Northeastern California Wildlife Connectivity Symposium

Redding, California | January 8, 2020

PEW

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

Northeast California Connectivity Symposium Planning Team ("Planning Team") Many thanks to the Planning Team, which engaged in all aspects of planning and design of the symposium, as well as, providing review and input to this summary report. The Planning Team includes:
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Caltrans: Lindsay Vivian, Chris Pincetich, Amy Bailey, Jennifer Gillies, and Simon Bisrat
Pew Charitable Trusts: Laurel Williams, Leslie Duncan, and Brian Geiger
Science & Collaboration for Connected Wildlands: Kristeen Penrod

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1. Background

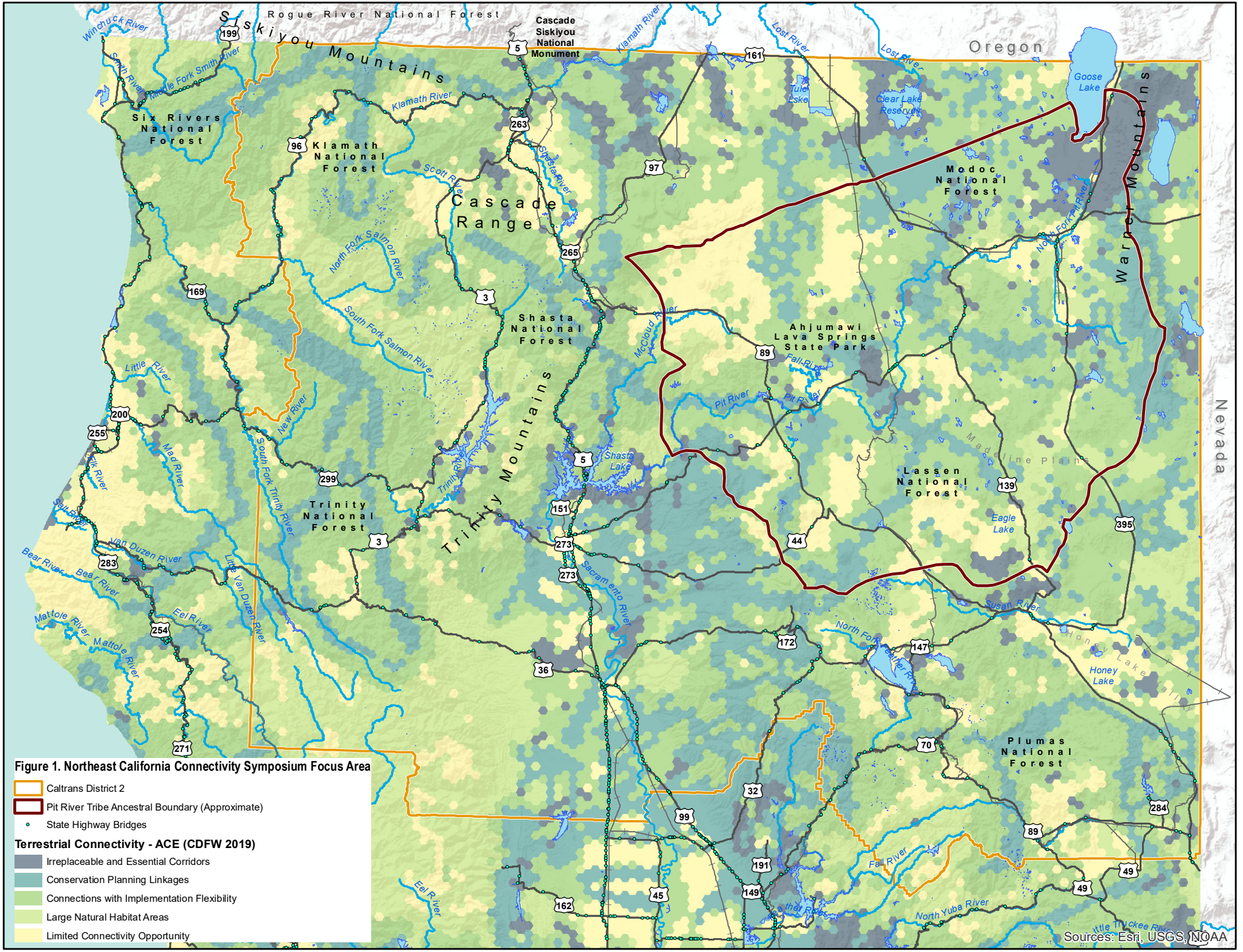
This report summarizes the planning and results of a one-day collaborative symposium held on January 8, 2020, in Redding, California. A diverse group of stakeholders and experts was invited to participate. The symposium was intended to help address issues recently highlighted by the California Biodiversity Initiative: A Roadmap for Protecting the State's Natural Heritage (2018) and the Department of Interior's Secretarial Order 3362 Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors (S.O. 3362). One of the primary goals of the California Biodiversity Initiative is to "Preserve ecosystems at the regional scale, with sufficient linkages, buffers and refugia to provide a robust future for all native species in the face of climate change". Signed in 2018, S.O. 3362 directs federal agencies to work with the California Department of Fish and Wildlife (CDFW) and other western state wildlife agencies to conserve, improve, or restore habitat and migration corridors necessary to sustain local and regional big game populations.

CDFW recently compiled and synthesized the best-available spatial information in California on connectivity and wildlife movement into the Terrestrial Connectivity Dataset to better integrate biodiversity conservation with transportation and infrastructure planning. The Terrestrial Connectivity dataset is one of the four key components of CDFW's Areas of Conservation Emphasis (ACE) data visualization platform, along with terrestrial Biodiversity, Significant Habitats, and Climate Resilience (CDFW 2019a). The Terrestrial Connectivity dataset summarizes information by ACE hexagons (2.5 square miles each) including the presence of mapped corridors or linkages and the juxtaposition with large, contiguous, natural areas. This map (Figure 1) builds on the California Essential Habitat Connectivity Project (Spencer et al. 2010), based on guidance given in that report, and incorporates species-specific, fine-scale linkage information that has been developed at a regional scale.

The California Department of Transportation (Caltrans) and CDFW are working together to integrate habitat connectivity conservation with transportation and infrastructure planning to help restore landscape connectivity for species and ecological processes.

2. Purpose and Need

Habitat fragmentation, particularly by roadways, railways, and other linear infrastructure, is recognized as one of the greatest threats to biodiversity (Noss 1983, Harris 1984, Wilcox and Murphy 1985, Wilcove et al. 1986, Noss 1987, Reijnen et al. 1997, Trombulak and Frissell 2000, Forman and Deblinger 2000, Jones et al. 2000, Forman et al. 2003). Roads create


Rogue River National Forest
Siskiyou Mountains
Cascade Siskiyou National Monument
Oregon
Nevada
Six Rivers National Forest
Klamath National Forest
Cascade Range
Shasta National Forest
Trinity Mountains
Trinity National Forest
Modoc National Forest
Warner Mountains
Ahjumawi Lava Springs State Park
Lassen National Forest
Plumas National Forest
Madeline Plains
Goose Lake
Clear Lake Reservoir
Tule Eske
Shasta Lake
Eagle Lake
Honey Lake
Winchuck River
Smith River
Middle Fork Smith River
Klamath River
Lost River
Scott River
Shasta River
North Fork Salmon River
South Fork Salmon River
McCloud River
Pit River
Fall River
North Fork Pit River
Little River
New River
Mad River
South Fork Trinity River
Trinity River
Van Duzen River
Bear River
Eel River
Mattole River
Little Van Duzen River
Sacramento River
Susan River
North Fork Feather River
Fall River
North Yuba River
Little Truckee River
199
5
161
263
96
97
265
3
169
89
200
255
299
151
273
44
139
395
283
254
36
172
147
70
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149
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162
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271
Figure 1. Northeast California Connectivity Symposium Focus Area
Caltrans District 2
Pit River Tribe Ancestral Boundary (Approximate)
State Highway Bridges
Terrestrial Connectivity - ACE (CDFW 2019)
Irreplaceable and Essential Corridors
Conservation Planning Linkages
Connections with Implementation Flexibility
Large Natural Habitat Areas
Limited Connectivity Opportunity
Sources: Esri, USGS, NOAA

discontinuities in natural vegetation, alter animal behavior (due to noise, artificial light, human activity), promote invasion of exotic species, and contribute to wildlife-vehicle collisions (Lyon 1983, Noss and Cooperrider 1994, Forman and Alexander 1998). Railroads share many of the deleterious effects of highways (Messenger 1968, Niemi 1969, Klein 1971, Stapleton and Kiviat 1979, Muehlenbach 1979, Lienenbecker and Raabe 1981, Forman 1995). The demographic and genetic isolation resulting from habitat loss and fragmentation increase extinction risks for populations (Gilpin and Soulé 1986), which are further exacerbated by climate change. Enhancing connectivity and linking natural landscapes has been identified as the single most important climate adaptation strategy to conserve biodiversity (Heller and Zavaleta 2009). Disruption of landscape connections for species movements and range changes is one of the greatest stressors to ecosystems.

California has recognized the importance of identifying, maintaining, and restoring wildlife movement corridors, habitat linkages and landscape connectivity with statutory authority and legislative intent found in California Fish and Game Code Sections 1345, 1346, 1347, 1850, 1851, 1930, 1930.5, 1932, 1932,5, 2787; Public Resources Code Sections 37015, 71154, 80076, 80130, 80132; Street and Highways Code Section 2704.09; and the following legislative bills introduced in 2019-2020: Assembly Bill 65, 74, 85, 190, 352, 1298, 2441, 2642, 2839; and Senate Bill 45, 73, 85, 474, 1372, and 62.

California's State Wildlife Action Plans (California Department of Fish and Game [CDFG] 2005, CDFW 2015) highlight the importance of connectivity to maintain biodiversity and restore populations of imperiled species. Furthermore, all of California's climate adaptation strategies (California Natural Resources Agency 2009, 2014, 2018, *in prep* 2020) identify maintaining habitat connectivity as one of the most important adaptation strategies to conserve biodiversity and support ecological functions as the climate changes. Strategically conserving and restoring functional connections between habitat areas is an effective countermeasure to the adverse effects of habitat loss and fragmentation, and it is an essential mitigation measure against climate change.

Conserving connectivity and remediating barriers to wildlife movement at a landscape scale, across multiple jurisdictions, will require agencies, organizations and individuals from across diverse sectors to work together. No single entity can do it alone. State agencies are interested in partnering to identify, maintain, and restore wildlife movement corridors and habitat connectivity, and understand the importance of external stakeholder involvement to achieve related conservation goals. The Symposium sought

to engage federal, state and local wildlife, transportation, land management, and land use agencies; tribes; academic institutions; land trusts; non-profit organizations; and others for a one-day collaborative effort to gather data and information, promote coordination among diverse stakeholders, and build the partnerships needed to conserve habitat connectivity at a landscape scale.

The focus area (Figure 1) for the symposium is defined by the boundaries of Caltrans District 2 (Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama, and Trinity counties) and overlaps with parts of CDFW management Regions 1 and 2. Additionally, the focus area abuts Oregon and Nevada and the symposium efforts could potentially contribute to connectivity planning efforts in these neighboring states. There are critical wildlife movement corridors that cross state lines, including those that support seasonal migrations of species targeted by S.O. 3362, and these efforts could facilitate the leveraging of funds across state boundaries, thus further meeting the goals of S.O. 3362.

The northeast portion of the state was targeted because a) that area supports all the species targeted by S.O. 3362 (elk, mule deer, and pronghorn antelope); b) includes a priority area identified in response to S.O. 3362 and is a Natural Resources Conservation Service Critical Conservation Area; c) the majority of the area lacks a fine-scale, regional connectivity analysis identifying species-specific linkages, and has therefore been identified as a priority area for additional connectivity analysis; and d) and there is local management support for collaborative wildlife connectivity assessments.

3. Symposium Objectives

The symposium served as an opportunity for participants to share data and knowledge to inform a larger collaborative effort between CDFW and Caltrans. Both departments want to coordinate, integrate, and focus investments on projects that maintain and restore habitat connectivity and support landscape resiliency. Both departments want to focus their efforts on incorporating wildlife connectivity features into future transportation projects that have the highest biological priority and provide the greatest benefit to the safety of the traveling public and Caltrans maintenance operations. The overall objectives of the symposium included the following:

- Engage a diverse group of stakeholders.
- Identify partnership opportunities and funding sources to support design and implementation of wildlife crossings to remediate barriers to wildlife movement.

- Identify potential partnership opportunities for filling data gaps and research needs.
- Identify data gaps and research needs related to animal movement and barriers in the focus area.
- Identify potential focal species that could be used in developing a fine-scale regional connectivity assessment.
- Identify engagement points in which CDFW and other agencies, such as non-governmental organizations, can provide comments and be involved in transportation scoping and nomination.
- Brainstorm criteria and explore parameters that could be used to develop a transparent and repeatable method to prioritize barriers for remediation that can be replicated in other parts of the state.
- Work to develop a map of wildlife connectivity areas of interest based on scientific data, expert opinion, and stakeholder input.
    - Collaboratively identify wildlife movement barriers on the State Highway System in District 2.
    - Gather connectivity-related data and information on the barriers identified.
- Develop recommendations for replicating the process statewide.

4. Symposium Layout and Introductory Remarks

The symposium included morning and afternoon sessions. During the morning session, there was a series of presentations describing connectivity issues and work currently under way. In the afternoon, there was a series of facilitated breakout sessions to gather data and collect participant input.

The symposium was opened by department officials from CDFW and Caltrans and an elder from the Pit River Tribe. We then did brief introductions of all 90+ workshop participants with each stating their name, position and, affiliation, so that everyone could get a sense of who all was in the room.

Karen Miner, Chief of the Biogeographic Data Branch at CDFW provided welcoming remarks and introduced officials from her agency and Caltrans, as well as the symposium facilitator, **Kristeen Penrod, Director of Science and Collaboration for Connected Wildlands (SC Wildlands).**

The workshop was officially opened by **Stafford Lehr, Deputy Director of the Wildlife and Fisheries Division at CDFW**. In his opening remarks, he stressed the importance of maintaining connectivity to ensure the viability of California's wildlife populations. He stated that habitat loss and fragmentation have resulted in dramatic species declines and local

extirpations in some areas of the state. He said that it's crucial to reconnect fragmented habitats so animal populations can thrive. He spoke briefly about how the state's biodiversity initiative intends to address connectivity, and how important it is for state agencies to work together and with other agencies, organizations and stakeholders across the state to achieve a connected landscape. He emphasized the importance of engaging diverse stakeholders and thanked all participants for attending the workshop and contributing their knowledge on this critical topic.

Kelly Kawsuniak, Senior Environmental Planner and Branch Chief District 2 for Inland Environmental Stewardship at Caltrans welcomed participants on behalf of Caltrans District 2. She thanked CDFW and Pew for hosting this important meeting. She said the District strongly supports integrating wildlife connectivity into transportation improvement projects, and expressed her excitement about the data that would be generated by the participants gathered.

Bill George, an elder from the Atsuge Band of the Pit River Tribe then addressed the audience. The Pit River Tribe is comprised of eleven autonomous bands including Ajumawi, Atsugewi, Atwamsini, Ilmawi, Astarawi, Hammawi, Hewisedawi, Itsatawi, Aporige, Kosalektawi, and Madesi. Mr. George explained that the Pit River Tribe’s ancestral territory (Figure 1), an area known as the 100-mile square, is located in parts of Shasta, Siskiyou, Modoc, and Lassen Counties. He explained that the tribe’s history, and their way of life in the past and future, is rooted in living in harmony with the land. He explained how cultural traditions and knowledge are handed down from generation to generation, and have been for thousands of years. He talked about the many changes and loss of nature that he’s seen in his lifetime, and how many of the wildlife that need safe passage are culturally significant to the tribe. He ended by saying that several tribal representatives are at the workshop because improving wildlife populations is essential to their people.

The introductory session was followed by several presentations on connectivity research on ungulates (e.g., deer, elk, and pronghorn), conservation tools, statewide connectivity planning, and two case studies from District 2. These presentations were intended to set the stage for the afternoon breakout sessions, which included:

1) Identifying Barriers, Data Gaps and Research Needs;
2) Focal Species Selection;
3) Identifying Partnership Opportunities and Funding Sources; and
4) Brainstorming Criteria to Prioritize Barriers for Remediation.

A summary of the morning presentations is provided below, followed by sections on each breakout session. The detailed agenda of the meeting and the list of participants is available in **Appendices 1** and **2** of the report. Datasheets used in the breakout sessions are included in **Appendix 3**.

5. Summary of Presentations

Wildlife Migration Initiatives
Laurel Williams, The Pew Charitable Trusts (Pew)

Ms. Williams described Pew's wildlife migration conservation initiative, which is part of Pew's U.S. Public Lands and Rivers Conservation Program. She discussed Pew's support of the science and research of wildlife migrations in the western U.S. for the last several years, including the Wyoming Migration Initiative and the development of the Migration Mapper GIS application. Ms. Williams noted Pew's continued engagement to seek solutions to conserving wildlife migration corridors, including across roads and highways. More, broadly noting that this is an exciting time in the field of wildlife research. For instance, new advancements in GPS collars have enabled scientists to better see the movements of wild animals across the landscape. These new technologies provide information that can inform wildlife management as well as transportation policy, to make our roads safer for drivers and wildlife, and to better conserve the corridors along which animals need to move to survive.

The Big Picture: Science and Tools of Wildlife Migration
Arthur Middleton, Ph.D., University of California Berkeley
Hall Sawyer, Ph.D., Western Ecosystems Technology, Inc.

Dr. Middleton's presentation began with an overview of why connectivity is important for all species. He explained that species need connectivity for day-to-day movements of individuals, juvenile dispersal, season migrations, for recolonization after a local population is extirpated, and for species to shift their range in response to climatic changes. He then told a story of an elk herd's migration route through the Greater Yellowstone Ecosystem. He described how difficult it is to study these migrations and showed the challenging terrain the research team crossed as they followed a herd using GPS collars and radio tracking in the field.

