28. TOWNSEND'S BIG-EARED BAT PETITION

Today's Item **Information** ☐ **Action** ☒

Consider whether to add Townsend's big-eared bat to the list of threatened or endangered species and, if FGC determines that listing may be warranted, authorize staff to publish notice of its intent to amend Section 670.5, Title 14, CCR.

Summary of Previous/Future Actions

• Received petition	Nov 1, 2012
• FGC transmits petition to DFW	Nov 9, 2012
• Published notice of receipt of petition	Nov 30, 2012
• Approved DFW request for 30-day extension	Dec 12, 2012; San Diego
• Received DFW's evaluation and recommendation	May 22, 2013; Los Angeles
• Accepted petition for candidacy	Jun 26, 2013; Sacramento
• Approved DFW request for six month extension	Dec 3, 2014; Van Nuys
• Receive DFW's status review report	Jun 22-23, 2016; Bakersfield
• **Today take action to determine if listing is warranted**	**Aug 24-25, 2016; Folsom**

Background

A petition to list Townsend's big eared bat was received in Nov 2012 (Exhibit 1). DFW submitted a status review report to FGC at the Jun 2016 meeting (Exhibit 2). The status report represents DFW's final written review of the status of the Townsend's big-eared bat and is based upon the best scientific information available to DFW.

Significant Public Comments

1. Keith A. Hamm, representing Green Diamond Resource Company (Green Diamond), supports DFW's recommendation that listing the Townsend's big-eared bat as a threatened or endangered species is not warranted. Green Diamond believes that its current practices implemented through state timber harvesting plans protect potential roosting habitat, reduce risk of take and prevent significant adverse impacts to the Townsend's big-eared bat.

Recommendation

FGC staff: Staff agrees with DFW findings and supports DFW recommendation to not list the Townsend's big-eared bat as a threatened or endangered species.

DFW: DFW recommends that listing of Townsend's big-eared bat as threatened or endangered is not warranted.

Exhibits

1. Petition
2. DFW's status review report (see: http://www.fgc.ca.gov/CESA/index.aspx#tbeb)

3. Email from Green Diamond, received Aug 11, 2016
4. DFW presentation

Motion/Direction

1a. Moved by _____ and seconded by _____ that the Commission, pursuant to Section 2075.5 of the Fish and Game Code, finds the information contained in the petition to list Townsend's big-eared bat (*Corynorhinus townsendii),* and the other information in the record before the Commission **warrants** listing Townsend's big-eared bat as a threatened or endangered species under the California Endangered Species Act. (Note: Findings will be adopted at a future meeting.)

AND

1b. Moved by _____ and seconded by _____ that the Commission, authorizes publication of its intent to amend Section 670.5, Title 14, CCR, to add Townsend's big-eared bat to the list of animals of California declared to be threatened or endangered.

OR

2. Moved by _____ and seconded by _____ that the Commission, pursuant to Section 2075.5 of the Fish and Game Code, finds that the information contained in the petition and other information before the Commission **does not warrant** listing Townsend's big-eared bat as an endangered or threatened species under the California Endangered Species Act. (Note: Findings will be adopted at a future meeting.)

INSTRUCTIONS TO

PETITIONERS

The Fish and Game Commission (FGC) requires that petitions to list, change the status of, or delist a species of plant or animal must use the official petition form. This form is provided to assist you in preparing a petition that includes specific kinds of information used by the Department of Fish and Game (DFG) and by the FGC in evaluating the proposed action. We understand that all of the questions on this form may not be addressed, and that different issues are important for different species, but we believe that using the form will ensure that you include the basic information necessary to this process. We encourage you to include suggestions for management and recovery activities that would improve the status of the species involved. We have revised the petition form in order to expedite the listing/delisting process.

Certain sections of the California Fish and Game Code pertain to the petition and listing process. The most pertinent information can be found in Sections 2062, 2067, 2072.3, 2074.6, and 2074.8 of the Code, and Section 670.1, Title 14, California Code of Regulations.

We hope that this information, along with the revised petition form, will facilitate the petition writing process and result in a complete document. Additional information on rare, threatened, and endangered species is available from the DFG. For further information, please contact Ms. Helen Biriss, Chief, Habitat Conservation Planning Branch, Department of Fish and Game, 1416 Ninth Street, Sacramento, California 95814, or telephone (916) 653-4875.

Please mail the petition to:

Sonke Mastrup, Executive Director
Fish and Game Commission
1416 Ninth Street, Room 1320
Sacramento, CA 95814

FGC - 670.1 (3/94)

A PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION

For action pursuant to Section 670.1, Title 14, California Code of Regulations (CCR) and Sections 2072 and 2073 of the Fish and Game Code relating to listing and delisting endangered and threatened species of plants and animals.

I. SPECIES BEING PETITIONED:

Common Name: Townsend's Big-eared Bat

Scientific Name: (*Corynorhinus townsendii*)

II. RECOMMENDED ACTION:

(Check appropriate categories)

a. List X b. Change Status ☐

As Endangered X from _____

As Threatened to _____

Or Delist ☐

III. AUTHOR OF PETITION:

Name: Noah Greenwald, Mollie Matteson, Zoë Sheldon, Allison Trowbridge

Address: PO Box 11374, Portland, OR 97211

Phone Number: 503-484-7495

I hereby certify that, to the best of my knowledge, all statements made in this petition are true and complete.

Signature: _____

Date: October 18, 2012

PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION
SUPPORTING INFORMATION FOR

Townsend's Big-eared Bat	**(*Corynorhinus townsendii*)**
Common Name	**Scientific Name**

EXECUTIVE SUMMARY

Provide a brief statement explaining why the petitioned action is being recommended. Include a brief summary of each section of the petition. If a species is being petitioned for listing, state why its survival is threatened by any one or a combination of the following factors (listed in Section 670.1, Title 14, CCR):

(1) present or threatened modification or destruction of its habitat;

(2) overexploitation;

(3) predation;

(4) competition;

(5) disease; or

(6) other natural occurrences or human-related activities.

If a species is being recommended for delisting, indicate why State-listing is no longer warranted, and state why any one or a combination of the aforementioned factors no longer threatens its existence.

1. POPULATION TRENDS

Describe current population trends (with numbers and rate) and relate these to viable population numbers. Explain survey methodology used to arrive at numbers or estimates and what assumptions, if any, were involved.

2. RANGE AND DISTRIBUTION

In the text, indicate the percentage of historic distribution that is in existence and the rate of loss. If appropriate, indicate the number of extant occurrences, populations or portions of populations in California. Indicate whether the rate of loss is accelerating, and estimate when extinction would occur if current trends continue. Discuss the relationship between historic and current acreage and degree of habitat fragmentation. Describe the quality of the existing habitats in terms of ability to maintain viable populations with or without enhancement. For delisting, indicate how current distribution reflects the recovery of the species since its listing.

3. **ABUNDANCE**

Provide available historic and current population estimates/trends, densities, vigor, sex and age structures, and explain population changes relative to human-caused impacts or natural events. Compare current and historic abundance in terms of overall population size or size of occurrences, populations or portions of populations, as appropriate. Describe current population trends (with numbers and rate) and relate these to viable population numbers. Explain survey methodology used to arrive at numbers or estimates and what assumptions, if any, were involved.

4. **LIFE HISTORY (SPECIES DESCRIPTION, BIOLOGY, AND ECOLOGY)**

Include pertinent information that is available on species identification, taxonomy and systematics, seasonal activity or phenology, reproductive biology, mortality/natality, longevity, growth rate, growth form, food habits, habitat relationships and ecological niche or ecological attributes, interactions with other species or special habitat requirements that may increase vulnerability of the species to certain natural or human-caused adverse impacts (e.g., obligate wetland or riparian habitat species, low birthrate, colonial species).

5. **KIND OF HABITAT NECESSARY FOR SURVIVAL**

Describe habitat features that are thought to be important to the species' ability to maintain viable population levels. Any or all of the following features may be included, as appropriate:

> *Plant community; edaphic conditions; climate; light; topography/microtopography; natural disturbance; interactions with other plants or animals; associated species; elevation; migration or movement corridors; wintering habitat; breeding habitat; foraging habitat; other habitat features.*

For aquatic organisms, the following features may be included in addition to the above:

> *Water temperature; water flow patterns; stream gradient; water chemistry (dissolved oxygen, salinity, etc.); water depth; bottom type; cover type and availability; fish assemblage/community; aquatic plant abundance; other habitat features.*

6. **FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE**

Discuss the basis for the threats to the species or subspecies, or to each population, occurrence or portion of range (as appropriate) due to one or more of the following factors:

(1) present or threatened modification or destruction of its habitat;

(2) overexploitation;

(3) predation;

(4) competition;

(5) disease; or

(6) other natural events or human-related activities.

Identify the direct, indirect, and cumulative adverse impacts and discuss how these are contributing to the decline of the species. Indicate whether the species is vulnerable to random catastrophic events.

For delisting, state why any one or a combination of the aforementioned factors no longer threatens the existence of the species.

7. DEGREE AND IMMEDIACY OF THREAT

Indicate the immediacy of the threat and the magnitude of loss or rate of decline that has occurred to the present or is expected to occur without protective measures.

8. IMPACT OF EXISTING MANAGEMENT EFFORTS

Describe any ongoing protective measures or existing management plans for the species or its habitat. Information on species or land management activities that are impacting populations or portions of the range and information on proposed land-use changes should be included. This may be best accomplished by discussing populations or portions of the range. A chart may be useful.

Include available information on any or all of the following:

(1) property ownership/jurisdiction for known populations or portions of the range;

(2) current land use;

(3) protective measures being taken, if any, and effectiveness of current management activities;

(4) current research on the species;

(5) existing management/recovery plans and the extent of their implementation;

(6) proposed land-use changes (include knowledge of forthcoming California Environmental Quality Act documents that may or should address impacts, and lead agencies involved); or

(7) county general plans, federal and State agency plans/actions or other plans/actions that address or should address the species.

9. SUGGESTIONS FOR FUTURE MANAGEMENT

Describe activities that may be necessary to ensure future survival of the species after listing or delisting. Include recommendations for any or all of the following:

(1) activities that would protect existing populations (site maintenance, preserve design establishment, etc.);

(2) monitoring programs and studies;

(3) needed amendments to existing management and land-use plans, including county general plans;

(4) agencies/organizations that should be involved in planning and implementing management and recovery actions;

(5) other activities that would help protect existing habitat or ensure survival of the species;

(6) how other sensitive species (listed and unlisted) may benefit from protection of this species;

(7) how other species/habitats may be impacted by management and recovery activities for this species; or

(8) at what point this species would be considered stable and sustainable.

10. AVAILABILITY AND SOURCES OF INFORMATION

Cite literature, available specimen collection records, and other pertinent reference materials. Attach documents critical to the recommended action. Be sure to include recent status surveys. List names, addresses, and telephone numbers of persons providing unpublished information and list those supporting the recommended action.

11. **DETAILED DISTRIBUTION MAP**

Delineate on appropriate maps the historic and present distribution (estimated if not known). Include one map of California showing general distribution, and U.S. Geological Survey topographical maps (or equivalent) of appropriate scale, for more detailed distribution information, including locations of occurrences, populations or portions of populations, as appropriate. Include historic and current distribution as documented by literature, museum records, Natural Diversity Data Base and other Department of Fish and Game records, and testimony of knowledgeable individuals. All maps must be suitable for black and white reproduction and fully labeled, including borders, base map name, map scale and species name, and should not exceed 11" x 14" in size.

BEFORE THE CALIFORNIA FISH AND GAME COMMISSION

A PETITION TO LIST THE TOWNSEND'S BIG-EARED BAT, *CORYNORHINUS TOWNSENDII* AS THREATENED OR ENDANGERED UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

Photo by J. Scott Altenbach (used with permission)

October 18, 2012

CENTER FOR BIOLOGICAL DIVERSITY

PETITIONER

NOTICE OF PETITION

For action pursuant to Section 670.1, Title 14, California Code of Regulations (CCR) and Sections 2072 and 2073 of the Fish and Game Code relating to listing and delisting endangered and threatened species of plants and animals.

I. SPECIES BEING PETITIONED:

Common name: Townsend's big-eared bat
Scientific name: *Corynorhinus townsendii*

II. RECOMMENDED ACTION: List as threatened or endangered

The Center for Biological Diversity submits this petition to list the Townsend's big-eared bat as endangered throughout its range in California pursuant to the California Endangered Species Act (California Fish and Game Code §§ 2050 et seq., "CESA"). This petition demonstrates that the Townsend's big-eared bat clearly warrants listing under CESA based on the factors specified in the statute.

III. PETITIONERS

Primary author: Noah Greenwald, Endangered Species Program Director, Center for Biological Diversity; Mollie Matteson, Bat Advocate, Center for Biological Diversity; Zoë Sheldon, B.A. Conservation Biology, Middlebury College; and Allison Trowbridge.
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The Center for Biological Diversity is a nonprofit conservation organization with more than 300,000 members and online activists dedicated to the protection of endangered species and wild places. http://www.biologicaldiversity.org

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BEFORE THE CALIFORNIA FISH AND GAME COMMISSION

IV. EXECUTIVE SUMMARY

Townsend's big-eared bat (*Corynorhinus townsendii* ssp.) is in widespread decline throughout the western United States. In California, populations are widespread but sparsely distributed and surveys show serious declines in the number of colonies, colony size, and availability of suitable roosting habitat primarily related to habitat destruction and disturbance.

In 2011, the California Department of Fish and Game conducted a status review of the Townsend's big-eared bat and found that of the 25 bat species in California, the Townsend's big-eared bat was of greatest conservation concern based on several ranking methods and was at highest risk in every province in the state that it is found in any numbers (Pierson et al. 2011). According to the status review, the bat is severely threatened by a combination of disturbance of cave and mine sites, loss of mine and cave habitat to mining, logging and urban development, white-nose syndrome and other factors (Pierson et al. 2011).

The most recent rangewide survey of Townsend's big-eared bats was conducted by Pierson and Rainey (1998), who conducted a four-year comprehensive survey of all historically reported maternity colonies comprised of >30 bats and several hibernacula in California and reported substantial declines in all metrics utilized. They documented a 52% decline in the number of maternity colonies statewide, a 32% decline in the average size of maternity colonies, a 55% decline in the total population size, and a 44% decline in the number of available roosts, all within the past 40 years. The female population showed a decline from 3,004 to 1,365 individuals. The greatest declines have been in coastal, central Sierra, and Colorado River populations. Pierson and Rainey (1998) concluded that many roosts have a history of disturbance, and none are likely to survive long-term without active maintenance and/or protection.

The Townsend's big-eared bat has disappeared from a significant proportion of historical roost sites and hibernacula (Pierson & Rainey 1998). It is highly sensitive to human disturbance. Humans simply entering a maternity roost can cause a colony to abandon the young or move to another roost. Disturbance at maternity roosts and hibernacula and the loss of these unique habitats to mine closures, renewed mining, timber harvest, or cave commercialization are the principle threats to the Townsend's big-eared bat in California, though other natural and anthropogenic factors clearly play a role in the species' widespread and ongoing decline.
The perilous conservation status of the Townsend's big-eared bat has been recognized by several state and federal agencies, most notably California Department of Fish and Game itself, but it has not yet been afforded any formal status that mandates the protection of habitat or individuals. Listing under the California Endangered Species Act will provide protections essential to the long-term persistence of this species in the state of California.

V. PROCEDURAL HISTORY and CESA LISTING PROCESS

Recognizing that certain species of plants and animals have become extinct "as a consequence of man's activities, untempered by adequate concern for conservation," (Fish and G. Code § 2051 (a)) that other species are in danger of extinction, and that "[t]hese species of fish, wildlife, and plants are of ecological, educational, historical, recreational, esthetic, economic, and scientific value to the people of this state, and the conservation, protection, and enhancement of these species and their habitat is of statewide concern," (Fish and G. Code § 2051 (c)) the California Legislature enacted the California Endangered Species Act ("CESA").

The purpose of CESA is to "conserve, protect, restore, and enhance any endangered species or any threatened species and its habitat...." Fish and G. Code § 2052. To this end, CESA provides for the listing of species as "threatened" and "endangered." "Threatened species" refers to a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts. Fish and G. Code § 2067. "Endangered species" refers to a "native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease." Fish and G. Code § 2062.

The Fish and Game Commission ("Commission") is the administrative body that makes all final decisions as to which species shall be listed under CESA, while the Department of Fish and Game ("Department") is the expert agency that makes recommendations as to which species warrant listing. The listing process may be set in motion in two ways: "any person" may petition the Commission to list a species, or the Department may on its own initiative put forward a species for consideration. "Petitions shall include information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant." Fish and G. Code § 2072.3. In the case of a citizen proposal, CESA sets forth a process for listing that contains several discrete steps.

Upon receipt of a petition to list a species, a 90-day review period ensues during which the Commission refers the petition to the Department, as the relevant expert agency, to prepare a detailed report. The Department's report must determine whether the petition, along with other relevant information possessed or received by the Department, contains sufficient information indicating that listing may be warranted. Fish and G. Code § 2073.5.

During this period interested persons are notified of the petition and public comments are accepted by the Commission. Fish and G. Code § 2073.3. After receipt of the Department's report, the Commission considers the petition at a public hearing. Fish and G. Code § 2074. At

this time the Commission is charged with its first substantive decision: determining whether the Petition, together with the Department's written report, and comments and testimony received, present sufficient information to indicate that listing of the species "may be warranted." Fish and G. Code § 2074.2. This standard has been interpreted as the amount of information sufficient to "lead a reasonable person to conclude there is a substantial possibility the requested listing could occur." Natural Resources Defense Council v. California Fish and Game Comm. 28 Cal.App.4th at 1125, 1129.

If the petition, together with the Department's report and comments received, indicates that listing "may be warranted," then the Commission must accept the petition and designate the species as a "candidate species." Fish and G. Code § 2074.2. "Candidate species" means a "native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that the commission has formally noticed as being under review by the department for addition to either the list of endangered species or the list of threatened species, or a species for which the commission has published a notice of proposed regulation to add the species to either list." Fish and G. Code § 2068.

Once the petition is accepted by the Commission, then a more exacting level of review commences. The Department has twelve months from the date of the petition's acceptance to complete a full status review of the species and recommend whether such listing "is warranted." Following receipt of the Department's status review, the Commission holds an additional public hearing and determines whether listing of the species "is warranted." If the Commission finds that the species is faced with extinction throughout all or a significant portion of its range, it must list the species as endangered. Fish and G. Code § 2062. If the Commission finds that the species is likely to become an endangered species in the foreseeable future, it must list the species as threatened. Fish and G. Code § 2067.

Notwithstanding these listing procedures, the Commission may adopt a regulation that adds a species to the list of threatened or endangered species at any time if the Commission finds that there is any emergency posing a significant threat to the continued existence of the species. Fish and G. Code § 2076.5.

The California Fish and Game Commission ("Commission") has not yet protected Townsend's big-eared bat populations in California under the California Endangered Species Act. It is recognized as a Mammal Species of Special Concern by the California Department of Fish and Game (CDFG), based on its sparse distribution and ongoing decline. It was given this status in 1986 (Pierson & Rainey 1998, Williams 1986). In a 2011 draft California Bat Conservation Plan, the Townsend's big-eared bat was again listed as a Mammal Species of Special Concern by the state of California (Pierson et al. 2011). *C. t. townsendii* is a Regional Forester's Sensitive Species throughout Region 5, a Bureau of Land Management (BLM) Special Status Species, a Western Bat Working Group High Priority species, and a U.S. Fish and Wildlife Service (USFWS) former Category 2 candidate species (Pierson et al. 2011, Pierson & Rainey 1998).

VI. NATURAL HISTORY

A. Description

Townsend's big-eared bat (*Corynorhinus townsendii*) is a medium-sized bat, weighing between nine and 14 grams, and measuring approximately 10 cm total length. Fur is brown, buff, or grayish in color with lighter underparts. Its eponymous ears measure roughly a third of its total body length. Townsend's big-eared bat can be distinguished from other big-eared bat species by the two-pronged lump on its snout (the origin of its other common name, "lump-nosed" bat). Townsend's big-eared bat curls its ears tightly against its head when resting or hibernating. At these times the large tragus remains erect and can be mistaken for an ear, so the lumps on its snout are an important identifying feature (Pierson et al. 1999; Armstrong et al. 1995). The wings of *Corynorhinus* in general, including *C. townsendii*, have a low aspect ratio, a morphology that enhances maneuverability but discourages long-distance flight (Piaggio & Perkins 2005).

B. Taxonomy

Townsend's big-eared bat was originally placed in the genus *Corynorhinus* until that genus was subsumed by the Eurasian genus *Plecotus* (Handley 1959). The species was then known as *Plecotus townsendii* (and may still be referred to as such by some sources) until recent studies confirmed *Corynorhinus* as distinct from *Plecotus* (summarized by Pierson et al. 1999, p. 1; Pierson & Fellers 1998, and supported by genetic studies, e.g. Piaggio & Perkins 2005 and references therein). There are only three named *Corynorhinus* species: *C. townsendii*, *C. rafinesquii* in the southeastern USA, and *C. mexicanus* in Mexico.

Five subspecies of *Corynorhinus townsendii* have been recognized within the US: *virginianus*, *ingens*, *australis*, *pallescens*, and *townsendii* (the nominate subspecies). The *virginianus* and *ingens* subspecies (Virginia big-eared bat and Ozark big-eared bat) are isolated from other *Corynorhinus* populations and both are federally listed as endangered species. They occur in parts of Virginia, West Virginia and Kentucky; and Oklahoma, Arkansas and Kansas, respectively. Subspecies *australis* occurs primarily in Mexico, western Texas and Oklahoma.

Recent genetic studies by Piaggio and Perkins (2005) clarified the phylogenetic relationships of the Townsend's big-eared bat subspecies. They found five well-supported phylogenetic groupings within *C. townsendii*, broadly corresponding to Handley's subspecies; however, the ranges of the subspecies do not always match those outlined by Handley (1959). In particular, the phylogenetic grouping most closely corresponding to *C. t. townsendii* – formerly thought of as a Pacific coastal subspecies – ranges from the Pacific eastward to parts of South Dakota, Colorado, Arizona, and Sonora, Mexico. The phylogroup most closely corresponding to *C. t. pallescens*, formerly thought to occupy much of the arid American West, appears confined primarily to New Mexico and central and southern Colorado. It seems that morphological characteristics are not reliable diagnostics for distinguishing among subspecies.

In this petition, we address Townsend's big-eared bat at the full species level and describe its

status throughout California, following the approach used by Pierson and Rainey (1998) and by the California Department of Fish and Game (CDFG).

C. Reproduction and Growth

Mating occurs primarily in hibernacula, where bats congregate between October and February. Female Townsend's big-eared bats exhibit delayed implantation, wherein sperm are stored until spring emergence; ovulation and fertilization occur subsequently. The gestation period varies somewhat with variance in climate, but typically lasts between 56 and 100 days (Pearson et al. 1952, Pierson & Fellers 1998).

Following spring emergence, females establish maternity colonies, which vary in size; recorded colonies have been comprised of between 30 and 400 females (Pierson et al. 1999). Date of establishment for maternity colonies is variable throughout the state, based on regional climate. Desert and central coast populations may form maternity colonies as early as March, while colonies in the interior portion of northern California may not be established until June (Pierson & Fellers 1998). Males and non-reproductive females roost singly during this period (Pierson & Rainey 1998).

Early in the gestation period, females typically roost in cooler, darker locations, but will often move to warmer places after parturition so as to facilitate thermoregulation and reduce energetic costs associated with lactation, foraging, and other maternal care (Pierson & Rainey 1998). Females exhibit high site fidelity to maternity roosts, returning to the same colony year after year; return rates are reported at 73-77% (Pearson et al. 1952, Pierson et al. 1999). However, reproductive females may switch sites if disturbed by climatic, anthropogenic, or other factors (Pierson & Rainey 1998). The availability of abundant and diverse potential roosting sites for maternity colonies is necessary to accommodate changes in habitat preference throughout the reproductive period.

Females bear a single offspring annually, which at birth weighs roughly ¼ of the mother's weight. Parturition occurs between May and July (Easterla 1973, Pearson et al. 1952, Pierson & Fellers 1998). Juveniles may become volant between 2.5 and 3 weeks of age, and are fully weaned at 6 weeks (Pearson et al. 1952, Pierson & Fellers 1998). Maternity colonies begin to disperse in August after the young are weaned, and have generally fully dissipated by September or October (Pearson et al. 1952, Tipton 1983, Pierson & Fellers 1998, Pierson et al. 1999).

D. Demography

Annual survivorship is estimated to be approximately 50% for young and 80% for adults, in the absence of disturbance (Pierson & Fellers 1998, Pearson et al. 1952). Observed average age is five years, but banding-recapture studies have recorded individual Townsend's big-eared bats that lived up to 24 years, though this may be unusual (Perkins 1994).

