4.12) Red Fir Plots (Pitcher Plots)

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INTRODUCTION

Ecological relationships and long-term stand dynamics of red fir forest have been poorly studied in the Sierra Nevada. Most studies have been descriptive, concentrating on composition, structure, and very basic biology (Oosting and Billings 1943; Pitcher 1981; Barbour and Woodward 1985; Laake et al. 1996). Similarly, fire effects information is sparse and poorly understood for this forest type in the Sierra, although the first prescribed burn of over a few acres in size in the western United States was carried out and studied in a red fir forest in Kings Canyon National Park (Kilgore 1971). Within Sequoia and Kings Canyon National Parks red fir forest comprise approximately 26,511 ha or about 13.2% of the parks' vegetation (based on parks' GIS vegetation maps). Within this forest type a range of natural burn severities and potential fire effects appear to exist, from understory burns with minor impacts on stand structure to severe burns that are stand replacing events (Pitcher 1981; Taylor 1993; Carl Skinner personal communication). The spatial scale of these events also appears to vary within stands.

Sequoia and Kings Canyon National Parks have been carrying out an expanding burn program which has included a substantial amount of prescribed burning in this forest type with even greater acreage planned for the future. This has led to the realization that a better understanding of both the long-term role and specific ecological effects of fire in this ecosystem is needed. This would include aspect differences, fuel load and its variability, fire behavior, variability in forest structure and demographics, and an improved classification scheme for this wide ranging vegetation type.

In the late 1970s Donald Pitcher (graduate student at UC Berkeley) established three permanent plots near Mineral King to study forest structure and composition (what species are present and how they are arranged in a forest), and fuel dynamics (fuels available to forest fire) (Pitcher 1981). Because little long-term data from red fir forest exist, resampling these plots will provide information to park managers on changes in forest structure and composition, and fuel loads over the intervening 20 year period. Additionally, postburn sampling will provide detailed information on forest changes and fire effects. When combined with the detailed spatial data (tree locations, fuel loads, crown dimensions) this data will provide an excellent opportunity to examine changes over time and fire effects at a degree of sophistication not usually available. Our understanding and interpretation of fire effects and longer-term postfire vegetation responses will be improved by having the 20 years of background information.

STUDY AREA

The three plots established by Pitcher (1981) are located in red fir forest along the Tar Gap Trail **(Fig. 4.12-1**). They were established in roughly three forest "age types" on a north aspect: plot #1 in "mature" red fir forest, plot #2 in "young" red fir forest, and a mixed stand with patches of young and old trees (plot #3). They were relocated in 1995 and have been resampled prior to the burning of Tar Gap Segment (segment #10) in 1999. UTM coordinates for each plot have been obtained using a PLGR to facilitate their relocation in the future (**Table 4.12-1**). Plots #1 and #2 are in close proximity to one another and plot #3 about 1.5 km away. At this time the latter plot is being maintained as a control by protecting the immediate plot area and a small surrounding buffer zone from burning.

Within the plots the dominant tree species is red fir (***Abies magnifica***) with a significant component of western white pine (***Pinus albicaulis***). Lodgepole pine (***P. contorta***) is present but very uncommon. Understory vegetation is extremely sparse with small patches of chinquapin (***Castanopsis sempervirens***)

