

Data Submitted (UTC 11): 3/21/2016 7:00:00 AM

First name: Jim

Last name: Verrier

Organization:

Title:

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 beneficial fire ecology of these mountains has been permanently altered with the human introduction 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 ciliaris*), fountain grass (*Cenchrus setaceus*), 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 aurally 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 convallarioides*. 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 dolii*, *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 mohogany 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 mohogany, 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 personnel, 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-phosphonic 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 to 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 long-term 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 tebuthiuron 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 imazapyr 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% kerosene.

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. Dicamba 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 FireScope 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 carcinogen' 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 FireScope 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 FireScope 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).

FireScope Effects on an Endangered and Threatened Species

The FireScope 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.

References

- Aminomethylphosphonicacid (AMPA); MSDS [Online]; Sigma-Aldrich, Saint Louis, MO, Apr 02, 2008, http://sigmaaldrich.com/Graphics/COFAInfo/SigmaSAPQM/SPEC/32/3214817/324817-BULK____ALDRICH_.pdf (accessed Mar 17, 2016)
- Alvarez-Moya, C., M.R. Silva, C.V. Ramirez, D.G. Gallardo, R.L. Sanchez, A.C. Aguirre, and A.F. Velasco. 2014. Comparison of the in vivo and in vitro genotoxicity of glyphosate isopropylamine salt in three different organisms. *Genetics and Molecular Biology*, Vol. 37, No. 1, pp. 105-110.
- Anable, M.E., M.P. McClaran and G.B. Ruyle. 1992. Spread of introduced Lehmann lovegrass *Eragrostis lehmanniana* Nees. in Southern Arizona, USA. *Biological Conservation*, Vol. 61, pp. 181-188.
- Benbrook, C.M. 2016. Trends in glyphosate herbicide use in the United States and globally. *Environmentally Science Europe*, Volume 28, Issue 3, pp. 1-15.
- Bolognesi, C., S. Bonatti, P. Degan, E. Gallerani, M. Peluso, R. Rabboni, P. Roggieri, and A. Abbondandolo. 1997. Genotoxic Activity of Glyphosate and Its Technical Formulation Roundup. *Journal of Agricultural Food Chemistry*, Vol. 45, pp. 1957-1962.
- Brooks, M.A. 1993. Evaluation of roadside revegetation in central Arizona (Doctoral Dissertation). University of Arizona, Tucson, Arizona. Retrieved from University of Arizona Libraries.
- Cable, D.R.. 1965. Damage to Mesquite, Lehmann Lovegrass, and Black Grama by a Hot June Fire. *Journal of Range Management*, Vol. 18, No. 6 (Nov.), pp. 326-329.
- Cable, D.R.. 1971. Lehmann Lovegrass on the Santa Rita Experimental Range, 1937-1968.

Journal of Range Management, Vol. 24, No. 1 (Jan), pp.17-21.

Castillo, A.M., M.I.B. Valladares, R.M. Gonzalez, and C.P. Alvarez. 2014. Biology of natal grass *Melinis repens* (Willd.) and implications for its use or control: Review. *Revista Mexicana De Ciencias Pecuarias*, Vol. 5, Issue 4, pp. 429-442.

Cave, G.H. and D.T. Patten. 1984. Vegetation Responses to Fire in the Upper Sonoran Desert. *Journal of Range Management*, Vol. 37, No. 6 (Nov.), pp. 491-496.

Chaufan, G., I. Coalova, M. del Carmen Rios de Molina. 2014. Glyphosate Commercial Formulation Causes Cytotoxicity, Oxidative Effects, and Apoptosis on Human Cells: Differences With its Active Ingredient. *International Journal of Toxicology*, Vol. 33, Issue 1, pp. 29-38.

Clair, E., R. Mesange, C. Travert, and G.E. Seralini. 2012. A glyphosate-based herbicide induces necrosis and apoptosis in mature rat testicular cells in vitro, and testosterone decrease at lower levels. *Toxicology in Vitro*, Vol. 26, pp. 269-279.

Coalova, I., M. del Carmen Rios de Molina, G. Chaufan. 2014. Influence of the spray adjuvant on the toxicity effects of a glyphosate formulation. *Toxicology in Vitro*, Vol. 28, pp. 1306-1311.

