EXHIBIT E - SIERRA CLUB GSNM PLAN APPEAL

Declaration of Dr. Chad Hanson in Support of Comments by Sierra Club and Sequoia ForestKeeper on the Giant Sequoia National Monument Draft Environmental Impact Statement

I, CHAD HANSON, Ph.D., hereby declare as follows:

1. I submit this declaration in support of the Comments by Sierra Club and Sequoia ForestKeeper on the Giant Sequoia National Monument DEIS and Draft Plan. I have personal knowledge of the matters stated herein and, if called as a witness, would and could competently testify thereto.

2. My name is Chad T. Hanson. I have a Ph.D. in Ecology from the University of California at Davis, with a research focus on forest and fire ecology in the Sierra Nevada. In the fall of 2007, I was appointed to the research position of Associate in the Agricultural Experiment Station of the College of Agricultural and Environmental Sciences at the University of California at Davis. I have authored or co-authored several scientific studies and technical papers on the subject of fire ecology, which have contributed to the published literature. My curriculum vitae is included below. The subjects of my research have included: mechanical thinning and fire severity; wildlife response to wildland fire; fire history; and post-fire conifer survival. A particular focus of my research has been the ecological importance of large snags (standing dead trees) to native wildlife species in the Sierra Nevada.

3. I have been working to protect the forests of the Sierra Nevada, and to ensure more scientifically-based forest management, for over a decade, reviewing proposals for logging on national forest lands. I have submitted hundreds of comments on timber sale projects on in the Sierra Nevada national forests. These comments focus on the misuse or disregard of scientific evidence, including both wildlife and fire science, by the U.S. Forest Service and the degradation that their logging projects can cause to habitat essential for imperiled species such as the California spotted owl.

4. Over the past four years I have spent on average of 40-50 days per year in the field on Sierra Nevada national forests, including the Sierra, Sequoia, Tahoe, El Dorado, Plumas,

and Lassen National Forests. During my field visits, I gather scientific data for my ongoing studies, and often monitor proposed logging projects on national forests. I have seen first hand the impacts of these logging projects on forest characteristics, including stand structure and canopy cover, in late-successional and old growth forests.

5. I have been asked to comment about a number of ecological issues with respect to the Draft Environmental Impact Statement (DEIS) for the Giant Sequoia National Monument plan amendment, including the importance of large snags, studies cited in the DEIS to support thinning of trees, the importance of large down logs, and Pacific fishers, use of the term "resilience", "forest health", and "ecological restoration."

The Importance of Large Snags and Management that Affects Snag Recruitment

6. Snags are standing dead trees. Large snags, which are preferentially selected by numerous wildlife species for foraging and nesting/denning habitat, are perhaps the most ecologically important habitat element in conifer forests (Hutto 1995, Hutto 2006). Woodpeckers feed upon native bark beetle larvae under the bark of large snags, and excavate nest cavities in them as well. Other bird species later use abandoned woodpecker nests. Various small mammal species also live within cavities in large snags (Smith 2000). The California Spotted Owl, a Forest Service Sensitive Species (i.e., a species for which there is concern about a risk of extinction), depends upon having at least 20 square feet per acre of basal area in large snags, i.e., about 6-8 large snags per acre, in its suitable habitat in order to maintain an adequate population of its small mammal prey, which live in the large snags (Verner et al. 1992). The Pileated Woodpecker (North America's largest woodpecker species) depends generally upon the same sort of habitat as that used by California Spotted Owls for nesting/roosting, both in terms of having high forest canopy cover (generally over 50%) and high levels of large snags (USDA 2007, AR294-97). Other species, such as the Hairy Woodpecker and the Black-backed Woodpecker, depend upon much higher large snag densities for foraging and nesting needs (Hanson 2007).

7. There is currently a pervasive deficiency of large snags in California's forests,

with less than 2 large snags per acre presently existing in every region, including the Sierra Nevada, according to a comprehensive analysis conducted by Forest Service scientists in a recently-released report (Christensen et al. 2008). This report also warned about the threat posed to the ecological health of California's forests by this large snag deficiency, pointing out that current levels may not be sufficient to support populations of numerous wildlife species (Christensen et al. 2008).

8. This is relevant to management activities proposed for the Giant Sequoia National Monument and studies cited to justify thinning of dense stands. Nowhere does the DEIS divulge the current densities of large snags in the GSNM, either in terms of basal area or number per acre, nor does the DEIS disclose the potential adverse effects of proposed thinning of dense stands on the future recruitment of large snags in the Monument or the adverse effects on wildlife needs that depend on large snags, including California spotted owls and Pacific fishers.