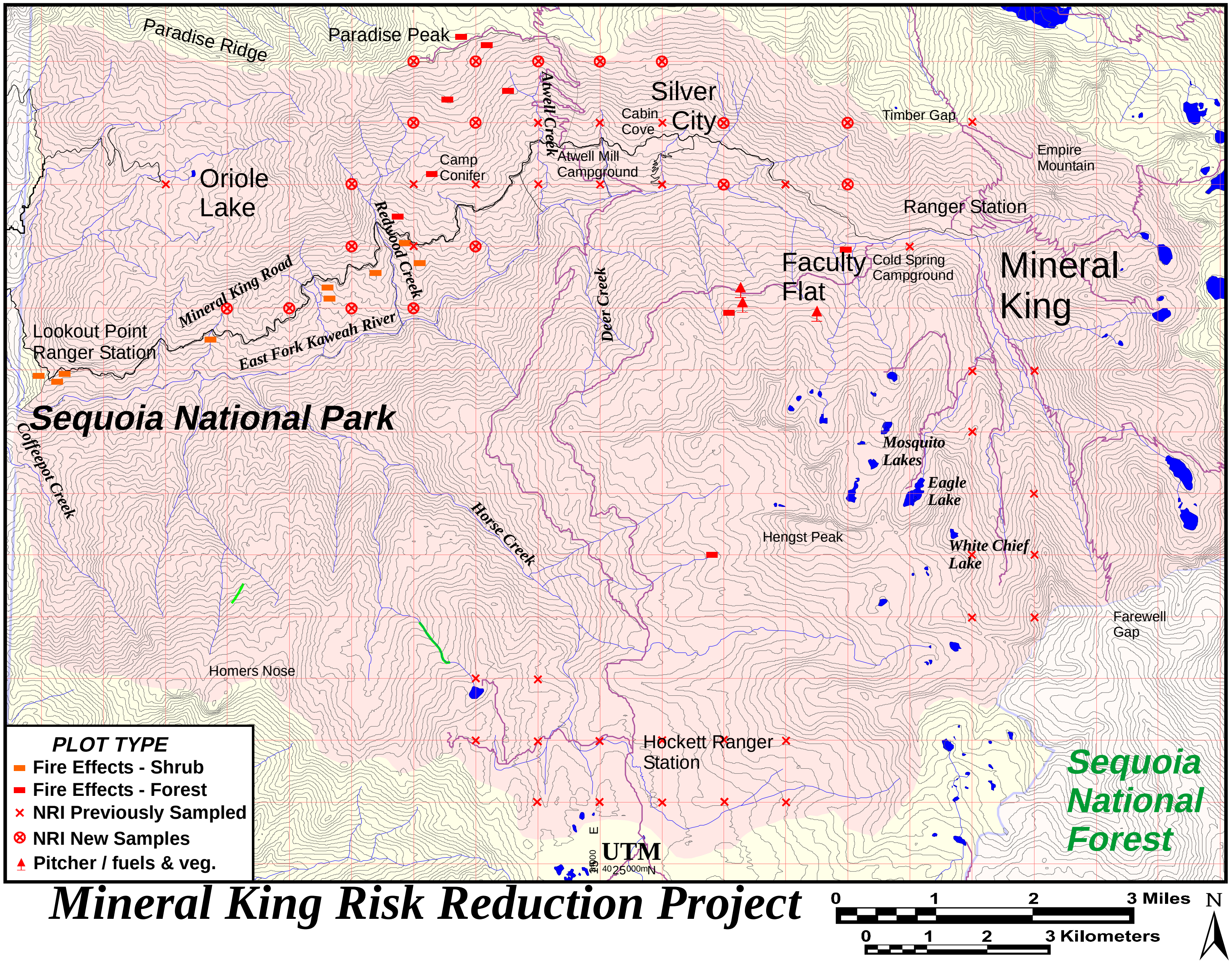

Figure 4.12-1. Plot location for vegetation sampling projects.

Table 4.12-1. UTM locations and elevation of the NE corner of each plot.

Plot	UTM North	UTM East	Elevation	Plot Size
Plot #1	4033980 N	353328 E	2545 m (8400 ft)	80 x 80 m
Plot #2	4034150 N	353273 E	2485 m (8200 ft)	50 x 50 m
Plot #3	4033910 N	354464 E	2612 m (8620 ft)	50 x 50 m

the most common. Herb species are widely scattered. Primary fuel model in the area is model 8; consisting mainly of red fir. Secondarily, model 5, composed mainly of greenleaf manzanita (***Arctostaphylos patula***) and chinquapin, represents the remainder of the area (on more open drier slopes). The fire history of the area was originally studied by Pitcher (1981, 1987) and recently expanded and updated (Caprio 1998, 2000). Plots # 1 and #2 last burned in 1886 and plot #3 in 1848 based on fire scarred trees sampled nearby. Between 1400 and 1899, at plots #1 and #2, nine fires with fire intervals ranging from 9 to 87 years was found, while at plot #3 five fires with fire intervals ranging from 27 to 119 years were found.

