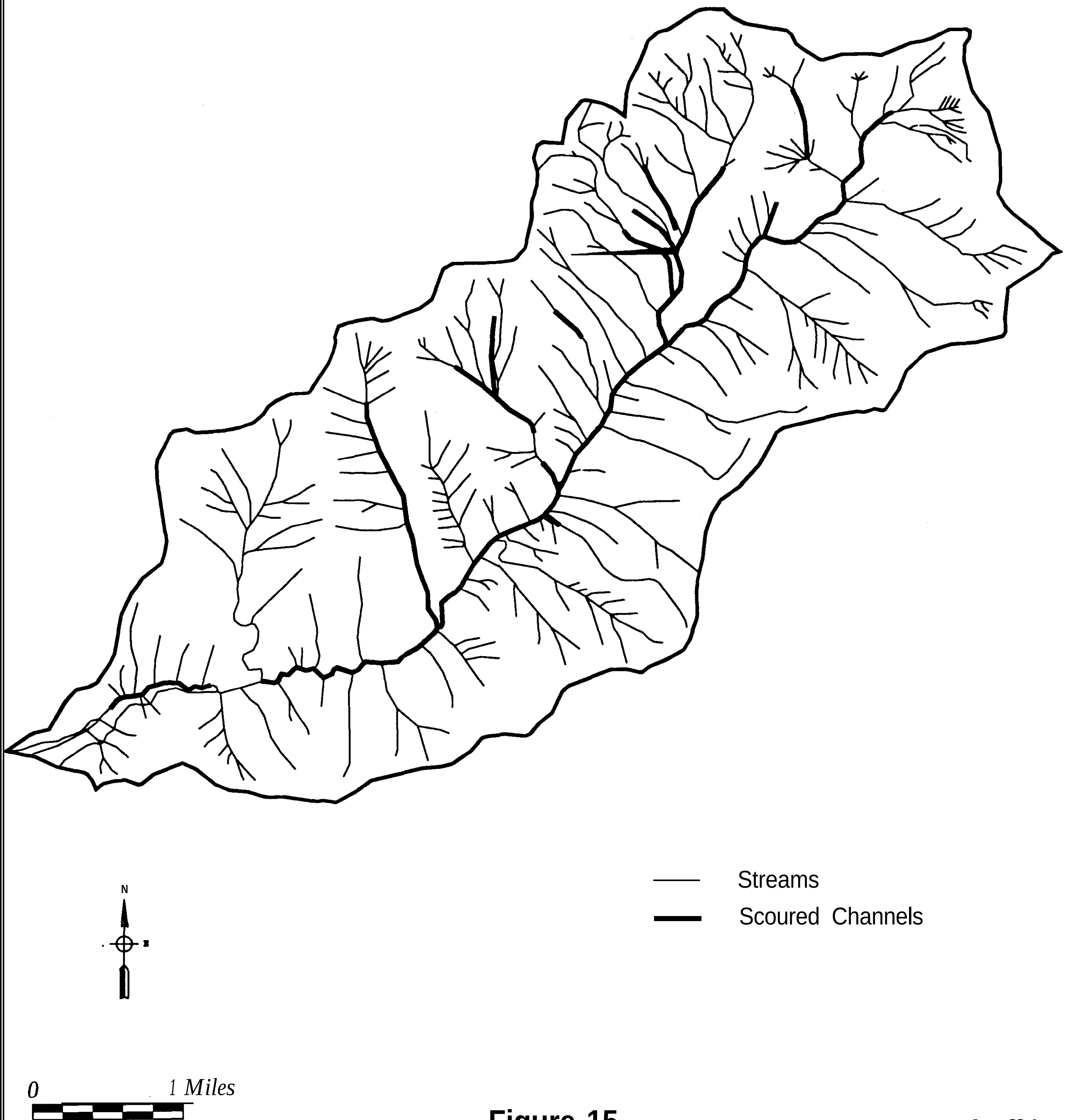


Figure 15

June 23, 1994

Crapo Watershed

Channels Scoured in the Floods Of the Early 1970's

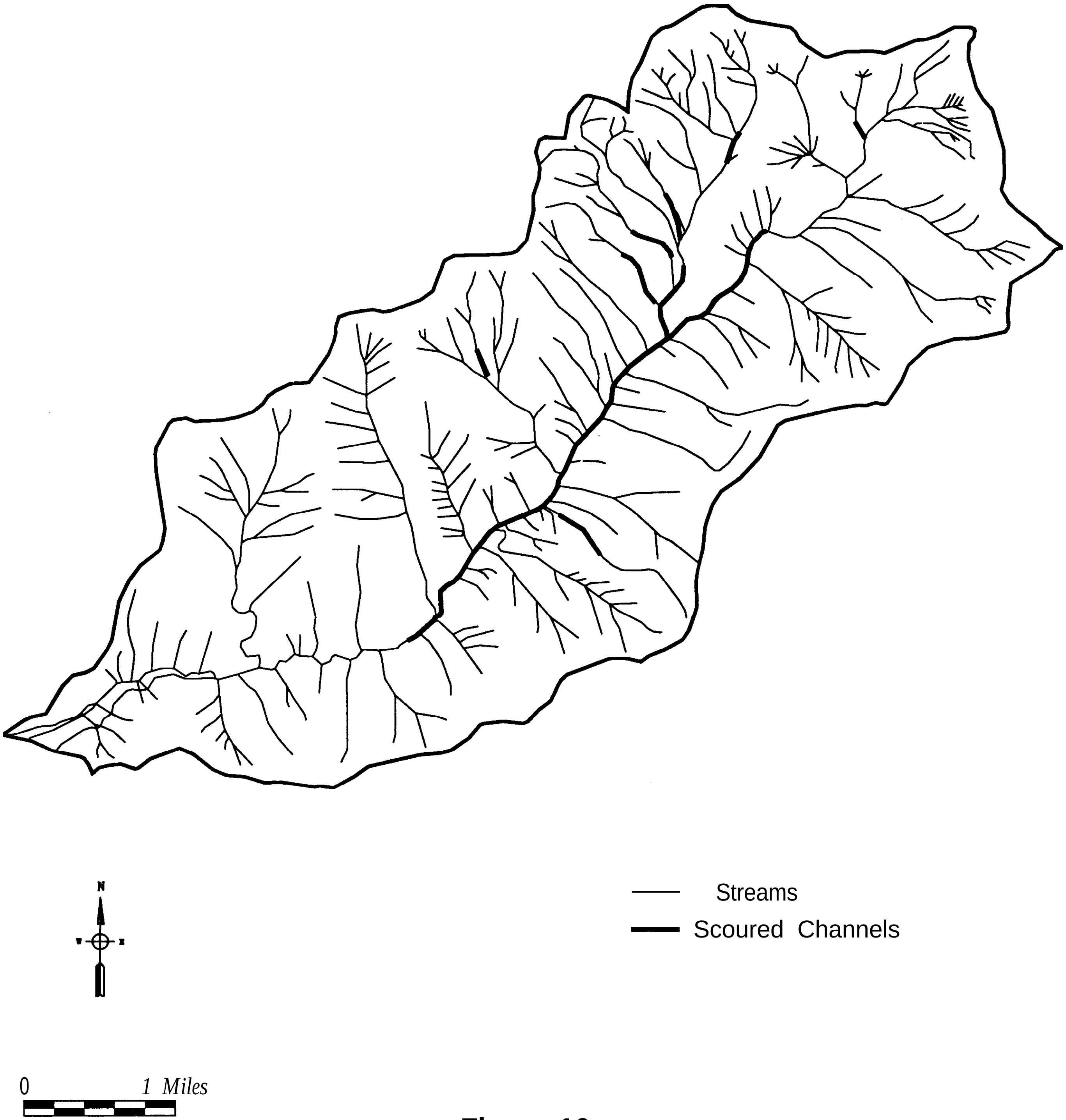


Figure 16

June 23, 1994

The post-fire water monitoring project was conducted from November 1989 to April 1993. Measurements were taken near the mouth of Crapo Creek. During five winters and one summer, streamflow and turbidity were measured several times daily. Suspended sediment was analyzed for all years but 1993, with random samples taken approximately every other day. The purpose of this project was to track the recovery trend of the watershed and fish habitat, using turbidity as an indicator. Suspended sediment was an added parameter, to provide a cross-check and ultimately provide more information about sediment loads in Crapo Creek. While the analysis is not complete, some preliminary observations can be made from the data.

