Special Interest Plant Species of the Trinity Ultramafic Region

A cooperative research project sponsored by Sierra Pacific Industries, Shasta-Trinity National Forest, California Department of Fish and Game, and University of California, Berkeley

Project Abstract

Sierra Pacific Industries (SPI), the Shasta-Trinity National Forest (STNF), the California Department of Fish and Game (DFG), and the University of California, Berkeley (UCB), are interested in assessing the abundance and habitat requirements of approximately 50 Special Interest Plant Species (SIPS) that grow on or near a major region of serpentine soil in Trinity, Siskiyou, and Shasta counties, California. A number of these SIPS have potential habitat on private land managed for timber production, wildlife habitat, and water quality and on land managed by the Forest Service for multiple uses. **The project's goals are to test an alternative sensitive plant survey method, to advance plant habitat characterization descriptions, and to better predict effects of land management activities on these habitats**.

There are two phases to this study:

Phase 1. Conduct floristic surveys that sample both privately and publicly managed forestland in the study area to identify new populations of SIPS. An alternative sampling method will be developed that combines random transects with intuitive-directed searches of habitat types where targeted species are expected to be found. New SIPS populations identified within Phase I will contribute to a better understanding of the variability of suitable habitat for these plant species, which will be determined in Phase 2. **Deliverables:** (1) A floristic survey of SIPS within the Trinity Ultramafic region, a species-diverse ecological zone; (2) vouchered plant specimens for deposit in local herbaria; and (3) new plant population reports to the California Natural Diversity Database.

Phase 2. Habitats of newly discovered populations and existing known populations of selected SIPS will be characterized in the field. The goal is to develop and implement a site characterization protocol for SIPS habitat. This information will help us to better predict where future SIPS populations may be found. Proposed habitat characteristics to be measured include

- geographic (elevation, slope, aspect)
- edaphic (soil moisture, degree of soil development)
- plant associates (canopy cover, shrub proximity, herbaceous associates)
- seasonal moisture regime (local weather stations)
- previous disturbance at the site (e.g., timber harvest, skid trails, roads, grazing)

For many species, a combination of these characteristics may be predictive of suitable habitat. For other species, evidence of wider habitat ranges will be valuable information for predicting possible population locations. **Deliverables:** A habitat characterization list for selected special interest plant species.

Introduction

There are a number of plant species that are endemic to, or have ranges largely restricted to, the region around the Trinity ophiolite. This area of Northern California is of special interest because it is a species-diverse ecological zone that is relatively undersurveyed. Several species have been recently described (e.g., *Smilax jamesii*, *Erythronium citrinum* var. *roderickii*, *Arctostaphylos klamathensis*). In addition, the habitat characteristics of many of these species are not well known. Although some species are known to be restricted to serpentinized soil, others are more abundant on serpentine but will also grow on other soil types. Some species grow on harsh, usually rocky sites, whether serpentine or not. Still others are thought to avoid serpentine altogether. However, for many SIPS, not enough populations have been described well enough to make even this basic qualification. The relative importance of serpentine mineralization and its toxic properties and/or nutrient deficiencies, the lack of competition at these sites, and the rocky nature of the substrate to habitat needs is unknown. Addressing these questions will require a better analysis of what areas have been surveyed, the ecological amplitude of the SIPS populations, and a standardized description of the habitat at each population.

Timber production is a major land use on the privately owned land and portions of the Forest Service land in the area. For a number of SIPS, the amount of overlap of their habitat with forested landscapes is unknown. The degree of overlap, and whether it encompasses entire populations, is important in analyzing potential impacts of various types of timber harvest activities on each species. The question of how the disturbance introduced by timber harvesting activities mimics or differs from the natural disturbances under which these species evolved is of great importance in making management decisions. In order to design future studies that test how various species respond to disturbance, both a better representation of populations and a better characterization of habitats are needed. There is also a need to identify the variability of suitable habitat for each of the species. Characterization of many known sites will provide the basis for understanding the degree of specificity of habitat requirements for each species.

