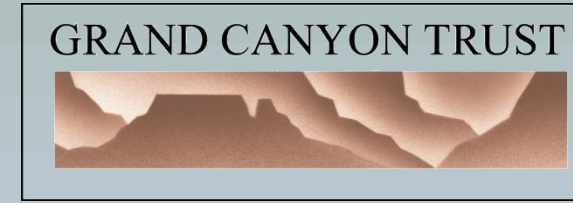


A Rapid Plot Monitoring Design for the Kaibab National Forest

Christopher Ray, Ophelia Wang, Luke Zachmann, Brett Dickson
Lab of Landscape Ecology and Conservation Biology
Northern Arizona University, Flagstaff, AZ
christopher.ray@nau.edu, ophelia.wang@nau.edu,
luke.zachmann@nau.edu, brett.dickson@nau.edu



Matt Williamson
Grand Canyon Trust
Flagstaff, AZ
mwilliamson@gcanyontrust.org



Valerie Stein Foster, Ariel Leonard
Kaibab National Forest
Supervisor's Office, Williams, AZ
vkstein@fs.fed.us, aleonard@fs.fed.us



Travis Belote
The Wilderness Society
Bozemon, MT
travis_belote@tw.s.org



Cory Davis
Southwestern Crown of the Continent Collaborative
University of Montana, Missoula, MT
cory.davis@cfc.umt.edu



Overview

We developed a “rapid plot” vegetation monitoring design to be implemented across all of Kaibab National Forest (KNF, Figure 1). Our objective was to provide a transparent method of data collection to track changes in major vegetation types through time in a financially and time-efficient manner. Our approach complements, but does not replace, project level monitoring. It aims to capture parameters of interest that will inform progress toward desired conditions related to vegetation structure, function, and composition. The variables to be measured were chosen to maximize sampling efficiency. We conducted a statistical power analysis to derive a minimum sample size required to detect change, and developed a statistical guide to assist Forest Service personnel with analysis of the data.

