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Comments: March 17th, 2016
Coronado National Forest
Santa Catalina Ranger District
Attn: Christina Pearson, Interdisciplinary Team Leader
Re: Catalina/Rincon Firescape Plan 2016

I am extremely concerned with the details and scope of the current FireScape proposal, which constitutes burning half of the combined Santa Catalina and Rincon Mountain ranges.

Historically fire has played an essential role in these mountains, but fire ecology has changed dramatically due to the establishment of a permanent community in the middle of the mixed conifer forest (Summerhaven) and the introduction of many species of invasive, fire-adapted grasses and plants (many of which were introduced by the USDA & Forest Service). The CNF has not identified how it will mitigate the effects of fire-adapted invasive grasses that have been shown to expand their range after prescribed burns and continue to alter local fire ecology. The CNF has not elaborated how the killing of 7,000 acres of specific trees in a wide range of plant communities will be conducted to avoid mortality of adjacent rare plants, especially from herbicide residues in soil which can be phytotoxic to native plants and associated mycorrhizal fungi and soil microbes. No mention in the CNF BE addresses the health effects associated with burning areas where herbicide has been used. It has been previously assumed that these herbicides quickly degrade and are not present in plants when they are burned, but this concept is not supported by scientific literature in over half of the proposed herbicides. The combustion of all of the proposed herbicides results in the production of toxic and hazardous fumes that pose health risks to fire personnel, CNF employees, the general public and all native fauna.

Tree removal/herbicide use is also planned in limestone communities, which have been identified by the CNF as being areas of special concern. The CNF needs to better define the scientific justification for these actions, and especially disclose the exact actions to occur on limestone substrates. The CNF also needs to consult with current, peer-reviewed and published scientific research in regards to its stand on the safety of the nine proposed herbicides, rather than relying on previous USDA documents. It is highly concerning that of the proposed herbicides, the one considered to be the safest (glyphosate) has been declared a 'probable carcinogen' by the World Health Organization. It is also important that the CNF publicly discloses the exact species composition of revegetation seed mixes that will be used following the burns, as the CNF has historically and recently dispersed non-native invasive grass seeds in the forest.

Prescribed Burns in Altered, Modern Plant Communities

The historically beneficially fire ecology of these mountains has been permanently altered with the human introduction of of a permanent town in the middle of the mixed conifer forest, livestock grazing and invasive grasses. The CNF fire plan does not clearly explain how this large-scale burning will be accomplished without incurring further ecosystem alteration as a result of intense and hot burning fires. Invasive plants that contribute to fires in our area include: buffelgrass (Cenchrus ciliare), fountain grass (Cenchrus setaceum), natal grass (Melinis repens), Mediterranean grass (Schismus barbatus), Arabian grass (Schismus arabicus), Lehmann's lovegrass (Eragrostis lehmanniana), Boer's lovegrass (Eragrostis curvula var. conferta), weeping lovegrass (Eragrostis curvula var. curvula), red brome (Bromus rubens), cheatgrass (Bromus tectorum), and mullein (Verbascum thapsus).

Lehmann's lovegrass is one of the dominant invasive grasses found in the middle elevations of the CNF. Unfortunately this grass was seeded by the CNF as recently as 1990 (Anable et al, 1992; Brooks, 1993). Many different studies have been conducted in this region about whether fire increases the invasive spread of Lehmann lovegrass, with contrasting results. Although studies by Geiger (2006) and McGlone (2013) found that Lehmann's lovegrass did not expand in range after a prescribed burn, these authors acknowledge that Lehmann's does have the potential to outcompete natives and rapidly expand in range as a result of fire. Lehmann's produces 3 to 4 times more biomass than native grasses, resulting in increased fire intensity in June (Cox et al, 1990; Geiger, 2006; McGlone et al, 2004). Previous studies have found that Lehmann's dramatically increased after burns (Cable, 1965; Martin, 1983). Lehmann's lovegrass is also quicker to recover after fires than native grasses, and produces a much higher volume of seed production than native grasses after a fire (Martin, 1983; Sumrall et al, 1990; Cox et al, 1990). Lehmann's seems to benefit greater than native grasses from the resulting nutritional availability in the soil in the year following a burn. Cable concluded that Lehmann's lovegrass reestablishes itself quickly with heavy seeding after fire and eventually forms pure stands within 20 to 30 years (Cable, 1971).

