# Appendix A: Methodology for Photo Monitoring of Change in Vegetation or Soil

## Contents

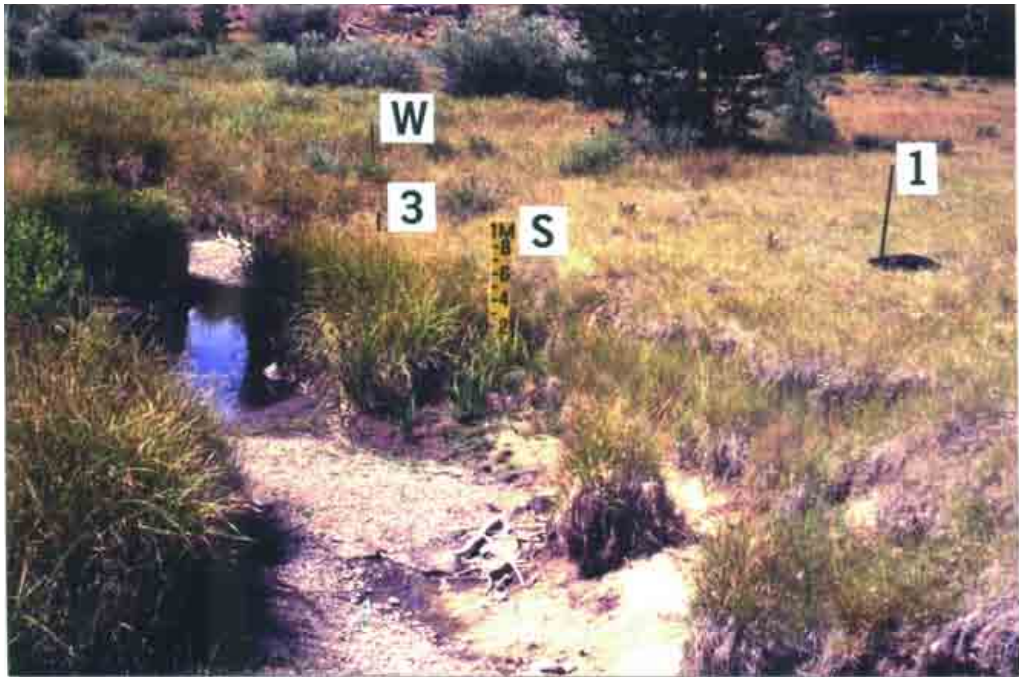


Figure 40—Ageneral photograph taken in 1997 with the topic of streambank stability. It is part of a riparian study on Emigrant Creek, Snow Mountain District, Ochoco National Forest, near Burns, Oregon. The site is Pole Camp, a place livestock find highly attractive. The location of Pole Camp is shown on the map in figure 41. This streambank photo point is taken up stream from camera location 2 shown on the map in figure 42. Fencepost 1 is camera location 1, fencepost 3 is camera location 3 looking downstream at photo point S, S is photo point streambank, and fencepost W is photo point wet meadow. Other views of this streambank are shown in figures 23 and 49.

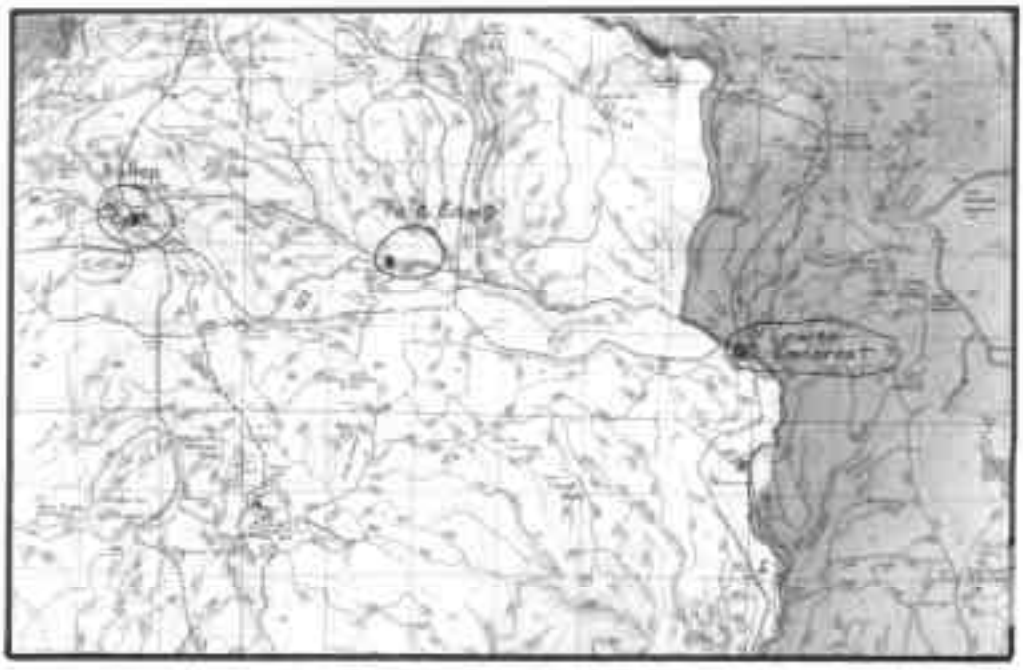

Figure 41—Local map showing location of the Emigrant Creek riparian study, Snow Mountain District, Ochoco National Forest, near Burns, Oregon. Three study areas are shown: Button Meadow at the head of Crowfoot Creek, Pole Camp shown in figures 20, 23, 26, 40, 44 and 49, and Lower Emigrant. This is one of two essential maps designed so people other than those installing the monitoring system can find the sampling sites. The other map is shown in figure 42.

## Introduction

This appendix contains instructions on how to apply various photographic sampling methods designed to document changes in vegetation or soil on specific tracts of ground. It does not deal with general landscape photography or remotely operated cameras.

Nine photographic methods are discussed:

1. General photography where a scene is followed over time.
2. Topic photography dealing with a selected item, such as a streambank (fig. 40) or logging disturbance (fig. 21).
3. Grid analysis of photographs to document change in the selected topic or item.
4. Shrub sampling to record change in shrub profile area, usually accomplished by use of grid analysis.
5. Transect photography, in three dimensions, of square-foot plots.
6. Transect photo sampling of nested frequency plots.
7. Transect sampling of meter square (or 3-ft square) plots photographed at an oblique angle.
8. Photo documentation of tree canopy cover.
9. Photo records of herbage utilization using the Robel pole system.

All nine methods have several features in common, which are detailed in the following sections.