Because this species has low fecundity (one offspring per year per reproductively active female)

and fairly low juvenile survivorship, populations are slow to recover from decline or loss. Maintenance of high adult survivorship is crucial to long-term population viability (Crooks et al. 1998, Simons 1983).

Young males disperse after their first summer. However, many, perhaps all, surviving females return to their natal group, so that maternity colonies appear to be multi-generation, matrilineal groups (Pierson & Rainey 1998).

E. Hibernation

Townsend's big-eared bat,, like many other bat species, spends the coldest months of the year in hibernation. Temperature, humidity, and airflow contribute to the maintenance of suitable hibernating conditions, and Townsend's big-eared bats exhibit fairly strict requirements in their selection of hibernacula, preferring stable cold temperatures (below 10ºC) and moderate airflow (Humphrey & Kunz 1976, Perkins et al. 1994, Pierson et al. 1991). The vast majority of hibernacula known to be used by Townsend's big-eared bats are caves, but a few hibernating populations have also been located in buildings (Barbour & Davis 1969, Pearson et al. 1952). In the state of California, Townsend's big-eared bats generally form small hibernating aggregations (<50 animals), though in areas that experience longer periods of sub-freezing temperatures, larger hibernating colonies (>100 animals) may form (Pierson &Fellers 1998). In California, these larger aggregations are typically found at higher elevations (above 2,000 meters) in the White and Inyo Mountains, and in some lower-lying areas north of Lake County (Szewczak et al. 1998, Pierson & Fellers 1998). In regions with more moderate winter conditions, Townsend's big-eared bats may hibernate solitarily or in small groups.

As individuals enter a state of torpor, body temperature falls to within 1-2°C of the ambient temperature in the hibernaculum (Geiser et al. 2004). The decrease in body temperature and metabolic rate reduce energy expenditures by approximately 95% (as compared to remaining normally active) (Geiser et al. 2004, Dunbar & Tomasi 2006). Bats periodically break torpor during hibernation and may become active within or outside of the hibernaculum. The reason for these arousals is not fully known. Arousals may be necessary to enhance immune function, allow bats to consume water or forage, or move among hibernacula (Luis & Hudson 2006, Speakman & Racey 1989, Thomas & Geiser 1997). Townsend's big-eared bats may move between hibernacula even in regions with prolonged or more severe winters in California (Clark & Clark 1997). In areas with moderate winter conditions, hibernating Townsend's big-eared bats arouse more frequently and may forage on warm nights (Pierson et al. 1991). Individual Townsend's big-eared bats have been documented to fly from hibernacula in temperatures below freezing (Humphrey & Kunz 1976). Arousals represent as much as 75% of an individual bat's winter energy expenditures (Boyles et al. 2006).

Duration of hibernation varies with climatic variation across this species' considerable range in the state of California, but bats generally begin to arrive at hibernacula in October, and reach maximum numbers in January. Few active hibernacula are known in California, though some formerly occupied sites have been abandoned by Townsend's big-eared bats as a result of regular anthropogenic disturbance (Pierson & Rainey 1998).

F. Movement

Townsend's big-eared bat seems to be a relatively sedentary species—banded individuals are rarely observed to disperse more than a few kilometers from natal sites, and radio-tracking studies indicate that breeding females generally restrict movements to a range within 15 km of the primary maternity roost (Pierson & Rainey 1998, Brown et al. 1994). Females also exhibit high fidelity to their natal roost sites, returning annually to the same site. Less is known about the movements of male Townsend's big-eared bats, who disperse away from natal sites and do not form colonies in the summer months; males are typically found roosting alone when not hibernating (Pierson & Rainey 1998).

Migration between summer roosting habitat and hibernacula is typically fairly short though bats may move to higher elevations to find suitable hibernating sites (Sherwin et al. 2000b, Szewczak et al. 1998). The longest documented movement between summer roosting habitat and hibernacula in California is 43 km (Pierson & Rainey 1998). Substantial aggregations of adult Townsend's big-eared bats may form in spring and fall at sites near to maternity roosts or hibernacula. The purpose of these gatherings is not entirely clear but it is thought that such behavior may be some form of swarming, a phenomenon wherein some bat species congregate in large numbers prior to hibernation for breeding; they may also serve as staging grounds for the subsequent establishment of maternity colonies (Pierson & Fellers 1998).

Given their capacity for accurate echolocation, Townsend's big-eared bats are probably capable of avoiding most anthropogenic obstacles (they are capable of avoiding mist nets unless taken unawares). However, whether various anthropogenic habitat modifications (roads, habitat fragmentation, lights, renewable energy technologies) may represent barriers to dispersal or other threats to this species bears further investigation.

G. Foraging and Diet

Townsend's big-eared bats are nocturnal insectivores. The western subspecies reportedly forages in a variety of habitats. Foraging individuals have been observed in native oak and ironwood forest on Santa Cruz Island (Brown et al. 1994), in Mojave mixed desert scrub, Great Basin desert scrub and pinyon-juniper forest in the White and Inyo Mountains of the California-Nevada border region (Szewczak et al. 1998), and in riparian woodland in coastal California. Also, foraging bats have been located in sagebrush steppe and open ponderosa pine habitat in central Oregon (Dobkin et al. 1995), and in pinyon pine and juniper woodlands in Nevada and Utah (Kuenzi et al. 1999; Ports & Bradley 1996; Sherwin et al. 2000a).

Townsend's big-eared bats in coastal California are consistently observed to forage primarily in riparian corridors, closely following stream corridors within or along the edge of forested habitat at mid- or canopy level. Radio-tracking data shows that Townsend's big-eared bats avoid open grassland or meadow habitat, though they may occasionally venture to forested patches within a more open matrix (Fellers & Pierson 2002). When flying across open habitat to reach these foraging patches, individuals fly only 1 meter or so above the ground, as if to minimize exposure to potential predators. Townsend's big-eared bats may travel between 1 and 10 kilometers from a

day roost in search of prey, though females typically travel farther than males when foraging. The majority of individuals tracked or observed returned to the same roost each night, though in places where alternate roosts are available, some may switch on a regular basis (Fellers & Pierson 2002).

At Point Reyes National Seashore, Marin County, Fellers and Pierson (2002) observed light-tagged Townsend's big-eared bats foraging around the outer contours of trees and shrubs. Foraging flight is slow, and generally occurs as a methodical series of rising horizontal sweeps, each 3 to 10 meters long, along vegetation's edge. Foraging Townsend's big-eared bats do not pause or hover in a manner that would indicate gleaning, and have been observed feeding on moths in flight (Fellers & Pierson 2002). However, this species' morphology (low wing loading, low aspect ratio) makes it maneuverable in cluttered habitat suitable for gleaning, and it is possible that the limited observations of foraging Townsend's big-eared bats have not noted all foraging behavior.

Townsend's big-eared bats may drink from ponds, lakes, streams, and other sources of open water. Drinking may be the first thing a bat does after leaving the day roost. On the other hand, Townsend's big-eared bat roosts, including maternity colonies, may occur miles from any water source (e.g., over 40 kilometers away in desert areas: P. Brown, pers. comm. 2003), so drinking appears not to be obligatory.

Townsend's big-eared bats feed primarily on moths (greater than 90% of the diet; studies cited in Pierson & Fellers 1998; Pierson et al. 1999). Studies done in Kentucky (subspecies *virginianus*) found that noctuid and sphingid moths dominated the diet, and geometrid and notodontid moths also were consumed (Burford & Lacki 1998; Sample & Whitmore 1993; Shoemaker & Lacki 1993; these moth families include many agricultural pests). Small quantities of other insects are also consumed, particularly beetles and dipterans (flies, mosquitoes, and their relatives) (Dalton et al. 1986; Ross 1967; Sample & Whitmore 1993; Pierson & Fellers 1998).

VII. HABITAT REQUIREMENTS

Townsend's big-eared bats require a range of habitats for various parts of their life history, including summer roosts (maternity roosts), hibernacula, and foraging habitat.

Summer roosting habitat

Preferences for summer roosts are better known than those for any other Townsend's big-eared bat site type (e.g., hibernacula). Reproductively active females form maternity colonies in the summer months, while adult males and non-reproductive females typically roost singly. Reproducing female Townsend's big-eared bats seek out warm, undisturbed roosts in caves, abandoned mines, hollow trees, and human-made structures in California. Pierson & Rainey (1998) describe all maternity roosts identified by their surveys as cave analogues. Documented maternity roosts used by Townsend's big-eared bats are relatively large (of a size sufficient to allow flight but still enclosed)—many are at least 25 m deep, with the primary roosting area located between 1 and 2.5 m above the floor. The size of roost entrances is variable; most are at least 15 cm high and 30 cm wide, though smaller openings seem to be tolerated under some conditions (Pierson & Rainey 1998). Ambient temperature in known maternity roosts range from 18°C in cooler northern regions to 30°C in warmer southern regions; occupied roosts are consistently warmer than unoccupied roosts, suggesting that temperature plays a significant role in roost site selection by Townsend's big-eared bats. Relative humidity in occupied roosts is highly variable, ranging from 19-93%, an indication that humidity is not likely to be a major factor in roost site selection (Pierson & Fellers 1998). All known roosts are consistently semi-dark or dark. Pierson and Rainey (1998) report that in their four-year survey of maternity roosts throughout the state, 43% of those documented were located in caves, 39% in abandoned mines, and 15% in buildings; the remainder were found in other anthropogenic structures that provided cave-like conditions such as bridges and culverts.

Townsend's big-eared bat maternity roosts have been recently documented in the basal hollows of coastal redwoods (*Sequoia sempervirens*). A colony consisting of approximately 40 bats was reported to use at least 2 and as many as 13 of these hollows within Grizzly Creek State Park (Humboldt County) in the summer of 2000 (Mazurek 2004). Previous studies hinted at this use (e.g., Gellman and Zielinski 1996) but none had so thoroughly documented it. Individual Townsend's big-eared bats have also been observed to use redwood hollows as summer roosts (Fellers & Pierson 2002). The formation of these basal hollows is facilitated by fire and aging; older *S. sempervirens* may develop hollows more than 10 meters tall and several meters in diameter (M.J. Mazurek, pers. comm., 2003). Especially in areas with limited suitable cave or mine roosts, these tree hollows represent a significant habitat resource for Townsend's big-eared bat, and Mazurek (2004) suggests that such habitat may have historically constituted the majority of roosting habitat for this species in northwestern California (a region where caves and mines are limited). The documentation of a single maternity colony using as many as 13 roosts in one season suggests that the frequency of roost-switching is higher that previously known; preservation of adequate alternate roosts within the range of maternity colonies is desirable.

Though most records are from lower elevations, maternity colonies have been documented as high as 1,600 meters in the Sierra Nevada and 1,700 meters in the White and Inyo Mountains (Pierson & Fellers 1998).

Early in the gestation period, females typically roost in cooler, darker locations, but will often move to warmer places after parturition so as to facilitate thermoregulation and reduce energetic costs associated with lactation, foraging, and other maternal care (Pierson & Rainey 1998). Females exhibit high site fidelity to maternity roosts, returning to the same colony year after year; return rates are reported at 73-77% (Pearson et al. 1952, Pierson et al. 1999). However, colonies may switch sites if disturbed by climatic, anthropogenic, or other factors (Pierson & Rainey 1998, Sherwin and Gannon 2001). The availability of an abundance and diversity of potential roosting sites for maternity colonies is also necessary to accommodate the aforementioned changes in habitat preference throughout the reproductive period.

Hibernacula

The vast majority of hibernacula known to be used by Townsend's big-eared bats are caves, but a few hibernating populations have also been located in buildings (Barbour and Davis 1969, Pearson et al. 1952). Unlike many other bat species, they rarely hibernate in cracks or crevices, instead hanging singly or in highly visible clusters from open surfaces. Being so exposed, hibernating Townsend's big-eared bats are highly vulnerable to detection and disturbance; they therefore seek and require hibernacula that are secure from disturbance and predation and typically avoid or abandon sites that are disturbed (Pierson & Fellers 1998; Pierson et al. 1999). Few active hibernacula are known in California. Some of those that are known have been abandoned by Townsend's big-eared bats as a result of regular anthropogenic disturbance. The largest hibernating aggregations (200-600 animals) occur in the northern portion of the state, many in Siskiyou County, while hibernacula in southern California tend to host smaller groups (fewer than 20 animals; Pierson & Rainey 1998).

Hibernacula, like maternity roosts, tend to be large, with ceilings high enough to offer a degree of security to hibernating bats. They are often L-shaped, with both horizontal and vertical entrances, a shape that generates an interior cold sink and substantial airflow within the hibernacula (Pierson & Rainey 1998). Townsend's big-eared bats appear to seek the coldest non-freezing temperatures available when selecting hibernacula; in northern California, mean hibernacula temperature is 4.3ºC, while in southern and coastal areas it may be warmer, though preferred temperatures are consistently below 10ºC (Pierson & Rainey 1998). Though the majority of records are from lower elevations, hibernacula have been found as high as 3,188 meters elevation in the White Mountains (Szewczak et al. 1998).

It is possible that Townsend's big-eared bats hibernate in hollow trees in the more climatically mild parts of their California range, but this has yet to be confirmed and bears further investigation. D. Pierson and co-workers are documenting thermal stability and use by other hibernating bat species in basal hollows of giant sequoia in the southern Sierra (Pierson et al. 2006). At this writing Townsend's big-eared bat has not been found in Yosemite giant sequoia hollows.

Connectivity between summer roosting habitat and hibernacula is essential, particularly because Townsend's big-eared bats seem to restrict travel to protected habitat corridors (e.g., riparian areas, forest), avoiding prolonged periods of exposure in more open habitat.

High sensitivity to anthropogenic disturbance (Pierson & Rainey 1998) suggests that freedom from these disturbances is one of the most imperative criteria in hibernacula selection by Townsend's big-eared bats.

Foraging Habitat

The western subspecies of Townsend's big-eared bat reportedly forage in a variety of habitats. Foraging individuals have been observed in native oak and ironwood forest on Santa Cruz Island (Brown et al. 1994), in Mojave mixed desert scrub, Great Basin desert scrub and pinyon-juniper forest in the White and Inyo Mountains of the California-Nevada border area (Szewczak et al. 1998), and in riparian woodland in coastal California. Also, foraging bats have been located in sagebrush steppe and open ponderosa pine habitat in central Oregon (Dobkin et al. 1995), and in pinyon pine and juniper woodlands in Nevada and Utah (Kuenzi et al. 1999; Ports & Bradley 1996; Sherwin et al. 2000a).

Within these various ecosystems, Townsend's big-eared bats forage primarily in riparian corridors, closely following creeks or streams through forest or shrub habitat in search of insect prey (Pierson & Fellers 1998, Fellers & Pierson 2002). Because this species occurs in a wide variety of habitats in California, it is likely to be somewhat adaptable in its foraging requirements, though foraging individuals consistently avoid open grassland or pasture habitat where they may be exposed to predation (Fellers & Pierson 2002, Pierson & Fellers 1998). The degree to which cleared habitat (natural or anthropogenic) represents a barrier to dispersal for this species is not known and bears further investigation, particularly in light of the rapid urbanization occurring in much of the state.

In addition to protecting the habitat where Townsend's big-eared bats forage, it is necessary to conserve the areas where the insects that this species consumes breed and mature. It is thought that moths (Dioptidae, Notodontidae, Doptinae, and others) comprise the primary food source for this bat species.

Townsend's big-eared bats may drink from numerous available water sources near to roosting or foraging habitats. As they are highly agile in flight, individuals are capable of drinking from open water on the wing. Pierson and Fellers (1998) report that Townsend's big-eared bats travel 4 km or farther to drink at ice caves in the Lava Beds National Monument. However, maternity colonies are known more than 40 km from water in arid areas, and it is possible that some populations of Townsend's big-eared bat obtain all necessary water from their insect prey (P. Brown, pers. comm. 2003, S. Osborn, pers. comm. 2010).

VIII. RANGE AND DISTRIBUTION

Townsend's big-eared bat conforms to a type of rare species, as classified by Rabinowitz et al. (1986), that has a wide geographic distribution but is everywhere uncommon and has restrictive habitat needs. Such species are particularly vulnerable to habitat fragmentation and loss of their naturally rare habitat. The range of the Townsend's big-eared bat extends from southern British Columbia in the north to Mexico in the south, and from the west coast, including California, approximately to the western edge of the Great Plains (Pierson et al. 1999). The species is not common in any part of this wide range.

Townsend's big-eared bat is found throughout California in all but subalpine and alpine habitats, and may be found at any season throughout its range (CDFG 2000 and 2008, Figure 1, 2 and 3).

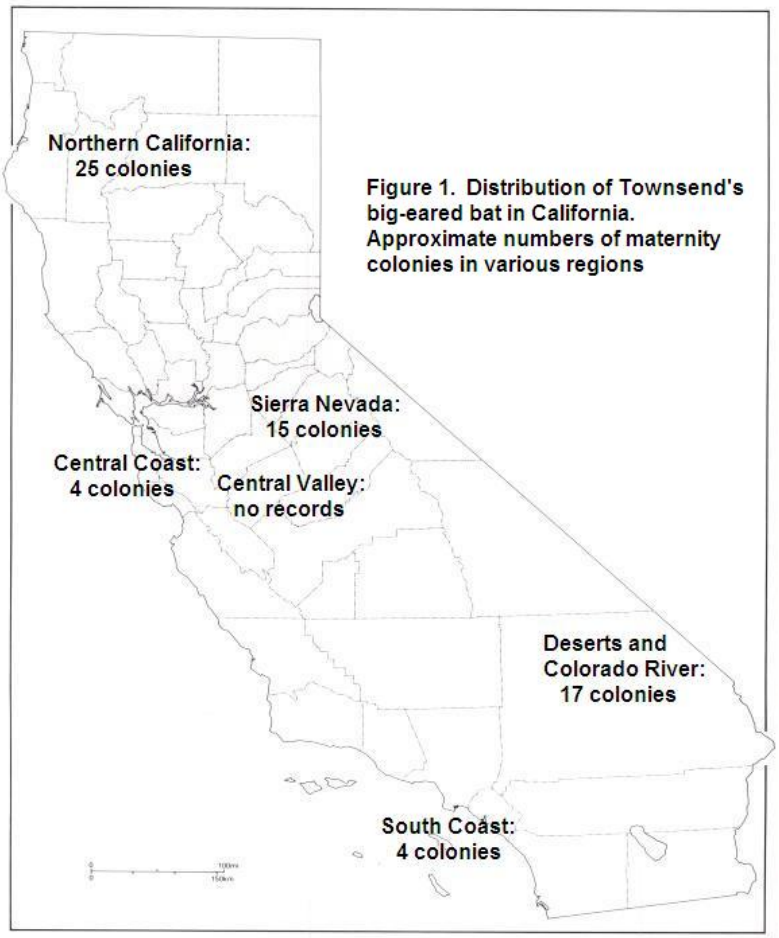

Figure 1. Approximate number and distribution of significant Townsend's big-eared bat maternity colonies in California. (After Pierson & Fellers 1998, Figure 2; plus San Benito County).

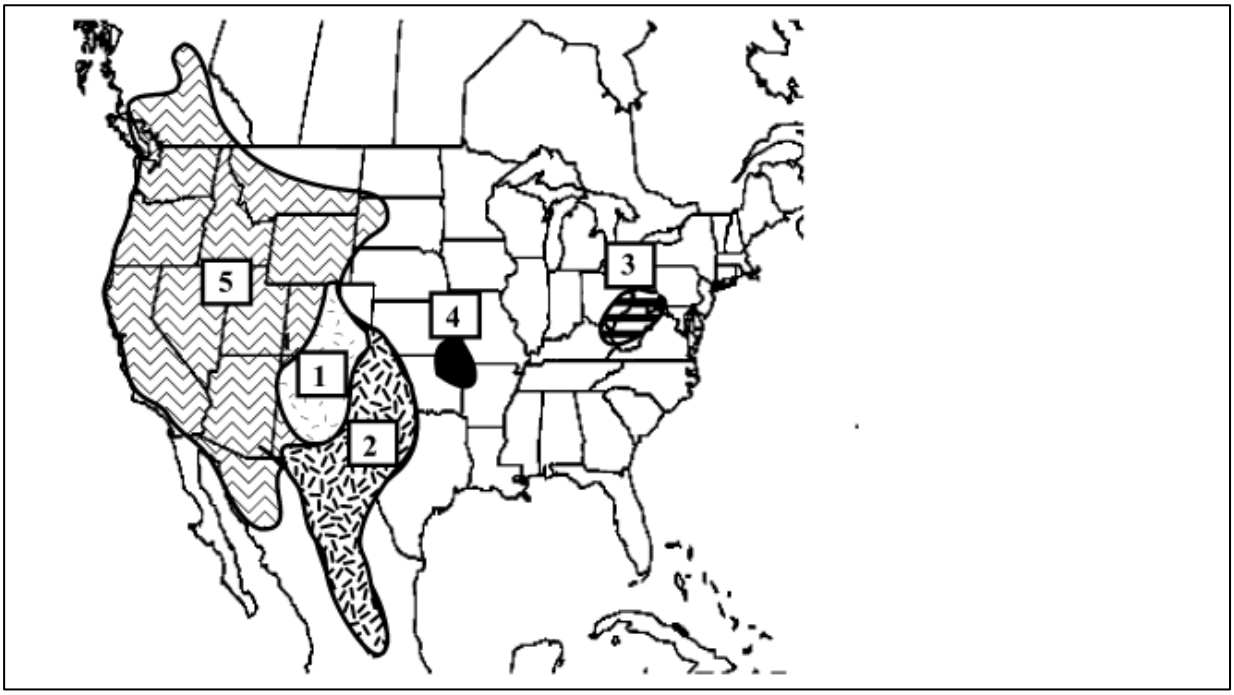

Figure 2. From Piaggio and Perkins (2005) showing the five recognized subspecies of Townsends big-eared bat.

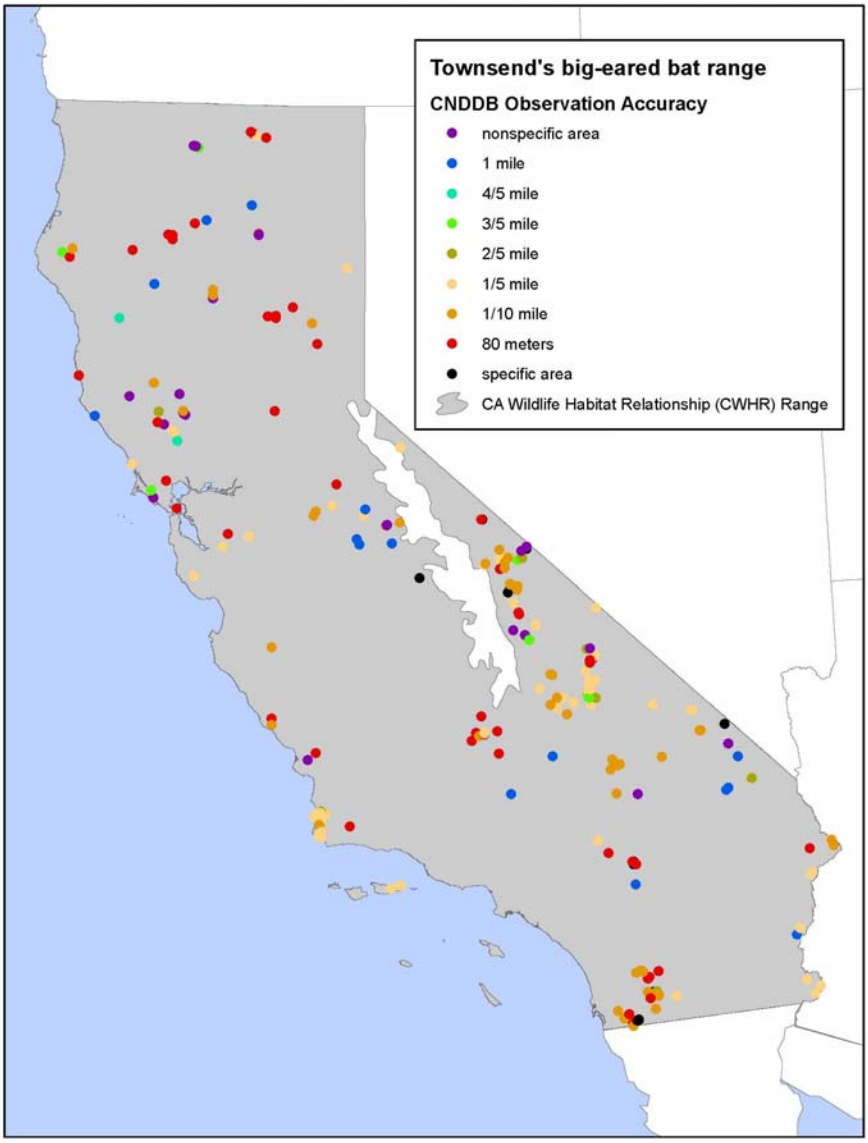

Figure 3. Roughed occurrence locations from the California Natural Diversity Database Biogeographic Data Branch and California range from CDFG 2008.

