State of California
Department of Fish and Game

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Memorandum

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COMMISSION MEETING MLS
AGENDA ITEM 6

Date: October 19, 2011

To: Sonke Mastrup
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director
Department of Fish and Game

Subject: Department Listing Recommendation - American Pika

It is my understanding that, at its October 19, 2011 meeting, the Fish and Game Commission (Commission) will consider whether the listing of the American pika as a threatened species pursuant to the California Endangered Species Act (CESA) may be warranted. In my capacity as the new Director of the Department of Fish and Game (Department), I have reviewed the petition submitted by the Center for Biological Diversity, the Department's related evaluation report and prior recommendation submitted to the Commission on August 23, 2011, and other available information. On behalf of the Department, I believe that there is sufficient information available to indicate that the petitioned action may be warranted.

To be clear, the Department expresses no opinion at this time regarding whether actual listing is or is not warranted. At this stage in the listing process, the Department's recommendation is limited solely to whether there is sufficient information available to indicate the petitioned action *may be* warranted. Accordingly, the Department recommends, pursuant to Fish and Game Code section 2073.5, subdivision (a), that the Commission accept the petition for further consideration and designate the species as a candidate for listing.

If you have any questions, or need additional information, please contact Eric Loft, Chief, Wildlife Branch at (916) 445-3555.

State of California
Department of Fish and Game

Flex your POWER

Memorandum

Date: August 23, 2011

To: Sonke Mastrup
Executive Director
Fish and Game Commission

From: John McCamman
Director
Department of Fish and Game

Subject: Evaluation of the Center for Biological Diversity amended petition to list the American pika

The Department has prepared the attached evaluation report pursuant to Fish and Game Code section 2073.5 and California Code of Regulations Title 14, section 670.1, and recommends that the Commission find that the existing and new information is not sufficient to warrant listing of the American pika.

This review summarizes the Department's evaluation of the twice amended petition submitted by the Center for Biological Diversity (Petitioner) to list the American pika as a threatened species pursuant to the California Endangered Species Act with a focus on information of the status of the American pika in California that was not available to the Department during its evaluation of the original petition. In summary, the Department's evaluation found that American pika are well distributed in their range; that sufficient information does not exist to describe population trend and that although this species does not occupy all sites where it occurred historically, evidence for re-colonization of existing sites occurs; and that one recent finding suggests that micro-habitat conditions allow pika to exist in lower elevation areas despite trends in climate.

The Petitioner described recent studies indicating the climate in California and western North America has changed over roughly the past century and that this has resulted in a reduction of suitable range and habitat for American pika. Several modeling scenarios of the future habitat suitability of American pikas suggest that under existing climate change scenarios, most of the habitat in California will be rendered climatically unsuitable for pikas within the next century. However, several recent studies suggest future climate change impacts to the American pika in California may not be as drastic as the models predict. These include the occurrence of pikas outside the typically-reported range of habitat conditions, both in terms of physical landforms and thermal regimes. Within classic talus habitat, one study of

rock-ice features as thermal refugia for pikas highlights the importance of this little-studied aspect of pika ecology.

The Department recognizes that some climate change models indicate an effect on pika habitat. However, the Department notes that climate change modeling is an evolving science, with new efforts sometime conflicting with previous results, and therefore the accuracy of the modeling results is often uncertain. In addition to climate change, other factors, such as grazing, mining, predation, competition, disease, small population size (as well as the interactions between these factors), may also impact the pika in California; however, the magnitude of these potential effects individually or in combination with other threats is unknown. In conclusion, the best available scientific information suggests there is insufficient evidence to indicate that the threat of climate change by itself or in combination with other factors is an immediate threat to American pika.

If you have any questions or need additional information, please contact Eric Loft, Chief, Wildlife Branch at 916 445-3555.

Attachments

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME

REPORT TO THE FISH AND GAME COMMISSION

EVALUATION OF THE PETITION FROM THE CENTER FOR BIOLOGICAL DIVERSITY TO LIST AMERICAN PIKA (*Ochotona princeps*) AS THREATENED

Prepared by

Scott D. Osborn and Daniel B. Applebee
Wildlife Branch

Cartography

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August 25, 2011

Evaluation of Amended Petition from the Center for Biological Diversity to List the American Pika as Threatened

Draft August 25, 2011

EXECUTIVE SUMMARY

The Department of Fish and Game (Department) has prepared this Evaluation Report pursuant to Fish and Game Code section 2073.5. (See also Cal. Code Regs., tit. 14, § 670.1, subd. (d).). As required by statute this Evaluation Report sets forth the Department's evaluation of the twice Amended Petition on its face and in relation to other relevant information possessed or received by the Department, and a related recommendation to the Fish and Game (Commission) as to whether the Petition contains sufficient information to indicate that the petitioned action may be warranted.

The Center for Biological Diversity (Petitioner) originally submitted a petition to the Commission on August 21, 2007, to list the American pika (*Ochotona princeps)* as a threatened species pursuant to the California Endangered Species Act (CESA; Fish and Game Code (FGC) sections 2050- 2115.5.) The Department determined, after its initial scientific evaluation of the Petition, that it did not contain sufficient scientific information to indicate the petitioned action may be warranted. On April 10, 2008, the Commission determined that the petition provided insufficient information to indicate the petitioned action may be warranted. On June 24, 2009, the Commission set aside its April 10, 2008 decision, and again determined that the petition did not provide sufficient information to indicate the petititioned action may be warranted. The Petitioner subsequently filed a lawsuit. In accordance with a court judgment, at its February 3, 2011 meeting, the Commission set aside its decision of June 24, 2009 and its formal findings, which were adopted on October 1, 2009, and superceded on April 10, 2010. Also at the February 3, 2011 meeting, the Commission reconsidered Petitioner's petition to list the American pika as threatened or endangered under CESA, including a new submission by Petitioner dated May 15, 2009. The Commission treated the petition, including Petitioner's new submission, as an amended petition pursuant to Fish and Game Code section 2073.7, and also determined the amendment to be substantive. The Petitioner subsequently submitted a 43-page letter. At its May 4, 2011 meeting, the Commission determined that letter dated March 31, 2011, from the Petitioner amounted to a substantive amendment of the petition. Pursuant to Section 2073.7 of the Fish and Game Code, the Commission transmitted the twice amended petition (hereinafter Petition) to the Department for review.

Since the original petition and Department evaluation, the American pika has undergone a taxonomic revision. The five formerly recognized subspecies in California are now regarded as one subspecies, *Ochotona princeps schisticeps*, which ranges from the Sierra Nevada and southern Cascades in California and Oregon through many of the Great Basin ranges in Nevada to the Utah border, as shown on the attached map from Hafner and Smith (2010).

Several studies in California have reported on the occurrence or absence of American pikas from both historic and previously-unsurveyed habitat (Goehring 2011, Jeffress and Ray 2011, Massing and Perrine 2011, Stewart and Wright 2011, Millar 2011a, 2011b, Millar and Westfall 2010a, Nichols 2009, 2011b). In some cases, historically-occupied sites were found to be not occupied by pikas, but other sites, including sites that were previously unsurveyed, were found to have pika populations. Some of the

now-vacant sites occur at lower elevations within the range for American pika, however it is not possible to conclusively identify the factors which have affected the persistence[1] of pikas.

The Department prepared the attached map depicting known recent and historic locations of the American pika in California, as well as the current delineation of the pika's geographic range by the Department. Analysis by the U.S. Fish and Wildlife Service for the 12-month status review for the federal listing petition indicated that, for the *schisticeps* subspecies, about 95% of its range is on federal lands, with almost half its range in designated wilderness areas. About two-thirds of the subspecies' range in North America is found in the Sierra Nevada.

There is essentially no modern information or precise historical information on the numbers of American pikas in California. No new information on life history of pikas has come to light since the original petition, with the exception of new habitat associations. Pikas have been found in a wider range of habitats and thermal regimes in some parts of their range (including outside of California) than has been generally reported (Simpson 2009, Millar and Westfall 2010a, Manning and Hagar 2011). An association of pikas in the eastern Sierra Nevada and western Great Basin with rock-features suggests that thermal refugia may ameliorate extremely hot or cold surface temperatures.

Both direct and indirect effects of climate change may impact American pikas in California. These effects may include: mortality and stress associated with increasing temperatures; changes in behavior as pikas adapt to increasing temperature (e.g., curtailed mid-day foraging, shifts to nocturnal foraging exposing pika to nocturnal predators); mortality and stress associated with cold temperatures and reduced insulation from declining snow pack; reduced survival of dispersing individuals due to heat stress, heat mortality, and changes in food plant availability due to changed growing seasons; changes in vegetation community composition at occupied pika sites; changes in competitor and predator communities; and the combined and interrelated effects of all of these impacts. American pikas have been considered especially sensitive to warm temperatures due to early experiments where death of caged pikas occurred at relative low ambient temperatures (though with high solar radiative heat load). Unconfined pikas seek cool shelter when ambient temperatures are too high.

Studies have documented that the climate in California and western North America has warmed over the past 50 to 100 years. Hydrologic cycles have also changed, with snowmelt from the Sierra Nevada occurring earlier, on average, than historically. A number of studies, including population studies of pikas in the field (Great Basin, southern Cascades, central Sierra Nevada) and modeling studies, have implicated recent warming with pika persistence or occurrence. For the field studies, factors other than climate change have also been suggested for some of the observed losses of pika-occupancy. These include small and isolated populations, grazing, predation, competition, mining, and disease.

Global climate models project warming over all land areas of the globe, including North America, through 2100. These models project greater summertime warming over the western U.S. than elsewhere in North America. Due to the impacts of temperature, projections show a decline in lower-

[1] In the scientific literature related to population biology and conservation, the word "persistence" is used to mean a population that continues to exist, despite factors such as predation, competition from other species, or disease that negatively affect the species' ability to survive or reproduce. "Extirpation" refers to a local extinction of a species at a particular site, which for a patchily-distributed species like the American pika, may be considered at the scale of a talus patch or a small mountain range. Such local extinctions may be reversed by recolonization of the site by individuals dispersing from other sites. When conditions favor the species, survival and reproduction are high and recolonization events may outweigh extirpations, leading to higher site-occupancy. When conditions are less favorable, extirpations may outweigh recolonizations, leading to reduced site-occupancy.

elevation snowpack (below 8,200 ft/2,500 m elevation) by the mid-21st century, with more modest declines at elevations above 8,200 ft where some pika populations live. A high-resolution climate model predicted early-season snowmelt runoff as much as two months earlier than present by 2100.