Natal grass is another African savannah grass that alters fire ecology (Denbrow, 2013). Fire favors the growth of Natal grass, and plants produce much larger numbers of seeds on years of lower than average precipitation (Castillo et al, 2007). After the devastating Bullock fire in the Santa Catalina Mtns (2002), the CNF proposed aerially dropping seeds of Natal grass to stabilize soil on the east side of the Catalina's just northeast of Green Mountain in the area surrounding upper Buehman Canyon, which was opposed at a public meeting by local ranchers (J. Goff & C. Goff) due to low forage value. In August of 2010, I made the long hike into the extremely remote area just west of upper Buehman Canyon and found the largest population of Natal grass in the Santa Catalina/Rincon Mtn complex. All of the surrounding hills were completely pink from the flower heads of Natal and the extent of the population seemed to be almost a square mile or bigger. Did the CNF reseed with Natal grass and has any CNF employees visited this site (GPS - 34 22 25N, 110 39 37W, 5773 ft elevation; including all surrounding hills/mountains)? How is the CNF going to manage a controlled burn in an area like this that is now dominated by an invasive savannah grass?

The CNF has mentioned the dangers of prescribed burns in the lower elevations, but intense fires happen at nearly all elevations due to the abundance of invasive grasses present in nearly all plant communities. Red brome and cheatgrass are also fire-loving grasses that provide increased fine fuels, higher intensity fires, and expand in range after fires (Crawford, 2001; Jurand, 2002; Esque, 2006; Keeley, 2007). Mediterranean grass was used in seeding mixes by the CNF as recently as 1991(Brooks, 2003). It generates high fine fuels, increased fire intensity, increased biomass and density after fires, and increased mortality of palo verdes and saguaros after fires (Cave and Patten, 1984; Esque and Schwalbe, 2002; Esque et al, 2006; Esque et al, 2010a; Esque et al, 2010b).

Buffelgrass is the premier fire grass that is much talked about, so little discussion is necessary here on this. McDonald and McPherson (2013) described buffelgrass fires reaching temperatures between 1600 - and 1652 degrees F. Fountain grass burns at extremely hot temperatures near 900 degrees F (Rahlao et al, 2009). These invasive grasses are widespread and represent huge swaths of flammable biomass.

Boer's lovegrass and Weeping lovegrass also respond strongly to fire (Cox et al, 1988a; Cox et al, 1988b). Boer's lovegrass can create a 5.4 times greater fuel loads than native grass communities, resulting in much hotter fires in controlled burns (Kupfer and Miller, 2005). After fire, weeping lovegrass has been shown to double the production of crude protein, due to benefiting from the additional nitrogen release following the burn (Klett et al, 1971). Han et al (2012) found that weeping lovegrass has many advantages over native grasses, a) faster germination, b) earlier flowering times, c) quicker growth rates, and d) grew taller than natives two weeks after germination.

No appropriate considerations have been elaborated as to how the CNF plans to address the issues of how the proposed prescribed burns will influence further invasion and expansion of these invasive grasses. Rather than rushing into an all-encompassing prescribed burn for such an extensive area without addressing these challenges, it would be better to find individual strategies for specific areas of the mountain - in order to limit the devastating effects to native plant communities, which is the goal of the FireScape plan.

Herbicide Treatment on Target Tree Species

Great care must be taken with tree removal in the mixed conifer forest, in relation to targeted maple species. Mastication, grubbing and herbicide treatment are extremely poor options due to inevitable collateral damage in the densely crowded forest floor - particularly species of orchids which are found in association with maples. There are approximately 7 species of orchids native in the mixed conifer forest in the Catalina Mtns, including several rare species: Malaxis abieticola, Malaxis porphorea, and Listera convalarioides. Despite the non-addressed issue of herbicide translocation into root systems and soil, herbicides adsorb to soil near treated plants and damage vital mycorrhizal fungi and soil bacterial communities. Herbicide residues in soil also create phytotoxic conditions for emerging seedlings of native plants. Many of our orchid species are mycoheterotrophic (Coleman, 2002), and are dependent upon the fungus that they live with. These fungus are easily damaged or killed by exposure to herbicides, which are inherently selective fungicides and biocides. Mastication and grubbing results in mortality of nearby rare plants or bulbs in the soil, which may be completely dormant at the time of activity when they would not be visible to the eye. Herbicides should not be used in the mixed conifer forest.