Dr. Middleton explained that elk migrate to get the resources they need to survive and reproduce. They go to where the grass is green. He explained that elk that migrate grow fatter and produce more offspring than elk in

herds that don't migrate. He said in summer, they climb to high elevations where it's cooler and the summer rains keep the grass greener for longer, with many herds leaving Yellowstone Park. Then in winter, they come back to lower elevations to avoid the harsh weather conditions in their summer ranges, which are then deep in snow. Dr. Middleton then showed how the collar data that they'd collected for the herd was put into the Wyoming Migration Initiative's Migration Mapper application to show the detailed route the herd takes between their summer and winter ranges. He explained how they worked with all regional agencies and organizations tracking other elk herds pull all of their GPS collar data together. They put all the GPS collar data through the Migration Mapper application to generate the first ever map of nine different elk herd's migration routes in the Greater Yellowstone ecosystem.

Dr. Sawyer presented on the Red Desert to Hoback migration corridor in Wyoming, the longest mule deer migration ever recorded and the 2nd longest known land migration in North America. He explained how his research uncovered this migration route where a deer herd travels a one-way distance of 150 miles from their low-elevation winter ranges in the Red Desert to their high-elevation summer range in the mountains surrounding the Hoback Basin. He described how the deer herd spends about four months out of the year migrating between their winter and summer ranges to complete their 300-mile round trip journey.

Dr. Sawyer showed maps and graphs of how the herd crosses a patchwork of public and private land managed by several different state and federal agencies, as well as a number of privately owned parcels. He described how the herd encounters all kinds of obstacles and barriers during migration, including lake and river crossings, oilfields and residential developments, multiple highways, and over 100 fences. He showed photos of some of these barriers and a short video of the herd using a wildlife overpass. He then talked about the complexities of managing and conserving this long-distance migration route, and described how they also mapped land use patterns and all of the specific locations of barriers and risks that the herd encountered.

University of Wyoming produced a book *Wild Migrations: Atlas of Wyoming's Ungulates* that guides readers through the entire 150-mile migration and all of the obstacles the deer must traverse and provided this information to all stakeholders that could help conserve the migration route. Finally, Dr. Sawyer talked about the public outreach program that includes a traveling photographic exhibition and short film that's now been seen by over four million people.

Identifying Movement Barriers for Pronghorn in the Modoc Plateau
Brian Hudgens, Ph.D., Institute for Wildlife Studies

Dr. Hudgens presented on a study that looked at pronghorn habitat use and movements in the Modoc Plateau, California. He explained that they radio-collared 48 adult females and 42 fawns over the course of their study, and used approximately 247,000 locations collected from GPS collars to examine pronghorn movements and habitat use. He said that pronghorn generally use more open habitats with less shrub cover and more forbs, and often used places where there had been recent livestock activity. He explained that when females had fawns, they used different habitats for bed sites, choosing areas with both short and tall shrubs to conceal their young. He said that pronghorn usually avoid forest year-round, but that they did use conifer woodlands a bit in the spring and riparian areas in some seasons.

Dr. Hudgens then described pronghorn daily and seasonal movement patterns. He said that pronghorn are most active from about noon until dusk, and they move an average of about a quarter mile per hour. He clarified that they did record pronghorn moving during all hours of the day but that they were least active in the morning. He explained that few migration events were recorded in the winter of 2014/2015, possibly because of the mild winter, but said most radio-collared females shifted their ranges during the winter of 2015/2016.

Dr. Hudgens presented maps showing all of the point locations documenting pronghorn movements and pointed out where large clusters of points indicated areas where they remained for a while. He also pointed out that small clusters would butt up against highways and that it's clear where they are making it across the road. He explained that migration movements ranged from very quick range shifts that occurred over a few days, to shifts that spanned several days or even weeks. He also highlighted how pronghorn from Modoc and Lassen counties made it all the way up into Oregon.

Abundance and Population Characteristics of Elk in Northern California
Erin Nigon, CDFW

Ms. Nigon gave an overview of CDFW's research efforts to examine elk populations in northern California. She shared work completed in northwestern California in collaboration with CDFW and Humboldt State University that focused on estimating elk abundance and comparing several survey techniques for monitoring elk populations. She showed maps of the

data collected in Humboldt and Del Norte counties as part of her graduate studies in association with CDFW. Ms. Nigon explained how CDFW is continuing with additional elk research in northeastern California. She said the Department is getting ready to capture a number of Rocky Mountain elk over the next several days in Shasta, Lassen, Modoc, and Siskiyou counties. Each elk will be ear tagged and fitted with a GPS collar that will provide data and information for up to five years. The study will help CDFW understand how elk use different habitats, their distribution and abundance, what types of resources they select, movement behaviors, and cause of mortality.

Connectivity and the California Biodiversity Initiative
Melanie Gogol-Prokurat, Ph.D., CDFW

Dr. Gogol-Prokurat presented on the CDFW's update to the statewide connectivity map for California that is being done as part of the California Biodiversity Initiative. Building on the California Essential Habitat Connectivity Project (Spencer et al. 2010), the Biogeographic Data Branch has brought together regional fine-scale connectivity studies, as well as recent statewide connectivity studies that use state-of-the-art modeling methods, to reflect the best available connectivity data in the state at multiple scales. The data are compiled in the Statewide Terrestrial Connectivity map for CDFW's ACE (2019a). Dr. Gogol-Prokurat explained that the data are displayed in five categories and included details on the data sets used to generate the map in northeastern California. Please see https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=150835&inline for more details.

Dr. Gogol-Prokurat explained that the statewide connectivity map update project also identified data gaps and research needs. Northeastern California was identified as a priority area to begin addressing data gaps because the majority of the area lacks a regional, fine-scale connectivity model to identify species-specific linkages. Additional data needs include the identification of species movement corridors based on GPS collar data, and the identification of priority wildlife movement barriers. She explained that one goal of the symposium is to begin filling these data gaps by engaging partners and stakeholders. She also said that CDFW and Caltrans recently had a one-day meeting to identify **Areas of Interest** in Caltrans District 2, which are sections of roadway that the agencies identified for further assessment of barrier status and animal movement research needs. She showed a map of these Areas of Interest overlain on the ACE Terrestrial Connectivity map and explained how this map would be used in the afternoon breakout session for participants to identify barriers, data gaps and research needs.

Wildlife Connectivity and Transportation Project Planning at Caltrans
Lindsay Vivian, Caltrans Headquarters
Chris Pincetich, Ph.D., Caltrans Headquarters

Ms. Vivian presented on how Caltrans Headquarters is working to integrate wildlife connectivity considerations into Caltrans' transportation planning and scoping processes statewide to improve the likelihood that opportunities to remediate barriers are not missed. She noted that ideally, opportunities to improve wildlife connectivity should be identified in long range plans to inform early project planning and nomination. She explained that Caltrans is collecting connectivity data statewide, such as wildlife use of underpasses and culverts that can be used at the state, regional, and District levels. Caltrans Headquarters is working on developing a library of plans and specifications for wildlife crossing structures to assist with implementation of designs to accommodate wildlife connectivity. She also referenced how Caltrans is working to improve project scoping guidance to draw planners' attention to the need to consider wildlife connectivity on transportation projects. Regionally, Caltrans would like to work with agency partners and other stakeholders to develop methods that would identify priorities for wildlife barrier remediation in each of Caltrans' 12 Districts. Ms. Vivian also described a GIS scoping tool for District staff that includes regional and state connectivity and species-related data to inform preliminary environmental analysis and project scoping. She also told participants that Caltrans has established a connectivity working group with District biologists to share data and identify research opportunities and needs.

Dr. Pincetich presented on recent research Caltrans commissioned with the Western Transportation Institute to conduct a large mammal-vehicle collision hotspot analyses for California (Huijser and Begley 2019). He said the analyses used data from collisions between vehicles and wildlife and carcass data collected statewide between 2005 and 2014. Because collisions with deer represented 65.6% of the wildlife-vehicle collisions and deer represented 97.8% of the large wild animal carcass data, all of the hotspot analyses focused on deer-vehicle collisions or mule deer carcasses. He explained that three different levels of analyses were conducted: a statewide deer-vehicle crash hotspot analysis, per District deer-vehicle crash analyses, and per Caltrans District mule deer carcass analyses.

Dr. Pincetich showed maps of the results of each analysis and described what it showed for District 2. The statewide deer-vehicle crash hotspot analysis identified the worst hotspots in the state, and four of the 13 are in District 2 including three on Interstate 5, and one on US Highway 395. The District deer-vehicle crash analysis identified eight of the worst hotspots in District 2, including seven hotspots on Interstate 5, and the most severe

hotspot in the District on US Highway 395 near Susanville. The hotspots on Interstate 5 include one near Hornbrook, two near Yreka, one near Mount Shasta, two near Red Bluff, and another near Black Butte.

Dr. Pincetich zoomed into maps showing each of these hotspots in District 2. He stated the results of the analyses are primarily intended to inform implementation of measures to reduce wildlife-vehicle collisions and improve human safety while also enhancing wildlife passage for multiple species. He said he was excited for the afternoon breakout session to gather additional data and information from participants on barriers to wildlife movement. He explained how to provide a Location ID on the breakout session datasheets that includes county, route, and post miles; Caltrans uses these variables to identify spatial information related to the State Highway System.

Caltrans Case Studies: Twin Gulches Project and State Route 139
Kelly Kawsuniak, Caltrans District 2 – Twin Gulches Project
Julie Owen, Caltrans District 2 – State Route 139

Ms. Kawsuniak presented on the highly successful Twin Gulches Project that includes a series of wildlife undercrossings on State Route 299. She explained that the wildlife structures were constructed as part of compensatory mitigation for the Twin Gulches Curve Improvement Project, which was completed in multiple phases and finished in 2016. She showed maps of where the project is located, and where the wildlife undercrossings were placed. She walked participants through the construction process and showed pictures of the major steps for installing the structures, including the Trail Gulch culvert (6’ in diameter x 204’ long) and the Water Gulch culvert (8’ in diameter x 155’ long). She also provided details on the habitat restoration plan for restoring vegetation at the approaches to each culvert to guide animals to the crossings and showed photos of this process. She described the District’s monitoring plan to document use of the wildlife crossings, which includes motion triggered cameras at the inlets and outlets of the culverts and also cameras that have been placed farther out in surrounding habitat. She enthusiastically shared with participants that while the culverts were constructed to provide safe passage for a candidate species for listing, the Pacific fisher, they were

A Pacific fisher passes through an oversized culvert constructed specifically for wildlife west of Redding on State Route 299.

documenting use of the culverts by several species., including the elusive fisher.

Ms. Owen presented on successful partnerships developed through public outreach for planning on State Route 139. She explained how Caltrans develops Transportation Concept Reports (TCRs) to inform regional transportation planning needs and to identify future transportation projects. For the State Route 139 TCR, she described how the District received over 40 responses regarding the need to reduce collisions and improve wildlife passage. She said that this highway is located in a rural area, so that number of responses was unprecedented. She explained that though the TCR has public outreach components, the scale of the community response was a combination of the activism of a grassroots stewardship group focused on solutions regarding local wildlife collisions, and by chance, the right information being communicated at the right time to that group about how their concerns could be incorporated into the TCR. As a result, the local's concerns regarding wildlife collisions will now be considered at the planning stage in future transportation projects on State Route 139.

Ms. Owen explained that there is a need for defensible data. In Caltrans process, the next step after a transportation concept report, is a Project Initiation Document (PID). One component of that document is to include measurable data to justify projects and their costs and develop a robust purpose and need. Defensible data is needed to justify projects that address animal-vehicle collisions and wildlife passage barrier remediation projects.

Ms. Owen described how much more emphasis is being placed on preserving fish and wildlife connectivity across the state than ever before. For example, state-mandated fish passage projects now require open-span solutions, and emphasis is being placed on collecting data to identify wildlife corridor issues. She noted that current state and federal funding priorities don't offer a path for funding stand-alone wildlife crossing projects; these projects generally stem from there being a mitigation requirement.

Other recommendations beyond gathering defensible data included:

1) Conducting outreach to stewardship groups in the transportation planning process and how that can advance wildlife issues.
2) Ensuring advanced planners use system planning documents like the TCR and know how to access wildlife collision and local wildlife behavior data.
3) Conducting education and outreach on the basics of Caltrans' system planning and advanced planning processes.
4) Developing funding mechanisms beyond project-specific triggers.
5) Developing wildlife crossing design standards to help reduce costs.

6. Identifying Barriers, Data Gaps, and Research Needs

This session focused on identifying barriers, data gaps, and research needs in the focus area. The areas identified were termed Areas of Interest, which are sections of roadway identified for further assessment of barriers status and animal movement research needs. CDFW and Caltrans co-led this session, which began with an overview of the objectives of the working session and logistics of linking the datasheets to any spatially related information drawn on the large-format maps. All participants were able to participate in this breakout session, which was repeated twice during the symposium. A total of 80 spatially-delineated Areas of Interest were identified in this breakout session, in both polygon (16) and line (64) format (Figure 2 and Appendix 4). CDFW and Caltrans met in late 2019 to start the data collection process in preparation for the symposium and identified 15 additional Areas of Interest at that meeting that were unique and not identified at the January symposium, which have been included in this summary for a total of 95 records.

An important caveat for the summary of this session is that there is some spatial overlap between the linear segments identified. Thus, there could be 3 records that indicate a deer crossing submitted on different datasheets by different people in the same general location (e.g., Post-Mile 30–31; 30–40; and 35–45). The lines may be fully overlapping, partially overlapping, or directly adjacent. Some are short segments indicating a specific crossing or culvert location, but that might be within a longer segment mapped by someone else. If consolidated spatially, specific locations of the shorter mapped segments would be lost. Thus, the decision was made to keep the data records separate. When total numbers of segments are reported, it is important to note that there is some overlap among segments.

Participants identified a number of target wildlife species or species groups that would benefit from connectivity improvements. Of the 95 datasheets completed by CDFW, Caltrans, and symposium participants, 91% (86/95) mentioned specific species (Figure 3). The top three species cited were all ungulates. Deer was the number one species mentioned in the records for the Areas of Interest (48/95), followed by elk (21), and pronghorn (20). Bear was also mentioned in quite a few records (18), as was Pacific fisher (8). Three records referenced gray wolf, including one that mentioned CDFW GPS collar data for the Gray Wolf Lassen Pack. As expected, mammals were identified as the most targeted taxonomic group, representing 92% (79/86) of the records that mentioned specific species. Other taxonomic groups mentioned included birds, amphibians, and reptiles. Birds were mentioned in

