Restoration Monitoring — A Simple Photo Monitoring Method

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Abstract

One of the most important aspects of any revegetation or restoration project is monitoring. In cases where regulatory compliance or the need for detailed monitoring does not exist, the use of photographic monitoring is often an acceptable alternative. In 1999, a photographic monitoring project was begun at the Rocky Flats Environmental Technology Site, to visually document the restoration of a disturbance created after a pipeline was buried across part of the site. An additional project goal was to make the information available to users in an interactive electronic form using web browser technology. After the disturbance was seeded with native species and hydromulched, the perimeter of the disturbance and seven permanent photo locations were mapped with a geographic positioning system. This information was used in a geographic information system to produce an electronic map of the project area. Using both photo points and photo quadrats, both landscape and ground view photographs were taken twice during 1999 to document changes as restoration efforts began. A simplified photo quadrat methodology was used that did not involve complicated efforts to precisely position the camera over the quadrat for repeat photographs. Final photographs were scanned electronically and used with the electronic map to produce an interactive display of the results using web-browser technology. This simple, yet visually effective technique allows clients to open the map in a web browser and view the photographs taken at each location by simply clicking on a photo location. As new photographs are taken in the future, they can easily be added to the collection and continue to update the monitoring results. The project has demonstrated that through the use of a simple photo monitoring design it is possible to visually document, with both landscape and ground views, the progression of a restoration/revegetation project in a repeatable, cost-effective manner. The use of web browser technology can display the results in a simple, informative, professional manner, suitable for presentations and displays.

Introduction

One of the most important aspects of any revegetation or restoration project is monitoring. When detailed monitoring is necessary, especially for regulatory compliance, the expense of sending a field crew out to collect the data, and the associated costs of analyzing and reporting the results, can add up quickly. In the absence of legal requirements, such a level of detail may not be necessary, and in these cases, simple photographic monitoring might be a practical, cost-effective alternative.

The idea of photographic monitoring is not new, nor is there any lack of methods. Photo points and photo quadrats have often been used to document change over time in plant communities (Turner, 1990; Sharp et al., 1990). Photo points are used to document landscape changes by taking a series of photographs over time from the same location and looking in the same direction (Brewer and Berrier, 1984). Photo quadrats evaluate the vegetation in permanently marked plots by taking photographs from directly above the plot. Typically, photo quadrat methods have involved elaborate schemes to get the camera in exactly the same position above the plot, often so that quantitative analyses can be made from the photographs (Wandas, 1986; Schwegman, 1986). For many applications, however, especially for general restoration documentation, these elaborate, time-consuming methods are not needed because extremely precise photographs that allow for quantification of the photo data are not required. A simple, cost-effective, repeatable method of visually recording the progression of a restoration project through time is all that is

desired. Additionally, a map of the restoration area that shows the photo point and photo quadrat locations is also important to assist in relocating points for future monitoring.

During the summer of 1999, a-pproximately 3400 feet of native prairie was disturbed where a water diversion pipeline was buried across a portion of the Rocky Flats Environmental Technology Site (Site). The Site is a former nuclear weapons component production facility, south of Boulder, Colorado, owned by the U.S. Department of Energy. At the completion of the pipeline burial, the disturbance area (approximately 11 acres) was drill seeded with native species and hydromulched to prevent wind and water erosion. Photo monitoring was chosen to visually document the progression of the restoration effort for Site managers and ecologists.

The goals of this monitoring were to:

- Provide photographic documentation of vegetation progression through both landscape and ground surface views
- Provide an accurate map of the restoration area and locations of photo points and photo quadrats
- Make the information available to users in an interactive electronic form using web browser technology.

