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CENTER *for* BIOLOGICAL DIVERSITY — *Because life is good.*

May 15, 2009

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Vice President Jim Kellogg
Mr. Michael Sutton, Member
Mr. Richard Rogers, Member
Mr. Daniel Richards, Member
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Re: Petition to List the American pika (*Ochotona princeps*) under the California Endangered Species Act, submitted by the Center for Biological Diversity on August 21, 2007

Dear Ms. Gustafson, Mr. Kellogg, Mr. Sutton, Mr. Rogers, Mr. Richards, and Mr. Koch,

I am writing regarding the Petition to List the American pika (*Ochotona princeps*) under the California Endangered Species Act ("CESA"), submitted by the Center for Biological Diversity ("Center") on August 21, 2007. On April 10, 2008, the California Fish and Game Commission concluded that the Center's petition ("Petition") did not provide sufficient information to indicate that listing may be warranted and therefore rejected the petition. The Commission adopted written findings in support of its decision on June 27, 2008.

On April 16, 2009, San Francisco Superior Court Judge Peter Busch ruled that the Commission abused its discretion in rejecting the Center's listing petition. The Court issued a writ of mandate on May 11, 2009 directing the Commission to set aside its June 27, 2008 findings and ordering the Commission to reconsider whether the pika may warrant listing.

The purpose of this letter is to apprise the Commission of several recent scientific studies that provide additional information regarding anthropogenic climate change and its impacts on American pikas in California. We ask the Commission to take this information into account on remand as it reconsiders whether listing the pika may be warranted. We also expect to present this information at the public hearing(s) on the Commission's reconsideration of the pika petition.

I. Additional Scientific Studies on Pika Population Trends and on the Degree and Immediacy of the Threat of Climate Change to the Pika in California Support the American Pika Listing

Since the submission of the Petition, two scientific studies have provided additional information on pika population trends in two regions in California: Moritz et al. (2008) and Nichols (2009). These studies supplement the scientific studies on pika population trends and on the degree and immediacy of the threat of climate change that were provided to Commission with the Petition and supporting materials.

The Petition (on pages 17, 23, and 24) discusses the findings of the Grinnell Resurvey Project for the Yosemite transect, reported in Moritz (2007), which detected an upslope range contraction of the American pika which was linked to climate warming. The findings of Moritz (2007) have recently been published in the eminent journal *Science* in Moritz et al. (2008), which we summarize below.

Moritz et al. (2008) "quantified the impact of nearly a century of climate change on the small-mammal community of Yosemite National Park (NYP) in California, USA, by resampling a broad elevational transect (60 to 3300 m above sea level) that Joseph Grinnell and colleagues surveyed from 1914 to 1920" (p. 261). Moritz et al. (2008) predicted that species ranges' would have shifted upward in the past ~90 years given the "marked regional warming in the past century," and specifically that mid-to high-elevation species like the pika would experience an upward contraction of their lower range limit. Moritz et al. (2008) noted that the average minimum monthly temperature in the region increased by 3.7°C over the past 100 years, with notable increases from 1910 to 1945 and from 1970 to the present.

Consistent with their predictions, Moritz et al. (2008) found that the pika experienced an upward range contraction of 153 meters on the west side of the Yosemite transect in the western Sierra Nevada (Table 1, Figure S3) and an upward range contraction of 350 meters on the east side of the transect in the eastern Sierra Nevada (Figure S3). These upward range contractions for the pika reported by Moritz et al. (2008) match those reported by Moritz (2007) in Table 6, except that the upslope range contraction reported for the west side of the transect was reduced from 497 m (Moritz 2007) to 153 m (Moritz et al. 2008) based on data from subsequent surveys at non-Grinnell sites.

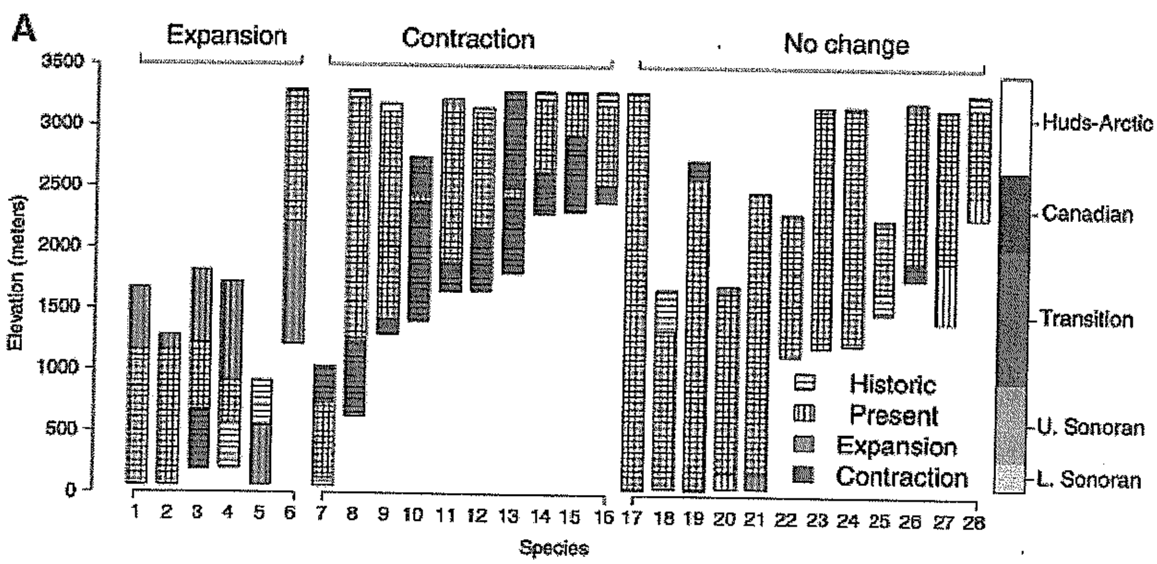
Overall, Moritz et al. (2008) found a strong pattern of significant upward range shifts for high-elevation mammal species including the pika (Figure 1). The pika was one of nine mid-to-high elevation species that exhibited a range contraction, while only one mid-to-high elevation species expanded its range. Of the nine mid-to-high elevation species exhibiting range contractions, seven species including the pika experienced an upward shift in their lower range limit while two experienced a range collapse in which their lower limit shifted upward and upper limit shifted downward (Moritz et al. 2008: Table 1).