Several modeling studies of the future habitat suitability of American pikas suggest that under existing climate change scenarios, most of the habitat in California will be rendered climatically unsuitable for pikas within the next century (Loarie unpublished report 2009, Galbreath 2009, Calkins 2010, Trook 2009). Several recent studies suggest future climate change impacts to the American pika in California may not be as drastic as the models predict. These include the occurrence of pikas outside the typically-reported range of habitat conditions, both in terms of physical landforms and thermal regimes. Within classic talus habitat, Millar and Westfall's (2010a) data on rock-ice features as thermal refugia for pikas highlight the importance of this little-studied aspect of pika ecology.

The U.S. Fish and Wildlife Service recently determined the American pika does not warrant listing as threatened or endangered (USDI 2010). The finalized (in press) IUCN Red List account for the American Pika (A. Smith, pers. comm. August 15, 2011) designates it as a "Least Concern" species.

The Department considered ongoing research, conservation, and adaptation planning activities being conducted in California by pika researchers and the Department's Climate Science program. Many pika-specific activities are now being coordinated through the work of the California Pika Consortium and North American Pika Consortium. These groups currently provide a forum to discuss and implement activities for the conservation of the American pika in California. The Department, along with other state and federal agencies, is addressing the impacts of climate change through a combination of initiatives aimed at curtailing greenhouse gas emissions of its own activities, proposed projects and regulations reviewed under the California Environmental Quality Act and National Environmental Policy Act, and adaptation planning for California's wildlife, fish, and plant species.

INTRODUCTION

The subject of this Evaluation Report is the Petition to List the American Pika as a Threatened Species pursuant to CESA submitted by Petitioner on August 21, 2007. This Evaluation Report is intended by law to inform the Commission's related determination as to whether the Petition, when considerd with this Evaluation Report and other related information before the Commission, provides sufficient information to indicate the petitioned action may be warranted. (See generally Fish & G. Code, §§ 2073.5, 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d), (e).) The Department's charge and focus in its advisory capacity to the Commission is scientific. The title of the subparagraph in the regulation governing the Department's obligations directs the Department to evaluate the petition and make its related recommendation to the Commission based on whether there is "Sufficient Scientific Information." (Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1).)

Petition History. The Center for Biological Diversity (Petitioner) submitted a petition to the Commission on August 21, 2007, to list the American pika (*Ochotona princeps*) as a Threatened species, pursuant to CESA. As an alternative, the Petitioner asked that the Commission list each of the then recognized five subspecies of the American pika occurring in California as, variously, either Endangered or Threatened species. The Commission received the petition on August 22, 2007. The Commission referred it for evaluation to the Department on August 30, 2007.

On September 12, 2007, the Department asked the Commission to grant the Department an additional 30 days, for a total 120 days, to evaluate the petition pursuant to FGC section 2073.5(b). On October 19, 2007, the Commission granted this request.

The Department evaluated the petition, using the information in that document and other relevant information available at that time, and found that the scientific information presented in the petition was insufficient to indicate that either of the petitioned actions may be warranted. That is, the Department found the petition did not provide sufficient scientific information to indicate that the following actions may be warranted: 1) State listing of the pika as a Threatened species, and 2) State listing of any of the five subspecies of the pika occurring in California as, variously, either Endangered or Threatened species. The Department's review of additional scientific information supported these findings. The Department recommended in its December 21, 2007 evaluation report to the Commission that, pursuant to FGC section 2073.5(a), the Commission reject the petition.

The Commission twice rejected the petition and adopted findings that indicated there was insufficient information to indicate the petitioned action may be warranted. The Petitioner filed a lawsuit after each set of findings was adopted. As a result of the litigation, the Commission reconsidered Petitioner's petition to list the American pika as threatened or endangered under the CESA, including a new submission by Petitioner dated May 15, 2009. The Commission treated the petition, including Petitioner's new submission, as an amended petition pursuant to Fish and Game Code section 2073.7, and also determined the amendment to be substantive. At its February 3, 2011 meeting, the Commission transmitted the amended petition to the Department for review.

The Petitioner submitted another comment letter to the Commission on March 31, 2011. The Commission voted at its May 4, 2011, meeting that the March 31, 2011, letter submitted by the Petitioner amounted to a substantive amendment of the petition. The Commission indicated in a memorandum to the Department dated May 13, 2011, that the Department's evaluation report should be submitted to the Commission on or before August 2, 2011.

On June 27, 2011, the Department requested that the Commission grant the Department an additional 30 days, for a total 120 days, to evaluate the amended petition, pursuant to FGC section 2073.5(b). On August 3, 2011, the Commission granted this request. This evaluation report is due to the Commission on September 2, 2011.

Report Content and Organization. This report summarizes the Department's evaluation of the amended Petition with a focus on information of the status of the American pika in California that was not available to the Department during its evaluation of the original petition. Information available to the Department since its December 2007 evaluation of the original petition includes several comment letters from the petitioner, comment letters from other interested persons, and published and unpublished reports, presentations, and meeting summaries. The American pika, sometimes regarded as an early-warning indicator of climate change, has been the focus of much research and conservation discussion since the original petition was filed in 2007. The pace and volume of research and modeling on climate change in general has similarly increased in the past few years. Together, these two areas of research and conservation have provided new information and model results relevant to the issue of whether listing of the American pika under the California Endangered Species Act may be warranted.

This report follows the outline of the Department's 2007 report, which is incorporated by reference (Gustafson and Logsdon 2007). For each of the major report headings (Population Trend, Range, Distribution, etc.), a brief synopsis of the Department's conclusions in 2007 is provided, followed by a summary of new information relevant to that topic. Each section concludes with the Department's determination of whether new information changes the Department's original conclusions on that topic.

TAXONOMIC REVISION

Since the original petition and Department evaluation, the American pika has undergone a taxonomic revision. The 36 subspecies of American pika have been reclassified into five subspecies (Galbreath et al. 2009, Hafner and Smith 2010). The five formerly recognized subspecies in California are now regarded as one subspecies, *Ochotona princeps schisticeps*, which ranges from the Sierra Nevada and southern Cascades in California and Oregon through many of the Great Basin ranges in Nevada to the Utah border (see the attached map from Hafner and Smith (2010) depicting the general ranges of the revised subspecies). The Department has adopted the new taxonomy for the American pika, as did the U.S. Fish and Wildlife Service in its review of the federal Endangered Species Act petition (USDI 2010).

POPULATION TREND

The Department's evaluation of the population trend information in the original petition found no information on population size or trend of American pikas in California. The Department rejected the petitioner's finding that the Grinnell resurvey project area (as reported at the time in the unpublished report by Moritz 2007; see also the peer-reviewed publication by Moritz et al. 2008) found that pikas had been lost at "multiple low-elevation sites" in the Yosemite area. The Petitioner (Siegel et al. 2008) later acknowledged the study found that pikas no longer occupy one of the Yosemite sites (not multiple sites) where they had been documented early in the 20th century, but that pikas still occur at the other historical sites in the study area.

There remains little information on population numbers for the American pika in California. As a proxy for changes in population size, conservation biologists often use trend information in the occupancy of suitable habitat or the proportion of the geographic range occupied by a species. The Petitioner (Siegel et al. 2008) acknowledged the general lack of population or range trend information for pikas in California, with the exception of the Grinnell resurvey project in Yosemite (Moritz et al. 2008). The Petitioner noted that other high-elevation small mammals also exhibited upslope range retractions in the Yosemite study, and that the study authors noted that warming temperatures in the study area since the early 20th century suggested climate change was the cause of the range retraction. The Petitioner (Wolf 2009) also noted that warming climate has been implicated in range retractions of the American pika in the Great Basin (primarily Nevada) over prehistoric (Grayson 2005) and historic times (Beever et al. 2003).

In California, on-going surveys at sites where pika were found historically and at other suitable habitat patches have shown that pikas have been lost from some sites, but persist at others. Between 2001 and 2010, Goehring (http://www.bluetang.org/shastapika/index.html) attempted to survey all suitable talus patches on Mt. Shasta between elevations of 2,290 and 2,900 m (7,500 - 9,500 feet). Pikas were detected at 28 sites, including six of the seven locations where pikas were reported by C. Hart Merriam in 1899 in his Results of a Biological Survey of Mount Shasta, California (USDA Division of Biology). Elevations of the 28 occupied sites range from 2,241 to 2,918 m (7,354 to 9,575 feet).

Jeffress and Ray (2011) reported preliminary results from a National Park Service pika study at eight NPS units in the western U.S. Two of the sites, Lava Beds National Monument (LABE) and Lassen Volcanic National Park, (LAVO) are located in California. This study involved surveys at randomly-located suitable habitat patches (i.e., not historical pika sites). At the two California park units, site-occupancy at LABE was 15% (n = 76 plots) and at LAVO was 24% (n = 101 plots).

Massing and Perrine (2011) reported on resurveys of historical Grinnell sites on the Lassen transect, plus additional sites in the area. Eleven of 17 (65%) historical pika sites were occupied; 6 of 17 (35%) additional surveyed sites were occupied. One historical site changed status from unoccupied in year 1 to occupied in year 2 of the study.

Stewart and Wright (2011) presented preliminary information on resurveys at 19 historical sites in the Sierra Nevada. Seventeen of the sites were occupied during their study period. The authors combined their field results with information from other pika sites in the Sierra Nevada and found the amount of talus within a 1-km radius of the survey plot had a statistically significant effect on whether a site lost pikas (i.e., more talus area reduced the chance of extirpation). There was also a marginally significant effect of elevation on persistence, with lower (presumable warmer) sites more likely to lose pikas than higher sites.

Millar (2011a, 2011b) reported on a survey project at both historical and previously unsurveyed habitat in canyon systems of the eastern Sierra Nevada and adjacent ranges, including sites in the Great Basin (California and Nevada). American pikas were found to occupy most of the available habitat and were widely distributed throughout the region. Millar and Westfall (2010) reported on the first three years of this on-going study and found that pikas use a wide range of sites in terms of elevation and temperature. The researchers found no consistent pattern in terms of elevation or habitat quality for sites that had lost pikas (as evidenced by old fecal pellets).