Cochrane, W.P., J. Singh, W. Miles, and B. Wakeford. 1981. Determination of chlorinated dibenzo-p-dioxin contaminants in 2,4-D products by gas chromatography-mass spectrometric techniques. *Journal of Chromatography*, Vol. 217, Issue C, pp. 289-299.

Coleman, R.A. 2002. *The Wild Orchids of Arizona and New Mexico*. Cornell University Press, Ithaca, New York.

Cox, J.R., M.H. Martin-R., F.A. Ibarra-Flores, J.H. Fourie, F.G. Rethman & D.G. Wilcox. 1988a. The Influence of Climate and Soils on the Distribution of Four African Grasses. *Journal of Range Management*, Volume 41, No. 2 (Mar.), pp. 127-139.

Cox, J.R., G.B. Ruyle, J.H. Fourie & C. Donaldson. 1988b. Lehmann Lovegrass - Central South Africa and Arizona, USA. *Rangelands*, Vol. 10, No. 2 (Apr.), pp 53-55.

Cox, J.R., G.B. Ruyle and B.A. Roundy. 1990. Lehmann Lovegrass in Southeastern Arizona: Biomass Production and Disappearance. *Journal of Range Management*, Vol. 43, No. 4 (Jul), pp. 367-372.

Crawford, J.A., C.H.A. Wahren, S. Kyle, and W.H. Moir. 2001. Responses of exotic plant species to fires in *Pinus ponderosa* forest in Northern Arizona. *Journal of Vegetation Science*, Vol. 12, pp. 261-268.

Denbrow, J. 2013. *The Archaeology and Ethnography of Central Africa*. Cambridge University Press, Cambridge, England.

du Toit, J.C.O., and K.P. Sekwadi. 2012. Tebuthiuron residues remain active in soil for at least eight years in a semi-arid grassland, South Africa. *African Journal of Range and Forage Science*, Vol. 29, Issue 2, pp. 85-90.

Ehlert, K.A., R.E. Engel, and J.M. Mangold. 2015. Imazapic Activity in a Semiarid Climate in Downy Brome (*Bromus tectorum*) - Infected Rangeland and CRP Sites. *Weed Technology*, Vol. 29, Issue 3, pp. 472-479.

El-Shenawy, N.S. 2009. Oxidative stress responses of rats exposed to Roundup and its active ingredient glyphosate. *Environmental Toxicology and Pharmacology*, Vol. 28, pp. 379-385.

Esque, T.C. and C.R. Schalbe. 2002. Alien Annual Grasses and Their Relationship to Fire and Biotic Change in Sonoran Desertscrub. In *Invasive Exotic Species in the Sonoran Region*. (Ed. Barbara Tellman). Tucson, Arizona: The University of Arizona Press, Arizona-Sonora Desert Museum.

Esque, T.C., C.R. Schwalbe, J.A. Lissow, D.F. Haines, D. Foster and M.C. Garnett. "Buffelgrass Fuel Loads in Saguaro National Park, Arizona, Increase Fire Danger and Threaten Native Species." *Park Science*, Vol. 24, No. 2, Winter 2006-2007, United States Department of the Interior, National Park Service.

Esque, T.C., J.A. Young and C.R. Tracy. 2010a. Short-term effects of experimental fires on a Mojave Desert seed bank. *Journal of Arid Environments*, Vol. 74, Issue 10, pp. 1302-1308.

Esque, T.C., J.P. Kaye, S.E. Eckert, L.A. DeFalco, and C.R. Tracy. 2010b. Short-term soil inorganic N pulse after experimental fire alters invasive and native annual plant production in a Mojave Desert shrubland. *Oecologia*, Vol. 164, pp. 253-263.

Fast, B.J.. 2010. Aminopyralid Fate in Plant Tissues and Soil. Dissertation, University of Florida. Ann Arbor: ProQuest/UMI (Publication No. 3436385)

Gasnier, C., C. Dumont, N. Benachour, E. Clair, M.C. Chagnon, and G.E. Seralini. 2009. Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines. *Toxicology*, Vol 262, pp. 184-191.