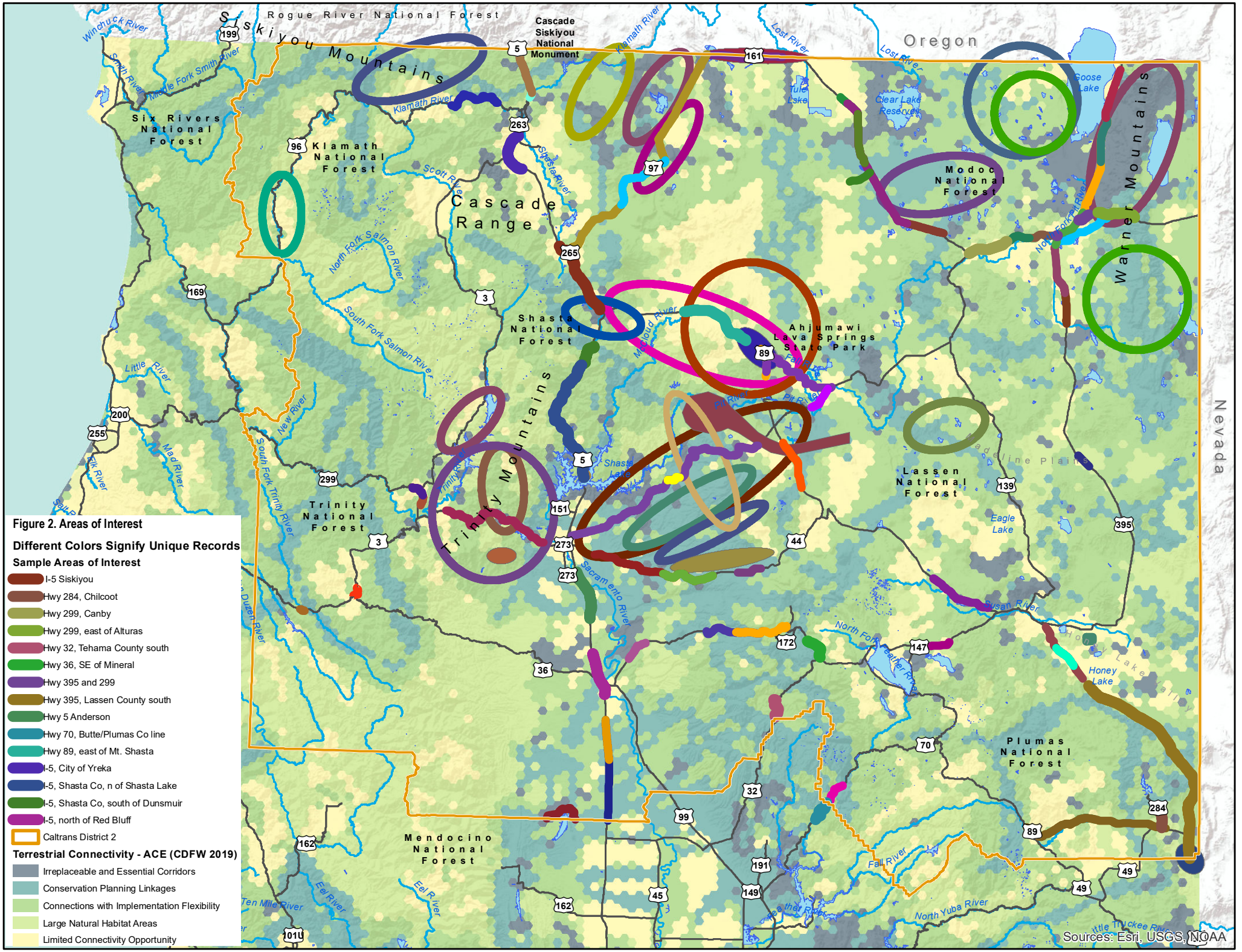
Figure 2. Areas of Interest
Different Colors Signify Unique Records
Sample Areas of Interest
I-5 Siskiyou
Hwy 284, Chilcoot
Hwy 299, Canby
Hwy 299, east of Alturas
Hwy 32, Tehama County south
Hwy 36, SE of Mineral
Hwy 395 and 299
Hwy 395, Lassen County south
Hwy 5 Anderson
Hwy 70, Butte/Plumas Co line
Hwy 89, east of Mt. Shasta
I-5, City of Yreka
I-5, Shasta Co, n of Shasta Lake
I-5, Shasta Co, south of Dunsmuir
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Caltrans District 2
Terrestrial Connectivity - ACE (CDFW 2019)
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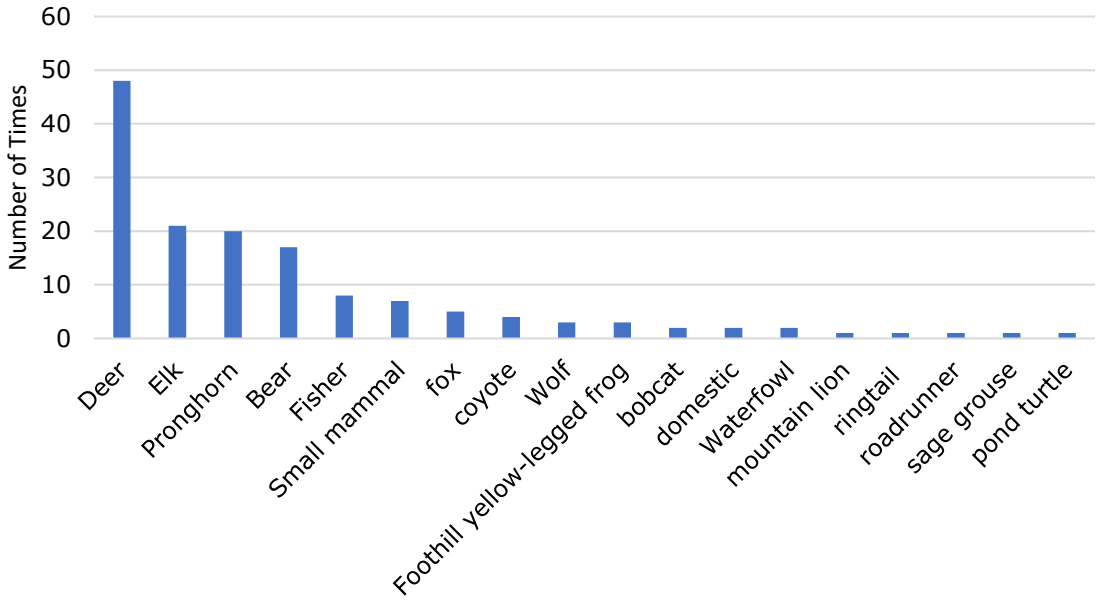
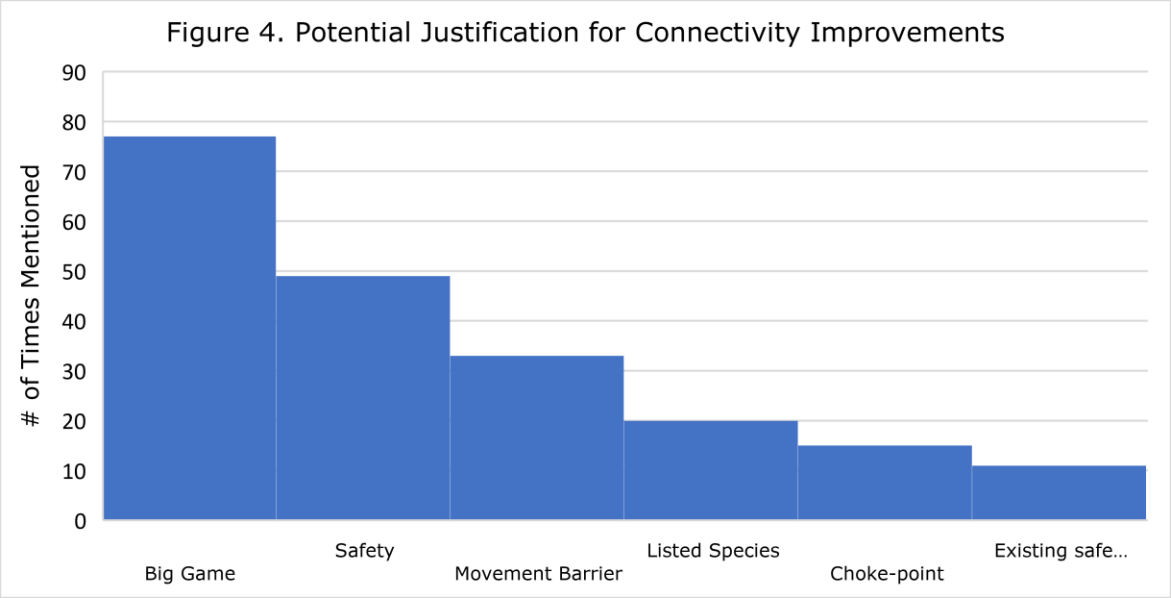
Cascade Range
Shasta National Forest
Trinity Mountains
Trinity National Forest
Mendocino National Forest
Modoc National Forest
Warner Mountains
Ahjumawi Lava Springs State Park
Lassen National Forest
Plumas National Forest
Nevada
Sources: Esri, USGS, NOAA

7% of records, including roadrunner, sage grouse, raptors and water birds, while 5% of records mentioned an amphibian or reptile, including foothill yellow-legged frog and western pond turtle.

Figure 3. Species Mentioned in Areas of Interest



Participants were asked to identify potential justifications for connectivity improvements (Figure 4). Big game species and safety were identified as the top reasons for remediating barriers to movement, with 81% (77/95) and 52% (49/95) of records citing these reasons, respectively. Listed species were specifically mentioned as a reason for improving connectivity in 22% (21/95) of the datasheets. Listed species specifically mentioned included gray wolf, Pacific fisher, sage grouse, and foothill yellow-legged frog. Other justifications provided include habitat choke-point, existing safe passage, and movement barriers. Movement barrier was explicitly circled on 33 of the datasheets, though 59 of the records included terms indicative of a movement barrier (e.g., barrier, deer-vehicle collisions, roadkill, hotspot, carcass data).



Barriers, data gaps, and research needs were identified throughout District 2 (Figure 5). Roughly half of the records (31/59) that mentioned terms indicative of a movement barrier included a term related to mortality (e.g., deer-vehicle collisions, roadkill, hotspot, carcass data). Not surprisingly, roadkill was mentioned on Interstate 5 more than any other route in District 2 (seven times), with the associated records covering a combined 92 linear miles (Table 1). Interstate 395, while only mentioned in two records related to roadkill, also covered a considerable distance of 63 miles. One record for both State Route 70 and 44 each mentioned 30-mile segments.

Table 1. Summary of datasheets mentioning roadkill.

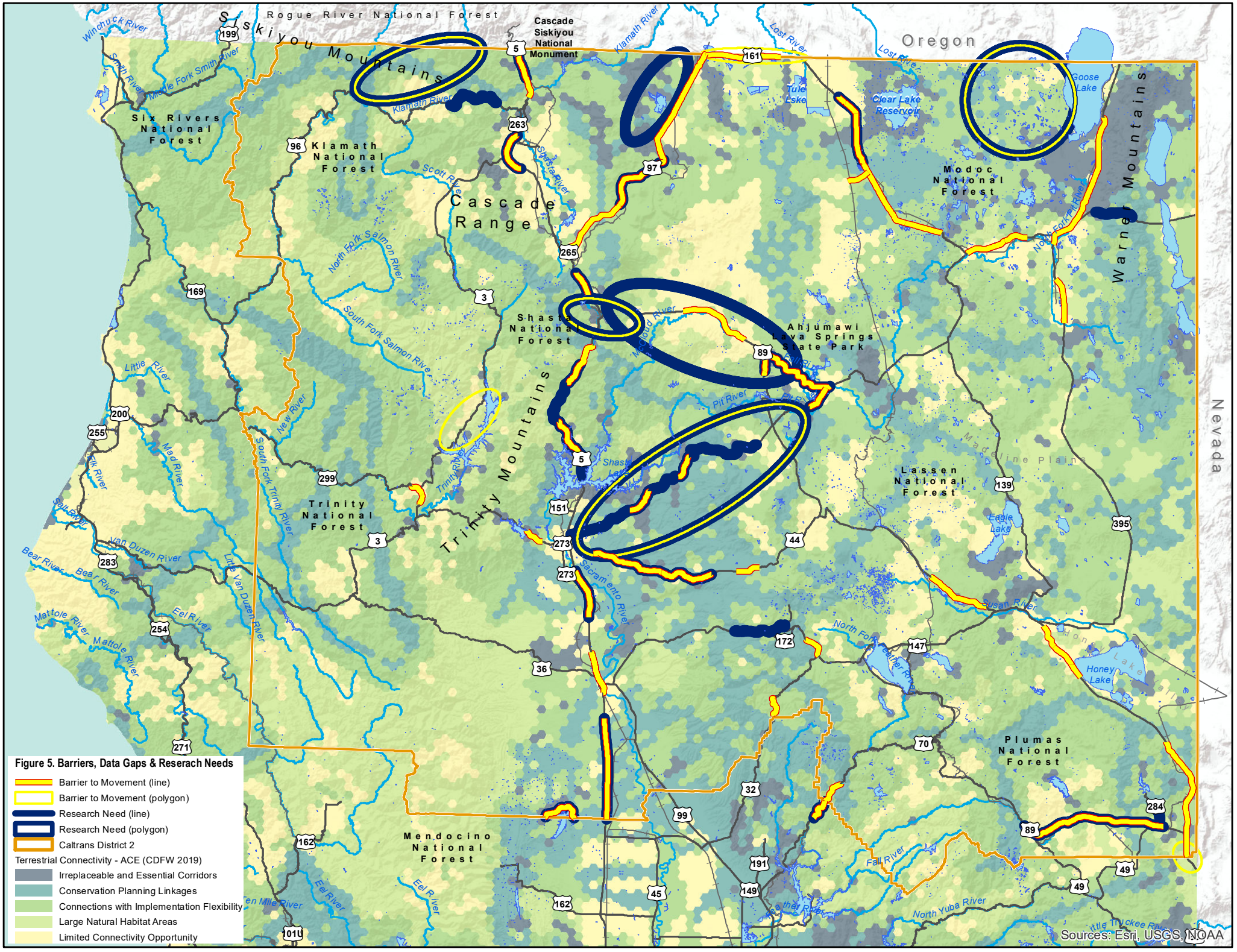
Route	County	Post Mile or Location	Miles
32	Tehama	5–10	5
36	Tehama	95–100	5
299	Modoc	22–30	8
299	Shasta	90-95	5
97	Siskiyou	15–30	15
97	Siskiyou/Modoc	none provided	
139	Modoc	35–45; 30–40; 15–43; 30	30
89	Siskiyou	0–15	15
44	Shasta	5–35	30
70	Plumas	65–95	30
395	Lassen	47–60; 5–55	63
5	Tehama	12–20	8
5	Shasta	0–10; 5–62; 55-65	65
5	Siskiyou	41–50; 59–69; 63–69	19
161		Tulare/Klamath Lakes	

Fencing was identified as a barrier to wildlife movement on six of the datasheets. All but one of these records cited pronghorn antelope as the target species and four out of six of these were associated with Interstate 395:

- Interstate 395: Location data of collared pronghorn show roadside fences prevent movement.
- Interstate 395: Exclusionary fences have been erected without corresponding wildlife crossings.
- Interstate 395/State Route 299: Need signage, removal of hazard fences, and possible underpass. CA Pronghorn Foundation has data. Need collar tracking and studies for over or underpass. Traditional ecological knowledge of migration corridors and hunting grounds.
- General Modoc County: Improve fence impediments or mark fences to facilitate pronghorn movement.
- State Route 70: Deer movement is obstructed near Davis Rest Area; large 20-foot culverts are being used but fencing needs to be extended and modified to improve connectivity.

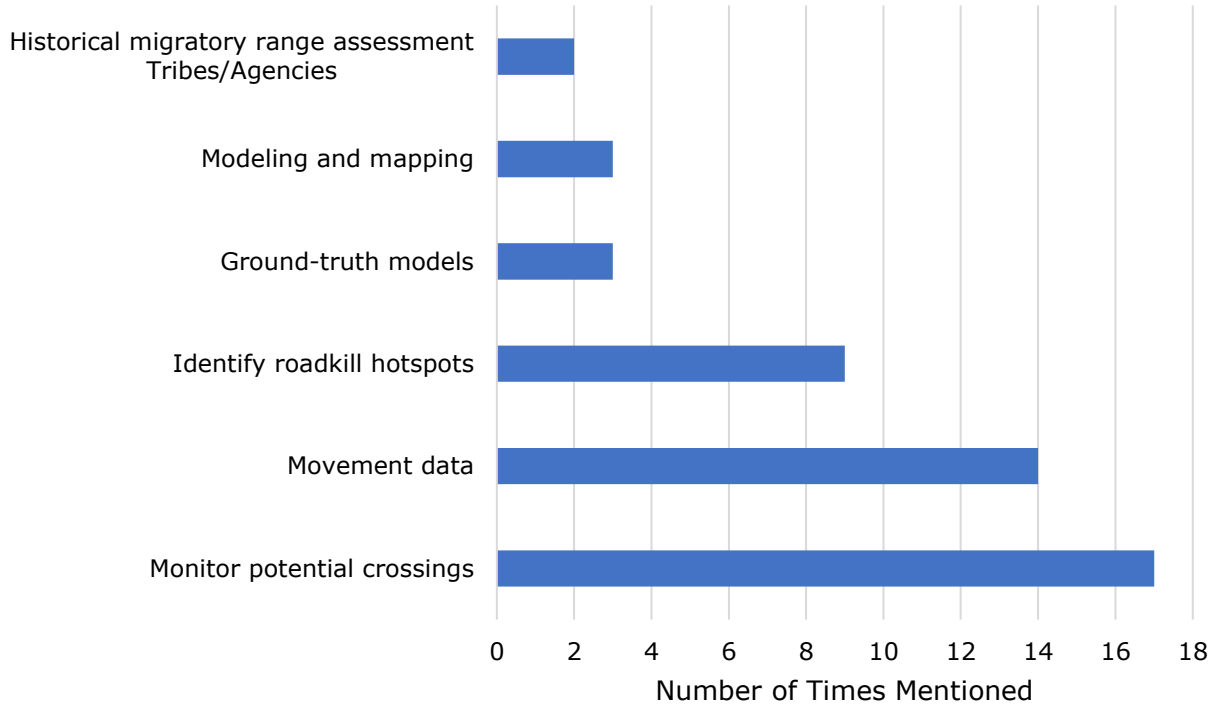
Research needs were logged in 38 records associated with the Areas of Interest (Figure 5). Six general categories of research needs were interpreted from the datasheets, as shown in the summary graph depicted in Figure 6. Some of the records identified more than one type of research need. For example, one record stated, “high incidence of roadkill, especially in fall and winter, need collar data,” which was interpreted as two research needs: movement data (e.g., GPS collar), and identify roadkill hotspots to determine needed locations for crossing improvements. Monitoring potential crossings (e.g., bridges, culverts) to assess use by target species was identified as the number one research need, followed by movement data, and identifying roadkill hotspots.

A few records identified an assessment of historical migratory pathways as a research need (Figure 6). A few participants suggested this research project be a collaborative effort between the tribes, CDFW, and non-governmental organizations, such as the California Deer Association, all of which have extensive data and knowledge. Tribal elders have historic knowledge passed down from generation to generation. CDFW has historical migratory/range data for the last several decades. The collaborative effort could collect and synthesize historical "local" information (from tribes, wardens, officials, and NGO's) and produce a historical range and migratory corridor map that could be used to assess and identify changes in historical pathways due to


Rogue River National Forest
Siskiyou Mountains
Cascade Siskiyou National Monument
Oregon
Six Rivers National Forest
Klamath National Forest
Cascade Range
Shasta National Forest
Trinity Mountains
Trinity National Forest
Modoc National Forest
Warner Mountains
Ahjumawi Lava Springs State Park
Lassen National Forest
Plumas National Forest
Mendocino National Forest
Nevada
Winchuck River
Smith River
Middle Fork Smith River
Klamath River
Lost River
Tule Lake
Clear Lake Reservoir
Goose Lake
Scott River
Shasta River
North Fork Salmon River
South Fork Salmon River
Little River
Mad River
New River
South Fork Trinity River
Trinity River
Pit River
Shasta Lake
Sacramento River
Eagle Lake
Susan River
Honey Lake
Bear River
Van Duzen River
Little Van Duzen River
Mattole River
Eel River
Fall River
North Yuba River
Little Truckee River
199
5
161
263
96
97
265
169
3
89
200
255
299
151
273
44
139
395
283
254
36
172
147
70
32
99
284
162
191
45
149
49
271
101
Figure 5. Barriers, Data Gaps & Reserach Needs
Barrier to Movement (line)
Barrier to Movement (polygon)
Research Need (line)
Research Need (polygon)
Caltrans District 2
Terrestrial Connectivity - ACE (CDFW 2019)
Irreplaceable and Essential Corridors
Conservation Planning Linkages
Connections with Implementation Flexibility
Large Natural Habitat Areas
Limited Connectivity Opportunity
Sources: Esri, USGS, NOAA

fragmentation from infrastructure development, urban development, and climate change.

Figure 6. General Categories of Research Needs



Four records identified research needs related to ground-truthing a connectivity model for Pacific fisher (Figure 7) developed by Conservation Biology Institute for the U.S. Fish and Wildlife Service (USFWS) (Spencer et al. 2019). Caltrans and USFWS are currently working together to fill some of these research gaps related to bridge and culvert monitoring for fisher. The research needs identified are associated with four routes on the State Highway System:

- Interstate 5: A few existing culverts and bridges, but they are widely dispersed. Need field verification to determine use by Pacific fisher post-fire.
- State Route 299: Connecting core area with translocation of fishers. Need ground-truthing of connectivity model. It's possible bridges and culverts exist within the delineated linkage.
- State Route 36 (east of Interstate 5): Connectivity model, just north of fisher translocation. Need field monitoring to determine if individuals are dispersing north from reintroduced population. If connectivity is impaired, then it could possibly limit recovery potential.

