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RE: Peer Review for the U.S. Fish and Wildlife Service's Proposed Rule to List the Dunes Sagebrush Lizard (*Sceloporus arenicolus*) as Endangered Throughout its Range

Because of the habitat specificity exhibited by Dunes Sagebrush Lizards, habitat alteration is a most pertinent factor affecting their populations. Many of the studies cited and conclusions drawn involve habitat alteration caused by oil and gas wells, herbicides, and pollution, all of which, it is suggested, are facilitated by inadequate regulation. My review, therefore, focuses on these aspects.

Quality of Information and Analyses

A fundamental relationship affecting any lizard's population density and distribution is that between the lizard and its habitat use. Fitzgerald *et al* (1997) provide strong evidence for the linkage between the Shinnery oak dune habitat and Dunes Sagebrush Lizard (Page 77803). Indeed, they conducted a survey among multiple habitat types, but found 100% of the Dunes Sagebrush Lizards in Shinnery oak dunes habitat. Furthermore, they found lizard density to vary among microhabitats within the Shinnery oak dunes habitat. The size of a blowout (bowl shaped depressions between sand dunes) affected the number of lizards found. Relatively, small blowouts were used by lizards less than expected and very large were used more than expected. Shinnery oak dunes, and specifically dune blowouts, are

associated with the Dunes Sagebrush Lizard. More importantly, Shinnery flats and other adjacent habitat compositions, which may include some Shinnery oak, did not contain the lizards. The title given to the Dunes Sagebrush Lizard of habitat specialist is based on sound scientific methodology and statistical analyses.

The studies examining how habitat alteration affected Dunes Sagebrush Lizard densities were also based on sound scientific methodology and statistical analyses. The negative relationship between oil well density and Dunes Sagebrush Lizards is important, and is better supported by the data than is currently explained in the proposed rule (Page 77806, column 1, last paragraph). One may question whether the negative relationship is caused by other factors that happen to be correlated with the placement of oil wells. Sais and Snell (1998) actually analyze the data to address this concern, and find that the negative effect of oil wells on Dunes Sagebrush Lizard density occurs even after accounting for the effects of other habitat variables (percent open sand, the number of blowouts, and the abundance of a competitor – the Side-Blotched Lizard *Uta stansburiana*).

The relationship between Shinnery Oak removal (through herbicide application) and reduced numbers of Dunes Sagebrush Lizards is also well supported by the data in Snell *et al*. (1997; Page 77809, column 1, paragraph 1). The experimental design and sample sizes (8 treated and 12 untreated sites) were more than adequate to address this relationship. Sensibly, if one takes the habitat away from a habitat specialist, the habitat specialist is negatively affected.

The conclusion that pollution is a threat to the Dunes Sagebrush Lizard has the weakest support among the threatening factors. The negative relationship between oil and gas well density and Dune Sagebrush Lizard density, however, is well supported, and the effects of pollution caused by the oil and gas extraction could help explain this negative relationship. With regard to negative effects of pollution

on lizards, more support than that referenced in the proposed rule can be found in the literature. For instance, the belief that soil sulfate concentrations may be high enough to affect Dunes Sagebrush Lizards (juveniles and adults), although reasonable, may disregard another important life stage. It may be more reasonable to believe that high sulfate concentrations could affect embryonic development (Page 77812, column 1, paragraph 2). Dunes sagebrush lizards lay flexible-shelled eggs in the soil that absorb moisture from their surrounding environment throughout incubation. Sulfates make the soil more acidic and acidic embryonic conditions can have negative effects on development (Marco *et al*. 2005. Soil acidification negatively affects embryonic development of flexible-shelled lizard eggs. *Herpetological Journal* 15: 107-111).

Oversights, omissions, and inconsistencies

One possible oversight, or at least avenue of future research, involves the fact that Dunes Sagebrush Lizards select sites with relatively medium sized sand grains instead of finer grains (Page 77803, column 3, paragraph 2). There are no data referenced to support a reason for this preference, but finer sand grains are suggested to limit the lizard's ability to breathe while burrowed in the sand (something this species does regularly). I have another possible reason based on my experience with rearing Eastern Fence Lizards (*Sceloporus undulatus*) in the lab. I first reared juvenile lizards using a sand substrate in the terrariums, but many individuals began having problems with sand sticking and/or getting in their eyes. Once the problem occurred, these individuals could or would not open their eyes, which led to them not eating because they could not see their food, and subsequently starving to death.