Gehin, A., Y.C. Guillaume, J. Millet, C. Guyon, and L. Nicod. 2005. Vitamins C and E reverse effect of herbicide-induced toxicity on human epidermal cells HaCaT: a biochemometric approach. *International Journal of Pharmaceutics*, Vol. 288, pp. 218-226.

Guyton, K.Z., D. Loomis, Y. Grosse, F. El Ghissassi, L. Benbrahim-Tallaa, N. Guha, C. Scoccianti, H. Mattock, and K. Straif. 2015. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. *Lancet Oncology*, Vol 16, Issue 5 (May), pp. 1-2.

Han, Y., Y.M. Buckley, and J. Firn. 2012. An invasive grass shows colonization advantages over native grasses under conditions of low resource availability. *Plant Ecology*, Vol. 213, No. 7 (Jul), pp. 1117-1130.

Han, Y., W. Liu, W. Pan, P. Wang, Z. Tian, Y. Zhao, M. Wang, X. Chen, X. Liao & M. Zheng. 2015. Formation Pathways of Mono- and Octa-Chlorinated Dibenzo-p-dioxins and Dibenzofurans in Main Organochemical Industries. *Environmental Science & Technology*, Vol. 49, pp. 10945-10950.

Holt, E., R. Weber, G. Stevenson & C. Gaus. 2010. Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans (PCDD/Fs) Impurities in Pesticides: A Neglected Source of Contemporary Relevance. *Environmental Science and Technology*, Vol 44 (14), pp 5409-5415.

Holt, E., R. Weber, G. Stevenson, and C. Gaus. 2012. Formation of dioxins during exposure of pesticide formulations to sunlight. *Chemosphere*, Vol. 88, pp. 364-370.

Humphrey, R.R. 1970. *Arizona Range Grasses*. University of Arizona Press, Tucson, Arizona.

Garlon 4 Herbicide (Triclopyr); MSDS [Online]; Dow AgroSciences, Indianapolis, IN, Feb 22 2002; <http://www.nwmissouri.edu/naturalsciences/sds/g/Garlon%204.pdf> (accessed Mar 5 2016)

Geiger, E.L. 2006. The Role of Fire and a Nonnative Grass as Disturbances in Semi-Desert Grasslands (Doctoral Dissertation). Retrieved from The University of Arizona Libraries.

Gil-manov, A., S.N. Galimov, F.K. Kamilov, E.G. Davletov, and V.O. Schhepanskii. 1997. The effect of the dioxin-containing herbicide 2,4-D on the hormonal status of experimental animals. *Meditina truda i promyshlennaia ekologiya*, 1997, Issue 8: 15-8.

International Agency for Research on Cancer Volume 112: Some organophosphate insecticides and herbicides: tetrachlorvinphos, parathion, malathion, diazinon and glyphosate. IARC Working Group. Lyon; 3-10 March 2015, IARC Monograph Evaluation of Carcinogenicity Risk of Chemicals to Humans (in press), pp.1-92.

Johnsen, Jr., T.N., and H.L. Morton. 1990. Long-Term Tebuthiuron Content of Grasses and on Semiarid Rangelands. *Journal of Range Management*, Vol. 44, No. 3 (May), pp. 249-253.

Johnson, R.J. 2001. Effects of Fire on Agave palmeri (Master's Thesis). Retrieved from the University of Arizona Libraries.

Jurand, B.S. 2002. Exploring the Seed Bank Dynamics of Red Brome: Longevity, Density and Relationship to Fire (Master's Thesis). University of Nevada, Las Vegas. Retrieved from the University of Arizona Libraries.

Kalipci, E., C. Ozdemir and H. Oztas. 2013. Assessing eco-toxicological effects of industrial 2,4-D iso-octylester herbicide on rat pancreas and liver. *Biotechnic & Histochemistry*, Vol. 88, Issue 3-4, pp. 202-207.

Keeley, J.E., and T.W. McGinnis. 2007. Impact of prescribed fire and other factors on cheatgrass persistence in a Sierra Nevada ponderosa pine forest. *International Journal of Wildland Fire*, Vol. 16, pp. 96-106.