Study Area

The far northwestern part of California is known worldwide for its abundant serpentine soils. Ultramafic geology in this region includes the Trinity, Rattlesnake Creek, Western Hayfork, and Sawyers Bar terranes (Miles and Goudey 1997). This region of serpentine soils encompasses a large area of northwestern Trinity county and extends into southern Siskiyou County, eastern Humboldt County, and northwestern Shasta County. Because of the location of intermixed private land, a portion of the Trinity terrane surrounding Trinity Lake was chosen as the focus of this study. The high-elevation areas of the Trinity terrane, which are predominantly under Wilderness or other types of reserves status under federal management, were concluded to be outside the scope of this study. The proposed study area contains approximately 20,000 acres of both serpentine and non-serpentine soils and falls into Ecological Subregions M261 Aj (Upper Scott Mountains) and M261 Ak (Lower Scott Mountains) (Miles and Goudey 1997) (see Figure 1 at the end of this report).

Special Interest Plant Species (SIPS)

The term “Special Interest Plant Species” (SIPS) encompasses species that are

1. Listed under the Federal Endangered Species Act (ESA)
2. Listed under the California Endangered Species Act (CESA)
3. Included on the California Native Plant Society (CNPS) lists 1A, 1B, 2, or 4
4. Included on USDA Forest Service Sensitive or Watch Lists
5. Included on USDI Bureau of Land Management Sensitive or Watch Lists
6. Not included on a list but of interest for conservation or other purposes.

There are about 50 SIPS that are known from, or might be expected to be found in, the study area (Table 1). This table provides the listing status, two habitat categories (described below), the known elevation range, and the approximate identification period for each species. Although other unexpected SIPS that are discovered during surveys will be documented, these targeted species will be used to plan survey timing and to target suitable habitat types to survey in addition to random transect surveys. In Phase 1, floristic surveys will be designed to discover as many populations of these species as possible by conducting surveys for groups of species in areas within potential elevation ranges during the potential identification periods. In Phase 2, revisits to reported sites of selected SIPS, whether in or out of the study area, will be made for the purpose of confirming present site status and recording site characteristics.

Table 1. Targeted SIPS that May Be Encountered in this Study

Species	CNPS	Serp. Cat.	Elevation Range (ft)	Identification Period (Month)											
				J	F	M	A	M	J	J	A	S	O	N	D
Abies lasiocarpa var. lasiocarpa	2	A	5600-6930	X	X	X	X	X	X	X	X	X	X	X	X
Arctostaphylos klamathensis	1B	G	5000-7000			X	X	X	X	X	X	X	X	X	
Arnica fulgens	2	A	5900-8900					X	X	X	X				
Calochortus greenei	1B	A	2100-3400						X	X	X				
Campanula shetleri	1B	A	3600-6000						X	X	X	X			
Campanula wilkinsiana	1B	A	5000-9000							X	X	X			
Carex hystericina	2	A	0-1650					?	X	?					
Carex leptalea	2	A	0-2300					X	X	X	X				
Carex limosa	2	A	3900-8900						X	X	X				
Chaenactis suffrutescens	1B	E	2500-7000					X	X	X	X	X			
Cordylanthus tenuis ssp. pallescens	1B	A	3600-4400							X	X				
Cypripedium californicum	4	E	150- 7000				X	X	X	X					
Cypripedium fasciculatum	4	G	300- 6500			X	X	X	X	X					
Cypripedium montanum	4	A	600- 6600			X	X	X	X	X	X				
Darlingtonia californica	4	G	150- 7300			X	X	X	X	X	X	X	X	X	

