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Dragged-Rail Treatments for Reducing Cholla Infestation in Southeast New Mexico, USA

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Cholla infestations can be problematic on rangelands in North America, Australia, Africa, and Europe, and treatment options for this plant are limited because of its ability to resprout from broken stem fragments. We investigated dragged-rail treatments, where iron rails are dragged across the rangeland by tractor and knock plants over while uprooting them, as a treatment option for tree cholla in southeast New Mexico. Railing effectively controlled tree cholla plants over 0.5 m tall, but did not effectively control plants smaller than 0.5 m. Nevertheless, treatment did effectively reduce overall cholla density: Treated areas averaged 40 to 50 plants ha^{-1}, whereas nontreated areas averaged over 350 plants ha^{-1}. Railing can be an effective means of cholla control, especially if followed by another treatment, such as prescribed fire, that is known to be effective against the smaller sizes of cholla.
Nomenclature: Tree cholla, *Cylindropuntia imbricata* (Haw.) F.M. Knuth.
Key words: Cholla, control, *Cylindropuntia imbricata*, railing.

Las infestaciones de *Cylindropuntia imbricata* pueden ser problemáticas en los campos de pastoreo en Norte América, Australia, África y Europa, y las opciones de tratamiento para esta planta son limitadas debido a su habilidad de rebrotar a partir de fragmentos del tallo. Investigamos tratamientos de arrastre de rieles, en los cuales rieles de hierro fueron arrastrados con un tractor a lo largo de campos de pastoreo para volcar las plantas y sacar las raíces del suelo, como una opción de tratamiento de *C. imbricata* en el sureste de New Mexico. El arrastre de rieles controló efectivamente plantas de *C. imbricata* de más de 0.5 m de altura, pero no controló efectivamente plantas de menos de 0.5 m de altura. Sin embargo, el tratamiento redujo efectivamente la densidad de *C. imbricata*: las áreas tratadas tuvieron un promedio de 40 a 50 plantas ha^{-1}, mientras que las no-tratadas promediaron más de 350 plantas ha^{-1}. El arrastre de rieles puede ser un medio efectivo de control de *C. imbricata*, especialmente si es seguido de otro tratamiento, como quema dirigida, la cual se sabe es efectiva contra plantas de *C. imbricata* de menor tamaño.

Cacti have invaded many areas around the world (Daehler 1998; Essl and Kobler 2009; Chuk 2010), and can be a major problem on rangelands, where they store water that could be beneficial to the surrounding desirable grasses, interfere with livestock movements, and complicate livestock handling (Pieper 1971). Jointed cacti such as prickly pear (*Opuntia* spp.) and cholla are especially difficult to control because stem segments that are not killed are likely to develop roots wherever they fall and establish new plants (McGinty and Ueckert 2005).

In the southwestern United States and northern Mexico, the tree cholla is common on rangelands (Ibarra et al. 1985). Millions of hectares are infested with cholla in New Mexico and Texas, and its range extends from Colorado and Kansas south and west through Texas, New Mexico, and Arizona into Mexico (Kunst 1988). In North America, distribution of this species appears limited by climate, especially the average January temperature (Kinraide 1978). Cholla actively grows from April through August (Fraser and Pieper 1972; Miller et al. 2009). Plants have a lifespan of around 40 years, and are generally slow-growing, though larger plants grow faster than smaller plants (Fraser and Pieper 1972). Allen et al. (1991) found that cholla required 10 to 30 yr to reach high densities.

Cholla has also invaded areas of South Africa and Australia, where it is among the most important cactaceae weeds (Chuk 2010; Moran and Zimmerman 1984, 1991). It is also known to colonize dry meadows, garrigue and scrub habitats, and fallow fields in Spain, France, and Switzerland (Essl and Kobler 2009; Sanz-Elorza et al. 2006). The distributional limits in these areas have not been well characterized.

Like several species of cactus, cholla is considered to be a major pest plant on rangelands in the

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southwestern United States, where high densities may contribute to reduced grass production, reduced wool quality, and inhibited movements for livestock grazing these rangelands (Kunst 1988; McGinty and Ueckert 2005; Pieper 1971). There are also potential ecosystem service costs to high cholla density: Vasquez-Mendez et al. (2010) found that areas with high densities experienced rates of soil erosion similar to those measured on bare soil and much higher than other types of vegetation.

These factors make cholla a frequent target for control efforts, but options for reliably successful treatment are limited. Using fire to control cholla can be erratic, because success depends on the presence of other fuels to carry the fire (Ibarra et al. 1985) and on plant height; smaller cholla plants are controlled better than larger plants (Kunst 1988; Parmenter 2008). Chemical methods are often not successful at controlling cholla when applied aerially, though individual plant treatment can work (Kunst 1988, McDaniel 2009). Finally, since cholla has the ability to resprout from stem fragments when treated mechanically, such mechanical treatments can result in final densities equal to or higher than before treatment (Ibarra et al. 1985; Kunst 1988). The objective of this study was to evaluate the effectiveness of dragged-rail (railing) treatments for reducing cholla density on grazed rangelands in the southern high plains.