### Selection of an Area

Selection of a monitoring area requires professional expertise liberally dosed with artistic finesse. The **purpose** for photographic monitoring is the most critical factor: Where in the landscape is the topic of concern, and once at the area, what kind of change should be documented? In some cases, *where* is straightforward; for example, documenting impacts of logging requires going to an area being logged (fig. 21) and documenting effects of beavers on a stream requires finding beaver dams. On the other hand, documenting impacts of livestock grazing requires understanding livestock distribution plus knowing the location of areas sensitive to grazing and the most critical season of use (figs. 20 and 40).

Once in an area, determine specifically what is to be documented for change. In figure 40 at Pole Camp, for example, the purpose was to document effects of livestock grazing on a riparian area. Pole Camp was selected because livestock preferred it. Specific objectives were to evaluate grazing effects on streambanks, willow shrub utilization, and differences in use between grass and sedge sites (Kentucky bluegrass by the fencepost on the right [1]) and sedge (at the fencepost in the background [W]). The topic in figure 40 is streambank stability.

Another example is the ponderosa pine stand shown in figure 21. In this case, the purpose for photo sampling was to document effects of a two-stage overstory removal and subsequent precommercial thinning on stand structure and ground vegetation. The site was selected based on the sale area. Stand conditions of open pine and clumped reproduction across an opening were chosen for the photo point. The opening was selected to avoid tree crown encroachment between the camera location and photo point and to appraise logging effects on livestock forage. It was photographed before and after each entry (fig. 21).

**PHOTOGRAPHIC SITE DESCRIPTION AND LOCATION**

Date 1974/10/5 Area Snow Mtn. Dist.
Unit Pole Camp Observer: F. C. Hall
No. of Camera locations: ~~X~~ 5 No. of Photo points: ~~X~~ 4
Plant community Dry & wet meadow; willows
Location: T. 19S R. 27E Sec. 29 SW of NE
Location description S of rd 43; 0.25 mi W of junc. 43 & 4365 rds off of turnout at E end of meadow
Photo purpose: Document effects of change from season-long cattle use to 3-pasture rest-rotation
Discussion: Three photo points established in Oct 1974 documented dry meadow (D), wet meadow with willows (W) and a fallen block of sod at the stream edge (S). (1997) Flood of 2/96 washed out beaver dams & created a new channel. Shrub sampling initiated 6/97.

**MAP**

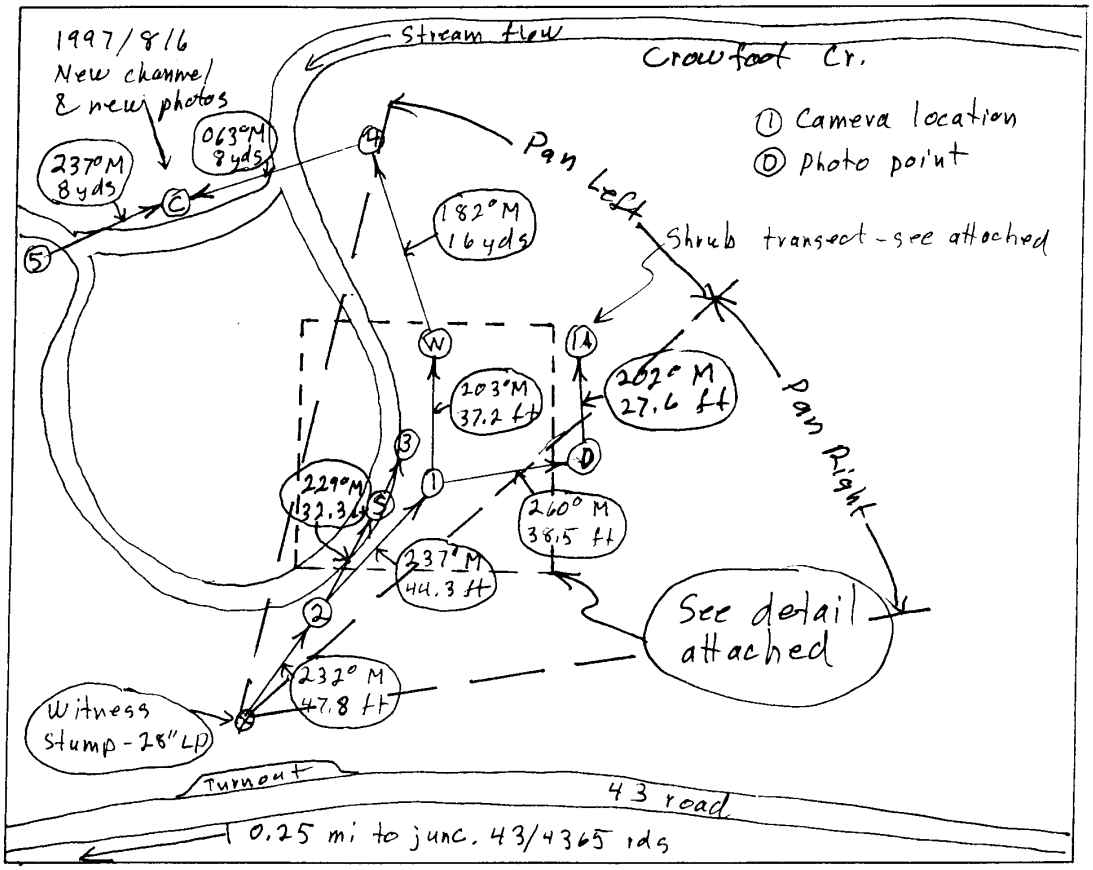


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Figure 42—Filing system form “Photographic Site Description and Location” showing the monitoring layout for Pole Camp. Note in the lower left corner a reference to the junction of roads 43 and 4365 at 0.25 mi. Immediately opposite the road turnout is a 28-in-diameter lodgepole pine stump. An aluminum tag, orange for visibility, is attached to the stump with directions and distances to camera locations: a witness site. An additional map, noted by the square labeled “See detail attached,” is shown in figure 27. It documents triangulation of the streambank photo point. Another note, “Shrub transect - see attached,” installed in 1997, is shown in figures 64 and 65.

### When to Photograph

When to photograph usually is determined by the activity being monitored. Pole Camp is part of a study evaluating effects of cattle grazing on a riparian area. Figure 20 includes photographs taken three times per year corresponding to livestock activity: June 15 before grazing, August 1 as cattle change pastures, and October 1 after animals leave the allotment. This three-season monitoring is repeated every year.

The ponderosa pine stand (fig. 21) illustrates a very different monitoring schedule. Photography was planned for the first week in August so that vegetation development would be consistent. Photographs were taken just before logging and in each of the two growing seasons afterward to document rapid changes in ground vegetation. Then a 5-year rephotographing cycle was established to follow slower changes in both stand structure and ground vegetation. The routine was repeated with the second logging and the precommercial thinning.