Figures 17 through 20 depict the monthly rainfall, stream discharge, turbidity and suspended sediment data for the five seasons. Water year 1989 (1988-1989) had the highest rainfall and discharge, although 1993 had high snowmelt runoff which occurred after the monitoring period. The maximum instantaneous suspended sediment concentration for the monitoring period occurred on March 6, 1989 after consistently high flows which continued through April. A 2 inch rainfall initiated a rainy March. The storm occurred on the day of the peak sediment concentration of 8210 milligrams per liter (mg/l). It jumped from 3 mg/l on March 1 through 4th to over 8000 within hours of the onset of rain. Suspended sediment remained high, over 1000 mg/l through mid April. An earlier storm in November resulted in high monthly values of turbidity, but not suspended sediment. Salmon River at Somes station peaked at 12,800 cfs on November 22, and again at 11,000 cfs on March 10. November 22 was the maximum flo for this water year at the USGS Somes station. The instantaneous record for Crapo station cannot be fully reconstructed from this storm as equipment had to be temporarily decommissioned to protect loss.

Although monthly discharges were greater in 1989 than in 1990 water year, the maximum instantaneous flow peak previously mentioned was recorded on January 8, 1990. This is consistent with the USGS record for the Salmon River, which crested at 14,400 cfs on Janaury 8. This was the maximaum for water year 1990. It was accompanied by a corresponding maximum of record of 80 nepolometric turbidity units (NTU). This was in response to a greater than 3 inch rainfall that day at Sawyers Bar. Although there was an associated suspended sediment load of 2186 mg/l, the highest for the 1990 water year, this was not as high as the sediment values from water year 1989 discussed above. During the 1990 season, flows fell off after the January peak until March, then were sustained by rain storms from early March into the first part of June. Even with this sustained flow, turbidity remained under 10 NTU and suspended sediment under 125 mg/l. These are in contrast with the January stormy period, which had kept suspended sediment in the thousands of milligrams per liter.

The 1993 data that was collected into April indicates that turbidity dropped off rapidly after the rising limb of the season's hydrograph, which peaked initially in January. After turbidity dropped off, water stayed fairly clear (less than 2 NTU) through March.