Species	CNPS	Serp. Cat.	Elevation Range (ft)	Identification Period (Month)											
				J	F	M	A	M	J	J	A	S	O	N	D
Draba aureola	1B	H	6500-12000							X	X				
Draba carnosula	1B	E	6500-10000						X	X	X				
Epilobium oreganum	1B	G	1000-7400						X	X	X				
Epilobium siskiyouense	1B	E	6500-8000							X	X	X			
Eriogonum alpinum[1]	1B	E	6700-10000						X	X	X	X			
Eriogonum congdonii	4	H	3000-7000						X	X	X				
Eriogonum siskiyouense	4	E	5600-8300								X	X			
Eriogonum umbellatum var. humistratum	4	E	5700-9000					X	X	X	X	X			
Erythronium citrinum var. citrinum	4	G	330-3630			X	X	X							
Erythronium citrinum var. roderickii	1B	G	900-4000			X	X	X							
Erythronium hendersonii	2	A	990-5300				X	X	X	X					
Gallium serpenticum ssp. scotticum	1B	E	3500-6000						X	X					
Hierochloe odorata	2	A	6000				X	X	X	X					
Ivesia longibracteata	1B	A	4000-4600						X						
Ivesia pickeringii	1B	E	2500-5500							X	X				
Juncus dudleyi	2	A	0-6600							X	X				
Juncus regelii	2	A	2600-6300								X				
Lewisia cantelovii	1B	A	1200-5000					X	X						
Lewisia cotyledon var. heckneri	1B	A	2500-8000					X	X	X					
Minuartia stolonifera	1B	E	4100-5300					X	X	X					
Penstemon filiformis	1B	H	1400-6000						X	X					
Penstemon tracyi	1B	A	6600-8000						X	X	X				
Phacelia dalesiana	4	E	4900-7000					X	X						
Phacelia greenei	1B	E	5000-7000					X	X						
Phacelia leonis	1B	H	3600-6300						X	X					
Picea engelmannii	2	A	4000-7000	X	X	X	X	X	X	X	X	X	X	X	X
Pinguicula vulgaris ssp. macroceras	2	E	0-1700				X	X	X						
Polemonium chartaceum	1B	H	8500-14000						X	X	X				
Potentilla cristae	1B	H	5900-9200								X	X			
Raillardella pringlei	1B	E	4000-7500							X	X	X			
Scirpus subterminalis	2	A	2400-7500					?	?	?	?				
Sedum laxum ssp. flavidum	4	H	2500-6600					X	X	X					
Sedum paradisum	1B	A	960-6500						X	X					
Smilax jamesii	1B	A	3600-8300			?	X	X	X	X	X	X	X		
Vaccinium scoparium	2	A	5900-7300				?	?	X	X	X	?			

[1]Listed as “endangered” under California Endangered Species Act

An analysis of the 50 SIPS targeted in this study is shown below by listing status, SPI habitat category, and serpentine habitat category. No species listed under the federal ESA is known from or expected to be found in, the study area.

Listing Status

# Species	List	Description
1	CESA – Endangered	(Eriogonum alpinum)
26	CNPS 1B	Plants Rare, Threatened, or Endangered in California and Elsewhere
13	CNPS 2	Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
10	CNPS 4	Plants of Limited Distribution – A Watch List

Serpentine Habitat Categories

Based on a literature survey and unpublished descriptions of known sites of each species, the 50 SIPS are thought to belong to one of four general categories of using serpentinized soils:

# Species	Serpentine Category	Description
23	A	Avoiders: have never been found growing on serpentine soil

14	E	Endemics: have always been found growing on serpentine soil
6	G	Generally on serpentine soil: more common and/or abundant on serpentine soil, but are also known to grow on other types of soil; comparable to the category Kruckeberg called “indicators” (1984)
7	H	Harsh Sites: usually found growing on harsh, often rocky, sites, whether serpentine soil or some other soil type

Phase 1. Floristic Surveys

A major problem with the current reporting of purported rare plant species is that surveys have often been limited to proposed project areas or the serendipity of populations being discovered in the course of surveying for some other species. Where broader surveys have been conducted, they are rarely planned with a sampling method that allows an analysis of survey effort in relation to potential habitat. Thus, conclusions about the actual rarity of many plant species are not well known. In addition, project-level survey areas in forested landscapes have been biased toward higher productivity forests where timber harvest was traditionally focused. One problem with this type of sampling is known occurrence sites tend to be clustered around project areas. In addition, suitable habitat for many species has been described based on the first populations that happened to be discovered. Only a more general floristic study can assess whether those populations truly represent the range of suitable habitat for that species.