If vegetation is a primary topic, consider establishing a fixed date for rephotography. An established date has several advantages: (1) It offers an opportunity to evaluate seasonal differences in plant phenological development, (2) it provides a consistent reference for comparing change over several years, and (3) it establishes a consistent time interval over which change is documented.

### Maps to Locate the Monitoring System

When the photo monitoring system has been established, prepare maps to locate the area and document the sampling layout. Assume that the person installing the monitoring program will **not** be the one to find and rephotograph the area. Provide maps and instructions accordingly. A local map showing roads and site locations is illustrated in figure 41 for Pole Camp, one of three locations for the Emigrant Creek riparian study.

After establishing the sampling system, establish a witness site or tree which marks the area. Identify it with a permanent marker, such as an orange aluminum tag, and determine direction and distance to camera locations or transects. Inscribe these on the identification tag. Next create a map of the camera locations and photo points or transects with directions and measured distances by using the filing system form "Photographic Site Description and Location" (fig. 42) found in appendix B. Note whether the direction is taken in magnetic or true degrees by indicating either "M" or "T." A 21-degree deviation in the Pacific Northwest must be accounted for. Measure distances between witness site, camera location, and photo points on the ground. Do not convert to horizontal distance.

**Fenceposts or stakes**—Monitoring, by definition, means repeated observation. Therefore, all camera locations, transects, and photo points must be permanently marked. The recommended method is with stamped metal fenceposts (fig. 40). These cost about $2.25 each for a 5-ft size in 2000. Stamped metal has several advantages over strong T-bar posts: the former are flimsy and will bend if driven into by a vehicle or run over by an animal; they will bend flat and remain in the ground to mark the spot; they resist theft because they are just as difficult to pull out as a good fencepost but not worth the trouble; and they are easy to carry and pound. But the primary advantage of flimsy fenceposts is their visibility, as shown in figure 40. If visibility is not desired, steel stakes are a choice but require a metal detector to relocate.

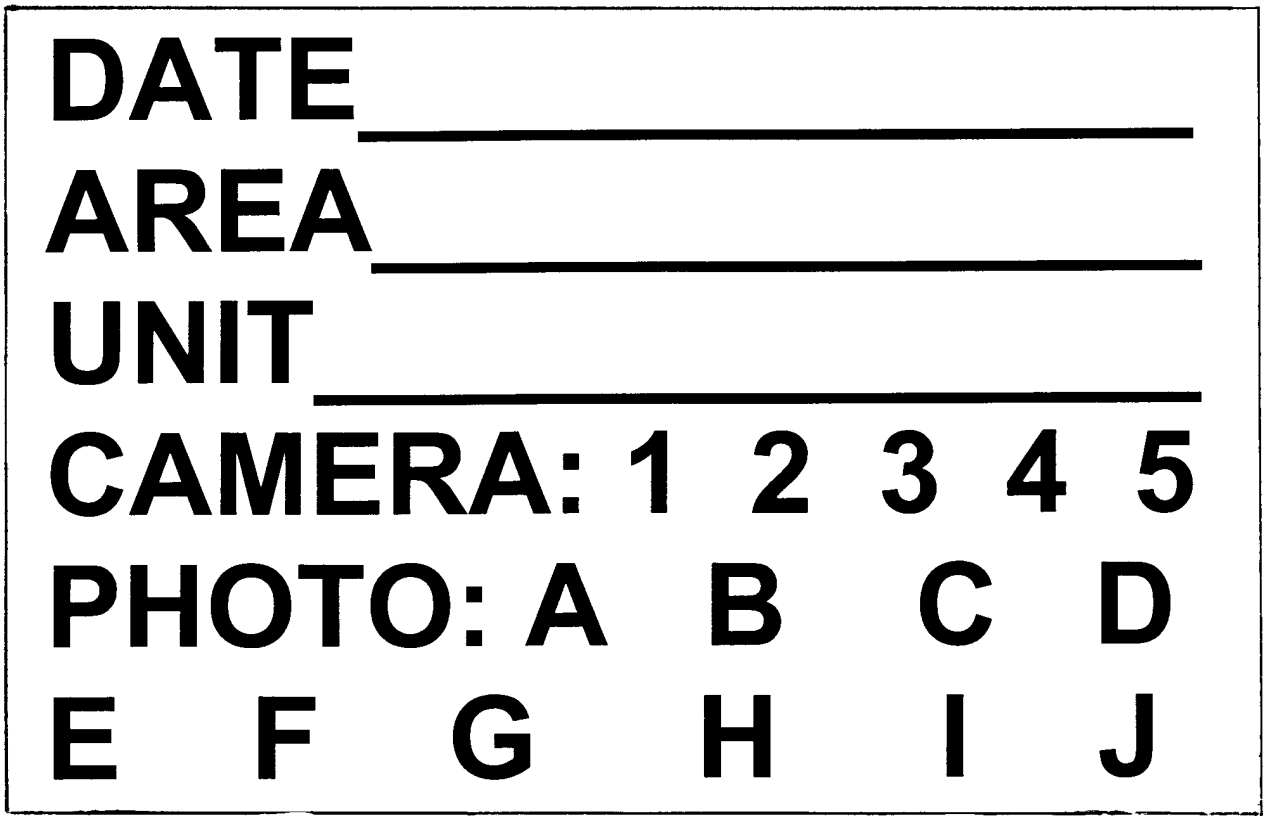



Figure 43—An example of a photograph identification card to be placed in the camera view (fig. 44). This has been reduced to 60 percent. Appendix B has blank forms for reproduction onto dark blue paper. The best paper colors are Hammermill Brite Hue Blue® or Georgia Pacific Papers Hots Blue®. Light colored paper, common in the office environment, fades out under direct sun and should not be used.

Steel stakes often have been used and may be necessary in shallow soils or in areas that will be disturbed. If disturbance or shallow soils prevent use of fenceposts, the stakes should be driven flush with the ground. If left a few inches aboveground, stakes will damage tires, hooves, or feet and are often difficult to find. When driven flush with the ground, they require a metal detector for location (White's Electronics, Inc. 1996). Even then, the stakes must be of some mass for detection with a simple, $250 machine. Angle iron should be 1 in on the angle and at least 8 in long. Cement reinforcing bar should be at least three-eights of an inch in diameter and at least 8 in long.

One overriding consideration in photo monitoring is the requirement that the **same distance** be observed between the camera location and photo point for all subsequent photography of that sample. Any analysis of change depicted in the photographs can be done **only** when the distance remains the same. Therefore, always **measure** distance from camera location to photo point. A fixed distance for all photo monitoring is not required; this may differ from one photo point to another. Camera format also may change, such as first pictures with a 50-mm lens and next pictures with a 35-mm lens, but distance must remain the same. It can remain the same only if permanently marked.