Nichols (2009, 2011a, 2011b) reported on the results of on-going surveys in the Bodie Hills and Bodie State Historic Park in eastern California. Attention has been placed on the Bodie SHP pika population because it has been studied since the 1970s and occurs at a relatively low elevation (2,500 m, 8,200 feet). As Nichols (2011b) notes, this population also is somewhat unusual in that the broken-rock habitat it occupies are mine ore dumps. Pikas apparently moved into the Bodie townsite from the surrounding Bodie Hills after mining activity began in the late 19th century. As reported by Nichols (2011b), Severaid (1955) described the ore-dump sites in the Bodie townsite as nearly 100% occupied. By the 1970s, site-occupancy had declined to about 61%, and the southern and middle clusters of sites were completely unoccupied by 2008, although favorable seasons has resulted in some re-occupancy at the southern sites since then (Nichols, pers. comm. August 5, 2011). The northern cluster of sites has exhibited a pattern of abandonment and re-occupancy since the 1970s and currently the percent occupancy is at about where it was when modern surveys began there in the 1970s (Smith 2011b).

In the Bodie Hills, natural talus habitat occurs in larger patch areas and at greater distances from one another than the ore-dump patches in the Bodie townsite. Surveys in the Bodie Hills by Nichols (2011b) indicate high occupancy in historical times (determined by the presence of old pika sign, including fecal pellets and urine stains), but nearly complete loss of occupancy in the recent past.

In summary, almost no information on population size or trend is available for the American pika in California. Losses of pika occupancy at some sites have occurred, suggesting that some reduction in population size since historical times may have occurred. But the lack of comprehensive survey data throughout the state or at representative monitoring sites makes it impossible to draw firm conclusions about population trend.

RANGE

The Department's evaluation of the geographic range information in the original petition found it to accurately portray the American pika's discontinuous distribution throughout mountainous areas in western North America.

Much of the current information on the geographic range of the American pika in California is presented under Population Trend. The Petitioner (Siegel et al. 2008) added information on the range of the American pika and the five subspecies in California recognized at the time. The information on range, as amended by the Petitioner, is complete. The new information from the studies described under Population Trend have not changed the Department's assessment of the geographic range of the American pika in California, although based on recent work it appears that pikas may inhabit a wider range of habitats and elevations than previously described (Millar and Westfall 2010a; but see also Wolf 2010, Millar and Westfall 2010b).

The attached map entitled "Known Distribution of American Pika (*Ochotona princeps*) in California" depicts the Department's current geographic range for the pika as delineated for the California Wildlife Habitat Relationships System (CWHR). The Department periodically reviews and revises such range maps based on available distribution and other information for all of California's terrestrial vertebrate species. It is important to note that within the large polygon depicting the pika's range, the Department expects that a large proportion of the area area not occupied due to absence of suitable landform (talus or other broken rock habitat), suitable vegetation, other conditions necessary for survival, or simply because pika populations, like other wildlife, may not typically occupy all suitable habitat within their range due to other factors limiting their area of occupancy. These factors may include a lag between local extinctions and recolonization of suitable patches.

Analysis by the U.S. Fish and Wildlife Service (USDI 2010) for the federal status review of the American pika determined that habitat for the subspecies occurring in California (*Ochotona princeps schisticeps*) occurs largely on federal land, with a majority of its habitat in the Sierra Nevada of California. Throughout its range in California, Nevada, Oregon, and Utah, more than 95% of the geographic range for the *schisticeps* subspecies is comprised of federal land, and nearly half is designated as wilderness (USDI 2010, Table 2). Approximately 64% of the *schisticeps* geographic range exists in the Sierra Nevada, with the remainder in the southern Cascades and mountain ranges of the Great Basin (Finn 2009 in USDI 2010).

In summary, the geographic range of the American pika was delineated in 2007 based on known pika-occupied locations and descriptions of habitat associations. Based on the available information, the Department's view of the geographic range of the American pika in California has not changed since its evaluation of the original petition.

DISTRIBUTION

The Department's evaluation of the original petition found that it lacked a comprehensive description or map of known pika locations in California. The evaluation report noted the petition's statement that "elevations of historic populations [in California] ranged from 1370 [meters] to 3700 [meters]". The Petitioner has since provided additional information on distribution and it is considered complete.

The attached map entitled "Known Distribution of American Pika (*Ochotona princeps*) in California" depicts all the localities for which the Department has information on American pika occurrence in California. These locations include museum specimens and reliable observation dating from the late 19th century through the end of 2010. These locations include information from survey work conducted in the last few years (see summaries of these surveys under "Factors affecting Ability to Survive and Reproduce" and "Degree and Immediacy of Threat" below). The locations are color-coded by date of observation; that is, either prior to or after 1980. The year 1980 was chosen as a cut-off because relatively recent climate change effects on pika persistence have been found in other studies (e.g.,

Beever et al. 2010, 2011). In some cases, historically-occupied sites have been resurveyed and found to be recently unoccupied. In other cases (as described above) historically-occupied sites remain occupied.

Although recent resurvey work at historically-occupied sites are beginning to shed light on changes in distribution of the American pika, the avalable information does not allow the Department to draw strong conclusions about trends or patterns of distribution change in California. Given the various recent efforts to survey for pika, the species appears to be well-distributed throughout its historical range in California.

ABUNDANCE

The Department's evaluation of the original petition found it provided no information on abundance or population densities for pika in California. The Department found no additional information on abundance of American pikas, and only two references for density estimates in a study conducted in the Rocky Mountains of Colorado.

The Petitioner subsequently provided some information regarding abundance and density of pikas in the White Mountains and Sierra Nevada. Siegel et al (2008) noted the current IUCN classification for the White Mountains pika (no longer considered a separate subspecies) indicates less than 1000 mature individuals in that mountain range. This is an estimate based on the expert opinion of the IUCN account preparers. Wolf (2011) cited historical accounts (Howell 1924, Grinnell and Storer 1924) indicating the pika was abundant in the Sierra Nevada. "Abundant" and "a common resident" and "relatively dense" were terms used by early naturalists studying pikas and other small mammals. One cited reference provided a point estimate for density of pikas at a typical site of about 15 pikas per hectare of rock slide habitat. These historical descriptions did not follow modern methods for estimating abundance or density, but do offer some context if modern studies eventually provide estimates of population size or density in natural habitats.

The Department concludes, based on the best available information, that population abundance or density estimates based on empirical data for the American pika in California are still lacking.

LIFE HISTORY

The Department's evaluation of the original petition found it accurately described the ecology of the species. In particular, the petition and evaluation report noted the pika's association with talus and other broken rock habitats, primarily diurnal (day-active) activity, solitary and territorial nature, central-place foraging and stockpiling of "haypiles" for food during winter, inability to hibernate, relatively low dispersal ability, physiological adaptations to cool environments (including sensitivity to high ambient temperatures), and behavioral responses to relatively high ambient temperatures.

One recent finding is the association of American pikas in the eastern Sierra Nevada and Great Basin with rock-ice features (RIF), as documented by Millar and Westfall (2010a). These features, which include rock glaciers and boulder stream landforms, have thermal characteristics that may make the interstices (spaces between rocks) used by pikas for cover substantially cooler than surface temperatures during the summer warm season and, in some cases, warmer than the surface during the winter.

In summary, the Department finds that new information on the life history of the American pika is available. That information, along with previously-available information, suggests that pikas may have the ability to cope with some of the expected effects of climate change.

FACTORS AFFECTING ABILITY OF POPULATION TO SURVIVE AND REPRODUCE

The original petition and the Department's evaluation focused on increased ambient temperature due to climate change as a potential factor that may impact pika populations. The Department's evaluation disagreed, in part, with the petition's assertion that "two recent studies of pika population persistence in California and the Great Basin … concluded that increased temperatures provide the best explanation for low-elevation population extirpations". The Department disagreed that the Yosemite study demonstrated that increased temperature was a cause for the disappearance of pikas from one of the lowest-elevation Yosemite sites historically occupied by pikas. The Department also noted the Great Basin study authors listed other factors, such as human-altered fire regimes, livestock grazing, and introduced exotic plants, as possibly implicated in the site extirpations in that study. The Department mentioned predation on pikas by a variety of species, including long-tailed weasels (*Mustela frenata*), as another factor affecting pika populations.

Climate Change

Several pathways through which climate change could be negatively impacting pikas have been identified, including: mortality and stress associated with increasing temperatures; changes in behavior as pika adapt to increasing temperature (e.g., curtailed mid-day foraging, shifts to nocturnal foraging exposing pika to nocturnal predators); mortality and stress associated with cold temperatures and reduced insulation from declining snow pack; reduced survival of dispersing individuals due to heat stress, heat mortality, and changes in food plant availability due to changed growing seasons; changes in vegetation community composition at occupied pika sites; changes in competitor (e.g, California ground squirrel (*Otospermophilus beecheyi*) and bushy-tailed woodrat (*Neotoma cinerea*)) and predator (e.g. rattlesnake (*Crotalus* sp.) communities at occupied pika sites; and the combined and interrelated effects of all of these pathways (Smith 1978, Beever et al. 2003, Morrison and Hik 2008, Nichols pers. comm. August 5, 2011).

A predominant effect of climate change on wildlife populations in the Sierra Nevada region will likely result from changes in vegetation communities. These changes will include increases in the amount of grassland and oak/pine vegetation, and a loss of conifer dominated vegetation, especially at higher elevations (e.g., red fir/lodgepole pine/subalpine conifer). This shift may be hastened by changes in fire severity and frequency. (PRBO 2011)

Several authors, when defining and modeling suitable pika habitat reference Andrew Smith's 1974 (Smith 1974) experiment demonstrating mortality of two caged pikas from exposure to ambient temperatures of 25.5 to 29.4° C (78° to 85° F). It is important to note the author of the study concluded that pika survival is based on the pika's ability to behaviorally thermoregulate by retreating to cool spaces within talus. Therefore, ambient temperature alone may not be a reliable predictor of suitable pika habitat.

Observed Climate Change to Date

The Petitioner (Wolf 2009, Wolf 2011) described recent studies indicating the climate in California and western North America has changed over roughly the past century. For example, Bonfils et al. (2008) estimated average temperature trends in California over the past half century and found an increase in annual-mean average temperature between 0.36° C and 0.92° C (0.6° and 1.7° F), positive trends in daily mean and maximum temperatures for late winter and early spring, and increases in minimum daily

temperature from January to September in the second half of the 20th century. These effects were attributed to human-induced climate change.