A few minor problems were found with citations. Peterson and Boyd (1998) do show that Shinnery oak does not grow in areas with high amounts of calcium carbonate, however, the evidence is

not on page 6 as cited, but on page 7 of their article (Page 77807, column 1, paragraph 1). Painter (2010) is not in the literature cited (page 77804, column 1, paragraph 3). Sias and Snell (1997) also is not in the literature cited, but this may be a typographical error, intended to refer to Sias and Snell (1998) (Page 77805, column 3, paragraph 2).

Reasonableness of Judgment

I focused on judgments within the proposed rule that I felt someone may be able to question, or that I questioned myself. Other judgments within the proposed rule were deemed reasonable. It is reasonable to conclude that areas within this dynamic system must be considered one complete system instead of multiple separate habitats. This is important because areas that are not occupied currently may go through habitat shifts that result in these areas becoming suitable habitat, as the opposite habitat shifts cause currently suitable habitat to become unsuitable. At least two references support this conclusion. Muhs and Holliday (2001) provide evidence of the changing of Shinnery flats to Shinnery Oak dunes in a constantly dynamic system (Page 77803, column 2, paragraph 4). Chan *et al.* (2008) also suggest that this dynamic system must be considered one complete system instead of multiple separate habitats based on genetic data of lizard populations in New Mexico (Page 77804, column 2, paragraph 2).

There are two instances where the conclusion may not reasonably match the supporting reference. Firstly, Boyd and Bidwell (2002) do not provide strong evidence for (or against) Shinnery oak reestablishing after Caliche is removed (Page 77807, column 1, paragraph 2). Boyd and Bidwell (2002) looked at the effects of fire on Shinnery oak habitat in Oklahoma, which does not consist of sand dunes. The soils in Oklahoma are likely different than the sand dunes in Texas and New Mexico in which the

Dunes Sagebrush Lizard inhabits. They mention that Shinnery oak has not reestablished on old fields after 70 years, but has on recently ploughed areas. Because the old fields were ploughed consistently 70 years ago, Boyd and Bidwell are arguing for the uncertainty of the effects of long-term disturbance, be it fire or ploughing. The Shinnery oak may not reestablish while the hard calcium carbonate exists, as Peterson and Boyd (1998) show, but it may not reestablish even after its removal. Secondly, Dramstad *et al.* (1996) describe what generally happens when habitat fragmentation occurs, but do not give any information specifically about *S. arenicolus*, hence the previous sentence begining with "It is thought" (Page 77805, column 1, end of paragraph 2). Because the general statement about edge habitat having limited resources relies on indirect evidence, a hedge term seems more appropriate (i.e. "may have limited resources"). The citation refers to page 28, however, which was not included in the pdf I received (pages 19-24 only). The other uses of the Dramstad *et al*. (1996) reference are reasonable.

The conclusion that current regulations are not adequate to protect the Dunes Sagebrush Lizard is reasonable based on the non-comprehensive nature of the current regulations (Page 77811, column 2, paragraph 3). Currently, Shinnery oak habitat, which is strongly linked to the Dunes Sagebrush Lizard's existence, is not protected. Many of the protections that currently exist are based on "Agreements" that are not binding necessarily, and can change over time. Plus, these current protections only pertain to New Mexico, and much of the Dunes Sagebrush Lizard habitat is in Texas.

Overall Strengths and Limitations

In general, the scientific uncertainties, with regard to factors such as disease or predation (Factor C) and overutilization (Factor B), were identified and characterized. In light of these scientific uncertainties, these factors were reasonably considered not to be major threats to the Dunes Sagebrush

Lizard. Those factors regarded as threats – habitat alteration (Factor A), inadequate regulation (Factor D), and pollution (Factor E) – were supported by high quality data with minimal scientific uncertainty. Although there is some uncertainty pertaining to the role of pollution, the effects of habitat alteration through oil and gas extraction and herbicide application are well supported. Whether pollution caused by oil and gas extraction plays a role or not, the effects of pollution would only serve as a mechanism through which the negative relationship between oil and gas well density and Dune Sagebrush Lizard density occurs.