**Identification of Photographs**

Identify each photograph by site name, photograph number, and date. Figure 43 is an example of a form for use in general or topic photographs (fig. 44). (Forms are in appendix B.) The critical factor is identification of **negatives** for color or black-and-white

**CAMERA LOCATION AND PHOTO POINTS**

Date 1997/6/17 Camera Location Witness Stump
Area Snow Mtn. Dist. Number of Photo points: 2
Unit Pole Camp Observer E.C. Hall
Comments From rd junc. 43/4365, on rd 43 for 0.25 mi W. to turnout on S. side road; witness stump 22" LP 20 yds. S
slope 1 Aspect W Slope position bottom

Photo point A
Compass bearing: 237° M
Distance:
Flood plain, left view of Pole Camp study site, Mt. pine beetle killed LP stand in background 1, 2, 3 are camera locations; S & W are photo points


Photo point B:
Compass bearing: 270° M
Distance:
Flood plain, right view of Pole Camp study site. 1 & 2 are camera locations, D is dry meadow photo point.


Figure 44—Filing system form “Camera Location and Photo Points” showing general photographs of Pole Camp taken from the witness stump: (**A**) left landscape and (**B**) right landscape noted in figure 42. Note repeat of fenceposts 1 and 2 in both pictures. Fenceposts identify camera locations 1, 2, and 3 and photo points D for the dry meadow, W for the wet meadow, and S for the streambank. Photo identification cards similar to figure 43, a form from appendix B, are at the bottom of each picture. The purpose of these photographs is twofold: (1) to illustrate the general sampling area and (2) to show location of the photo monitoring layout. Used in conjunction with the map in figure 42, someone other than the original sampling crew should be able to find and rephotograph this site.

pictures or digital images. Slides have borders to write on, but there is no similar space on negatives. Placing a photo identification card in each view as it is photographed assures a permanent record on the negative. Negative identification has been one my biggest problems!

Paper color is the next consideration. Plain white or light colors, common in the office environment, are not suitable because they are too light and will fade when photographed outdoors in full sunlight (fig. 30). The recommended paper color is either Hammermill Brite Hue Blue® or Georgia Pacific Papers Hots Blue® (app. B). Tests have shown these darker blue hues are superior to other vibrant colors such as green and yellow.

**Description of the Topic**

Describe what is in the scene to be photographed (fig. 44). This might include plant species, ground conditions, disturbances, or any other pertinent item. Appendix B contains forms with provision for recording these notes. For example, the filing system form, "Camera Location and Photo Points," is shown in figure 44 with two views of Pole Camp. Figures 46 to 48 (shown below), using the same form, illustrate mountain pine beetle effects on lodgepole pine over 13 years. And figure 50 (also shown below) is the "Photo Points and Close Photos" form for a general view and two closeup photographs of a ponderosa pine-elk sedge plant community in undisturbed condition. Recording of the percentage of cover for various items is recommended for good photo descriptions.

**Filing System**

Photo monitoring requires a way to file slides, prints, and negatives. My system is organized around each study with an expandable file used to contain everything (app. D).

The expandable files are placed in a file cabinet dedicated to sampling and organized first by geographic location and then by date for next photography. By filing studies geographically, generally around overnight facilities, travel planning is greatly facilitated. Noting the next photography date on each file helps with seasonal planning (app. D).

## General Photography

General photographs document a scene rather than a specific topic or conditions along a sampling transect (discussed below). They are similar to landscape pictures in that they do not require a size control board (meter board) on which to focus the camera and to orient subsequent photographs. They usually cover an area of 2 to 20 acres and distance of 50 to 200 yards (figs. 26 and 44).