Several rare native, plant communities have evolved as a result of overgrazing and improper land management over the past century. These include the only pure juniper grassland that I have seen in the Santa Catalina Mountains. Juniper species host a massive number of specialized insects including: Callophrys gryneus, Sphinx dollii, Digrammia triviata, Holochroa dissociaria dissociaria, Glena interpunctata, Pero behrensaria sperryi, Diedra cockerellana, Henricus infernalis, Chrysina gloriosa, Chrysina lecontei, Paracotalpa puncticollis, Phloeosinus serratus, Trachykele blondeli, and Styloxus bicolor (Verrier, 2016, unpublished). Pure mountain mohagany grasslands are another unique community that is only found in a handful of locations. These seldom found plant communities should be protected and appreciated as being rare and special resources, even if they are a product of manmade impacts. It is ironic that the CNF planted non-native Chilean mesquites and eucalyptus along the Catalina Highway (many of which still persist), but is now planning on killing native trees like mountain mohagany, juniper, and oak because they are not part of the 'desired plant communities'.

Herbicide Treatment With Prescribed Burns

The CNF has proposed to spray herbicides on up to 6,800 acres of forest that will then be burned approximately 30 days later. Scientific studies show that 5 of the 9 proposed herbicides persist in plant tissue much longer than 30 days. Burning these chemical residues results in the release of toxic fumes, posing a health issue to wildlife, fire personal, CNF employees, and the public. It is critical for public safety that the CNF clearly post along trails and trailheads when spraying has occurred to warn people of the dangers of interacting with plants in those areas. Glyphosate, widely considered the safest herbicide ever created, persists in plants and soils much longer than was generally believed (Myers et al, 2016). Glyphosate residues in plant stems were 31% of the original application dosage after 8 weeks (Marshall et al, 1987). The primary decomposition metabolite of glyphosate is aminomethyl-phosponic acid (AMPA), which is also found in plants, leaf litter and soil. Glyphosate and AMPA residues in ground leaf litter from treated plants were 35% of original application after 28 days and 20% of original applications after 37 days. Herbicide residues in shrubs were 30% of original dosage after 28 days and 20% after 40 days (Newton et al, 1984). Toxic fumes are released by burning glyphosate/AMPA residues and include nitrogen oxides and phosphorus oxides. Nitrogen oxides are associated with biological mutations in mammals, and phosphorus oxides include