By applying a standardized sampling methodology to a large geographic area, it may be possible to estimate the percentage of many species’ range and habitat that have been surveyed. Surveys without preconceived notions improve the opportunity to locate plant populations growing where they are not expected. Efficiency will be gained by combining surveys for a suite of plant species that can be identified at a certain time. However, very rare species would be expected to have few representatives in a standardized, completely random, sampling method. For example, both the Survey and Manage strategic surveys and a study of serpentine plant associations on the Klamath National Forest found few rare plants in randomized plots. Therefore, this study proposes to survey habitat types previously described for the targeted SIPS in addition to random survey routes.

Surveyors will sample along transect lines, which will be spaced at some sampling interval. The proposal is to choose random transect lines at a spacing that efficiently covers a very large geographic area. Features that tend to be species-rich (such as riparian areas, rocky ridges, and rock outcrops) will be chosen for additional surveys. While walking these transect lines, surveyors may leave the transect line to investigate habitat that intuitively fits one of the habitat types where targeted SIPS are expected. Pilot studies will be done within selected watersheds where one or more of the cooperators has upcoming activity planned. Results from the pilot studies will be used to refine and adopt a survey protocol.

The floristic survey phase is not designed to measure the frequency of any species over the landscape. Rather, the intent is to use a traditional botanical intuitive-directed search protocol along transects so that the geographic area covered and the minimum sampling intensity is known. This approach efficiently meets the goals of locating as many additional populations as possible and of improving chances of discovering populations outside their expected habitat.

Within the study area, a heavier emphasis will be placed on areas of serpentinized soil because it is an important habitat type for many of the targeted SIPS. However, the floristic phase of the study will also survey areas that are not categorized as having a serpentinitic mineralogy for two reasons. First, many of the SIPS from the study area are already known to not grow exclusively on serpentine soils, or to avoid serpentine soils altogether. Second, the level of precision provided by the soil surveys is not adequate to detect the many small outcrops of ultramafic soils in the study area. The “Order 3” soil map created by the STNF will be utilized when choosing additional survey areas. This soil map provides information on the mineralogy of the parent geology (serpentinitic) as well as noting within soil families if the soil is ultramafic. It may also be possible to digitize hardcopy maps created by earlier ecology work in the area during a serpentine plant associations study. Aerial photographs may provide another tool for targeting habitat types. Maps of known populations of the targeted SIPS will be created using a combination of the California Natural Diversity Database (CNDDB maps), STNF known sites, and SPI known sites. These maps will be provided to surveyors to assist with planning additional survey areas.

Each day, surveyors will check off the first instance of each plant species encountered on the list of known plants of the Weaverville Ranger District. Species identified that are not on the known-plants list will be collected and vouchered.

The floristic surveys will document the acreage encompassed by each population discovered, the number of plants, and the demographics of the population. Collections should be made and vouchered if population size is adequate.

Once verified, these populations will be submitted to the California Natural Diversity Database, appropriately summarized as occurrences according to NDDB protocol.

Personnel

A botanist with the appropriate taxonomic expertise to distinguish the SIPS on the targeted list will oversee a four-person crew performing the floristic surveys. Botanists from the STNF, SPI, and DFG will perform quality assurance by visiting sites discovered as soon as possible and perhaps sampling portions of the survey routes where no populations were reported.