Moritz et al. (2008) concluded that the pattern of upward range shifts for high-elevation species like the pika is consistent with climate warming due to climate change. Moritz et al. (2008) also noted that habitat change in upper elevations of the transect is limited and thus unlikely to be a contributing factor to observed changes in the distribution of high-elevation species:

> The preponderance of upward range shifts, leading to contraction of high-elevation species and expansions of low-elevation taxa, accords with the predicted impacts of climate warming (5, 8, 9). Although vegetation dynamics have likely contributed to changes at low to mid-elevation, habitat change at higher elevations is limited (15) (fig. S6). (Moritz et al. 2008: 263).

In addition Moritz et al. (2008) noted that "the ~500-m average increase in elevation for affected species is also consistent with estimated warming of +3°C, assuming a change of temperature with elevation of ~6°C per km." (Moritz et al. 2008: 263)

Figure 1. Summary of elevational range changes across all species in relation to life zones. Significant (Pfa < 0.05) shifts are colored green for range expansion and red for contraction. Species were classified as "No Change" if range shifts were biologically trivial (<10% of previous elevation range) or of small magnitude (<100 m). The pika is coded as species "16." Source: Moritz et al. (2008): Figure 3A.



Finally, Moritz et al. (2008) warned that the trends in range contraction "do not bode well" for mid- to high-elevation species like the pika, including some species endemic to the high Sierra (e.g., *T. alpinus*). Moritz et al. (2008) specifically raised concern for the pika in noting that "several small-mammal taxa that responded to changing temperature also showed large range fluctuations during late Quaternary climate fluctuations (28), and some have declined regionally (29)" (p. 263). This statement specifically references the pika studies of Grayson (2006) and Beever et al. (2003).

Grayson (2006) documented the late Pleistocene-Holocene declines of the American pika and the bushy-tailed woodrat (*Neotoma cinerea*) in the Great Basin during a period of warmer, drier temperatures. The Grayson (2006) study concluded:

> We know that the Holocene history of pikas in the Great Basin has been characterized by ever-increasing lower altitudinal limits and thus of ever-decreasing population numbers, trends undoubtedly caused by climate change. Given that this trend has continued in recent decades, it is very possible that these animals—the global warming canaries of western North America—are facing extinction unless strong action is taken to reduce anthropogenic impacts on them (Grayson 2006: 2986).

Beever et al. (2003) documented the extirpation of six of 25 pika populations (24%) in the Great Basin during the 20th century and found strong evidence that changing climate conditions have contributed to these extirpations.

Overall, Moritz et al. (2008) provide evidence that pika populations have disappeared from lower elevations in the Sierra Nevada mountains of the Yosemite transect over the past century, resulting in an upslope range shift similar to the pattern detected in the Great Basin by Beever et al. (2003), and that increased temperatures due to climate change provide the most likely explanation for the observed range contractions of high-elevation species like the pika.

Nichols (2009) provides a detailed description of Dr. Nichols' research findings on the status of pika populations in the Bodie Hills in the eastern Sierra Nevada mountains. Dr. Nichols first transmitted a summary of his pika research findings to the California Department of Fish and Game ("CDFG") in his review of the pika Petition, a review which was solicited by the CDFG. In his review, Dr. Nichols not only supported the Petition, but also provided information on the declining population status of the American pika in the Bodie Hills and expressed his support of CESA protection of these populations:

> Like other pika populations in the Great Basin the Bodie Hills population has suffered marked declines in recent decades. I have surveyed 29 talus patches in the Bodie Hills that have evidence of pika occupation (droppings, haypiles, bones) and found that 21 of these sites (72%) are extinct (unpublished data). Only one site (at Bodie State Historic Park) has a relatively stable population.
>
> Protection under the California Endangered Species Act should certainly be extended to the Bodie Hills population regardless of its taxonomic status.
>
> (from Nichols (2007), Review of Petition to list the American pika as threatened under the California Endangered Species Act, dated August 21, 2007.)

Nichols (2009) provides an updated analysis of the current status of pika populations in Bodie State Historic Park ("Bodie SHP") and in the surrounding Bodie Hills in Mono County, California. Nichols (2009) surveyed for the presence of pikas (either sightings or vocalizations) and pika sign (droppings, haypiles, and whitewash) in 50 talus patches in the Bodie Hills surrounding Bodie SHP in 2008. Nichols (2009) also censused a subset of ore-dump patches in Bodie SHP in 2003-2006 and 2008, which have been censused periodically by researchers since 1972.