9. The DEIS (p. 431) misrepresents North et al. (2009), misleadingly claiming that this unpublished and non-peer-reviewed report concluded that it is necessary to "remove 20- to 30-inch [diameter] trees when overly dense stands are moisture stressed". In fact, North et al. (2009) specifically warn that such thinning of mature trees should be avoided where there is not an overabundance of large snags with regard to wildlife needs, since such thinning would tend to reduce stand density and adversely affect future large snag recruitment (North et al. 2009, p. vii). North et al. (2009) specifically warns against the adverse impacts of such thinning in terms of the potential to exacerbate what North et al. (2009) describe as the "deficit" of larger snags in the Sierra Nevada (see North et al. 2009, pp. vii and 29). Moreover, where North et al. (2009) discuss thinning of trees 20-30 inches in diameter in relation to moisture stress, they do not provide a single citation to any ecological study which recommends removal of such mature trees as opposed to converting such trees into ecologically-important large snags or large downed logs. In other words, there is no explanation why, ecologically, a large stump would be more important in the forest ecosystem than a large live tree, large snag, or large downed log—or, stated differently, why such mature trees would be more ecologically beneficial to the forest ecosystem and native wildlife on the bed of a logging truck headed for the timber mill than it

would be as a live tree, large snag, or downed log providing habitat for wildlife species in the forest. Clearly, the authors of North et al. (2009) were either discussing "removal" of trees 20-30 inches in diameter in the context of socioeconomic issues (without directly stating so), or they were simply less careful than they should have been with regard to their language, and did not mean to discuss "removal" of mature trees, as opposed to simply turning some live mature trees into large snags or large downed logs. Indeed, one of the authors of North et al. (2009), Dr. William Zielinski, repeatedly states in the GSNM Science Consistency Review Report (on pp. II-47 and II-48) that it was not the intention of North et al. (2009) to suggest or support the removal of mature trees 20-30 inches in diameter, that only a tiny portion of the GSNM is predicted to be affected by fire of any type in a given decade (making the need for such thinning unclear), and that such removal would be harmful to the Pacific fisher.

10. Nowhere does the DEIS explain why, ecologically, a 19-inch-diameter tree, for example, would need to be "removed" from the ecosystem, as opposed to being converted into a large snag or large downed log. Nowhere does the DEIS explain why, ecologically, a 19-inch-diameter stump would be more ecologically valuable than a 19-inch-diameter live tree, snag, or downed log; or, stated differently, why a 19-inch-diameter tree would be more ecologically valuable to the GSNM forest ecosystem on the bed of a log truck headed for the timber mill than it would be as a live tree contributing to canopy cover for fishers, or a large snag providing prey habitat for fishers and spotted owls or nesting habitat for Black-backed woodpeckers. Nor does the North et al. (2009) report, an unpublished and non-peer-reviewed report cited frequently in the DEIS, provide any such explanation. Clearly, as discussed above, either the North et al. (2009) report did not mean to use the word "remove" to suggest commercial logging of mature trees up to, or over, 20 inches in diameter—as opposed to simply "removing" a given mature live tree from competition with other larger trees by turning it into a large snag or downed log, or the North et al. (2009) report intended the "removal" of some mature trees for economic purposes in the context of the multiple use, general forest landscape outside of protected areas (like the GSNM) on national forests. In fact, the authors of North et al. (2009), on page 24 of that report, specifically discuss the potential removal of trees over 10-16 inches in diameter "for

socioeconomic purposes" such as "generating revenue" or "providing merchantable wood for local sawmills". Nowhere do the authors of North et al. (2009) specifically recommend "removal" of mature trees (as opposed to snag creation or downed log creation) for strictly ecological purposes, or offer a single citation to any ecological study concluding that some mature trees must be removed from the forest ecosystem, as opposed to being left as live trees, converted into large snags, or converted into large downed logs.

11. Moreover, the DEIS (p. 431) seriously misrepresents the Moghaddas and Craggs (2007) study, inaccurately claiming that this study concluded that "removal of some larger trees" is necessary in order to facilitate fire suppression. This study made no such conclusion. While the study did indicate that fire intensity was likely reduced in a particular thinned area, nowhere did the authors conclude that removal of some larger trees was necessary to accomplish this; nor did the authors examine any differences in effects between thinning of only small trees versus thinning that includes larger tree removal.