Figure **17: Rainfall in Water Years 1988-1993**

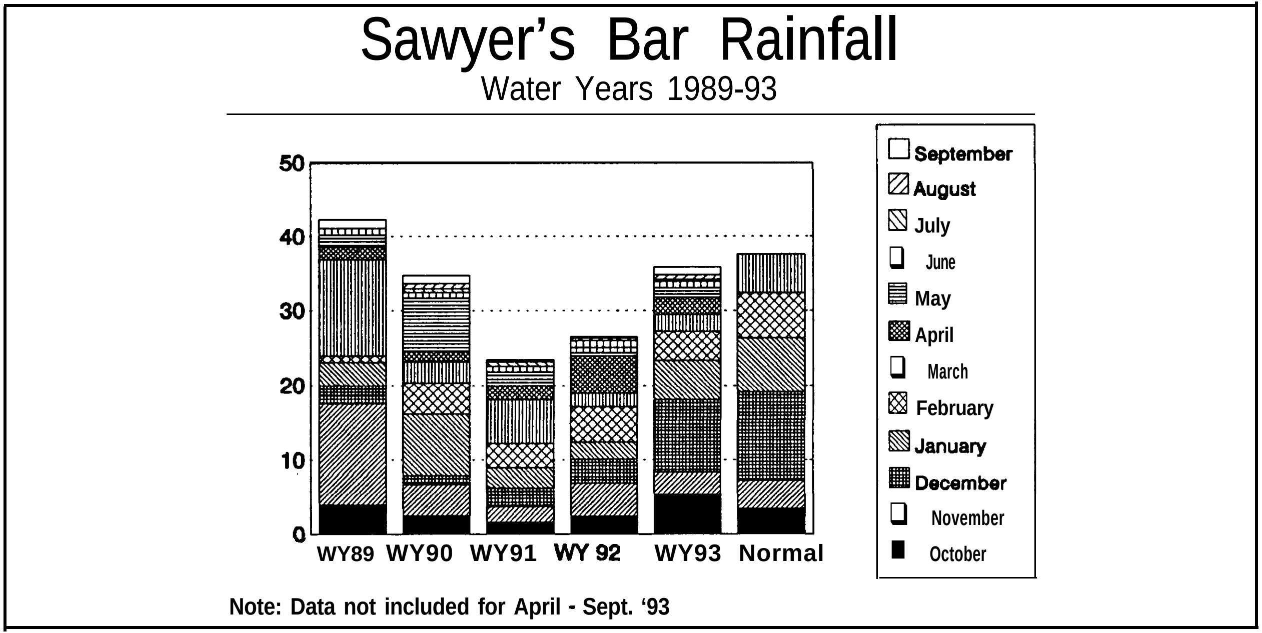


Figure **18**: Discharge in Water Years **1988-1983**

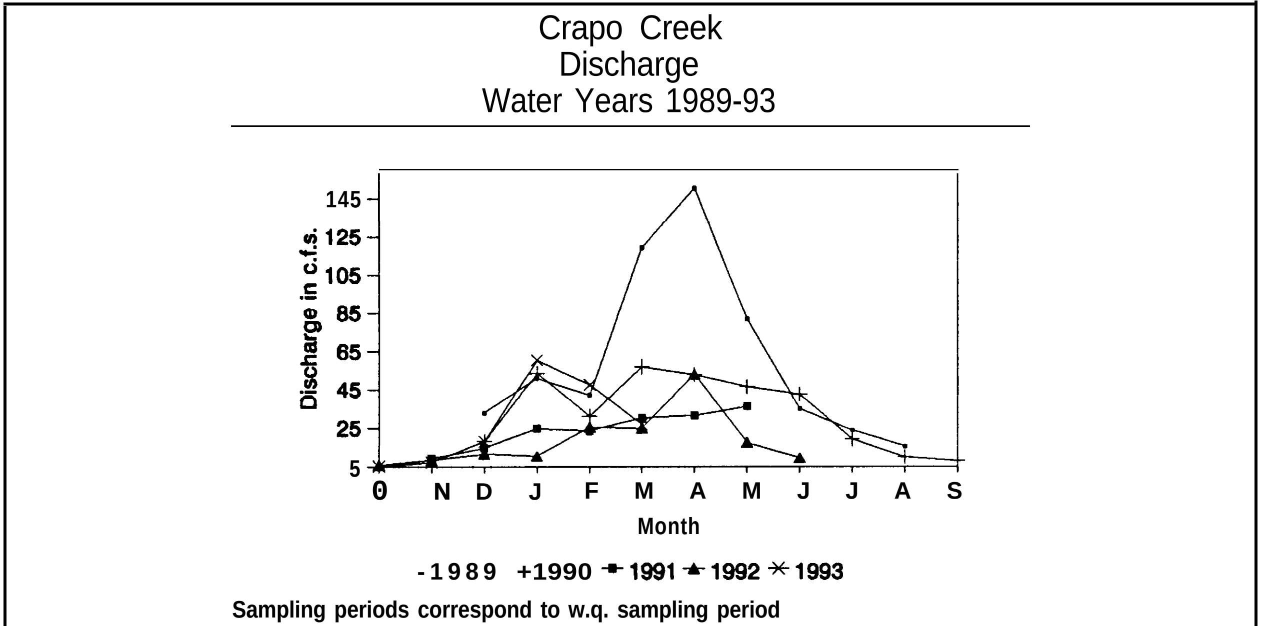
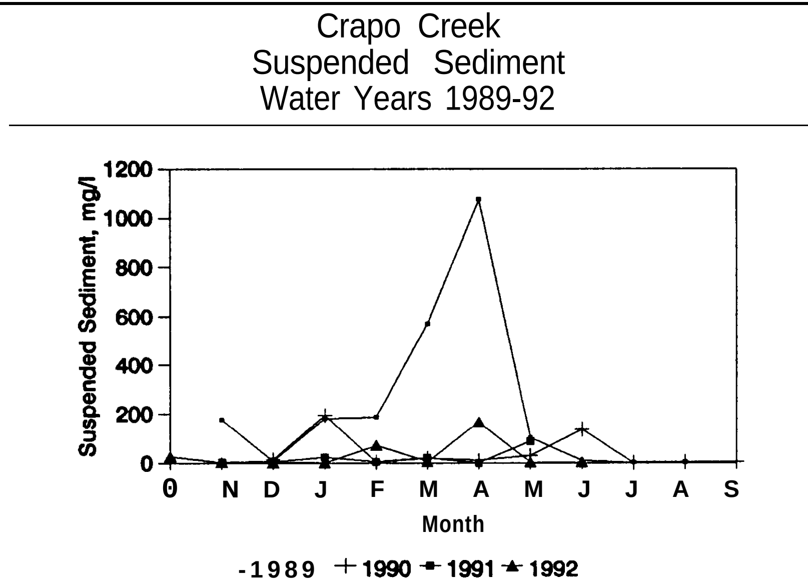
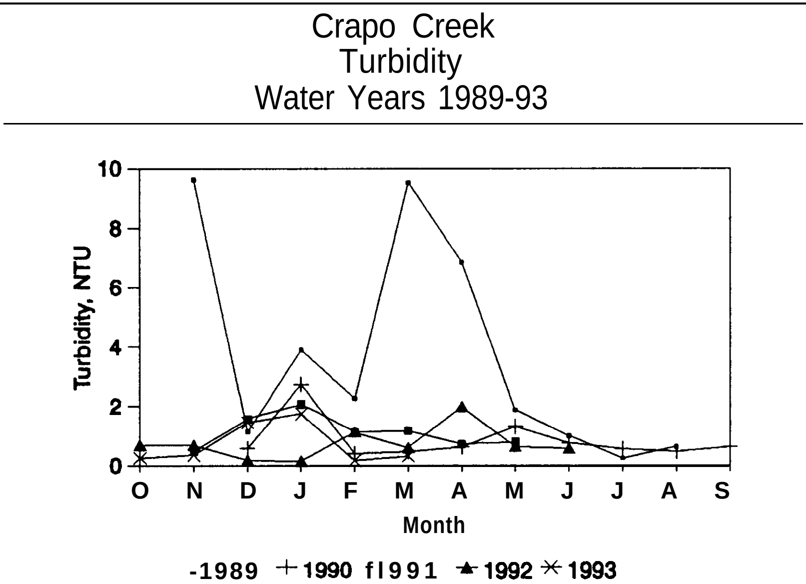


Figure 19: Suspended Sediment



Monthly averages

Figure 20: **Turbidity**



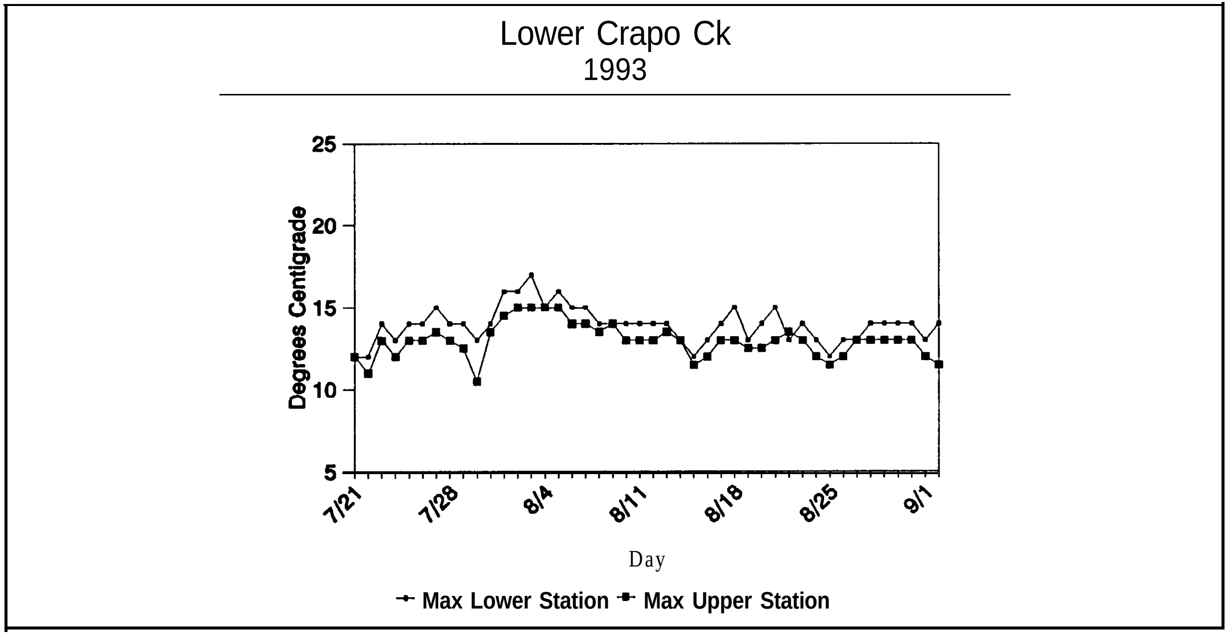
Monthly average nephelometric turbidity units (NTU)

Preliminary analysis of this data shows a typical seasonal pattern with the first high flows resulting in the lowest water quality, and subsequent high flows being relatively high in quality. This trend became more pronounced over time, along with an overall trend of improvement in absolute water quality since the fire. In 1989 there were three separate episodes of turbid water, while in 1990 the runoff periods which followed the initial peak were characterized by relatively clear water. In water year 1993, high sustained flows early in the season were not accompanied by poor water quality as in the initial storms of 1988 and 1990, even though some of the highest monthly flows on record occurred in 1993.

Water Temperatures

The Salmon River District collected water temperature data at two stations in the summer of 1993. The first station, referred to as "Lower Station" was at the water quality monitoring station near the mouth. The second station, referred to as the "Upper Station" was between to tributaries just above Station 6. We installed Ryan Model J recording thermographs at both stations. The thermographs remained in place from July 21, through September 2, during the aquatic survey. Maximum daily temperatures near the mouth were generally within 1^{o}C for most of the survey period. On 5 of the 44 days, the temperature varied as much as 2.5^{o}C.