IX. HISTORIC AND CURRENT DISTRIBUTION AND ABUNDANCE

In California, several areas host substantial populations of the Townsend's big-eared bat, including the northeastern corner of the state, the northern coast and northern coast ranges, and mining regions in the Sierra Nevada and desert zones (Pierson & Rainey 1998). Townsend's big-eared bat is found in a variety of habitat types, including coastal redwood forests, oak savannahs, mixed conifer forests, pinyon-juniper forest, and desert habitats (Pierson and Fellers 1998).

The most recent rangewide survey of Townsend's big-eared bat was conducted by Pierson and Rainey (1998) in which all known significant maternity colonies (>30 animals) for Townsend's

big-eared bat within the state were included. The draft California Bat Conservation Plan (Pierson et al. 2011) provides additional, updated information on the species. This petition relies primarily on the 2011 draft conservation plan (CBCP) as well as the Pierson and Rainey survey in addressing the distribution and abundance of Townsend's big-eared bat in California. Because the CBCP organizes its regional descriptions by U.S. Forest Service "ecoregions," we adopt the same format. We also summarize distribution and abundance from the CBCP in Table 1.

The primary centers of distribution for Townsend's big-eared bat in California in the past 30-70 years are found in areas that offer caves or cave analogues (such as old mine workings) with populations concentrated in the limestone formations of the Sierra Nevada and Trinity mountain ranges, the volcanic formations in the northern part of the state, and a number of mining districts, most significantly those in the desert regions east and southeast of the Sierra Nevada, the Mother Lode country, and the inner coast range north of San Francisco (Pierson & Rainey 1998). Both historically and currently, there have also been significant coastal populations located in buildings or other human-made structures (e.g., bridges or water tunnels).

There have been notable declines in either number of colonies or population levels in many areas where Townsend's big-eared bats occur, such as in the Mother Lode country of the Western Sierra foothills and in the mining district along the Colorado River, likely because of heavy recreational use in both areas, as well as in San Francisco Bay area counties, where native habitat and rural land have undergone conversion for agriculture (i.e., wine production) or suburban/urban development (Pierson & Rainey 1998).

Below are descriptions of Townsend's big-eared bat by ecoregion in California. The U.S. Forest Service defines 19 ecoregions in the state; the CBCP combines four ecoregions into two (the Southern California Coast with the Southern California Mountains and Valleys, and the Mono ecoregion with the Southeastern Great Basin). This petition follows the format of the draft CBCP. However, one additional entry is made for the Channel Islands, and the draft CBCP does not yet include an entry for the Northern California Coast Ranges, so information pertaining to the Northern Coast Ranges is included in this document's description of Townsend's big-eared bat in the Northern Coast ecoregion.

A. Northern California Coast

This ecoregion is a narrow band running north along the coast from the San Francisco Bay to the Oregon border. It includes the western third of Del Norte County, the western halves of Humboldt and Mendocino counties, most of Sonoma County, the western half of Napa County and all of Marin County. The ecoregion ranges in elevation from sea level to 3,000 feet.

There are a number of important early records of Townsend's big-eared bat from the Northern California Coast ecoregion, but biologists consider the species rare there now (Pierson et al. 2011). Into the mid-twentieth century, investigators documented significant populations in the redwood belt (Pearson et al. 1952; Pierson & Fellers 1998), and found the species roosting in the basal hollows of old-growth redwood trees—a feature that has become rarer as commercial

logging has eliminated stands of primary redwood forest. Some scientists believe that before the advent of widespread logging, large, old redwoods were the primary roost sites for Townsend's big-eared bat in this part of the state (Pierson & Fellers 1998). Caves are naturally rare along the coast.

Older buildings have served an important role as roost sites. But building deterioration, as well as renovation, has been responsible for the loss of historic colonies (Pierson & Fellers 1998). The loss of these anthropogenic roosting sites is a leading threat to Townsend's big-eared bat in the region. Disturbance at unprotected sites is another leading cause of colony decline and disappearance.

At this time, only three maternity colonies are known in the ecoregion, and two are in buildings (Pierson et al. 2011). The only adequately protected colonies are on National Park Service land at Point Reyes National Seashore and Golden Gate National Recreation Area.

The CBCP considers Townsend's big-eared bat to be a "highest risk" species in the region (Pierson et al. 2011).

The CBCP draft omits an entry on the Northern Coast Ranges ecoregion, which lies between the Northern California Coast to the west, and the Northern California Interior Coast Ranges, to the east. Two colonies on the Shasta-Trinity National Forest exist at Butter Creek and Cecilville Caves. However, these are not protected, nor is a colony at Calistoga. The greatest threat to Townsend's big-eared bat in the Northern Coast Range is human disturbance at roost sites and deterioration of buildings that host maternity colonies.

B. Klamath Mountains

This ecoregion encompasses much of northwestern California. It includes the western half of Siskiyou County, the eastern two-thirds of Del Norte County, the northeastern portion of Humboldt County, the northern three-quarters of Trinity County, and much of the western half of Shasta County. The Marble Mountains and the Trinity Range are part of this ecoregion. Significant limestone formations occur in the Marble and Trinity mountains. Elevations range from 200 feet to 9,000 feet.

The distribution of Townsend's big-eared bat is patchy in the Klamath Mountains; biologists consider the species rare. However, bat experts also agree that the ecoregion is a very important one for Townsend's big-eared bat in California (Pierson et al. 2011). Historically, a number of limestone caves in the Klamath Mountains have been significant sites for Townsend's big-eared bat (Graham 1966); biologists have also made more recent observations of the species hibernating and roosting in the ecoregion (Marcot 1984; Pierson & Fellers 1998). The abundance of both limestone caves and abandoned mines contributes to the habitat significance of the ecoregion for Townsend's big-eared bats. Important historic roosts occur in the Lake Shasta area and near Cecilville, Hyampom and Hayfork. A large, important roost occurs in a mine on BLM land in Siskiyou County. Caves and mines are used for both nursery roosts and hibernation sites

at this latitude (Pierson et al. 2011).

Disturbance at or loss of roosting and hibernation sites is the leading threat to Townsend's big-eared bat in the region. Biologists consider the risk of white-nose syndrome, the invasive fungal disease now spreading westward from the eastern United States, to be high in this ecoregion (Pierson et al. 2011).

Townsend's big-eared bat is ranked "highest risk" among bat species in the ecoregion (Pierson et al. 2011).

C. Southern Cascades

The Southern Cascades ecoregion is sandwiched between the Klamath Mountains to the west and the Modoc Plateau, to the east. It reaches from the Oregon border to the northern end of the Sierra Nevada range. It encompasses most of eastern Siskiyou County, a small slice of western Modoc County, the eastern half of Shasta County, portions of Lassen County, a piece of northern Plumas County, the northeast corner of Butte County, and eastern Tehama County. Volcanic geology characterizes the region, and lava flows, including lava tube caves, are common throughout the region. The elevational reach of the ecoregion is 2,000 feet to 14,000 feet.

This ecoregion, with its abundance of lava caves, is the most important in California for Townend's big-eared bat. The greatest density of caves in the state, and one of the most important cave regions in North America, is found here. Concomitantly the largest colonies of Townsend's big-eared bat in California are in the Southern Cascades (Pierson et al. 2011). Lava caves provide habitat suitable for both maternity roosts and hibernation, often in close proximity to each other. Ambient air in summer warms more shallow caves, making them suitable for maternity roosts. Deeper, colder caves are suitable for hibernation (Pierson et al. 2011).

The density of caves in the Southern Cascades, and the temperate climate in the region, puts bat populations in this ecoregion at particularly high risk for white-nose syndrome (Pierson et al. 2011). The large colonies of Towsend's big-eared bat found here are especially vulnerable to this fast-spreading infectious disease.

The largest known population, within Lava Beds National Monument, had 134 animals when first discovered in November 1988, and over 600 in early March 1994 (Pierson & Fellers 1998). This site is being monitored and protected by the Monument. Other populations are less secure. The population identified in Pluto's Lava Flow #l in January 1988 was significantly reduced when the site was vandalized a few years later by young people who removed a number of bats and released them in a local store. A nearby site, Pluto's Lava Flow #4, confirmed as a significant hibernating site in February 1994 (with about 250 animals) (Pierson & Fellers 1998), receives heavy recreational traffic. Preliminary survey results indicate that population numbers within this cave are unpredictable, and may fluctuate in response to human disturbance.

The greatest threat to populations in this region is disturbance caused by recreational caving

(Pierson & Rainey 1998) and active vandalism. The CBCP ranks Townsend's big-eared bat as "highest risk" in the Southern Cascades ecoregion (Pierson et al. 2011).

D. Modoc Plateau

Unlike the Southern Cascades ecoregion, the Modoc Plateau includes not only volcanic geology, but also fault-block mountains and intervening valleys. The ecoregion takes in most of Modoc County, extends into the northeastern and southeastern corners of Siskiyou County, south to the center of Lassen County, and a small piece of eastern Shasta County
Elevations range from 3,000 to 9,900 feet (Pierson et al. 2011).

Townsend's big-eared bat is considered extremely rare in the region, but lava flow formations are extensive, and important mining districts occur in the Warner Mountains and in the Hayden Hill area (Pierson et al. 2011), so habitat appears to be available. Surveys have been limited in the ecoregion, but bat experts believe new surveys might turn up more records of the species (Pierson et al. 2011). The only record of Townsend's big-eared bat in the Modoc Plateau is a 1991 study that reported the species in an historic mining district (Pierson & Brown 1992).

As elsewhere, on the Modoc Plateau, the strong association between Townsend's big-eared bats and caves and mines, along with its profound sensitivity to disturbance, makes the species highly vulnerable to disruptive activities such as recreational caving, vandalism, and renewed mining activity. The CBCP ranks Townsend's big-eared bat as "highest risk" in the Modoc ecoregion (Pierson et al. 2011).

E. Northwestern Basin and Range

This ecoregion lies in the easternmost portion of northern California, taking in the eastern parts of Modoc and Lassen counties. Arid valleys occupied by alkali lake beds characterize the area. Elevations range from 4,000 feet to 8,000 feet (Pierson et al. 2011).

Very little bat inventory work has been done in this part of California. Only 12 museum records exist, and all were collected between 1923 and 1941. Of the nine localities in these records, two were for buildings, one of which serves as the only record for Townsend's big-eared bat in the ecoregion. Historic mining areas likely provide suitable habitat for bats, but scientists know very little about bat use of these sites. Biologists consider the area high risk for infection by white-nose syndrome. The CBCP designates Townsend's big-eared bat as "highest risk" among bat species in the Northwestern Basin and Range (Pierson et al. 2011). Vandalism and disturbance from recreational caving likely pose the greatest risks to the species in this ecoregion.

F. Northern California Interior Coast Ranges

This ecoregion is a narrow strip running north-south along the interior, eastern side of the Coast Ranges, north of San Francisco. The elevational gradient goes from 300 to 3,100 feet.

Two Townsend's big-eared bat colonies are protected on land owned by the Homestake Mine Company (Knoxville and Sulphur Creeks), at the south end of the ecoregion. However, most of the caves and mines in the ecoregion are at the northern end. Where caves and mines are more limited, as at the southern end of the ecoregion, buildings become more important for roosting for Townsend's big-eared bats. Disturbance at or loss of cave and mine habitat threatens the species, as does loss of artificial structures (i.e., houses, abandoned buildings). A large and active recreational caving community in northern California, along with tourism at commercial caves, could harm Townsend's big-eared bats due to the species' sensitivity to disturbance (Pierson et al. 2011).

Townsend's big-eared bat has a limited distribution in the Northern Interior Coast Ranges, and the CBCP considers the species "highest risk" in the ecoregion.

G. Great Valley

The Great Valley ecoregion runs the length of the Sacramento and San Joaquin valleys and includes the delta of the Sacramento and San Joaquin rivers. Overall, the ecoregion lies at low elevation, from sea level to 2,000 feet. At the southern end of the ecoregion, however, some highlands reach up to 4,000 feet. Little natural roosting and hibernating habitat exists for Townsend's big-eared bat outside of the Sutter Buttes area and a few other large rock outcrops. The species is sparsely distributed in the Great Valley and the CBCP considers it "lowest risk" in the ecoregion.

H. Sierra Nevada Foothills

The Sierra Nevada Foothills ecoregion is long and narrow, stretching along the west side of the Sierra Nevada Range for over 400 miles, from just east of Redding to the Tehachapi Mountains south of Bakersfield. Elevations range from 200 feet to 5,000 feet. Rivers flowing out of the Sierra Nevada into the Great Valley cut deep canyons in a number of places; most rivers have been dammed at one or more places along their length, creating reservoirs in the foothill zone (Pierson et al. 2011).

The foothills region hosts most of the important cave and mine habitat in the Sierra Nevada. Limestone caves are especially prevalent in the "Mother Lode" country, as are mines. Recreational caving, tourism at caves, rock climbing, and quarrying all threaten caves that serve as bat habitat. Townsend's big-eared bat uses bridges as roosting habitat in the Sierra Nevada foothills, as well. Older buildings can be important habitat in the ecoregion (Pierson et al. 2011).

Townsend's big-eared bat has a limited foothills distribution. Many important roosts have been destroyed or are at risk in the region (Pierson et al. 2011). Pierson & Rainey (1998) found that Townsend's big-eared bat is no longer in many of its traditional maternity sites in this region and populations appear to be seriously reduced. The six currently used roosts that could be monitored have a total population of only 125 animals. In the 1990s, the mean size of maternity colonies in this region was 46.6 with a total of 326 adult females (Pierson & Rainey 1998).

A number of historical roosts are no longer occupied. Several caves have become tourist destinations. One of these, privately owned Moss Cave, once contained the largest known colony in the Mother Lode area. Although cavers report occasional sightings of a colony in the area, several attempts to locate this colony have been unsuccessful.

Those roosts that are still occupied have small, highly disturbed populations. For example, the Murphys population appears to move with disturbance among three known caves, and another locality, yet to be identified. An attempt by a landowner and one group of recreational cavers to gate one of these caves at first met with intense resistance from other recreational cavers, and the gate was breached a number of times.

The Bodfish Cave population, the only one known in the Lake Isabella area, had been vandalized (i.e., 10 dead, smashed animals were found) when visited in August 1988, and was threatened again in the spring of 1992 by the proposed closure of numerous mine workings in the area by Sequoia National Forest (Pierson & Brown 1992). Semi-fossilized guano formations within this cave suggested a very large colony had existed here at one time, although the colony is now relatively small (about 33 adults; Pierson & Rainey 1998).

A reactivation of mining in the Mother Lode country also poses a potential threat to Townsend's big-eared bat. One small colony is located in an old mine near Jamestown, which, until recent suspension of mining activities, was scheduled for demolition as part of a current mining operation. The extent to which Townsend's big-eared bat is using old mines in the Mother Lode area has not been fully explored (Pierson & Rainey 1998).

The CBCP considers Townsend's big-eared bat at "highest risk" in the Sierra Nevada foothills.

I. Sierra Nevada

This ecoregion stretches north-south along the Sierra Nevada Mountains from Susanville to Tehachapi Pass. Bordering the foothills region on the west, and the desert regions of the Northwestern Basin and Range, and the Mohave Desert on the east, the Sierra Nevada ecoregion ranges in elevation from about 1,000 feet to the highest summit of the range, at 14,495 feet (Pierson et al. 2011).

Early, pre-1900 records exist for Townsend's big-eared bat in the Sierra Nevada, but most studies of bat distribution did not occur until the 1990s. The majority of summer cave and mine habitat for Townsend's big-eared bat occur at lower elevations, in the foothills of the Sierra Nevada, rather than higher in the mountains. However, some of the most important roosts for the species occur in this ecoregion, including Boyden Cave, Clough Cave, and Bower Cave. Biologists also believe it likely that hibernacula occur in the higher elevations of the Sierra Nevada, based on survey work done in the nearby Inyo and White Mountains.

Characteristic ceiling stains at old roosting locations in Bower Cave indicate that this site once contained a very significant (many hundreds) Townsend's big-eared bat population. Although

recently acquired by the Stanislaus National Forest, which is developing a management plan, the cave is currently being heavily used for recreation by local residents. Attempts to date by the Forest Service to control access appear to have been unsuccessful. Occasional accumulations of Townsend's big-eared bat guano indicate a population is still trying to use this cave (Pierson & Rainey 1998).

The Boyden Cave population roosts near the gated entrance of a tourist cave. Although the guides are sensitive to the bats, groups pass below the cluster a number of times each day, and colony size is much smaller than it once was (S. Fairchild, pers. comm.). Boyden Cave is within the Giant Sequoia National Monument, administered by the Forest Service.

In April 1991, staff at Sequoia National Park located a well-protected cave within park boundaries that had a large (0.3 x 0.6 m) cluster of Townsend's big-eared bats suggesting a colony size >200. Although the colony was not occupying the cave in July 1991, a large Townsend's big-eared bat guano deposit confirmed the presence of a colony in the area. The Park has expressed a commitment to protecting this colony (Pierson & Rainey 1998).

Old buildings suitable for Townsend's big-eared bat to roost in are less numerous in the Sierra Nevada than other ecoregions; nonetheless, some important roosts for the species have been found in old mine buildings (Pierson et al. 2011). Below about 7,000 feet, bridges are also important roost sites for the species (Pierson et al. 2011).

Threats to Townsend's big-eared bat in the Sierra Nevada ecoregion include recreational caving, tourist activity at commercial caves, and recreational climbing (Pierson et al. 2011). Renewed mining activity and other disturbance at roosting sites in mines likely also poses a threat to the species. Where hibernacula occur at higher, colder elevations, white-nose syndrome could become a major threat (Pierson et al. 2011).

The CBCP considers Townsend's big-eared bat a "highest risk" species in the Sierra Nevada, due to its limited distribution and rarity, and sensitivity to disturbance (Pierson et al. 2011).

J. Central California Coast

The Central Coast ecoregion picks up south of the Northern California Coast ecoregion, and includes the San Francisco Bay area. It hugs the coastline south from San Francisco to the east-west mountains north of Los Angeles. Elevations range from sea level to close to 6,000 feet.

Out of eight Townsend's big-eared bat colonies that were known in the past along the coast from San Francisco Bay area to Santa Barbara, only one remains, and only one new roost was found. One extant colony is near Pescadero (San Mateo County) and another is near Santa Inez (Santa Barbara County), both fairly large (>150 animals); these colonies are located on private lands, making their future very uncertain. Individual animals have been located near Livermore and Calaveras Reservoir, but populations there are not known. The species has been extirpated from the East Bay and Peninsula regions, areas that have been heavily suburbanized (Pierson &

Rainey 1998). Mean maternity colony size in this region is 162.5 with a total of 325 adult females (Pierson & Rainey 1998).

Townsend's big-eared bat roosts in coastal redwoods in this ecoregion. Caves and mines are patchily distributed and many are unprotected as bat habitat. Anthropogenic roosts probably provide the greatest amount of roosting habitat. Because of the rarity of natural roosts, the species was likely always rare along the Central Coast. Townsend's big-eared bats have been extirpated from more urbanized areas. Loss of roost sites, whether caves, mines, or buildings, and urbanization and development of foraging habitat, are likely the greatest threat to the species. The CBCP considers the species "highest risk" in the Central Coast (Pierson et al. 2011).

K. Central California Coast Ranges

This ecoregion encompasses inland coastal ranges from the Sacramento-San Joaquin delta reaching south to the Transverse Ranges. Elevations span 100 feet above sea level to just above 5,000 feet (Pierson et al. 2011).

As in the Central Coast ecoregion, cave and mine habitat is rare in the Central Coast mountain ranges. Mines that do exist are inadequately protected for bats. A magnesite mine in the Mount Hamilton Range used to provide habitat for a small population of Townsend's big-eared bat, but the species has not been observed there in recent surveys. Bear's Gulch Caves at Pinnacles National Monument host over 300 female Townsend's big-eared bats and their young. The site seems to be adequately protected from disturbance (Pierson et al. 2011).

Among the threats to Townsend's big-eared bat in the Central Coast ranges is inundation of important habitat by the proposed Los Banos Grandes Dam. Water would flood the largest remaining stand of old growth sycamore in the region. Townsend's big-eared bat is among the bat species that utilize these large, old trees to roost. Another threat is a planned solar energy plant in the Panoche Valley which will demand large amounts of water and likely draw down sources important to Townsend's big-eared bats that roost in nearby mines (Pierson et al. 2011).

The CBCP considers Townsend's big-eared bat "highest risk" among bat species in the Central Coast Range ecoregion.

L. Mono and Southeastern Great Basin

The CBCP combines the Mono and Southeastern Great Basin ecoregions into one, for the purposes of discussing the status of bats in California (Pierson et al. 2011). The Southeastern Great Basin ecoregion, it should be noted, is in the southeastern area of California, but is actually the southwestern corner of the Great Basin desert in the interior West. In California, these ecoregions stretch from just south of Lake Tahoe to the southern ends of the Panamint Range, the Coso Range, and other desert ranges east of the Sierra Nevada. Elevations range from 1,000 feet to over 14,000 feet in the White Mountains.

This part of the state supports some of the largest populations of Townsend's big-eared bat. Extensive historic mining activity provides abundant bat habitat today. Approximately one-third of the total known population within state resides here. Mean maternity colony size in this region is 118.7 with a total of 1,306 adult females (Pierson & Rainey 1998). There are 12 known roosting colonies. Of these, 11 occur in mines, and most are on public lands (Pierson & Rainey 1998). P. Brown and R. Berry (pers. comm. cited in Pierson & Rainey 1998) report finding at least 20 hibernating Townsend's big-eared bats in a shaft in January 1994 on the China Lake Naval Weapons Center. A significant hibernating population has been found in a mine adit in Death Valley National Monument. At this site, the population increased, once a protective gate was installed, from 17 on March 5, 1992 to 54 on March 5, 1993.

Mine closure poses a significant threat to Townsend's big-eared bat populations in these two desert ecoregions (Pierson et al. 2011). The Bureau of Land Management and Forest Service both have Abandoned Mine Lands (AML) programs to close off dangerous mine openings to human access. However, because these sites function as vital bat habitat in some cases, the appropriate process is for bat surveys to precede closure, and if bats are found, land managers should install bat-friendly gates that keep people out, but allow bats free travel in and out of subterranean habitat. Often, these protocol are not followed and bat colonies may be either excluded from important habitat when mines are sealed off, or they may be entombed underground.

Renewed mining activity also threatens Townsend's big-eared bat roosts in these ecoregions. Mining companies may commence activity in abandoned sites, or may initiate new diggings but backfill old ones in the same vicinity, to relieve themselves of liability issues (Pierson et al. 2011).

Recreational caving and vandalism are other threats to the Townsend's big-eared bat in the Mono and Southeastern Great Basin ecoregions. The roost at Wilson Canyon on the Naval Weapons Center was vandalized in 1988 and has not been reoccupied since then. Since numbers increased at the nearby Mountain Springs Mine, some animals from Wilson Canyon may have moved there. Other mines such as Poleta, Snowflake, and Yaney all had evidence of extensive recreational use in the Pierson and Rainey (1998) survey. The only colony in the area with assurance of future protection is located in Death Valley National Monument. Yet, despite efforts by the Park to protect this site through gating, it was vandalized in 1993, and the number of animals occupying the site in the summer of 1993 was greatly reduced (Pierson & Rainey 1998).

The CBCP considers Townsend's big-eared bat a "highest risk" species in these two desert ecoregions.

M. Southern California Coast and Southern California Mountains and Valleys

Authors of the CBCP combine two ecoregions, the Southern Coast and the Southern Mountains and Valleys, to address the status of bats in the southern coastal zone. These ecoregions lie west

of the southern desert regions of California, stretching from the Sonoran and Mojave deserts to the Pacific Ocean. The Transverse Ranges form the northern boundary and the U.S./Mexico border is the boundary on the south. Elevations range from sea level to over 10,000 feet (Pierson et al. 2011).

Cave and mine habitat exists in the ecoregions at middle and higher elevations. Mining dates back to approximately 150 years ago and abandoned mines are numerous, but few surveys for bats have occurred in them. Biologists believe these AMLs serve as maternity roosts and hibernacula for small groups of bats. Caves are rare (Pierson et al. 2011). Trees and snags may also serve as roost habitat for Townsend's big-eared bat.