Gershunov and Cayan (2008) examined heat-wave trends in California using data from 95 weather stations collected between 1948 and 2006. Heat waves, identified from high maximum daily temperatures or high minimum daily temperatures, showed an increasing trend over the study period. Two extreme nighttime heat waves occurred in 2003 and 2006. The authors noted that nighttime heat waves contribute to increased maximum daily temperature and don't provide wildlife the nighttime respite from extreme high temperatures. They concluded that the observed increase in nighttime heat waves is consistent with global climate change and can be expected to continue. The authors also found daytime heat waves to be increasing, with most of the observed increase occurring since the 1970s. The increase is more pronounced at higher elevations than lower, possibly due to decreased snowpack and earlier snowmelt, which lead to drier, hotter summers.

Kapnick and Hall (2009) analyzed snow station data and detected a trend toward earlier peak snow pack in the Sierra Nevada over the period 1930 to 2007, which has shifted 0.4 days per decade since 1930. This shift is associated with an increase in temperatures in March. The authors predict larger shifts toward earlier snowpack peaks as March temperatures continue to rise.

A study of climate change in montane areas in the western U.S. by Barnett et al. (2008) found that similar temperature, snowpack, and runoff effects can be detected in observational datasets throughout the study region. The authors also tied in hydrologic effects (rain versus snow, seasonal shifts in river flow rates) to human-caused climate changes.

Ray et al. (2010) found that the western United States has warmed about 1° C (2° F) during the past 30 years. Climate stations near pika locations in the Sierra Nevada and western Great Basin and in Oregon show a statistically significant warming trend of 1° to 2.4° C (1.7° to 4.3° F) in the summer during the past 30 years. The authors also found that spring has warmed more than other seasons at many locations in the western United States. The onset of spring has come earlier, by 2-3 weeks, and snow cover, postulated to provide insulation to pikas during extreme cold snaps in the spring, is melting out earlier.

Moritz et al. (2008), in providing context for their Yosemite transect resurvey results, analyzed regional weather records for their study area. Their analysis pointed to a substantial increase in the average minimum monthly temperature of 3.7° C (6.7° F) over the past 100 years, with notable increases from 1910-1945 and from 1970-present.

Taken together, the recent research on climate change during the 20th century indicates that California is already showing increased temperatures, shifts in precipitation patterns, and reduced snowpack during the spring relative to conditions 50 to 100 years ago.

Evidence of Climate Change Impact on Pika

Morrison and Hik (2008), in a 10-year study of a Yukon population of collared pika (*Ochotona collaris*) documented a 90% reduction in population size in the period of 1998 - 2000. The decline occurred across the entire study area and did not appear to be related to biotic factors such as disease, food resources, or predation, leaving climate factors as the most likely explanation. The population began to recover in the last few years of study, but not to the levels observed at the start of the study.

In Loarie et al's (2008) study of American pika extirpations throughout its range in North America, the best fitting model to explain the loss of pikas at a site was the univariate mean annual temperature

hypothesis. The strongest correlation with pika extirpations was increasing mean annual temperature at pika sites.

Trook (2009) modeled pika habitat suitability using current climate data for western North America. Two climate variables, the maximum temperature of the warmest month and the annual maximum temperature, served as the primary explanatory variables in modeling current and future suitable pika habitat.

Beever and his co-authors examined the patterns of persistence and extirpations at 25 sites historically occupied by pikas in the Great Basin (Beever et al. 2003, 2010, 2011). These sites are outside California and occur within the relatively small and isolated Great Basin mountain ranges. The results suggested that climate change has already had an impact on some populations of the *schisticeps* subspecies and provide a mechanistic framework for evaluating the potential for future climate change impacts to pikas in California.

Beever et al. (2003) found that maximum elevation of a site was an important factor in predicting whether pikas persisted at the site. The authors hypothesized that higher available elevations at a site allow pikas to retreat upwards as temperatures warm and lower elevations become unsuitable.

Beever et al. (2010) provides information from additional surveys and analysis. In addition to the data from the previous round of surveys (1994-1999), the sites were surveyed for pikas during a second period (2005-2007). In total, pikas were extirpated from 9 of the 25 sites (six sites lost pikas prior to the study, and three during the period between 1999 and 2005). Temperature loggers were deployed at the sites and historical temperature profiles for the sites starting in 1945 were predicted using the observed temperatures at the sites and data from the Historical Climate Network (HCN).

The authors hypothesized that three measures of temperature stress may affect pika persistence and extirpation: Chronic heat stress (mean summer temperature), acute heat stress (number of days above 28° C (82° F) during the hindcast and observed periods), and acute cold stress (number of days below two cold thresholds, 0° C (32° F) and -5° C (23° F). The authors noted that cold stress temperatures are difficult to hindcast due to the insulating effect of snow cover. Presence or absence of snow cover could not be modeled using the HCN data.

Three periods were available for analysis: the hindcast period of 1945-1975, the hindcast and observed period of 1976-2006, and the observed period of 2005-2006. Absolute values for these three periods were used, as well as the differences between the periods. The latter variable is considered a measure of climate change.

Inspection of the temperature profiles for the site with pika persistence versus extirpation suggests acute heat stress (number of days above 28° C (82° F)) was higher at pika-extirpated sites, while chronic heat stress (mean summer temperature) was similar between the two groups. Pika-extirpated sites also had more days below -5° C (23° F) than sites where pikas persisted. Information-theoretic analysis of logistic regression models indicated that chronic heat stress, acute cold stress (using the -5° C threshold), and acute heat stress were the best predictors for pika extirpations. The climate values for the recent time period were the best predictors, while the climate change (difference) values were poor predictors.

Beever et al. (2011) used additional data on pika sites in the Great Basin to estimate the rate of pika extinctions and upslope range retractions during the 20th century and the last 10 years. They also looked at within-site elevations for pika occurrence, and anthropogenic factors that may affect pika extirpation or persistence.

The "drivers" of pika extirpations changed over the three periods examined (from late 19th century to 2006, 19th century to 1999, and 1999 to 2006), with different statistical models resulting depending on which interval was examined. Maximum temperature in August became the best predictor of persistence for the most recent interval, whereas maximum elevation was the best predictor in the earlier interval. The latitude-corrected residual of maximum site elevation had the most predictive power in the recent and overall intervals. The authors cautioned that the change in drivers of extirpation over the intervals suggests that past patterns may not be predictive for future extirpations.

Lower elevation boundaries at 10 sites where pikas were detected since the 1999 survey shifted at least 145 m (475 feet). For the historical sites (n = 25) to the 20th century period (n = 19), the average upslope range retraction was 13.2 m (43 feet) per decade. The rate increased to 145.1 m (476 feet) per decade for the recent period sites (n = 16) since the 20th century period (n = 19). These upslope range retraction rates are much faster than the average rates reported for other species in the literature. In this study, the upper elevation boundaries of pika sites did not shift, which is similar to the 18 mid- to high-elevation mammal species studied in the Yosemite transect (Moritz et al. 2008).

The average rate of site extirpation increased over the two intervals: six of the 25 sites were lost between historical period and the late 20th century surveys (an average of one loss per 10.7 years), while four additional sites were lost between 1999 and the 2000s surveys (one loss per 2.2 years). The authors note haypiles were observed at four of the six 20th century-extirpated sites, suggesting relatively recent loss of pikas at those sites.

Overall, extirpations occurred at the most thermally stressful sites, rather than the sites that had the greatest change in temperatures. In general, sites or locations where pikas were lost exhibited higher summer temperatures and lower winter temperatures than sites where pikas persisted. By PRISM (spatial climate data) estimates, pika-persistence sites received more precipitation than sites where pikas were lost (although precipitation was a poor predictor in the analysis).

Pika abundance (as patch saturation) increased with latitude. Declines between 1990s and 2000 surveys in numbers of animals detected per site were greater in the south than in the north.

The authors cautioned that differences in the size and configuration of the mountain ranges in the northern and southern Great Basin may have affected the results. Further, population losses in other parts of the American pika's range (including the Sierra Nevada and southern Cascades in California) "appear less extensive" than the documented Great Basin losses.

Moritz et al. (2008), in their Yosemite transect resurvey found that several high-elevation species' contemporary ranges, including pika's, were contracting up slope from where they were detected in the early 20th century by Grinnell and Storer. The elevation range in which pika were detected in the period of 1914-1920 was 2,377 - 3,871 m (7,800 – 12,700 feet). The contemporary lower elevational range limit of pika was found to have shifted upslope by 153 m (502 feet). (Moritz et al. 2008)

Lyle Nichols provided unpublished summaries of work in the Bodie Hills and Bodie State Historic Park (Nichols 2009, 2011a, 2011b). The 2011b summary includes information from pika surveys at suitable habitat patches in the Bodie Hills starting in 2008 (n = 51 natural patches) and New York Hill (n = 1 natural patch, 16 ore-dump patches). It also summarizes ore-dump occupancy at Bodie over several years starting in 1972. Additional occupancy data from Severaid's (1955) work in 1948-49 is reported. Nichols could identify 28 of Severaid's ore-dump patches and revisted them in 2010. Occupancy is reported as the percentage of surveyed patches that were occupied each year. The following bullets summarize Nichols' reports:

- Ore-Dump Sites, BSHP. Overall, patch occupancy at the Bodie ore-dump patches has declined dramatically since recent surveys began (from 61% in 1972 to a low of 25% in 2008; 2010 occupancy was 41%). Of the three "patch networks" described by Moilanen et al (1998), only the northern network was occupied by pikas as of 2010; the middle and southern networks are abandoned. Likewise, of the 28 Bodie patches occupied in Severaid's study (1948-1949), 16 were occupied in 2010.
- Ore-Dump Sites and Natural Talus Patch, New York Hill. Seven of the 17 recently surveyed patches were occupied by pikas in 2010 (41.1% patch occupancy). All 17 New York Hill patches contained pika fecal pellets showing that all had been occupied in the recent past. Elevations of New York Hill patches range from 2,513 to 2,618 m (8,245 to 8,590 feet).
- Natural Talus Patches, Bodie Hills. All 51 habitat patches recently surveyed in the Bodie Hills were found to have fecal pellets indicating occupancy in the past, but none had fresh sign or pikas observed. Elevations of the Bodie Hills sites range from 2,209 to 3,112 m (7,250 to 10,210 feet).
- Rates of Extirpation. Based on his technique for aging fecal pellets (Nichols 2010), Nichols estimated the date of abandonment of sites in Bodie SHP, New York Hill, and the Bodie Hills. His Figure 3 shows the percentage of occupied sites as a function of year in these three areas since the 1940s. Large declines for all three areas are shown in the period from 1980 to the present.