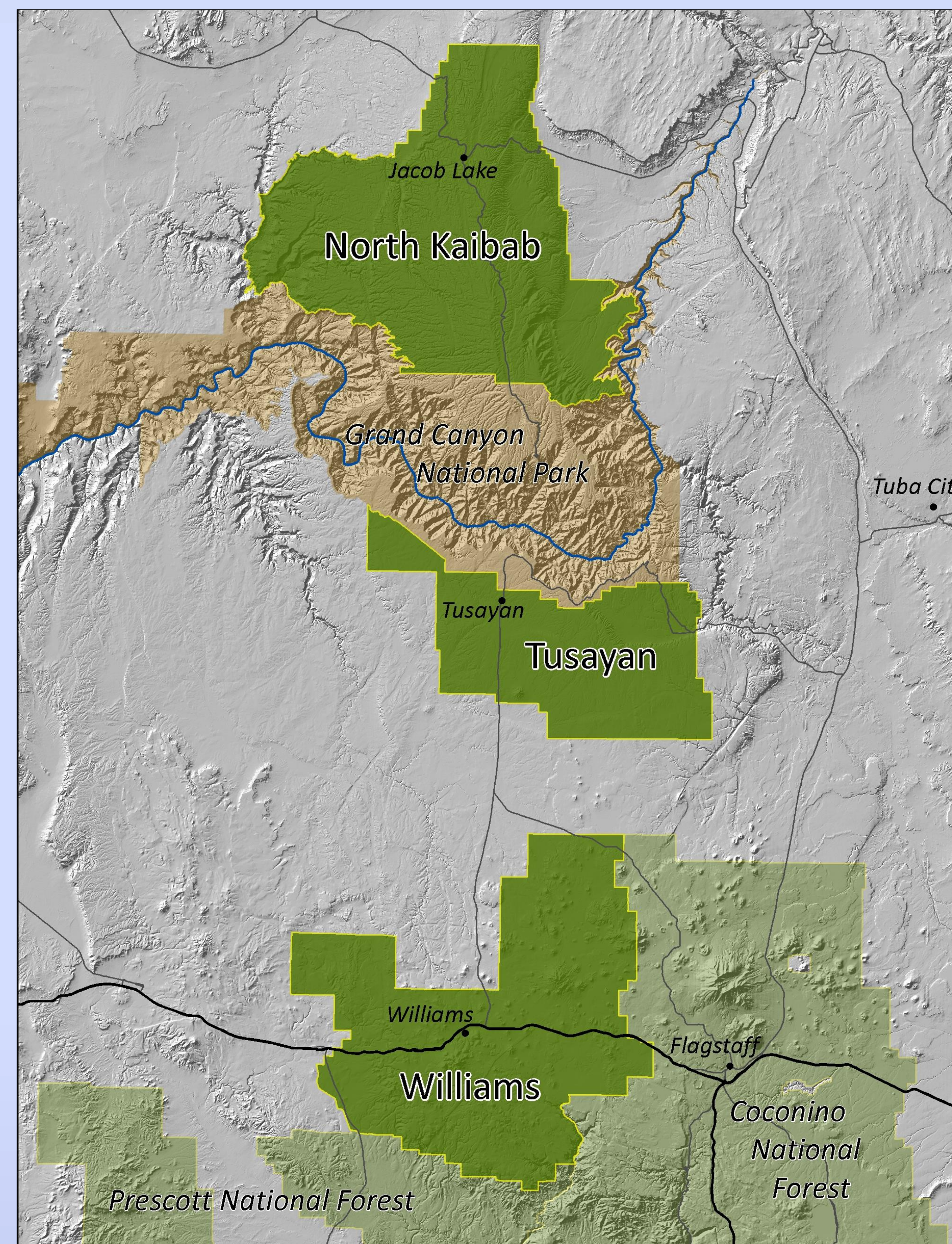


Figure 1. Map showing the three ranger districts of Kaibab National Forest (dark green) in northern Arizona.

Plot Placement and Design

We conducted a power analysis to determine the number of plots necessary in each vegetation type to detect 2-6% annual change in the variables of interest at an 80% power level.

We assigned a dominant cover type to KNF stands using broad vegetation classes of aspen, grassland, mixed conifer, oak, pinyon-juniper, ponderosa pine (*Pinus ponderosa*), and spruce-fir. We distributed the total number of plots in each vegetation class proportionally the area of KNF covered by that class (Table 1). Project area-specific plots could be located prior to treatment and paired with control plots, similar to a before-after-control-impact (BACI) study design.

We used a circular plot design to maximize efficiency setting up plots in the field and to reduce “edge effects” from perimeter : area ratios (Figure 2). Precisely geo-referenced plot centers allow data collected on these plots to be related to remote sensing platforms and characterize ecological conditions at multiple spatial extents.

Live tree, snag, and downed logs will be classified into diameter classes using a “go/no go board”. Fine fuels will be assessed by measuring the depth of litter/duff on the forest floor and through photo analysis. Presence/absence of invasive species will also be recorded.