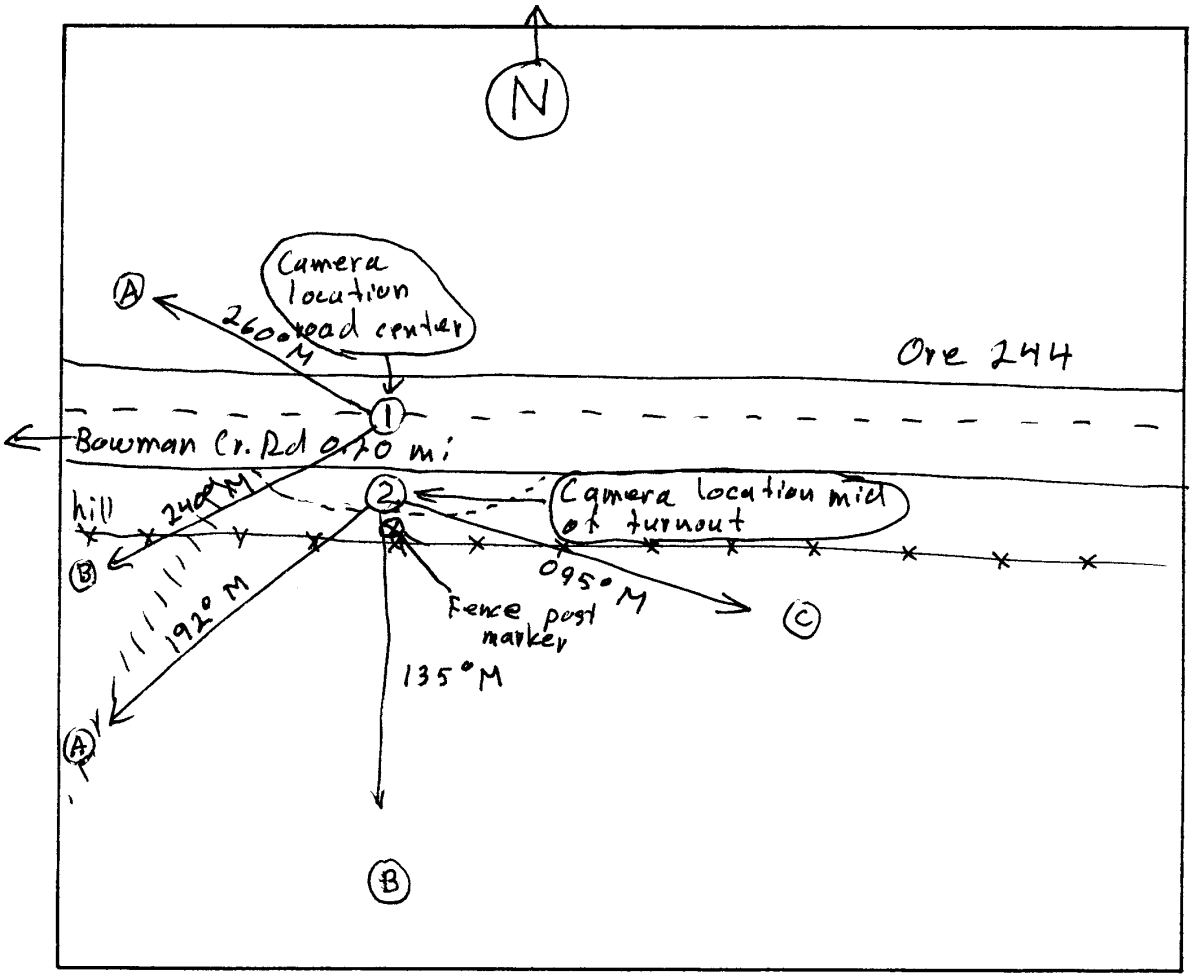
**Concept**

In many cases, general photographs document a scene in which a meter board cannot be placed where the camera can be focused on the "1M" of the board for distance and photo orientation (fig. 18). One use of a general photograph is shown in figure 26 depicting the setting of Pole Camp. Figure 44 is filing system form, "Camera Location and Photo Points," containing this and a second view of Pole Camp wherein the fenceposts marking camera locations and photo points may be identified. Another use is illustrated in figures 45 to 48 documenting effects of mountain pine beetle attack on lodgepole pine.

**PHOTOGRAPHIC SITE DESCRIPTION AND LOCATION**

Date Aug 1976 Area Camas Cr. Meadows
Unit Ukiah District Observer: F. C. Hall
Number of photo points 5 Plant community: lodgepole pine
Location: T. 4S R 3E Sec. 35 SW of SW
Location description On Ore. hiway 244 between mile posts 15 & 16; 0.20 mi. east of junc with Bowman Cr. Rd.
Photo purpose: Document effects of Mt. pine beetle attack on bottomland climax lodgepole pine
Discussion Some beetles noticed in 1975; this year major kill (70%) of dominant lodgepole - needles red. Follow for each year for 3 yrs, then about 5 yr. intervals.

**MAP**




**Use back of sheet for additional details.**

Figure 45—Filing system form "Photographic Site Description and Location" with map to locate camera locations and photo points documenting affects of mountain pine beetle on lodgepole pine. Two camera locations are shown. Figures 46 to 48 are from camera location 1 showing photo points 1Aand 1B.

**Equipment**

The following equipment needs to be taken to the photography site:

1. Camera or cameras for different film or digital camera
2. Photograph identification form “Camera-Photo” (see index to app. B; the form itself is not labeled)
3. Clipboard and holder for the photo identification sheets (app. C)
4. Previous photographs for orientation of the camera
5. Filing system form “Camera Location and Photo Points” (app. B)
6. Fenceposts and angle steel stakes, sufficient for the number of camera locations desired, with pounder
7. A tripod to use for camera orientation while viewing the photographs

**Technique**

Select a scene that will meet your monitoring objectives. Describe it by using the filing system form, “Camera Location and Photo Points,” and include plant species, ground cover items, disturbance, or whatever the topic of the photograph is. Photograph the scene.

Make maps of the location and layout of the scene on the filing system form, “Photographic Site Description and Location” (app. B; fig. 45).

**Reorientation**—Reorientation of subsequent pictures is a major concern if a meter board was not used originally to mark and establish photo orientation. Key items of each view have to be identified. For example, in figure 44, the tall tree in the right background of picture (A) is the same tree in the left background of picture (B). Panoramic views such as figure 44 always should have about 10 percent overlap between photographs.

Systems used for landscape photo reorientation, (see fig. 16) are of major help. On a black-and-white copy of the scene, mark reorientation items as shown in figures 16 and 38. With the camera mounted on a tripod, compare the picture in hand with the scene through the camera. Orient the camera accordingly.

Figure 37 illustrates a method for rephotographing general views. It shows 3- by 5-in photographs mounted on 5- by 5-in cardboard. Instructions are given under each picture for its location and orientation. These fit into a vest pocket for use in the field. Figure 44A is a recent picture of figure 37A.

**Example**—Figures 45 to 48 illustrate general photography to document effects of mountain pine beetle on lodgepole pine along Oregon highway 244 in the Blue Mountains of eastern Oregon. Figure 45 is filing system form “Photographic Site Description and Location” mapping two camera locations. Camera location 1 has two photo points (figs. 46 to 48) and camera location 2 has three photo points. Monitoring started in 1976 when beetles first attacked the stands.

CAMERA LOCATION AND PHOTO POINTS

Date 77/8/2 Camera Location Ore 244, Series 1

Area Camas Cr. Meadow Number of Photo points: 5

Unit Ukia Dist Observer

Comments LP 20% with white needles, many shed; 20% red needles. Stands 90% dead – all larger trees; Mtn. pine beetle

Slope 10 Aspect E Slope position Top

Photo point A:
Compass bearing: 260° M
Distance: —
Camera located on Ore 244 centerline
Massive lodgepole kill


Photo point B:
Compass bearing: 240° M
Distance: —
Camera on Ore 244 centerline


Figure 46—Filing system form “Camera Location and Photo Points” documenting stand conditions in 1977, 1 year after a mountain pine beetle (*Dendroctonus ponderosae*) attack on lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.). Trees killed the first year have lost their needles. Compare to figures 47 and 48. Photo orientation used the road center line but cut off tops of the trees in both **A** and **B**.

Figures 46 to 48 use filing system form “Camera Location and Photo Points” to document beetle effects over 14 years. Figure 46 depicts effects in the second year of beetle attack when trees killed the first year started to drop their needles. Figure 47 is the third year after attack and shows massive standing fuel in A and salvage in B. Figure 48, taken 14 years after initial attack and 13 growing seasons after figure 46, illustrates tree fall in A and growth of natural regeneration in B.