Nichols (2011b, pers. comm, August 5, 2011) emphasizes the differences between the natural talus patches in the Bodie Hills versus the ore-dump patches in BSHP and New York Hill. In general, the ore-dumps are very small and are separated by relatively short distances. The ore-dumps have relatively small rocks and presumably shallow cover. The natural patches in the Bodie Hills are relatively larger but more distant from one another. They are composed of generally larger rocks and likely have deeper cover than the ore-dumps. Taken together, Nichols (pers. comm., August 5, 2011) suggests these characteristics make the natural sites in the area more likely to lose pikas if climate change is a stressor affecting the pika populations, primarily because dispersal and patch re-occupancy would be limited for the more widely dispersed natural patches. He notes the percent occupancy trend for the Bodie SHP and New York Hill sites suggests possible extinction (the Department would consider this to be extirpation rather than extinction) in these areas by the end of the 21st century.

In the Lassen area, Massing and Perrine (2011) found that historical pika sites that lost occupancy averaged warmer than the occupied sites (overall mean temperature, summer mean temperature, and warmest 10 days temperature). There was no discernable difference in the coldest 10 days temperature.

Other Factors Affecting Pikas in California

Population Size and Isolation

Small, isolated populations are at increased risk of extinction due to demographic stochasticity (unpredictable changes in sex and age ratios, distribution of individuals and geographic structure of a population (Mace and Lande 1991)) and genetic stochasticity (random changes in gene frequencies and fitness which are amplified in small populations) (Pimm et al. 1988). Because it inhabits a naturally patchy habitat type (talus) and has relatively poor dispersal ability, the American pika tends to occur as relatively small subpopulations with limited exchange between the subpopulations. Climate change could exacerbate the risks associated with small populations and isolation by decreasing habitat patch sizes and increasing the distance between patches as pika populations contract upslope.

In their study of the population genetic structure of the American pika throughout its range in North America, Galbreath et al. (2010) found the distribution of genetic diversity in *O. princeps* is highly structured across its range at both regional and local scales. The researchers found that populations that comprise the *schisticeps* subspecies are strongly isolated from other subspecies to the north and east, although evidence exists for past gene flow between the subspecies. Population genetic structure among Sierra Nevada pika populations indicates genetic exchange is ongoing or has occurred there relatively recently. There is relatively strong isolation between the Sierra Nevada pika populations and populations in the northeastern-most extent of the *schisticeps* subspecies range in central Utah, suggesting a degree of isolation even within the subspecies. This result is not surprising, given the basin-and-range topography of the Great Basin, in which pikas are found in suitable habitat in relatively small mountain ranges surrounded by expanses of unsuitable habitat.

Grazing

Beever et al. (2003) and (2011) found evidence that livestock grazing near talus negatively impacts pika persistence in the Great Basin sites they studied. Millar (2011a) described her finding that pika haypiles in talus with adjacent livestock grazing were located farther upslope than sites where grazing did not occur. These grazing site haypiles were comprised of lower nutritional quality vegetation than in patches without grazing.

Although fairly preliminary, available information indicates that livestock grazing adjacent to talus may have a negative impact on pikas occupying a site. Such impacts may occur through either reduced nutritional value of available vegetation or less-favorable microclimates.

Mining

Nichols (2011a, 2011b) suggested in his unpublished report and related CPC meeting presentation that gold mining in the Bodie Hills poses a threat to pikas that may persist in unsurveyed areas. Nichols reports that exploratory drilling at the abandoned Paramount Mine was conducted in 2009. An Environmental Assessment, dated May 1, 2009, briefly mentioned pikas but did not analyze potential impacts or propose mitigation measures. Additional proposals to open the Bodie Hills to gold mining are "ongoing." Nichols (2011a, 2011b) indicated that, although it is unknown whether the Paramount Mine ore-dumps are occupied by pikas, mining activity could directly impacts pikas (if they are there) or indirectly impact pikas (if nearby sites are disturbed through habitat alteration, including increased human activity). The potential for future occupation by pikas of the impacted sites could also be reduced.

Disease

Plague was among the several factors implicated by Wei-Dong and Smith (2005) in the population decline in the Ili pika (*Ochotona iliensis*) of northwestern China. Plague has been reported in an individual pika found at Lava Beds National Monument in 1989 (Bonkrude 2009, pers. comm. in USDI 2010).

Predation and Competition

Natural and introduced predators may affect pika populations. Wei-Dong and Smith (2005) attributed some of the population decline in the Ili pika (*Ochotona iliensis*) of northwestern China to predation by domestic dogs associated with livestock grazing.

Long-tailed weasels (*Mutsela frenata*) are among the most efficient and ubiquitous native predators on the American pika. It has been suggested that weasels may switch from preying predominantly on meadow voles (*Microtus* sp.) during episodic population crashes of that species to preying

predominantly on pikas (C. Millar, pers. comm., July 31, 2011). It has been suggested that weasels may be partly to blame for the loss of pikas from the middle and southern ore-dump patches at Bodie SHP (Millar 2011a, Smith 2011a).

Rattlesnakes (*Crotalus* sp.) may be a newly-occurring native predator at some low-elevation sites, such as Bodie State Historic Park (Nichols, pers. comm., August 5, 2011).

Species with similar resource needs compete with pika for food and cover. Two rodents, the bushy-tailed woodrat (*Neotoma cinerea*) and California ground squirrel (*Otospermophilus beecheyi*) are of particular interest in this regard. Woodrats have long been recognized as a species that co-occurs with American pikas in their talus habitat. Numerous anecdotes of woodrats taking over pika haypiles as nests have been related to Department staff by pika researchers. California ground squirrels appear to be expanding their elevational range (Moritz et al. 2008, Morelli 2011) and now may be found co-occurring with pikas at some sites in California (Nichols, pers. comm., August 5, 2011).

Other Potential Threats

The U.S. Fish and Wildlife Service identified the following potential threats to American pika: climate change, livestock grazing, native plant succession, invasive plant species, fire suppression, disease, predation, roads, off-highway and off-road vehicles, trails, and recreational shooting (USDI 2010). The Service concluded none of the identified potential threats pose a significant threat to the species or any of the identified subspecies now or in the foreseeable future.

In summary, and based on best available information, the Department agrees with the Petitioner that climate change and other factors, such as mining, grazing, predation, competition, and disease, are potential threats to the American pika in California.

DEGREE AND IMMEDIACY OF THREAT

The original petition and the Department's evaluation focused on increased ambient temperature as the primary potential threat to the American pika. The Department disagreed with the petition's assertion that "pika scientists have attributed pika population extirpations in the past century to rising temperatures due to global warming, and therefore, continuing warming poses a significant threat to the American pika." The Department cited Beever et al. (2003), who listed other potential threats to Great Basin pika populations, as well as climate change studies from the 1980s and 1990s that suggested that biological resources in general, and high-elevation species in particular, as vulnerable to climate change effects.

Degree and Immediacy of Threat from Climate Change

The observed effects of climate change on pika up to the present has been described under "Factors Affecting the Ability of the Population to Survive and Reproduce" section above. Following is a discussion of the projected future change in climate and the projected effect of that change on pika habitat and populations.

Climate Change Projections

Global climate models project warming over all land areas of the globe, including North America, though 2100. These models project larger summertime warming over the western U.S. than elsewhere North America, +5° F / +2.75° C (3° -7° F / 1.65° -3.85° C) and winters by about +3° F / +1.65° C (2° -5° F / 1.1° -2.75° C) (Ray et al. 2010).

The 2050 summer (June, July, August) temperature projections average about 3° C (5.4° F) higher than the recent climatology for most of the western U.S., and for the 22 specific locations analyzed as representative of pika habitats. Due to the impacts of temperature, projections show a large decline in lower-elevation snowpack (below 8,200 ft/2,500 m) by the mid-21st century, with more modest declines at elevations above 8,200 ft where some pika populations live (Ray et al. 2010). Snow pack in the Sierra Nevada is expected to decrease 12% to 46% by the 2035-2064 time period according to a low-end warming scenario, or 26% to 40% according to a high-end warming scenario for California; by the 2070-2099 time period, snow pack could have decreased by as much as 90% according to a high-end warming scenario (Cayan et al. 2006). Additionally, Rauscher et al. (2008) used a high-resolution climate model to predict (under the A2 emissions scenario) early-season snowmelt runoff as much as two months earlier than present by 2100.

Pika Habitat and Distribution Projections

Several recent studies have modeled the expected impact of projected changes in climate on the amount and distribution of suitable pika habitat. These studies utilize the concept of a "climate envelope", the geographic area with a climate suitable for pika survival. The "envelope" is generally expected to move up in elevation and north in latitude in the future with a warming climate. These models generally assume that pika populations will be able to move with the moving climate envelopes over time within a mountain range; however, in some cases pika may not be able to follow the envelope due to gaps in suitable structural habitat and additional extinctions would occur. Another consideration when examining these models is that they do not account for the pika's observed ability to persist in suitable microclimates within otherwise unsuitable areas.

Finally, when evaluating projected pika habitat distribution models one should be cognizant of the interrelated effects of climate-driven reductions in available habitat and the effects inherent to small and isolated populations (see above discussion of Population Size and Isolation). A warming climate can be expected to exacerbate these effects by creating smaller mountaintop patches of habitat and greater expanses of unsuitable habitat between patches (i.e. more isolation). Below are key findings from recent studies.

Loarie et al. (unpublished report 2009) examined 429 known pika sites and estimated a greater than 50% chance that climate change will extirpate pika from 15-59% (depending on the climate change model scenario used) of those sites by the year 2099. They predicted the majority of the extirpations would occur west of the Rocky Mountains. In the Sierra Nevada, 72% of examined pika sites were given a less than 50% chance of persisting through 2099.

Trook (2009) examined climate change projections through 2090 and reported 81-98% decreases in predicted extent of suitable pika habitat depending on the climate projection model used. Additionally, Trook found that the average habitat patch size for *Ochotona princeps schisticeps* (the California subspecies) is only expected to shrink by 0-17% due to the contiguous nature of the Sierra Nevada. He concluded that even under the greatest warming projection model examined, habitat "possibly large enough" to maintain a pika population will persist in the Sierra Nevada out to year 2090.