Figure 21: Graph of Water Temperature



Large Woody Debris

Throughout the watershed there is an extensive amount of large woody debris. This includes amounts greater than 24" diameter pieces in the mainstem and extensive amounts of smaller (24" diameter or less) throughout the associated smaller tributaries in the system. The results of the inventory indicate that minimum recommended concentrations of woody debris are met or exceeded (Sedell, 1984, and USDA, 1993). Future recruitment potential of all sizes of woody debris is excellent throughout the middle and upper reaches of the watershed, based on the large number of down and standing fire burned snags.

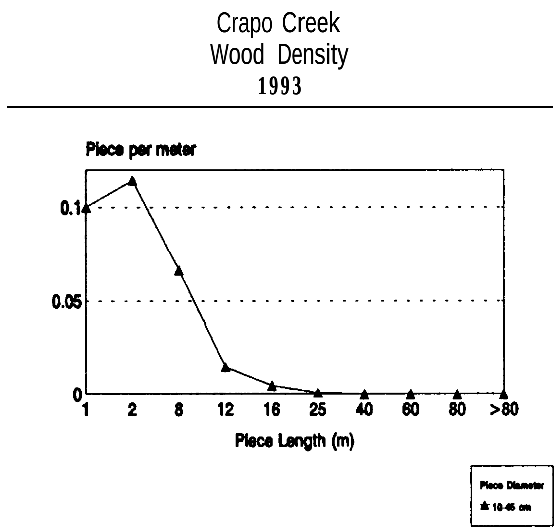
Forest Service crews conducted woody debris surveys across the Klamath National Forest in 1993. Crapo Creek and Bridge Creek can be compared. Both streams were surveyed using the same method. Bridge Creek is a tributary to Wooley Creek. Bridge Creek is contained within the Marble Mountain Wilderness. Crapo and Bridge creeks are of the same stream order, and have similar bankfull widths.

Woody debris from 1 meter to 40 meters in length exists in both streams. In Crapo Creek, material between 10 cm and 45 cm in diameter was predominate. There was three times as much of the smaller woody debris in Crapo Creek than in Bridge Creek (Figure 22).

The most common pieces of wood less than 45 cm in diameter where less than 8 meters in length. The most common pieces of wood greater than 45 cm in diameter were approximately 8 meters in length. This relates to roughly $^{3}/_{4}$ of the bankfull width.

For pieces of wood between 45 cm and 60 cm in diameter, the distribution of wood by length is similar for Crapo Creek and Bridge Creek. However, for woody material greater than 60 cm in diameter, there is nearly twice as much material in Bridge Creek (Figure 23).

Figure 22: Graph of Large Woody Debris < 45 cm



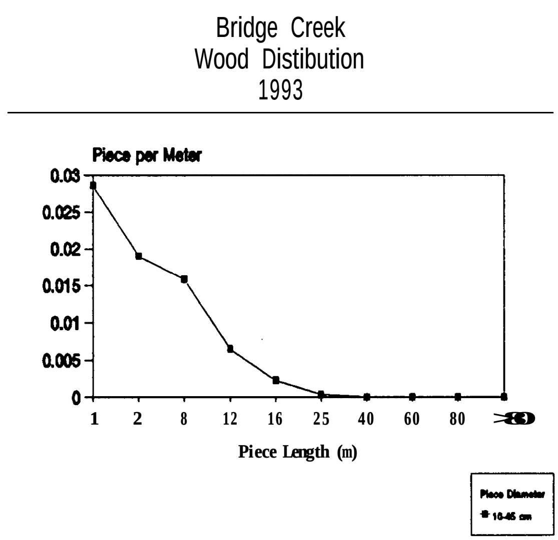
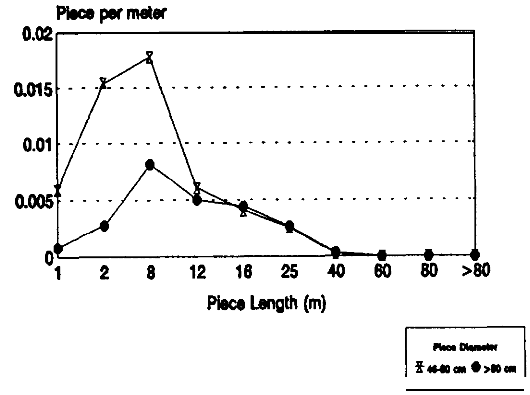
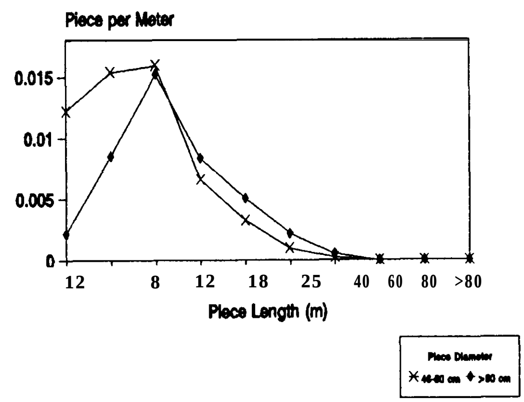


Figure 23: **Graph of Large Woody Debris from** 45 to 60 cm

Crapo Creek
Wood Density
1993



Bridge Creek
Wood Distribution
1993



Aquatic Habitat

A small population of rainbow trout (O. Mykiss) exist in Crapo Creek. There are no lakes in the headwaters of Crapo Creek. The cascade at the mouth is a low flow barrier for Chinook and possibly Coho Salmon migration. The steelhead may be able to negotiate the cascade in spring flows. However, a 6 meter vertical waterfall blocks upstream migration 884 meters upstream from the mouth. It is reasonable to assume that anadromous fish do not populate most of the system. Observed densities of 1+ and older fish increased slightly as the survey progressed upstream. The start and end points of the biological and physical surveys are the same (Figure 24). Divers estimated the size of 1+ and older fish to ranged from 65 mm to 300 mm. Divers observed very few (61) young of the year trout.