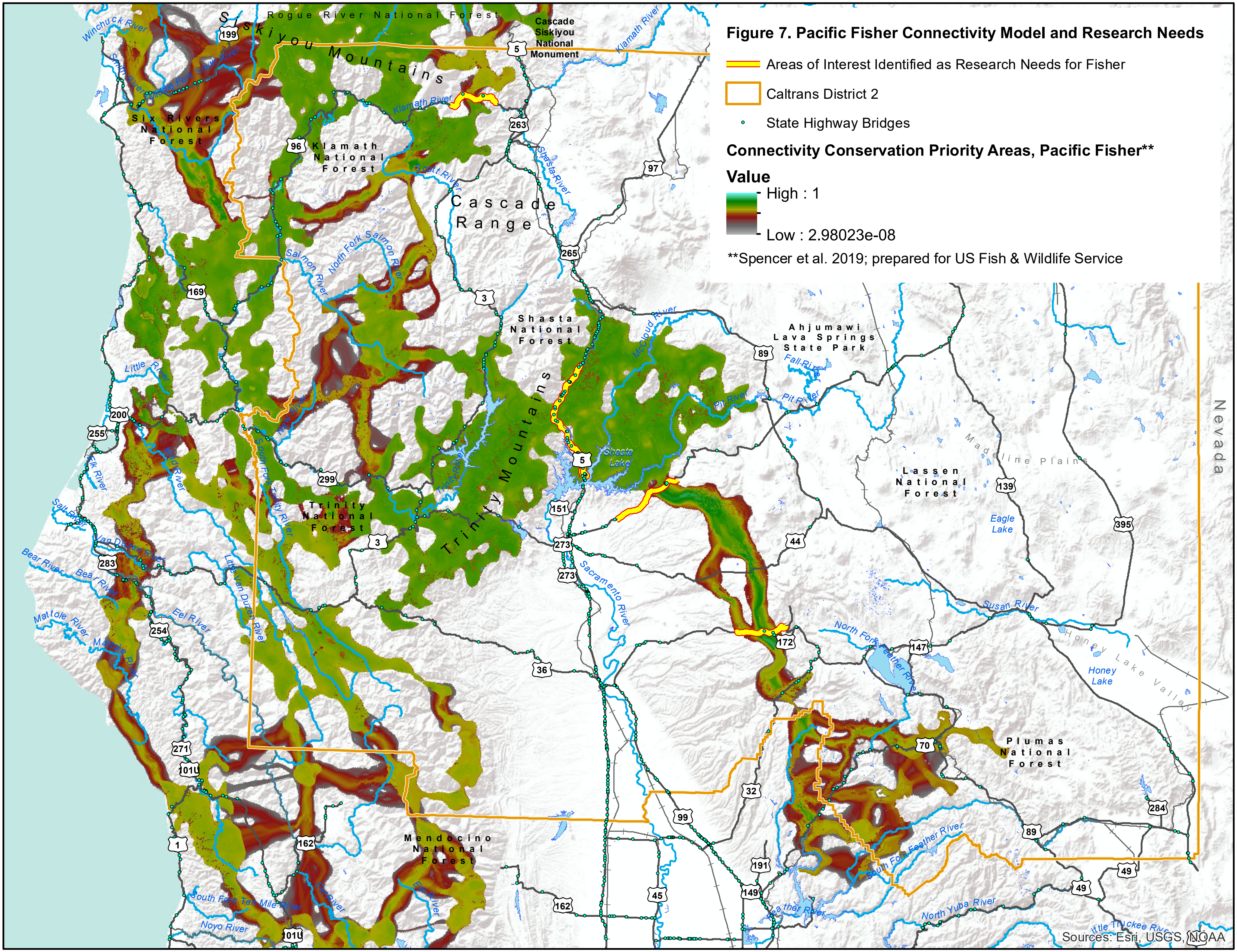


Figure 7. Pacific Fisher Connectivity Model and Research Needs

- State Route 96: CBI/USFWS connectivity model, eastern Klamath study area, need research on post-fire use of habitat. There is a river and a road and may be an existing culvert that should be monitored.

Other modeling and mapping needs identified by participants included:

- Brownian bridge movement models to better understand pronghorn movement in Modoc County.
- Pacific Forest Trust is currently working on a grant from Wildlife Conservation Board to create a model/mapping tool for this region, to combine spatially explicit climate risk maps with target species habitat.
- Need fine-scale vegetation/habitat mapping to identify preferred wildlife habitat.

7. Focal Species Selection

The primary objective of this breakout session was to gather local expertise of symposium attendees to help identify potential focal species for a fine-scale, regional connectivity analysis, as well as to identify species experts and data sources. This breakout session was repeated twice during the symposium, and all attendees had the opportunity to participate. Participants represented a broad range of knowledge and scientific expertise, land owners and managers, infrastructure planners and engineers, scientific policy experts, and holders of traditional knowledge.

Models of focal species movement within the focus area would be used to identify corridors and linkages needed to maintain habitat connectivity, wildlife movement, and ecological processes. The focal species approach (Beier and Loe 1992, Lambeck 1997) recognizes that species move through and utilize habitat in a variety of ways. Modeling linkages for a range of focal species that are sensitive to habitat loss and fragmentation, represent a diversity of habitat requirements and movement needs, and represent a range of taxonomic groups, will identify an array of linkages within different habitat types needed to maintain biodiversity. Focal species may include wide-ranging species that need connectivity for a variety of reasons, such as juvenile dispersal and seasonal migration; habitat specialists; keystone species that have a disproportionately large effect on their environment relative to their abundance; and species with limited dispersal ability that may take generations to move between targeted cores areas (corridor dwellers), and may be needed to maintain the ecological integrity of the linkage over time (e.g., prey species). CDFW's Guidance Document on Fine-

Scale Connectivity Analysis (Krause and Gogol-Prokurat 2014; https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=93018&inline) provides a detailed description of considerations when selecting focal species.

Participants broke out into four taxonomic work groups to identify potential focal species: (1) mammals, (2) birds, (3) amphibians, reptiles and fish, and (4) plants and invertebrates. Attendees chose which taxonomic work group to participate in based on their interest and expertise. Each work group was provided with maps of vegetation, rare species diversity and hotspots, a list of rare species within each taxonomic group in the focus area, and the habitats in which each species is found. Each work group had a facilitator to help guide the discussion. Participants were provided with datasheets that included points of discussion to help participants identify potential focal species, provide expert knowledge, and data sources (Appendix 3).

Symposium participants identified a taxonomically diverse suite of potential focal species that met the criteria provided or were otherwise identified as important, including seven mammals, nine birds, three amphibians, three reptiles, one fish, five invertebrates, and four plant communities. These 28 focal species capture a diversity of movement needs and ecological requirements and include area-sensitive species, barrier-sensitive species, less mobile species or corridor dwellers, habitat specialists, and ecological indicator species. Of the 28 focal species identified, 13 were identified as species of greatest conservation need in the State Wildlife Action Plan (CDFW 2015), which are defined to include all Species of Special Concern in addition to listed species, and those species particularly vulnerable to climate change.

The information collected during the focal species session will be incorporated into a focal species selection process by CDFW, which will be used to develop a comprehensive focal species-based connectivity assessment for the focus area as called for in the California Essential Habitat Connectivity Project (Spencer et al. 2010). Additional information that will be considered, which was beyond the scope of the symposium breakout session, include the availability of species occurrence data to build the models, input from wildlife experts not present on the day of the symposium, and ensuring that the final focal species list is fully stratified by species movement needs and taxonomic groups, and includes habitat specialists for all key habitat types in the ecoregion. Many of these focal species would also be ideal species to monitor for connectivity improvements (e.g., wildlife crossings, habitat restoration) in the focus area. The following

pages describe why each potential focal species was selected and includes a summary of the threats to, status of, and habitat associations of each species.

7.1 Mammals

The mammal groups (two independent sessions) were tasked with developing a list of mammals that could serve as focal species for evaluating barriers and habitat linkages throughout northern California. Both sessions were well attended with a range of expertise from agency, non-profit, and academic institutions, as well as representatives of the Pit River Tribe. Deer, pronghorn, fisher, and porcupine were selected as focal species by both groups. Other species selected included elk, gray wolf, and marten. Consistent reasons the groups cited for selecting the focal species included their sensitivity to fragmentation and edge effects and need for habitat connectivity to maintain genetic diversity, and the importance of dispersal and migration to their ecology and metapopulations. The large ungulates were also selected because they are reluctant to use small culverts under roads and can serve as a useful umbrella species for other animals with the same reluctance. The fisher and marten were selected because of their habitat specialization, and the gray wolf and porcupine were selected in part for their conservation status.

Gray wolf (*Canis lupus*) The naturally low densities of this wide-ranging species make them highly sensitive to habitat loss and fragmentation. The loss of large carnivores can have adverse ripple effects through the entire ecosystem (Soulé and Terborgh 1999). Gray wolf was likely extirpated from California in the 1920s and is now returning on its own by dispersal of individuals from populations in other states (https://wildlife.ca.gov/conservation/mammals/gray-wolf). Dispersal is vital to their persistence. The gray wolf is listed as endangered under the California Endangered Species Act, and although also federally listed as endangered, is proposed for delisting by USFWS (2019a). The gray wolf is a species of greatest conservation need in the focus area; it is a habitat generalist that may use most habitats in the Klamath Mountains, Southern Cascades, Northwest Basin and Range, and Modoc Plateau (CDFW 2015).

Fisher (*Pekania pennanti*) is a small, forest-dwelling carnivore, and habitat specialist that depends on late-successional mixed conifer/hardwood forests (Buskirk and Powell 1994, Powell and Zielinski 1994, Carroll et al. 1999, Zielinski et al. 2004, Zielinski et al. 2006, Lofroth et al. 2010). Timber harvest has been identified as one of the primary causes of fisher decline across the United States (Douglas and Strickland 1987, Powell 1993, Powell and Zielinski 1994). Fishers in northern California, southern Oregon, and the southern Sierra Nevada, may be the only native populations remaining west of the Rocky Mountains in the United States (Aubry et al. 2004, Drew et al. 2003, USFWS 2010). In California, they are restricted to two disjunct populations in the Klamath and Sierra Nevada mountains that are separated by more than 300 miles (Zielinski et al. 2005).

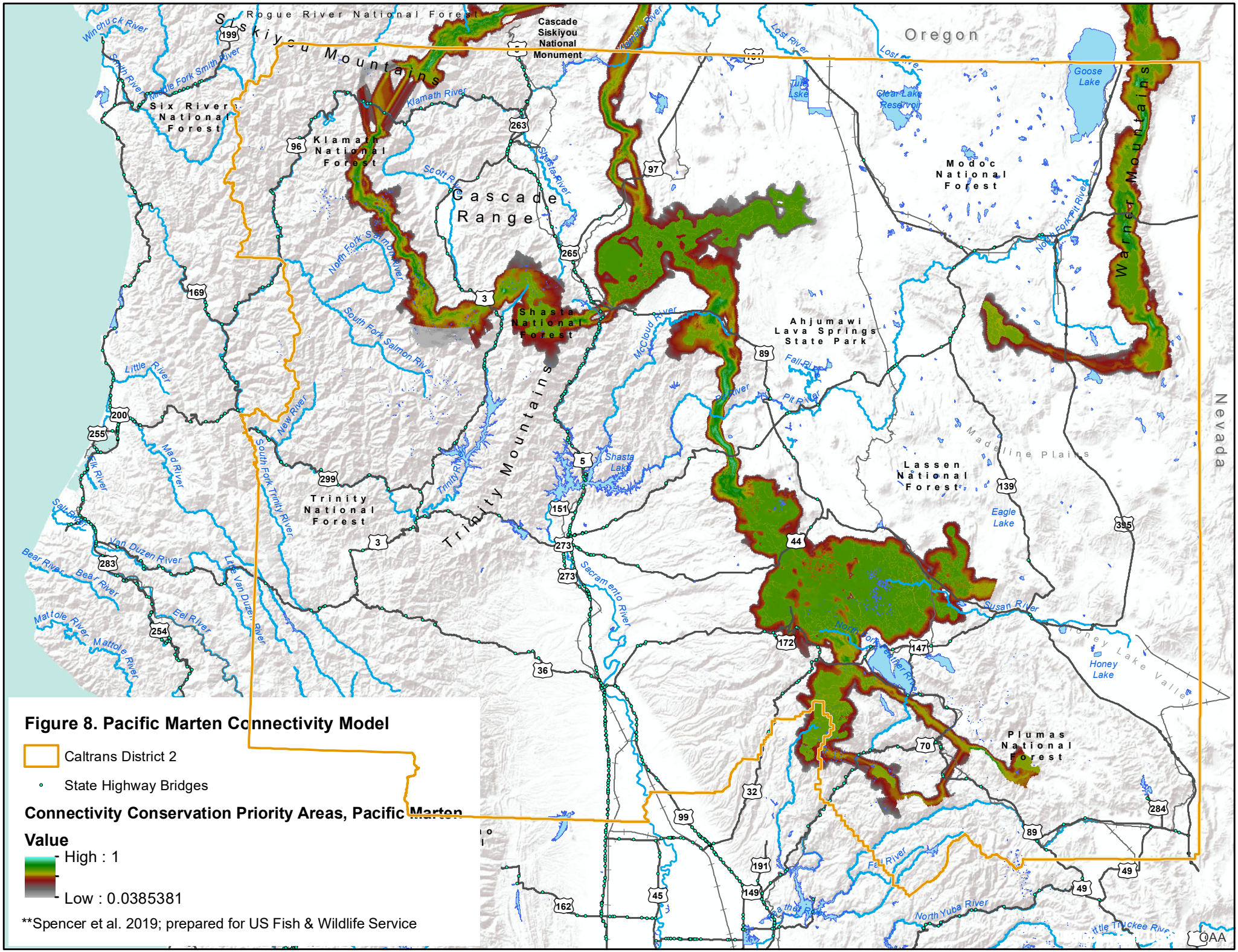
The impacts of habitat loss and fragmentation on fishers are severe due to their large home ranges, relatively low fecundity, and naturally low population density (Ruediger et al. 1999). The species needs connectivity of late-successional forests restored for its recovery. USFWS recently listed the Southern Sierra Nevada population of fisher, located outside of the symposium focus area, as endangered under the Endangered Species Act, but chose not to list the Distinct Population Segment (DPS) in the focus area (USFWS 2020). A participant from USFWS in Yreka brought a recent connectivity assessment for fisher in the Klamath Basin (Spencer et al. 2019), which overlaps part of the focus area (Figure 7). The fisher occurs in all four ecoregions in the focus area and is identified as a species of greatest conservation need in the Klamath Mountains, Southern Cascades, and Modoc Plateau ecoregions (CDFW 2015). Within these ecoregions, fisher may be found in late-successional forests and woodlands including riparian forests, from the foothills to high-elevation subalpine forests (CDFW 2015). Participants from the Pit River Tribe identified the fisher as being of cultural interest.

Pacific marten (*Martes caurina*) is a small carnivore with a relatively large home range (Buskirk and Zeilinski1997). There are two subspecies of marten in California and both occur in the focus area. The Klamath River separates the historical range of the Humboldt marten (*M. c. humboldtensis*) from the range of the Sierra Nevada marten (*M. c. sierrae)* (Slauson and Zielinski 2004). The Humboldt marten subspecies was listed as endangered under the California Endangered Species Act in 2018 (CDFW). The coastal

DPS of the Pacific marten was federally listed as threatened in October of 2018 (USFWS 2018). The marten was identified as species of greatest conservation need in the Klamath Mountains, Southern Cascades, Modoc Plateau, and Northwest Basin and Range ecoregions in the focus area (CDFW 2015).

The marten's reliance on low-elevation late-successional forests (Slauson et al. 2009, Hamlin et al. 2010) and extensive space requirements make it highly sensitive to habitat loss and fragmentation. Marten densities are lower in logged than unlogged landscapes (Soutiere 1979, Bissonette et al. 1989, Philips 1994, Thompson 1994, Hamlin et al. 2010), and martens are known to avoid clear cuts (Steventon and Major 1982, Snyder and Bissonette 1987, Frederickson 1990, Katnik 1992, Chapin et al. 1998, Hamlin et al. 2010). Larger patches of late-successional forest with dense shrub cover are more likely to be occupied by marten (Slauson et al. 2009). Maintaining and restoring connectivity of late-successional forests with a dense understory of shrubs is essential for martens attempting to recolonize unoccupied stands. The participant from USFWS in Yreka also brought a recent connectivity assessment for marten in the Klamath Basin (Spencer et al. 2019), which overlaps part of the focus area (Figure 8). Within these ecoregions, it may be found in late-successional forests and woodlands including riparian forests, from the foothills to high-elevation subalpine forests, as well as wet shrubland habitats in mountainous terrain (CDFW 2015).

