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Contribution of log erosion barriers to soil protection and vegetation recovery after wildfire in a *Pinus halepensis* forest, in Greece

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Abstract

Initial results from a research project on the effects of different management practices of post-fire timber salvage are presented. Specifically, the protective role of log erosion barriers on clear-cut burnt areas of a *Pinus halepensis* forest of Evia Island, Greece, is investigated. The work was carried out in three pairs of experimental plots, established in the burnt slopes of the area, classified into low (10-20%), moderate (20-35%) and high (35-55%) slope category respectively. The burnt trees in one plot of each pair were harvested and part of them was used for the construction of log erosion barriers while the three other plots remained untreated for control. Iron pins were hammered in all the plots systematically for the estimation of soil erosion. The effect of this management practice on soil erosion, pine regeneration and recovery of the annual and perennial vegetation is being studied. The first results, covering a period of six months, are presented.

Keywords: log erosion barriers, erosion, vegetation recovery, rehabilitation, timber salvage, natural regeneration, forest fires, post-fire management.

Introduction

Pinus halepensis Mill. and *Pinus brutia* Tens. forests, especially those with evergreen broadleaves understory, comprise the most fire prone ecosystems in Greece. Both species regenerate easily after a fire and mainly *Pinus halepensis* expands its natural range after such an event (Trabaud et al. 1985, Dafis 1987, Daskalakou 1996).

Concerning soil protection, the intensive sprouting of the evergreen broadleaved shrubs provides quick soil coverage, which does not exceed 50% during the first three years after a fire and reaches the pre-fire level from the sixth year after it (Keeley 1986, Papanastasis 1986, 1988).

The need for implementation of protective and rehabilitation measures on burnt areas is due to the danger for erosion, flooding and site degradation and is also associated with the need for quick salvage of the burnt timber. The latter probably causes ecological damage and adds disturbance to the soil conditions and hence is considered as a probable source of additional erosion and flooding potential.

From the various protective measures taken in clear-cut burnt areas, the present study focuses on the role of log erosion barriers which are usually constructed parallel to the contours, aiming to reduce surface and rill erosion and to improve vegetation recovery.

Materials and Methods

The research project was financed by the Greek General Secretariat for Research and Technology and was carried out in a burnt *Pinus halepensis* forest, located on Evia Island, Greece, in the 1996-98 period.

The fire occurred on July 6th, 1996. It was a crown fire which burned an area of about 70 ha. The burnt area is located at 23°14'52'' N and 38°48'26'' E, is adjacent to the sea and has a mean altitude of 100 m approximately. Three pairs of experimental plots, 1600 m^2 each, were established on the burnt slopes. They covered an inclination range between 10% to 55% and were classified into low (10-20%), moderate (20-

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35%) and high (35-55%) slope category.

The first plot of each pair functioned as a control plot and was left untreated. In the second plot of each pair the standing burnt timber was harvested and part of it was used for the construction of log erosion barriers. The logs were secured on stumps, forming lines 10 m apart from each other, parallel to the contours. The effect of this management practice on soil erosion, pine natural regeneration and recovery of the annual and perennial vegetation was studied using appropriate methodologies. Eighty-one iron pins were hammered systematically into the soil in each of the six plots, as shown in Figure 1, to serve for the measurement of soil erosion and/or deposition. Then, daily weather measurements close to the site were recorded and the plots were monitored. The results of the first monitoring period (January - June 1997) are presented here.

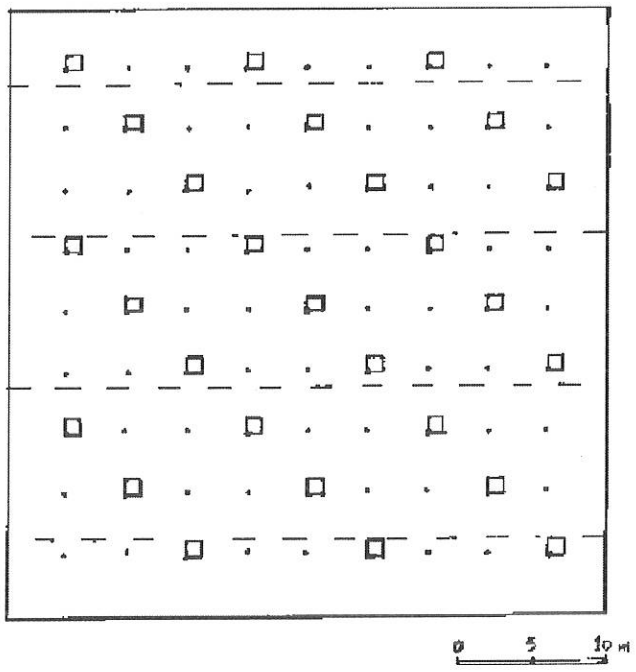

FIGURE 1: Plot layout for a treated plot
..... iron pins
- - - - - log erosion barriers (only in the treated plots)
□ 1 m² plots for measurements of vegetation recovery