12. Nor is there a reason to prevent recruitment of snags (due to natural disturbance processes) in order to reduce fire intensity. Contrary to popular myth, higher densities of snags do not result in higher fire intensity, based upon a study of recent tree mortality and subsequent wildland fire in the San Bernardino National Forest (Bond et al. 2009a). Another recent study found that areas of higher tree mortality from beetles and competition burn at lower fire intensities when wildland fire occurs (Simard et al. 2010 in press). Moreover, if large snags fall they do not contribute in any significant way to fire intensity, if a fire occurs. Due to the extremely low mass (or surface area) to volume ratio in logs over about 8 or 10 inches in diameter, such logs make no significant contribution to fire intensity, according to the Forest Service's own research (Brown et al. 2003 [Fig. 3]).

13. Nowhere does the DEIS divulge the current densities of large snags in the GSNM, either in terms of basal area or number per acre, thus there is no way of evaluating whether there is currently even the minimum number/density of larger snags necessary to maintain populations of native wildlife species, particularly some of the rarest and most imperiled species, such as the California spotted owl, Pacific fisher, and Black-backed woodpecker. The scientific literature

indicates that California spotted owls should have at least 20 square feet per acre of large snag (>15 inches in diameter) basal area per acre, which equates to about 6-8 large snags per acre at least (Verner et al. 1992). The scientific literature indicates that Pacific fishers select areas with 31 square feet of medium/large snag basal area per acre (two and a half times higher than the snag basal area at random sites), and that medium/large snag basal area is one of the two most important factors in predicting occupancy at fisher rest sites (Purcell et al. 2009). Freel (1991) ("A Literature Review for Management of the Marten and Fisher on National Forests in California"), recommended 2 snags/acre over 44 inches in diameter and 4-5 snags per acre over 20 inches in diameter for fisher habitat—equating to a large snag basal area of 30-45 square feet per acre (not including medium-sized snags). The Black-backed woodpecker, the sole Management Indicator Species for snag habitat in burned forest in the Sierra Nevada, selects areas with *hundreds* of medium/large snags per acre in recently burned forest (generally less than 7 or 8 years post-fire) that has not been salvage logged (Hanson and North 2008, Saab et al. 2009), and that a single pair of Black-backed woodpeckers requires a few hundred acres of such habitat (USDA 2010; see also JMP/CBD 2010 attached hereto, and incorporated herein by reference). There is nothing in the DEIS which indicates that the current medium and large snag densities in the GSNM even reach the levels selected by the California spotted owl and Pacific fisher, on average, or that there are any significant areas in the GSNM that could provide suitable habitat for the Black-backed woodpecker. The DEIS is simply devoid of this vitally-important information—i.e., the current density of medium and large snags in the GSNM. Indeed, page 573 of Appendix I of Volume 2 of the DEIS provides data on current snag density in the giant sequoia groves alone within the GSNM (these groves comprise only a minor portion of the total area of the GSNM), and shows that the current snag basal area in the sequoia groves is only 17 square feet per acre—and that includes basal area from small snags (generally less than 10 inches in diameter) that are little used by imperiled wildlife species or their prey.

14. The Forest Service's own comprehensive survey of California's forests, using thousands of fixed plots, recently concluded that there is a large snag deficit in all forested regions of California relative to the minimum habitat needs of many cavity-nesting wildlife

species, with less than 2 large snags per acre in all forested areas of the state (Christensen et al. 2008). There is a pervasive deficit of large snags in these forests, so why is the Forest Service proposing to further exacerbate this deficit by conducting massive landscape-level thinning in the GSNM to reduce competition between trees, thereby reducing future large snag recruitment? Moreover, in the context of an existing serious deficit of large snags, why is the GSNM DEIS defining additional snag recruitment as a negative factor with regard to "forest health" and ecosystem "resilience"? There is simply no credible scientific basis for this.

The Importance of Large Snags and Down Logs for Pacific Fishers

15. Zielinski et al. (2006 [Table 2]) found that fishers selected sites with 15.4 large snags (over 38.1 cm in diameter, or over 15 inches in diameter) on average per 0.5 hectares, or about 12.5 large snags per acre, within Sierra and Sequoia National Forests, including within the Giant Sequoia National Monument. Using the U.S. Forest Service's own Forest Inventory and Analysis (FIA) fixed plots to determine the average snag density across the forested landscape within the fisher's range in Sequoia and Sierra National Forests, including the Giant Sequoia National Monument, Zielinski et al. (2006) found that there were only about 8.7 large snags per acre on average—well below the level selected by fishers. Nowhere do the DEIS or Wildlife BE analyze the impacts of repeatedly thinning over three-quarters of the GSNM for the express purpose of preventing medium/large snag recruitment from fire and insects; nor do the DEIS or BE anywhere divulge whether the current basal area levels of medium/large snags in the GSNM even meet the levels selected by fishers, or whether they may be lower than optimal. Given the importance of medium/large snag basal area to fishers, this must be carefully analyzed in the EIS.