Elk (*Cervus canadensis*) are considered a barrier-sensitive species as major freeways and even paved roads can limit the range and movements of herds (R. Stafford, CDFW pers. comm). Elk are known to be reluctant to use small culverts under roads, preferring open-span bridges or wildlife overpass (Ruediger et al. 2005). Elk is a species targeted by S.O. 3362, which seeks to increase and maintain sustainable big game populations and migration corridors across western states. Wildlife-vehicle collisions with elk are a public safety issue, as elk can cause substantial damage to vehicles and result in motorist injuries and fatalities. CDFW has GPS collar data and roadkill data for elk near Grass Lake on Highway 97


Rogue River National Forest
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Klamath National Forest
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Modoc National Forest
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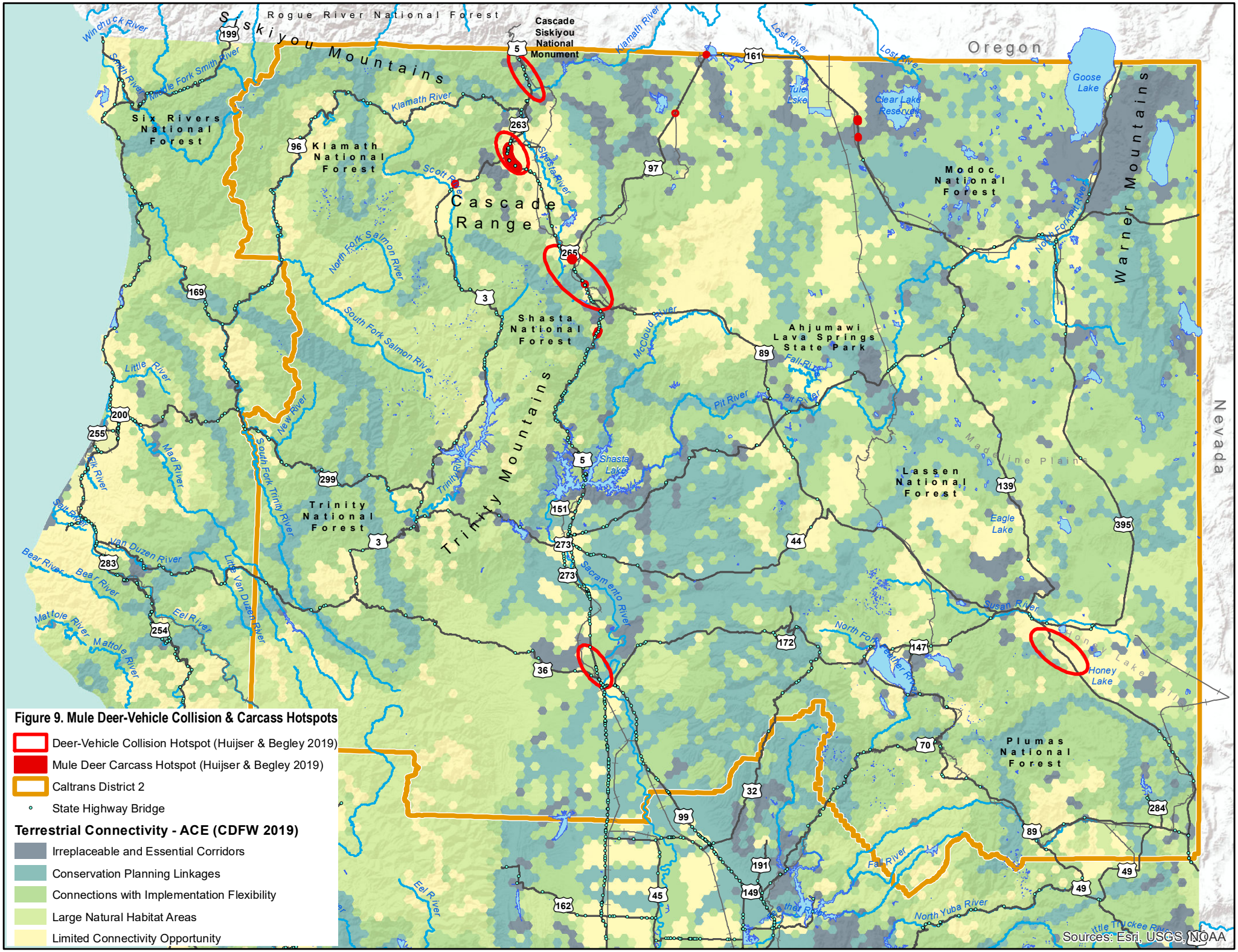
Trinity Mountains
Trinity National Forest
Lassen National Forest
Madeline Plains
Plumas National Forest
Honey Lake Valley
Nevada
Winchuck River
Smith River
Middle Fork Smith River
Klamath River
Lost River
Tule Lake
Clear Lake Reservoir
Goose Lake
Scott River
Shasta River
North Fork Salmon River
South Fork Salmon River
McCloud River
Fall River
Pit River
North Fork Pit River
Little River
Mad River
New River
South Fork Trinity River
Trinity River
Shasta Lake
Eagle Lake
Van Duzen River
Bear River
Eel River
Mattole River
Lake Van Duzen
Sacramento River
North Fork Feather River
Susan River
Honey Lake
Fall River
North Yuba River
Little Truckee River
199
96
263
97
265
169
3
89
200
255
299
5
151
139
395
44
273
283
254
36
172
147
70
32
99
191
149
45
162
49
284
Figure 8. Pacific Marten Connectivity Model
Caltrans District 2
State Highway Bridges
Connectivity Conservation Priority Areas, Pacific Marten
Value
High : 1
Low : 0.0385381
**Spencer et al. 2019; prepared for US Fish & Wildlife Service
OAA

where there has been high elk mortality due to vehicle strikes (E. Nigon, pers. comm.). Elk occur in all four ecoregions in the focus area. Two subspecies of elk occur in the focus area, Rocky Mountain elk (*C. c. nelsoni*) and Roosevelt elk (*C. c. roosevelti*). Both breed in open, brushy stands of deciduous and conifer forests and feed in riparian areas, meadows, and herbaceous and brush stages of forest habitats (McCullough 1969, Zeiner et al. 1988-1990). Elk are also a species of cultural interest, as identified by participants from the Pit River Tribe.

Mule deer (*Odocoileus hemionus*) were chosen as a focal species in part to help support viable populations of carnivores, which rely on deer as prey. This large herbivore can have significant effects on vegetation composition and also plays a role in ecosystem processes such as nutrient cycling (Molvar et al. 1993, Wallis de Vries 1995, Hanley 1996, Hobbs 1996, Kie et al. 2002). The mule deer is also a barrier-sensitive species whose movements are inhibited by highways (especially with solid median barriers), large reservoirs, expanses of open areas without cover, urban and suburban development, and high fences. (Sawyer et al. 2012, Wakeling et al. 2015).

Deer are particularly vulnerable to habitat fragmentation by roads; nationally, vehicles kill several hundred thousand deer each year (Romin and Bissonette 1996, Conover 1997, Forman et al. 2003). Mule deer represented 97.8% of all large-mammal carcasses collected on highways in California, totaling 3,424 collisions between 2000 and 2009, representing a significant safety issue for California drivers (Huijser and Begley 2019). Across the state, there were 6,922 wildlife-vehicle collisions with deer between 2005 and 2014 (Huijser and Begley 2019). A total of four out of 10 of the worst hotspots for deer-vehicle collisions in the state occur in the northeast part of the state in Caltrans District 2 (Figure 9), with three on Interstate 5 near the towns of Yreka, Mt. Shasta, and Red Bluff, and one on US Highway 395 near Susanville (Huijser and Begley 2019). The mule deer is also a species targeted by S.O. 3362 and a species of cultural interest to the Pit River Tribe. Mule deer occur in all four ecoregions in the focus area and can be found in most forest, shrub and grassland habitats in the focus area.

Pronghorn antelope (*Antilocapra americana*) were historically common in southern, central, and northeastern California (Yoakum 2004a), and grasslands of the San Joaquin Valley once supported exceptional numbers (Newberry 1855, cited in Yoakum 2004b). However, pronghorn disappeared from many parts of California by the 1940s due to over-hunting and the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Eagle Lake
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Madeline Plains
Klamath River
Lost River
Pit River
McCloud River
Fall River
Sacramento River
Trinity River
Scott River
Shasta River
North Fork Salmon River
South Fork Salmon River
New River
South Fork Trinity River
Little River
Mad River
Van Duzen River
Bear River
Mattole River
Eel River
Susan River
North Yuba River
Middle Fork Smith River
Smith River
Winchuck River
Figure 9. Mule Deer-Vehicle Collision & Carcass Hotspots
Deer-Vehicle Collision Hotspot (Huijser & Begley 2019)
Mule Deer Carcass Hotspot (Huijser & Begley 2019)
Caltrans District 2
State Highway Bridge
Terrestrial Connectivity - ACE (CDFW 2019)
Irreplaceable and Essential Corridors
Conservation Planning Linkages
Connections with Implementation Flexibility
Large Natural Habitat Areas
Limited Connectivity Opportunity
Sources: Esri, USGS, NOAA

conversion of native grasslands to croplands (Yoakum 2004b). CDFW has since reintroduced pronghorn throughout portions of their historic range. In 1987, 1988, and 1990, a total of over 200 pronghorn antelope were translocated from the shrub-steppes of northeastern California to the Carrizo Plain and surrounding rangelands (Koch and Yoakum 2002, Yoakum 2004b, Longshore and Lowrey 2008).


Photo Courtesy of USFWS

Pronghorn avoid predators by visual detection and speed, and primarily use open grasslands and shrub communities with good horizontal visibility, gentle slopes, and few movement obstacles. Fences can impede movements, reduce habitat quality, and cause mortalities, depending on fence design, because pronghorn do not readily jump fences, rather pronghorn crawl underneath fences (Byers 1997, Yoakum 2004c). Pronghorn movement in Arizona was not impacted by unfenced, paved two-lane roads, but fenced rights-of-way including two- and four-lane roads and railroads acted as barriers and influenced shapes of pronghorn home ranges (Ockenfels et al. 1997). Only one pronghorn carcass was reported in California between 2000 and 2009 (Huijser and Begley 2019). Pronghorn antelope are also a species targeted by S.O. 3362. Pronghorn are identified as species of greatest conservation need in the Klamath Mountains, Southern Cascades, Modoc Plateau, and Northwest Basin and Range ecoregions (CDFW 2015). Within these ecoregions, pronghorn may occur in annual and perennial grassland, lowland to montane shrubland and grassland, sage shrubland and steppe, and meadow plant communities (CDFW 2015). Pronghorn are also of cultural interest, as identified by participants from the Pit River Tribe.


Photo Courtesy of USFWS

Porcupine (*Erethizon dorsatum*) are long-lived rodents that produce only one offspring annually, and they tend to occur at low densities (Roze 2009). Porcupines are sensitive to habitat fragmentation with road mortalities identified as a significant cause of death across their range, perhaps due to their size and relatively slow gait (Roze 2009, Barthelmess and Brooks 2010). Their population increased significantly between the 1920s and 1970s, evidently due to land use changes (Dodge and Barnes 1975), and a reduction in predators due to fur trapping and government control practices (Stone 1952, Appel et al. 2017). Efforts to control porcupines began in 1925 and

continued on national forest lands in California into the 1980s (Anthony et al. 1986, Appel et al. 2017). Porcupine populations now appear to be declining across California (CSERC 2011, Allen and Casady 2012, Appel et al. 2017), which may coincide with the recovery of some of their main predators, like fisher (Appel et al. 2017), and widespread use of rodenticides. The porcupine is identified as a species of greatest conservation need in the Klamath Mountains, Southern Cascades, Modoc Plateau, and Northwest Basin and Range ecoregions (CDFW 2015). Within these ecoregions, the species may be found in foothill, montane, and subalpine forests, wet shrubland, freshwater marsh, and wet meadow plant communities (CDFW 2015). Many native people use porcupine quills for regalia and basketry, and consider it a culturally important species (Merriam 1979). Traditional knowledge would make for a more complete account of the occurrence of porcupines, similar to recent historical range reconstructions for beaver (*Castor canadensis*) and gray wolf in California (Lanman et al. 2013, Newland and Stoyka 2013, Appel et al. 2017).

7.2 Birds

On the face of it, because birds can fly, they may seem less susceptible to the negative effects of habitat fragmentation then other more terrestrially bound species. In reality, as a group, birds display a high degree of variance with regard to their susceptibility to fragmentation (Kociolek et al. 2015). Some are habitat specialists that are dependent on vanishing habitats, such as the northern spotted owl that depends on old growth forests. Other birds use various modes of locomotion, such as California quail that runs and walks, and flies low to the ground.

The dialogue at this breakout group was somewhat limited due to there being few participants with species expertise. Participants had some difficulty determining what was important to connect for avian species in the focus area. A lot of the discussion was based on species that people knew occur, or historically occurred in the area, or species that are threatened or endangered. The species presented below are those identified by symposium participants. The facilitators for this session recognized more information on fragmentation sensitive species may be of use to guide focal species selection for birds. Unfortunately, not all of the birds identified as having fragmentation conflicts in the Identifying Barriers, Data Gaps and Research Needs session (e.g. roadrunner, sage grouse, waterfowl), which was happening concurrently with this working session, were identified as focal species, and should be considered for inclusion in follow up discussions to finalize focal species.

Golden eagle (*Aquila chrysaetos*) is highly sensitive to human disturbance and has very large territories in northern California. Some golden eagles are non-migratory, dependent year-round on their territory (Smith and Murphy 1973, Zeiner et al. 1988-1990), and require large expanses of habitat (Tesky 1994). The golden eagle depends on a mammalian prey base (e.g., black-tailed jackrabbit, cottontail, California ground squirrel), and to a lesser extent on avian prey (e.g., ducks, coots, ravens, etc.). They prefer open habitats such as grasslands, scrub with young trees, and open oak woodlands where hunting efficiency is greatest (Verner and Boss 1980, Matchett and O'Gara 1991). Nest site disturbance is responsible for many reproductive failures, especially because isolation during nesting is critical (D. Bittner pers. comm.). Golden eagles occur in all four ecoregions in the focus area. They use a variety of plant communities including grasslands, scrub, woodlands, and forests (Verner and Boss 1980, Collopy 1984, Cooperrider et al. 1986, Palmer 1988, Wassink 1991).


Photo Courtesy of USFWS


Photo Courtesy of USFWS

Swainson's hawk (*Buteo swainsoni*) is a habitat specialist, adapted to hunting in open grasslands and nesting in riparian systems (CDFW 2016). The Swainson's hawk was listed as threatened under the California Endangered Species Act in 1983 primarily due to loss of native foraging and breeding grounds. Other threats include climate change, infrastructure placement, disease, pesticide poisoning, and electrocution (CDFW 2016). The Swainson's hawk is considered sensitive by federal agencies (CDFW 2019b) and is identified as species of greatest conservation need is the southern Cascades, Modoc Plateau, and Northwest Basin and Range ecoregions (CDFW 2015). Within these ecoregions, Swainson's hawks occur in forest and woodland, shrubland, annual and perennial grassland, riparian forest, and vernal pool habitats (CDFW 2015). The Swainson's hawk has become increasingly dependent on agriculture, especially alfalfa crops, as native plant communities are converted to agricultural lands. They will use lone trees in agricultural fields or pastures

for nesting when adjacent to suitable foraging habitat but it is not their preferred habitat (CDFW 2016).

Northern harrier (*Circus cyaneus*) also known as the marsh hawk, is a ground-nesting raptor, long-distance migrant, and the most northerly breeding of all harriers (MacWhirter and Bildstein 1996). A pattern of long-term population decline due to habitat loss has been seen throughout the species' range (Sauer et al. 2004). While its breeding range remains similar to its historical distribution, extensive local population declines continue to occur as habitat is lost through conversion to agriculture and urbanization (Ramsen 1978, Martin 1989, MacWhirter and Bildstein 1996). Agricultural practices can destroy nests because of the northern harrier's propensity to nest on the ground (MacWhirter and Bildstein 1996). Risk of pinyon-juniper encroachment in sagebrush habitat used by northern harriers is moderate to high, and fairly widespread throughout its range (Boyle and Reader 2005). The northern harrier is listed as a California Species of Special Concern (CDFW 2019b). The northern harrier occurs in all four ecoregions in the focus area and is identified as a species of greatest conservation need in the southern Cascades, Modoc Plateau, and Northwest Basin and Range ecoregions (CDFW 2015). Within these ecoregions, the species may be found in diverse habitats, including shrublands, annual and perennial grasslands, wet meadows, fresh and saltwater marshes, and vernal pools (CDFW 2015).

Great gray owl (*Strix nebulosa*) is the largest owl in North America and one of the largest owls in the world. It is also one of the most reclusive bird species (Wu et al. 2016). It was listed as endangered under the California Endangered Species Act in 1980 (Wu et al. 2016), and is considered sensitive by federal agencies (CDFW 2019b). There are likely less than 100 breeding pairs in the state (Wu et al. 2016). In northern California, scattered nesting records occur in El Dorado, Nevada, Sierra, Yuba, Butte, Plumas, and Modoc counties with a few historic records in the Klamath Mountains in northwestern California (Winter 1980, Hull et al. 2014, Wu et

al. 2016). They breed most commonly near montane meadows in mid-elevation conifer forests with dense canopy cover. In recent years, multiple nests have also been found at lower elevations in mixed hardwood-conifer forests, sometimes miles from the nearest montane meadow (Wu et al. 2016). The great gray owl is identified as a species of greatest conservation need in the southern Cascades Ecoregion (CDFW 2015). The great gray owl uses diverse habitats, including forest and woodland, shrubland, riparian forest, and wet meadow (CDFW 2015). Some of the recommended actions in the conservation strategy for the great grey owl (Wu et al. 2016) include: designating and managing Great Gray Owl Core Management Areas; managing and restoring meadows and other foraging habitats; conserving and restoring nesting habitat; and preventing vehicle strikes.

Northern spotted owl (*Strix occidentalis caurina*) depends on mature and old-growth forests for nesting, roosting, and foraging, and is considered an indicator species for forest ecosystem health. Habitat loss and fragmentation have contributed to the decline of northern spotted owl populations throughout its range. The primary threats to this species are habitat loss and fragmentation due to timber harvests and even-age forest management. Competition from the barred owl (*S. varia*) also poses a significant threat to the species, as do noise disturbance, and pesticide poisoning (USFWS 2008). Northern spotted owls are listed as threatened under the federal and state Endangered Species Acts (USFWS 1990, CDFW 2019b). In 1992, 1.4 million acres of forest were designated as critical habitat for the northern spotted owl in California (USFWS 2008), including parts of the focus area. The northern spotted owl is identified as a species of greatest conservation need in the Klamath Mountains and Southern Cascades ecoregions within the focus area, and may be found in late-successional forest and woodland, high-elevation wet shrubland and meadows, and riparian forest plant communities (CDFW 2015). The maintenance and restoration of late-successional forests are essential for the recovery of northern spotted owls (USFWS 2011).

Burrowing owl (*Athene cunicularia*) is sensitive to habitat loss and fragmentation from agricultural and urban land uses (Grinnell and Miller 1944, Zarn 1974, Remsen 1978, Zeiner et al. 1988-1990). They are also particularly vulnerable to wildlife-vehicle collisions (Zeiner et al. 1988-1990). The species is experiencing precipitous population declines throughout most of the western United States, and has disappeared from most of its historical range in California. Nearly 60% of California burrowing owl colonies that existed in the 1980s were gone by the early 1990s (DeSante and Ruhlen 1995, DeSante et al. 1997, USFS 2002). Once widespread, its distribution is now highly localized, and fragmented. Burrowing owls are identified as a Species of Special Concern by CDFW and a species of conservation concern by federal agencies (CDFW 2019). In the focus area, burrowing owl is identified as a species of greatest conservation need in the southern Cascades, Modoc Plateau, and Northwest Basin and Range ecoregions; it also occurs in the Klamath Mountains Ecoregion (CDFW 2015). Within these areas, this species may be found in diverse plant communities, including forest, coastal scrub, sage shrubland and steppe, meadow, grassland, riparian forest, desert wash, alkali-saline wetland, and vernal pools habitats (CDFW 2015).