The Townsend's big-eared bat has a limited and patchy distribution in the South Coast and South Mountains and Valleys ecoregions. Threats to the species include disturbance at mine and cave sites, and loss of foraging habitat to grazing, fires, and development. Timber cutting may result in the loss of roost trees for the species. Townsend's big-eared bat has largely disappeared from urbanized areas. The species once was found near the coast. In the 1930s it was not common in San Diego county, but was widely distributed and frequently encountered there (Krutzsch 1948). None of the colonies in San Diego county exist any longer (Pierson & Rainey 1998). The likely cause of the species' disappearance in the lower elevation and more western parts of the southern coastal area is likely widespread urbanization and suburbanization (Pierson & Rainey 1998). The authors of the CBCP believe the species has been to exist with habitat fragmentation and conversion of natural habitat to more urban settings (Pierson et al. 2011).

The CBCP considers the Townsend's big-eared bat "highest risk" among bat species in the South Coast and South Mountains and Valleys ecoregions.

N. Mojave Desert

The Mojave Desert ecoregion occupies a large portion of southeast California, extending from the southern terminus of the Sierra Nevada to the northern and northeast ends of the Transverse Ranges, and reaching east to the Nevada and Arizona borders. Most of the ecoregion is within San Bernadino County. There are many physical and biological characteristics of the Mojave Desert ecoregion that are shared with the Colorado and Sonoran deserts to the south. Low elevations begin at 280 feet below sea level (in Death Valley) and reach up to over 7,900 feet.

Abandoned mine lands are abundant in the Mojave Desert, and provide plentiful bat roosting habitat. Natural caves are rare, but some exist at higher elevations, such as limestone caves in the Providence Mountains and Mescal Range. Townsend's big-eared bats have been reported in lava tubes at Pisgah Crater (Brown pers. obs.; BLM 2012). A maternity colony of Townsend's big-eared bats roosts in a pumice cave near Haiwee Reservoir, south of Owens Lake (Brown, pers. obs.; Pierson & Rainey 1996).

Unfortunately, a number of important roosts for Townsend's big-eared bat are not protected and colonies have disappeared or shrunk. One well-known roost for the species was in Mitchell

Caverns in the Providence Mountains, now a state park. Another was in mine workings in Macedonia Canyon. Unfortunately, a number of these sites are not protected. The Mitchell Caverns colony was excluded in about 1970, when the cave entrance was redesigned and a bat-proof gate installed. The occasional occurrence of individual Townsend's big-eared bats in the caverns or nearby mine workings indicates a population still exists in the area. Within days of replacing the gate in the summer of 1993, Townsend's big-eared bats began to reoccupy the cave (pers. comm. cited in Pierson & Rainey 1998). Reactivation of a private mining claim in Macedonia Canyon has excluded the Townsend's big-eared bat colony from its historical roost, but the colony has relocated to another mine in the area. In the Mescal Range, modern day "miners" visit Kokoweef Caverns in search of a "lost river of gold" (Pierson et al. 2011). The lava tube caves near Twentynine Palms and near Owens lake are not protected either, and as a result, receive considerable visitation from recreational cavers, especially in the winter hibernation months when Townsend's big-eared bat is especially vulnerable to disturbance (Pierson et al. 2011).

Another population of Townsend's big-eared bat was identified to the east of the Providence Mountains, in the Castle Mountain range, by the capture of a lactating female (Pierson & Rainey 1998). A total of 75 adult females were estimated in the maternity colony observed by Pierson and Rainey (1998).

Prime habitat in the Mojave Desert for the species seems to combine roosts in canyons with permanent water and riparian vegetation. The largest maternity colonies in the Panamint Mountains possess all these features (Pierson et al. 2011). Biologists believe the higher elevations of ranges such as the Clark, Old Woman, Providence, New York, Granite, Panamint and Kingston ranges provide foraging habitat for Townsend's big-eared bat (Pierson et al. 2011).
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The CBCP rates Townsend's big-eared bat as "highest risk" in the Mojave ecoregion. The species is especially dependent on abandoned mines for roosting and hibernating habitat, due to the scarcity of natural caves. Mine closures and reactivation of abandoned mines jeopardize the species in the ecoregion.

O. Sonoran Desert and Colorado Desert

The CBCP combines two ecoregions, the Sonoran Desert and the Colorado Desert, in its discussion of bats in the extreme southeast corner of California. The ecoregions encompass southern and eastern Riverside County, eastern San Diego County, southeast San Bernardino County, and all of Imperial County. Arizona lies on the eastern border, across the Colorado River, and Mexico is the southern border. Elevations range from below 230 feet below sea level at the Salton Sea, to 4,400 feet.

With mining dating back 150 years, plentiful abandoned mine areas provide roosting sites for bats. Townsend's big-eared bat depends on this abundant mine habitat for roosting, as natural caves are extremely rare in these ecoregions. The few that do exist and were historically used by bats have been largely abandoned, likely due to human disturbance (Pierson et al. 2011).

The Colorado River Basin once supported large bat populations. The Pierson and Rainey (1998) survey and work conducted by P. Brown and P. Leitner since the 1960s have documented alarming declines for most species. Townsend's big-eared bats were once found in many mines along the Colorado River (Pierson & Rainey 1998); three maternity sites were known; and the Alice Mine housed the largest colony (>l000 adults) known in California. Extensive surveys by P. Brown and E. Pierson in 1990, and further surveys by P. Brown in 1991 and 1992 have revealed only one relatively small maternity roost in the Mountaineer Mine with an estimated 50 adult females (present in 1991, but not in 1992), and one isolated individual. Recreational use of abandoned mines is high along the Colorado, and may account for much of the observed decline. A number of surveyed mines, however, which had no evidence of disturbance and offered suitable roosting conditions, also had no bats. Historically, Townsend's big-eared bat was found in large colonies in mines in the Riverside Mountains; the bats foraged along the floodplain of the Lower Colorado River (Stager 1939). The lush and diverse habitat that existed in the floodplain has been converted over the last sixty years to agricultural fields, or is dominated by exotic tamarisk. This conversion has likely reduced available foraging habitat, and contributed to the observed declines (although this species is known to feed over alfalfa and corn fields in the eastern U.S. (Pierson & Rainey 1998). Pesticides, which are heavily used in this area, also may have had a negative effect.

In the Sonoran and Colorado deserts, mine closures, conducted for hazard abatement, threaten Townsend's big-eared bat habitat. Renewed mining activity on old abandoned mine lands also threatens current the species' roosting sites (Pierson et al. 2011). Together with human disturbance and the loss of foraging habitat, Townsend's big-eared bat is today more rare in these two desert ecoregions. The CBCP ranks the species as "highest risk" in this part of California.

P. Santa Cruz Island (Channel Islands)

The CBCP does not include discussion of bats on offshore islands of California. However, there are isolated records for Townsend's big-eared bat on four of the Channel Islands (Brown 1980). The only maternity colony that has been identified occurs on Santa Cruz Island. It has been disturbed a number of times over the years both by displacement from roosts and collection for scientific purposes. A colony, relocated in 1991, in a building at the east end of the island (Brown et al. 1994), is less than half its former size. It is currently roosting in an area under negotiation for purchase by the National Park Service (Pierson & Rainey 1998).

X. POPULATION STATUS AND TRENDS

Townsend's big-eared bat is in widespread decline throughout the western United States, particularly in California. Disappearance from a significant proportion of historical roost sites and hibernacula in California indicate that populations are either being extirpated or forced into sub-optimal habitat (Pierson & Rainey 1998).

The tenuous conservation status of the Townsend's big-eared bat in California or elsewhere in

the West has been recognized by state and federal agencies, but it has not yet been afforded any formal status that mandates the protection of habitat or individuals (WBWG 2005). At the federal level, the western subspecies, *C. t. townsendii* and *C. t. pallescens* were listed as former USFWS category 2 candidates for listing under the Endangered Species Act (ESA) until this category was eliminated (USFWS 1985; USFWS 1994). The U.S. Forest Service (USFS) lists this bat as a sensitive species in region 5, which encompasses all of California, as well as regions 2, 3 and 4 (USFS 2012a). Townsend's big-eared bat is a BLM sensitive species in California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Wyoming. Townsend's big-eared bat is listed as a state Species of Special Concern by the following states: Arizona, California, Idaho, Montana, Oregon, Texas, and Utah (WBWG 2005).

The Western Bat Working Group lists Townsend's big-eared bat as the highest priority for conservation action in all eight regions of the West that the group evaluated. No other bat species ranked highest priority in every region (WBWG 2007).

Bat biologists have consistently recognized the precarious status of Townsend's big-eared bat in California. The California Bat Conservation Plan (CBCP), which currently exists only in draft form and is the most recent overall assessment of bat species in the state, lists Townsend's big-eared bat as "highest risk" for California. Biologists evaluated bat species in the state by two different methods, as described in the CBCP, and the species was ranked at the top of the risk list by both approaches (Pierson et al. 2011). In fact, the species is listed as "highest risk" in every ecoregion in the state except the Great Valley, where very little natural or artificial roosting habitat exists, and where the species was likely always very rare.

Graham (1966) first expressed concern for Townsend's big-eared bat in California in the 1960s. In the years since, concern has only grown. Williams (1986) commented that Townsend's big-eared bat was common in central California in the 1960s, but has rarely been seen since the early 1970s. In the 1930s, large colonies of Townsend's big-eared bat were common in the Lower Colorado River area (Stager 1939) but many of these colonies have been reduced or disappeared. A similar story is repeated in other parts of the state, such as the Sierra Nevada foothills and Mojave Desert regions.

Pierson and Rainey (1998) conducted a four-year comprehensive survey of all historically reported maternity colonies in California comprised of >30 bats and several hibernacula and report substantial declines in all metrics utilized, including a 52% decline in the number of maternity colonies statewide, a 32% decline in the average size of maternity colonies, a 55% decline in the total population size, and a 44% decline in the number of available roosts, all within the past 40 years from the survey date. The female population showed decline from 3,004 to 1,365 individuals. The status of all 54 currently known maternity roost sites was evaluated using four criteria: the structural integrity of the roost, the risk of human disturbance, the prospects for future protection, and the availability of alternate roosts. Only four roosts (7.4%) were deemed to be secure. For three roosts (5.6%) the risk was assessed to be very high, for 23 (42.6%) moderately high, and for 24 others (44.4%) moderate (Pierson & Rainey 1998). Pierson and Rainey (1998) identified limited roost availability and roost disturbance by humans as the

primary reasons for the decline. The greatest declines have been in coastal, central Sierra, and Colorado River populations.

Pierson and Rainey (1998) noted that since Townsend's big-eared bats are long-lived animals with a low reproductive rate and high fidelity to their roosts, the consistent pattern of colony loss and declines over a broad geographic area is evidence for a general decline in the species that is a matter of concern.

Pierson and Rainey's survey included searches for additional or alternate roosts within 15 km of historic colony sites, finding about 20 new colonies. In subsequent further intensive surveys, 3 additional maternity colonies were found (Pierson et al. 1999). Since these reports, a significant Townsend's big-eared bat colony has been found in San Benito County (E. Pierson, pers. comm. 2003). There is evidence that additional undiscovered colonies still remain to be found (e.g., several nettings of lactating females far from known maternity colonies), which is unsurprising given the cryptic nature of Townsend's big-eared bat roosts. Such discoveries do not alter the observed trend of extirpations and population decline at historically documented, highly valuable roost sites. It is reasonable to expect that previously undiscovered roosts have been experiencing the same decline. Given human interest in caves, it seems likely that most of the best underground colony sites are already known, and newly found colonies may be occupying suboptimal habitat, perhaps relegated there by disturbance at preferred sites.

Pierson and Rainey (1998) found that of the 18 historic colonies, 33% (6) were apparently extirpated, 33% (6) decreased in size, 6% (1) remained stable, and 28% (5) increased. The average interval between past and recent surveys was 35 years. Of the five colonies that increased in size, four have special protections within Lava Beds National Monument and Point Reyes National Seashore (Pierson et al. 1999). They also documented that only 4 of 54 maternity colonies were secure and that present day maternity colonies averaged 32 percent smaller than historic colonies (112 vs. 164 adult females; Pierson & Rainey 1998). If the 4 protected colonies on National Park Service (NPS) lands discussed above are excluded, the difference is even greater: less-protected present day colonies average 38 percent smaller than in early surveys (n = 34).

Pierson and Rainey (1998) concluded that although some of the known roosts are more secure than others, many have a history of disturbance, and none are likely to survive long-term without active maintenance and/or protection. Building roosts, because they are often abandoned structures in poor repair, are frequently at high risk to destruction by vandalism, fire and/or disintegration. Cave roosts, while generally secure structurally, are often at high risk of disturbance from recreational activities. Old mines vary in their structural integrity, and often experience high recreational use. Mine entrances have a tendency to slump closed over time, and are particularly vulnerable to collapse during winter rains. Renewed mining operations are often located in old mining districts, and many old mine workings have been destroyed by current, open pit mining practices. Additionally, old mines are frequently perceived as a safety hazard, and mine closure programs, particularly on public lands, are common (Pierson & Rainey 1998).

Pierson and Rainey (1998) also surveyed some historic hibernation sites. It is more difficult to assess hibernating than maternity populations because animals appear to move among sites during a hibernating season (Pearson et al., 1952; Humphrey & Kunz, 1976). Nevertheless, four formerly substantial hibernacula (>50 bats) in Napa, Lake, and Shasta counties were observed to have experienced declines from 69 to 94 percent in the past 40 years. A cave on National Forest land in Mariposa County that was a significant Townsend's big-eared bat hibernaculum in the 1960s is now unoccupied due to high recreational use. Two hibernacula within Lava Beds National Monument, one small and one very large (>600 bats) have remained consistent or increased in response to protection from disturbance. A hibernating population in a mine in Death Valley National Park also increased after protective measures (gating) (Pierson & Rainey 1998). Other than a few large hibernacula, hibernacula in California generally have fewer animals, are deeper underground, and are more difficult to find than maternity roosts.

Pierson and Rainey (1998) also review other information regarding Townsend's big-eared bat population decline in California. Perhaps the most unique is their citation of a public health authority that the number of Townsend's big-eared bats submitted for rabies testing has declined in recent years. Since this statistic is collected by completely different means than bat biologists' surveys, it may provide an independent index of the population trend. Since California's human population has been increasing, if there were no change in the Townsend's population we would have expected the number of human-Townsend's big-eared bat encounters to increase.

Pierson and Rainey (1998) explored whether observed discrepancies between current and historic records are indicative of a long-term trend, or fall within the expected variation for populations sampled at two points in time. This survey plus available information on the population biology of Townsend's big-eared bat point to a long-term declining trend. Because bats are long-lived animals with a low reproductive rate (for Townsend's big-eared bat, one young per year), and tend to show great loyalty to chosen roosts, their populations do not show the interannual fluctuations in numbers and distribution characteristic of some mammalian taxa. Pearson et al. (1952) predicted that, with a 38-46% survival rate in the first year, and 75% chance of survival thereafter, population size at maternity sites should remain relatively stable year to year. Studies on two species of Plecotus in Britain (Stebbings 1966), and populations of Townsend's big-eared bat in Virginia revealed that undisturbed populations maintained constant numbers over time (Pierson & Rainey 1998). Although a precipitous decline due to a catastrophic event would not be surprising for any one colony, the pattern, observed in this survey, of a number of colonies, sampled over a broad geographic area, showing serious declines is alarming, and argues for a general decline in California Townsend's big-eared bat populations. Available evidence suggests that human activity has been the primary cause (Pierson & Rainey 1998, Pierson et al. 2011).

XI. FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

A. Present and Threatened Destruction, Modification, or Curtailment of Habitat or Range

The disturbance and destruction of roosts is a major threat to Townsend's big-eared bat. Of the

58 roost sites known to be used by Townsend's big-eared bat prior to 1980, Pierson and Rainey (1998) documented that 23 (39.6%) have been destroyed or made unavailable to bats, 15 others (25.9%) appear suitable, but are unoccupied, and only 20 (34.5%) are still being used. In many of these, disturbance levels are sufficiently high that occupation is not predictable. Attrition has been highest for building roosts, with 88.2% destroyed or unavailable to bats. Fifty percent of the original cave roosts, and 57.1% of the mine roosts, are no longer being used. Even though caves are inherently the most stable structurally, and thus might be expected to provide the most consistently available habitat, four have become unavailable to bats through human intervention: two by inappropriate gating, one by flooding for a reservoir, and another by quarrying for highway rip-rap. The fifteen roosts that are structurally suitable but unoccupied (1 building, 7 caves, 6 mines, and one flume), all are subject to moderate to high levels of human disturbance. Of the 23 roosts that are no longer available to bats, 9 (mostly buildings) have been demolished, 4 (all buildings) have burned, 4 (all buildings) have been renovated in such a way that bats were excluded, and 6 (including buildings, caves, mines, and a water diversion tunnel) have had the entrance closed. Additionally, three roosts discovered since 1980 have been lost—two have been demolished, and another abandoned following a vandalism incident in 1988, in which a number of juvenile bats died.

Threats to the availability or suitability of important roosts such as disturbance, vandalism, and mine impacts, are widely reported to be the primary factors in the species' decline in California (Pierson & Rainey 1998). Mine closures and mine reactivation, and other impacts to Townsend's big-eared bat habitat are discussed in this section. Forestry practices and transportation issues are also listed as having severe effects on Townsend's big-eared bats. In certain parts of its range in California, the species depends on large, old trees, particularly redwoods for roosting. Bridges are also important roost sites in some parts of the state. Thus, forestry and transportation issues also relate to the need of this species for suitable, undisturbed roost sites. Direct disturbance and vandalism are addressed in section E, under "Other Natural or Anthropogenic Factors."

Timber harvest

Research conducted at Point Reyes National Seashore in Marin County and at Grizzly Creek Redwoods State Park in Humboldt County has demonstrated that large hollow trees, particularly fire-scarred redwoods and large California bay trees with basal hollows, are used by Townsend's big-eared bats (Pierson & Fellers 1998; Fellers & Pierson 2002; Mazurek, 2004). The bats have been found in these trees both summer and winter (Pierson and Fellers 1998), including use of large hollows for maternity roosts (Mazurek 2004). In fact, known colonies of Townsend's big-eared bat along the north and central coast are all in close proximity to residual patches of redwood forest, and the species appears extirpated from areas of former distribution that no longer have redwood forests. According to Pierson and Fellers (1998), "it seems possible that redwood forests are critical to the survival of coastal populations, and that historically, along the coast where caves are few, this species roosted predominantly in very large hollow redwoods." Because second-growth redwoods mostly have not experienced the scarring fire regime that creates large basal hollows, such hollows are found mostly in old-growth redwoods, including old trees left behind in previously cut areas (L. Diller, pers. comm. 2003). From a study of fecal

pellets deposited in basal hollows, it has been shown that, in smaller patches of old growth, bat use of individual hollow redwoods is denser–i.e., bats are more concentrated into large hollow trees where these trees are a more limited resource (Rainey et al. 1992; Zielinski & Gellman 1999).

Based on these findings, timber harvesting in areas with trees with hollows suitable for bats is a threat to the Townsend's big-eared bat. Effects of timber harvest may range from actually cutting or knocking down trees with basal hollows to adversely altering the surrounding habitat. In redwoods, adequate or even sizeable basal hollows suitable for bat use can occur in trees that are otherwise sound and valuable and sought after for harvest and sale. If trees with hollows are left standing, they may be blown down due to removal of surrounding trees that formerly moderated strong winds or to destabilization of soils from damage to or death of surrounding root systems and removal of cover. Finally, trees with hollows that remain standing in harvested areas may be reduced in quality as roosts, by being made more apparent to predators and concentrating predator activity due to removal of surrounding trees; by having their internal environment altered by greater exposure to sun, wind, and lower humidity; and by removal of foraging habitat and cover immediately around the roost.

Because Townsend's big-eared bat is so roost-limited, destruction or degradation of roosts by timber harvest is a significant negative impact to the species. Timber harvest also reduces foraging habitat by removing trees; Townsend's big-eared bats feed extensively around trees (Pierson & Fellers 1998).

Road construction is often associated with timber harvest. Roads for logging may disrupt bats if a road is located too close to a cave or mine entrance or passes over subterranean bat habitat. Roads also have the indirect effect of facilitating greater human visitation and activity in an area. This can lead to more disturbance and possibly vandalism at roosting or hibernation sites (Pierson et al. 2011).

Impacts of forestry practices on Townsend's big-eared bat vary widely in California. In forested environments, biologists have frequently radiotracked the species foraging around oaks, and Townsend's big-eared bats may use large, old oaks for roosting, as other bat species do. Bat experts consider the loss of oak woodlands, due to logging as well as suburbanization and conversion to agriculture (especially vineyards), a potentially severe threat to the species. Together, forest management and oak woodland issues rank high as threats to Townsend's big-eared bat, along with issues associated with caves, mines, and anthropogenic roosts, and urbanization (Pierson et al. 2011).

Timber operations also may affect Townsend's big-eared bats through their applications of chemicals for forest management–herbicides, pesticides, and perhaps fungicides and fertilizers. This subject is further discussed below.

This threat is ongoing and continuing into the foreseeable future. Because populations appear limited by available maternity roosts, caves and mines are lacking in coastal areas, and the species is very limited in number of maternity roosts, this is a severe threat in forested areas.

New or Renewed Mining

Active mining, either at new locations or renewed working of older sites can, and has, destroyed roost sites. In particular, the resurgence of gold mining in the West threatens mine- and cave-dwelling bat species, including Townsend's big-eared bats (Brown & Berry 1991; Brown et al. 1993; Brown 1995; Pierson & Rainey 1991). Since open pits created by current mining practices often are located in historic mining districts, old mine workings are frequently destroyed as part of renewed operations. Several instances of such destruction are confirmed from California; for example, circa 1997, pit mining at the Briggs mine of Briggs Corporation/Canyon Resources, near Manly Fall, Inyo County, destroyed a colony of approximately 250 Townsend's big-eared bats (P. Brown, pers. comm. 2004). The renewal of Radcliff/World Beater gold mine also has affected this area. Renewed mining at the Knoxville Site in Napa County demolished the Townsend's big-eared bat population there (Pierson & Rainey 1998). Quarrying for a California Department of Transportation project caused the extirpation of a Townsend's big-eared bat cave roost (Pierson & Rainey 1998).

Mining can harm bats in a variety of other ways, beyond simple destruction of roosting and/or hibernation sites. New, expanded, or renewed mining operations can degrade or destroy foraging habitat for Townsend's big-eared bat. Chemical contamination of water, including acid drainage and heavy metal leaching, may harm bats and their insect prey. Mining may draw down the water table or otherwise alter hydrological systems, which can affect availability of water for bats and their prey (Pierson et al. 2011).

Quarries are another form of mining that can harm Townsend's big-eared bats. Three roosts in limestone caves occupied by Townsend's big-eared bat in the Mother Lode country are currently owned by quarry companies. One of these roosts is one of the most significant in the state (Pierson et al. 2011).

While mitigation of mining's impacts may be possible in some scenarios, there is currently no legal mandate for any such action to protect resident bat populations or their roosts (Brown et al. 1995, Pierson et al. 1991, Pierson & Fellers 1998).

Mine closures

Abandoned underground mines provide important roosting habitat for the Townsend's big-eared bat, but in recent years, concern for human safety has prompted the closure of inactive mines across many western states at the expense of bats that rely on these sites (Altenbach & Pierson 1995, Belwood & Waugh 1991, Brown et al. 1993, Pierson et al. 1991). Mines are typically closed without consideration for the biological value of abandoned mines as habitat, by collapsing or filling all entrances, which either excludes or entraps resident bat populations, effectively extirpating them from the site (Pierson & Fellers 1998). Pierson & Rainey (1998)

documented the loss of two historic maternity roosts of Townsend's big-eared bats in California due to closure of a mine and an associated tunnel and closure of an old railroad tunnel near Dunsmuir, Siskiyou County in 1991 by Southern Pacific Railroad (Pierson & Rainey 1998). Several sites identified in Pierson and Rainey (1998) were threatened by mine closures. Given the high roost fidelity exhibited by the Townsend's big-eared bat and the shortage of suitable maternity roosts and hibernacula, mine closures represent a significant source of habitat loss to this species.

According to the Office of Surface Mining (OSM, Department of the Interior), state and federal agencies estimate there are over 300,000 open underground mines across the United States. Agencies have closed approximately 33,000 mine openings considered to be dangerous since passage of the Surface Mining Control and Reclamation Act of 1977 (SMCRA; Henry 2001). Most of these closings were funded by the Abandoned Mine Land (AML) Reclamation Fund, administered by OSM. A survey conducted by OSM in 2000 indicated approximately 1,234 of the mine closures (3.7%) have involved some form of bat-compatible closure method such as bat gates or bat pipes. No consistent or comprehensive reporting or monitoring is available for mine closures on private lands.