Results

Soil erosion

During the six-month period the plots received 230 mm of rain. Both soil erosion and deposition were observed and measured in various points of each plot. This was an indication of a continuous redistribution of the eroded soil particles. Specifically, in the control plots of the low and moderate slope categories the measurements indicated an average of deposition of 0.15 mm and 0.75 mm respectively. Erosion was observed in the treated plots of the same slope categories where it reached 2.47 mm and 1.94 mm respectively (Figure 2).

As far as the high slope category is concerned, a significant amount of soil erosion (2.23 mm) was measured in the control plot and a significant quantity of deposition (3.44 mm) was collected by the log erosion barriers (Photo 1).

Natural regeneration of *Pinus halepensis* and post – Fire vegetation recovery

Pine seedling density

Pine seedling density was inversely related to slope increase. The maximum seedling density was 2.26

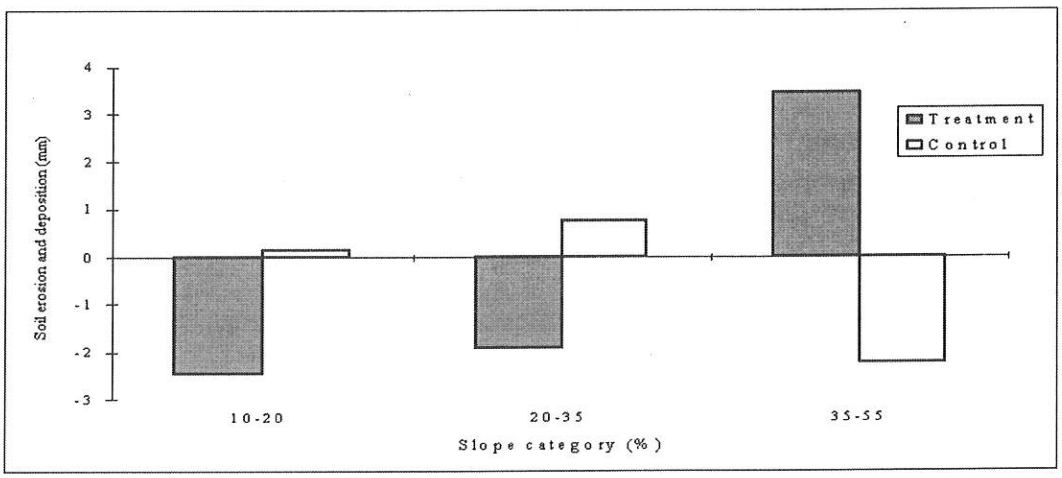

FIGURE 2: Soil erosion (-) and deposition (+) in the treated and control plots to the corresponding slope categories

PHOTO 1. Construction of log-erosion barriers using felled burnt pine logs.

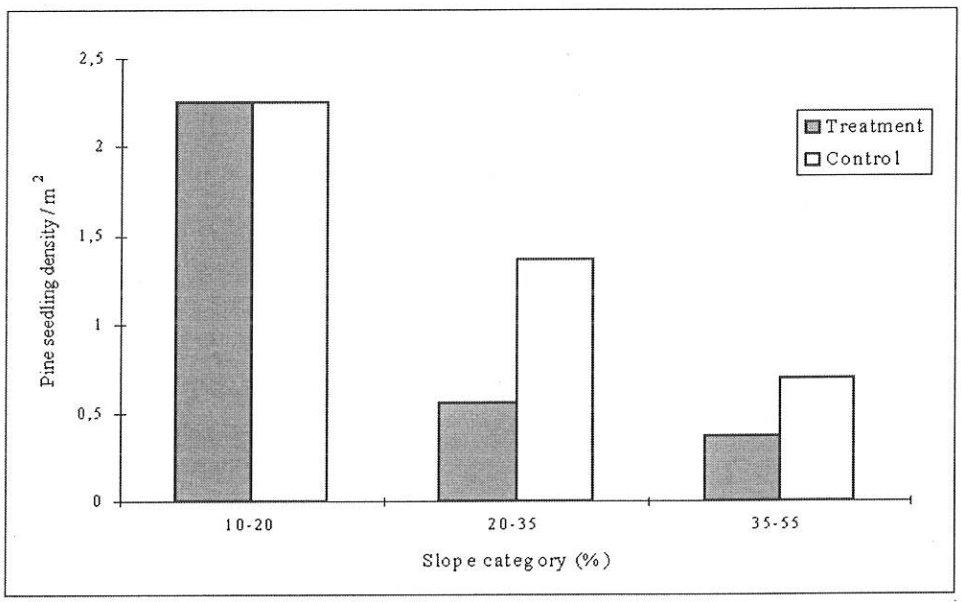

FIGURE 3: Pine seedling density per m² in treated and control plots to the corresponding slope categories

seedlings per m² and it was found in both plots (treated and control) of the low (10-20%) slope category. The smallest density values were measured on the higher slopes (Figure 3).