Nichols (2009) found that 48 of 50 Bodie Hills talus patches surveyed "were positively determined to be extinct" (Figure 2). All 50 talus patches had been occupied by pikas in the past as indicated by the presence of droppings, but 48 were determined to be extinct based on the conditions of dropping and lack of direct detection of pikas. The two remaining patches appear to have been last occupied by pikas in late spring or early summer 2008. In addition, Nichols (2009) documented a significant decline in the percentage of occupied ore-dump patches in Bodie SHP between 1972 and 2008 (Figure 3).

Figure 2. Bodie Hills study area showing surveyed patches. Extinct patches are indicated with an "X" (n=48). The two recently extinct patches (Masonic) are indicated with a "?" (n=2). The single extant population (actually metapopulation) at Bodie SHP is indicated with a solid dot. Coordinates are UTM grid 11S.
Source: Nichols 2009: Figure 1.

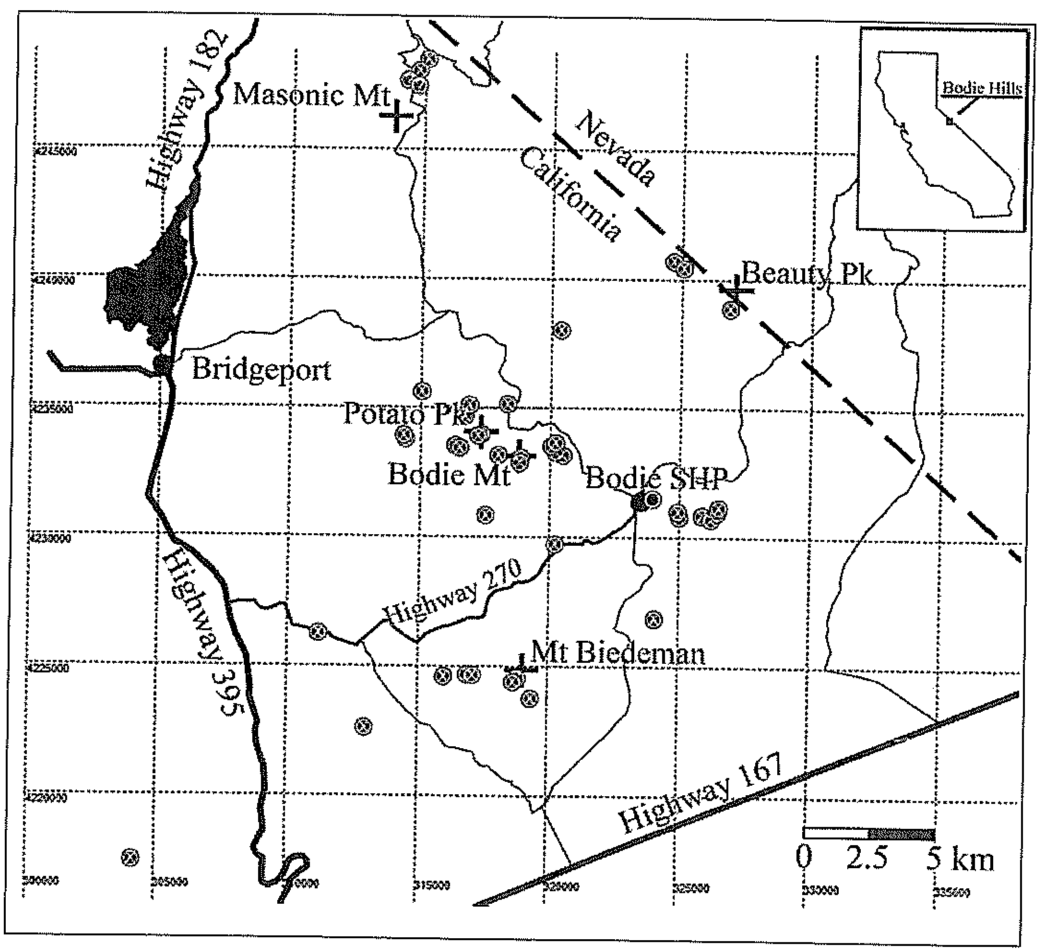
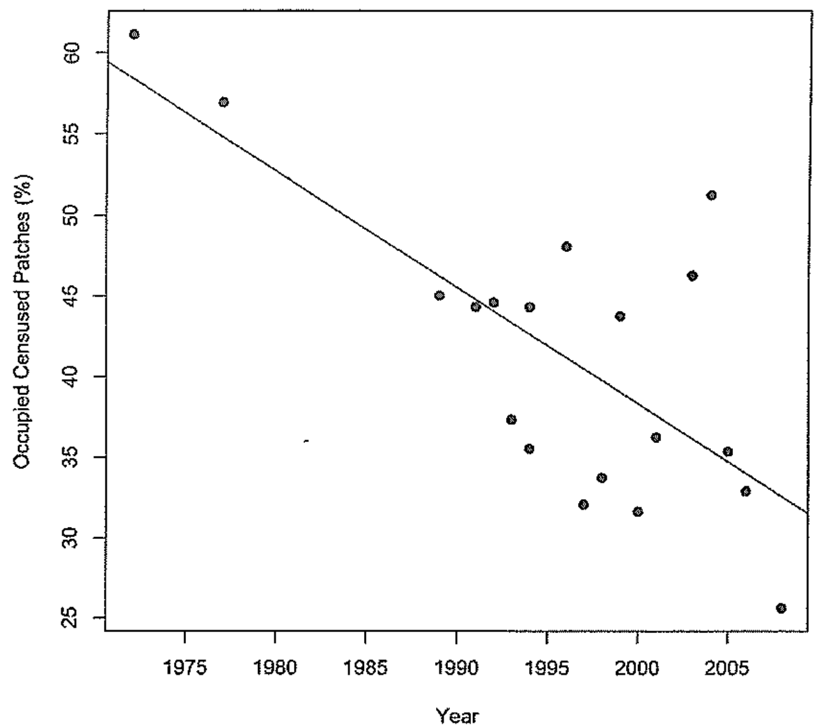


Figure 3. Changes in patch occupation by pikas (*Ochotona princeps*) in Bodie State Historic Park from 1972 through 2008 as measured by percentage of censused patches (n=79). $R^2 = 0.49$, $F(1, 17) = 18.5$, $p = 0.00048$.
Source: Nichols 2009: Figure 2.