Based on a review of topographically mapped mining symbols, the California Department of Conservation's Office of Mine Reclamation estimates that there are more than 47,000 abandoned mining sites in California, some with multiple openings or points of access. Approximately 62,000 hazardous abandoned mine openings are estimated to exist in the state, about 31% of which are located on private lands, 67% percent on federal lands, and about 2% on state lands (see also California Department of Conservation 2000). An unknown but probably small fraction of mine openings are likely to be suitable for Townsend's big-eared bats. All are potentially subject to closure by federal, state, private, or local action. Mine closures in California in response to perceived safety hazards, particularly on public lands, are common.

No comprehensive report of mine closures in California has been compiled. An inventory of National Park Service lands in California (14 units) reported 7,337 hazardous openings and 402 closures (National Park Service 2001). Over 12,000 mine properties in California and northwest Nevada are believed to be on BLM land, and about another 5,000 yet unrecorded are likely on BLM land, but no comprehensive inventory has been conducted (BLM 2003). The number of potentially unsafe mine openings at these approximately 17,000 BLM sites is unknown. The Forest Service estimates that at least 154 closures for physical hazards were done in California national forests from 1996 to 2002 (J. Clayton, pers. comm. 2003). By some estimates, as many as 200 or more bat-compatible mine closures have occurred in California, though consistent standards for the Townsend's big-eared bat have not been applied (Milford 2000). While some bat-compatible closures have resulted in significant increases in colony size, (as reported in Pierson and Rainey (1998), the Death Valley population of bats found in a mine adit increased once a protective gate was installed), the contribution of such actions to statewide recovery efforts is not yet known. Bat-compatible gating may be the best alternative in some situations, though Burghardt (2001) reports that gates intended to be bat-compatible apparently caused a Townsend's big-eared bat colony to abandon its Arizona roost for reasons not yet understood.

Some of the available but unoccupied roosts discussed in Pierson and Rainey (1998) were abandoned mines that were gated improperly so as not to accommodate bats.

The California Office of Mine Reclamation recently began a program of abandoned mine remediation. As of 2003, of 56 mining "features" addressed at 23 sites, roughly half were fenced, and 7 (6 sites) were gated in a bat-compatible fashion (D. Craig, pers. comm. 2003). Depending on configuration, fencing may or may not leave mine entrances accessible to Townsend's big-eared bat. Some of the remaining features (those not fenced or gated) were filled with soil or foam or collapsed to achieve closure, rendering them unusable by bats.

Recently, the American Reinvestment and Recovery Act (ARRA) has accelerated the number of mine closures on public lands, due to greater availability of funds for such work. It remains to be seen whether these closures will be made compatible with bat use (Pierson et al. 2011). If they are done without regard for bat-compatibility, additional mine habitat for Townsend's big-eared bat will be lost.

Abandoned mines are particularly important habitat for Townsend's big-eared bat in California's desert regions, where natural caves tend to be rare. The western Sierra Nevada foothills are another region where mines play an especially significant role in supporting populations of Townsend's big-eared bat (Pierson et al. 2011). Widespread mine closures in these regions, in the absence of protective measures, could seriously diminish regional populations of the species.

As mine closures and renewed mining are ongoing, these threats are immediate and continuing for the foreseeable future. The degree of threat is severe because the activities are widespread and renewed gold mining is on the rise. Although there is increasing awareness of the need for consideration of bats and installation of bat gates, strict habitat protections for Townsend's big-eared bats are lacking and safety considerations often drive closures of old mines. Many mines are on private lands and may be subject to impacts without detailed environmental consideration.

Roost inundation by construction of dams

Most reservoirs in California have been placed on rivers draining the Sierra Nevada, Klamath and Trinity Mountains, at the same elevations favored by Townsend's big-eared bats for maternity roost sites. Many of the known caves used by the species are in river drainages or near the shores of current reservoirs. Townsend's big-eared bat roosts have been impacted by past dams. For example, at least one former significant cave roost, along the Stanislaus River, is known to have been inundated by the damming of the river, forming New Melones Reservoir (Pierson & Fellers 1998).

Proposals to build or raise dams in the state currently threaten known populations of Townsend's big-eared bat. For example, proposals to raise the level of Lake Success, a reservoir on the Tule River, would impact Townsend's big-eared bat roost sites. In addition, proposals to raise Shasta dam and the water level of Lake Shasta would impact two important Townsend's big-eared bat maternity colonies known to occur on National Forest lands near Lake Shasta (Pierson & Fellers 1998). Other dam sites or raises are proposed and the affected lands may not have been fully

surveyed for Townsend's big-eared bat roosts.

Inundation by dams also kills riparian vegetation that provides suitable foraging habitat and movement corridors for Townsend's big-eared bats.

A great number of the hydroelectric dams in the state are coming due for their fifty-year permit review and renewal by the Federal Energy Regulatory Commission. It is not clear whether the environmental review process will include any issue pertaining to bats, other than bat use of hydro-electric facilities for roosting, and the need for safe bat exclusion, if necessary. However, the review process should include indirect impacts to bat habitat, as well. For example, fluctuating water levels in reservoirs and alteration of downstream flows affect riparian areas important to bats for foraging. The clearing of forests for installation of power lines or water diversion corridors can also harm bat habitat and bat populations (Pierson et al. 2011).

As evidenced by active proposals for dam siting or raising that would impact Townsend's big-eared bat, this threat is immediate. Significant roosts would be threatened, therefore this is a severe threat.

Deterioration or destruction of building roosts

Most known Townsend's big-eared bat building roosts are in abandoned structures that are generally in a poor state of repair. Even if maintained, such structures have a limited life expectancy relative to cave roosts. With increasing suburbanization, many historically known building roosts have been demolished or renovated to the exclusion of resident bat colonies. Of 17 buildings known to have supported Townsend's big-eared bat maternity colonies prior to 1980, 11 (65%) had been demolished, renovated, or otherwise altered in such a way as to exclude the colony by 1990 (Pierson & Rainey 1998). For example, an abandoned ranch house used by a coastal northern California colony was scheduled for demolition when a Townsend's big-eared bat colony was first discovered. The previous roost for this colony was likely a privately owned deteriorating building in a town nearby, from which a Townsend's big-eared bat colony was excluded in the 1970's when renovations converted it to an upscale bed-and-breakfast. To protect this colony, the park canceled plans for demolition and has conducted repairs to insure the persistence of the structure.

The Santa Cruz Island colony of Townsend's big-eared bats uses an abandoned human-built structure and potential construction on or demolition of this property threaten the bat population there. The landowner, the National Park Service, has considered excluding the bats. The building's roof was recently torn off and replaced, which temporarily adversely affected the bats. Off national park lands, it is unlikely that maternity colonies would receive any consideration.

Both larger maternity colonies, as well as bachelor groups and mixed groups of non-reproductive bats, may occupy buildings and other structures. Smaller groups are more likely to escape notice, and as a consequence, may be unintentionally destroyed in the course of renovation or other changes to structures (Pierson et al. 2011).

Disturbance at buildings, just as with disturbance at caves and mines, is also an issue for this sensitive species (see Disturbance, below). Illegal or incompetent exclusion, or outright killing of bats by pest control operators, is discussed under Pest Control Operations, below. The burning of abandoned buildings also causes loss of building roost habitat, and is discussed under Vandalism, below.

Aging, demolition, fire and other threats to buildings used as roosts by Townsend's big-eared bats are ongoing and immediate. The degree of risk is high because although buildings are not the most common roosts, the species cannot afford to lose even a few maternity roosts. The risk to coastal populations is severe, since buildings account for nearly all of the known roosts in these areas.

Repair and renovation of bridge roosts and other anthropogenic roosts

Bridges are a special category of anthropogenic structure that may be used for roosting by Townsend's big-eared bats. The species uses bridges and other transportation structures (such as culverts) infrequently, but in certain areas, such as the Sierra Nevada foothills, bridges appear to provide an important alternative to natural caves or mine habitat. Generally, older bridges are more conducive to use by Townsend's big-eared bats. Retrofitting and renovation of such structures can result in the loss of a roost site (Pierson et al. 2011).

Townsend's big-eared bats may roost in other structures, as well, such as hydroelectric dams or abandoned railroad tunnels. Renovations, repairs, or earthquake retrofitting may harm, exclude, or disturb bats to the point of causing them to abandon these types of roost sites.

Threats to bridges, dams and other anthropogenic structures used by Townsend's big-eared bats are ongoing and immediate, as such structures are renovated, retrofitted or replaced. The importance of human-made structures as roosts varies regionally. The degree of threat overall is moderate because although these types of structures are not commonly used by Townsend's big-eared bats, the species cannot afford to lose even a few roost sites.

Loss of riparian habitat

Radio tracking and light-tagging studies conducted at Pt. Reyes National Seashore demonstrated that riparian vegetation is important foraging and movement habitat for Townsend's big-eared bat (Pierson & Fellers 1998). According to Pierson, conversion of cottonwood riparian habitat to agriculture along the lower Colorado River provides the most likely explanation for observed declines in Townsend's big-eared bat and other bat species in this area. Foraging areas adjacent to water sources may be essential for desert populations (Pierson & Fellers 1998). The widespread invasion of tamarisk (*Tamarix* spp.) in desert areas also has contributed to loss of native riparian vegetation.

Throughout California, there have been dramatic losses of riparian habitat, mainly due to agriculture, including livestock grazing as well as crop production, and urban development. Dams for flood control and water withdrawal inundate riparian habitat. They also alter natural flood regimes downstream of dams, which can lead to the eventual loss of cottonwood and sycamore stands that depend on periodic flooding. Water drawdown and diversion also alters and degrades riparian habitat. Mining activities can be water-intensive, and particularly in arid regions, water drawdown for mining can have a significant impact on riparian habitat (Pierson et al. 2011). Mining itself can directly destroy riparian habitat; e.g., dredging, bulldozing, construction of mining access roads along streams, etc. Similarly, logging and road construction associated with timber harvest has had a significant effect on riparian areas in certain parts of California. Channeling and riprapping of rivers for flood control is yet another way that riparian areas important to bats may be damaged or lost (Pierson et al. 2011).

While a variety of restoration efforts are underway, California is far from regaining its former extent of riparian habitat; therefore this threat is ongoing.

Urban and Suburban Development

Urban and suburban expansion affects Townsend's big-eared bats in a variety of ways. The effects of urban and suburban development include destruction or modern "upgrading" of old buildings that have historically served as bat roosts; clearing of forests that may be used for foraging, or large old trees used for roosting, for development; increases in human disturbance, including cave recreation, mine exploration and hobby prospecting, and vandalism, associated with increased urban and suburban populations near Townsend's big-eared bat hibernacula and roosts; loss of riparian habitat due to urbanization and increased water withdrawal; inundation of roosts by reservoirs, also associated with increased human populations requiring more water, flood control, and hydropower (Pierson et al. 2011). Urban and suburban development may have other effects on Townsend's big-eared bat, including release of pollutants into the environment, loss of habitat that supports prey species, and even issues that for the most part can only be speculated upon, such as increased automobile/bat collisions, and more frequent contact between humans and bats in built environments, leading possibly to increased "bat hysteria" and persecution of remnant bat populations.

The particular ways in which urbanization leads to the loss of Townsend's big-eared bats are likely complex and interrelated and difficult to tease apart. There is a dearth of detailed information regarding the impacts of urban/suburban development on Townsend's big-eared bat in California. Nonetheless, biologists considering the status of bats in California overwhelmingly concluded that urban development was a leading issue for bat conservation, and that Townsend's big-eared bat was one of the "highest risk" bat species on this issue.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Collection for scientific purposes

Though the harvesting of individual Townsend's big-eared bats for museum or academic specimen collections is no longer a common practice, it may have contributed to historical declines. Pierson and Rainey (1998) report several incidences wherein entire colonies may have been destroyed by collection for scientific purposes; the Olema Inn colony (Marin County) was almost entirely extirpated in the 1970s, and a series of collections from the isolated Santa Cruz Island population were likely responsible for its decline there. Several institutions have single-site collections of more than 75 Townsend's big-eared bats. This approaches the size of the majority of documented populations of this species.

Activities related to research and monitoring have also been documented to harm populations of this highly sensitive species: Twente (1955) reported that many individuals abandoned a hibernaculum after being banded, and most were never recaptured. Monitoring activities have been shown to instigate movement to alternate hibernacula; such disturbance may have detrimental effects on bats' already-marginal winter energy budgets (Humphrey & Kunz 1976).

Recently, the appearance of white-nose syndrome in the eastern U.S. has generated new interest in cataloging and studying hibernating bats in the West. Biologists have a concern and a desire to better understand where bats occur and how many there are, before the invasive fungal disease spreads to the western part of the country. Public land managers need to know more about where bats occur and which sites are important hibernacula, in order to make better management decisions about where to focus protective actions. Greater scientific information is desirable, but increased research and monitoring activity at Townsend's big-eared bat roosts and hibernacula may lead to increased disturbance, depletion of energy reserves during hibernation, and diminished reproductive success. Biologists will need to carefully consider whether and how to survey Townsend's big-eared bat sites, in order to obtain valuable information in advance of white-nose syndrome, but without causing harmful increases in stress and disruption to the bats.

All of the above said, public agencies and universities already exercise a degree of oversight, so we estimate the degree of this threat is small.

C. Disease or Predation

Disease

The most significant disease threat to Townsend's big-eared bat is the westward spread of white-nosed syndrome (WNS). Since discovered in 2006, white-nose syndrome has been rapidly spreading throughout the eastern United States, killing up to 6.7 million hibernating bats (USFWS 2012a). As with other infectious diseases, WNS appears to have multiple routes of transmission. Bats spread the deadly fungus to each other, and likely to new cave or mine environments as well. There is strong evidence that people have also spread the fungus into new areas, beginning with the appearance of the fungus at the disease epicenter, a heavily visited commercial cave in upstate New York. Biologists now believe the fungus came to North America from Europe. The fungus is found on bats in many European caves, but does not cause

mortality or even many ill effects.

In order to slow the potential spread of WNS by people, some land owners and public land managers have closed caves, either in targeted fashion or on a broad basis. Winter season closures had been a management strategy at both private and public caves for some time, pre-WNS, when the goal was simply to limit human disturbance to hibernating bats. For Townsend's big-eared bats, which roost in caves and mines in summer and hibernate in them in winter, winter-only closures do not eliminate human disturbance (although the particular sites used by Townsend's big-eared bats for summer versus winter may very well be different). An additional consideration for land managers and private owners of caves will now be that the WNS fungus can likely be spread in summer as well as winter. Spores deposited in a cave or mine on the boots, clothing or gear of a person, may remain viable for months or longer. So, winter-only closures are unlikely to be a sufficient management approach for Townsend's big-eared bat conservation, either from the perspective of minimizing human disturbance in summer, or lowering the risk of WNS fungal transmission by people.

To date, the threat of WNS spreading to the West has resulted in very little change with regard to cave management on either public or private lands in California. Lava Beds National Monument is one of the most important areas in California for the Townsend's big-eared bat (see Southern Cascades ecoregion). It also attracts cave recreationists from around the world (Pierson et al. 2011). The Monument has instituted screening procedures and requires that no gear from WNS-affected states be brought for use in the Monument. Similar policies have been instituted by the National Park Service at Pinnacles National Monument and Sequoia-Kings Canyon National Parks, the other main "cave" parks in California. Several important hibernating and roosting sites for Townsend's big-eared bat occur on national forest land, including the Stanislaus, Sequoia, Lassen, and Shasta-Trinity National Forests, and Bureau of Land Management lands (Pierson et al. 2011). Although the USFS has declared emergency cave closures in its Eastern, Southern, and Rocky Mountain regions, beginning in 2009, no national forest caves in California have been closed as a precautionary measure against the potential human spread of WNS. The BLM has essentially taken no action on any of its lands to close caves, except in New Mexico, where the BLM cooperated in an interagency WNS response plan; a total of approximately 30 caves, on various public land ownerships, are now administratively closed to human access as a result. Decontamination protocols for WNS and gear restrictions are also not yet required for cave visitors on California federal lands.

Environmental conditions conducive to WNS fungal growth appear to exist in caves and mines throughout much of California, from the northern regions to the southern Sierra Nevada foothills. The temperature range for growth of the fungus is 5-15˚ C. It does not grow above 20˚C. Most hibernating bats seek sites that maintain temperatures at 5-10˚ C. The optimal temperature range for fungal growth is 10-15˚ C. Caves as low in elevation and as far south as the southern Sierra Nevada foothills maintain year-round temperatures at 12-18˚ C (Pierson et al. 2011). Thus, it is possible that fungal growth could occur in cave and mine sites dispersed through much of the state.

One cause for hope for Townsend's big-eared bats is that WNS has not infected other subspecies of the big-eared bat found in the eastern U.S., including the Virginia big-eared bat (*C. t. virginianus*) or the Ozark big-eared bat (*C. t. ingens*). It is unclear why these subspecies have

thus far avoided the emergent fungal disease, which has affected seven other bat species. Biologists do not yet know how WNS will affect western bats should it continue to spread, and in which western species it is likely to cause mortality.

Predation

Predation on Townsend's big-eared bats is common, given the vulnerability of roosting individuals, particularly juveniles. Owls, snakes, hawks, and carnivorous mammals have all been reported to prey on bats of one species or another (e.g., Tuttle 1994; Pierson et al. 1999). Natural levels of predation are not thought to influence population dynamics in Townsend's big-eared bat. However, human presence can artificially increase the abundance of some native predators (e.g., raccoons), and humans also introduce and provide support for non-native predators such as rats, cats, and dogs. Pearson et al. (1952) observed domestic cats carrying dead Townsend's big-eared bats in California. Fellers (2000) documented severe effects of predation by introduced black rats (*Rattus rattus*) on a maternity colony of Townsend's big-eared bats roosting in an attic; rats apparently killed all young produced by the colony of 215 female bats before the young became volant. These studies suggest monitoring of predators should be considered and control instituted where necessary and appropriate.

The threat of disease is possible, with WNS likely to spread into California in the foreseeable future. The degree of threat to Townsend's big-eared bat is unknown, but potentially severe if the subspecies proves susceptible to the fungal disease**.**

Predation is ongoing and presents a moderate threat. Juveniles may be completely wiped out in some situations (Fellers 2000).

D. Inadequacy of Existing Regulatory Mechanisms

To date, existing regulatory mechanisms have been inadequate to halt or reverse the statewide decline in the populations and habitats of the Townsend's big-eared bat. The inadequacy of existing mechanisms is ongoing and therefore an immediate threat. This petition seeks to redress this threat by bringing Townsend's big-eared bat under the protection of CESA. In the absence of such protection, Townsend's big-eared bat is under severe threat and likely to go extinct.

1. Federal Regulatory Mechanisms

Federal Species Status

The Townsend's big-eared bat is currently afforded no protection under the Federal Endangered Species Act. The Townsend's big-eared bat was formerly recognized as a C2, species of concern until USFWS abandoned this category in 1996. Although this category did not provide any regulatory protection, USFWS did in some cases encourage federal agencies to consider "species of concern" and to adopt conservation recommendations during ESA Section 7 consultation (e.g., informal consultation with East Bay Regional Parks regarding a mine closure in Black Diamond Mines Regional Park, USFWS reference number 1-1-95-I-952, July 5, 1995). However, these informal measures were implemented only at the discretion of the landowner,

have not provided sufficient protection for Townsend's big-eared bat, and have largely ceased since the species of concern category was eliminated.

National Environmental Policy Act

For federal actions, because the BLM and Forest Service consider the Townsend's big-eared bat a special status species in the state, it may receive some National Environmental Policy Act (NEPA) review. NEPA is a disclosure law that only requires the agencies to consider the impacts of their actions on the environment, including the Townsend's big-eared bat, but does not require selection of an environmentally benign alternative. NEPA typically only applies to major projects and programs.

Federal Cave Protections

Federal cave protections may be found under regulations for the Departments of Interior and Agriculture (e.g., Code of Federal Regulations, Title 36, Part 2 [36 CFR 2]; 36 CFR 261; 36 CFR 290; 43 CFR 37). Federal regulations protect caves only on federal lands (e.g., national forests, national parks), where prohibited acts include harming wildlife, curtailing free movement of wildlife, discharging firearms, firecrackers or other explosives, throwing rocks or other items, and, in national parks, smoking.

The Federal Cave Resources Protection Act of 1988 (16 U.S.C. 4301-4309) mandated that the Secretaries of the Interior and Agriculture list "significant caves" within 21 months of enactment of the legislation, and that this list be actively maintained and updated. Caves may be designated as significant for their importance to wildlife (36 CFR 290; 43 CFR 37.11(c)(1)). All caves on National Park Service-administered lands have been designated "significant" (43 CFR 37.11d); and the Forest Service has delegated designation of significant caves to employees at the individual forest level. No centralized list of significant caves appears to be available, and some local delegates appear to be far behind in designating significant caves within their jurisdictions. Protections provided by the 1988 act arguably apply only to caves officially listed as significant; but some of the federal regulations cited above regarding caves appear to apply to all caves on certain federal lands, regardless of listing as significant or lack thereof.

The cave protections discussed here are limited in their application in California (to caves on public lands). Enforcement is rarely pursued and penalties are rarely imposed, despite common reports of cave vandalism. Listing of caves as significant under the 1988 federal act does not appear to be a priority. Further, although protection of caves is highly valuable to Townsend's big-eared bats, mines and other roosts constitute more than half of maternity roosts known for the species (Pierson & Fellers 1998), and cave laws do not protect these roosts.

2. State Regulatory Mechanisms

California Fish and Game Code

Bats are non-game mammals under California Fish and Game Code, §4150. As such, bats are protected from being taken or possessed without a permit (Fish and Game Code §4152; take means hunt, pursue, catch, capture, or kill, or attempt any of these; §86). The State may pursue

civil damages for violation of these sections, but enforcement is rare. A major exception in the law is that bats may be taken or harassed for the purpose of preventing damage to property, which allows building owners to exclude bats from human-made structures where they roost. Section 251.1 of the California Code of Regulations, Title 14, otherwise protects bats and other mammals and birds from harassment (intentional disruption of normal behavior, including but not limited to feeding, breeding, or sheltering). These provisions do not provide protection for bat habitat.

California Species Status

Currently, Townsend's big-eared bat has no protection under the California Endangered Species Act. The species is designated a California Special Concern species by CDFG. This category carries no protective weight other than to enhance the likelihood of being considered in NEPA and CEQA analyses (see below). The stated purpose of such designation is "to halt or reverse their decline by calling attention to their plight and addressing the issues of concern early enough to secure their long term viability" (CDFG). However, the factors leading to the decline of Townsend's big-eared bat continue.

California Environmental Quality Act

Under the California Environmental Quality Act (CEQA, §15380), Townsend's big-eared bat receives some consideration because of its status as a state Species of Special Concern. As routinely implemented, however, CEQA is primarily a disclosure law, and avoidance or mitigation of effects is largely at the discretion of the acting agency. Further, only limited categories of actions come under CEQA review. For example, destruction or disturbance of roosts at existing structures typically would not come under CEQA review (B. Bolster, pers. comm. 2003; Pierson & Fellers 1998). The CBCP notes that even when impacts to bats are considered in CEQA analysis, the impacts are addressed through mitigation measures, and take and/or loss of roost habitat may still be the result (Pierson et al. 2011).

It is worth noting that neither CEQA nor NEPA nor other laws mentioned here, other than federal and California ESA, include a recovery component. That is, without being included on the list of endangered and threatened species, no regulatory mechanism is in place that seeks the recovery of the Townsend's big-eared bat from its reduced and vulnerable condition. In the same vein, CEQA and NEPA do not require consideration of unoccupied areas, even if such areas were formerly valuable habitat (e.g., previously occupied by large colonies), and are important for recovery of the species.

California Cave Protection Act

Caves and their physical and biological resources, including bats, have protections under the California Cave Protection Act (California Penal Code §623). Killing or harming cave wildlife by any means is prohibited, as is burning any material that produces any smoke or gas that is harmful to them. Penalties are imprisonment for up to one year or a fine up to $1000 or both. The statute applies to knowing and intentional acts, and may be bypassed with written permission of the cave owner. Presumably cave owners can do anything otherwise legal in or with their own caves–even destroy them if other laws are met.

Unfortunately, the cave statute discussed above is limited in its application in California (to caves on private lands when damage is done without written permission of owner). Enforcement is rarely pursued and penalties are rarely imposed, despite common reports of cave vandalism. Further, although protection of caves is highly valuable to Townsend's big-eared bats, mines and other roosts constitute more than half of maternity roosts known for the species (Pierson & Fellers 1998), and cave laws do not protect these roosts.

Various federal and state agencies, often in cooperation with other agencies or organizations, have policies and programs intended to benefit bats, including Townsend's big-eared bat. Nonetheless, the CBCP cites the lack of any interagency effort to date to identify the most important bat caves in the state and to take coordinated, appropriate management action to protect them—a key need. This issue is especially pressing for hibernation sites in caves in the northern lava bed country (Pierson et al. 2011). Altogether, although these efforts have created some localized successes, they are non-regulatory in nature, and, have not been able to stop or reverse the statewide decline of the species.