DATA COLLECTION

I was fortunate to be able to relocate Donald Pitcher and he was kind enough to provide us with a copy of his original data set which has been partially re-entered into digital format from the paper printout. This data set is being checked for errors, although portions were used to make preliminary estimates of changes in the plots. Utilizing the original data set will greatly facilitate comparisons between the 1978

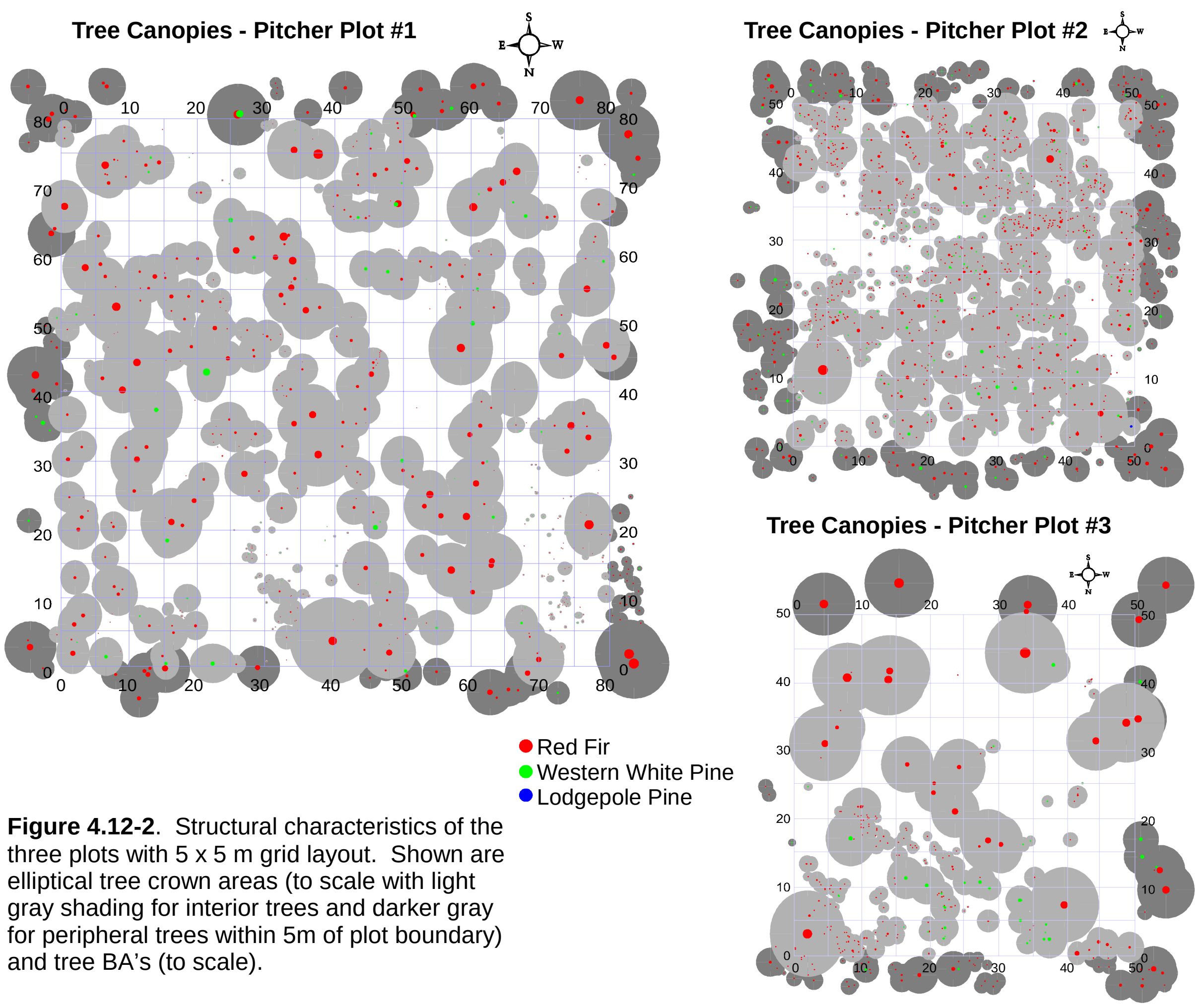

Figure 4.12-2. Structural characteristics of the three plots with 5 x 5 m grid layout. Shown are elliptical tree crown areas (to scale with light gray shading for interior trees and darker gray for peripheral trees within 5m of plot boundary) and tree BA's (to scale).

sampling and the current sampling, since we will have the exact measurements and locations for trees from the original data. As a result we will be able to describe changes in DBH, fuels, and stand structure over the intervening time very accurately.

Preburn resampling of all three plots was completed in 1999. Data recollected on the plots included: DBH, mortality checks (1978-1998), fuel, fuels, plus canopy cover, width and height . Additional data (location, species, and DBH) were also collected on peripheral trees, those trees > 1.4 m high that have stems within five meters of a the plot boundary, since these trees would influence trees in the outer subplots of each plot (see **Fig. 4.12-2**). For example, canopies of these peripheral trees overhang the outer subplots and mortality or fire effects in these subplots may be related to stand characteristics in adjacent areas (for instance tree density or size classes). Canopies of these trees were estimated using the relationship between BA and canopy cover of the internal plot trees.