Cooperator Contributions

SPI – Funding and contract administration for field work on federal and private land

STNF – Soil maps; SIPS location GIS; list of plants known on the Weaverville Ranger District; assistance developing survey protocol; quality assurance of sites discovered; incidental field time on federal land

DFG – Assistance developing survey protocol; quality assurance of sites discovered

UCB – Assistance developing survey protocol

Phase 2. Site Characteristics

The fundamental questions that botanists must address when assessing suitable habitat are: “Why does this species grow here and not there?” and “Where else could it be expected?” For some species, the answers are fairly well known. For these species, certain habitat characteristics, combined with hypothesized random dispersal and random population extirpation events, adequately describe suitable habitat. Unfortunately, these questions remain unanswered for some species even after laborious study. Nevertheless, it is expected that for many species, a study of geographic, edaphic, plant association, moisture regime, and history of disturbance characteristics will yield patterns that greatly improve our ability to describe (and therefore predict) suitable habitat.

Plot Design

The goal of the site characterization phase of the project is to develop and implement a protocol that standardizes the description of major elements of the habitat of populations of SIPS. Challenges to be addressed in designing a protocol include questions of scale and accounting for linear and irregular features in the landscape. Scale issues arise both in regard to the size of plants and the size of their populations. The SIPS typical of forested habitats range in size from tiny herbs (several centimeters tall), to shrubs, to trees. Populations of SIPS also vary from one or a few plants to clumps of plants scattered over many acres at different densities. Linear features, such as riparian zones and rocky ridge-tops, are expected to be important landscape features at SIPS sites. Because this phase of the study emphasizes edaphic characteristics, the irregular size and shape of soil types and features such as rocky outcrops (and their relation to population polygons) need to be considered in plot design. The life histories of the targeted SIPS include annuals, perennial herbs, shrubs, and long-lived trees. Differences caused by these life-history strategies, as well as seed dispersal and vegetative reproduction differences, may affect the delineation of a population from year to year, and how plots are designed.

The pilot stage of this phase will develop and test plot designs that define the size, shape, and number of plots that will be measured in SIPS populations. These parameters will likely be different for SIPS of different sizes, life histories, population sizes, and will take into account different landscape features.

Geographic

A polygon defining the shape and size of the population will be mapped. For each population polygon, the range of elevations, slopes, and aspects will be recorded. A census of plants and their phenology (percent vegetative, flowering, and fruiting) will be made. For perennial species, observations about seedlings, vegetative reproduction, and so forth, will be made.

Edaphic

Other researchers and land managers have recognized the need to integrate soil science and geology with the study of vegetation. For example, the USDA Forest Service developed a protocol for its Ecological Unit Inventory (EUI) program that utilized a team made up of a geologist, a soil scientist, and an ecologist to delineate polygons with shared characteristics. Although the goal of the EUI program was to form the basis for land-management decisions on public lands, the multidisciplinary approach developed techniques that are useful for studying the habitat of SIPS. The major change in emphasis is that the techniques will only be applied to known populations of SIPS.

The degree of weathering of ultramafic rocks to produce the soils described as “serpentine” varies dramatically. However, Brooks (1987) listed the following four general characteristics:

1. High concentration of siderophile elements such as iron, chromium, nickel, and cobalt
2. Low concentration of plant nutrients such as nitrogen, phosphorus, and potassium
3. Low calcium/magnesium quotient compared with non-serpentine soils
4. A tendency to have lower clay contents than “normal” soils and the clay minerals that occur tend to have a low exchange capacity

Early California botanists, (e.g., W. L. Jepson, E. L. Greene, K. Brandegee, A. Eastwood) did not record whether their specimens were growing on serpentine (Brooks 1987). More recently, botanists have used two divergent methods to describe the edaphic habitat of species. First, some field workers use soil survey maps to determine if the soil family is ultramafic. In the study area, the Beaughton, Copsey, Deadfall, Dewmine, Dubakella, Gozem, Grell, Henneke, Ishi Pishi, Kang, Parks, Shadeleaf, Tamflat, Toadlake, and Weitchpec soil families are considered ultramafic. This method is limited by the precision of the soil survey maps used, which typically are not scaled to delineate the small pockets of soil types common to the study area. The second method is an assessment in the field based on soil visual characteristics and “indicator” plant species. This method is limited by the expertise of the surveyor and the degree of specificity for serpentine soil displayed by for the “indicator” species chosen.