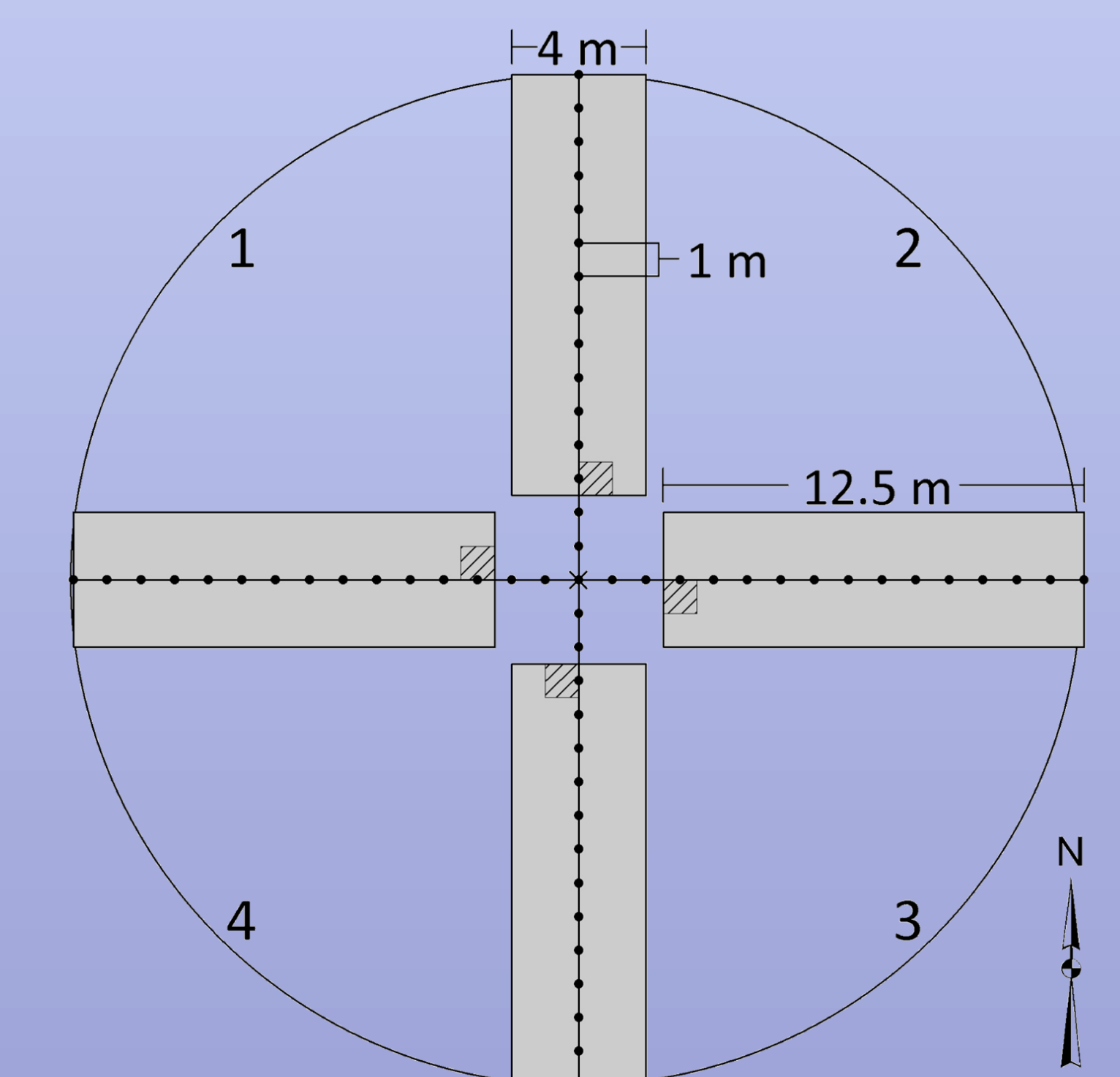
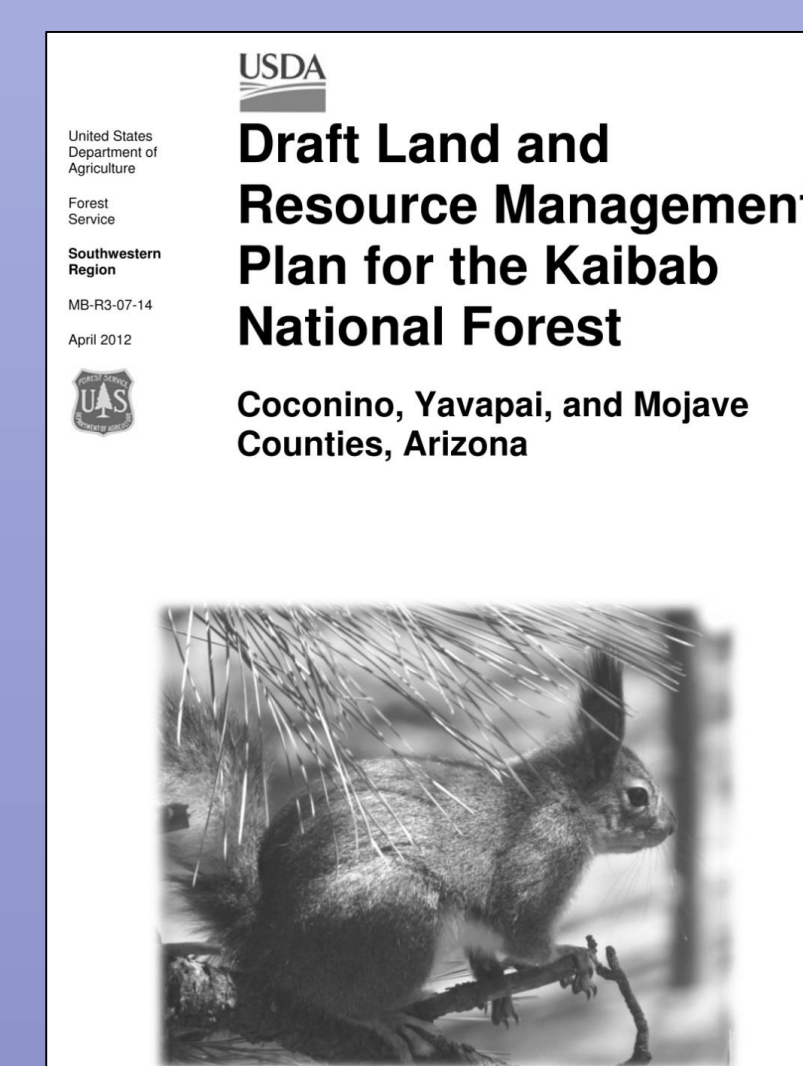