Kim, Y.H., J.R. Hong, H.W. Gil, H.Y. Song, and S.Y. Hong. 2012. Mixtures of glyphosate and surfactant TN20 accelerate cell death via mitochondrial damage-induced apoptosis and necrosis. *Toxicology in Vitro*, Vol. 27, pp. 191-197.

Klett, W.E., D. Hollingsworth, and J.L. Schuster. 1971 Increasing Utilization by Weeping Lovegrass by Burning. *Journal of Range Management*, Vol. 24, No. 1 (Jan), pp. 22-24.

Koller, V.J., M. Furhacker, A. Nersesyan, M. Misik, M. Eisenbauer, and S. Knasmueller. 2012. Cytotoxic and DNA-damaging properties of glyphosate and Roundup in human-derived buccal epithelial cells. *Genotoxicity and Carcinogenicity*, Vol. 86, pp. 805-813.

Kupfer, J.A. and J.D. Miller. 2005. Wildfire effects and post-fire response of an invasive mesquite population: the interactive importance of grazing and non-native herbaceous species invasion. *Journal of Biogeography*, Vol. 32, pp. 453-466.

Lee, H.L., C.D., Kan, C.L. Tsai, M.J. Liou, and H.R. Guo. 2009. Comparative effects of the formulation of glyphosate-surfactant herbicides on hemodynamics in swine. *Clinical Toxicology*, Vol. 47, pp. 651-658.

Lindsay, D.L., P. Bailey, R.F. Lance, M.J. Clifford, R. Delph, and N.S. Cobb. 2011. Effects of a nonnative, invasive lovegrass on *Agave palmeri* distribution, abundance, and insect pollinator communities. *Biodiversity Conservation*, Vol. 20, pp. 3251-3266.

Lui, W., H. Li, F. Tao, S. Li, Z. Tian & H. Xie. 2013. Formation and Contamination of PCDD/F's, PCBs, PeCBz, HxCBz and polychlorophenols in the Production of 2,4-D products. *Chemosphere*, Vol. 92, pp. 304-308.

Marshall, G., R.C. Kirkwood and D.J. Martin. 1987. Studies on the Mode of Action of Asulam, Aminotriazole and Glyphosate in *Equisetum arvense* L. (Field Horsetail). II: The Metabolism of [14C] Asulam, [14C] Aminotriazole and [14C] Glyphosate. *Pesticide Science*, Vol. 18, pp. 65-77.

Martin, S.C.. 1983. Responses of Semidesert Grasses and Shrubs to Fall Burning. *Journal of Range Management*, Vol. 36, No. 5 (Sep), pp. 604-610.

Martinez, A., I. Reyes, and N. Reyes. 2007. Cytotoxicity of the herbicide glyphosate in human peripheral blood mononuclear cells. *Biomedica*, Vol. 27, Issue 4 (Dec), pp. 594-604.

Masunaga, S., T. Takasuga and J. Nakanishi. 2001. Dioxin and dioxin-like PCB impurities in some Japanese agrochemical formulations. *Chemosphere*, Vol. 44, Issue 4, pp. 873-885.

McDonald, C.J. and G.R. McPherson. 2013. Creating Hotter Fires in the Sonoran Desert: Buffelgrass Produces Copious Fuels and High Fire Temperatures. *Fire Ecology*, Vol. 9, Issue 2, pp. 26-40.

McGlone, C.M., and L.F. Huenneke. 2004. The impact of a prescribed burn on introduced Lehmann lovegrass versus native vegetation in the northern Chihuahuan Desert. *Journal of Arid Environments*, Vol. 57, pp. 297-310.

McGlone, C.M. 2013. No Long-Term Effects of Prescribed Fire on Lehmann Lovegrass (*Eragrostis lehmanniana*) - Invaded Desert Grassland. *Invasive Plant Science and Management*, Vol. 6, No. 3, pp. 449-456.

Mesnage, R., B. Bernay, and G.E. Seralini. 2013. Ethoxylated adjuvants of glyphosate-based herbicides are active principles of human cell toxicity. *Toxicology*, Vol. 313, pp. 122-128.