Acorn woodpecker (*Melanerpes formicivorus*) is a cavity nester that is indicative of intact forest communities. They require multi-successional oak woodlands with a variety of oak species (Bock and Bock 1974), and an abundance of snags in riparian areas or mixed conifer forests for use as granary trees (Benítez-Díaz 1993). Absence of granary trees can lead to rapid population declines (Ligon and Stacey 1996). The continued elimination of oaks is a threat to this species (Verner and Boss 1980, Zeiner et al. 1988-1990). These birds are highly susceptible to competition with invasive, non-native birds (Butler 2005). Symposium participants also noted woodpecker roadkill in the Dana Falls area of northern California. The geographic distribution and density of acorn woodpeckers are significantly correlated with oak species diversity (Bock and

Bock 1974, Koenig and Haydock 1999). It occurs in all four ecoregions in the focus area, and is of cultural interest, as identified by participants from the Pit River Tribe.

California quail (*Callipepla californica*) is highly sensitive to habitat fragmentation (Crooks and Soule 1999). This species moves through and utilizes a wide variety of natural habitats. It has relatively short dispersal distances, is a weak flyer often relying on terrestrial locomotion, and is highly sensitive to road barriers. Numbers of California quail have declined sharply due to large scale habitat loss and in some areas, are severely threatened by a combination of native and introduced predators, such as feral cats (Point Reyes Bird Observatory 2010). It is included on the National Audubon Society's list of threatened bird species (Martin 1999). The California quail is considered a Species of Special Concern (CDFW 2019b). The species occurs in all four ecoregions in the focus area and may be found in most natural habitats with cover in the region (Zeiner et al. 1988-1990), except high-elevation habitats, some conifer forests such as Jeffrey pine and lodgepole pine, riverine, wetland, estuary or agriculture land cover types.

Willow flycatcher (*Empidonax traillii*) was selected as a focal species to represent riverine environments. This species is listed as threatened under the California Endangered Species Act and considered sensitive by federal agencies (CDFW 2019b). The willow flycatcher is identified as a species of greatest conservation need in the Klamath Mountains and Southern Cascades ecoregions (CDFW 2015). Within these ecoregions, it may be found in riparian forest, wet meadow montane/boreal peatland, and temperate grassland plant communities (CDFW 2015). Most often, the willow flycatcher occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows (Serena 1982, Zeiner et al 1988-1990). Numbers of willow flycatchers have declined in recent decades because of cowbird parasitism, habitat destruction (Remsen 1978, Serena 1982), and heavy grazing of willows by livestock (Ehrlich et al. 1988).

7.3 Amphibians, Reptiles, and Fish

The facilitator for this taxonomic working group reported that participants struggled with the formatting initially and what was being asked of them, and spent considerable time discussing characteristics of fragmentation-sensitive species included on the datasheets. The other major hurdle reported was that few participants had expertise in reptiles, amphibians, or fish, so the selection was mostly limited to a few experts' thoughts and viewpoint on species and habitats. SC Wildlands has been coordinating connectivity symposiums for nearly two decades and it's not uncommon for participants to spend a great deal of time discussing characteristics of potential focal species. Participants in this working group selected the seven focal species highlighted below, five of which have been identified by regional ecologists as focal species in other regional connectivity efforts (Penrod et al. 2013).

California newt (*Taricha torosa*) was selected as a focal species because of the large movements that this species makes to and from breeding and overwintering sites. Migration to breeding sites begins with the first fall rains (Sweet 2018 *in* Zeiner et al. 1988-1990). After breeding, many adults spend the summer in aquatic habitats and return to land in the fall and winter (Kats 2018 *in* Zeiner et al. 1988-1990). Within the focus area, this California endemic species occurs in the Klamath Mountains and Southern Cascades ecoregions. The California newt is a lotic and lentic breeder and may use ponds or streams in montane riparian, valley foothill riparian, riverine, lacustrine, fresh emergent wetland, and wet meadows. When on land, it may be found in oak woodlands, hardwood-conifer, chaparral, coastal scrub, and occasionally annual grassland and mixed conifer habitats (Zeiner et al. 1988-1990).

Western spadefoot toad (*Spea hammondii*) was selected as a focal species to represent lentic environments, particularly vernal pools. Habitat loss and fragmentation may negatively impact the metapopulation structure of western spadefoot toad (Jennings and Hayes 1994). Spadefoot toads can absorb moisture through its skin better than most other amphibians (Ruibal et al. 1969); however, this otherwise beneficial evolutionary adaptation can leave it more vulnerable to impacts from pollution (Davidson et al. 2002,

Davidson 2004). The western spadefoot is a California Species of Special Concern as well as a U.S. Bureau of Land Management sensitive species (CDFW 2019b). Within the focus area, this species occurs in the Klamath Mountains Ecoregion. In addition to vernal pools, this species may also be found in oak woodlands, chaparral, coastal and desert scrub, fresh emergent wetlands, lacustrine, and riverine environments (Zeiner et al. 1988-1990). Much of the vernal pool habitat of the spadefoot in California has been lost to urban and agricultural development (Davidson et al. 2002). Urbanization in the vicinity of breeding pools and agricultural conversion within a 3-mile radius has been shown to negatively impact this species (Davidson et al. 2002). Other threats include exotic species, off-road vehicle use, overgrazing, and pollution (Yolo Natural Heritage Program 2008).

Foothill yellow-legged frog (*Rana boylii*) was selected to represent movements along stream corridors and at the watershed scale. The foothill yellow-legged requires relatively undisturbed streams that have adequate riffles, pools, and glides, appropriate substrates, and moderate shading (Jennings and Hayes 1994). They have a narrow ecological tolerance and their presence is an indicator of pristine stream environments. It is impacted by pesticide use (Davidson 2004, Sparling and Fellers 2009), climate change-driven increases in parasites (Kupferberg 2009), water management (Jennings and Hayes 1994), and exotic species (Moyle 1973). They are vulnerable to habitat loss and fragmentation, altered flow regimes, and sedimentation. Populations of the foothill yellow-legged frog in Placer and Lassen Counties are listed as threatened under the California Endangered Species Act, a California Species of Special Concern, and a BLM and U.S. Forest Service sensitive species (CDFW 2019b). Within the focus area, the species is identified as a species of greatest conservation need in the Klamath Mountains and Southern Cascades ecoregions, and may be found in subalpine and high montane conifer forest, rainforest, forest and woodland, montane and foothill forest, flooded and swamp forest, and riparian forest habitats (CDFW 2015).

Western pond turtle (*Actinemys marmorata*) uses a wide variety of aquatic habitats within its range. It also spends much of the year, including nesting, in terrestrial areas away from aquatic habitats, requiring intact aquatic terrestrial connectivity (Rathbun et al. 1992). Thus, it can serve as an indicator species of connections within and between aquatic and upland habitats. The western pond turtle is considered federally sensitive and a California Species of Special Concern (CDFW 2019b). In the focus area, the pond turtle is identified as a species of greatest conservation need in the Klamath Mountains and Southern Cascades ecoregions; it also occurs in the Modoc Plateau Ecoregion (CDFW 2015). Within these ecoregions, it may be found in forest and woodland, montane and foothill forest, flooded and swamp forest, grassland, riparian forest, freshwater aquatic vegetation, and freshwater marsh habitats (CDFW 2015). The main threat to the species is the alteration and loss of both terrestrial and aquatic habitats by dams, water diversions, stream channelization, and development. Agricultural conversion and heavy grazing near aquatic habitats can also impact the species (Jennings and Hayes 1994). Other threats include exotic predators and competitors (Jennings and Hayes 1994, Spinks et al. 2003). Dams along the Trinity River in northern California were found to negatively impact the species by reducing available habitat and juvenile recruitment (Reese and Welsh 1998a, 1998b).

Common gartersnake (*Thamnophis sirtalis*) is a non-venomous snake that was selected as a focal species to represent snakes and riparian corridors. It is also a habitat quality indicator due to its reliance on high-quality aquatic environments that support their primary prey (i.e., native amphibians) and are free of introduced predators. Jennings et al. (1992) predicted that declines of amphibians would lead to a decline in gartersnakes. The common gartersnake occurs in all four ecoregions in the focus area. It is associated with permanent or semi-permanent bodies of water in a variety of habitats (Zeiner et al. 1988-1990). Habitat loss, fragmentation and degradation due

to urban and agricultural development, and the associated modifications to the hydrological system threaten species of this genus (Stebbins 1985; Jennings and Hayes 1994). Snakes are also highly sensitive to habitat fragmentation by roads (Dodd et al. 1989, Bonnet et al. 1999, Kjoss and Litvaitis 2001).

Gopher snake (*Pituophis catenifer*) was selected as a focal species to represent terrestrial xeric (dry) habitats, and as prey to support many other selected focal species. Because of their wide distribution, activity patterns, and abundance, gopher snakes are taken by a wide range of predators including mammals, predatory birds, especially hawks, and other snakes. Snakes are sensitive to habitat fragmentation from roads and are susceptible to roadkill (Dodd et al. 1989, Bonnet et al. 1999, Kjoss and Litvaitis 2001). Gopher snakes are found in most habitats, especially xeric vegetation communities, and are generally absent only from densely forested habitats (Zeiner et al 1988-1990).

Coho salmon (*Oncorhyncus kisutch*) is an anadromous species requiring unblocked access between upstream spawning areas and the ocean. Coho salmon and other California salmonids have been identified as optimal focal species for conservation planning because of their flagship nature to the general public, their ability to serve as umbrellas for other species, and their keystone status in the ecosystem (Viers 2008). Moyle (1994) concludes that the decline of Coho populations is linked primarily to water degradation (through logging, urbanization, agriculture, etc.), water diversions (such as dams), and hatchery fish. Coho salmon are associated with cool (54-57°F), clear streams with both overhead riparian cover, and instream cover provided by large woody debris (Moyle 2002). Coho salmon are culturally significant to several tribes in the focus area.

7.4 Plants and Invertebrates

The plants and invertebrates work group was provided with maps of vegetation, rare species diversity and hotspots, and a list of all rare plants and invertebrates within the focus area, and the habitats in which each species is found. The group immediately recognized the challenge of working through these lists because they were very long, and there were few botanists and entomologists present to provide species expertise. In addition, the life histories of these species are often not well known. The list below represents the species expertise of a small handful of botanists and entomologists who were present. Rather than identifying particular plant species, participants focused on identifying key habitat types that would be important to incorporate into a model through the inclusion of habitat specialists that rely on these habitat types, including sage steppe, oak woodlands, high diversity mixed conifer stands, and riparian habitats. Members of the Pit River Tribe discussed the cultural importance of oaks (*Quercus* spp.) as well as elderberry (*Sambucus nigra*), willow (*Salix* spp.), mugwort (*Artemisia douglasiana*), and other riparian species.

Carson's wandering skipper (*Pseudocopaeodes eunus obscurus*) is currently known from only two populations, one in Washoe County, Nevada, and one in Lassen County, California (Black and Vaughan 2005). The species was federally listed as endangered in 2002 (USFWS). In the focus area, the subspecies is found in grassland habitats on alkaline substrates; and has been seen in the Wendell area, and at Honey Lake in northern California. Carson’s wandering skipper breeds on salt grass (*Distichlis spicata*)/alkaline grasslands, and feeds on lotus as nectar plants (pers. comm. R. Lis). Females lay their eggs on salt grass, their larval host plant (Black and Vaughan 2005). Threats to remaining populations include livestock grazing, off-road vehicles, habitat conversion, gas and geothermal development, changes in the water table, pesticide drift, and non-native plant invasions (Black and Vaughan 2005). The population in Lassen County is on public and private land, which Black and Vaughan (2005) identified as a good opportunity for immediate conservation action.

Monarch butterfly (*Danaus plexippus*): The monarch butterfly is dependent on the abundance of milkweeds in its summer breeding range (Brower 2001). Monarchs are host-plant specific; they will only lay eggs on milkweeds (*Asclepias* spp.), and caterpillars will only eat leaves of milkweed plants (Brower 1984). Stevens and Frey (2010) identified the majority of the focus area (i.e., Caltrans District 2) as breeding grounds, based on late-summer milkweed occurrence, and thermal conditions. To survive and move, adults sip nectar from many native and nonnative flowers (Tooker et al. 2002, Brower et al. 2006). Other habitat requirements include sites for roosting, thermoregulation, mating, hibernation, and predator escape (Zalucki and Lammers 2010), as well as conditions and resources for initiating and completing migration both to and from winter roosting areas (Center for Biological Diversity 2014). The first few generations of Monarch butterflies don't migrate far but the super generation (i.e., fall migration of millions of monarch butterflies) will migrate hundreds of miles in a few weeks. They move directionally toward their winter roosts, covering an average of 25 to 30 miles per day (Brower et al. 2006). The 2014 petition to list the species as federally endangered (Center for Biological Diversity), stated the North American monarch population had declined by 90% over the preceding twenty years. Breeding habitat in the West is being lost to urban and rural development, herbicides (particularly glyphosate as found in Roundup®), roadside management, large-scale agriculture, and long-term drought. The monarch is also threatened in its winter range, in California by development and natural senescence, and in Mexico by logging, forest diseases, and climate change. Other threats include disease, predation, and overutilization primarily for education and entertainment.

Klamath pebblesnail (*Fluminicola n*. sp.) is a localized endemic known from two sites in the Pit River system. The common name for this family is "spring snails," which is the type of habitat where they are primarily found. Spring snails need connected springs or stream systems, and may move only centimeters on their own (pers. comm. R. Lis). According to Furnish and Monthey (1998), the Klamath pebblesnail lives in swift flowing water, generally near shore, on sand-cobble substrates. It requires water

temperatures below 65°F to avoid thermal stress and ensure adequate availability of oxygen, which also represents the critical threshold for trout (Furnish and Monthey 1998). Individuals only breed once and then die with about 90% turnover in the population annually, making the species extremely vulnerable to extirpation. Furnish and Monthey (1998) identified water pollution, activities that increase sedimentation (e.g., logging, mining), eutrophication, and dams and diversions as threats to this species.

Branchinecta hiberna is a species of fairy shrimp that occurs in many ephemeral pools along Highway 97 southwest of Dorris, and requires connected waterways to persist (pers. comm. R. Lis). According to Rogers and Fugate (2001), *B*. *hiberna* occurs in south-central Oregon to northeastern California and northwestern Nevada, typically in high-desert volcanic mud-flow vernal pools with clear or highly turbid water. Typical dominant species in the surrounding uplands are *Artemisia* spp., annual grasses, and western juniper (*Juniperus occidentalis* var. *occidentalis*). In California, populations are found throughout the Modoc Plateau from Lava Beds National Monument to Clear Lake Reservoir, and from the City of Tule Lake to the Skedaddle Mountains, north of Honey Lake in Lassen County (Rogers and Fugate 2001).

Pearl shell mussel (*Mergaritifera falcata*) is an aquatic invertebrate dispersed by anadromous fish, such as coho salmon identified by participants in the amphibian, reptile, and fish work group. The pearl shell mussel primarily occurs in cold and clear open river systems (pers. comm. R. Lis). The pearl shell mussel is typically associated with sand, gravel, and cobble substrates (Nedeau et al. 2005 *in* Cordeiro 2005). It is associated with several salmonids that serves as hosts for this species, including chinook salmon (*Oncorhynchus tschawytscha*), coho, steelhead trout (*O. mykiss*), and cutthroat trout (*Salmo gairdneri*) (Fuller 1974, Karnat and Millemann 1978 *in* Cordeiro 2006).

Sagebrush steppe is a prominent plant community on the Modoc Plateau and mainly occurs below elevations of coniferous forests. As the name implies, this community is dominated by sagebrush (*Artemisia tridentata*) with several species of perennial bunchgrasses (*Bromus marginatus, Festuca idahoensis, and Stipa spp.*) interspersed in between (Holland 1986). Another important component of sagebrush steppe habitat identified by participants is winter fat (*Krascheninnikovia lanata*), which is an important browse for deer in winter. The distribution of sagebrush steppe has been much reduced by overgrazing.

High diversity mixed conifer stands are extensive in the focus area. Ponderosa pine (*Pinus ponderosa*) is often the dominant tree species in the canopy of mixed conifer stands that may also include incense cedar (*Calocedrus decurrens*), sugar pine (*P*. *lambertiana*), Coulter pine (*P. coulteri*), Jefferey pine (*P.* jeffreyi*)*, and Douglas fir (*Pseudotsuga macrocarpa*). Juniper (*Juniperus* spp.) may also be a significant component in some stands or in adjacent plant communities (Riegel et al. 2006, Sawyer et al. 2009). These communities support a diversity of wildlife and are fairly resilient to fire.

Oak woodlands: species in this genus *Quercus* were discussed as potential focal species because of their slow growth and long-lived nature, including white oak (*Q. alba*), Oregon white oak *(Q. garryana*; lower elevation oak), black oak (*Q. kelloggii*; higher elevation oak), valley oak (*Q. lobata*), blue oak (*Q. douglasii*), and coastal oak (*Q. agrifolia*). Oak woodland communities also support numerous wildlife species. For example, valley oak woodlands are used by at least 21 species of amphibians, 31 reptiles, 142 birds, and 74 mammals (CDFG 2005). Participants also noted that oaks are very resistant to fire. With climate change, oaks can help stabilize more fire-prone communities like savannah grasslands, because when fire hits an oak, it typically doesn't make it to the crown where it can leap from tree to tree, like in pine forests.

Riparian plant communities: Many species are known to travel along riparian corridors. For example, many butterflies and frogs preferentially move along stream corridors (Orsack 1977, Kay 1989, U.S. Geological Survey [USGS] 2002). Although western pond turtles are capable of overland movements of up to 0.5 km (0.3 mi) (Holland 1994), they preferentially move along stream courses (Bury 1988). Even large, mobile vertebrates, such as mountain lions, have shown preferences for moving along riparian corridors (Beier 1995, Dickson et al. 2004). Riparian systems, because they provide connectivity between habitats and across elevational zones, will be especially important to allow species to respond and adapt to climate change (Seavy et al. 2009).