Figure 2. Rapid plot design for monitoring vegetation on Kaibab National Forest: each plot consists of two perpendicular 30-m point-intercept transects, with 1m² quadrats along each transect at 2.5 m from the plot center. Four 4 m X 12.5 m belt transects are located along the point-intercept transects.

Variable Selection

We developed a list of variables to be measured at each rapid plot with emphasis on 1) relevance to the monitoring goals outlined in the draft revised Kaibab National Forest Land Management Plan (LMP) and 2) the information gained by measuring the variable relative to time efficiency. The type of data collected will vary by cover type, due to the need to capture relatively rare ecosystem elements throughout the variety vegetation systems present in the Forest. We selected a group of 17 variables (based on specific forest plan monitoring questions) to be measured as indicators of the following forest components:

- Diameter distribution of all live trees and snags
- Understory community
- Amount and distribution of coarse woody debris
- Fine fuels
- Encroachment on aspen, grasslands and oak
- Soil disturbance and non-native invasive species



Cover type	North Kaibab	Tusayan	Williams	TOTAL
Aspen	17	-	5	39
Grassland	25	17	33	58
Mixed conifer	16	-	6	22
Oak	10	7	15	32
Pinyon-juniper	35	33	43	111
Ponderosa pine	34	22	43	99
Spruce-fir	18	-	1	19
TOTAL	155	79	146	380

Table 1. Number of rapid monitoring plots by cover type and district on Kaibab National Forest.

Implementation

The data collected through this monitoring design will allow KNF to assess the effectiveness of the LMP in directing management towards desired conditions. Statistically sound and robust data provide an empirically based platform through which the LMP can be adapted over time as knowledge changes and/or improves as a result of monitoring.