16. Furthermore, the Wildlife BE and DEIS fail to analyze the impacts of proposed forest thinning in the GSNM on large downed log levels, and the impacts of this on fishers. Zielinski et al. (2006) found that fishers selected sites with 65 large downed logs (over 25.4 cm in diameter) per hectare, or about 26 logs over 10 inches in diameter per acre. Using the U.S. Forest Service's own Forest Inventory and Analysis (FIA) fixed plots to determine the average

large downed log density across the forested landscape within the fisher's range in Sequoia and Sierra National Forests, including the Giant Sequoia National Monument, Zielinski et al. (2006) found that there were only about 19 large downed logs per acre on average within the fisher's range—well below the level selected by fishers. Zielinski et al. (2006) also found that fishers selected sites with 169 cubic meters of large down logs per hectare (2,427 cubic feet per acre), relative to only 118 cubic meters per hectare at FIA plots in general (1,690 cubic feet per acre).

Large Felled Tree Boles or Downed Logs are Irrelevant to Fire Behaviour

17. The Forest Service's own science clearly concludes that large logs are essentially irrelevant to fire behavior. Due to the extremely low mass (or surface area) to volume ratio in logs over about 8 inches in diameter, such logs make no significant contribution to fire intensity, according to the Forest Service's own research (Brown et al. 2003 [Fig. 3]). Specifically, these Forest Service scientists concluded that the curves representing fire hazard "flatten" at a diameter of about 5 inches or 8 inches, depending upon how it is measured (Brown et al. (2003), p. 8 and Figure 3). In other words, the relevance to fire hazard becomes insignificant when pieces of coarse woody debris are over 5-8 inches in diameter. This is consistent with another seminal Forest Service study, Rothermel (1991), which found that pieces of coarse woody debris over 6 inches in diameter did not contribute to a significant increase in fire intensity even where a large amount (30 tons per acre) of such material was added.

18. The reason that large logs do not significantly affect fire hazard is that they have an extremely low ratio of surface area to mass, while small woody material (0-3 inches, and 3-6 inches, in diameter) has a very high ratio of surface area to mass (Brown et al. 2003, Fig. 3). A low ratio of surface area to mass means that there is relatively little fuel available for combustion, while a high ratio means the opposite. To illustrate this point, consider a solid block of wood one cubic foot in size. This cubic foot of wood has a surface area of 6 square feet and, for fir and pine species, it would weigh approximately 21 pounds—equating to a surface area to mass ratio of 0.29 square feet per pound. Now imagine that that same cubic foot of wood is an equal mass (21 pounds, or, conservatively, 2000 sheets of 8.5" x 11" paper) of writing paper, and that each page has been crumpled into loose balls and made into a pile. Each of the 2000 sheets

of paper has a surface area of 1.3 square feet (front and back side included), for a total of about 2600 square feet of surface area. Thus, the surface area to mass ratio of the 21 pounds of crumpled paper is 124 square feet per pound—more than 400 times the surface area to mass ratio of the 21-pound block of wood. Anyone who has ever built a fire in a woodstove, or in a campground fire pit, will understand intuitively the significance of this. If you put a match to the solid 21-pound block of wood, the match will likely burn out long before you achieve ignition, as will the next match, and the next; whereas the 21 pounds of crumpled paper will become a very intense fire within seconds of coming in contact with the match flame.

Resilience and Ecological Restoration

19. The GSNM DEIS misuses the term "resilience." Under the international Convention on Biological Diversity, the United Nations Environment Programme (UNEP) describes a distinct difference between "engineering resilience" and "ecological resilience". The former is based upon the goal of maintaining a given system in an exact, unchanged, permanent state for purposes having nothing to do with biodiversity or ecosystems, while the latter embraces the dynamic nature of ecosystems and the natural disturbance processes and successional stages that provide the range of natural habitats needed to maintain the complete range of native biodiversity (Thompson et al. 2009). Under the ecological definition of "resilience", natural disturbance processes like tree mortality from competition and native bark beetles, and wildland fire, are essential occurrences that create and maintain the various habitat types needed to maintain viable populations of the plant and wildlife species native to fire-adapted conifer forest ecosystems. Ecological resilience, in fact, is defined by the maintenance of the full complement of biodiversity native to the ecosystem, and the ecosystem is not defined by only one vegetation type (Thompson et al. 2009). For example, in fire-adapted conifer forest ecosystems, mixed-intensity wildland fire is a natural part of fire regimes, and many plant and animal species depend upon the unique montane chaparral and snag forest habitats created by patches of high-intensity fire (where most or all trees are killed), and pockets of tree mortality from beetles or other natural factors. Thus, the natural early-successional habitat created by

high-intensity fire patches (e.g., snag stands and montane chaparral) or insects is as much a part of the forest *ecosystem* as the unburned stands of live green trees (Thompson et al. 2009, Swanson et al. 2010).