Methods

A map of the restoration area was generated by walking the perimeter with a geographic positioning system (GPS) unit. GPS data were added to the Site's geographic information system (GIS) to produce a map in ArcView (Figure 1). Seven photo locations were chosen to use as both photo point and photo quadrat monitoring locations. These locations were marked permanently with rebar and tagged with their respective location codes; then their GPS coordinates were added to the GIS map. At each photo location, a minimum of two landscape photographs were taken, in addition to a single quadrat photograph. Photographs were taken with a 35-mm SLR camera with a 35-mm wide-angle lens, using Kodacolor 100 film. Photograph information, including date, photo location code, photo aspect, lens length, and film type were recorded on a data sheet for each photograph. Landscape photographs were taken so that the horizon was visible where possible to assist in future photograph positioning. Quadrat photographs were taken using a 50×100-cm quadrat made from PVC pipe. The quadrat was positioned with its southwest corner touching the rebar (Figure 2). The 100-cm side of the quadrat was aligned east-west with a compass for repeatability. A small blackboard showing the date and quadrat number was included in the quadrat photographs. Quadrat photographs were taken standing over the center of the quadrat from the north side of the quadrat to prevent shadows. No attempts were made to precisely position the camera above the quadrat each time, because quantitative analysis was not a goal. The purpose was simply to visually document the vegetation inside the quadrat. Photographs were taken twice during 1999, once in July and again in September.

After the photographs were processed, the prints were scanned electronically. To produce the web-browser interactive display, an electronic version of the map was created in the GIS showing the restoration area and photo locations. The electronic image of the map was converted to an image map using web-browser development software such as Microsoft FrontPage98. An image map allows the user to create hot links to other documents or photos by clicking on selected areas of the image. Each photo location on the map was linked to the time series of photographs taken at that location, which had been combined into single web pages. Thus, by opening the map in a web browser, the photographs taken at each location could be viewed by simply clicking on a photo location. As more photographs are taken during 2000, these will then also be linked to the map to continue documenting the progress of the restoration effort.

Results and Discussion

The use of the GPS and GIS worked very well for the production of an accurate map of the restoration area and photo locations (Figure 1). This information can be used for future evaluation of the project area. On the computer, using only a web browser, the photo point and photo quadrat photographs for each location are accessed by clicking on one of the photo locations on the map. The examples of selected time series photographs taken in 1999 (Figures 3-6), show how the photographs can depict changes in the restoration

area. After only 2 months, the restoration area was already beginning to green up. As photo monitoring continues in 2000 and beyond, additional photographs can easily be added electronically to update the monitoring summary.

From a practical standpoint, many benefits can be obtained from a simple monitoring effort such as this. A minimum amount of time and effort are needed. Initial setup of this monitoring design took 3–4 hours, including taking the initial photographs. Retaking the photographs took less than 2 hours, and adding the photographs to the web pages only another couple of hours. The use of a digital camera would eliminate film and processing costs, as well as scanning time. For documenting the changes in the restoration area, photographs are very simple and easy for anyone to interpret. The use of web browser technology presents the results in a simple, easily accessible, informative, and professional-looking manner. The final product could also be used for presentations.

Conclusions

Through the use of a simple photo monitoring design it is possible to visually document, with both landscape and ground views, the progression of a restoration/revegetation project in a repeatable, cost-effective manner. The use of web browser technology can display the results in a simple, informative, professional manner, suitable for presentations and displays.

Literature Cited

Brewer, L. and D. Berrier. 1984. Photographic techniques for monitoring resource change at backcountry sites. USDA Forest Service. Northeastern Forest Experimental Station. General Technical Report NE-86. 13p.

Schwegman, J. 1986. Two types of plots for monitoring individual herbaceous plants over time. Natural Areas Journal 6:64-66.

Sharp, L.A., Sanders, K., and N. Rimbey. 1990. Forty years of change in a shadscale stand in Idaho. Rangelands 12:313-328.

Turner, R.M. 1990. Long-term vegetation change at a fully protected Sonoran desert site. Ecology 7:464-477.

Windas, J.L. 1986. Photo-quadrat and compass mapping tools. Natural Areas Journal. 6:66-67.