Although a reduced number of seedlings was observed on the higher slopes and in the treated plots, this difference was statistically significant only in the moderate (20-35%) slope category.

Pine seedling height

A similar trend to density was observed for pine seedling height. The mean height decreased from the lower to the higher slope categories in both treated and control plots (Figure 4).

In each slope category, smaller mean seedling height was measured in the treated plots. However, the differences were not statistically significant.

Shrub recovery

The percentage of shrub recovery was higher in the control plots than in the treated ones, in all slope

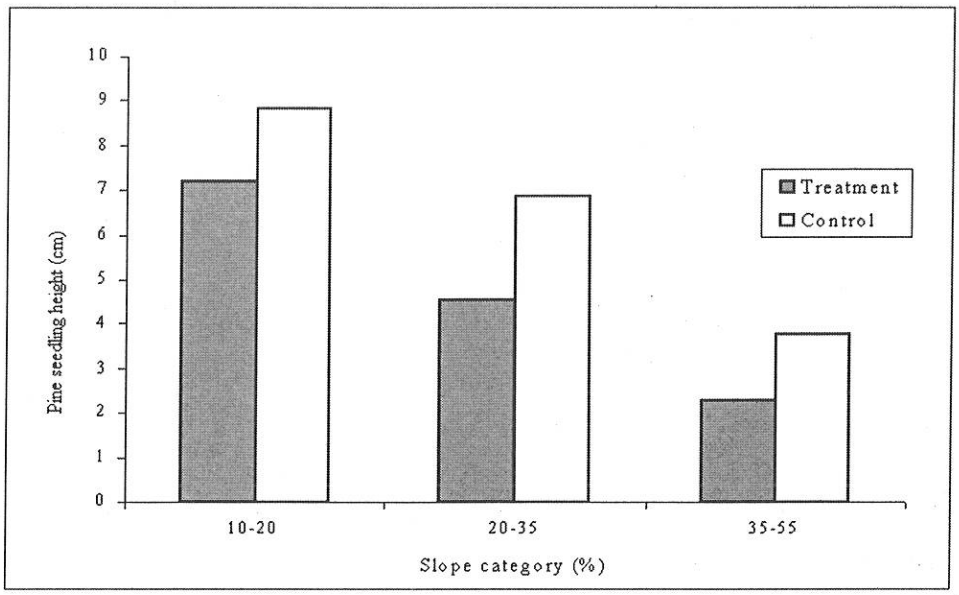

FIGURE 4: Pine seedling height (cm) in the treated and control plots to the corresponding slope categories

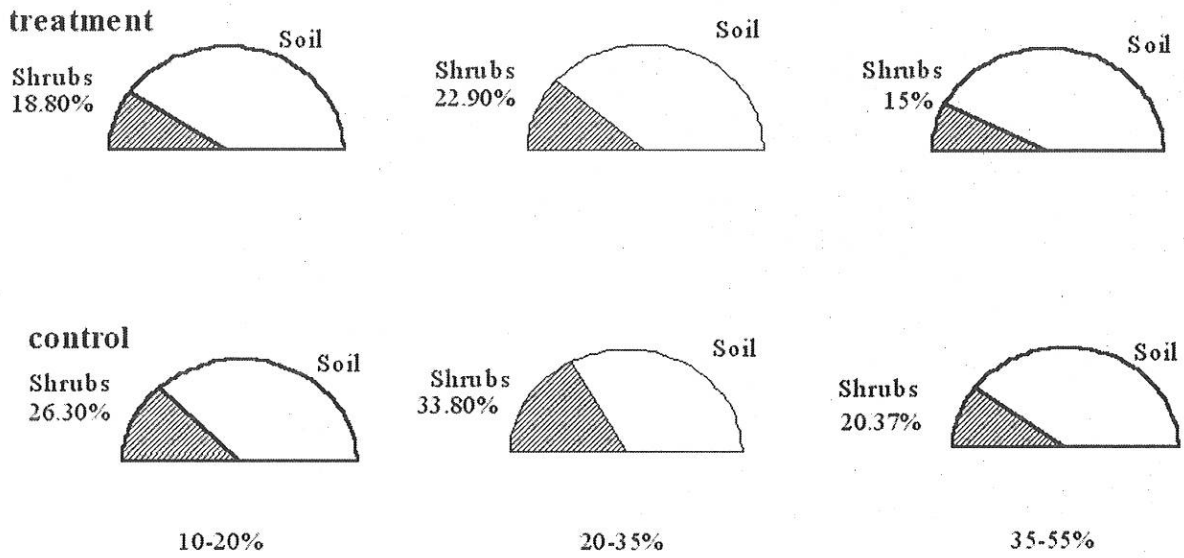

FIGURE 5: Percentage of shrub recovery in the treated and control plots to the corresponding slope categories.

categories (Figure 5).