Overall, Nichols (2009) concluded that pikas appear to be extinct in the Bodie Hills outside of Bodie SHP, and that the Bodie SHP population is declining and "may be well on its way to extinction":

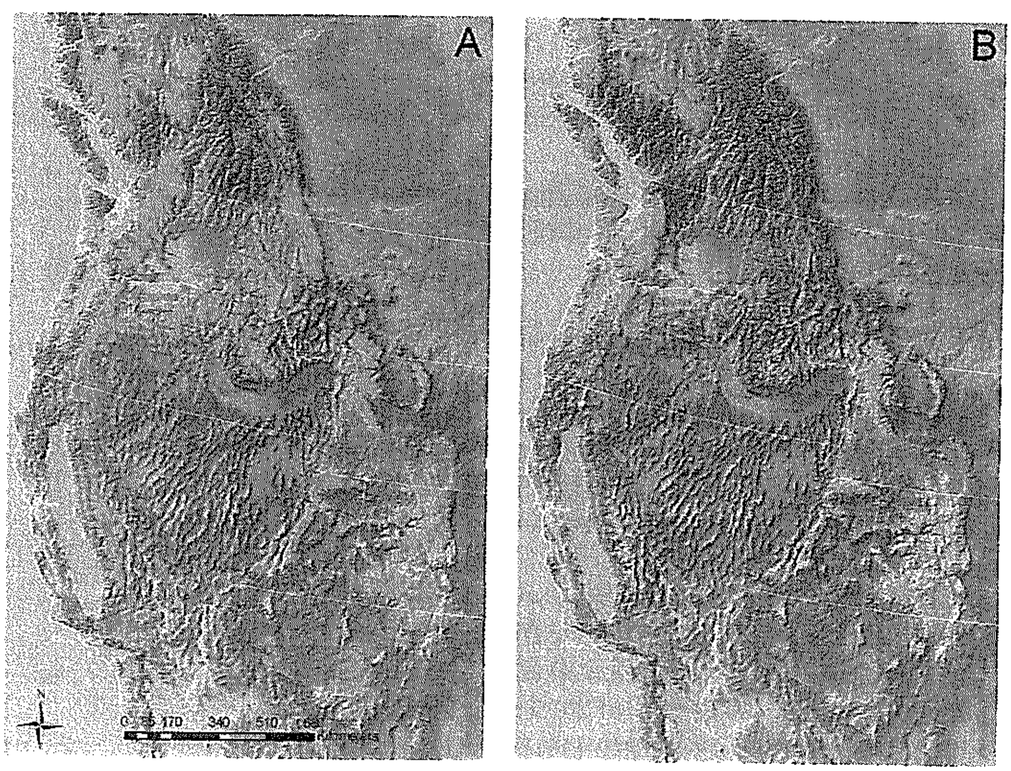
> Pikas appear to be extinct in the Bodie Hills outside of Bodie SHP. The possibility remains that a population has survived in an unsurveyed area; however, many apparently high quality patches were included in this survey and all are extinct. Several Bodie Hills patches have apparently gone extinct very recently. Two patches at Masonic went extinct in 2008. In June 2003 Bodie Mountain was occupied by pikas. By June 2008 the Bodie Mountain population had gone extinct.
>
> The decline in occupied patches in Bodie State Historic Park is consistent with the decline of pikas region-wide. Because patches of pika habitat in Bodie SHP are so close together this population functions as an interconnected metapopulation (Smith and Gilpin 1997). Metapopulation dynamics may have allowed the Bodie SHP pika population to decline more slowly than more isolated populations on natural talus piles throughout the Bodie Hills (but see Clinchy et al. 2002). In spite of metapopulation dynamics it appears that the Bodie SHP population may be well on its way to extinction (Figure 2). (Nichols 2009: 2-3).

II. Scientific Evidence on Projected Impacts of Climate Change to the Pika in California Supports the American Pika Listing

We are resubmitting the Loarie (2008) study that modeled changes in suitable pika habitat in California within this century under changing climate conditions. We note that Scott Loarie received his PhD from Duke University in 2008 and is currently a Post Doctoral Fellow at the Carnegie Institution of Washington, Department of Global Ecology, based on Stanford University Campus.

Loarie (2008) projected the impacts of climate change on the distribution of the American pika throughout its range in the western United States. This analysis used an ecological niche modeling approach to model habitat suitability for American pika under both present-day climate conditions and climate conditions projected for 2100 under a lower-emissions B1 scenario. Loarie (2008) found that that habitat suitability for the pika will be significantly reduced throughout its range in California, the western United States, and western Canada (Figure 4) by the end of the century. In California, remnant suitable habitat is predicted to remain only in a small region of the southern Sierra Nevada mountains. In other regions of the western United States, remnant suitable habitat is predicted to remain only in a few small regions of the southern and northern Rocky Mountains, the Cascades, and the Olympic range. In Canada, remnant suitable habitat is predicted to remain in small regions of the Northern Rocky Mountains and Coast Range.