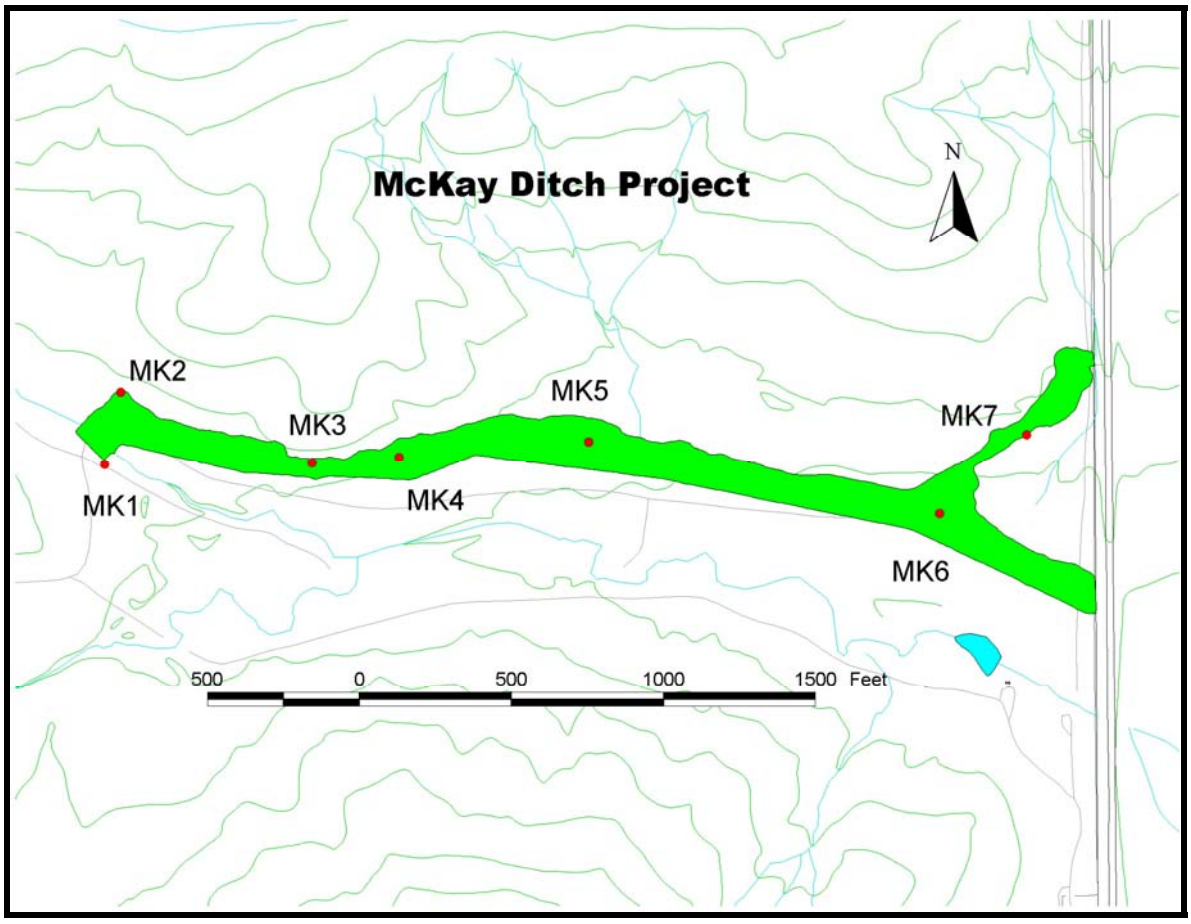

Figure 1. Map of McKay Ditch restoration area and permanent photo monitoring locations. North is towards the top of the map.