20. The DEIS, on pp. 430-438, suggests several times that stands in the GSNM may need to be thinned, including removal of mature trees up to or over 20 inches in diameter, ostensibly in order to maintain "healthy forests" (p. 431), "retain resiliency" (p. 432), and (p. 432) "protect the stand from drought, insects, disease, and wildfire." The DEIS misrepresents these concepts, and fails to provide baseline data on the current conditions in the GSNM, or provides data that contradicts the representations on pp. 430-438 or contradicts other information in the DEIS.

21. Recent forest management projects, including biomass extraction projects, are often proposed ostensibly to promote "forest health". However, it is critically important to understand what this means when articulated by land managers in the context of such projects. In such contexts, "forest health" activities mean thinning designed to reduce forest density, and thus competition between trees, with the goal of reducing and minimizing future tree mortality. In other words, "forest health" projects are designed to reduce and minimize the recruitment and maintenance of snags (standing dead trees) on the forested landscape—especially large snags. This definition of "forest health" was developed in the context of silvicultural studies designed to inform industrial forestry operations on how maximize the orderly extraction of timber from the forest by keeping stand densities very low and essentially eliminating tree mortality (Cochran et al. 1994, Cochran and Barrett 1999, Oliver 1995, Oliver 2005). Tree mortality, from this industrial forestry perspective, was seen as a detriment and an economic waste. It must be understood, however, that this has nothing whatsoever to do with the **<u>ecological</u>** health of the forest ecosystem and the maintenance of the full complement of native wildlife diversity. In terms of ecological health/integrity, snag recruitment should be promoted and maintained, not discouraged, since, as discussed below, much of the biodiversity in the forest ecosystem depends on an abundance of large snags and downed logs, which are in deficit currently, as discussed below. Ironically, the most "healthy forest" under the industrial forestry definition of "forest

health" would be one with very few if any dead trees—i.e., one in which many of the native wildlife species in California's forests simply could not maintain viable populations. Such stands are relatively sterile, ecologically-dead environments characterized only by very widely-spaced live trees and little else. Snags, downed logs, shrubs, and other key ecological features—habitat elements upon which most of the biodiversity in the forest ecosystem depends for food and shelter (see discussion below)—are simply missing from the industrial forestry concept of a "healthy forest". Again, this is because "forest health", in industrial forestry, is an economic concept, not an ecological one. An ***ecologically*** healthy forest has an abundance of large snags and downed logs, large areas of dense old forest, and many natural openings created by mixed-intensity wildland fire—areas dominated by patches of native shrubs/brush and dense pockets of natural conifer regeneration. In an ecologically healthy forest, these essential habitat features are maintained by an active wildland fire regime, and by tree mortality due to native bark beetles and competition between trees, and ecosystem resilience cannot be maintained without such natural disturbance. Nor does the continued suppression of these natural ecological processes, and the vitally-important habitat elements that they create (e.g., snag forest patches, individual large snags, large downed logs, patches of montane chaparral, dense pockets of natural conifer regeneration, etc.) equate to "ecological restoration" by any remotely credible scientific definition.

I declare that the foregoing is true and correct to the best of my knowledge.

DATED: October 29, 2010

Chad Hanson

CHAD HANSON, Ph.D.

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EDUCATION

University of California at Davis, Ph.D., Ecology, June 2007
Completed a Ph.D. in Ecology, with 3.97 GPA, focusing research on forest and fire ecology in the Sierra Nevada.

University of Oregon School of Law, Juris Doctorate, May 1995
Specialized in natural resources law
Meritorious Brief Award in Best Brief Competition
Hired by Law School's Legal Research & Writing Program at end of first year of law school
Created and wrote course texts for the Legal Research and Writing Program for two years

University of California at Los Angeles, Bachelor of Science, 1990
Individual major in Nutritional Biopsychology through the Honors Department
Designed original research on blood sugar levels and reading comprehension
Awarded President's Undergraduate Research Fellowship for outstanding research design

RESEARCH PUBLICATIONS

Hanson, C.T., D.C. Odion, D.A. DellaSala, and W.L. Baker. 2010. More-comprehensive recovery actions for Northern Spotted Owls in dry forests: Reply to Spies et al. Conservation Biology **24**: 334-337.

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