Figure 4. Habitat suitability for the American pika, depicted in orange shading, modeled under (A) present-day and (B) future (2100) climate conditions. The red "+"s represent the 2556 recent pika occurrence records. The background depicts elevation.



Importantly, the U.S. Fish and Wildlife Service ("USFWS") found that the American pika may be warranted for listing under the U.S. Endangered Species Act due to the effects of climate change based in part on the Loarie (2008) study. In making this determination, the USFWS agreed with the Petitioner that climate change is likely to decrease the pika's range and habitat, based in part on the findings of the Loarie (2008) study:

> Based on the results of these empirical studies, along with predictions of declining climatic habitat suitability (Loarie 2008, pp. 1–4), we find that the range of the American pika and the habitat within the range are likely to decrease as surface temperatures increase. (74 Fed. Reg. 21306).

USFWS specifically summarized the Loarie (2008) study as follows:

> Loarie (2008, pp. 1-3) predicted impacts of climate change on the distribution of the American pika. Under a relatively low emissions scenario, habitat suitability for the pika would be significantly reduced throughout its range by the year 2100, with suitable habitat occurring only in the southern Rocky Mountains, Yellowstone National Park region, Cascade Mountains, Olympic Mountains, Canadian Rockies, and a small portion of the Sierra Nevada (Loarie 2008, Figure B). The petitioner cites these modeling efforts to demonstrate that the range of American pika habitat is likely to diminish greatly in the future. (74 Fed. Reg. 21305).

Finally, we note that ecological niche modeling and climate envelope modeling approaches to forecasting climate change impacts on species, analogous to those used by Loarie (2008) for the pika, are routine analyses in the published scientific literature (*see, e.g.* Loarie et al. (2008), Lovejoy and Hannah (2005), McKenny et al. (2007), and Thomas et al. (2004) for a small sample of published papers). In addition, projects using these modeling approaches have been supported by funding from California's Public Interest Energy Research (PIER) program.

III. The U.S. Fish and Wildlife Service Determined that the American Pika May Be Warranted for Listing Under the U.S. Endangered Species Act and Has Launched a Range-Wide Scientific Status Review of the Pika

On May 7, 2009, the U.S. Fish and Wildlife Service found that the Center's Petition to list the American pika under the U.S. Endangered Species Act presented substantial information indicating that listing the American pika may be warranted due to the effects of climate change. Accordingly, the USFWS has initiated a range-wide scientific status review of the pika. The USFWS specifically concluded that "the range of the American pika and the habitat within the range are likely to decrease as surface temperatures increase":

> Based on the results of these empirical studies, along with predictions of declining climatic habitat suitability (Loarie 2008, pp. 1–4), we find that the range of the American pika and the habitat within the range are likely to decrease as surface temperatures increase. Furthermore, the results of studies in the 20th century correspond with results of biogeographic research into historical range shifts by

the American pika in response to historical climate change (Hafner 1994, p. 381; Grayson 2005, pp. 2108–2109). Therefore, we find that the petitioner presents substantial information to indicate that listing the American pika may be warranted as a threatened or endangered species due to the present or threatened destruction, modification, or curtailment of its range due to impacts attributed to climate change. (74 Fed. Reg. 21306).

The scientific studies used by the USFWS to make its "may be warranted" finding overlap substantially with the scientific studies presented to the California Fish and Game Commission in the state Petition and supporting materials. For example, primary studies cited by the USFWS in making its positive 90-day finding include Beever et al. (2003), Beever (2002), Moritz et al. (2008), Loarie (2008), and the body of scientific literature on observed and projected climate change in the western United States that also applies to California.

IV. Additional Scientific Evidence on Climate Change in California Supports the American Pika Listing

The Petition reports the findings of numerous published studies documenting observed climate change (pages 18-21) and projecting future climate change (pages 27-30) in the range of the pika in California. New scientific analyses supplement and support these studies by showing that anthropogenic climate change has resulted in significant increases in temperature, increases in heat wave activity, and decreases in snowpack in recent decades in the mountainous regions of the California inhabited by the pika. In addition, new scientific studies project that these climate change trends in California will accelerate in this century, which will further imperil the pika.

As discussed on pages 30-34 of the Petition, warmer conditions, increased heat wave activity, and loss of snowpack in the pika's range in California due to climate change increase thermal stress on the pika through four mechanisms discussed by Smith (1978) and Beever et al. (2003): (1) exposing pikas to higher heat stress during the summer; (2) reducing the pika's ability to forage midday; (3) reducing the dispersal success of juveniles; and (4) exposing pikas to increased cold stress and cold extremes during the winter by reducing the insulating snowpack. Additionally, rising summer temperatures coupled with increasing summer dryness may lead to the earlier desiccation of vegetation and curtail the pika's ability to accumulate a sufficient summer haypile for surviving winter months (Hafner 1994). In hotter, low-elevation portions of the pika's range in California, summer desiccation already limits the length of the summer season when hay can be collected (Smith 1974). Thus, these studies on observed and projected climate change in California are relevant and important to assessing the degree and immediacy of the threat of climate change to the pika.