Materials and Methods

The Troy Fort Ranch (33.0°N, 103.483°W), located near Lovington, NM, has controlled tree cholla through railing since 2004. The ranch is composed of blue grama (*Bouteloua gracilis* [Willd. ex Kunth] Lag. ex Griffiths) grasslands that are heavily invaded by cholla. The 80-yr average precipitation for the area is approximately 40 cm, with the majority of precipitation occurring during the period of May through September (NOAA Weather Station COOP: 298713). Average monthly temperatures range from 3.8 C (January) to 25 C (July). Average extreme minimum temperature is –14 C in January, and high temperatures average 33.3 C in July.

For several years, the ranch owner has attempted to control cholla by railing treatments. These treatments were applied during the cool season and after the first freeze, from November to March, by dragging three railroad irons horizontally connected to each other by steel cables behind a John Deere 4440 tractor. Rails were dragged only one direction, at a constant speed of approximately 9 km hr^{-1}. In 2010, pastures were selected that were treated in 2006 (two pastures), 2007 (three pastures), and 2008 (four pastures), as well as adjacent, nontreated areas (four pastures), for comparison of treatment effects. Nontreated areas had an average of 136 (SD = 26.8) large plants (> 1 m), 131 (SD = 32.9) medium plants (0.5 to 1 m), and 98 (SD = 18.3) small (< 0.5 m) plants per hectare. Control areas were directly adjacent to treated areas, separated only by pasture fencing. Treated pastures ranged from 276 to 1,229 ha, and averaged 868 ha. Nontreated areas were of similar size, and soil characteristics to the treated areas.

Within each pasture, four randomly assigned sample points were established, with three, 50 by 4 m belt transects arranged at random but equidistant radial degrees around the central point. Cholla density was measured by belt-transect sampling as described in Herrick et al. (2005). All cholla individuals within each belt were recorded and classified by height: > 1 m, 0.5 to 1 m, and < 0.5 m. Belt data were averaged by sample point, and then analyzed by ANOVA in the statistical program JMP (SAS 2010). Treatment year was considered the independent variable while density of cholla in each size class, and in total were considered the dependent variables. Replications were considered random effects. Significant differences were accepted at the $P = 0.5$ level.

Results and Discussion

Railing treatments were generally effective against the larger size classes (> 1 m and 0.5 to 1 m) of cholla, but not against the smallest size class (< 0.5 m). All treated areas had significantly lower total density than nontreated areas (Figure 1a). Treated areas averaged 40 to 50 total plants ha^{-1}, whereas nontreated areas averaged over 350 plants ha^{-1}. A similar pattern was evident in the two larger size classes. Nontreated areas had approximately 130 cholla plants ha^{-1} greater than 1 m (Figure 1b) and of individuals between 0.5 and 1 m (Figure 1c), whereas treated areas generally had less than 5 plants ha^{-1}. Areas treated in different years (2006, 2007, and 2008) did not differ in cholla density (Figures 1a–c),

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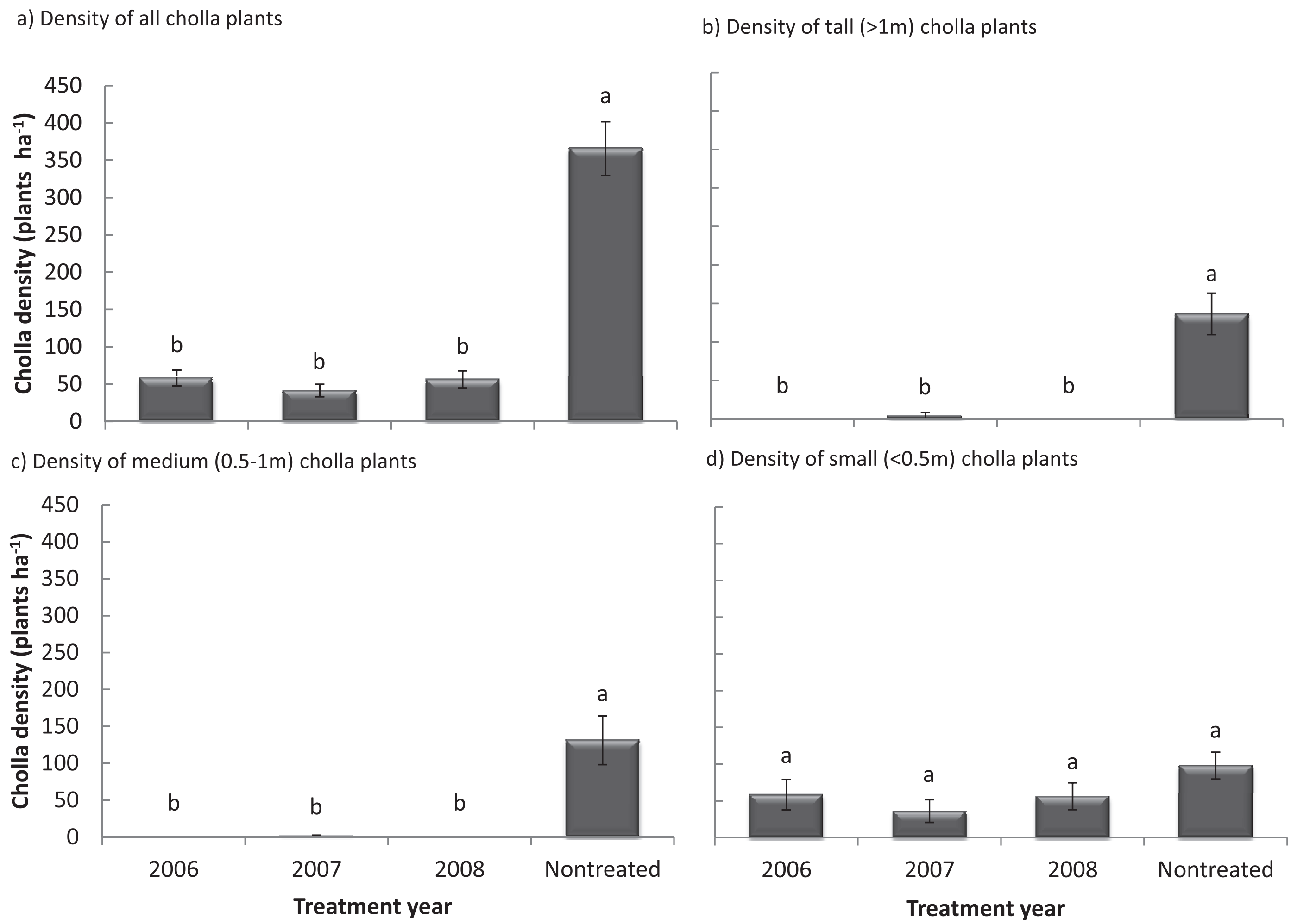