Participants discussed willow, mugwort, and elderberry as plants to consider as focal species representing riparian plant communities. For example, elderberry is common along streams and rivers and open places in riparian zones, or in openings in moist forest habitats (Munz 1968). Symposium participants said that the associated elderberry beetle is becoming rare. Elderberry is of great value to native people for the many purposes it serves. Edible berries and flower, which are high in vitamin C, are used for medicine, food, and dyes for basketry, while other parts of the plant are used for arrow shafts, flutes, whistles, and clapper sticks (Barrows 1967). Participants from the Pit River Tribe said that elderberry is important for them for collection,

for baskets, and for other cultural reasons. They noted a particular area where elderberry grows, along with willows and grasses, near Iron Gate Reservoir where a creek flows into the reservoir, as important for native material collection.

8. Identifying Partners and Funding Sources

The primary objectives of this breakout session were to have participants discuss successful partnerships and how they were funded and to identify different types of programs, policies, projects, and planning efforts that may contribute to maintaining and restoring connectivity. A datasheet and map were provided to help guide the discussion and capture data and information provided by participants (Appendix 3). The idea here was to get participants to look at the big picture, talk about where there are existing partnerships, and to identify opportunities for places in need of partnerships. Time was spent discussing successful partnerships and sharing stories from the field. Another objective of this session was for participants to interact with each other to encourage future partnerships.

There were three general types of partnership opportunities discussed in this session, including partnerships focused on wildlife crossings, research and monitoring, and acquisitions and easements of areas critical for wildlife movement. Examples of these partnership types are presented in the sections below, as well as results from brainstorming among symposium participants to generate lists of conservation, research, and funding partner organizations within the symposium focus area.

8.1 Importance of Partnerships to Fund Wildlife Crossings

The session began with a discussion on just how expensive it can be to design and build a wildlife crossing structure, especially when factoring in costs for environmental compliance, engineering, design, and construction. Retrofitting existing highway infrastructure to install new passage structures and funding standalone crossings projects can be substantial. Integrating wildlife crossings into transportation improvement projects can also be costly but is more efficient than installing standalone projects. The cost of these projects is often the single most significant hurdle to getting wildlife crossings built. The cost of wildlife crossing projects may include the installation of directional fencing and associated features (e.g., jump-outs), and their long-term maintenance costs can be considerable. One participant commented that wildlife fencing to direct ungulates to crossings and keep them off highways is estimated at roughly $64,000 per mile, or about $12 a foot for materials and installation. Identifying the most important areas to

focus connectivity investments and partnering is essential for maximizing the limited amount of transportation funding available.

Partnerships are critical to get wildlife crossings built. Partners can assist with a broad range of activities, from helping to identify or pursue grant funding, to getting local measures passed, increasing community support, conserving a key parcel, or providing in-kind support for research and monitoring. Partners may also be able to assist with researching ways to make wildlife crossing solutions less costly.

Caltrans is currently participating in a Pooled Fund Study with several other state departments of transportation to investigate cost-effective measures for reducing wildlife-vehicle collisions. One study funded by that project includes funds awarded to District 2 to develop design plans for a wildlife overpass fiber reinforced polymer (FRP, essentially recycled plastic materials) bridge along State Route 97. These grant funds are intended to take District 2 up to 65% design completion. If built, it would be the first wildlife overpass made of FRPs in the country. One major benefit of FRPs, is that such structures may be constructed more quickly and from readily available materials, and can thus be done at a lower cost than traditional construction methods.

Experienced experts at the symposium shared the following stories from the field to demonstrate the critical role of partnerships and ongoing strategies to fund the planning and implementation of wildlife crossings:

Stories from the Field: Liberty Canyon Wildlife Crossing

Don Crocker at Wildlife Conservation Board talked about their Proposition 68 Wildlife Corridor Grant Program that awarded a $5 million grant for a wildlife overpass at Liberty Canyon. The project is estimated to cost $87 million, with 80% of the funding coming from private sources. The wildlife crossing at Liberty Canyon, if built, would be the largest wildlife overpass in the world, spanning 10 lanes of freeway and a parallel collector road (Figure 10). The Liberty Canyon wildlife overpass project is intended to restore connectivity between large blocks of important wildlife habitat in the inland Sierra Madre Mountains and the coastal Santa Monica Mountains. The South Coast Missing Linkages Project (Penrod et al. 2006) and the California Essential Habitat Connectivity Project (Spencer et al. 2010) identify the proposed project location, a section of US-101 near Liberty Canyon Road, as a critical link in the corridor. This is a large-scale public-private partnership involving Caltrans, National Park Service, Santa Monica Mountains Conservatory/Mountain Recreation and Conservation Authority, Resource

Conservation District of the Santa Monica Mountains, and the National Wildlife Federation—along with local and state elected officials. The #SaveLACougars campaign (savelacourgars.org) is helping support the conservation, education and fundraising for this project. The partnership has made significant advancements by acquiring and protecting land; galvanizing community support; educating youth and adults on wildlife coexistence; conducting wildlife research; completing the environmental review and permitting phases; launching a multi-year fundraising campaign; and convening a design workshop with crossing experts. More background information on the Liberty Canyon Wildlife Crossing is available at https://www.scc.ca.gov/webmaster/ftp/pdf/sccbb/2015/1501/20150129Board06_Liberty_Canyon_Wildlfe_Crossing.pdf.

Figure 10. Wildlife Habitat Overpass at Liberty Canyon; design and rendering www.rcdsmm.org.

Don Crocker at Wildlife Conservation Board said that the only way this project worked was by putting together this large partnership involving diverse stakeholders. NWF has created an extensive outreach campaign that includes use of social media and news outlets, including videos to emphasize the importance of the crossing to mountain lions. NWF has engaged the general public and schools from around the region. The Wildlife Conservation

Board is more likely to fund grant proposals that involve partnerships contributing to the costs, especially for a $87 million project.

Stories from the Field: Highway 17 Wildlife Crossings

There are two planned crossing projects on State Route 17, one in Santa Clara County south of the Lexington Reservoir near Los Gatos and one in Santa Cruz County at Laurel Curve. There is quite a lot of overlap in the groups involved in these partnerships. The Midpeninsula Regional Open Space District (MidPen) is spearheading the effort in Santa Clara County, and the Land Trust of Santa Cruz is the organizer for the Laurel Curve effort. Other partners include Peninsula Open Space Trust, Santa Clara County Parks, Santa Clara Valley Transportation Authority, Santa Clara County Roads and Airports, Santa Cruz Puma Project (partnership between University of California (UC) Santa Cruz and CDFW), Pathways for Wildlife, and others. Caltrans Districts 4 and 5 have played a critical role in both partnership efforts as the department responsible for overseeing the State Highway System. The Critical Linkages: Bay Area and Beyond effort (Penrod et al. 2013) and the California Essential Habitat Connectivity Project (Spencer et al. 2010) identified both of the proposed project locations as important for restoring wildlife permeability across transportation features.

Jennifer Garrison at CDFW talked about the partnership for the Laurel Curve wildlife crossing on Highway 17 in Santa Cruz County in Caltrans District 5. Jennifer worked with CDFW Region 3 Randi Adair to develop the first mitigation crediting agreement for a wildlife crossing. She explained that the Santa Cruz partnership comprised of land trusts and other NGOs had already identified the area as a critical crossing location and secured the land on either side with conservation easements, and working with Caltrans was the last piece for actual implementation. She recommended building partnerships between local governments, NGOs, CDFW regional staff and transportation agencies (County and Caltrans) to pool resources to identify areas crossing locations and conserve land on either side with conservation easements.

The wildlife crossing location near Los Gatos to the south of Lexington Reservoir in Caltrans District 4 was included in the linkage design to connect the Santa Cruz Mountains with the Diablo Range (Penrod et al. 2013). Studies done by the Santa Cruz Puma Project (partnership between UC Santa Cruz and CDFW) and Pathways for Wildlife have documented numerous road-kill animals on Highway 17 near Lexington Reservoir in Santa Clara County (MidPen 2019). The MidPen board advanced four crossing structure alternatives – wildlife crossings at two proposed locations, and recreational crossings at two different proposed locations (2019). The

intended schedule and information on funding can be found on the project's webpage. Project costs are estimated at $16 million and was obtained from a local bond measure (Measure AA; https://www.openspace.org/our-work/projects/wildlife-crossing).

8.2 Discussion on Partnerships for Conserving Critical Linkages

When planning for wildlife crossing structures, it is essential to have compatible land uses. Integrating wildlife crossings into the state's transportation networks is meaningless if land on either side of the structure isn't protected from development or conversion. Participants discussed the importance of conserving the land first because it simply doesn't make sense to spend millions for crossing structures only to direct wildlife to an area where a housing development or shopping center is planned. As mentioned above in section 8.1, it's ideal if land is secured before approaching state or local transportation agencies with wildlife crossing proposals.

Participants were given two examples of out-of-state projects: The first Idaho example showed a significant increase in cost for not having stakeholder involvement and not having partners on board. The second was a project in Colorado that would not have happened if the local landowner hadn't been involved, because it was a lot of money and they helped encourage other stakeholders to be involved. This shows that partners can make a huge difference in cost.

8.3 Discussion on Partnerships for Connectivity-related Research

Christine Found-Jackson, Wildlife Supervisor from CDFW Region 1 talked about partnership opportunities for connectivity-related research. She said that Region 1, which overlaps with Caltrans District 2, has some of the most opportunities for doing big game and wildlife research in the state. CDFW has a number of ongoing research and monitoring projects focused on mule deer, elk, pronghorn, bear and mountain lions. Erin Nigon mentioned how CDFW is just starting on designing some of the research project questions to be answered and there's a lot to investigate. Ms. Nigon said CDFW's collar data is providing information on migration routes for elk that include movements into Oregon and Nevada. CDFW is already partnering with their sister agencies in those states. CDFW has extensive collar data to contribute to identifying hotspots and wants to work with sister agencies like Caltrans and transportation agencies in neighboring states to maintain and restore connectivity between populations across the landscape.

Ms. Found-Jackson and Ms. Nigon both agreed that there are several more partnership opportunities from an agency standpoint in terms of the science. They explained that CDFW is partnering with universities like Humboldt State and UC Davis to get graduate students to gather data to help answer various questions on big game species. CDFW also works with non-profit organizations on common goals, including hunting and recreational opportunities for some of these big game species that would benefit from wildlife crossing projects. CDFW also works with tribes and wants to continue working with tribes in the focus area. In particular, CDFW finds working with tribes is extremely useful to acquire historical local knowledge, which is essential in so many ways.

A partnership in the making happened during the discussion on research opportunities. Dr. Arthur Middleton from UC Berkeley explained the University's model for how they do research, which includes not just providing the research capacity but also convening multiple partners to support the research. He said maybe his institution could assist the state with meeting their research needs, including helping find other partners who might match those resources, whether they're private foundations, other state agencies, or federal agencies. Partnering can help grow and leverage resources on the research side. At this point, Lindsay Vivian mentioned Caltrans has its own research division that has funded biology-related research in the past and could partner with university researchers like Dr. Middleton to answer questions on wildlife interactions with roadways.

8.4 Discussion on Partnership Efforts in Focus Area

The connectivity and conservation-related efforts listed below have been summarized from information participants provided on the datasheets, or that was captured during group discussions in this working session. This is not meant to be a comprehensive list.

California Deer Association's Habitat Restoration Efforts involve design, planning, fundraising, grant administration, on-site management, and monitoring (https://caldeer.org/). They work with several agencies and organizations, and are engaged in several restoration projects in the focus area, including Warner Mountains Meadow Restoration completed in 2018, and three current projects, including the Modoc-Warner Mountains Mule Deer Recovery Project, Rock Creek Meadow Restoration, and Buffalo-Skedaddle spring and riparian restoration project Phase 1.

CDFW Wildlife Collar Projects reported that in February 2020, CDFW captured Rocky Mountain elk and pronghorn in northeastern California. The elk were captured on lands managed by the U.S. Forest Service and National Park Service, as well as on private timberland and other private lands where owners provided access for the captures. Each elk was ear tagged and fitted with a GPS collar that will provide detailed information for approximately five years. CDFW partners with Caltrans to improve connectivity https://wildlife.ca.gov/Science-Institute/News/roosevelt-elk. Pronghorn also were fitted with GPS collars in the last year of a study, contracted with Institute for Wildlife Studies, on pronghorn movements, distributions, habitat use, and survival.

California Trout's Advancing Fish Passage in the Little Shasta Watershed was funded through CDFW's Prop 68 Funding. This project will result in the complete elimination of a temporal migration barrier currently blocking access to over three miles of ideal cold-water spawning and over-summering habitat for juvenile coho salmon habitat in the Little Shasta River. The project will also result in habitat enhancement, improved ecological function, and improved streamflow at critical times of the year for out-migrating juvenile coho salmon (https://caltrout.org/).

Cascade-Siskiyou Connectivity Partnership is an ongoing interdisciplinary forum and communication network involving multiple agencies, organizations, academic institutions, and others, to promote coordination across jurisdictional boundaries and diverse disciplines in southern Oregon and northern California with the primary goal of protecting, maintaining, and restoring connectivity in this globally significant region. Stakeholders interested in joining the annual connectivity symposium are encouraged to contact info@scwildlands.org.

Elk Strike Prevention Team is dedicated to identifying ways to reduce the number of elk-vehicle collisions on State Route 97. Team members include the Caltrans District 2 office, California Highway Patrol, CDFW, UC Davis Road Ecology Center, Rocky Mountain Elk Foundation and the California Deer Association.

Klamath Dam Removal effort is the focal effort of the Klamath River Renewal Corporation (KRRC), a private, independent nonprofit 501(c)(3) organization tasked with implementing the largest dam removal and river restoration effort ever performed in the United States – and possibly the world (http://www.klamathrenewal.org/). The plan is to remove the four hydroelectric dams located on the Klamath River, three in California and one in Oregon. There are two separate but companion agreements which address the terms of dam removal. The Klamath Hydroelectric Settlement Agreement

is focused on restoring river flows, and the Klamath Basin Restoration Agreement focuses on habitat restoration and community sustainability. The Settlement Agreement is supported by governments, tribal nations, irrigators, fishermen, and conservation groups; 42 organizations signed the Klamath Agreements in 2010. The removal of four mainstem dams is being planned for 2020 (all out in 1 year) and already over $40 million is in the bank for the expected $275 million removal cost (https://caltrout.org/our-work/steelhead-salmon/klamath-dam-removal).

Klamath Cascades Fish Passage Advisory Committee (FishPAC) is a joint effort between the Caltrans, CDFW, National Marine Fisheries Service, USFWS, and other interested advocates of fish passage efforts. FishPACs cooperatively share science and data related to known fish barriers, and develop methods to prioritize locations for assessments, and biological priorities for remediating. The FishPACs track the status of active and funded fish passage barriers until they are remediated, track post-construction fish passage effectiveness, identify and prioritize barriers to fish passage, and support the implementation of meaningful, long-term solutions for fish passage projects (https://www.cafishpac.org/klamath-cascades-fishpac). Caltrans has already shared information gathered as a result of this effort with the Klamath Cascades FishPAC, which may provide opportunities for integrating terrestrial wildlife passage considerations with project development and priority locations for fish passage improvements.

Mule Deer Foundation's purpose is to ensure the conservation of mule deer, black-tailed deer, and their habitats. The Foundation works to *restore, improve and protect* mule deer habitat (including land and easement acquisitions); *encourage and support* responsible wildlife management with government agencies, private organizations and landowners; *promotes* public education and scientific research related to mule deer and wildlife management; support regulated hunting as a viable component of deer conservation; and develop programs to recruit youth (https://muledeer.org/state/california/).

There is currently a **Natural Resources Conservation Service Regional Conservation Partnership Program** action plan moving forward in the focus area right now that includes about 20 to 25 partners. It's a tri-state large improvement program which incorporates southern Oregon, northwest Nevada, and the majority of the symposium focus area including Lassen, Modoc, Siskiyou, and Shasta counties. The partnership is aimed at improving an interstate, keystone deer herd in the western United States. This has been a 4-year effort and they're waiting for the next program funding cycle to be approved.

Oregon Connectivity Assessment and Mapping Project is mapping habitat connectivity across the state for a wide diversity of Oregon's wildlife species, as called for in the state's wildlife action plan https://oregonconservationstrategy.org/success-story/the-oregon-connectivity-assessment-and-mapping-project-ocamp/. Oregon Department of Fish and Wildlife is leading the effort which has many opportunities for stakeholder engagement in the northern part of the symposium focus area.

Pacific Forest Trust is a non-profit organization focused on working forest conservation easements; visit https://www.pacificforest.org/conservation-projects/ to see a map of their conservation easements in the focus area. The Trust pioneers new sources of financial return for landowners to steward and protect their forests to conserve forests, advance climate solutions, protect water sources, and save wildlife habitat.

Trinity River Restoration Program is a multi-agency program with eight partners forming the Trinity Management Council, plus numerous other collaborators. The Program implements the U.S. Department of Interior's (DOI) 2000 Record of Decision, which directs DOI to restore the fisheries of the Trinity River impacted by dam construction and related diversions of the Trinity River Division of the Central Valley Project. Members include the U.S. Bureau of Reclamation, USFWS, Yurok Tribe, Hoopa Valley Tribe, California Natural Resources Agency, National Marine Fisheries Service, and Trinity County. Participating groups include Trinity Collaborative Forest Management Group, Trinity County Fish and Game Advisory Commission, and Trinity County Watershed Council (https://www.trrp.net/).

University of California Cooperative Extension is a statewide network of natural resources, forestry, and agriculture science staff that are dedicated to conducting research and extending results to farmers, ranchers, forest land owners, students, teachers and interested citizens. The UC Cooperative Extension has offices that serve every county in California (https://ucanr.edu/About/Locations/). Participants identified the following activities of the Extension in the focus area: restoration, research, habitat assessment, digitizing, and reviewing historical data.

Western Association of Fish and Wildlife Agencies Mule Deer Working Group was established in 1997 and consists of a representative from each western state and western Canadian province. As stated on their website, the purpose for the working group is to:

1. Begin to develop strategies to assist in management of declining mule deer populations throughout the West;
2. Improve communication among mule deer biologists throughout the West;

3. Provide a forum to respond to information needs from agency administration.

The Working Group has been very successful in reaching those goals and are considered one of the most active and productive working groups sponsored by the Association. One of their publications is particularly relevant, *Mule Deer and Movement Barriers* (Wakeling et al. 2015), available at https://www.wafwa.org/committees groups/mule deer working group/publications/).