Calkins (2010) examined the current extent of suitable habitat for 19 of the traditional 31 subspecies of American pika and then predicted the extent of suitable habitat for each subspecies under incrementally warmer climates. Below are results for the five traditional subspecies occurring in California. Although the five subspecies in California have been subsumed into one subspecies in the current taxonomy, the breakdown by the old subspecies designations provides a geographical context for the predicted changes.

- *O.p. albata* (southern Sierra Nevada):

    - presently 2,588 km² of habitat
    - 2° C warmer climate: 2,023 km² of projected habitat, 22% reduction
    - 4° C warmer climate: 1,387 km² of projected habitat, 46% reduction
    - 6° C warmer climate: 807 km² of projected habitat, 69% reduction.
- *O.p. muiri* (Yosemite region):
    - presently 8,525 km² of habitat
    - 2° C warmer climate: 6,412 km² of projected habitat, 29% reduction
    - 4° C warmer climate: 4,018 km² of projected habitat, 53% reduction
    - 6° C warmer climate: 2,046 km² of projected habitat, 76% reduction.
- *O.p. schisticeps* (traditional subspecies in the northern Sierra Nevada and northwestern Nevada):
    - presently 770 km² of habitat
    - 2° C warmer climate: 176 km² of projected habitat, 77% reduction
    - 4° C warmer climate: 8 km² of projected habitat, 99% reduction
    - 6° C warmer climate: 0 km² of projected habitat, 100% reduction.
- *O.p. sheltoni* (White Mountains):
    - presently 483 km² of habitat
    - 2° C warmer climate: 385 km² of projected habitat, 20% reduction
    - 4° C warmer climate: 273 km² of projected habitat, 44% reduction
    - 6° C warmer climate: 166 km² of projected habitat, 66% reduction.
- *O.p. taylori* (Warner Mountains, Mount Shasta, and southeastern Oregon):
    - presently 732 km² of habitat
    - 2° C warmer climate: 267 km² of projected habitat, 63% reduction
    - 4° C warmer climate: 102 km² of projected habitat, 86% reduction
    - 6° C warmer climate: 33 km² of projected habitat, 95% reduction.

Calkins noted that his model corroborates the USFWS finding (USDI 2010) that none of the five currently recognized subspecies of American pika will lose more than 95% of suitable habitat under predicted climate warming scenarios.

Galbreath et al. (2009) examined pika genetics and determined that there is evidence that the major pika lineages have persisted through climatic oscillations in the past which offers optimism that barring complete extirpation of a major genetic lineage, the species-wide pool of genetic diversity should not be greatly diminished by ongoing climate change. However, their projection of the distribution of the American pika under simulated future climatic conditions suggests that the Sierra Nevada lineage may be at risk of extinction if anthropogenic climate change continues unabated. They found that their Ecological Niche Model predicted nearly all patches of suitable habitat in the southwestern part of the Intermountain West will be lost if atmospheric CO_2 levels double.

The USFWS, after considering the above models (with the exception of Calkins 2010, which was not completed until after their review) concluded that increased summer temperatures as a result of climate change may have the potential to adversely affect some lower and mid-elevation pika populations of *Ochotona princeps schisticeps* in the foreseeable future (such as the Warner Mountains population in northeastern California); however adverse affects are not expected to occur to a significant portion of the suitable habitat of any of the five current subspecies. (USDI 2010).

Climate Change Impacts to Pikas in California May Not be Severe

Several recent studies suggest that American pikas may be able to persist in a wider range of habitat types and quality, and be more resilient to climate change impacts than generally thought. Much of this work was conducted outside California, but may have relevance to the situation in California.

MIllar and Westfall (2010a) surveyed for pikas from 2007 to early 2009 at 329 sites in the Sierra Nevada (SN), 67 sites in six mountain ranges in the southwestern Great Basin (swGB), 16 sites in three central Great Basin ranges, and eight sites from the central Oregon Cascades. Overall, 67% of the sites were occupied by pikas, 27% had recent indirect sign of occupancy, and 6% had old sign of occupancy. The proportion of "old" sites increases from the SN (2%) eastward into GB (17% in swGB, 50% in cGB). Old sites were distributed throughout the elevation range studied, with no indication of greater occurrence at lower elevations. The authors noted the occurrence of pikas at elevations lower than previously considered the limit for the species.

Rodhouse et al. (2010) observed that in some situations (Craters of the Moon, Idaho, Lava Beds National Monument, California) substrate features could enable pikas to persist outside their typical bioclimatic envelope and might reduce the effects of accelerated climate change. However, even at Craters of the Moon, elevation was associated with patterns of pika distribution, although the authors noted elevation also presumably influences vegetation cover. The authors cautioned that declines in pika site occupancy may lag behind declines in habitat quality. Some low elevation peripheral habitats with persistent pika populations could become particularly important refugia for the species, as well as sources of genetic and phenotypic diversity.

Beever et al. (2008) found persistence of pikas at a site in Nevada 407 m lower than the minimum elevation latitude-specific elevation modeling would have predicted. The authors suggested this result challenges some of the predictions of earlier climate envelope modeling. These authors also observed pikas haying *Bromus tectorum* (cheat grass) at this grazed site in Nevada. This is one of the few places cheat grass and pika are currently known to co-occur.

Two recent publications document pikas using atypical habitat in Oregon. Although outside of California, these studies suggest pikas have more habitat breadth than generally thought. Manning and Hagar (2011) detected pikas at 42 sites in anthropogenic substrate (rock quarries, road cuts, and rip rap) in western Oregon. The sites are at low elevations between 610 and 1701 m. Pikas were observed colonizing a human-made field of rip rap within 21 months of its creation. The authors also found pikas in natural talus as low as 538 m in western Oregon. Pikas were found as much as 60 km from the nearest alpine habitat.

Simpson (2009) described four low-elevation sites occupied by pika in the Columbia River Gorge between 108 and 255 m (354 and 837 feet)elevation. These sites are more than 1100 m below the low-elevation predicted Approximate Thermal Limit (ATL, Hafner 1993) for the latitude and longitude of each site. Summer temperatures at these sites are relatively mild (well below ATL), although many days have temperatures above 25.5° C, which is the often-cited lethal temperature limit for confined pikas. The sites had little snow, no snow pack, and many fewer days below 0° C (32° F) than the ATL. The author suggested that that snowpack may not be necessary for pika at all sites, such as non-alpine sites where temperature infrequently falls below 0° C. Such sites may not be negatively affected by climate change-driven reduction in snow cover. Interestingly, the author observed nearly no haying activity by pikas at his study sites, and hypothesized that hay storage may not be necessary due to the area's mild winters.

Surveys at historical and previously-unsurveyed sites on Mount Shasta showed high site occupancy. Between 2001 and 2010, Ken Goehring (http://www.bluetang.org/shastapika/index.html) surveyed all suitable talus patches on Mt. Shasta between between 2,286 and 2,896 m (7,500 and 9,500 feet)

elevation. Pikas were detected at 28 sites, including 6 of 7 locations where pika were reported by C. Hart Merriam in 1899 in Results of a Biological Survey of Mount Shasta, California (USDA Division of Biology). Elevations of the 28 sites range from 2,241 to 2,918 m (7,354 to 9,575 feet).

Millar (2011), in her comment letter on the amended petition, stated the information she provided to the Department provides evidence of the ongoing capacity of pika to occupy and use a diverse range of environments, elevations, and climatic conditions in eastern California, as well as the potential for talus habitats to serve as climatic refugia under future warming conditions. Millar summarized the information from her research (Millar and Westfall 2008; Millar and Westfall 2010a, b, 2011; Millar et al 2010; and Millar et al. 2011) as follows:

- Talus features with unique thermal regimes and micro-climatic processes provide cool conditions for pikas in summer and are more resistant to climate warming (ie, decoupled from regional surface air temperatures).
- For locations with topographic features (such as rock-ice features) that provide cooler than average temperatures relative to adjacent habitats, climate envelope models used for the region are inaccurate. This suggests that pika using buffered refugia in the future may be more resistant to regional temperature increases than pikas using sites without thermal refugia within the region.
- Occupied sites had recorded surface air temperatures well above the known thermal tolerance for pika survival.

The finalized IUCN Red List account for the American pika prepared by Beever and Smith (in press, pers. comm., August 15, 2011) notes the persistence of American pikas in climatically marginal sites (Craters of the Moon, Lava Beds, Columbia River Gorge, etc.) appears to reflect a strong decoupling of microclimates used by pikas (which are notably temperature sensitive), from the macroclimate of the region. In contrast to recent findings of pikas at atypical low-elevation areas, other studies have documented extirpations of pikas on a number of historically occupied low-elevation sites throughout the Great Basin. The authors categorized American pika as a Least Concern species under the IUCN Red List based on:

- The relatively large area of occupied habitat.
- The only adequately documented declines are largely restricted to the Great Basin, and some areas of the Great Basin are not declining (higher elevations, some mountain ranges).
- The documented decline only represents a small fraction of species' total population.
- Even within the Great Basin, a population decline of 80-90% (required for higher IUCN ranks) has not been documented.
- The estimated total population size for the American pika is consistent with a low ranking (i.e., Least Concern) in the IUCN system.

Although much of the concern about climate change impacts to the American pika is focused on the direct effects of increased temperature on pikas, the Department considers other factors as well. For example, climate envelope models do not account for the pika's ability to behaviorally adapt to warmer climates using crepuscular (dawn and dusk) or nocturnal foraging, retreating to cool interstitial spaces in talus during hot periods. However, climate change likely has and will continue to act synergistically with other threat factors, such as small and isolated population size, predator and competitor community changes, and changes in invasive plant species composition.

The Department recognizes the threat that ongoing and future climate change poses to many wildlife species in California, including the American pika. Some of the losses of pikas from historical sites in California may be due to direct or indirect effects of warmer summer temperatures or more extreme cold temperatures during winter due to loss of snowpack. Some of the losses that have occurred may also simply represent fluctuations in site occupancy by a species that occurs in patchily-distributed habitat, where local extinctions alternate with recolonizations. But the loss of pikas from some low-elevation sites found by Nichols (2011b) in the Bodie Hills, Massing (2011) in the Lassen area, and Stewart and Wright (2011) in the central Sierra Nevada, is suggestive that increasing temperatures at the lower elevational range of the pika may already have had an impact on the species. The best available information indicates the losses of pikas from sites in California to be not substantial, given the pika's current persistence throughout most of its historical range. However, the expected temperature increase over the next 100 years suggests pika habitat suitability will substantially decrease in California in the future. The threat from future climate change impacts can be considered immediate because current greenhouse gas levels are sufficient to cause continued warming, even if greenhouse gas emissions were curtailed now.

