Initial survivorship of 51 woody species in a reforestation experiment established after gold mining in the Peruvian Amazon

FRÉDY D. POLO VILLANUEVA¹, JUANA LLACASHUANGA¹, MARTIN PILLACA¹, JESÚS ALFREZ¹, ALEX HUAULLANI², FRANCOIS CABANILLAS¹, FRANCISCO ROMAN-DAROBETYA¹, CESAR ASCORRÚA¹, MILES SILMAN³, LUIS E. FERNANDEZ¹,³

¹ Centro de Innovación Científica Amazónica - CINCA, Madre de Dios 17001, Perú.
² Universidad Nacional de San Antonio Abad del Cusco - UNSAAC, Cusco 08003, Perú.
³ Center for Energy, Environment and Sustainability - CEES, Wake Forest University NC 27106, USA.

INTRODUCTION

Within the wide range of tropical forest degradation drivers, gold mining is one of the most aggressive and difficult to restore due to the magnitude and severity of its environmental impacts, making restoration particularly difficult (Brashares, 1997). Surprisingly, the science and practice of how to restore tropical forests after gold mining operations is still very limited (e.g. Roman et al. 2015). Here, we present initial results of one of the largest reforestation experiments in areas mined for gold across the tropics. We show an initial survivorship analysis in a trial of 51 woody species in areas where suction pumps were used to mine gold from alluvial deposits in Madre de Dios. This region is one of the highest biodiversity places on earth (Gentry, 1988; Asner et al. 2012) and has become an epicenter for gold mining in the Amazon watershed (Asner et al. 2012) and has become an epicenter for gold mining in the Amazon watershed (Gentry, 1988; Asner et al. 2012) and has become an epicenter for gold mining in the Amazon watershed

METHODS

A series of experimental reforestation plots were established in mining concessions in the Peruvian Amazonian district of Laberinto, where gold mining has been performed for more than 60 years (Fig. 1). A total of 6,150 seedlings from 51 species were planted in 4 sites comprised of 15 subplots ranging from 0.3 to 0.5 ha each, covering a total area of 6.3 ha (Fig. 2). Percent survival was calculated 3 months after planting on a subplot basis and before applying any amendments (ANOVA, F=6.01; p<0.05) and degradation categories (ANOVA, F=6.01; p<0.05), especially when certain species were planted in bare soils where extreme environmental conditions could limit seedling survivorship (Fig. 5). Imagery from the drones also revealed high mortality zones related to the occurrence of temporal floods during the wet season (Fig. 6).

RESULTS & DISCUSSION

Initial results are promising given that a total of 37 species showed excellent survival rates (≥75%); 12 species presented good survival rates (50-75%) and only 2 species showed moderate survival rates (26-50%), according to the performance standards proposed by Elliot et al. (2002) (Fig. 3).

Correlation analysis across species showed that survivorship of 18 species was increased in plants with greater basal diameters at the time of planting. Also, survivorship of 4 species was favored in the presence of taller plants (Fig. 4).

Moreover, we found initial evidence that survivorship was influenced by species (ANOVA, F=2.87; p<0.05) and degradation categories (ANOVA, F=6.01; p<0.05), especially when certain species were planted in bare soils where extreme environmental conditions could limit seedling survivorship (Fig. 5). Imagery from the drones also revealed high mortality zones related to the occurrence of temporal floods during the wet season (Fig. 6).

CONCLUSION

This study demonstrates that restoration plantings are feasible in highly disturbed areas. We present initial evidence on the potential of a wide range of species to survive across degradation categories, as well as the influence of seedling size at the time of planting on survivorship.

Further trials, that will be established across different sites mined with heavy machinery and suction pumps, will significantly increase knowledge on restoration.