A. Studies on Observed Climate Change in California

Three new studies on observed climate change in California indicate that temperatures have increased (Bonfils et al. 2008), heat wave activity has increased (Gershunov and Cayan 2008), and snow accumulation in the Sierra Nevada has decreased (Kapnick and Hall 2009). Each of these studies is described further below.

Bonfils et al. (2008) used nine observational datasets to estimate California average temperature trends during the periods 1950–1999 and 1915–2000, and to identify "fingerprints" of anthropogenic climate change. Bonfils et al. (2008) found that annual-mean average temperature across California increased by 0.36°C to 0.92°C over 1950 to 1999, depending on the observational dataset considered. Over both time periods, the researchers detected large positive trends in mean and maximum daily temperatures in late winter and early spring, as well as increases in minimum daily temperatures from January to September. Bonfils et al. (2008) concluded that "the warming of Californian winters over the twentieth century is associated with human-induced changes in large-scale atmospheric circulation."

Gershunov and Cayan (2008) analyzed long-term changes in California heat waves using data from 95 weather stations from 1948 to 2006. They classified heat waves into dry daytime events expressed primarily as higher magnitude daytime temperatures (Tmax) and humid nighttime events expressed primarily as higher magnitude nighttime temperatures (Tmin). Overall, Gershunov and Cayan (2008) detected a growing trend in daytime and nighttime heat wave activity across California.

Nighttime heat wave magnitude displayed a clear and increasing regional trend, with two extreme California nighttime heat waves occurring in 2003 and 2006. The researchers noted that the increase in nighttime summer heat wave events is consistent with the trend of increasing summer nighttime temperatures in California. Gershunov and Cayan (2008) highlighted that warmer nighttime temperatures encourage hotter daytime temperatures since days begin warmer, and lead to increased heat wave duration and area. They noted that nighttime heat waves increase heat stress to wildlife by eliminating the thermal refuge of cooler temperatures at night:

> During a persistent daytime heat wave, cool nights provide respite from the stressful effects of heat on the health and general well-being of plants and animals, as well as for the energy sector, and prepare nature and society to face another day of scorching heat. Heat waves strongly manifested at night eliminate this badly needed opportunity for rejuvenation and increase the chances for catastrophic failure in natural and human systems. (Gershunov and Cayan 2008: 3).

They concluded that this increase in nighttime heat wave activity is consistent with climate change globally and can be expected to continue for the long term.

Gershunov and Cayan (2008) also found that daytime heat wave activity is increasing, with most of the increase occurring since the 1970s. Of importance for the pika, daytime heat wave activity has intensified more rapidly over the high-elevation interior of California compared to the lowland valleys. The researchers hypothesize that California's high-elevation interior is becoming more vulnerable to daytime heat waves due to the combined impacts of decreasing snowpack and earlier snowmelt and runoff that are making the interior drier:

> [I]t appears likely that the highlands, which are drying in summer due to progressively decreasing snow/rain ratio (Knowles et al. 2006), earlier spring snowmelt and runoff (Cayan et al. 2001, Stewart et al. 2005) and generally

> decreasing snowpack (Mote et al. 2005), are becoming relatively more prone to intensified daytime heat wave activity compared to the irrigated farmland of the Central Valley and the coastal valleys…(Gershunov and Cayan 2008: 10).

Kapnick and Hall (2009) examined trends in California Sierra snowpack using first-of-the-month snow water equivalent measurements from snow stations to calculate peak snow mass timing from 1930 to 2007. The researchers detected a trend toward earlier snow mass peak timing of 0.4 days per decade since 1930, which was associated with warmer March temperatures. They found that regional mean March temperatures have increased by 0.4°C (1.8°F) per decade since 1948. Using the relationship between temperature and peak snow mass timing, the researchers projected a shift toward earlier snowmelt timing of 4 to 14 days by the end of the century. Kapnick and Hall (2009) noted that much larger shifts toward earlier snowmelt are likely as temperatures rise above the critical threshold of 0°C (32°F) more often during March. The researchers conclude:

> Taken together, this study and previous studies paint a picture of a California Sierra snowpack responding rapidly to the changing climate of the past few decades. (Kapnick and Hall 2009:12).

Finally, in a study examining the mountainous regions of the western US, Barnett et al. (2008) found that anthropogenic climate change has resulted in significant increases in temperature, decreases in snowpack, and earlier runoff in recent decades in the mountainous regions of the western United States inhabited by the pika. Specifically, Barnett et al. (2008) found that up to 60% of the trends in snowpack, timing of runoff of the major western rivers, and winter minimum daily air temperature in the mountainous regions of the western United States between 1950 and 1999 are due to human-induced climate change from greenhouse gases and aerosols. Barnett et al. (2008) used a multivariable detection and attribution methodology to show that simultaneous observed hydroclimatic changes differed significantly in length and strength from trends expected as a result of natural variability (detection) and differed in the ways expected of human-induced effects (attribution). Between 1950 and 1999, more winter precipitation fell as rain instead of snow, snowmelt occurred earlier, and river flows increased in spring and decreased in summer months. These hydrologic changes occurred in concert with temperature increases in the western United States which have exacerbated drier summer conditions (Barnett et al. 2008).

B. Studies Projecting Climate Change in California Within This Century

Cayan et al. (2008) investigated future climate change scenarios for California within this century using two global climate models, the Parallel Climate Model (PCM1) and the NOAA Geophysical Fluid Dynamics Laboratory (GFDL) CM2.1 model, under a lower B1 emissions scenario and a medium-high A2 emissions scenario. These models were selected based on their ability to realistically simulate California's recent climate, contain realistic representations of regional climate patterns, and represent different levels of sensitivity to greenhouse gas forcing. Overall, climate models projected significant increases in temperature across California, changes in precipitation, and large decreases in snow accumulation.