'white phosphorus', a chemical weapon currently banned by the Geneva Convention due its incredibly hot and sticky combustion that caused horrific human deaths during WWII (MSDS sheets AMPA, 2008; MSDS sheet Roundup, 1998).
2,4-d is best known as an ingredient in the carcinogenic, dioxin containing Agent Orange. Although the other chemical in Agent Orange (2,4,5T) has been thought to be the primary cause of the dioxin formation, scientific literature clearly shows that the synthesis of 2,4-d also results in the formation of highly toxic dioxins (Cochrane et al, 1981; Gilmanov et al, 1998; Han et al, 2015; Holt et al, 2010; Holt et al, 2012; Kalipci et al, 2013; Liu et al, 2013; Masunaga et al, 2001; Munoz et al, 2012; Nie et al, 2015; Zhavoronkov et al, 1998). 2,4-d residues persist in plant tissue for long periods: 40% of original application found in tree crown tissues after 37 days and 25% after 79 days. Levels of 2,4-d found in browse-level foliage remained consistent at 30% of original application between 37 and 153 days (Newton et al, 1990). When burned, 2,4-d residues in dried plant material release the following toxic fumes: hydrogen chloride, hydrogen oxides, and dimethyl amine. OSHA establishes the human limit to exposure of hydrogen chloride at 5ppm (CDC, 2016).
Tebuthiuron has been documented to persist in plant tissues over many years. Significant residues of tebuthiuron have been found in blue grama grass (Bouteloua gracilis) and sideoats grama grass (Bouteloua curtipendula) over a decade after application, at levels above legal standards for forage animals (Johnsen and Morton, 1990). Residues persist in soils for up to 8 years. Fifteen foot barren ground patches have been found where individual tebuthiuron pellets were dropped, resulting in longterm phytotoxicity of seedlings in the area (du Toit and Sekwadi, 2012). When tebuthiuron residues are burned, the following toxic and irritating fumes are released: nitrogen oxides, sulfur oxides and silicon oxides. Silicon oxides are associated with cancer and lung disease when inhaled. The MSDS sheet for tebuthioron also lists, "may cause cancer, may cause organ damage (pancreas)" (Spike 20 MSDS, 2015).
Imazapic is in the same family of herbicides as imazapyr, the Imidazolinone family. Imazapic, like imazapyr, also acts as a soil pre-emergent which prevents all seedlings from germinating for between 1 and 2 years (Ehlert, 2015). Using a known pre-emergent in the national forest is incredibly irresponsible as this will inhibit the germination of all native seeds - is this even legal? After the recent imazpyr debacle in the Catalina's, it is shocking to see imazapic in the FireScape plan. Revisiting the imazapyr/imazapic situation in the Catalina's will generate a lot of bad publicity for the CNF and a strong reaction from the local community. Hazardous fumes released from the combustion of imazapic include nitrogen oxide, nitrogen dioxide, and hydrocarbons (highly flammable and often contaminated with benzene).
Triclopyr also releases toxic and irritating vapors when burned, including nitrogen oxides, hydrogen chloride and phosgene (Garlon 4 MSDS, 2002). Phosgene was used as a deadly chemical weapon during WWI and resulted in the deaths of 85,000 people (or 85% of the total number of chemical weapon fatalities in that war). Garlon 4 formation is proposed for use by the CNF, which also contains 38.4% kerosine.
Picloram, brand name Tordon is in the FireScape plan, which is a combination of Picloram and 2,4-d - the synthesis of these two chemicals is much greater than the sum of the individual chemicals. When burned, Picloram releases toxic fumes of nitrogen oxides and nitrogen chloride. It is flammable above 190 degrees F, and has a phytolysis half-life in aerobic soil conditions of 167-513 days (Tordon Picloram MSDS, 2004).
Aminopyralid is readily absorbed in plant tissue, with 89% of the chemical concentrating in the leaves and 9% depositing into the stems. It is highly persistent in the environment. Plants grown in low level soil residues of aminopyralid have shown damage 6 weeks after treatment (Fast, 2010). Chemical residues are adsorbed in sandy soils at 3 fold greater rates than in loamy clay soils. When burned, aminopyralid releases toxic fumes of nitrogen oxides and nitrogen chloride (Milestone MSDS, 2014).
Clopyralid has also been shown to persist in treated grass clippings at approximately 50%

strength after 8 weeks (Lewis, 2014). When burned, Clopyralid releases the toxic vapors of nitrogen oxides, hydrogen chloride, and chlorinated pyridine (Transline MSDS, 2003).

Dicamba can decompose at high temperatures and form toxic gases. Dicambra is an organochlorine herbicide, which are known to be environmentally persistent and to cause neurological disorders in mammals. Thermal decomposition products of dicamba include hydrogen chloride, nitrogen oxides, and organochlorine products (Vaniquish Herbicide MSDS, 2001). It is important to note that dioxins are produced by burning organochlorines.

The idealistic idea that synthetic chemicals suddenly disappear in plants and soil shortly after application is optimistic at best. The above referenced literature shows much longer persistence for the herbicides glyphosate, 2,4-d, imazapic, clopyralid and tebuthiuron. The material safety data sheets on each of the proposed herbicides cannot be ignored. In addition to the health affects associated with burning chemicals, these toxic fumes can potentially contaminate soil, resulting in phytotoxicity to seedlings and plants. Some of these toxic chemicals like dioxins (from 2,4-d and the combustion of Dicamba) are highly environmentally persistent, with a half-life in soil sediment of over 100 years.