The higher percentage (33.8%) was observed in the control plot of the moderate (20-35%) slope category and the smaller one (15%) in the treated plot of the high (35-55%) slope category (Photo 2).

These results are considered interesting and important. However, it is emphasized that further measurements (taken until the end of the project) are expected to provide important additional information and contribute to a better understanding and explanation of the results above.

Discussion

From the initial results presented here it appears that the treatment did not have a positive contribution for soil protection in the low and moderate slope categories. The disturbance caused by logging and construction of the log erosion barriers, resulted in some erosion in the treated plots while the control plots even exhibited a small amount of deposition.

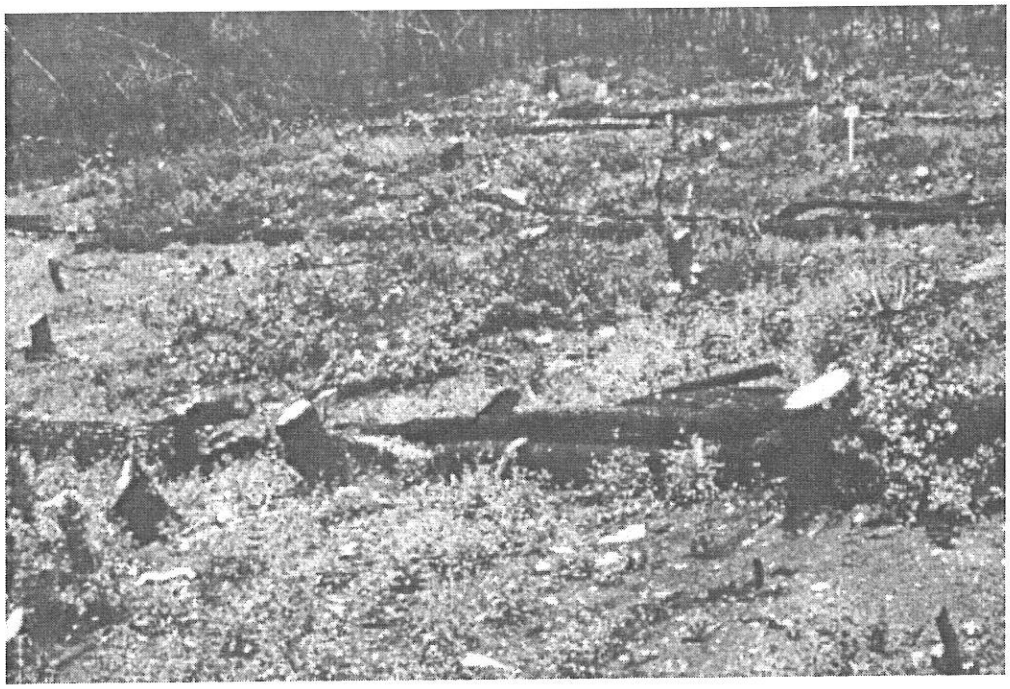

PHOTO 2. Soil deposition and natural regeneration progress, four months after the installation of log-erosion barriers.

In the high slope category plots, the treatment served its purpose. The log erosion barriers not only stopped soil erosion but also resulted in significant soil deposition behind each log. This effect was very pronounced and contrasts strongly with the significant amount of erosion observed in the high slope control plot.

While most of the effect of the treatment on soil erosion is expected in the first year after the fire, vegetation regeneration response will take more time to produce stable and meaningful results. The initial vegetation recovery observations indicate an advantage of the control plots. However, the final level of vegetation recovery, and the practical significance of any measured differences in terms of vegetation development and soil protection, will be better evaluated after further monitoring of its evolution.

Conclusions

Overall, it appears that construction of log-erosion barriers is unquestionably a positive measure in the high slope category where, without the treatment, the potential for erosion is very high. However, in less sloped areas, the need for the treatment is questionable given the adverse results observed in this study, especially if the economic aspects of the treatment are taken into consideration. Further measurements are expected to provide more data in support or against these initial conclusions.

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