Figure 1. Density of (a) all tree cholla plants, (b) cholla plants greater than 1 m tall, (c) cholla plants 0.5 to 1 m tall, and (d) cholla plants $<$ 0.5 m tall in pastures treated and not treated by railing treatments in 2006, 2007, and 2008 near Lovington, NM. Bars represent standard error, and columns with the same lowercase letters are not significantly different ($P = 0.5$).

and small plants, less than 0.5 m, displayed no differences between treated and nontreated plots (Figure 1d). Cholla is known to be relatively slow growing (Fraser and Pieper 1972), can take up to 30 yr to reach high density (Allen et al. 1991), and treated and nontreated sites had similar densities of small cholla plants; hence, it appears that railing treatments are effective at reducing the largest cholla plants, but are not effective against the smallest plants.

Large plants presumably cause the most problems for livestock managers, in terms of animal movements and handling, utilize water that could be used by grasses for forage production, and contribute to the high erosion potential of infested lands (Vásquez-Méndez et al. 2010). In this perspective, railing treatments might be a suitable method for controlling this species. However, because the smaller size classes of cholla are not affected by railing treatments, follow-up treatments are likely necessary if eradication is the goal. Prescribed fire might be a good follow-up treatment, because it is known to exert the greatest effect on the smallest plants (Kunst 1988; Parmenter 2008). Another good option for multitactic control might be herbicide application. Because herbicidal control of cholla generally requires covering all stems and joints with the herbicide, smaller plants may provide a more economical and easier target than larger plants (McGinty and Ueckert 2005; McDaniel 2009).

Precipitation and temperatures during the 2006 to 2010 period of this study were average, especially during the November to March treatment season when precipitation and temperatures are generally low. Because cholla can resprout from stem

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fragments when treated mechanically (Ibarra et al. 1985; Kunst 1988), it is often recommended that control not be attempted for this common rangeland weed (e.g., see McGinty and Ueckert 2005). However, Ibarra et al. (1985) suggested that mechanical treatment just prior to a dry season might be effective, but our study demonstrates that the observed reduction in cholla densities after railing treatments may be almost exclusively due to reduction of the largest, most visible individuals, whereas small individuals are not reduced.

Cholla continues to be a serious weed on some rangelands, and its control is challenging. This research shows that large cholla plants can be effectively controlled by railing that is timed to coincide with the cool, dry season. As yet unexplained is the relative importance of precipitation and temperature for the observed treatment effect. Kinraide (1978) suggested that the distribution of cholla was limited by climate, and that its northern limit in Colorado corresponded to a mean January temperature below 1 C. The site for this study experiences both wintertime cold and dryness; hence, we suggest that mechanical control of large cholla plants should be possible in other areas with similar climates, and might be possible in areas with either a dry or a cold season if treatments coincide with these seasons. Finally, it should be noted that controlling cholla might not always result in increased grass production (Pieper 1971). However, there may be other benefits to cholla control, including facilitating animal movement and handling, conservation of biodiversity, and reducing soil erosion and runoff (Kunst 1988; Vazquez-Mendez et al. 2010).

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