Degree and Immediacy of Threat from Other Factors Affecting Pikas in California

Grazing

The Petitioner (Wolf 2011) provided a list of federal grazing allotments in California and suggested that significant overlap of these allotments occurs with the pika's geographic range. According to Wolf (2011), there are "at least 118 U.S Forest Service (USFS) allotments allowing cattle, sheep, and/or horse grazing and 49 Bureau of Land Management (BLM) allotments may overlap with occupied pika habitat (Figure 7)." It appears that 82 of the USFS allotments are indicated as "Active" while the others are either indicated as "Vacant" or no status is given. No area is provided for these allotments. Area is provided for the BLM allotments, but status is not indicated.

While the Department recognizes the potential for adverse impacts from livestock grazing on nearby pika populations, it does not have sufficient Information to assess the degree or immediacy of threat from grazing. Although pikas occurred or recently occurred at the grazed sites studied by Millar, this does not necessarily mean that pikas will persist at these sites.

Mining

The report by Nichols (2011b) suggesting potential direct and indirect impacts of mining on American pikas in the Bodie Hills is plausible. However, the degree of impact from mining is unknown. It is not know whether pikas occur or occurred at the Paramount mine described by Nichols, nor does the Department currently have information on any other on-going or proposed mining activity in or near pika-occupied sites. The predominance of federal ownership within the pika's geographic range suggests that most new mining projects would be required to address potential impacts to pikas in documents prepared under the National Environmental Policy Act (NEPA). However, it is unclear to what extent potential impacts to a non-listed species like the pika would be assessed, disclosed, or mitigated. According to Nichols (2011b), the pika received only cursory treatment in the Environmental Assessment for the Paramount mine project. Moreover, on-going or renewed mining activity on federal, state, or private lands may not undergo a thorough environmental review.

Disease

The importance of disease, including plague, as a potential threat to pika population persistence is unknown. Wei-Dong and Smith (2005) found plague to be one of several factors likely causing the population decline of the Ili pika (*Ochotona iliensis*), and plague has been reported in one pika at Lava

Beds National Monument. A potential interaction between climate change and disease is the endemic occurrence of plague in California ground squirrels (*Otospermophilus beecheyi*). California ground squirrels are documented as expanding their range to higher elevations, and are now occurring at some pika sites. It is possible that increased exposure of pikas to this plague host may increase the impacts of the disease in the future. The Department is currently co-sponsoring a baseline health assessment of pikas in California to determine disease exposure and prevalence of disease-carrying parasites in natural populations (Clifford and Foley 2011).

Predation and Competition

It is unknown to what degree predation by native or introduced predators are affecting pika populations, or if recent and future circumstances will result in different predation risks to pikas. The potential for climate-induced changes, such as been suggested for the possibly new occurrence of rattlesnakes at Bodie (Nichols, pers. comm., August 5, 2011), does exist, however.

It is uncertain to what degree competition from other species using the same resources as pikas may be affecting the ability of pika populations to persist. It is possible that climate change may affect the interactions between the pika and competing species like the bushy-tailed woodrat and California ground squirrel, however the magnitude of such possible effects is unknown.

Population Size and Isolation

The degree and immediacy of threat of the pika's population distribution across the landscape is uncertain. However, in general pikas are more likely to be extirpated from small, isolated patches of suitable habitat than from larger patches that occur closer together. Size of talus patches has been implicated as a factor affecting persistence of pikas (Beever et al. 2003, Stewart and Wright 2011). As temperatures increase, it is likely that pika subpopulations will become more isolated as conditions between patches are less suitable for dispersal.

In summary, the Department recognizes that climate change models indicate an effect on pika habitat predicted to result in severe impacts in habitat suitability for the American pika over the next 100 years . Other factors, such as grazing, mining, predation, competition, disease, small population size (as well as the interactions between these factors), may also impact the pika in California; however, the magnitude of these potential effects is unknown.

IMPACT OF EXISTING MANAGEMENT EFFORTS

The Department's evaluation of the original petition found it did not provide any specific information to support its contention that management "has been inadequate to prevent the decline of the American pika in California."

The California Pika Consortium (CPC) was formed by pika researchers, wildlife and land management agency representatives, and non-government organization members in the fall of 2009 to facilitate communication on issues related to the American pika and other high-elevation small mammals in California. The group has met twice a year since its first meeting in 2009 to share information, prioritize research topics, discuss standardized field techniques, and most recently to visit natural and human-made pika sites in the eastern Sierra Nevada and western Great Basin. The CPC served as the model for the formation of the North American Pika Consortium (NAPC), which pursues similar goals throughout the geographic range of pikas in North America; CPC members are actively engaged with NAPC activities. These two organizations provide a forum for discussions of American pika biology, conservation, and

adaptation planning. The Department will continue to rely on the CPC for information related to the American pika.

In a comment letter submitted in 2011 (Wolf 2011a), the Petitioner reiterated and added to the argument that existing management actions are insufficient to ensure the long-term conservation of American pikas in California. Specifically, for climate change impacts, the Petitioner stated that California, U.S., and international climate initiatives are insufficient to ensure the reduction in CO_2 levels needed to slow, stop, or prevent the predicted effects on climate. For grazing impacts, the Petitioner suggested that grazing allotments on public lands do not appear to consider the potential for impacts to the American pika. And for mining impacts, the Petitioner noted that recent exploratory mining activity in the Bodie Hills was permitted without consideration of potential impacts to the pika.

The Department, along with other state and federal agencies, is addressing the impacts of climate change through a combination of initiatives aimed at curtailing greenhouse gas emissions of its own activities, proposed projects and regulations reviewed under the California Environmental Quality Act and National Environmental Policy Act, and adaptation planning for California's wildlife, fish, and plant species. Potential impacts to the American pika of proposed grazing and mining activities should be addressed during the environmental review process for such activities. Listing of the American pika under the California Endangered Species Act (CESA) would provide more weight to such impact analysis, and ensure that impacts to pika from projects subject to CESA are minimized and fully mitigated. However, significant effects on non-listed species may also be identified and mitigated for during the review process for proposed projects.

The Department agrees with the Petitioner that global, national, and state climate change initiatives to date have not moved atmospheric greenhouse gas levels off the trajectories predicted to result in severe impacts in habitat suitability for the American pika over the next 100 years. The Department, along with other state and federal agency partners, is actively engaged in adapation planning for climate change-affected species, as well as working to reduce greenhouse gas emissions from proposed projects and its own activities.

SUGGESTIONS FOR FUTURE MANAGEMENT

The original petition listed several recommendations related to assessing, monitoring, and limiting greenhouse gas emissions from proposed projects and regulatory changes; assessing, monitoring, and limiting greenhouse gas emissions from Department activities; conducting adaptation planning for California's wildlife; and public education and outreach about the importance of climate change impacts to wildlife and encouraging reductions in greenhouse gas emissions. The petition also recommended monitoring pika populations and their habitat. The Department concluded that monitoring of pika populations and their habitat is an activity within its purview and that it might be initiated if the pika's conservation status made such monitoring a high priority. Recommendations related to controlling greenhouse gases in general were determined to be outside the regulatory purview of the Department. The recommendations related to assessing the greenhouse gas emissions associated with proposed projects and activities were determined to not be significantly related to the conservation of pikas in California, but instead recommendations that could be considered by the Department as part of its general approach to the issue of climate change . Adaptation planning for climate change impacts on California's wildlife is an on-going task of the Department.

With the publication of the 2009 California Climate Change Adaptation Strategy, the state of California was one of the first state agencies to develop a comprehensive approach to addressing the impacts of climate change (California Natural Resources Agency 2009). The Department was the co-lead agency for

the Biodiversity and Habitat chapter of this report, and has been a strong proponent of addressing climate change impacts as they relate to biodiversity. The Department, along with its diverse group of stakeholders are actively working to address climate change adaptation actions for fish, wildlife, and habitats in the state. Integrating climate change considerations into Department functions, management activities, and conservation planning efforts such as the state Wildlife Action Plan, are serious undertakings by the Department that have placed it on the path towards successfully addressing climate change and the many challenges it presents.

In light of the potential climate change impacts to mountain ecosystems, and other ecosystems throughout California, the Department is working diligently with its partners and stakeholders to address the adverse effects of climate change on the natural biodiversity of California. Ecological changes, including changes in species' distributions, timing of life cycles, and abundance, have already occurred in California over the past century in concert with increases in average temperature and changes in precipitation patterns (California Natural Resources Agency 2009), and the Department expects there will be many more ecological changes to come. The Department recognizes that climate change is a major challenge to the conservation of California's natural resources and is taking steps to meet the challenge head on.

The Department is currently using a set of objective criteria to update its list of Mammal Species of Special Concern (MSSC). Among the goals of the MSSC project is to identify species at risk of becoming threatened or endangered in the future if conservation actions are not taken. The current MSSC project explicitly incorporates climate change threat as one of the criteria used to evaluate species for possible inclusion on the updated MSSC list. If the American pika is designated as an MSSC, then it will be among those species prioritized for additional research and monitoring if funding is available.

The amended petition specifically recommends a reduction in greenhouse gas emissions to levels that do not endanger the pika, mitigation of grazing and mining impacts on pika, and for the Department to implement a state-wide program to monitor trends in pika population status (site occupancy, density, and demography). As mentioned above, the Department is addressing greenhouse gas emissions associated with proposed projects and regulations, and participates in the review of other impacts through its environmental review programs. Development of monitoring programs for pika or other high-priority wildlife species will be determined, in part, by the conservation status of these species identified through the MSSC process and other evaluations.

In summary, the Department agrees with the Petitioner that significant impacts to the American pika in California associated with greenhouse gas emissions, grazing, and mining should be assessed and disclosed as part of the both the environmental review process for proposed projects and regulations, as well as the larger effort to plan for and minimize the impacts associated with predicted climate change. Depending on the results of current efforts to update the Mammal Species of Special Concern list, state-wide monitoring of the American pika may become a higher-priority task for the Department.