Plant Associates

Many field botanists are still describing plant associates without regard to the amount of competition provided by the associated tree, shrub, and herbaceous species. Often, the habitat description of a SIPS population is based solely on an herbarium label from one collection. Therefore, it is often not clear from a population description whether an associated plant is helpful (i.e., a “nurse” plant), a competitor that may be in the process of overtaking the rare plant, or is merely an indicator species because it does well in similar microhabitats.

This phase of the study will used nested plots inside populations to measure the coverage and proximity of tree, shrub, and herbaceous species. Canopy cover will be recorded in the nested plots. Litter depth will also be recorded.

Moisture Regime

Previous research has indicated that more favorable climates tend to support more species on serpentine. (Brooks 1987, p. 132). A Campbell 20-cm hand-held water content meter will collect soil moisture data at each plot. This microsite data will be correlated to mesoclimate information being collected by SPI fire weather stations at nearby Usher and Reading Creeks.

Previous Disturbance

Because timber production is a major land use in the Trinity Ultramafic Region, this study is designed to lay part of the groundwork for a long-term project that investigates population persistence or reestablishment after the types of disturbance typical of timber harvest activities. As a first step, sites will be characterized for evidence of previous disturbance. Within the plots, stumps, skid trails, landings, roads, gravel borrow-pits, and the like will be noted. The silvicultural prescription and approximate harvest date will be estimated. Sites with silvicultural data available will be matched for previous herbicide use, site-preparation techniques, and so forth.

Cooperator Contributions

SPI – Funding and administration of field work on federal and private land; vegetation correlations
STNF – Assistance developing plot protocols; incidental field time on federal land
DFG – Assistance developing plot protocols
UCB – Assistance developing plot protocols

Significance of the Project

This project has important implications for management decisions involving these SIPS. Better information on actual abundance and site characteristics will support better management decisions concerning potential impacts to these species. Structured, consistent, habitat descriptions will help determine the range of suitable habitat that may support many of the species. The discovery of more sites of some species will lay the foundation for disturbance studies by providing a range of sites from which to choose study plots.

For the floristic phase of the study, an article reporting the results of the populations discovered, along with a description of the sampling method adopted, will be written. This would be publishable in *Madrono, The American Journal of Botany,* the *Journal of Forestry,* or the *Western Journal of Applied Forestry*. New population occurrences would also be submitted to the NDDB. For the second phase of the study, an analysis of the site characteristics by species would be prepared for submittal to a journal.

Timetable

Phase 1

April – August 2002	Floristic surveys; refine and adopt sampling strategy
September 2002 – March, 2003	Catalogue data; vouchers; submit database info to state

Phase 2

April – September 2002	Pilot plot measurements; refine and adopt plot protocol
October 2002 – March 2003	Data analysis and report preparation

Personnel

SPI: Cajun James (Principal Investigator), Principal Research Scientist. Ph.D. (Cand.) (Wildland Resource Science), University of California, Berkeley; Tom Engstrom, Forester. B.S. (Forestry), M.F., University of California, Berkeley

USFS: Julie Kierstead Nelson, Forest Botanist. M.S. (Botany), Oregon State University; Susan Erwin, Weaverville District Botanist

DFG: Pete Figura, Environmental Specialist III. B.S., M.S. (Botany), California State University, Humboldt

UCB: Dr. Joe R. McBride, Professor, College of Natural Resources; Dr. W. Dean Taylor, Jepson Herbarium