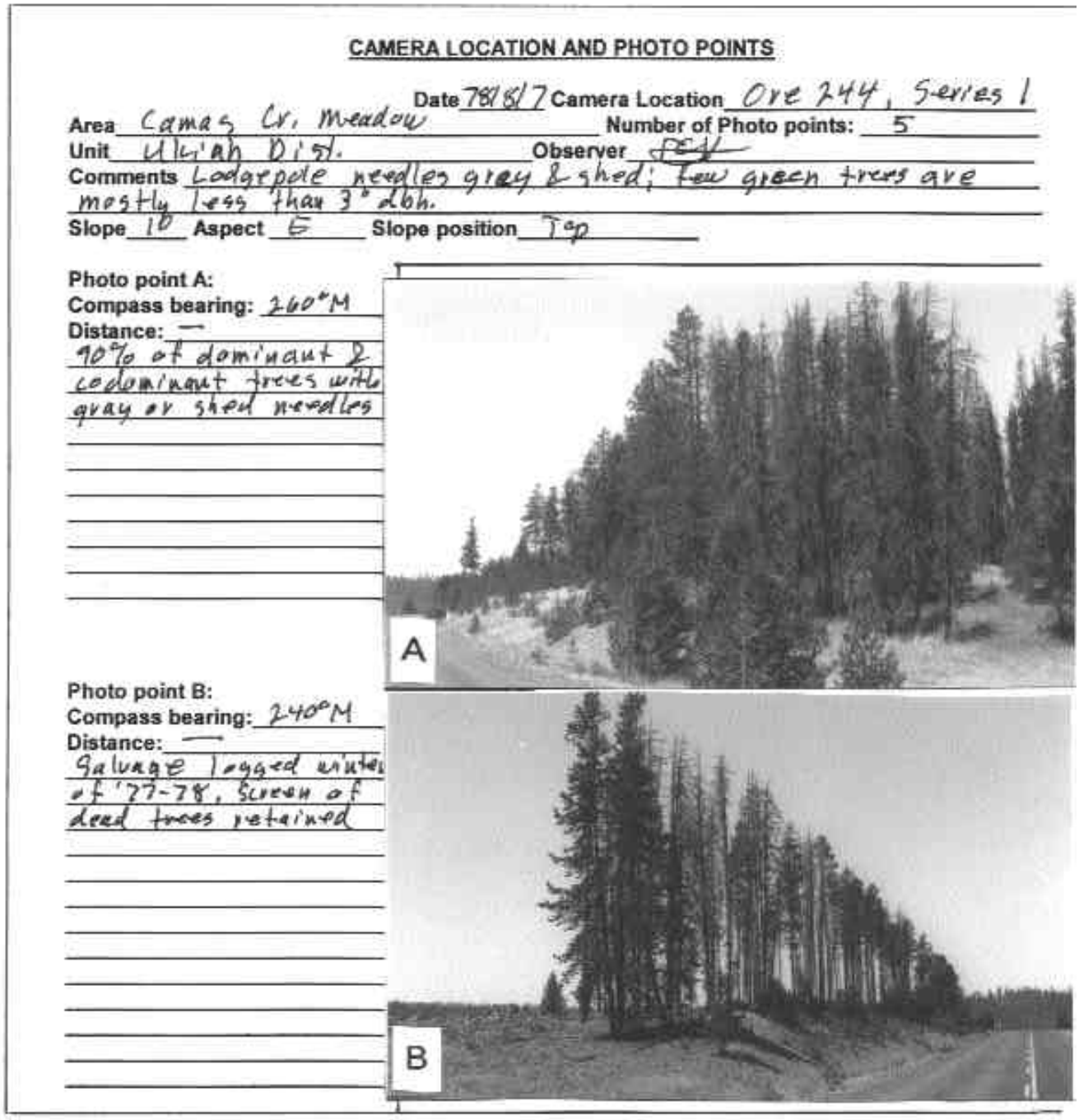



Figure 47—Stand conditions in 1978, 2 years after beetle attack in 1976. Photo point A shows 90 percent kill and massive standing dead fuel. Photo point B was salvaged in winter 1977-78. These photos were properly oriented to show tree tops and road center line.

Lack of a meter board on which to orient the camera is evident in figures 46 to 48. Treetops are cut off in figure 46, they are visible in figure 47, and again cut off in figure 48. It is important to precisely reorient repeat photos.

*Text continues on page 92.*

CAMERA LOCATION AND PHOTO POINTS

Date 91/8/5 Camera Location Ore 244 Series 1

Area Camas Cr. Meadow Number of Photo points: 5

Unit Ukiah Dist Observer Field

Comments Lodgepole regeneration growing well.

Slope 10 Aspect 5 Slope position Top

Photo point A:
Compass bearing: 26°M
Distance: —
70% of lodgepole down by 5th year after beetle kill


Photo point B:
Compass bearing: 240°M
Distance: —
70% of trees in screen down after 5 yrs; salvaged area well stocked (not planted) and growing well


Figure 48—Stand conditions in 1991, 14 years after beetle attack and 13 growing seasons since figure 46. Photo point A shows most dominant trees are down, thereby creating severe burn conditions at ground level. Photo point B illustrates natural regeneration height growth. Compare photo orientation with figure 47, which is optimum; here, B has the tree tops cut off and about a 1/2 inch more pavement at the bottom. Orientation of repeat general photography requires skill and a set of orientation pictures similar to figure 37.

**Topic Photography** Topic photography narrows the subject from a general view to a specific item of interest. It adds a meter board, or other size control object, to identify the photographic topic (figs. 40 and 49).


Figure 49—Topic photographs of streambank stability at Pole Camp. The specific topic of interest was fate of the fallen block of sod shown in 1977. Its fate might resolve the question of how fast the streambank will erode under change in livestock management from season-long use to three-pasture rest and rotation. By 1987, beavers had moved into the area raising the stream level, which converted Kentucky bluegrass on the fallen block to aquatic sedge. By 1997 the stream was dry because a flood in February 1996 washed out the beaver dams, cut a new channel, and drained late summer flows from this part of the stream. The block of sod is still present after 20 years of livestock grazing. See figure 23 for effects of a winter ice flood on the original camera location.