California Bat Conservation Plan

The California Bat Conservation Plan (CBCP) is currently in draft form (Pierson et al. 2011) and has not been released for public review. The team developing the plan is reviewing conservation issues, ecoregions and species accounts to produce a comprehensive conservation plan for California bat species. Since this plan is not complete, has not been accepted by regulatory agencies and is not yet funded, potential protections for Townsend's big-eared bat resulting from the plan cannot be considered in the ESA listing process. Listing under California's Endangered Species Act is required to ensure long-term survival of this species.

E. Other Natural or Anthropogenic Factors

The roosting biology of Townsend's big-eared bat, leads them to roost in highly visible clusters on open surfaces, near roost entrances, making them highly vulnerable to disturbance. Low reproductive rate and high roost fidelity increase the risks for the species (Pierson & Fellers 1998; Pierson et al. 1999). Additional natural and anthropogenic threats are discussed below.

Recreation and other Disturbance

Human disturbance of caves and mines in California is the most widely cited reason for the abandonment of historic Townsend's big-eared bat roost sites (Pierson & Rainey 1998; Pierson & Fellers 1998). According to Pierson et al. (2011), the primary threats to bats from recreational caving are:

1. Disturbance of roosting bats that may result in displacement, compromised reproductive success, or death;
2. Deliberate vandalism that may result in death of bats; and/or
3. Introduction of pathogens, particularly *G. destructans*.

Townsend's big-eared bats typically respond strongly to disturbance of maternity colonies, so much so that simply entering a maternity roost can cause a colony to abandon the young or move to another roost (Pearson et al. 1952; Graham 1966; Stebbings 1966; Mohr 1972; Humphrey & Kunz 1976). Alternate roosts are likely to be of sub-optimal quality in terms of temperature, proximity to foraging areas, or other factors that may expose bats to greater risk of predation, substantially increase energy expenditures, or otherwise compromise their reproductive success and survival. The threat of energy imbalance is especially significant during pregnancy and lactation, which are metabolically very demanding of adult females.

The species is also highly vulnerable in its hibernacula. Townsend's big-eared bats often roost well within human reach and are defenseless in their hibernating state (Pierson & Rainey 1998). Disturbance during hibernation may cause bats to awaken prematurely, expending energy reserves that often cannot be spared. Each arousal can consume the equivalent of between 10 and 30 days of fat reserves (Thomas et al. 1990; Tuttle 1991). Though bats may return to torpor after disturbance, the remaining energy reserves may not be adequate to last the winter (Amer. Soc. Mammal. 1992).

The sensitivity of Townsend's big-eared bat to disturbance is reflected in the extraordinary measures recommended to reduce disturbance when conducting roost surveys. These measures include limiting group size; minimizing use of lights and using only red lights or night-vision equipment; maintaining complete silence, placing tape over zipper pulls and not carrying equipment that might clank or jingle, not wearing fabrics that make rustling or scuffing noises (e.g., nylon); and minimizing time spent near the bats (e.g., Roswell RA, undated, Jagnow 1998). These measures are not widely known outside the research and specialized caving communities, and probably would be incompatible with most cave or mine recreation.

Most of the cave sites presently or historically known to be Townsend's big-eared bat roosts are now subject to considerable human disturbance and heavily used for recreational purposes. Recreational activity at mines including artifact collection and searching for mineral specimens is also a problem (Pierson et al. 2011).

In California, a study of 58 formerly occupied (pre-1980) maternity roosts found that only 20 (34%) were still occupied, and that 15 (26%) remained apparently suitable physically but were unoccupied. All 15 available but unoccupied sites were subject to between moderate and high levels of human disturbance (Pierson & Rainey 1998), and included caves (7), mines (6), and structures (2). Pierson and Rainey (1998) also found that at many of the sites still occupied, disturbance levels were sufficiently high that the sites were not reliably occupied during periods when they should be, and/or population numbers were lower. Pierson and Fellers (1998) reported signs of human intrusion at 5 of 11 caves they surveyed for hibernacula: footprints in several, evidence of a fire and of a climbing route, and they encountered parties of people in one cave during their survey.

A few specific examples are given below: In May 1998, an occupied roost, possibly a maternity roost, was discovered at a mine on BLM land in Siskiyou County. In a repeat survey in June

1998, an active campsite was found outside the mine and only two bats were present within (Pierson & Fellers 1998). Samwell Cave in the Shasta-Trinity National Forest was once an important roost but now receives too much recreational visitation (Pierson & Rainey 1998). A cave within Stanislaus National Forest in Siskiyou County was formerly an important Townsend's big-eared bat hibernaculum, but currently has no hibernating population due to high recreational use. Although recommendations for the protection of the cave were submitted to the Forest Service in October 1991, no effective protection measures have been implemented (Pierson and Fellers 1998). Disturbance may cause bats to be driven from preferred roosts to lower quality sites: for example, a colony in San Bernardino County that had been disturbed in its preferred roost was found at a roost with standing water, an atypical setting for a Townsend's big-eared bat roost (Pierson & Rainey 1998). Lower quality roosts are likely to lower reproductive success and survival of Townsend's big-eared bats, as has been shown for the big brown bat, *Eptesicus fuscus* (Brigham & Fenton 1986).

Another example of the effects of disturbance and failure to control disturbance comes from a pair of caves with a Townsend's big-eared bat colony on U.S. Forest Service land in Shasta County. The colony is monitored irregularly on a volunteer basis by the Shasta Area Grotto (a chapter of the National Speleological Society), in cooperation with the Klamath and Shasta-Trinity National Forests (Pierson & Fellers 1998). The site was identified in 1966 as a significant Townsend's big-eared bat maternity colony. Due to heavy recreational use, and the installation of an inappropriate gate, this cave was abandoned by the species many years ago. Despite recent replacement of the gate, the colony has not returned to the cave, since the gate does not protect the chamber where visitors congregate and the bats prefer to roost. Also, the Forest Service continues to issue keys on request to recreational users. A substantial colony of Townsend's big-eared bats was located in 1996 at a cave nearby and is likely to have been the same population that abandoned the previously occupied, disturbed site. This new cave, also under the jurisdiction of the Forest Service, has been subjected to frequent visitation disturbance for mapping and cave inventory (Pierson & Fellers 1998).

This degree of habitat loss and degradation through disturbance is a severe threat to the species. Further evidence that disturbance is a major factor in the decline of Townsend's big-eared bat is provided by the accumulating evidence that colonies respond positively, and numbers of animals often increase dramatically, when people are prevented from entering roost sites –e.g., through monitoring and enforcement or installation of "bat friendly" gates (Pierson et al. 1991; Riddle 1995; Stihler & Hall 1993; Pierson & Fellers 1998, Pierson & Rainey 1998, Pierson et al. 1999). For example, a hibernaculum in Lava Beds National Monument has increased from 134 to over 600 bats from 1988 to 1994 after being protected. A hibernaculum in Death Valley increased from 17 to 54 bats within one year of being gated. Such population increases in response to reductions in disturbance (e.g., via appropriate gating) have also been documented for the Ozark big-eared bat (USFWS 1995).

California's human population has grown from 5.7 million in 1930 (US Census Bureau 2000) to 38 million in the year 2011 (US Census Bureau 2012), and is expected to be close to 43 million

by 2025 (California Dept. of Finance 2012). As a first approximation, we may expect human visitation of caves and mines–and consequent disturbance and degradation of vital Townsend's big-eared bat roosting habitat–to grow along with the state's population.

Regionally, issues associated with disturbance of bats at caves and mines are of particularly serious concern to biologists in the northern California lava country, in the Klamath Mountains, Southern Cascades, Modoc, Northwest Basin and Range, and in the Sierra Nevada foothills (Pierson et al. 2011).

Disturbance and vandalism of caves and other roosts are ongoing, widespread, and affect critical roosting habitat. This threat is severe, jeopardizing the continued existence of the species, and is immediate and continuing.

Vandalism

Evidence of vandalism, sometimes clearly directed at the bats, has been observed at several Townsend's big-eared bat roosts (Pierson & Rainey 1998; Pierson & Fellers 1998), and is a well-documented phenomenon in caves and mines and toward bats (Tuttle 1979).

Fire can be a highly damaging form of vandalism. In October 1992, a hibernating population of over 10,000 Townsend's big-eared bats was discovered in New Mexico, 100 meters deep in a timber-lined mineshaft. When the site was revisited in February 1993, the shaft had been burned. Several hundred dead animals could still be seen hanging from the walls, and thousands more were presumed dead (Pierson & Rainey 1998). Burghardt (2001) reported an incident after gating of a mine used by bats (species not specified): "Individuals annoyed by being excluded from the mine and aware of the bat colony threw burning sticks through the gate directly under the roost." Numbers at the roost went from 200 to 20, perhaps due to effects of the smoke (Burghardt 2001). Smoke, toxic chemicals released by burning materials, depletion of oxygen, and the disturbance of fire all threaten bats. Empty buildings that shelter bats are also targets of vandals, and 4 of 17 buildings (24%) in California known to house Townsend's big-eared bat maternity colonies prior to 1980 had been burned as of Pierson and Rainey's (1998) subsequent survey.

Some people have irrational feelings about bats, and researchers report frequent vandalism and destruction, citing findings of bat colonies being burned, crushed, or otherwise destroyed, dead baby bats in an arranged pile, or individuals removing bats from roosts for use in pranks (Pierson & Rainey 1998). An account on the California Dept. of Fish and Game website described: "Caves and mines [used for 'parties'], frequently strewn with beer cans, shotgun shell casings, fireworks, or other litter [and] evidence of cruel vandalism in the form of hair spray cans, matches, and incinerated bats [being] not uncommon in easily accessible caves and mines" (Gruver and Keinath 2006).

Sometimes vandalism may have a more purposeful motivation--one Townsend's big-eared bat colony in an area of a proposed project was disturbed after a student located the colony and sought independent confirmation. When another researcher arrived to examine the roost, the bats

were gone and the site showed evidence of disturbance. (The project went forward: personal communication, 2003, name withheld by request.)

Land managers consistently report that strong measures are needed to keep trespassers out of underground openings in accessible, high-traffic areas, and even in remote areas where openings are known. Determined vandals can breach almost any barrier. Gates or fences at cave or mine openings require constant monitoring and repair due to vandalism (Burghardt 2001, Stabler & Herder 2001). The National Park Service has made repeated efforts over a number of years to protect a cave used by Townsend's big-eared bat in Sequoia-Kings Canyon National Park, but every gate installation has been breached and the cave repeatedly vandalized (Pierson & Fellers 1998).

Vandalism is ongoing and therefore immediate, and severe in the degree of threat it poses, jeopardizing the future of the species. Maternity roosts and hibernacula are the most critical and vulnerable sites.

Changes in the distribution and abundance of prey

Humans have caused many alterations of insect habitat that may affect Townsend's big-eared bats indirectly through reduction of prey species. Moths are the primary prey of Townsend's big-eared bats, and agriculture and urbanization have greatly altered or eliminated large areas of moth habitat. The great majority of moths preyed upon by the bats are herbivorous and may be more or less selective of native plant species as food (e.g., oak moths). By eliminating large areas of native vegetation or largely replacing it with introduced species or with monocultures, the moths fed upon by Townsend's big-eared bat may be reduced in diversity and abundance. Unfortunately, little data is currently available to assess the extent of any such effect. Dr. Patricia E. Brown (pers. comm., 2004) attributes a general decline of Townsend's big-eared bat along the lower Colorado River to loss of native habitat that once supported foraging by the species (see also Pierson & Rainey 1998, p. 24).

Perkins and Schommer (1991) assert that spraying Bt (*Bacillus thuringiensis*) may suppress reproduction of Tussock moths and spruce budworms to the extent that reproduction in Townsend's big-eared bat is also suppressed.

More information also is needed about the impact of artificial lighting on moth diversity and abundance. Outdoor lights attract many moths; less obvious is that these lights disturb their behavior and may inhibit reproduction and survival of many moth species (Frank 1988; Eisenbeis 2002). Frank (1996) quotes an entomological work from 1900–relatively early in the history of outdoor electric lighting–as saying,

> "While employed in Washington, D.C., I made a splendid collection of the moths of that region simply by going the rounds of a number of electric lights every evening. The lamps of the Treasury Building were sometimes very productive of fine specimens and the broad stone steps and pillars were frequently littered with moths. . . Besides making the acquaintance of a number of insects new to me, I met several entomologists who, like myself, had been attracted to the lights by the abundance of specimens."

Frank goes on to note, “Today lamps in big cities such as Washington, D.C., Philadelphia, and Boston rank among the worst places to collect moths or meet entomologists.” Although effects of lights on insects at the individual level are well recognized, population effects have been little investigated. We are not aware of data that find Townsend’s big-eared bats foraging around outdoor lights, nor of quantification of lighting effects on moth species abundance in California.

Forest management activities—particularly timber harvest and spraying—kill moths and other prey insects and may reduce the prey base for Townsend’s big-eared bats (Sample et al. 1993, Sample & Whitmore 1993). Perkins and Schommer (1991) suggest that Bt sprays may suppress tussock moth and spruce budworm moth reproduction enough to suppress reproduction in Townsend’s big-eared bats for one or two years (Pierson & Fellers 1998).

Changes in prey abundance are an ongoing threat. Surveys along the lower Colorado River, where there appear to be available, undisturbed roost sites that are unoccupied, suggest reduction of prey species through habitat alteration (for agriculture) may be responsible for a significant portion of regional Townsend’s big-eared bat decline.

Wind energy

Wind energy development is a growing issue in California. State law mandates that by 2020, 25% of the state’s energy come from renewable sources. The majority of bats killed at turbines are migratory species, rather than hibernating species (such as Townsend’s big-eared bat). However, based on currently available information, the CBCP considers the Townsend’s big-eared bat at “medium risk” from wind energy. The species is “known to fly high when in open or returning to roost.” Research elsewhere has shown that where there is “high local bat activity by species that fly at turbine height, there is mortality of those species” (Pierson et al. 2011).

More information is needed to determine how wind energy may specifically affect Townsend’s big-eared bat. Meanwhile, wind energy development is proceeding rapidly, and because no bat species in the state have any regulatory status, there are no requirements that impacts to bat be analyzed when officials review wind projects (Pierson et al. 2011).

Environmental contaminants

Townsend’s big-eared bats are at risk from anthropogenic toxins in the environment because they are long-lived, mobile and active, consume between 40 and 100 percent of their body mass in prey each night, have high specific metabolic rates, live amidst potential toxic exposures, and rely heavily on fat storage and use for survival (Hickey et al. 2001; McCracken 1986; Clark 1981). There are three primary pathways for exposure to environmental contaminants: ingestion (water or insect prey), inhalation, and dermal/cutaneous. Townsend’s big-eared bats may also be impacted by reduced prey availability due to pesticide spraying.

1. Ingestion

Townsend’s big-eared bats in California are at risk from drinking contaminated water. For example, mining and drilling operations often produce contaminated ponds, including temporary pools on the surface of the ground or on tailings. Since bats can and do drink from very small

water bodies, even depressions not intended as ponds can expose bats to contaminants. Cyanide contamination from gold mining operations is thought to have decimated a population of Townsend's big-eared bat in east-central California (Clark 1991). Bat deaths at cyanide concentrations less than 20 parts per million have been reported (Clark 1991). In Nevada, fifteen mines reported killing at least 158 bats of undetermined species between 1986 and 1989 in cyanide solution ponds (Pierson et al. 1999). This probably represents the tip of the iceberg, since dead animals are notoriously hard to detect, especially those as small as a bat. Although bats comprised about 34 percent of the detected wildlife fatalities (Clark & Hothem 1991), they may be neglected in assessment of cyanide risks (Nevada Mining Assoc. et al. 1990; Pierson & Fellers 1998). Oil extraction waste pits or reserve pits are also known to cause bat mortality (Esmoil & Anderson 1995; Flickinger & Bunck 1987).

The risk posed by contaminated waters may be exacerbated in arid areas and dry seasons where water associated with mining or drilling may be the only nearby water (Pierson et al. 1999). Netting to exclude bats and provision of clean water sources can be effective in reducing impacts, but sometimes the contaminated features are so large that complete netting is extremely problematic (Clark 1991). Grading to reduce surface ponding and to direct runoff to netted and/or treated ponds may also be useful.

Water sources may also be contaminated by pesticides, which may drift, run off, seep, or be sprayed into the water. Standard application practices avoid spraying directly into water, but water sources used by bats can be so small that spraying operations overlook them. Effects of pesticide ingestion by Townsend's big-eared bat are discussed further below under dietary exposure.

Dietary exposure to pesticides and contaminants has been documented for other species of bats. Organochlorine compounds (e.g., DDT), mercury, and cholinesterase inhibitors (e.g., organophosphorus [OP] and carbamate pesticides) are some of the toxins that have been found in bats (Clark et al. 1996; Hickey et al. 2001; McCracken 1986). Over 150 million pounds of active ingredient of pesticides were applied in California in 2001, and 188 million pounds were applied in 2000 (CDPR 2002). For Townsend's big-eared bats, the most likely path of exposure to these compounds is through diet, which consists predominantly of moths (terrestrial herbivores), but also includes aquatic insects (some of which are predators, adding a potential aquatic exposure pathway; Dalton et al. 1986; Whitaker et al. 1977; Pierson et al. 1999). Mercury, for example, would be most likely to reach Townsend's big-eared bats in toxic concentrations after being magnified through aquatic food chains, although in a few areas, dissolved mercury may be of concern. Research may be needed on mercury in Townsend's big-eared bats near former placer mining districts of California, which could be accomplished through analyses on carcasses or fur.

Chemicals of greatest concern in the Townsend's big-eared bat diet are those that are somewhat persistent, tend to accumulate up food chains, and are stored in fat reserves in the body. DDT fits this description and for a time was registered by the EPA for use on bats, which it kills and harms quite dramatically (USGS 1998). Other chemicals that also fit these characteristics, such as PCBs, dioxin and furans, need to be investigated for accumulation in, effects on, and degree of

threat to the Townsend's big-eared bat in California.

Some OP and carbamate pesticides are persistent or even bioaccumulative in food chains, such as diazinon and carbofuran. OP pesticides have been implicated as immune suppressors and endocrine disruptors in amphibians (Kiesecker 2002). OP pesticides are heavily used in California on tree crops to control moth and other pests. For example, more than 1.6 million pounds of chlorpyrifos were applied to more than 1.3 million acres in California in 2001 (6th in acreage of application among all pesticides), and approximately 1 million pounds of diazinon were applied to nearly half a million acres (30th in acreage; CDPR 2002). Orchards may be suitable foraging habitat for Townsend's big-eared bats, although sampling in these areas has been minimal, and contaminated moths could be consumed by the bats in orchards or nearby habitats. Diazinon also is used extensively for structural pest control, where bats could be exposed to contaminated insects or surfaces. Chlorpyrifos, diazinon, and other pesticides drift from the agricultural Central Valley into the Sierra Nevada, where their residues have been detected in frogs in areas inhabited by Townsend's big-eared bats (Sparling et al. 2001). Frog tadpoles inside national parks in the Sierra Nevadas, far from the sites of application of these pesticides, have reduced cholinesterase activity (OP and carbamate pesticides function as cholinesterase inhibitors; cholinesterase is an enzyme essential to normal neural function in vertebrates, including bats).

Atrazine, a triazine herbicide heavily used in California, is an immune suppressor and a developmental disruptor in amphibians at concentrations commonly found in the environment (Hayes et al. 2002, 2003; Kiesecker 2002). The developmental processes disrupted in amphibians are similar in mammals (Hayes et al. 2002). Nearly 30,000 pounds of atrazine (active ingredient) was used on more than 7,700 acres of forest land in California in 2001 (CDPR 2002). Other triazine herbicides include hexazinone, which is commonly used on forest land in California: 45,000 pounds on 18,000 acres in 2001 (CDPR 2002). Hexazinone has not been subjected to the same scrutiny for sublethal biological effects (e.g., immune suppression, gonadal deformities) as atrazine. Townsend's big-eared bats are likely to be exposed to these herbicides, as well as even more widely used chemicals including 2-4 D, glyphosate, imazapyr, and triclopyr), by ingesting contaminated prey, by being sprayed directly (see Dermal, below), and by drinking contaminated water. Both atrazine and hexazinone are soluble and mobile and tend to contaminate water sources (CDPR 2002; Extoxnet 1996-1998).

Contaminants typically have sublethal effects at lower concentrations. Pesticide testing traditionally has focused on mortality, and the study of sublethal effects is infrequent. Some sublethal effects nonetheless can have significant population level results.

2. Inhalation

Air quality in parts of California is poor due to human activities, with elevated levels of ozone, oxides of nitrogen, sulfur compounds, particulates, and other contaminants. Townsend's big-eared bats feed on the wing and require high respiration rates to fuel their activity. Poor air quality in California is demonstrated to adversely affect trees and mammals (causing increased

asthma and aggravating other respiratory illnesses in humans). It is reasonable to expect that areas of low air quality impair bats including Townsend's big-eared bats, but we are not aware of studies of this topic.

3. Dermal/cutaneous

Finally, pesticides may be absorbed through the skin. The main chance of this would be if bats were directly sprayed (to avoid wind, spray applications often begin at first light, a time when bats may still be flying), or through contact with sprayed surfaces. If Townsend's big-eared bats in California prove to forage by gleaning, this would produce contact with sprayed plant surfaces. Dermal exposure can be difficult to separate in the field from ingestion by licking pesticide residues off the fur and skin. Ingestion appears likely to be the more significant exposure route.

The CBCP cites pesticides associated with agriculture as a medium to high risk for bats in a number of ecoregions throughout the state. These include the Central Coast and Central Coast Range, Mono and Southeastern Great Basin, Mojave, and Sonoran and Colorado Deserts (Pierson et al. 2011). Agricultural pesticide and herbicide use is especially frequent in the Great Valley; however, Townsend's big-eared bat is extremely rare there, probably due to the dearth of suitable roosting sites. Pesticides and other contaminants in urban and suburban settings can also threaten bat. This is especially a concern in the South Coast region (Pierson et al. 2011).

Toxins pose a present and continuing threat to the Townsend's big-eared bat. The degree of the threat is most certain for drinking water contamination, which is well-documented and best known from mining and drilling districts. This threat is moderate to high. The degree of threat from pesticides, air pollution, and other sources of toxicity is uncertain and needs to be investigated.

Pest control operations

Private pest control operators may remove, kill, or exclude Townsend's big-eared bats at buildings and other anthropogenic roost sites where property owners wish to be rid of roosting colonies. There are no licensing or education requirements regarding bat exclusion for pest control operators. Such operators, or even private landowners, may inadvertently or purposefully seal in bats, including non-volant young in nursery groups, in attics or other structures, when they cover or calk bats' entry and exit points. Other methods of bat control include illegal application of poisonous chemicals, and capture and killing of bats. Take of bats is allowed under California state law where the "pest animal" is deemed to be harming crops or other property, including structures. Under this law, entire colonies may be destroyed (Pierson et al. 2011).

The threat of pest control operations to Townsend's big-eared bat is ongoing and immediate. It is unclear how many colonies are being harmed or destroyed, and in certain regions where Townsend's big-eared bat is especially dependent on anthropogenic roosts, the impact may be substantial.

Exotic invasives

Invasion and domination of riparian ecosystems in some drier portions of California by the non-native invasive plant, tamarisk or saltcedar (*Tamarix* spp.), has severely altered riparian ecosystems. Foraging areas of riparian vegetation adjacent to water sources may be essential for desert populations of Townsend's big-eared bat (Pierson & Fellers 1998), but tamarisk invasion reduces or nearly eliminates the native riparian vegetation, with corresponding impacts on the native insect (prey) community. The widespread invasion of tamarisk in desert areas also has contributed to the drying of water sources and salinization of soils (Larmer 1998). The Colorado River corridor in California is an area that is heavily invaded by tamarisk and has seen a decline in Townsend's big-eared bat population (Pierson & Fellers 1998).

Although ongoing, the degree of threat from exotic invasive species is unknown.

Small population size

Small population size can be a threat to a widespread and declining species like the Townsend's big-eared bat when the bats persist only in small, fragmented and remnant colonies through much of their range in California. Although the bats are relatively mobile, colonies are now few enough and widely enough dispersed that many may act as isolated small populations.