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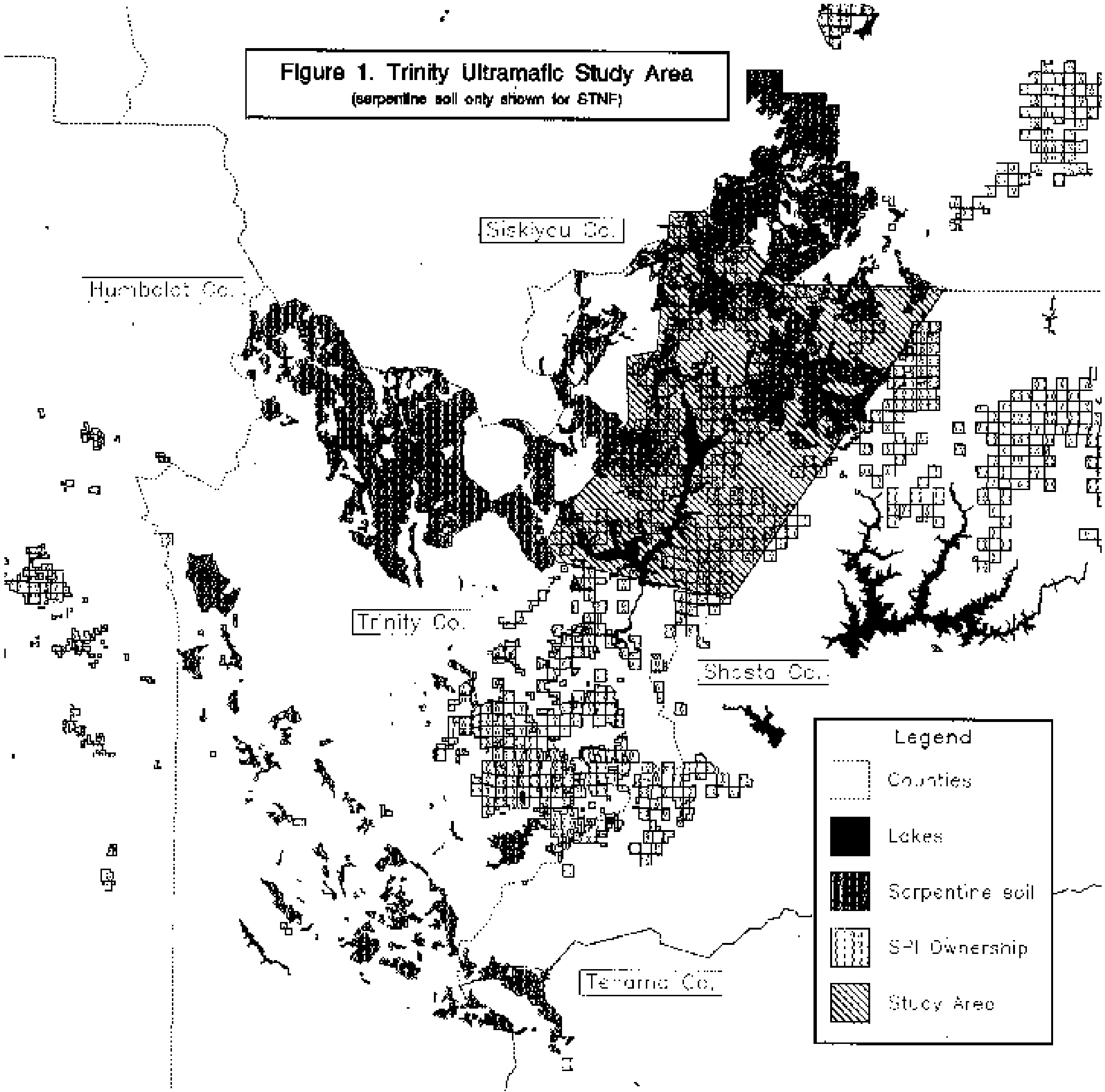

This map shows private lands in shaded sections. The USDA - Forest Service manages all other lands on this map.