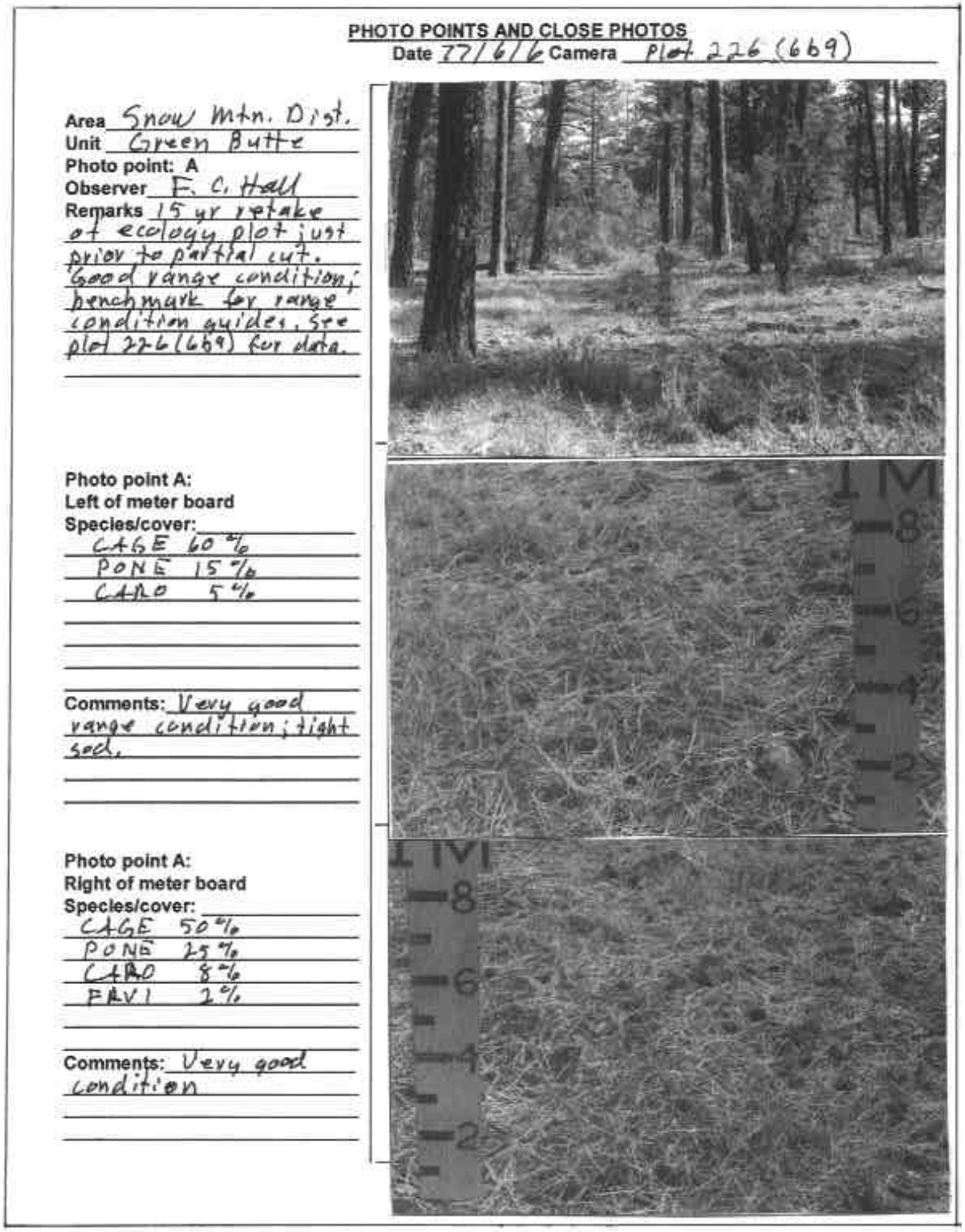


PHOTO POINTS AND CLOSE PHOTOS
Date 77/6/6 Camera Plot 226 (669)

Area Snow Mtn. Dist.
Unit Green Butte
Photo point: A
Observer E. C. Hall
Remarks 15 yr retake of ecology plot; just prior to partial cut. Good range condition; benchmark for range condition guides. See plot 226 (669) for data.

Photo point A:
Left of meter board
Species/cover:
CAGE 60 %
PONE 15 %
CARO 5 %

Comments: Very good range condition; tight sod.

Photo point A:
Right of meter board
Species/cover:
CAGE 50 %
PONE 25 %
CARO 8 %
FRVI 2 %

Comments: Very good condition

Figure 50—Filing system form “Photo Points and Close Photos” documenting effects of selection logging in a ponderosa pine/elk sedge community (fig. 29). This area had not been previously logged and had only sporadic sheep use because water was 1.5 mi distant. The general view is followed by pictures to the left and right of the meter board. The concept is to show both a general view and a pair of closeups to document change. Figure 29 illustrates what happened in this view after logging and 18 years later. Figure 51 illustrates the same series to the left of the meter board. Species are CAGE (*Carex geyeri* Boott, elk sedge), PONE (*Poa nervosa* (Hook) Vassey, Wheeler bluegrass), CARO (*Carex rossii* Boott, Ross’ sedge), and FRVI (*Fragaria virginiana* Duchesne, strawberry).

**Concept**

A meter board, or other size control board, is placed at the topic to (1) identify the item to be monitored for change; (2) establish a camera orientation reference point for subsequent photography; (3) set up a constant sized reference by which change may be documented, for example by grid analysis; and (4) provide a point to focus the camera for optimum depth of field.

Figures 40 and 49 illustrate identification of a very specific topic, streambank stability. Figure 50 deals with a general view limited to area around the meter board, the topic being effects of logging and precommercial thinning on stand structure and ground vegetation. The purpose of topic monitoring is the primary factor in selecting a monitoring layout.

Effects of camera focal length and distance from camera to meter board to emphasize the topic are discussed in figures 31 to 33. When the distance from camera location to topic is the same (figs. 6 and 7), the 70-mm and 35-mm pictures can be enlarged or reduced to the same size meter board as in the 50-mm photograph (fig. 7). When cropped, all pictures will be the same. This can be done with prints from negatives or digital images; it cannot be done with slides. Try to use the same focal length for all subsequent photographs.

**Equipment**

The following equipment is required for topic photography:

1. Camera or cameras with both color and black-and-white film, or digital camera
2. Form “Camera-Photo,” from appendix B for photograph identification, printed on medium blue paper
3. Forms from appendix B for site identification: “Photographic Site Description and Location,” and photo points: “Camera Location and Photo Points”
4. Meter board (app. C)
5. Clipboard and holder for the photo identification sheets (app. C)
6. Fenceposts and steel stakes, sufficient for the number of camera locations and photo points desired, with pounder
7. Compass and 100-ft tape for measuring distance
8. Metal detector for locating stakes

**Technique**

Several steps are necessary to establish topic photo monitoring. Pole Camp (fig. 44) will be used as an example.

**Define the topics of interest**—At Pole Camp, primary topics of interest were effects of livestock grazing on streambank stability, differential utilization of dry and wet meadows, and impacts on willow shrubs. Next, the desired coverage of the monitoring area must be defined. How many streambank sites are desired? How many dry and wet meadows and where? How many shrubs should be monitored and where are they located? Note in figure 44A the distribution of willow shrubs and in figure 44B, the pattern of dry to moist to wet meadow.

