Living on the edge: enhanced roadside growth of creosote bush (*Larrea tridentata*)

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ABSTRACT: We show examples of roadside creosote bush enhancement along desert roads and discuss the role of water and berm structure.

1. Introduction

"The "edge effect" is a fundamental ecological phenomena where plants and animals adapt to and often thrive at the edges of ecosystems compared to the interiors[1]. Among the many ecological transition zones, those along roads are extremely narrow, often only a few meters wide. Their easy accessibility and small dimensions make them convenient locations for ecological studies[2-6].

The deserts of the southwest are an ideal place to see edge effects. Many paved, two-lane desert roads show enhanced growth of creosote bush[7] within a few meters of the road (Figure 1). The bushes are larger, and appear healthier and greener than those just ten meters from the road. Their apparent vitality is obviously related to the road, but how? In this paper we discuss and speculate on other possible causes of such enhanced growth.

2. Observations

Most of the *in situ* observations were made in and around Death Valley National Park in Feb 2016. Approximately two hundred miles of roadside were monitored while driving between various destinations. In most cases the enhancements were present, varying between dramatic and subtle. Plants besides Creosote were also seen to hug the road, especially springtime wild flowers.

To compare paved and unpaved road edges, we surveyed many desert roads in southern California, Nevada and Arizona using Google Earth. We found enhancements in almost every case, though in some places there was none. The effect is readily visible in Google Earth and other satellite imagery (Figure 2). Growth enhancement is also seen along interstate highways, though in a somewhat more complex way owing to landscaping. Young or more recent roads showed little enhancement and this may be because Creosote is a slow growing plant and requires many years to reach a size detectable in satellite imagery. Other factors such as rainfall, soil chemistry and the degree of soil drainage certainly play a role.

3. Structure of the berm

A number of workers have suggested and in some cases shown that rain water running off paved roads can locally increase soil moisture and promote more vigorous growth[2-6]. Doubtless we have all seen puddles of water next to an otherwise dry road after a rain. Extra water is surely a contributing factor, perhaps the most important one. Indeed, creosote growth along unpaved desert roads where runoff is less or absent shows little or no enhancement (Figure 3).

Figure 1. Stretch of Scotty's Castle Road in Death Valley National Park. Note vigorous creosote growth adjacent to the road.

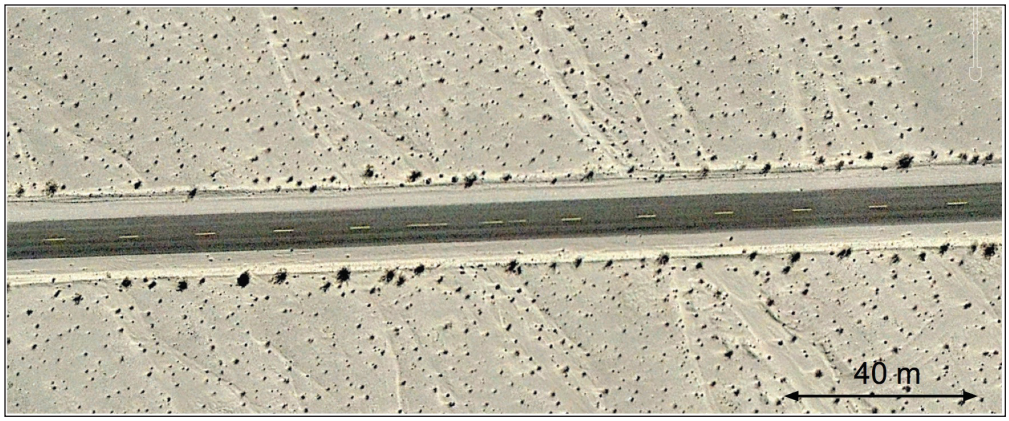

Figure 2. Google Earth image of a typical section of Panamint Valley Road between California State Road 190 and Trona, CA. Note the larger sizes of creosote bushes in the roadside berm compared to the surrounding plain.

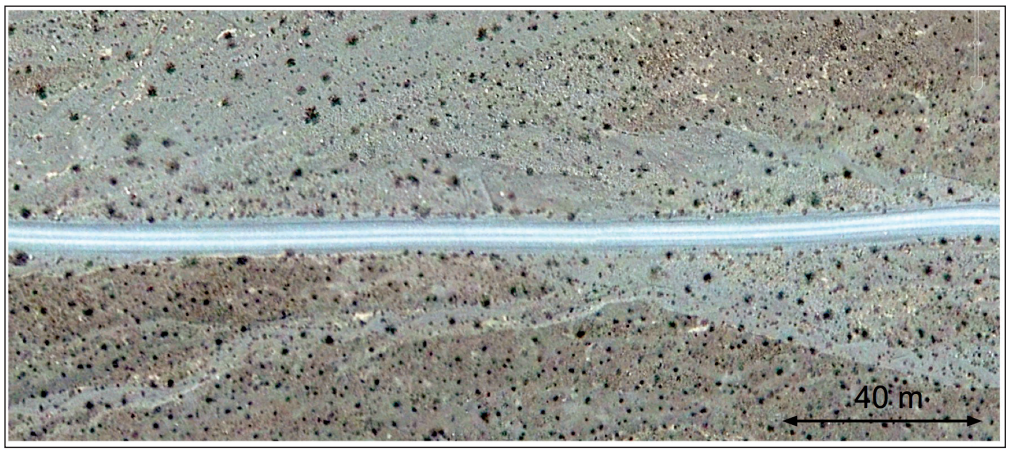

Figure 3. Google Earth image of a typical section of the Racetrack Road south of Ubehebe Crater. Note the absence of roadside creosote enhancement.