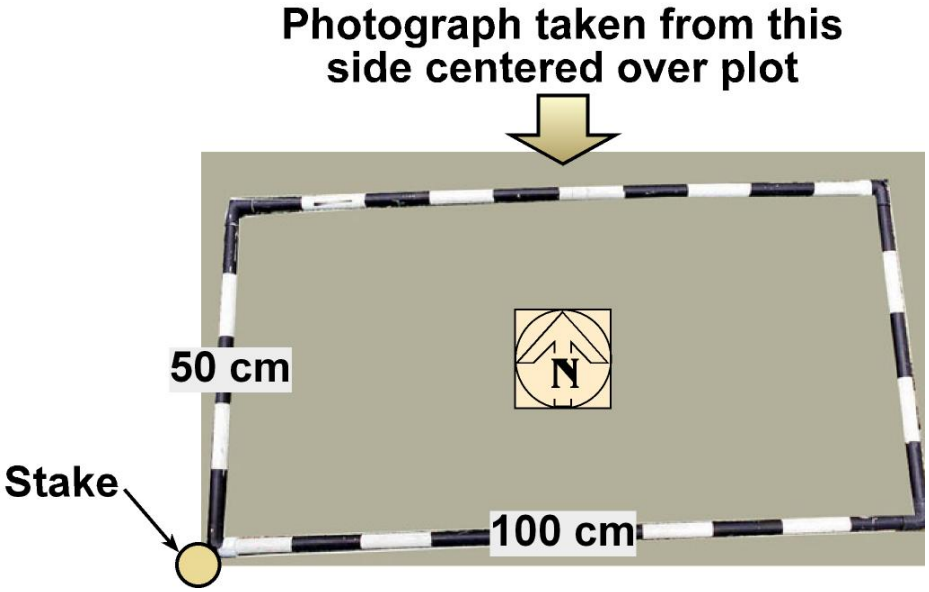

Figure 2. Photo quadrat set against the stake and aligned north-south for repeatability.

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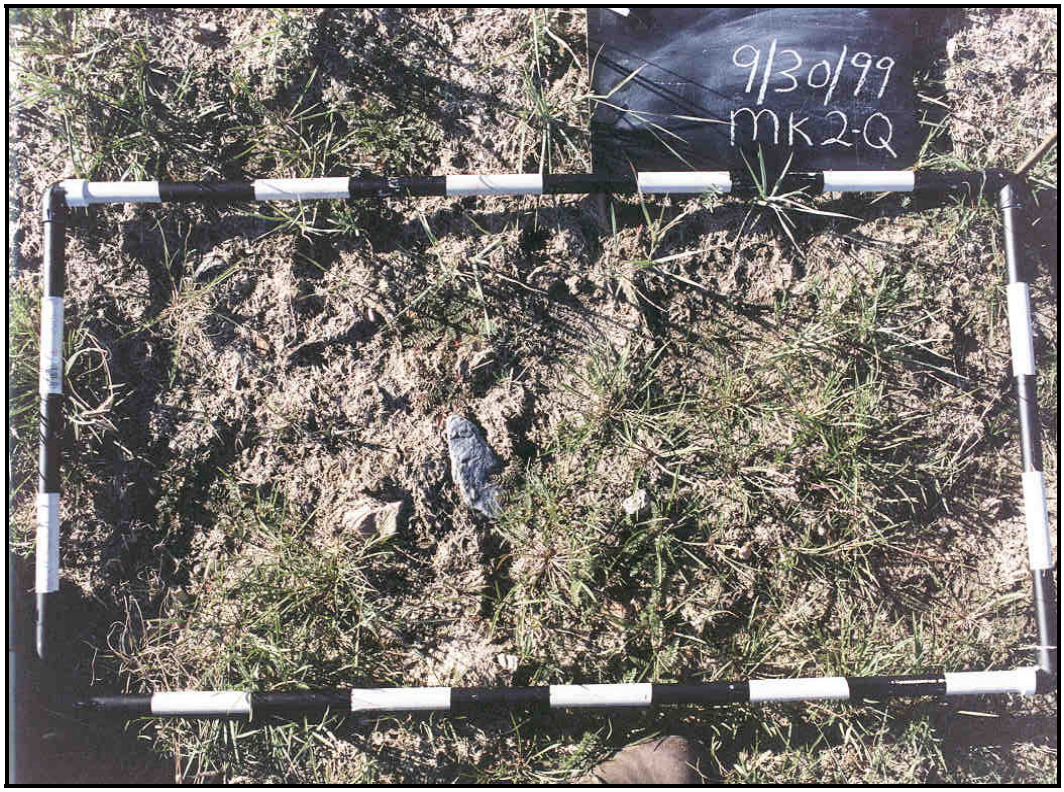

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Figure 3. Photo quadrat photographs taken at location MK2. Note how the vegetation has already begun coming up after only 2 months.

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Figure 4. Landscape photographs taken looking west from MK3.

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Figure 5. Photo quadrat photographs taken at MK7.

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Figure 6. Landscape photographs taken from photo location MK4.