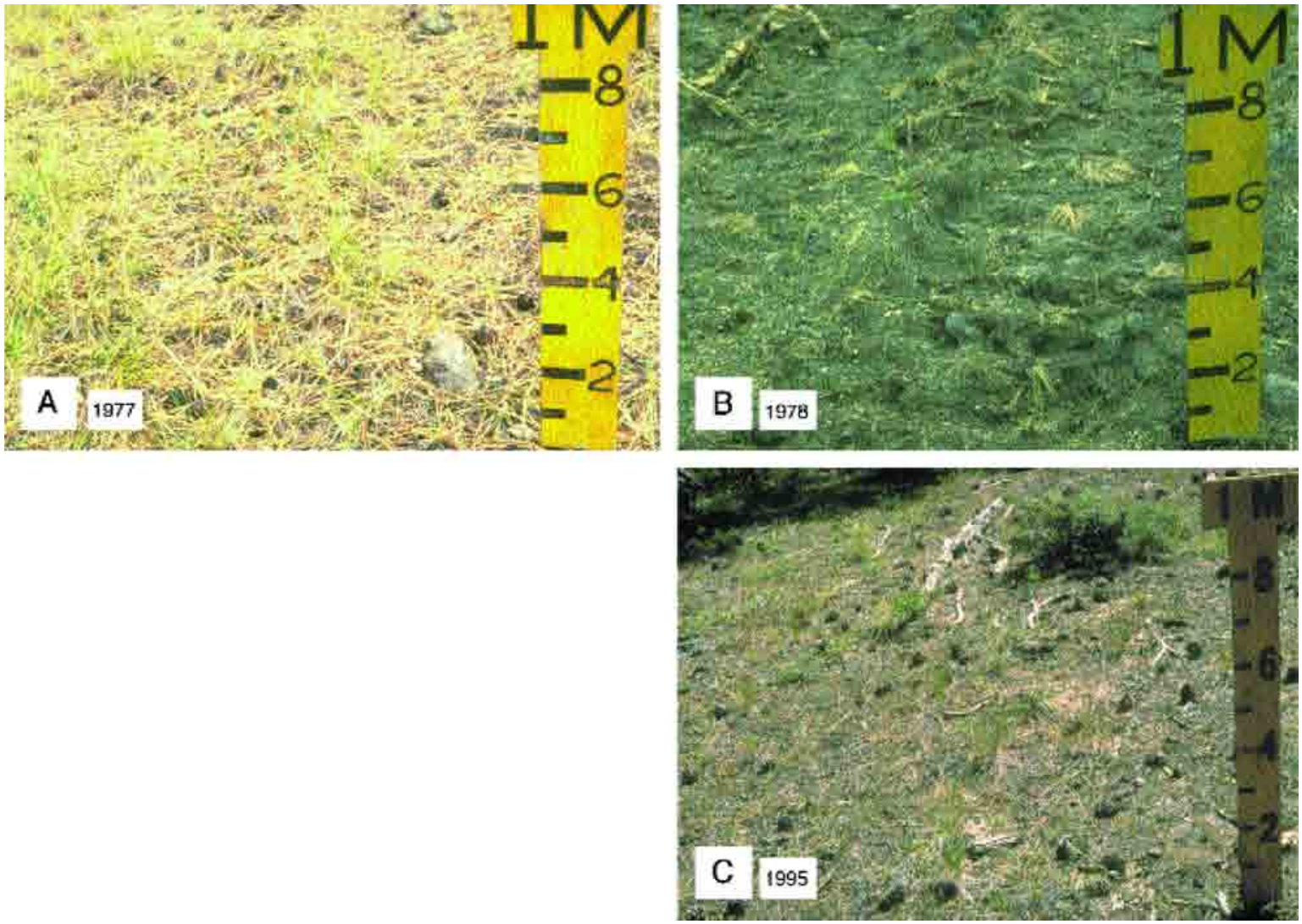



Figure 51—The ponderosa pine logging depicted in figures 29 and 50. (**A**) Prelogging with elk sedge clearly dominant, (**B**) tracts and destruction of the elk sedge, and (**C**) 18 years later, still with very little elk sedge, only some squirreltail grass, and a browsed bitterbrush.

## PHOTO POINTS WITH OVERHEAD VIEWS

Date 96/8/5 Camera Wide Thin #3
Area Prairie City Dist Number of Photo points: 1
Unit Cold Cr. Observer F.C. Hall
Comments 25 yrs since pct; clearcut about 1950

Slope 5 Aspect W Slope position mid Topography undulating

**Photo Point A**
Compass bearing: 178° M
Distance 32.0 ft
Photo comments:
No cow use, trees now growing at 2.2" per dec.

**Overhead of Photo Point A**
Photo comments:
Ponderosa pine in fairly good vigor. 100 ft line transect showed 47% covey

Figure 52—Filing system form “Photo Points with Overhead Views” documenting current tree canopy cover in a stand precommercially thinned 25 years previously. The form is in appendix B. Remember to make notes on what is in each photo.

**Closeup photos**—In many cases, details might be desired that are not accommodated by a meter board 7 to 10 m distant. Closeup photos, one on each side of the meter board, are recommended (fig. 34). After the general photo is taken, walk up to the meter board and photograph it on each side. With a 50-mm lens, stand 2 m away or with a 35-mm lens, stand 1.5 m away. Figure 34 illustrates the result with a 50-mm lens. The critical element is to always place the top of the meter board all the way up in a corner of the view (fig. 35). Details on the ground are shown in about a 1.5- by 1.5-m area on each side of the meter board (fig. 34). The concept is a general photo and two closeup photos to document change (fig. 50).

Figure 50 illustrates use of filing system form "Photo Points and Close Photos" (app. B) for mounting and filing topic photographs. It is the 1977 view of ponderosa pine shown in figure 29. Figure 51 has close views of general conditions, shown in figure 29 for prelogging, that were taken 1 year later and 18 years later.

**Multiple photo points**—Coverage could be either multiple photo points from the same camera location or multiple camera locations focusing on the same photo point. Figure 42 maps two photo points (D and W) from camera location 1 and two camera locations (2 and 3) focusing on one photo point (S). Figure 44 shows these camera locations and photo points. Advantages are twofold: First, relocation tends to be easier because only one point must be located that will serve two or more views, and second, one point showing several views tends to tie the sampling area together.

**Overhead canopy**—Overhead canopy pictures may be useful when documenting changes in tree canopy cover (fig. 52). A word of **caution**: camera focal length **must be the same** for all subsequent pictures because there is no size control board by which to adjust different photos taken at different focal lengths to the same size. Directions for overhead photography are contained in the "Tree Cover Sampling" section, later in this appendix.

**Distance from camera to photo point**—Distance between camera location and photo point is critical for any repeat photography from the camera location: It **must** remain the same. Exact replication of distance for all rephotography is the reason camera locations and photo points must be permanently marked in the field and their distances measured. I have found the best system is with flimsy fenceposts. The same distance is not required, however, for other photo monitoring. Figure 42 shows different distances of photo points from camera location 1.

An investigator may elect to do all three kinds of photography: topic view, closeups on each side of the meter board, and an overhead view for maximum documentation of treatment effects.

**Analysis of Change**

The meter board is used as a constant size reference point for analyzing changes. The recommended system is grid analysis, discussed next. A clear plastic form with site identification information is taped to the photo and topics of interest outlined. Then an analysis grid is adjusted to exactly match the size of the meter board in the outline and is printed on white paper. The outline form is taped to the grid, and grid intersects on and within the outlines are counted and recorded. Amount of change between photos can then be determined.

CONTINUE