Small populations are more vulnerable to extinction than large ones (Pimm 1991; Noss & Cooperrider 1994). Noss and Cooperrider (1994) identified four major factors that predispose small populations to extinction: (1) greater risk of being wiped out by environmental variation or natural catastrophes like unusually harsh weather, fires, or other unpredictable phenomena; (2) chance variation in sex ratios or other population parameters (demographic stochasticity); (3) genetic deterioration resulting from inbreeding and genetic drift (random changes in gene frequencies); and (4) disruption of metapopulation dynamics (i.e., some species are distributed as systems of local populations linked by occasional dispersal, which offsets demographic or genetic deterioration). As a colonial species, Townsend's big-eared bats also may be subject to a fifth factor, a tendency for the growth rate of a local population to be impaired when its size falls below a critical level. In other words, the species experiences advantages of colonial behavior (perhaps warmth, reduced predation risk), and as colonies decline in size they tend to lose these benefits. This is referred to as an Allee effect (Stephens et al. 1999), and it can lead to populations of colonial species crashing more rapidly than anticipated. It has been suggested that the passenger pigeon, a colonial breeder, was in part a victim of an Allee effect.

Climate change

Biologists assessing the array of threats to bats have only recently considered what harms climate change may pose. The draft revised CBCP acknowledges climate change as an issue with "potentially important consequences for bats" (Pierson et al. 2011). Pierson et al. (2011) express the greatest concern for species that hibernate like Townsend's big-eared bat and determined that effects from climate change may be "severe" to the species.

Early research on bats and climate change in the West suggests that at least one way in which bats will be affected is through increased drought and diminishment of water sources. Reduced

availability of drinking water in close proximity to maternity roosts appears to lower reproductive success in bats studied in Colorado (Adams 2010).

Other scientific research suggests that hibernacula conditions may shift with climate change, resulting in less favorable conditions at hibernacula in warmer climes. In the eastern U.S. for example, before the advent of white-nose syndrome, population trends for the Indiana bat (*Myotis sodalis*) appeared to be downward at more southerly hibernacula, whereas populations were creeping upward at more northern locations (USFWS 2009b). Scientists theorize that climate change is playing at least a partial role in this transition (USFWS 2007, Clawson 2002). Similarly, a pre-white-nose-syndrome model of the range of the little brown bat (*Myotis lucifugus)* predicted northward expansion with climate change (Humphries et al. 2002). However, adaptation to climate change for bats may not be so simple as northward or upslope shifts. Suitable hibernation sites must also be available in potential range expansion areas. Because areas of abundant caves and/or mines are not evenly distributed across the landscape, this could be a significant challenge for Townsend's big-eared bat.

Climate change may also cause phenological mismatches between bats' life cycle stages and that of their insect prey (USFWS 2009b). For example, the peak of female bats' energetic demand is during pregnancy and lactation. However, if the peak of insect prey abundance shifts due to climate change, this may diminish reproductive success.

XII. IMPACT OF EXISTING MANAGEMENT EFFORTS

The main existing management efforts related to Townsend's big-eared bat are to evaluate potential impacts on mine and cave habitat, and to install bat-friendly gates or fencing where appropriate and to the extent that funds are available. Evaluation of impacts may take place during CEQA or NEPA reviews. Gating for bats, to reduce roost disturbance, is typically done under discretionary or grant programs, and funding is often limiting (E. Lorentzen, pers. comm. 2003).

While the USDA Forest Service manages the largest area of public lands within California (about 20% of California's total land area), the BLM (about 15%) and the National Park Service (4%) also manage sizeable areas. National Park Service units in California contain thousands of abandoned mines, notably in Death Valley National Park, Mojave National Park, and Joshua Tree National Park (Houghton & Kerbo 1995; National Park Service 2001). Townsend's big-eared bat roosts discussed by Pierson and Fellers (1998) fell primarily on public lands (18 on federal, none on state, and 5 on private lands, of 23 roosts with ownership data provided), though this is probably strongly influenced by the greater accessibility and availability of information on public lands, and also by the extirpations and population decline of the species on less-protected lands (Pierson & Rainey 1998). Pierson and Rainey (1998) state that 13 of the 20 largest colonies currently known are on public lands. At least one site, though not currently among the largest, is in a State park (Mitchell Caverns).

As of about 2000, the National Park Service had placed about 28 bat-friendly closures in National Park units in California, including Death Valley. Of these, up to about 20 were placed or modified to address Townsend's big-eared bat concerns. Approximately 15 to 20 more bat

gates were in development on national park lands in California as of 2000, some of which should benefit Townsend's big-eared bats (Burghardt 2000). Pierson and Rainey (1998) and Pierson and Fellers (1998) also reported that NPS protective management at Lava Beds National Monument and Point Reyes National Seashore appeared to have stabilized or increased Townsend's big-eared bat populations at a handful of roosts.

There appear to be no centralized data on how many mines or caves exist in California, or how many bat gates have been installed. Numbers of mine openings are certainly in the tens of thousands, while caves appropriate to Townsend's big-eared bats may be fewer by orders of magnitude. By some estimates, as many as 200 or more "bat-friendly" mine closures have occurred in California (Milford 2000); however, consistent standards of what constitute mine closures friendly to Townsend's big-eared bats are needed to accurately interpret such numbers. While bat-friendly closures have yielded significant local protection and some colony population increases, to date, bat-friendly closures are not leading to a statewide recovery of the species (Pierson & Rainey 1998; Pierson & Fellers 1998).

Management by USFS, BLM, and in some cases the California Department of Parks and Recreation has in the past often weighed recreational interests as more important than bats. Forest Service management has been reluctant to act on the biological significance of caves and mines. The decision makers of this agency, often against the advice of their own biologists, give recreation first priority despite documented incompatibility between casual recreation and viable cave and mine bat populations. The Forest Service has allowed continued tourist disturbance at the historically important Samwel Cave and Subway Cave sites. BLM biologists report they are unable to obtain support from superiors for site protection (Pierson & Rainey 1998). While funding may sometimes be an issue, in the absence of a listing of the species, many public land managers will consider it their duty merely to balance recreational and competing interests. Unfortunately, the Townsend's big-eared bat does not respond well to multiple uses of its roosts, and there is presently little weight on its side for restricting or closing popular caves and mines to recreationists.

Even the recent advent of white-nose syndrome, the emerging bat disease that has killed nearly 7 million bats in the eastern, midwestern, and southern U.S. since 2006, has done essentially nothing to change cave management and recreational caving policy on California public lands. The disease is caused by a fungal pathogen that can be transmitted bat-to-bat, from bats to caves, and by people to caves, on their gear and clothing (USGS 2011). In the eastern states, caves on federal lands (primarily USFS and National Park Service) are either off-limits to non-essential entry, or visitation is controlled via permitting, screening, and decontamination procedures. Biologists are deeply concerned that this disease will spread to the western states, as it has to 19 states and four Canadian provinces in the eastern half of North America. The U.S. Fish and Wildlife Service and the USGS/National Wildlife Health Service have issued official policy recommendations to limit non-necessary human access into caves and other bat-inhabited sites (i.e., mines) in order to prevent the anthropogenic spread of the disease (USFWS 2009a, Sleeman 2011). Of particular concern is a leap-frogging of the disease into an entirely new part of the country, such as California, that could occur as the result of human transmission.

However, most caves on public lands in California remain open to the public, and there are no regulations that mandate use of decontaminated gear and clothing to enter caves on national

forest or BLM caves. To our knowledge, only the National Park Service has instituted management changes for cave visitation in California (e.g., Lava Beds National Monument, Sequoia-Kings Canyon National Park). The USFS web pages for Samwel Cave (on the Shasta-Trinity NF) and Subway Cave (on the Lassen NF) both indicate the historic Townsend's big-eared bat sites are open for visitation, and make no mention of the risk of white-nose syndrome, nor the need to follow established WNS decontamination procedures (USFS 2012 b and c; USFWS 2012b).

Existing management efforts to prevent the spread of white-nose syndrome on California public lands are far from adequate; essentially, they are non-existent. The degree to which the disease poses a threat to Townsend's big-eared bat is unknown, but the failure of public lands managers in California to safeguard the species from possible exposure to this devastating, fast-spreading malady is indicative of the shortcomings of bat protection efforts on the state's public lands.

Mitigations for new or renewed mining activities in California have been pursued, ranging from gating other roosts to constructing artificial mine- or cave-like structures (Brown & Berry 1991, Pierson et al. 1991, Brown 1995, Brown et al. 1993, Tuttle & Taylor 1998). The success of these mitigations relative to leaving roosts undamaged has not been comprehensively weighed.

XIII. RECOMMENDED MANAGEMENT AND RECOVERY ACTIONS

Based on the severe threats and clearly imperiled status of the Townsend's big-eared bat we hereby request the species be listed as endangered under the California Endangered Species Act. As part of this protection, the following actions are needed to secure the future of Townsend's big-eared bat:

1. Immediately prohibit unnecessary human access to known and historic Townsend's big-eared bat roosting sites during the period when bats use or may use these sites.

2. Promptly and systematically survey all caves, mines, and structures for Townsend's big-eared bat populations, and for potential habitat for the species.

3. Install bat-accessible gates for all caves and mines with potential habitat that are subject to human disturbance (do not close mines that are currently unoccupied if they provide potential habitat and can be gated). Bat-appropriate gating has proven to be a viable management option for the protection of roosting Townsend's big-eared bat colonies: protective gates have been installed at Knoxville, Sulfur Creek, Death Valley National Monument, and Mitchell Caverns, and populations (still below historical levels) have subsequently increased at all locations (Pierson & Rainey 1998). Monitor gate effectiveness and make changes as necessary. Gates should not alter net airflow and should minimize the bottleneck posed by the gate to exit or entry of large numbers of bats. Culvert closures with gates may be acceptable if they are large enough (Altenbach 2003).

4. Amend or prepare land management plans to include appropriate measures for Townsend's big-eared bat.

5. Monitor cave and mine roosts regularly and enforce regulations regarding public access, maintaining gates as needed.

6. Survey and evaluate the status of known populations regularly.

7. Monitor (e.g., with track plates or hair traps) predator activity at roosts, and institute measures for control where necessary.

8. Avoid broadcast of pesticides (insecticides, herbicides, fungicides) in forests, including spraying of *Bacillus thuringiensis* (Bt). Permitting for pesticide application should be evaluated for effects on Townsend's big-eared bat and effects mitigated by the establishment of buffer zones, use of least harmful chemical agents, and by contributions to roost protection efforts.

9. The California Department of Pesticide Regulation should develop information regarding pesticide effects on Townsend's big-eared bats, recommendations for minimization of effects, and conduct or fund research on effects of pesticides on the survival and reproduction of Townsend's big-eared bats or related species, including sublethal behavioral, developmental, and endocrine effects. Based on the results of such research, Department of Pesticide Regulation should develop regulations to ensure that pesticide effects on Townsend's big-eared bats are insignificant.

10. The California Department of Forestry (CDF) and CDFG should develop protocols for evaluating forest areas for Townsend's big-eared bat use and regulating timber harvest in such areas. Particular attention should be given to caves, mines, structures, and trees with hollows that potentially serve as roosts. Consider input from bat experts and the public on the draft protocols.

11. CDF and the California Department of Parks and Recreation, in coordination with CDFG, bat experts and the public, should develop a larger system of old-growth redwood reserves and a long-term strategy for encouraging development of basal hollows in large redwoods on State lands, to provide increased roosting habitat–including maternity roosts–for Townsend's big-eared bat.

12. Surveys for Townsend's big-eared bat should consider external exit surveys as a first option, rather than entering a mine, cave, building, or tree hollow and potentially disturbing a colony. Recent techniques such as motion detectors and infrared video with infrared floodlights can increase the accuracy and reduce the labor associated with exit surveys. Internal surveys are still appropriate in many cases but should be evaluated carefully and must be conducted by experienced, trained personnel for an absolute minimum of bat disturbance.

XIV. INFORMATION SOURCES

All sources used in the development of this petition are listed in the Literature Cited. We also attach, as Appendix 1 to this document (with some sources in compact-disc electronic format), copies of literature and documents pertinent to the status of Townsend's big-eared bat in

California and its context in the larger range, including copies of useful summary reports. If the Commission or the Department has any difficulty locating any necessary references, please contact petitioners.

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PERSONAL COMMUNICATIONS

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August 11, 2016

Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

Re: Proposed listing of the Townsend's Big-eared bat – Comment on "Report to the Fish & Game Commission – A Status Review of the Townsend's Big-eared bat (*Corynorhinus townsendii*) in California"

Dear President Sklar and Members of the Commission:

Thank you for the opportunity to comment on the Department's status review and recommendation to not list the Townsend's Big-eared bat as endangered under the California Endangered Species Act.

Green Diamond Resource Company (Green Diamond) is a family-owned company that was established in Washington State in 1890. Consistent with its long-term commitment to responsible forestry, Green Diamond owns and sustainably manages over 370,000 acres of timberland in California. Green Diamond's long-term perspective supports significant commitments to research and conservation for wildlife, water quality and aquatic resources on its forested lands through two federally approved habitat conservation plans and related consistency determinations from the CA Department of Fish and Wildlife.

In the Status Review Report, the Department describes the Townsend's bat as generally a cave and mine roosting bat, but it also roosts in large open spaces in buildings and in cavernous spaces in bridges and dams. There are a few occurrences of documented roosts in large old trees where repeated scarring from fires and other damage resulted in creation of large basal hollows. As a result of these habits, disturbance, degradation of and loss of suitable roost sites were recognized as threats to Townsend's bats. The petition relied on data trends from non-tree roost sites as an argument for the petitioned listing of Townsend's bats.

Green Diamond's timberlands do not provide the common roosting habitat (caves, mines, abandoned buildings, bridges or dams) for Townsend's bats. However, Green Diamond's lands do provide potential roosting habitat for Townsend's bats in the form of large trees with basal hollows. Green Diamond's lands contain stands of old-growth conifer habitat that range from 5 to 100 acres in sized that are currently withheld from harvest on due to protection for the state and federally listed marbled murrelet and our commitments under our Forest Stewardship Council certification. Some of these areas are also held in reserve through conservation easements. Other potentially suitable large diameter roost trees exist in a scattered distribution across the remainder of Green Diamond's ownership.

Since initiation of wildlife studies on its lands in 1990, Green Diamond has actively identified and retained trees with existing structure as important components of the forest that provide nesting, denning and roosting habitat for sensitive wildlife species (e.g., spotted owls, fishers). These tree retention commitments became an enforceable component of timber harvesting plans in 1992 upon approval and implementation of the Northern Spotted Owl Habitat Conservation Plan and continue to be implemented to this day. The tree retention commitments continued to evolve over time, and Green Diamond voluntarily adopted a Terrestrial Dead Wood Management Plan as a part of its timber harvest operations in 1999. That effort was jointly developed with the California Department of Fish and Game. The current version of our tree retention is being formally adopted as the TREE (Terrestrial Retention of Ecosystem Elements) guidelines in a proposed federal Forest Habitat Conservation Plan that will replace the 1992 plan for northern spotted owls. Green Diamond started implementing the TREE program in 2013 in timber harvest plans as part of our Forest Stewardship Council certification. When approved, the 50 year commitment of the federal Forest Habitat Conservation Plan will continue to protect potential roost sites for Townsend's bats by incorporating these measures in state timber harvesting plans.

Green Diamond believes that its current practices implemented through state timber harvesting plans protect potential roosting habitat, reduce risk of take and prevent significant adverse impacts to the Townsend's bat. Green Diamond supports the Department's recommendation that the petitioned action for listing the Townsend's bat is not warranted.

Sincerely,

Keith A. Hamm

Keith A. Hamm, Certified Wildlife Biologist®
Manager, Conservation Planning
Green Diamond Resource Company

Cc: Mr. Charlton H. Bonham
Director, California Department of Fish and Wildlife
1416 9th Street
Sacramento, CA 95814

A Status Review of Townsend's Big-Eared Bat (*Corynorhinus townsendii*) in California

Scott D. Osborn, Ph.D.

Wildlife Branch/Nongame Wildlife Program

August 25, 2016

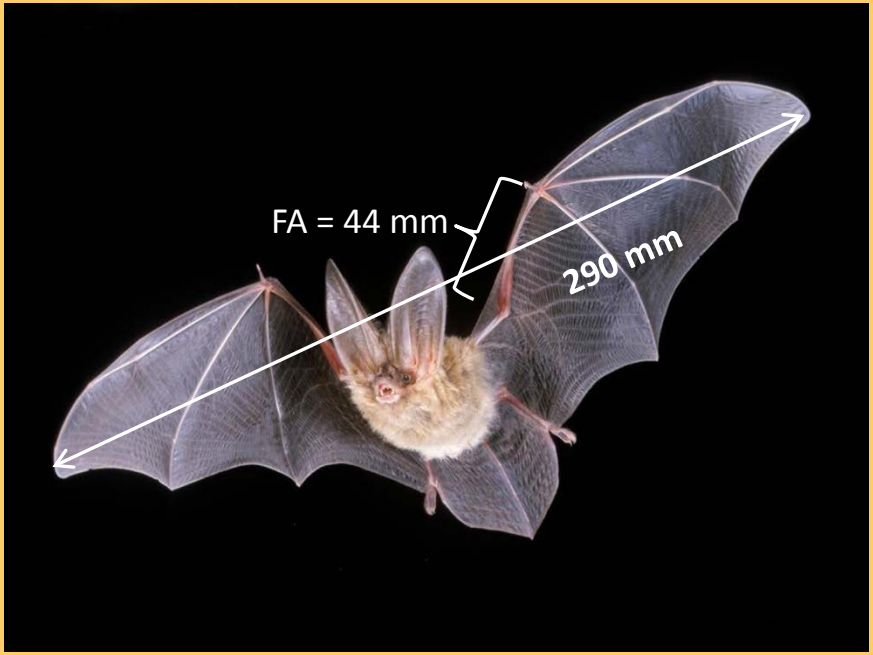
Photos: S. Osborn, L.S. Harris, Katrina Smith

Outline

- Taxonomy & Species Description
- Geographic Range
- Ecology
- Threats
- Status and Trends
- Conclusions
- Recommendations

Description

- Medium-sized ”micro” bat (10-12 g)
- Light brown dorsal fur; paler underparts
- Forearm 39-48 mm
- Ear 30-39 mm
- Two-pronged nose lump
- Broad, short wings



Photos: Merlin Tuttle, Bat Conservation International

Class Mammalia, Order Chiroptera, Family Vespertilionidae

Genus	Species	Subspecies	Common Name
Corynorhinus	*townsendii*		*Townsend's big-eared bat*

Class Mammalia, Order Chiroptera, Family Vespertilionidae

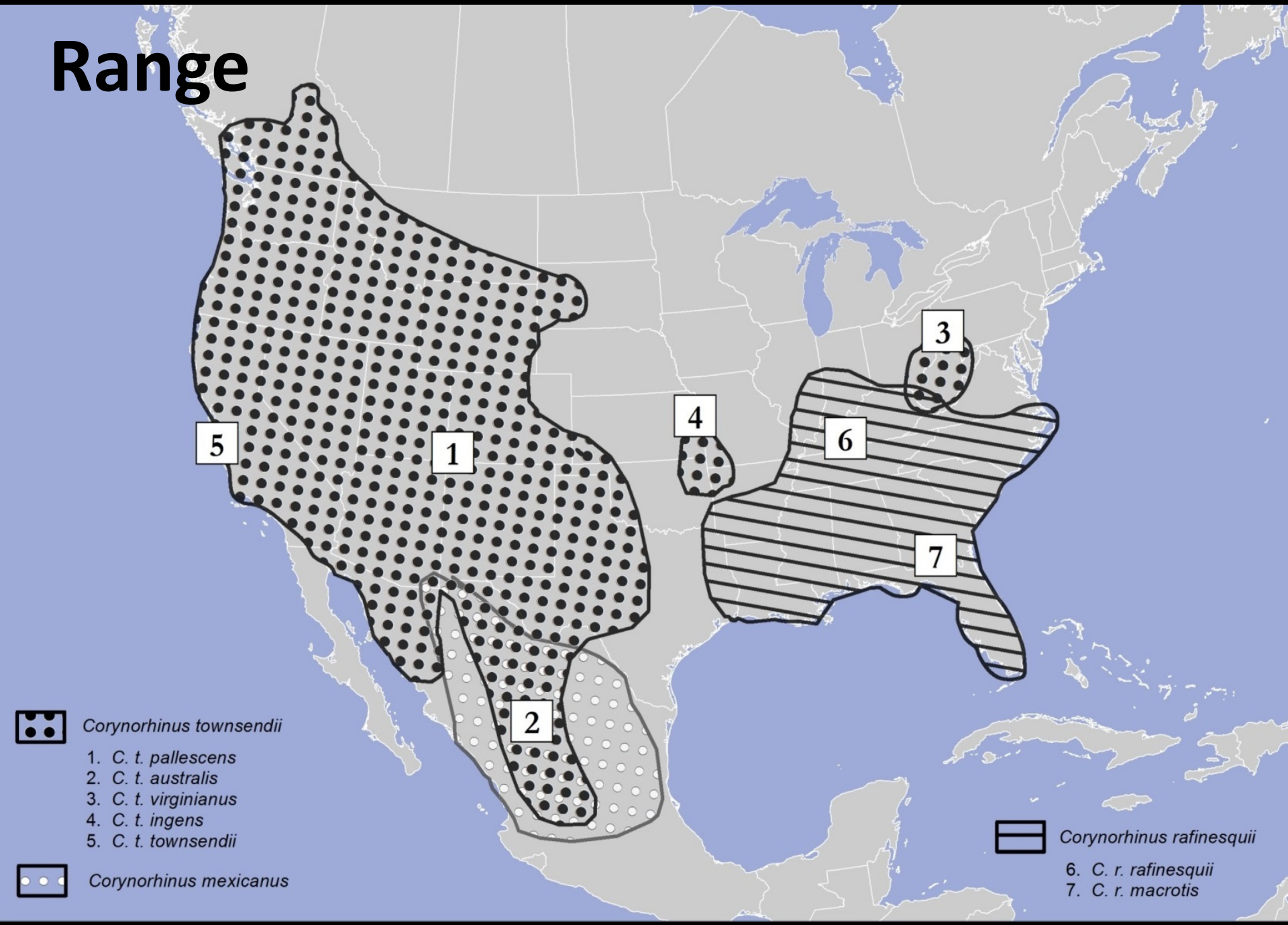
Genus	Species	Subspecies	Common Name
Corynorhinus	*townsendii*		*Townsend's big-eared bat*

Corynorhinus	*rafinesquii*		Rafinesque's big-eared bat
Corynorhinus	*mexicanus*		Mexican big-eared bat

Class Mammalia, Order Chiroptera, Family Vespertilionidae

Genus	Species	Subspecies	Common Name
Corynorhinus	*townsendii*	*townsendii*	
		pallescens	
		ingens	Ozark big-eared bat
		virginianus	Virginia big-eared bat
		australis	
Corynorhinus	*rafinesquii*		Rafinesque's big-eared bat
Corynorhinus	*mexicanus*		Mexican big-eared bat

Range


1
2
3
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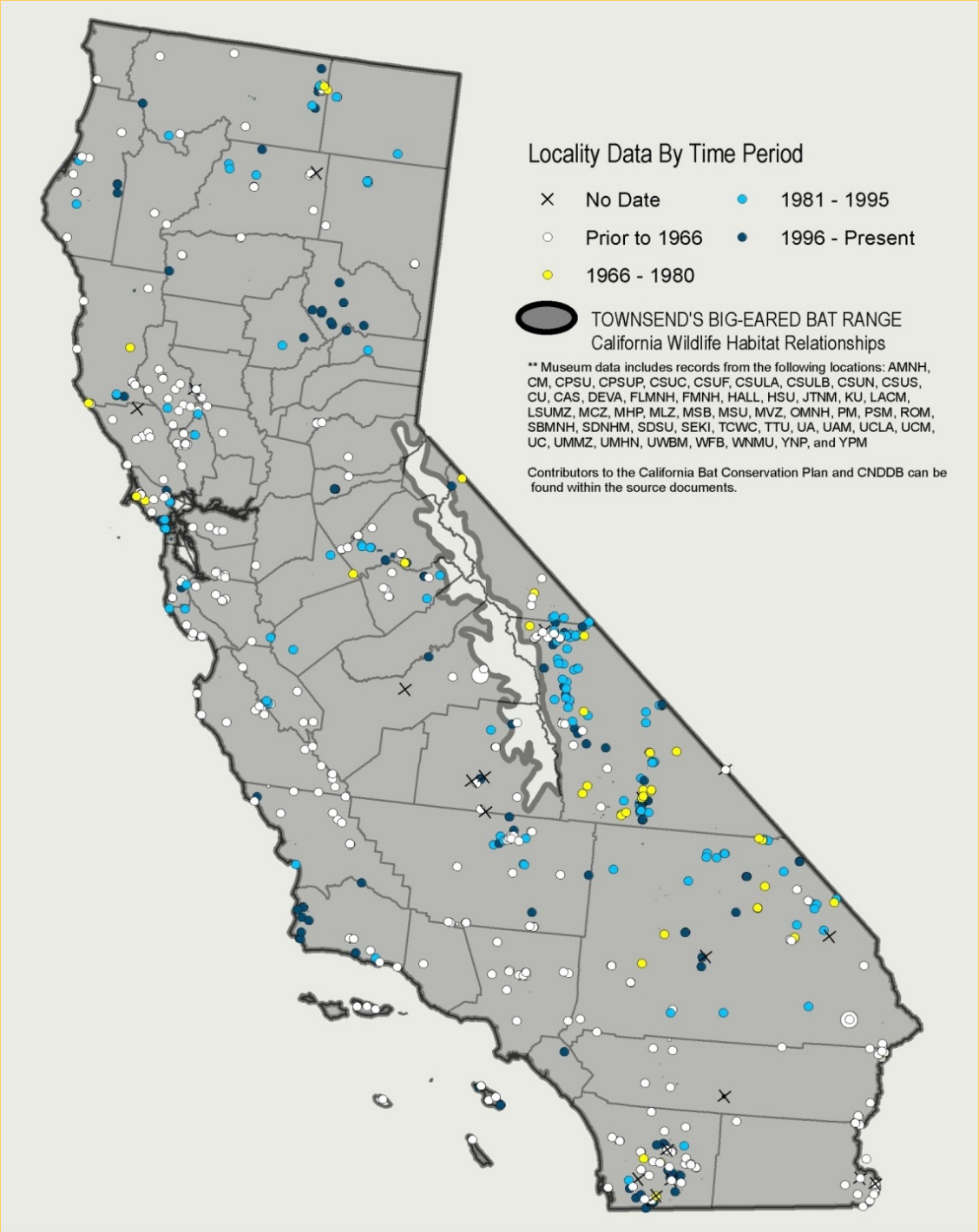
Corynorhinus townsendii
1. C. t. pallescens
2. C. t. australis
3. C. t. virginianus
4. C. t. ingens
5. C. t. townsendii
Corynorhinus mexicanus
Corynorhinus rafinesquii
6. C. r. rafinesquii
7. C. r. macrotis