The FireScape BE references itself repeatedly when claiming that all of these herbicides are extremely benign and present little or no potential damage to the mountain. Glyphosate, easily the most benign herbicide in the CNF plan, is a great example of the science or pseudoscience used to justify its safety. In 2015, the EPA begin a re-evaluation of the safety of glyphosate and presented 39 references to justify their stance of re-approving the safety of this herbicide. Of these, 72% of the references were old, non peer-reviewed, unpublished studies conducted by the registrant, Monsanto (Seralini et al, 2014). However, because of a growing collection of scientific data showing the dangers of this herbicide, the World Health Organization declared glyphosate a 'probable carcingen' last year (Guyton et al, 2015; IARC, 2015). Now the state of California has proposed glyphosate to also be listed as 'probably carcinogenic', and lawsuits are popping up across the country regarding the known health concerns of this herbicide. Recent disclosures of glyphosate residues found in beer, feminine products, bandaids, medical gauze and in most human urine samples are disturbing to the public. Glyphosate use has increased by 20 fold in the past 40 years, and a total of 1.6 billion kilograms of glyphosate have been applied in the United States since 1974 (Benbrook, 2016). A growing body of scientific literature shows that it causes mitochondrial damage in human cells, is an endocrine disruptor, is a selective fungicide and kills bacteria in mammals and in soil communities (Bolognesi et al, 1997; Peixoto, 2005; Sivikova and Dianovsky, 2006; Raipulis et al, 2009; Claire et al, 2012; Koller et al, 2012; Romano et al, 2012; Schrodl et al, 2013; Shehata et al, 2013; Thongprakaisang et al, 2013; Alvarez-Moya et al, 2014; Ugarte, 2014; Zaller et al, 2014; Pandey and Rudraiah, 2015; Myers et al, 2016; Xu et al, 2016). The CNF did not acknowledge that modern scientific literature proves that the surfactants/adjuvants of the proposed herbicide formulation Roundup have been shown to be toxic to human cells than the active ingredient, glyphosate (Gehin et al, 2005; Martinez et al, 2007; El-Shenawy, 2009; Gasnier et al, 2009; Lee et al, 2009; Kim et al, 2013; Mesnage et al, 2013; Chaufan et al, 2014; Coalova et al, 2014). An issue that needs to be addressed is the use of Torlon herbicide, a combination of two of the proposed herbicides. Combining these herbicides can have unexpected effects and this needs to be considered by the CNF, as the individual toxicity data does not apply to this chemical combination.

The CNF FireScape Plan BE does not appropriately deal with the actual health concerns from the proposed herbicides and their associated surfactants. A review of the current scientific data is necessary before proceeding with the application and burning of these chemicals on 6,800 acres of national forest.

Limestone Communities & Herbicide Treatment

Forest lands with limestone substrates have been identified by the CNF as areas of special concern because of the unique biological communities that they host. Limestone soils are extremely porous carbonate substrates that drain very well and therefore hold much less moisture than most other soils do. Historically, limestone substrates have never supported robust grassland communities due to the diminished water availability. Limestone communities generate a significantly lower biomass of plant material due to the reduced water availability, and do not pose the same fire dangers as communities that are supported by more mesic soil substrates. The FireScape plan needs to consider this, and the use of herbicides in these unique communities is completely unnecessary and should be abandoned.

I have huge concerns about the scope of herbicide and burning proposed for the limestone communities on the east side of the Catalinas. My longterm observations do not support that the CNF regularly monitors these areas to inspect the extent of grazing damage and spread of invasive grasses. How can the CNF effectively make an ambitious fire plan for these areas, when it is barely aware of what is happening with livestock grazing in these remote and distant areas? Most of these locations involve a 2+ hour one-way drive from Tucson, and many hours of hiking across rough terrain with no trails (other than cattle trails).

FireScape Effects on an Endangered and Threatened Species

The FireScape plan has concluded that the Lesser Long Nosed Bat (Leptonycteris yerbabuenae) and the Mexican long-tongued bats (Choeronycteris mexicana) will be minimally affected by the proposed fire plan. The primary plant food sources for both of these bats are agaves and saguaros, which are both very sensitive to high intensity fires (Esque et al, 2006; Johnson, 2001; Lindsay et al, 2011; McDonald and McPherson, 2013). Agaves experience increased mortality with higher intensity burns (Geiger, 2006; Lindsay et al, 2011). Agave seedlings emerging after a fire will take between 20 to 30 years to flower (Agave chrysantha, A. parryi & A. palmeri). Amole (Agave schottii) experiences high mortality with fires (Niering and Lowe, 1984), although these plants flower approximately 10 and 15 years after germinating. This huge gap in between seedling recruitment and actually supplying a nectar source to these endangered and threatened species questions the minimal impact that the CNF has concluded. Special care needs to be addressed in burning on all saguaro lands, especially those unique areas on limestone substrates in lower Buehman Canyon, Edgar Canyon and Alder Canyon. All three of these saguaro communities have sizable populations of Lehmann's lovegrass, red brome, with increasing numbers of Natal grass.

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