HABITAT NECESSARY FOR SURVIVAL

The Department found the original petition's description of the American pika's habitat to be accurate. Since the original petition, additional information developed by Millar and Westfall (2010a) suggests that rock-ice landforms provide important thermal refugia for American pikas, especially where surface temperatures are unfavorable. These features create subsurface microclimates that are significantly cooler than daytime surface temperatures in the summer and, in some locations, conditions that are wamer than surface conditions in the winter.

Manning and Hagar (2011) noted that, similar to the human-made habitat for pikas found in the ore-dumps at Bodie, the creation of rock quarries, road cuts, and rip rap may also create pika habitat. This study, which was conducted in Oregon, adds to the list of non-classic talus habitats used by American pikas. Each of these types of non-talus habitats, including lava tubes and flows (as at Lava Beds National Monument), ore-dumps, and the Oregon quarries, road cuts and rip-rap, suggest that American pikas may exhibit a wider habitat suitability than is generally thought.

In summary, the Department finds that additional new information since 2007 indicates that American pikas may inhabit a wider range of substrate types and elevations than previously documented. The association of pikas with rock-ice features may allow them to persist in warmer environments than previously thought.

DISTRIBUTION MAP

The Department determined the original petition's map of pika distribution in California to consist of a number of museum specimen collection localities, which appeared to be accurately plotted. The Department's updated map of pika localities and geographic range is attached.

AVAILABILITY AND SOURCES OF INFORMATION

The original petition included a list of cited literature. Electronic copies of most of these references were provided by the petitioner. Additional information has been provided by the Petitioner and pika researchers. A comprehensive list of scientific literature and other documents reviewed for this amended petition is attached.

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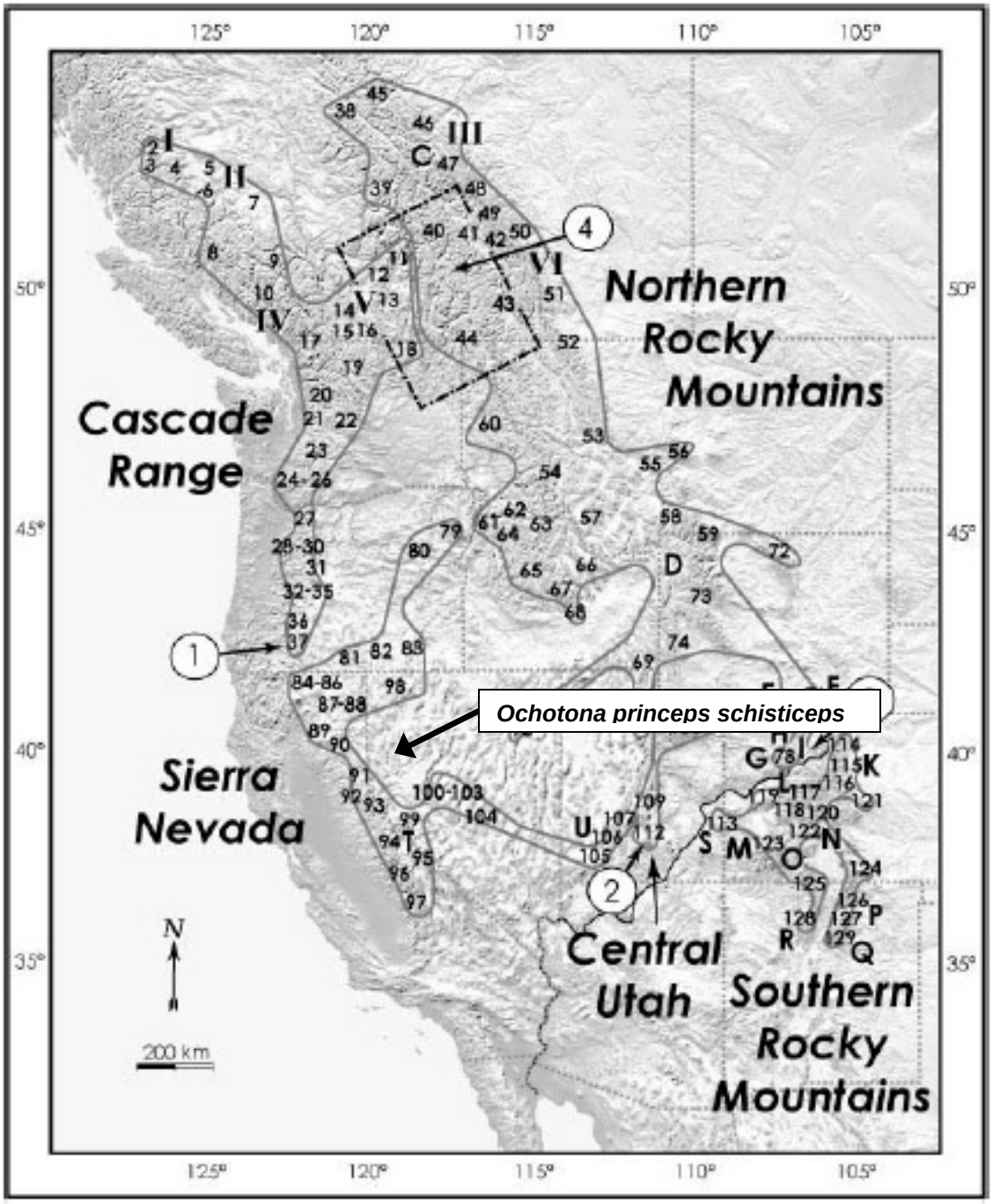
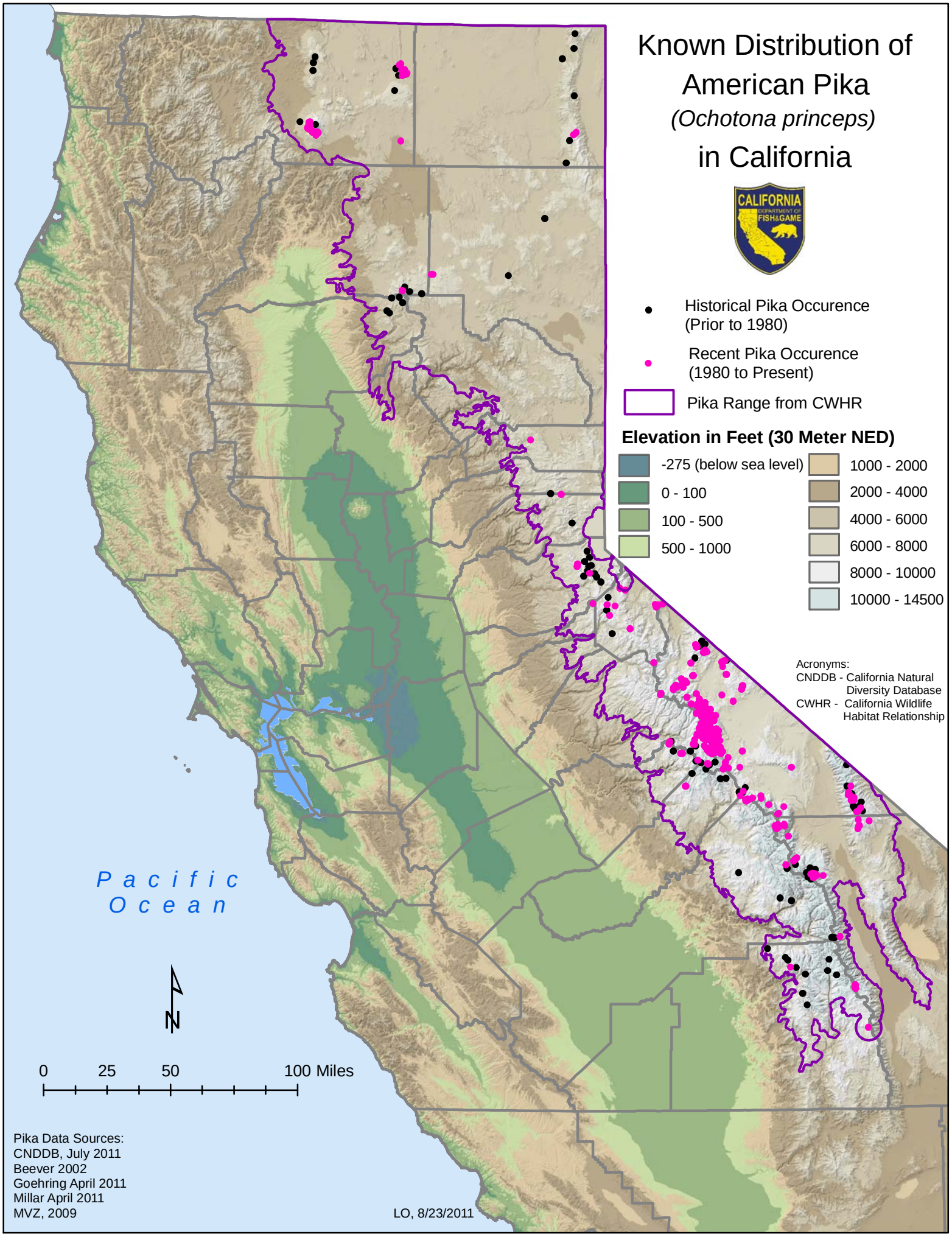


Figure 1 from Hafner and Smith (2010) depicting the sample locations used to determine the phylogenetic relationships of the five lineages that comprise the currently-recognized subspecies of the American pika. The geographic ranges of the subspecies are approximated by the polygons surrounding the sample locations. The subspecies of pika that occurs in California (*Ochotona princeps schisticeps*, indicated by the arrow) ranges from the Sierra Nevada north into the Cascades and east into the Great Basin ranges.


Known Distribution of
American Pika
(Ochotona princeps)
in California
CALIFORNIA
DEPARTMENT OF
FISH&GAME
Historical Pika Occurence
(Prior to 1980)
Recent Pika Occurence
(1980 to Present)
Pika Range from CWHR
Elevation in Feet (30 Meter NED)
-275 (below sea level)
0 - 100
100 - 500
500 - 1000
1000 - 2000
2000 - 4000
4000 - 6000
6000 - 8000
8000 - 10000
10000 - 14500
Acronyms:
CNDDB - California Natural
Diversity Database
CWHR - California Wildlife
Habitat Relationship
Pacific
Ocean
N
0
25
50
100 Miles
Pika Data Sources:
CNDDB, July 2011
Beever 2002
Goehring April 2011
Millar April 2011
MVZ, 2009
LO, 8/23/2011