During August 1999 plots #1 and #2 were burned in the Tar Gap Segment. Burning conditions were good through most of the burn operation (burn boss: Jeff Manley). Ignition was begun at 2,757 m elevation on August 17 with strip spot ignitions at 20-30 meter intervals down to the Tar Gap Trail. Ignition was completed on August 20 with the unit continuing to smolder into November due the unusual dry fall conditions. Total area burned in this unit was 54 ha (total area burned in the Tar Gap Segment was 170 ha).

Table 4.12-2. Fuel moisture.

Fuel Type	Percent
Duff	7%
Litter	12%
1 Hour	14%
10 Hour	11%

Table 4.12-3. Temperatures and relative humidity during burns.

Date	Maximum Temperature (time observed)	Minimum Relative Humidity (time observed)
8/17/99	69° (1530)	28% (1530)
8/18/99	66° (0945)	39% (0945)
8/19/99	70° (1200)	9% (0915)

Because of the Pitcher plots and a number of other research plots located in the area fire weather and burn operations were well monitored. Fuel moisture data was collected prior to the burn following monitoring protocols was tracked throughout the burn using 10 hour fuel sticks located adjacent to the Tar Gap trail. Fuel moisture samples for litter, duff, 1 hr, 10 hr, and 100 hr fuels were also collected (**Table 4.12-2**). Spot weather forecasts were requested each morning prior to ignition. On-site weather **(Table 4.12-3**), fire behavior (**Table 4.12-4**), and smoke observations were taken throughout ignition periods at regular intervals

Table 4.12-4. Fire behavior observations on days when plots were ignited (H = head fire, F = flanking, B = backing)

