disagreed" with the draft 2010 California Fire Plan because it contained the following statement:

> *. . . fires have been too frequent in many shrublands, especially those of southern California, which are then at risk of type conversion from native species to invasives that can pose a fire threat every fire season.*

The county explained that recognizing the threat of chaparral type conversion in the Fire Plan would impact its ability to obtain funding to carry out vegetation clearance activities.

Prescribed burning—one of the clearance activities that San Diego County was hoping to conduct—has been shown to seriously compromise chaparral plant communities. In a study that simulated the effect of frequent fire on southern California coastal shrublands, Syphard et al. (2006) concluded that, "Due to this potential for vegetation change, caution is advised against the widespread use of prescribed fire in the region."

One of the problems with prescribed burning in chaparral is that there is a narrow window when such burns can occur: in the cool season (late spring). Plants have too much moisture in their tissues in the winter and early spring months to carry a fire. In the summer and fall, the risk of wildfire is too high because of low moisture levels and weather conditions. As a consequence, prescribed burns are conducted when the chaparral ecosystem is most vulnerable. The plants are growing, the soil is still moist, many animal species are breeding, and some birds are occupying the chaparral during their annual migrations. Thus significant ecological damage can occur as a result of a prescribed burn (Knapp et al., 2009).

The exact mechanisms are not clearly understood, but cool-season burns likely cause significant damage to plant growth tissues and destroy seeds in the soil as soil moisture turns into steam. A prescribed burn conducted in the 1990s in Pinnacles National Park, California, led to immediate type conversion of chaparral to nonnative grassland (Keeley, 2006). An escaped prescribed burn in 2013 consumed more than 1090 ha of fragile desert habitat in San Felipe Valley, California, much of which was chaparral that was recovering from a fire 11 years before. The fire seriously compromised one of the last old-growth desert chaparral stands in the region (CCI, 2013) (Figure 7.9).

Combustible Resins and Hydrophobia

There is no question that the loss of vegetation after a fire exposes more soil surface and increases the kinetic force of precipitation on the soil, which can increase the flow of water on the surface. The result can be significant erosion, flash flooding, and large debris flows. However, a factor that seems to get more attention than its proven influence justifies is water repellency, or "hydrophobic soils."

The observation that heat during a fire can change or intensify the water repellency of soil depending on temperature and other factors has been studied

FIGURE 7.9 Photo shows an escaped, 40 ha prescribed fire in the San Felipe Valley Wildlife Area, San Diego County, California, that ultimately burned more than 1000 ha, most of which was 11-year-old desert chaparral. Considering the ecological fragility of the area because of its age and the multiple fires that have burned much of the valley over the previous decade, there likely will be a significant reduction of biodiversity in the region (photo: R.W. Halsey).

extensively (DeBano, 1981, Hubbert et al., 2006) and was first identified after chaparral fires. The hydrophobic soils theory suggests that because of the gas released by burning plants and soil litter, hot fires create an impermeable "waxy layer" a few inches below the surface. According to popular accounts, this layer then prevents water from permeating the ground, causing large chunks of topsoil to break loose during rain storms and slide down the hill (LAT, 2014). Warnings about the hazards of such waterproof layers are commonly raised by the media after fires.

However, the actual impact hydrophobic soils have on erosion is questionable. Contrary to the impression often left by popular accounts, water repellency is not like a layer of plastic wrap under the surface; instead it is quite patchy and transient, abating once soils are wetted. Water repellency is also a natural condition of many unburned soils. In fact, high-severity fires have been found to destroy repellency (Doerr et al., 2006). In a review of the literature, Busse et al. (2014) concluded the following:

> *Most studies have only inferred a causal link between water repellency and erosion, and have failed to isolate the erosional impacts of water repellency from the confounding effects of losses in vegetation cover, litter cover, or soil aggregate stability.*

Unfortunately, the theorized role hydrophobic soils play in erosion has been repeated so many times that it has taken on the power of myth and is used to justify questionable, and sometimes expensive, land management decisions. The chaparral has been especially targeted for blame.

FIGURE 7.10 Postfire treatments in chaparral are costly and often of questionable value. Strips of mulch were dropped by aircraft on the side of the Viejas Mountain in San Diego County after the 2003 Cedar Fire (photo: R.W. Halsey).

To justify the clearance of native chaparral habitat, the Arizona Game and Fish Department claimed that "... catastrophic wildfire in the chaparral type can burn intensely enough to create hydrophobic soils, reducing soil productivity, increasing erosion, and causing severe downstream flooding" (AGFD, 2007). The City of Los Angeles spent $2 million to spread mulch after the 2007 Griffith Park Fire in part because "... chaparral vegetation has a natural tendency to develop water repellent or hydrophobic soils due to their natural high wax content. As a result, burned watersheds generally respond to runoff faster than unburned watersheds..." (LACC, 2007).

More than $1.25 million was spent laying down strips of mulch on Viejas Mountain in San Diego County after the 113,473 ha, high-intensity 2003 Cedar Fire, ostensibly to control erosion (Figure 7.10). However, Viejas Mountain is composed of gabbro-type soils that are not typically prone to extensive erosion (Halsey, 2008). Hydrophobic soils also have been used to justify postfire "salvage" logging after the 2013 Rim Fire in the Stanislaus National Forest (USFS, 2013).

7.4 REDUCING COGNITIVE DISSONANCE

Despite clear research that disproves many of the commonly held misconceptions about fire in chaparral that are fostered by the fire suppression paradigm, misconceptions persist. Many have found their way into land management plans that advocate landscape-scale "fuel treatments" or vegetation management projects for the stated purpose of "returning" California's chaparral ecosystem to a more "natural" and supposedly less dangerous fire regime. How the media, policymakers, and managers have responded to the cognitive dissonance that