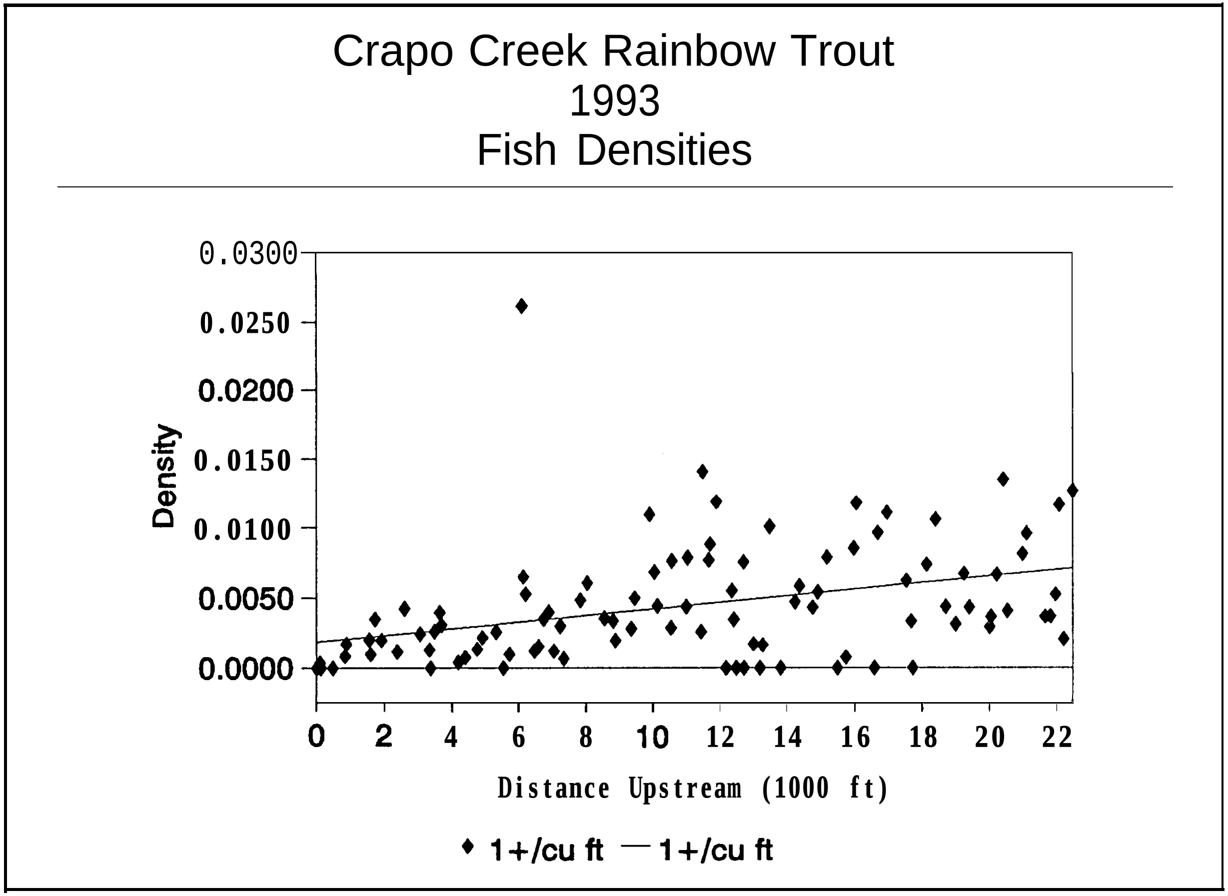


Figure 24: **Rainbow Trout Population Density**

Particle size distribution and the percentage of surface fines reflect the geology of the area. Quantities of granitic sand exist throughout the system. In one instance a pool in near the mouth was heavily impacted by sand. An observer was able to push a measuring rod by hand one meter into the substrate. Figure 25 displays the percentage of fines intersects for each of the 16 index reaches. The percentage of fines intersects is higher than is desireable for fish bearing streams in the majority of index reaches.

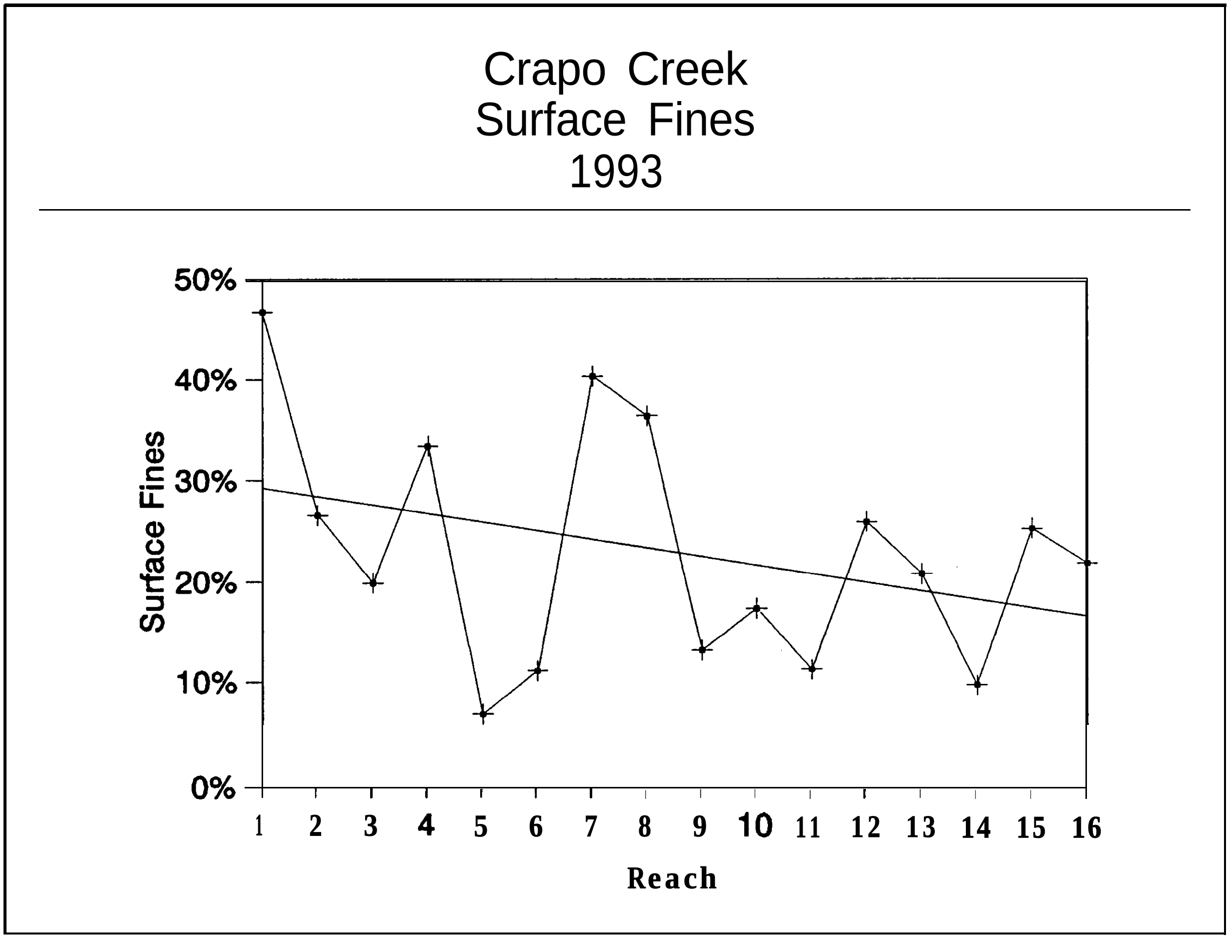


Figure 25: Graph of Fines in Substrate

Field crews observed both Pacific Giant Salamanders and Foothill Yellow-legged Frogs. We did not conduct quantitative surveys for those species.

Field crews observed both Pacific Giant Salamanders and Foothill Yellow-legged Frogs. We did not conduct quantitative surveys for those species.

The primary benefit Crapo Creek provides to anadromous species is the cold water influence at its confluence with the Salmon River. Forest Service biologists, and local citizens have observed both salmon and steelhead holding during summer months in the pool at the confluence for many years. Divers conducting direct observation surveys noted distinct areas of cooler water temperatures in this pool.

Assessment of Current Conditions by Subwatershed

Subwatershed A is composed mostly of metamorphic soils and is in very stable condition. See Figure 2 for location. This area contributes little to the water flow having no perennial streams and only one small intermittent. The old Crapo trail which is now a road transects this watershed and continues on to the Evergreen Mine located in Subwatershed B. Most of the area is extremely rocky and has good vegetative cover consisting of an even mixture of deciduous and conifer species. The deciduous component is mostly live oak, white oak, and madrone. The conifer component is mostly pine with some douglas fir. This is the least significant subwatershed in the Crapo watershed in terms of runoff and sediment contribution. Road density is .019 acres per acre, which is one of the two most densely roaded subwatersheds in Crapo. This density is still very low for the Klamath National Forest.

Subwatershed B is still in a predominantly metamorphic soil area and the Evergreen Mine is located in this area along with the associated road. The subwatershed contains one significant perennial stream system (B-1). This stream is in good, stable condition with excellent vegetative cover. It has no erosion problems and is contributing little or no sediment to Crapo mainstem. At the confluence with Crapo Creek the stream has a 40 foot high waterfall which drops over a bedrock substrate into the mainstem. In spite of the Evergreen Mine Road, road density is among the lowest of the roaded subwatersheds in Crapo: .002 acres/acre.