Cayan et al. (2008) found that temperatures over California are projected to warm significantly during the twenty-first century, with mean annual temperature increases by 2070-2099 of 1.5°C to 2.7°C under the B1 scenario and 2.5°C to 4.5°C under the A2 scenario. On a seasonal basis, more warming is projected for the summer than in winter under most simulations. By 2070-2099, summer (June to August) temperatures are projected to increase by 1.5°C to 3.7°C under the B1 and 2.6°C to 6.4°C under the A2 scenario, while winter (December to February) temperatures increase by 1.6°C to 2.3°C under the B1 and 2.4°C to 3.4°C under the A2 scenario. These projections are especially worrisome given that the worldwide emissions growth rate since 2000 has vastly exceeded both the B1 and A2 scenarios and has even exceeded that of the most-fossil fuel intensive IPCC SRES emissions scenario, A1F1 (Raupach et al. 2007).

The occurrence of extremely warm daily mean temperatures is also projected to increase significantly. Under the A2 scenario, the occurrence of extremely warm daily mean temperatures exceeding the 99.9 percentile of their historical distributions for June to September increases to 50 to 500 times their historical frequency by 2070–2099, while the incidence of even moderately cool daily mean winter temperatures decreases markedly. Cayan et al. (2008) warned that these temperature increases are outside the range of local experience and that temperatures will continue to rise into the twenty-second century:

> Such climate changes would be, in the words of Hansen et al. 2007, "climate changes outside of the range of local experience." A noteworthy feature in the temperature projections is that the warming through the twenty-first Century does not level off, especially in projections using the medium and high greenhouse gas emission scenarios, implying that California's climate would continue to warm in (at least) the subsequent decades of the twenty-second century. (Cayan et al. 2008: S40).

Climate models used by Cayan et al. (2008) projected relatively small (less than ~10%) changes in overall precipitation in California, but these researchers noted that analyses using a larger suite of IPCC Fourth Assessment climate models under three different emissions scenarios (A1B, A2, B1) yielded larger changes in total precipitation of 5-20%. Cayan et al. (2008) highlighted that a 10–20% change in annual precipitation can be significant, since historically a 15% loss in precipitation placed that year in the lowest third of the annual totals and can profoundly affect runoff.

Using a downscaling technique to project changes in snow accumulation on California's mountainous terrain, Cayan et al. (2008) detected marked future declines in spring snow accumulation over the Sierra Nevada that become progressively larger as warming increases within this century. By 2070–2099, virtually no snow is left below 1,000 m under the A2 scenario. By the end of the century, decreases in snow accumulation range from 60 to 93% between ~1,000 and 2,000 m (3,280 to 6,560 ft) and from 25 to 79% between 2,000 to 3,000 m (6,560 to 9,840 ft). The largest declines in snow accumulation in the Sierra Nevada are projected to occur in the central and northern parts of the range because the highest and coolest elevations are concentrated to the south.

The significant increases in temperature and losses in snowpack in California projected by Cayan et al. (2008) will increase thermal stress to the pika. Notably, all five pika subspecies in California inhabit elevation ranges that will be significantly impacted by reduced snowpack as projected by Cayan et al. (2008). As reported in the Petition and accompanying materials, according to historic records, the Taylor pika and Gray-headed pika inhabit elevations from ~5,000 to 9,000 ft, the Yosemite pika inhabits elevations from ~7,700 to 12,000 ft, the White Mountains pika inhabits elevations from ~8,000 to 13,000 ft, and the Mt. Whitney pika inhabits elevations from ~8,500 to 13,000 ft.

Finally, Rauscher et al. (2008) used a high-resolution climate model to project future changes in snowmelt-driven runoff in the western United States and found that hydrological conditions will continue to trend towards earlier snowmelt and drier summer conditions. Under an end-of-the-century A2 emissions scenario, increased temperatures forced by greenhouse gas emissions were projected to result in early-season snowmelt-driven runoff as much as two months earlier than present. Throughout most of the western mountainous areas, snowmelt-driven runoff was projected to occur at least 15 days earlier in early-, middle-, and late-season flow. These changes were driven primarily by increases in winter temperature that amplify the snow-albedo feedback. Specifically, higher temperatures reduce snow cover and consequently decrease surface albedo which increases the amount of absorbed surface radiation and further increases surface warming, leading to a positive feedback loop. Rauscher et al. (2008) concluded that reduced snowpack and early runoff are likely to result in substantial modifications to the hydrologic cycle, including reduced river flow and reduced natural snow and soil storage.

C. The Climate Commitment and Dangerous Climate Change

As noted in the Petition, the federal government is currently not implementing legal mechanisms regulating greenhouse gasses on a national level in the United States and thus regulatory mechanisms for climate change are inadequate. Regulations mandating immediate and large-scale reductions in greenhouse gas emissions are critical for preventing 'dangerous anthropogenic interference' (DAI) with the climate system. Most recently, Hansen et al. (2008) presented evidence that the safe upper limit for atmospheric CO_2 needed to avoid dangerous climate change is 350 ppm.