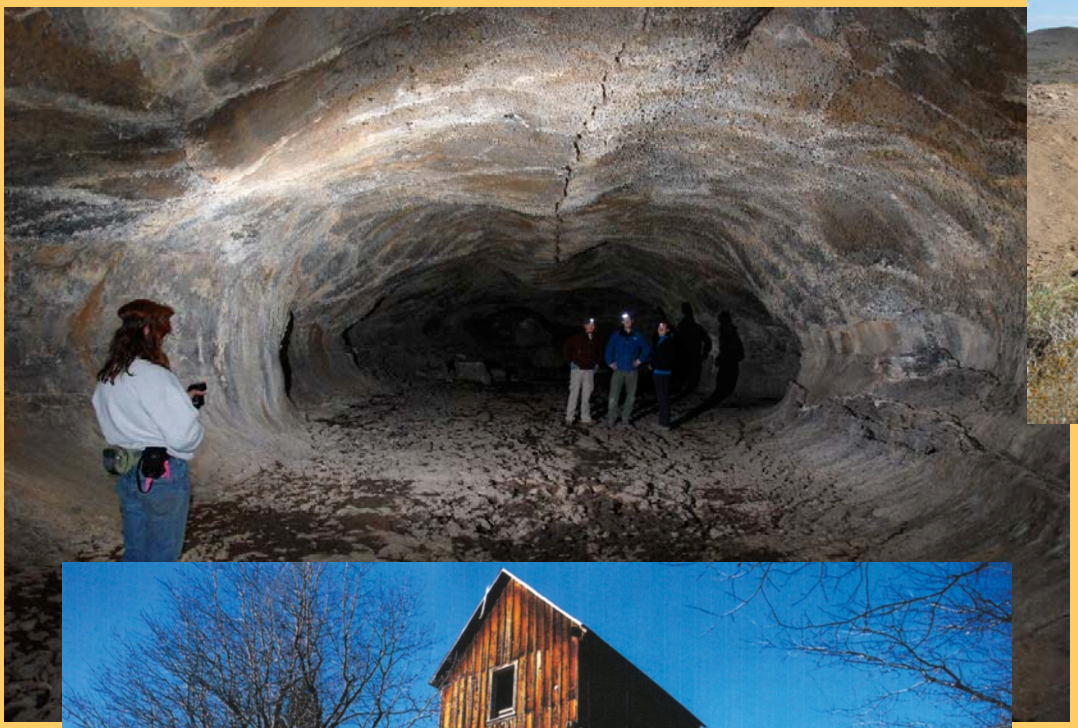
Calif. Range


Locality Data By Time Period
No Date
1981 - 1995
Prior to 1966
1996 - Present
1966 - 1980
TOWNSEND'S BIG-EARED BAT RANGE
California Wildlife Habitat Relationships
** Museum data includes records from the following locations: AMNH, CM, CPSU, CPSUP, CSUC, CSUF, CSULA, CSULB, CSUN, CSUS, CU, CAS, DEVA, FLMNH, FMNH, HALL, HSU, JTNM, KU, LACM, LSUMZ, MCZ, MHP, MLZ, MSB, MSU, MVZ, OMNH, PM, PSM, ROM, SBMNH, SDNHM, SDSU, SEKI, TCWC, TTU, UA, UAM, UCLA, UCM, UC, UMMZ, UMHN, UWBM, WFB, WNMU, YNP, and YPM
Contributors to the California Bat Conservation Plan and CNDDB can be found within the source documents.

Foraging Habitat

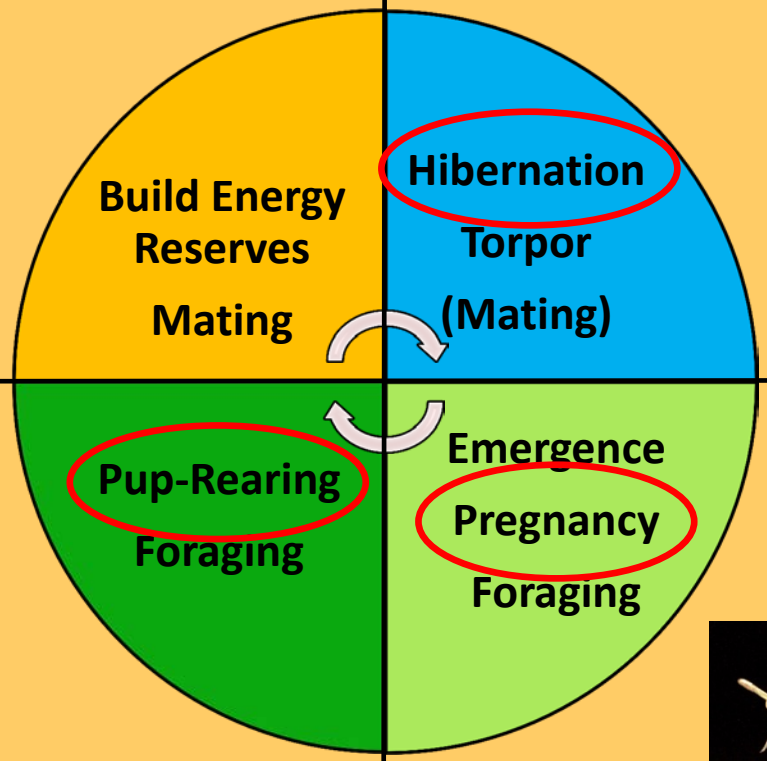
Photos: S. Osborn, NPS, W. Schlegel

Roosting Habitat



Photos: J. Chenger, S. Osborn, Sierra County Historical Society, BLM

COTO Annual Cycle



Photos: Aaron Corcoran, Katrina Smith, S. Osborn

Diet

Photos: Aaron Corcoran

Threats

- Habitat Loss/Degradation (Roost)
- Habitat Loss/Degradation (Foraging)
- Disease
- Mining
- Environmental Contaminants
- Climate Change (incl. Drought)
- Overexploitation
- Competition

Status & Trends

Summary of Pierson & Rainey (1998)

Photos: WBWG, TWS-WS, NPS

Status & Trends

Summary of Pierson & Rainey (1998)

Metric	Historical	Current (ca. 1990)
Number of adult females (18 colonies)	3,004	1,365
Number of maternity colonies	46	22 (43)
Average colony size	164	112

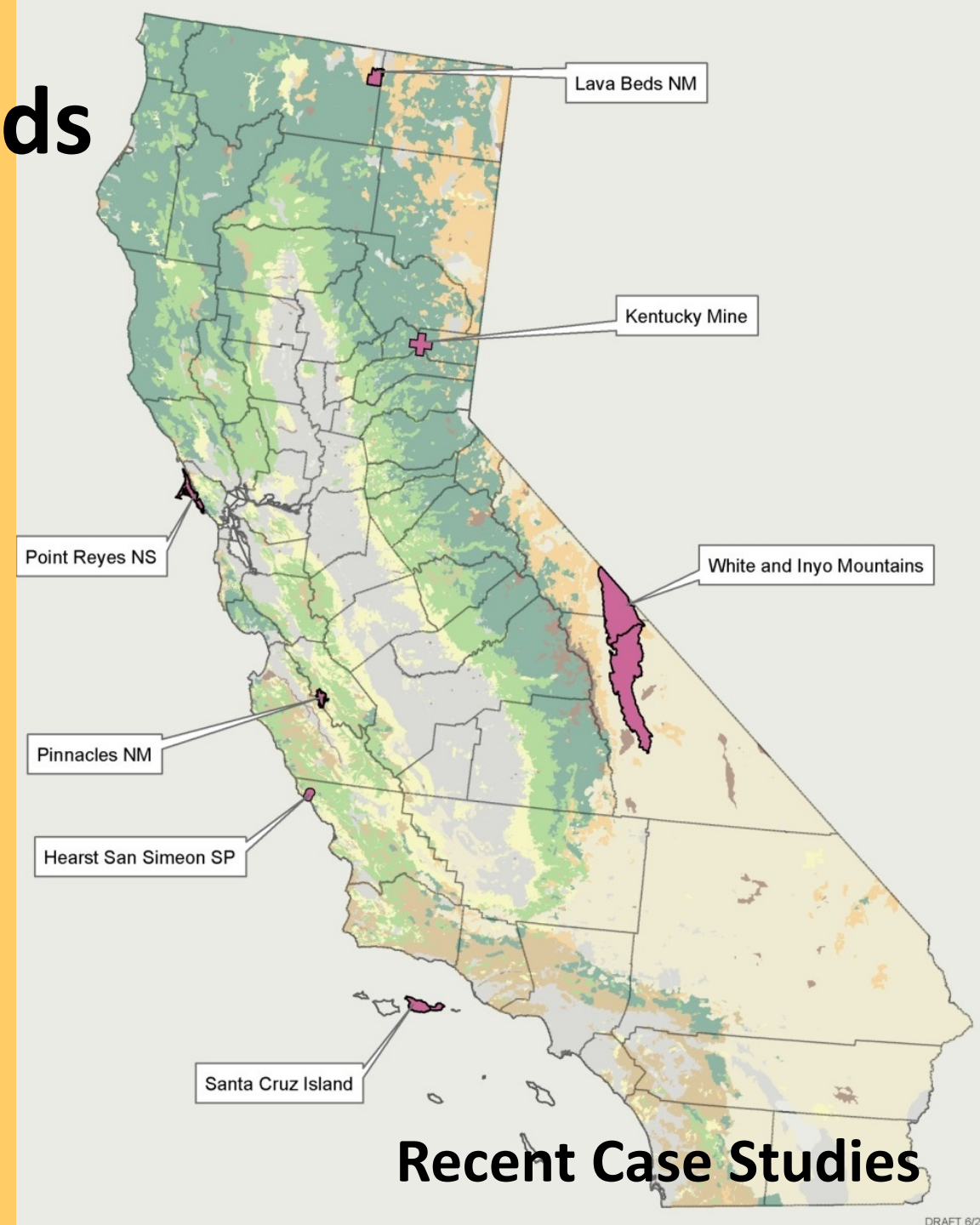
Status & Trends

Maternity Sites

- Randall House
- Kentucky Mine
- Lava Beds N.P.
- Pinnacles N.P.
- Hearst Castle
- Santa Cruz Island

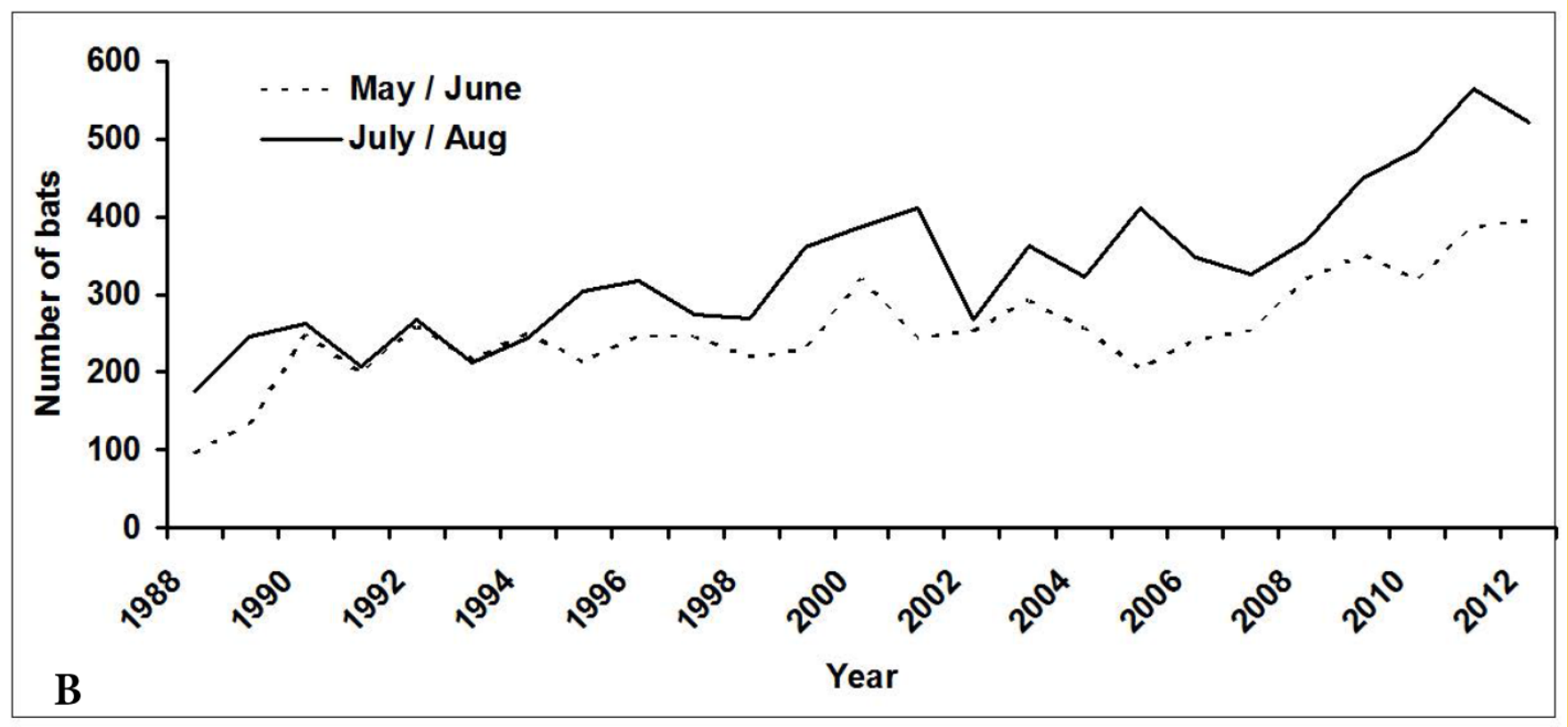
Hibernation Sites

- Lava Beds N.M.
- White-Inyo Mtns
- Pinnacles N.P.



Randall House,
Pt. Reyes Nat'l Seashore

Maternity Roost Exit Counts:

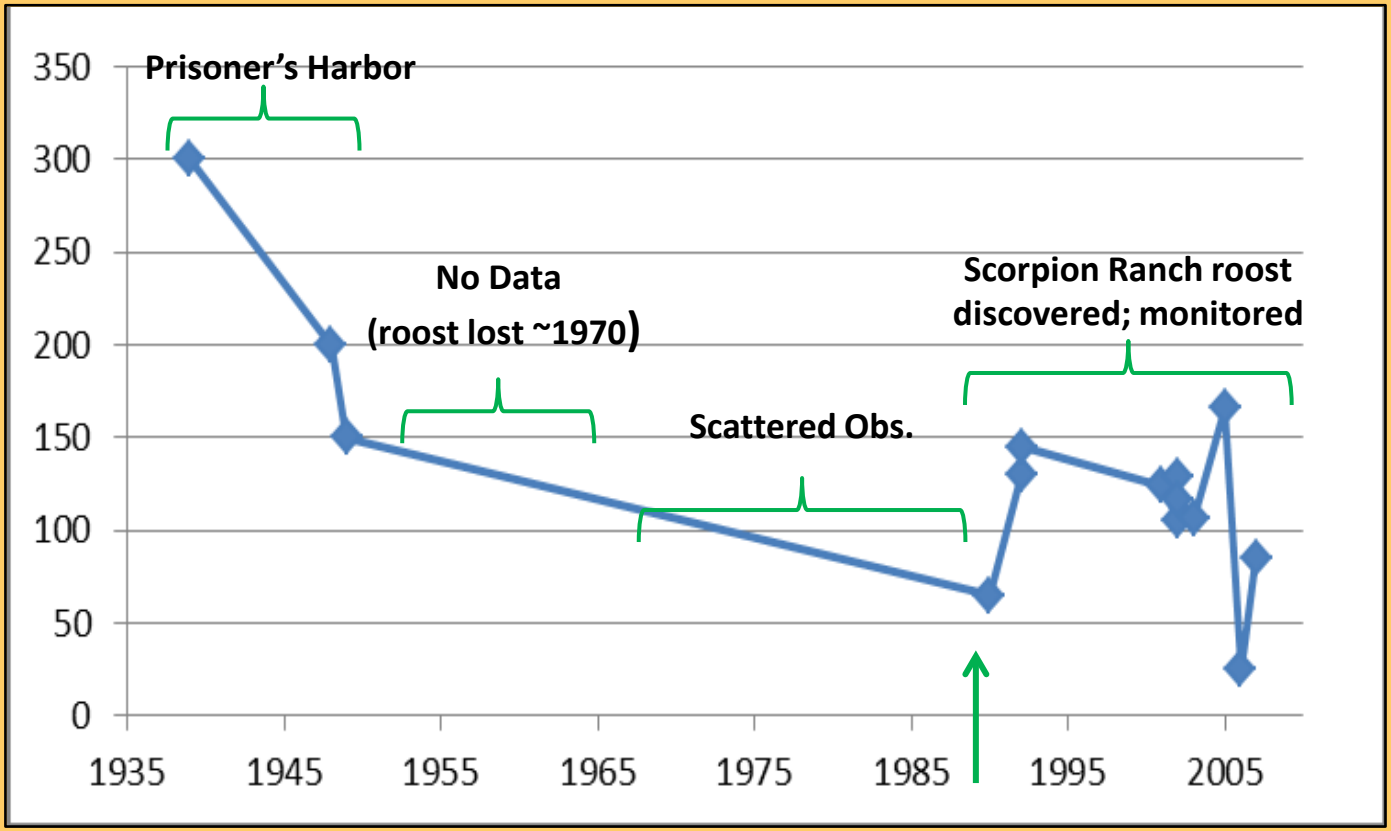


Fellers and Halstead 2015

Photo: Sonja Williams

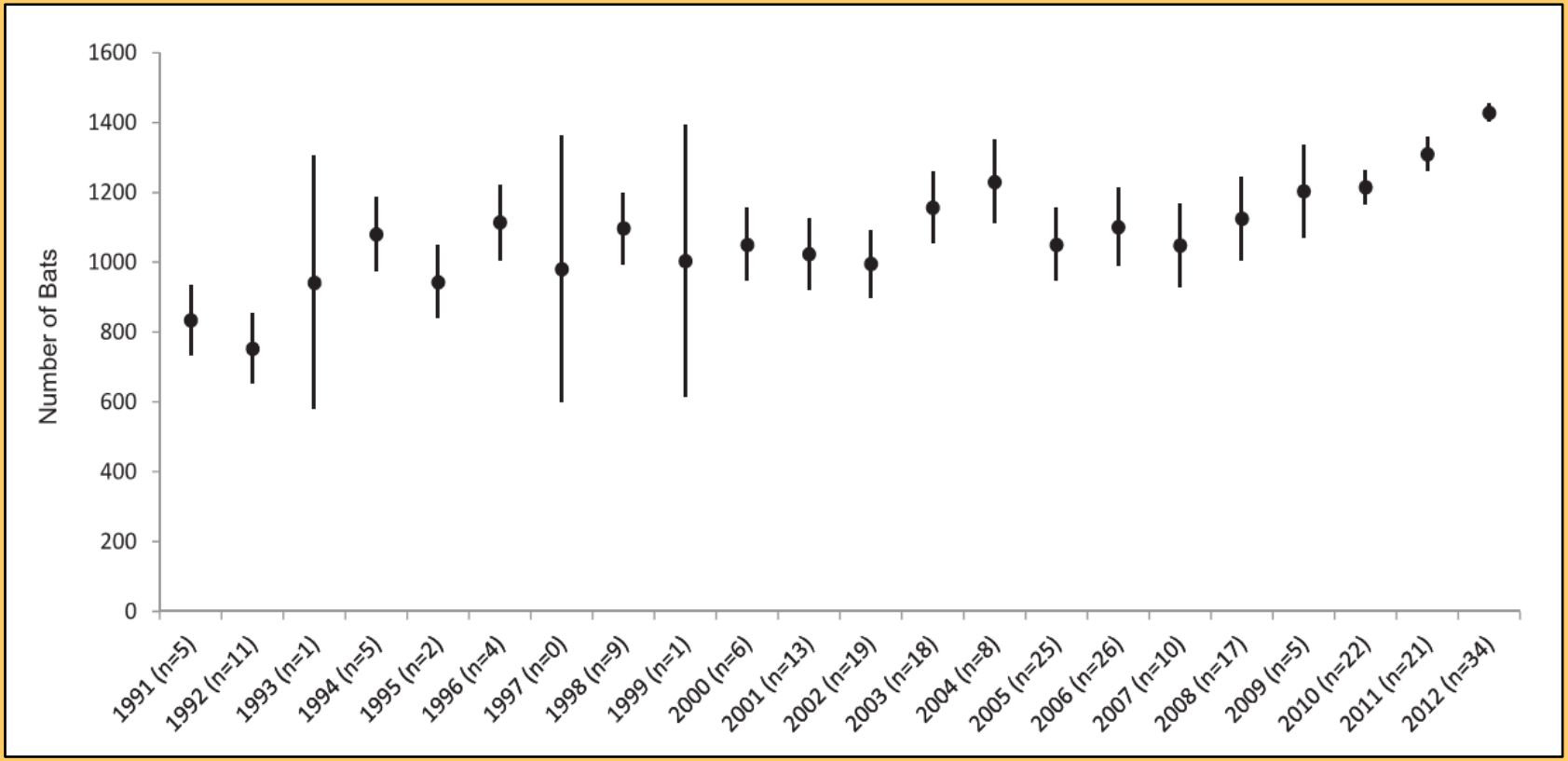
Santa Cruz Island, Channel Islands N.P.

Maternity Colony Counts:



Brown et al. 1994; Drost 2003, Brown and Berry 2007, NPS unpubl. data

Lava Beds N.M.



Weller et al. 2014

Photos: S. Osborn, J. Chenger, Katrina Smith

Case Study Summary

Hibernation	
Lava Beds N.M.	Statistically significant population increase over 22 years
White-Inyo Mountains	No statistical inference possible; many repeat visits had lower counts than initial visits 10-plus years earlier
Pinnacles N.P.	No inference possible
Maternity	
Randall House	Statistically significant population increase over 25 years
Kentucky Mine	Statistical tests not conducted; colony appears stable
Lava Beds N.M.	No inference possible
Pinnacles N.P.	Statistical tests not conducted, but colony appears to be stable or increasing
Hearst Castle	Statistical tests not conducted, but colony appears to be stable or increasing
Santa Cruz Island	No statistical tests conducted, but colony has decreased from historical size

Key Findings (Title 14 CCR 670.1)

1. Present or threatened modification or destruction of habitat
2. Overexploitation
3. Predation
4. Competition
5. Disease
6. Other natural occurrences or human-related activities

Recommendations

- The best available scientific information indicates to CDFW **the petitioned action is not warranted**.
- CDFW recommends to the Commission that Townsend's big-eared bat **not be added** to the list of Threatened and Endangered species under CESA.
- The Department presents several management recommendations in the Status Review report.

Questions?