Subwatershed C contains two significant perennial streams (C-2 and C-6) and one fairly large intermittent system (C-3). The contact zone between the metamorphic and granitic parent material is located in this subwatershed. The majority of the area is granitic but associated with loose metamorphic soils and rock. This area was burned with high intensity during both the 1977 and 1988 fires and was almost completely denuded. The area is currently in the early stages of recovery overgrown with thick shrubs, forbs, and grass. The tributaries are only fair in stability with erodible lower and upper banks and a substrate of smaller cobbles and fines. Stream gradients are steep (40% and above) at the headwaters, but shallow out to 20% and below from midreach to the confluence with Crapo mainstem. The stream channels have very little canopy cover with the only shading being the overhanging shrubs. The area also exhibits several shallow slumps associated with the smaller side tributaries. Although this subwatershed is contributing some erosion processes and fine sediment to the main system, it is still fairly insignificant when compared to the contributions found elsewhere in the watershed. There are no roads in this subwatershed.

Subwatershed D is mostly located above the Marble Mountain Wilderness boundary and along with Subwatershed E contributes most of the streamflow for the Crapo system. The main perennial tributary system in this subwatershed (D-8) is dominated by extensive meadow and wetland areas in the headwaters, including Crapo Meadows. The area is characterized by granitic soils, steep gradient (65% and greater) channels, and accelerated erosion processes in the middle and lower reaches. This entire subwatershed was burned over in 1987 but mostly at lower intensity underburning. There are significant patches of high intensity, crown fire areas which has left behind stands of snags. The meadow and wetland areas are very stable and appear undisturbed with the exception of a few burned areas scattered throughout the meadow complex. These meadow systems contain many species of wildflowers and have abundant populations of amphibians. Most of these meadows appear to have no transition zone to larger vegetation with the large conifer species growing at the immediate edge of the meadows. All the meadows and headwater systems are above the 6000 feet elevation and are located on interconnecting benches and plateaus. Below 5900 feet in elevation, these headwater areas feed tributaries which immediately fall off to gradients exceeding 65%. These steep channels are mostly cut through granitic soils and exhibit very unstable lower banks and are associated with some severe erosive process including numerous landslides. The channel substrate is made up of granitic fines, cobbles, and boulders, with much of these substrate materials being transported to the Crapo mainstem as bedload. There are no roads in this subwatershed.

Subwatershed E is also located almost entirely within the Marble Wilderness Boundary. Along with Subwatershed D, it is one of the largest stream flow contributors to the Crapo watershed. This subwatershed is made up predominately of granitic soils. The headwaters (above 6000 ft. elevation) are made up of diverse meadows, though not as complex a system as in subwatershed D. These meadows are associated with large areas of snowbrush, unlike the wetter, forb/grass Crapo Meadows. This area contributes fine granitic sand to the system but does not exhibit the extreme gradients (30% or less) that subwatershed D has. The smaller tributaries of the headwater area contain some insignificant erosional areas, but as these smaller tributaries enter into the Crapo mainstem at about 4800 ft. elevation, the erosion processes become extreme with high bank erosion and numerous landslides. From this point of subwatershed E, the mainstem Crapo Creek continues to flow through a rapidly eroding channel with extensive, high bank cutting and continuous landslides (station #7 to station #8). The gradient of the mainstem is 15% or less and the substrate contains intermittent, short reaches of bedrock. The non-bedrock substrate reaches are very unstable and mobile, made up of an equal distribution of granitic sands, cobbles, and boulders. This substrate distribution is based on an ocular estimate. Of the subwatersheds which have roads, the road density is lowest in Subwatershed E; .001 acres/acre.

Subwatershed F is located mid-reach in the Crapo watershed, on the south side. This subwatershed contains the majority of the Yellow Jacket road complex including lower landing. This area is characterized by steep gradient (30-70%) channels through unstable granitic soils associated with extensive slump areas in almost every channel. This area was totally burned over in 1987 and is almost entirely void of canopy cover. The vegetation is dominated by heavy brush and forbs. Good populations of willow are appearing in the immediate riparian areas. There are six perennial tributaries in this area (F-3, F-4, F-9, F-11, F-13, F-16). These tributaries appear to chronically contribute granitic sands. They course through loose granitic soils with lower streambank cutting and erosion associated with slump and slide areas. The only shading of the water surface comes from shrubs on the upper banks and willow populations in the main riparian corridor. The substrates of these tributaries are mostly granitic sands with a minor mixture of small to large cobbles. On a whole this entire subwatershed is very unstable. This area is exhibiting good regeneration of conifers from earlier plantings which appear to be surviving well under the heavy cover of brush. The entire subwatershed seems to be well along in the fire recovery process. The mainstem of Crapo Creek, which flows through this area, has less than five percent canopy cover and very little shading from lower bank vegetation. The channel is cut through a broad flood plain and has eroded a channel through loose granitic sands which has very unstable lower and upper banks. The tributaries entering at right angles create increased cutting and erosion. The substrate contains a loose mixture of granitic cobbles and boulders and is filled with granitic sand. There are numerous large woody debris log jams throughout the mainstem, some as high as 25 feet, with large volumes of granitic sands trapped behind these jams. This section of the Crapo Creek mainstem (Station #3 to Station #7) is one of the most unstable portions of the entire watershed. As this reach broadens and flattens in gradient it becomes a deposition zone for all the sediment yielded from steeper gradient reaches and actively eroding areas in the upper reaches. Road density is .011 acres/acre.

Subwatershed G was almost totally burned over in both 1977 and 1987. There are only two small perennial systems and two small intermittent systems in this area. The spur road off Rd. 11N21 to the lower landing transects this subwatershed. Although the channels have steep gradients (excess of 35%) the soil type in this area is mostly metamorphic and fairly stable. There is some slumping occurring in the lower half of the area close to the Crapo Creek confluence. The majority of the area is overgrown with shrubs and there is very little canopy cover or shading. The channels are carrying very little fine sediment and have a substrate mostly of cobbles and boulders. The lower edge of the subwatershed begins a green belt which was not adversely affected by the fires of 1977 and 1987. The Creek mainstem through this area becomes more entrenched and has an increased gradient (5-10%). The mainstem exhibits good canopy cover (50%) shading from a majority of deciduous species, especially alder. The channel narrows, and has fairly stable lower banks with dense vegetative cover. The stream substrate is metamorphic bedrock with granitic cobbles and boulders deposited on top. The system is still carrying an abundance of granitic fines. The most significant aspect of this subwatershed is the transition in mainstem channel morphology. Road density in this subwatershed is .017 acres/acre.

Subwatershed H was virtually untouched by the major fires of 1977 and 1987, except for a few patchy areas on the southerly ridge. It supplies very little streamflow to the system, having only three small intermittent systems in the area. There is good vegetative cover throughout the area with a good mix of both deciduous and conifer species. The entire area is on metamorphic parent material. The channel of the Crapo Creek mainstem continues to dramatically change to a very entrenched and confined channel, with sheer rock walls up to 100 ft. high. The substrate is a series of bedrock cascades creating several waterfalls and deep pools. The pools were found to be choked with granitic sands. The immediate riparian corridor has excellent vegetative cover of both conifer and deciduous species. The mainstem from the middle of this subwatershed to the confluence with the Salmon River changes again to a lesser gradient (5%) and less confined channel. The lower and upper banks have very dense vegetative cover. The stream substrate consists mostly of large cobbles and boulders with granitic sands still passing through the system. The portion of the mainstem of Crapo Creek which flows through this subwatershed is the most stable part of Crapo Creek. The stream diversion for domestic water use is located in this reach. It originates at a fifty foot high dam. Road density is .006 acres/acre.