Milestone Herbicide (Aminopyralid); Dow AgroSciences Canada, Inc., Calgary, Alberta, Canada, 2014; http://www.msdssearch.dow.com/PublishedLiteratureDAS/dh_091f/0901b8038091f471.pdf?filepath=/pdfs/noreg/010-22452.pdf&fromPage=GetDoc (accessed Mar 17,

2016)

- Munoz, M., B.K. Gullett, A. Touati, and R. Font. 2012. Effect of 2,4-dichlorophenoxyacetic acid (2,4-D) on PCDD/F emissions from opening burning of biomass. *Environmental Science and Technology*, 09/2012, Vol. 46, Issue 17, pp. 9308-9314.
- Myers, J.P., M.N. Antoniou, B. Blumberg, L. Carroll, T. Colborn, L.G. Everett, M. Hansen, P.J. Landrigan, B.P. Lanphear, R. Mesnage, L.N. Vandenberg, F.S. vom Saal, and C.M. Benbrook. 2016. Concerns over use of glyphosate-based herbicides and risks associated with exposures: a consensus statement. *Environmental Health*, Vol. 15, Issue 19, pp. 1-15.
- Newton, M., K.M. Howard, B.R. Kelpas, R. Danhaus, C.M. Lottman, and S. Dubelman. 1984. Fate of Glyphosate in an Oregon Forest Ecosystem. *Journal of Agricultural Food Chemistry*, Vol. 32, pp. 1144-151.
- Newton, M., F. Roberts, A. Allen, B. Kelpas, D. White, and P. Boyd. 1990. Deposition and Dissipation of Three Herbicides in Foliage, Litter, and Soil of Brushfields of Southwest Oregon. *Journal of Agricultural Food Chemistry*, Vol. 38, pp. 574-583.
- Nie, Z., Y. Fang, S. Tian, Y. Yang, Q. Die, Y. Tian, F. Liu, Q. Wan & Q. Huang. 2015. Perspective on polychlorinated dibenzo-p-dioxin and dibenzofuran emissions during chemical production in China: an overlooked source of contemporary relevance. *Environmental Science and Pollution Research*, Vol 22 (Oct), Issue 19, pp. 14455-14461.
- Niering, W.A. and C.H. Lowe. 1984. Vegetation of the Santa Catalina Mountains: Community Types and Dynamics. *Vegatatio*, Vol. 58, No. 1 (Dec. 15), pp. 3-28.
- Pandey, A., and M. Rudraiah. 2015. Analysis of endocrine disruption effect of Roundup in adrenal gland of male rats. *Toxicology Reports*, Vol. 2, pp. 1075-1085.
- Peixoto, F. 2005. Comparative effects of the Roundup and glyphosate on mitochondrial oxidative phosphorylation. *Chemosphere*, Vol. 61, pp. 1115-1122.
- Rahlaio, S.J., S.J. Milton, K.J. Esler, B.W. Van Wilgen, and P. Barnard. 2009. Effects of invasion of fire-free arid shrublands by a fire-promoting invasive alien grass (*Pennisetum setaceum*) in South Africa. *Austral Ecology*, Vol. 34, pp. 920-928.
- Raipulis, J., M.M. Toma, and M. Balode. 2009. Toxicity and Genotoxicity Testing of Roundup. *Proceedings of the Latvian Academy Sciences, Section B*, Vol. 63, No. 1/2, pp. 29-32.
- Roberts, F.H., C.M. Britton, D.B. Wester, and R.G. Clark. 1988. Fire effects on Tobosagrass and Weeping Lovegrass. *Journal of Range Management*, Vol. 41, No. 5 (Sep), pp. 407-409.
- Romano, M.A., R.M. Romano, L.D. Santos, P. Wisniewski, D.A. Campos, P.B. de Souza, P. Viau, M.M. Bernardi, M.T. Nunex, and C.A. de Oliveira. 2012. Glyphosate impairs male offspring reproductive development by disrupting gonadotropin expression. *Archives of Toxicology*, Vol. 86, Issue 4 (Apr), pp. 663-673.
- Roundup Original Herbicide (Glyphosate); Monsanto Company, St. Louis, MO, 1998; <http://www.greenhouse.ucdavis.edu/pest/pmsds/Roundup.PDF> (accessed Mar 4, 2016)
- Schrodl, W., S. Kruger, T. Konstantinova-Muller, A.A. Shehata, R. Rulff, and M. Kruger. 2014. Possible Effects of Glyphosate on Mucorales Abundance in the Rumen of Dairy Cows in Germany. *Current Microbiology*, Vol. 69, pp. 817-823.
- Seralini, G.E., R. Mesnage, N. Defarge, and J. Spiroux de Vendomois. 2014. Conflicts of interests, confidentiality and censorship in health risk assessments: the example of an herbicide and a GMO. *Environmental Sciences Europe*, Vol. 26, Issue 13, pp. 1-6.
- Shehata, A.A., W. Schrodl, A.A. Aldin, H.M. Hafez, and M. Kruger. 2013. The Effect of Glyphosate on Potential Pathogens and Beneficial Members of Poultry Microbiota In Vitro. *Current Microbiology*, Vol. 66, pp. 350-358.
- Siltanen, H., C. Rosenberg, M. Raatikainen and T. Raatikainen. 1981. Triclopyr, Glyphosate and Phenoxyherbicide Residues in Cowberries, Bilberries and Lichen. *Bulletin of Environmental Contamination and Toxicology*, Vol. 27, Issue No. 1, pp. 731-737.