Date	Spread Direction	Avg. Rate of Spread	Avg. Flame Length	Avg. Flame Zone Depth	Avg. % Slope
8/17	H	.6 c/h	12-18´´	5-6´´	35%
8/17	B	.25 c/h	2-5´´	1-3´´	30%
8/18	H	.75 c/h	11-15´´	4-5´´	28%
8/18	F	.15 c/h	6-8´´	2-4´´	30%
8/18	B	.16 c/h	4-5´´	1-2´´	35%
8/19	H	.6 c/h	13-21´´	7-12´´	35%
8/19	F	.2 c/h	1-2´´	2-3´´	35%
8/19	B	.2 c/h	2-3´´	1-2´´	35%

Postburn fuel sampling was completed following the burning of plots #1 and #2 during September 1999. This included the modified Brown's transects and a detailed mapping surface fuels consumed during the burn (**Fig. 4.12-3** and **4.12-4)**. Based on these burn maps surface area burned in the two plots was 74.6% and 36.8% respectively for plots #1 and #2. The difference in area burned is probably a reflection of stand age, structure and fuel accumulation with significantly greater fuel load in plot #1 (see **Fig. 3.12-11** Caprio 1998). Total fuel reduction at a nearby (200 m) fire effects plot (FABMA1T08-101) was 57.9% (Keifer and Dempsey, personal communication).

PLANS FOR 2000:

Postburn sampling will be completed during the summer of 2000. This will include mortality checks and postburn canopy characteristics.

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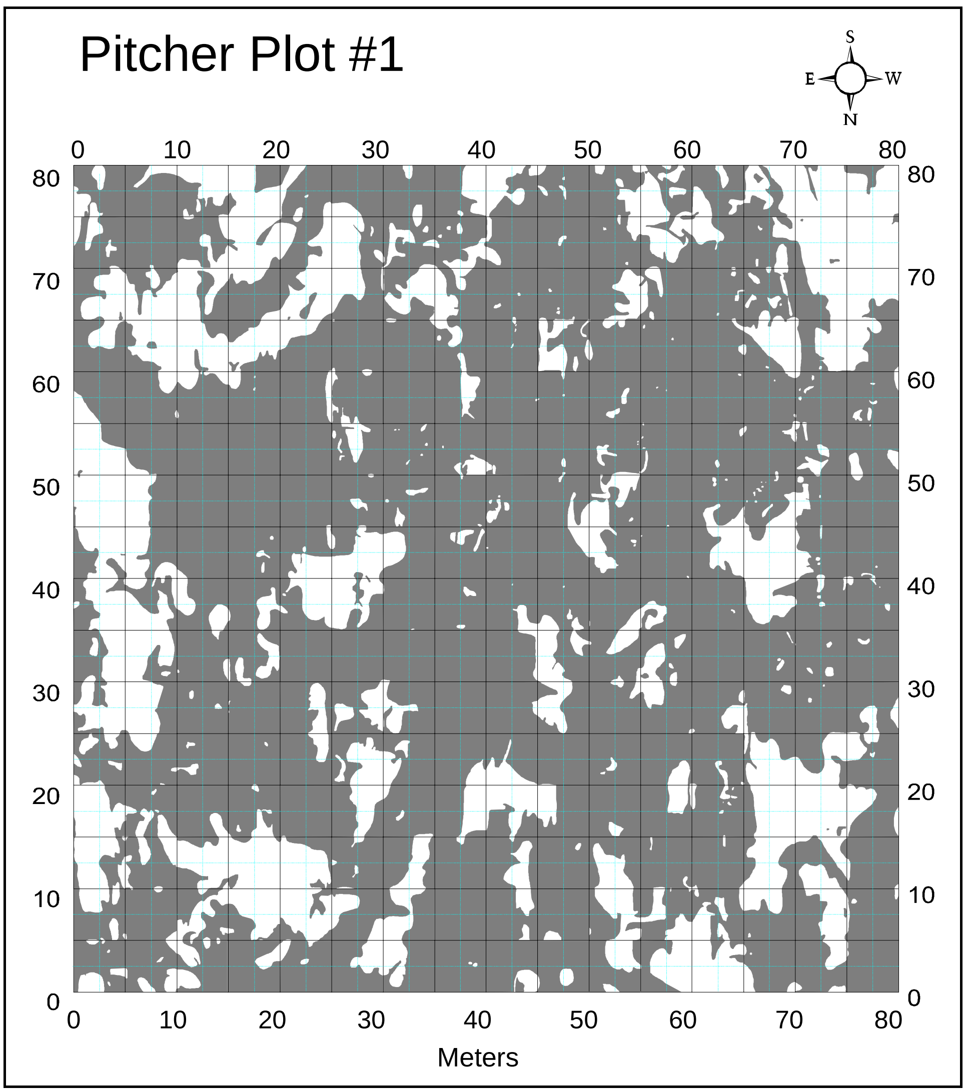