CONCLUSIONS

The overall condition of the Crapo watershed, in terms of supporting beneficial uses, is fair. The channel stability ratings, which are predominantly "fair", are an indication of this. Watershed disturbance level is low, except for fire effects. However, the recovery of the watershed, particularly upslope, has progressed well since the recent fires. Riparian vegetation in the lower and uppermost reaches has good canopy closure. The inherent instability of the watershed is apparently due to natural processes. Upslope problems are primarily associated with landsliding on steep granitic slopes, while channel problems are related to downstream transport of glacial deposition, and scour from floods in recent decades.

The upper half of the watershed is on mostly granitic soils and contributes significant amounts of granitic sands throughout the system. These are transported to the Salmon River as evidenced by the delta at the mouth of Crapo Creek. Many areas of the main channel and associated tributaries in this upper part of the watershed are very unstable. There is severe, continuous bank cutting associated with a large number of landslides. The majority of these landslides are immediately adjacent to the main channels and are continually being activated by stream flow, especially during high water periods. This unstable condition is mainly a result of the granitic parent material on steep slopes tending toward an angle of repose. There is chronic channel erosion where steep gradient tributaries enter the mainstem as they downcut to reach lower base levels. This is a natural process which has been occurring for thousands of years, along with tectonic uplift.

There have been significant fire-related disturbances over most of the watershed. The Hog Fire of 1977 and Yellow Fire of 1987 resulted in a severe loss of riparian vegetation with consequent reduction in channel canopy cover and increased surface erosion. The mid reaches of the watershed have been replanted and the area appears to be well into the natural recovery process. The current vegetation community is dominated by shrub species with healthy conifer growth under the brush. In contrast, fire areas in the upper reaches, which are almost totally in wilderness, are exhibiting thick new conifer growth in a relatively open understory. This growth has just begun within the last three years in the 1987 fire areas, but is twelve years old in the 1977 fire areas.

There is abundant large and small woody debris throughout the Crapo Watershed with many large debris jams along the mainstem of Crapo Creek. Near future recruitment potential is also very high as a result of the large amounts of standing burned snags in the mid and upper reaches. Large wood future recruitment beyond the next decade or two will be realized in another century at the soonest.

The headwaters of Crapo Creek are a network of springs and meadows located on a series of relatively flat glacial deposits. These deposits are the source of much of the alluvium found in the middle reach of the main stem. The meadows are in excellent condition and contain abundant amphibian life. In the Chimney Rock area, along the ridgeline just above these meadows, are large, dry, open areas with loose granitic soils and sparse low vegetative cover. These exposed areas, with their thin soils, are vulnerable to natural disturbance, such as wind erosion, as well as to human and bovine traffic.

The watershed is part of a cattle grazing allotment which allows up to 200 head of cattle each season. There is evidence of localized impacts by this grazing in the meadow systems and in areas near the lower landing. In years of high winter precipitation, the meadow areas appear to recover each year. The range shows evidence of a "recent use history of moderate utilization" (Menke, 12/93 memo). The grazing in the lower landing area has resulted in some erosive trailing and reduction in shrubby cover. However, the reduction in brush cover is possibly beneficial for long term watershed condition by helping to release the new conifer growth found in the area.

Additional man caused disturbances are recreational trails and helicopter landings. The trail system off Yellow Jacket Ridge has impacted two of the meadow systems it transverses. In early summer, these trail crossings are a source of turbidity to small tributaries which support aquatic wildlife. The log landings pose potential risks to slope stability, long term site productivity and water quality.

Fish habitat quality concerns are primarily related to the effects of granitic sediment on the Salmon River. There is also a small potential increase in water temperatures due to the lack of canopy cover in the mid and upper reaches. However, this was shown to be minimal. There is little or no anadromous fish population in Crapo Creek due to natural barriers close to its confluence with the Salmon River. There is a resident trout population. The habitat has a fair rearing habitat and generally poor spawning habitat capability. Both spawning gravels and holding pools are heavily sedimented. However, the source for most of this sand is from natural processes, and stabilization is not cost effective due to poor access and low predicted success rate for most sites.

The Crapo Watershed is subject to a great deal of natural disturbance. Crapo Creek can have a significant impact on the overall health and productivity of downstream habitats. Improvement needs were identified which are associated with conditions that can be changed by management. Restoration of these sites would not fix the problems inherent in Crapo watershed, but would benefit ecosystem health and water quality. Fourteen project proposals present opportunities for wetland and riparian enhancement, and soil and slope stabilization.

RECOMMENDATIONS

Watershed improvement needs for the benefit of fish and wildlife habitat, and water quality were identified through the WINI process. Further opportunities, especially those affecting larger scale ecosystems, could be identified during an ecosystem or watershed analysis.

Fourteen potential projects have been identified to date. Prioritization of restoration actions should consider the following: resident and anadromous fish, water quality, wildlife habitat, and the overall health of the riparian and upslope ecosystem.

Potential WIN projects are listed and prioritized in Table 5. The projects were prioritized based on descending order of values, with slope stability and erosion control being highest, followed by fish habitat (riparian) improvement, then wetland enhancement.
Project objectives include:

Slope Stability/Erosion Control	10 projects
Wetland Enhancement	2 projects
Channel Stabilization	2 projects

A brief description of these restoration proposals is presented below by project type. The project cost figures given are rough estimates. The exact treatment and cost figures can be finalized only after interdisciplinary input and project design.

Slope Stability/Erosion Control Projects

Proposed WIN projects #1 through 9 address the need to rehabilitate and stabilize landings built in 1978. These landings were used primarily for helicopter logging and average about one acre in size. Most of them are located in granitic landslide terrane or on narrow ridge tops with extremely steep side slopes. One of the landings is on an active earthflow. Slope stabilization and erosion control is highly recommended for protecting downstream water quality. However, a geologic investigation and survey needs to be done in order to determine the most cost-effective treatment. This investigation is scheduled for the 1994 field season. These project sites are primarily located in the mid reach areas of the Crapo watershed.

There are many landslides in the upper reaches of the Crapo Watershed. However, they are in loose, shallow soils, and are not accessible or cost effective to repair.

Project #14 identifies several sites with erosion problems associated with trails and old fire lines. The project calls for realignment or improvement of trails which are contributing to cutting and erosion through meadows and along old fire lines, in addition to rill and gully erosion control in sparsely vegetated granitic meadow areas. These areas include the trail along the ridge line in the Chimney Rock area, the trail along the fire line from Box Camp to Portuguese Peak trail, and the trail from Yellow Jacket Ridge which traverses two meadow systems before connecting with the Garden Gulch Trail. These problem spots are primarily located in the headwater areas of the Crapo Watershed.

Wetland Enhancement Projects

Proposed projects #10 and #11 present the opportunity to improve two wetland areas located on the eastern boundary of the Crapo watershed along Yellow Jacket Ridge. They are easily accessed by Road #11N21. Project #10 is a wetland and pond area just off Rd. 11N20. This area was totally burned over during the fire of 1987. Following the fire, riparian planting and fencing was accomplished to help protect the area during recovery. This need was critical for wildlife because cattle grazing in adjacent plantations were impacting this unique habitat. The fence has collapsed under snow. Possible enhancement work would include replacing the existing protective fence around the wetland area with a fence that can be let down in winter. Other work would be raising the level of the pond to expand water holding volume, and perform additional riparian planting. Project #11 is a wetland area located just above Rd. 11N21. This wetland area is along a one-quarter mile long reach with a low gradient (3-4%) and perennial flow. There is a plantation located at the headwater of this reach. Possible enhancement would be riparian planting and a series of check dams to pool and hold the water flow in the area. This would also improve wildlife habitat.