Yet a detailed study of roadside vegetation enhancement records *some* enhancement along unpaved roads[4]. If unpaved roads are well drained and consequently have little or no lateral runoff, then other factors must be at work besides extra water.

If water were the only factor, one might expect the strongest growth to occur in the depressions where water collects. But it's not. Enhanced growth occurs in the elevated berms. Therefore the structure of the berm must play a significant and perhaps dominant role in creosote enhancement (Figure 4). Listed below are some speculations as to why berm structure is important.

1. The enhanced growth is seen in slightly elevated berms (0.2–1 m). These were made when road-building equipment scraped the desert floor and piled up the rocks and soil alongside the road. In so doing, there may have been a few creosote bushes in the debris that survived in the deposited berm. This would increase the number of creosote bushes directly adjacent to the road.

2. The slightly elevated berms would also collect water running downhill from the side of the berm facing uphill and away from the road (Figure 4a). From the Google

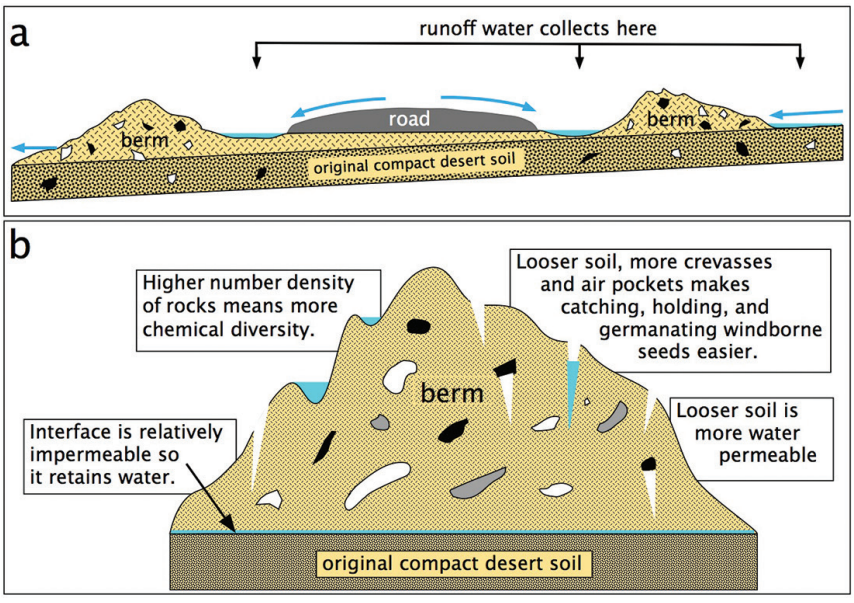

Figure 4 (a) Road and surface runoff collection. (b) Berm properties that may promote enhanced growth.

Earth survey our impression is that this is true, though to a varying and relatively minor degree.

3. Compared to the compacted desert floor, berms are composed of relatively loose rock and soil. Their increased porosity would allow water to more readily seep into the berm, thereby promoting deeper growth of new and existing bushes.

4. The looser berm soil would make it easier for plant roots to penetrate.

5. The looser berm soil would be more likely to let in sunlight to assist germination.

6. Dormant creosote seeds scraped up by road construction could germinate once deposited in the berm.

7. The slightly elevated berms would be more likely than the flatter surroundings to catch windborne seeds, thereby increasing the probability of new creosote growth.

8. There are more rocks per cubic meter in the berm than in the original desert floor because they have been moved from the roadbed to the berm. This creates more air space and conduits for water to seep. Concentrating rocks at the roadside is the same mechanism that makes the lines of Nazca visible.

9. The boundary between the original compact desert floor and the berm is relatively impermeable to water, so the berm stays more moist.

10. Being slightly elevated, the berms will catch early morning and late afternoon sunlight, keeping them slightly warmer than the plain in winter and thereby promoting growth.

There are probably other factors to enhance or affect growth. Among them might be the soil composition, drainage, the presence of competing plants and animals and possibly the effects of hydrocarbon emission from passing vehicles[8].

4. Summary and conclusions

Roadside enhancement of creosote bushes is the result of rainwater runoff from the pavement and from the loose soil of the berms that promotes germination and growth in a number of ways. A key factor in enhanced creosote growth would seem to be the internal structure of the berm, something that has not to our knowledge been investigated.

References

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7. Creosote grows in the arid regions of the southwest US and Mexico in U.S. Department of Agriculture plant hardiness zones 7 to 11.

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