Sivikova, K, and J. Dianovsky. 2006. Cytogenetic effects of technical glyphosate on cultivated bovine peripheral lymphocytes. *International Journal of Hygiene and Environmental Health*, Vol. 209, pp. 15-20.

Spike 20 Herbicide (Tebethiuron); MSDS [Online], Dow AgroSciences, Indianapolis, IN, May 4 2015; <http://www.ws.greenbook.net/Docs/Msds/M3795.pdf> (accessed Mar 5 2016)

Sumrall, L.B., B.A. Roundy, J.R. Cox and V.K. Winkel. 1991. Seedbed ecology and emergence of *Eragrostis lehmanniana* as influenced by burning. *International Journal of Wildland Fire*, Vol. 1, pp. 35-40.

Thongprakaisang, S., A. Thiantanawat, N. Rangkadilok, T. Suriyo, and J. Satayavivad. 2013. Glyphosate induces human breast cancer cells growth via estrogen receptors. *Food and Chemical Toxicology*, Vol. 59, pp. 129-136.

Torndon RTU Herbicide (Picloram); MSDS [Online]; Dow AgroSciences, Indianapolis, IN, Apr 15 2004; <http://www.wplanwinc.com/LiteratureRetrieve.aspx?ID=115337> (accessed Mar 5, 2016)

Transline Herbicide (Clopyralid); MSDS [Online]; Dow AgroSciences, Indianapolis, IN, Feb 2 2003; http://www.forestry-suppliers.com/Documents/125_msds.pdf (Accessed Mar 5, 2016)

Ugarte, R. 2014. Interaction between glyphosate and mitochondrial succinate dehydrogenase. *Computational and Theoretical Chemistry*, Vol. 1043, pp. 54-63.

Vanquish Herbicide (Dicamba); MSDS [Online]; Syngenta Canada Inc., Guelph, ON, Canada, Dec 31 2011; http://www.plantproducts.com/fr/images/Vanquish_MSDS_EXP2017-12-31.pdf (accessed Mar 5, 2016)

Verrier, J. 2016. Flora of the Santa Catalina Mountains: Pima and Pinal Counties, southeastern Arizona, 2007-2016. Unpublished.

Xu, J., G. Li, Z. Wang, L. Si, S. He, J. Cai, J. Huang, and M.D. Donovan. 2016. The role of Ltype amino acid transporters in the uptake of glyphosate across mammalian epithelial tissues. *Chemosphere*, Vol. 145, pp. 487-494.

Zaller, J.G., F. Heigl, L. Ruess, and A. Grabmaier. 2014. Glyphosate herbicide affects belowground interactions between earthworms and symbiotic mycorrhizal fungi in a model ecosystem. *Scientific Reports*, Vol. 4, Issue 5634, pp. 1-8.

Zhavoronkov, A.A., L.N. Malysheva, S.N. Galimov, F.K. Kamilov, and E.G. Davletov. 1998. Morphofunctional characteristics of the testis of albino rats exposed to dioxin-containing herbicide 2,4-D. *Arkhiv patologil*, Vol. 60 (Mar), Issue 2.