Figure 4.12-3. Surface area burned (grey shading) in plot #1.

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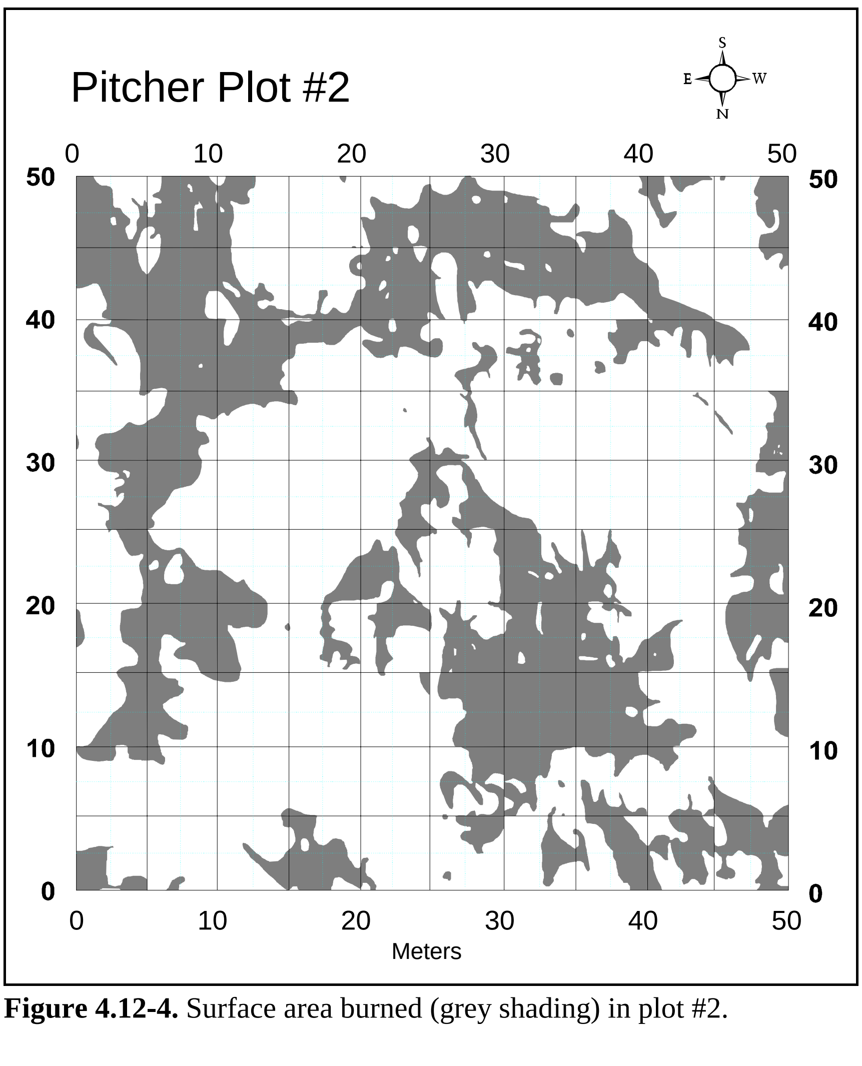

Figure 4.12-4. Surface area burned (grey shading) in plot #2.