Channel Stabilization Enhancement Projects

Projects #12 and #13 identify the need for riparian planting to provide vegetative shading and erosion control. This would improve of fish habitat. These two projects are located in the mid reach area of the watershed along two tributaries in an area that burned with high intensity and was totally denuded. Riparian areas just below and above these project areas appear to be recovering well. The recommendation is for riparian planting of mostly willow and alder species, which have been successful in past riparian restoration work in the area.

Crapo Watershed

Proposed Project Locations

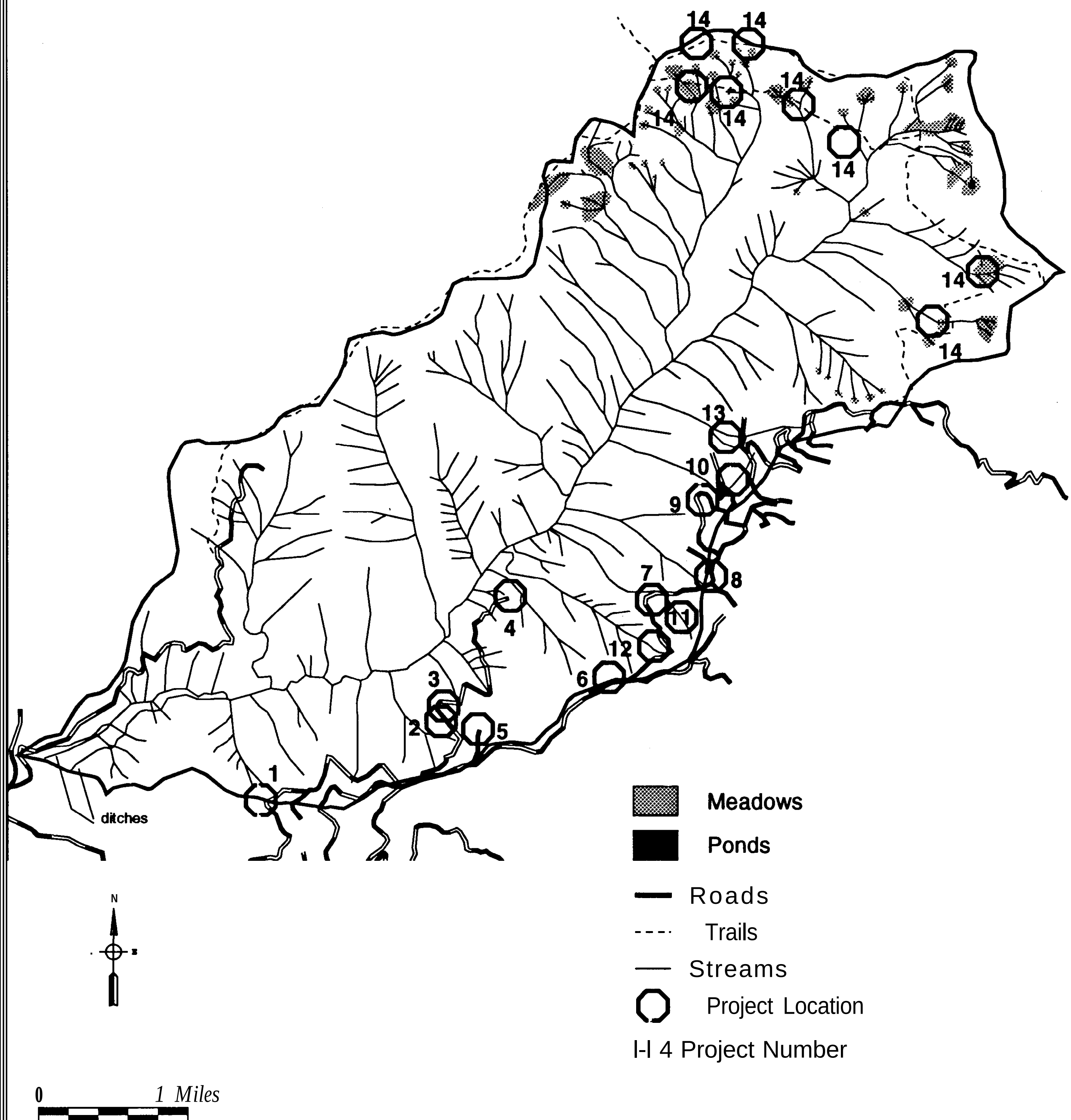


Figure 26

June 23, 1994

Crapo Watershed Improvement Needs
In Order of Priority

Proj #	Priority	Est Cost	Problem	Benefit	Proposed Treatment
14	High	$29,000	Erosion	Soil stab'n, reduced sediment	Erosion contr. structures, re-routing
4	Mod.	$20,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
2	Mod.	$20,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
3	Mod.	$15,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
9	Mod.	$16,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg site *
7	Mod.	$16,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
5	Mod.	$15,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
6	Mod.	$15,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
10	Mod.	$11,000	Ripar. cover, Water table	Wetland enhancement	Ripar. planting, flow reten. structures
11	Mod.	$7,000	Ripar. cover, water table	Wetland enhancement	Ripar. planting, flow reten. structures
	Mod.	$2,500	Riparian cover	Channel stability	Riparian planting
	Mod.	$3,500	Riparian cover	Channel stability	Riparian planting
8	Low	$12,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *
1	Low	$6,000	Erosion	Slope stab'n, soil productivity	Re-contour landing, reveg. site *

■ Riparian Improvement □ Wetlands Enhancement ▩ Erosion/Stability

* Future Implementation will depend on cost benefit analysis following geologic investigation

Figure 27

ACKNOWLEDGEMENTS

Work presented in this report was conducted under a cooperative agreement between the U.S. Department of Agriculture, Forest Service and the U.S. Department of the Interior, Fish and Wildlife Service under Interagency Agreement 14-48-0001-93522.

The field team was made up of Larry Alexander, Silas Beaver, Bob Brown, Mitzi George, Samantha George, Bill Jespersen, Jodi King, Sue Maurer, and Al Molitor.

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Ann Lehman, Richard Van de Water and Bob Varga - Cartography
Roberta Van de Water - Hydrology
Bill Bailey - Cultural History

Editorial review was provided by Brenda Olson, Bill Bailey, Juan de la Fuente, Tom Laurent and Orion Dix.

Office publication and data management was done by Roberta Van de Water and Orion Dix.

SUMMARY OF EXPENDITURES

Cooperative Agreement #14-48-001-93522
Project #93-HP-13, 11333-1331-1305

CRAPO CREEK WATERSHED CONDITION AND IMPROVEMENT NEEDS INVENTORY

Category	USFWS	USFS
Salary (including benefits)	13,466.	7,000.
Travel	0.	0.
Non-Expendable Equipment (Supplies)	0.	0.
Expendable Equipment	0.	0.
Operation and Maintenance	0.	0.
General Administrative Expenses	1,270.	1,950.
Subtotal	**$16,000.**	**$11,100.**
TOTAL PROJECT COST:		**$27,100**

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APPENDICES

APPENDIX A : Aquatic Habitat Inventory

APPENDIX B : Field Note Summary by Reach

APPENDIX C : Watershed Improvement Needs Data Sheets

APPENDIX D : Order 3 Soil Associations

APPENDIX E : Photographs and Photo Index

APPENDIX F : 1:24,000 Scale Inventory Maps with Overlays