Using data from paleoclimatic time periods, Hansen et al. (2008) measured the sensitivity of the global climate system to increasing CO_2 (where climate sensitivity is defined as the change in global mean surface temperature following a doubling of atmospheric CO_2) when only fast climate feedback processes were considered compared to when both fast and slow feedback processes were considered. Climate sensitivity was ~3°C considering only fast feedback processes such as changes in water vapor, clouds, aerosols, and sea ice, but doubled to ~6°C when slow surface albedo feedbacks were also considered, including ice sheet disintegration, vegetation migration, and greenhouse gas release from soils, tundra, and ocean sediments (Hansen et al. 2008). Current climate models generally do not include important slow climate feedback processes that dramatically increase climate sensitivity (Hansen et al. 2008). However, Hansen et al. (2008) presented evidence that these slow feedbacks may begin to be realized within time scale as short as centuries or less, adding urgency to rapidly reducing our emissions trajectory before the climate system is forced beyond a tipping point (Hansen et al. 2008). At current greenhouse gas emissions levels, our 'climate commitment' is ~2°C warming of which 0.6°C is attributable to fast feedback processes and an additional 1.4°C is attributable to slow feedback processes (Hansen et al. 2008). With the current climate commitment of ~2°C, no additional greenhouse gas forcing is required to raise global temperature to at least the levels of the Pleistocene, 2-3 million years ago, which is a degree of warming that would definitively produce dangerous climate impacts (Hansen et al. 2008).

Hansen et al. (2008) concluded that a 350 ppm CO_2 target is urgently needed, is achievable, and must be pursued on a timescale of decades in order to avoid catastrophic consequences:

> If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimatic evidence and ongoing climate change suggest that CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm (Hansen et al. 2008: 1).

Hansen et al. (2008) provided evidence for a 350 ppm CO_2 target since our current CO_2 level at 385 ppm has committed us to a dangerous warming commitment of ~2°C temperature rise and is already resulting in dangerous changes: the observed 4° poleward latitudinal shift in subtropical regions leading to increased aridity in many regions of the earth; the near-global retreat of alpine glaciers affecting water supply during the summer; accelerating mass loss from the Greenland and west Antarctic ice sheets; rapid loss of Arctic sea ice cover; and increasing stress to coral reefs from rising temperatures and ocean acidification. Hansen et al. (2008) concluded that the overall target of at most 350 ppm CO_2 must be pursued on a timescale of decades since paleoclimatic evidence and ongoing changes suggest that it would be dangerous to allow emissions to overshoot this target for an extended period of time.

Similar to Hansen et al. (2008), Ramanathan and Feng (2008) provide evidence that our current warming commitment has placed us within the realm of dangerous anthropogenic interference with the climate system and that emissions stabilization targets of 450-550 ppm CO_2 are unlikely to prevent dangerous climate change. Ramanathan and Feng (2008) estimated that greenhouse gas emissions since the pre-industrial era have committed the world to a warming of 2.4°C (ranging from 1.4°C to 4.3°C) above pre-industrial surface temperatures. The earth has experienced only ~25% of this warming commitment to date because the rest of the warming commitment has been masked by the cooling effect of aerosols, compensation by increases in surface albedo due to land-use changes, and delays due to the thermal inertia of the oceans (Ramanathan and Feng 2008). About 90% of the remaining 1.6°C warming commitment will be realized during this century at a rate determined by the rate of unmasking of the cooling effect from aerosols as air pollution is curbed and by the rate of release of greenhouse gas forcing stored in the oceans (Ramanathan and Feng 2008). Importantly, our current warming commitment of 2.4°C above pre-industrial levels exceeds the dangerous anthropogenic interference (DAI) thresholds of 1.7°C to 2°C above pre-industrial levels as defined by leading climate scientists and international bodies (Ramanathan and Feng 2008). In addition, stabilization targets for 450 to 550 ppm will not allow us to avoid this warming commitment and dangerous anthropogenic interference:

> The high probability that the DAI threshold is already in our rearview mirror highlights the urgency issue raised by several studies recently (2–4, 35). But as noted above, CO_2 emission reduction actions and proposals are aimed at containing CO_2 concentrations at ≈ 450 to 550 ppm (9, 12, 35), but this will help neither the 2.4°C (1.4°C to 4.3°C) warming commitment from the accumulated GHGs that are already in the atmosphere, nor the projected commitment of 3.1°C (1.8–5.4°C) as of 2030 (Ramanathan and Feng 2008: 14249).

With atmospheric carbon dioxide at 385 ppm and worldwide emissions continuing to increase by more than 2 ppm each year, rapid and substantial reductions are clearly needed immediately to protect the pika and its high-elevation habitat and prevent dangerous climate change.

Of critical importance for the pika, protection of the pika from global warming impacts is needed before its habitat in core, upper-elevation regions of California becomes climatically unsuitable and the pika is committed to extinction throughout significant portions of its range. Due to time lags in the climate system, once pika habitat at higher elevations approaches a point that is thermally unsuitable for pikas, the pika will be committed to range-wide extinction as temperatures continue to warm as part of the climate commitment and pikas have no more no more upper-elevation habitat to retreat to.

V. Conclusion

The best available scientific evidence presented here and in the Petition indicates that the American pika in California faces significant threats to its continued existence from climate change. We urge the California Fish and Game Commission to accept the Petition to list the American pika under the California Endangered Species Act and to initiate a scientific status review of the pika in California.

Thank you very much for your consideration of these comments. We are submitting all new references cited in this comment letter as pdfs on the enclosed compact disk. We will not include references that were submitted with the Petition and supporting materials. Please contact me at (415) 632-5301 or at swolf@biologicaldiversity.org if you have any questions.

Sincerely,

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Enc:
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