8.5 Funding to Address Connectivity and Fish and Wildlife Passage

The following funding programs and opportunities were identified by participants at the symposium to address various aspects of conserving habitat connectivity and improving fish and wildlife passage. This list is not exhaustive.

A symposium participant pointed out that there are funding streams that come from federal gas tax dollars for wildlife crossing improvements and improvements to habitat connectivity, which are eligible under parts of the federal transportation bill (https://www.fhwa.dot.gov/fastact/factsheets/). Whereas, Caltrans has a lot more difficulty programming stand-alone wildlife crossing projects because it's not an eligible project type under one of their asset classes.

Bureau of Land Management issues financial assistance through grants and cooperative agreement awards to institutions of higher education, non-profit organizations, state and local governments, foreign entities and Indian tribal governments for projects that meet the BLM mission and falls in line with the DOI's top priorities. Several programs are available https://www.blm.gov/services/financial-assistance-and-grants.

CDFW Big Game Grant Program funds are generated through the purchase of game tags that are used in programs and projects that benefit big game species (bighorn sheep, bear, deer, elk, pronghorn antelope, and wild pig). "Projects" refers to research and habitat restoration or enhancement activities that benefit big-game species. These projects may be conducted solely by CDFW staff or in partnership with outside entities (https://wildlife.ca.gov/Grants/Big-Game).

California Forest Improvement Program encourages private and public investment in, and improved management of, California forest lands and resources. Cost-share assistance is provided to private and public

ownerships containing 20 to 5,000 acres of forest land. Cost-shared activities include management planning, site preparation, tree purchase and planting, timber stand improvement, fish and wildlife habitat improvement, and land conservation practices (https://www.fire.ca.gov/grants/).

Caltrans Advance Mitigation Program authorizes Caltrans to plan and implement advance mitigation solutions for its future transportation projects to reduce delays by proactively obtaining environmental mitigation in advance of – rather than during – transportation projects. The primary goal of the Program is to address longer-term future environmental mitigation needs resulting in improved environmental, economic, and project delivery outcomes. By consolidating the forecasted mitigation needs of multiple future transportation projects, Caltrans can potentially provide strategically placed and environmentally sound replacement habitat and shorten project delivery timelines, resulting in both time and cost savings. Ultimately, the Program aims to help Caltrans meet conservation goals in addition to regulatory requirements (https://dot.ca.gov/programs/environmental-analysis/caltrans-biology/strategic-biological-planning-advance-mitigation-innovation/advancemitigation).

DOI S.O. 3362, Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors announced $3.2 million in grant funding on February 14, 2020, for 11 western states, bringing the DOI and other stakeholders' support of big game species habitat conservation and scientific research for migration corridors and winter ranges to more than $22 million since S.O. 3362 was issued. These grants are a part of DOI's ongoing efforts to implement S.O. 3362; $6.4 million has supported 36 research projects vital to scientifically identifying migration corridors and seasonal use areas (e.g., winter range). In addition to funding state-defined priority research projects, DOI has made available another $1.4 million over two years to assist state wildlife agencies with big game movement data analysis and corridor mapping, and almost $14.4 million has been matched in partnership-assisted grant funding for direct habitat conservation in support of the order.

Environmental Enhancement and Mitigation Program (EEMP) administered by the California Transportation Commission funds environmental enhancement and mitigation projects directly or indirectly related to transportation projects. EEMP projects must fall within one of three categories: highway landscape and urban forestry; resource lands; or roadside recreation. Projects funded under this program must provide environmental enhancement and mitigation over and above that otherwise called for under the California Environmental Quality Act (https://catc.ca.gov/programs/environmental-enhancement-mitigation).

Federal Lands Access Program (FLAP) was established in 23 U.S. Code 204 to improve transportation facilities that provide access to, are adjacent to, or are located within federal lands. FLAP supplements state and local resources for public roads, transit systems, and other transportation facilities, with an emphasis on high-use recreation sites and economic generators. The program is designed to provide flexibility for a wide range of transportation projects (https://flh.fhwa.dot.gov/programs/flap/).

Federal Lands Transportation Program was established in 23 US Code 203 to improve the transportation infrastructure owned and maintained by the following Federal Lands Management Agencies: National Park Service, Bureau of Land Management, U.S. Forest Service, USFWS, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and independent federal agencies with land and natural resource management responsibilities (https://flh.fhwa.dot.gov/programs/fltp/).

National Fish and Wildlife Foundation awards competitive grants through their programs to protect and conserve fish, wildlife, plants, and habitats. They have several relevant grant programs, such as Conservation Partners Program, Bring Back the Natives, and Acres for America (https://www.nfwf.org/programs).

Regional Conservation Partnership Program is a Natural Resources Conservation Service program that seeks to co-invest with partners to implement projects that address regional natural resource concerns. Partners must apply to either the Critical Conservation Area (CCA) or state/multi-state funding pool. Most of Caltrans District 2 is identified as a CCA. This program awards $300 million annually. It requires a 50% match, which can be in any combination of cash and in-kind (https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp//).

Resource Conservation Districts work with state, federal, and local partners to create publications that help local residents make smart conservation and land management choices. These resources can benefit anyone from students to farmers to land managers, and are developed with the public interest in mind. Caltrans District 2 overlaps with three Resource Conservation District Regions including Modoc Plateau, North Coast, and Sacramento Valley. The Modoc Plateau Region covers much of Caltrans District 2 and includes six different Resource Conservation Districts, including Fall River, Goose Lake, Honey Lake Valley, Lava Beds-Butte Valley, Modoc, and Pit RCDs (https://carcd.org/rcds/find/).

Rocky Mountain Elk Foundation works to permanently protect quality elk range, migration corridors and calving areas while seeking to open or improve quality public access opportunities. Their conservation tools include land acquisitions and exchanges, conservation easements, contributions, and other means through their Land Protection and Habitat Stewardship Programs. The Foundation's Project Advisory Committee Grant Program funds habitat enhancement, wildlife management and research projects in all states with wild and free ranging elk herds (https://www.rmef.org/grant-programs/).

Tribal Transportation Program is authorized under the Federal Lands Highway Program, and is jointly administered by the Bureau of Indian Affairs and Federal Highway Administration. Symposium participants said that Tribes can use this to do transportation improvements and projects of their own on the State Highway System or county roads. Partnerships with tribes are important because tribes may not have the capacity to do the actual work but they are able to get the money needed to fund the project. Having more partners improves an entity's chances of obtaining grant funding. A total of $505 million has been authorized for the program in fiscal year 2020 (https://www.fhwa.dot.gov/fastact/factsheets/tribaltransportationfs.cfm).

Wildlife Conservation Board's Wildlife Corridor and Fish Passage Program was allocated $30 million by Proposition 68 to fund planning and implementation projects that improve passage for fish and wildlife. Example projects for this program include the construction of wildlife crossings, restoration of habitat in wildlife corridors, removal of instream impediments to fish passage, etc., and planning projects that provide design and environmental review for wildlife corridor or fish passage restoration projects. Other programs that may contribute to conserving connectivity include Acquisitions and Conservation Easements, Forest Conservation, and Climate Adaptation. For more information, visit https://wcb.ca.gov/Grants.

8.6 Creative Funding Approaches to Improve Fish and Wildlife Passage

A symposium participant asked if S.O. 3362 could help leverage federal transportation dollars. John Tull, Nevada Science Coordinator and S.O. 3362 Liaison with USFWS, said most S.O. 3362 funding is directed to research purposes, not construction. Currently, the DOI S.O. 3362 Team is trying to leverage partnerships and start new ones across state agencies to begin talking about this. John said DOI put a call out to states to identify their top three to five priority areas for deer, elk, and pronghorn; the target species covered under S.O. 3362. John mentioned there may be an opportunity to bring up the concept of leveraging federal transportation dollars. Someone

asked John if he's accepting further amendments to the state plans that would make more of these areas eligible? He said the 2019 revisions only included an update to the original priority areas. The 2019 California update is focusing on analysis of historical and current telemetry datasets. There will be another round of revisions this year probably and he said they can have that conversation. Another participant stated that S.O. 3362 is a perfect example of why symposia such as this are so important. One other noted that S.O. 3362 has initiated a lot of conversations that wouldn't have happened otherwise (like the symposium).

Other creative funding approaches discussed include:

- A participant from Pacific Forest Trust said they're always looking/working for creative funding models to achieve and secure Working Forest Conservation Easements. The Trust would like to explore additional opportunities and partnerships for conservation easements to expand and include wildlife passage. They are particularly interested in the Siskiyou Crest Passage that spans the California Oregon border near Interstate 5.
- A participant mentioned that the state of Washington has its own gas tax that mostly paid for the Snoqualmie Pass Project on I-90, but getting it off the ground involved kids doing bake sales and designing billboards.
- Someone mentioned perhaps partnering with insurance companies because they pay out claims on animal collisions. However, because wildlife-vehicle collisions represent a small number of claims in comparison to the number they process overall; they likely wouldn't care enough to partner. Another participant responded saying for Caltrans, it has to trigger the safety index for them to fund a project, and it's likely the same with insurance companies.
- A participant suggested getting the trucking industry and the railroads as partners.
- A participant from University of California Cooperative Extension said they can leverage county, state and non-profit funds and opportunities in every county in California. They're expert facilitators, collaborators, and cooperators in bringing groups together.
- A participant from the Pit River Nation suggested partnering with native tribes to identify needs and funding sources for wildlife crossing projects.
- A participant from Caltrans suggested local sponsors and cooperatives to determine different roles and oversight on connectivity efforts.

- A participant from CDFW mentioned partnerships with NGOs, tribes, and private timber companies.
- A participant from Oregon Department of Transportation mentioned opportunities for creative funding approaches with Rocky Mountain Elk Foundation, Mule Deer Foundation, Pittman-Robertson Funds, Oregon Watershed Enhancement Board, U.S. Forest Service, Wyden Amendment (Good Neighbor money), Oregon Hunters Association, and Oregon Wildlife Foundation.

9. Brainstorming Criteria to Prioritize Barriers for Remediation

Participants were provided with a draft list of criteria for prioritizing wildlife barriers on the State Highway System that included potential criteria for biological importance, threats, and opportunities (Appendix 3), which were intended to stimulate discussion amongst participants and generate ideas for additional criteria. This draft framework was based on criteria for evaluating biological importance and irreplaceability, as well as threats to connectivity function (Pressey et al. 1994, Pressey and Taffs 2001, Noss et al. 2002, Beier et al. 2006). Participants were told that they were free to add or remove criteria from the list, and were not restricted to the three categories. Participants worked in small groups at tables.

Participants discussed the draft list of criteria for prioritizing barriers for remediation at length. Participants in one group decided to rank all of the criteria in each category on the list provided in order of importance to them, and suggested that the rest of the participants do the same. Most, but not all, participants ranked the criteria in order of importance, with one being most important. Thus, lower total scores signify the criteria ranked as most important by participants (Table 2). These rankings provide a suggestion for how potential criteria might be weighted. For example, wildlife-vehicle collisions were ranked as the most important criterion in the vulnerability and threats category, while conservation status of species and scientific evidence the corridor is used by species were ranked highest for biological importance. Facilitating species movements driven by climate change ranked last, not because participants thought it unimportant but because of the more immediate threats of habitat fragmentation and lack of connectivity.

Participants had a rich discussion on prioritizing barriers for remediation and identified several additional criteria that may be useful for developing a

Table 2. Ranking for potential criteria for barrier prioritization. Criteria were ranked in three categories: Biological Importance, Vulnerability/Threats, and Opportunities. Criteria were scored in order of importance by participants (A-K). Lower Scores = More Important.

CRITERIA FOR BIOLOGICAL IMPORTANCE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Score Total**
Conservation status of species (threatened, endangered, and sensitive species)/species recovery plans	7	2	4	4	5	1	1	2	2	3	3	**24**
Scientific evidence the corridor is used by species, including traditional ecological knowledge	3	3	5	6	2	3	3	1	1	5	4	**29**
Linkage is key to ungulate migrations (GPS evidence), dispersal and genetic exchange for multiple species, not just ungulates	2	5	1	1	4	2	6	3	6	2	1	**30**
Quality of habitat in linkage bisected by barrier (e.g., freeway, rail)	1	1	3	2	1	7	7	5	3	4	2	**33**
Size of both protected areas or wildlands served by linkage, as a proxy for climate resilience, ecological integrity, and what populations look like on either side of barrier (size and quality; larger areas = more species)	4	4	6	3	6	5	4	4	4	1	5	**46**
Adds value for freshwater features or catchments (fish passage)	6	6	7	7	3	6	2	7	5	6	7	**49**
Facilitates species movements driven by climatic change (fires, flooding, shifts in vegetative communities)	5	7	2	5	7	4	5	6	7	7	6	**50**

CRITERIA FOR VULNERABILITY/THREATS	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Score Total**
Wildlife-vehicle collisions	2	3	0	1	1	1	2	1	1	1	1	**11**
Distance between protected areas bisected by barrier	1	2	0	3	2	2	1	2	2	2	2	**16**
Habitat conversion in linkage bisected by barrier	3	1	0	2	3	3	3	3	3	3	3	**21**

CRITERIA FOR OPPORTUNITIES	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Score Total**
Transportation and infrastructure-related opportunities (in plan[s])	2	1	0	2	2		2	1	1	1	2	**10**
Partnership and funding opportunities	1	2	0	1	1		1	2	2	2	1	**11**

prioritization framework (Table 3). This brainstorming session was productive and will provide CDFW and Caltrans with a robust preliminary list of criteria to consider when developing an approach to assess and prioritize wildlife movement barriers for remediation. However, more detailed field assessments of identified road segments to verify barrier status are needed before moving forward to implement the barrier prioritization framework.

Table 3. Other Potential Criteria Identified by Participants for Prioritizing Barriers for Remediation.

CATEGORY	**POTENTIAL CRITERIA**
Biological Importance	Provides/promotes ecosystem services (e.g., pollination)
Biological Importance	Biodiversity hotspots served by linkage
Biological Importance	Serves umbrellas species
Biological Importance	Width of animal path
Biological Importance	Fixes fish passage and improves wildlife connectivity/crossing
Biological Importance	Number of movement types supported
Vulnerability/Threats	Number of barriers in linkage (roads, rail, data gaps, etc.)
Vulnerability/Threats	Is there another route or is this the last option?
Vulnerability/Threats	Invasive species/disease transmission/non-desirable species
Vulnerability/Threats	Lack of landowner support
Vulnerability/Threats	Potential for ecological trap/predator prey
Vulnerability/Threats	Public versus private land ownership
Opportunities	Recovery action or conservation plan
Opportunities	Public education and outreach opportunity
Opportunities	Wildlife viewing opportunities
Opportunities	Collaboration, communication between state agencies along CA/OR border
Opportunities	Public versus private jurisdictions (tribal, fed, state, private)
Opportunities	Already a fish passage priority
Opportunities	Private land owner; conservation easement opportunities

The focal species selection process and subsequent fine-scale connectivity assessment discussed in Section 7 above could help inform the prioritization of barriers for remediation. For example, the connectivity assessment could help identify segments of the State Highway System that should be targeted for detailed field studies. The results of the focal species analyses could also help identify potential locations for wildlife crossing improvements that could benefit the largest number of focal species in one location. These studies should be designed to evaluate the potential for existing structures to provide safe passage across transportation features, as well as, identify locations where wildlife crossing structures are needed.

10. Results Sharing, Meeting Wrap-up and Next Steps

The meeting wrapped up with a general summary of what came out of each breakout session, which has been summarized in the previous sections of this report. **Karen Miner from the CDFW** gave the closing remarks. She thanked everyone for their contributions and for taking the time to spend their entire day at the symposium. She expressed how thrilled she was with all of the data and information collected throughout the day, and explained that CDFW would be reviewing and evaluating the data collected to determine how best to factor it into their work. She told participants that the Planning Team would be developing a symposium summary report over the next few months and that participants would be sent a link to the report.

11. Recommendations, Next Steps, and Action Items

This highly collaborative and interactive symposium sought to engage diverse stakeholders from the inception; promote coordination across jurisdictional boundaries; focus disparate transportation, research, and conservation efforts on a coordinated District-wide plan; sharpen the focus of partners working at local scales; and foster the partnerships needed to maintain, restore, and conserve landscape connectivity in the focus area. Recommendations are organized into three categories: recommendations by the symposium facilitator (organized by breakout session); participant recommendations from the post-event evaluation; and recommendations on the format for potential future workshops.

11.1 Recommendations by Facilitator

The purpose of this section is to provide recommendations based on what was heard during the symposium and the data collected. The following recommendations are organized by breakout session and were generated by the symposium facilitator. The recommendations will need further refinement to fit within CDFW and Caltrans' existing priorities.

11.1.1 Identifying Barriers, Data Gaps and Research Needs

Background

The primary objective of the Identifying Barriers, Data Gaps and Research Needs breakout session was to gather input on these topics that CDFW and Caltrans may consider as they work toward developing a map of wildlife passage barriers in District 2 and areas that need to be investigated further. The Planning Team sought this input based on scientific data, expert opinion, and stakeholder contributions.

In filling out the datasheets and making observations, participants identified several Areas of Interest as described earlier. These Areas of Interest identify stretches of highway that may constitute barriers to wildlife movement and/or that warrant additional research. These areas have since been combined with the Areas of Interest identified by CDFW and Caltrans at their October 2019 pre-meeting into a GIS database. One overarching goal of the symposium is to see all Areas of Interest from the October 2019 and January 2020 events into one place. These data can then be further evaluated to prioritize projects, including research efforts, in the region.

As discussed earlier in the summary of presentations, Caltrans recently completed a statewide hotspot analysis in partnership with the Western Transportation Institute that identifies areas of the State Highway System with the highest frequencies of deer-vehicle collisions (Huijser and Begley 2019). Dr. Pincetich from Caltrans Headquarters presented the results of the analysis with an emphasis on District 2 in the morning session, which are depicted in Figure 9. The results of the analysis are intended to help determine where potential improvements may be needed to improve roadway safety for motorists and safe passage for wildlife.

The best time to address connectivity and wildlife barriers is early in the transportation planning process, when the potential need for costly improvements can be identified. Statewide and regional transportation planning analyses and studies precede initiation of studies for specific transportation improvement projects. There are several regional transportation planning entities that cover District 2 including Siskiyou County Local Transportation Commission (CLTC), Modoc CLTC, Shasta County Regional Transportation Agency, and Lassen CLTC. Knowing the details and timing of these processes, and how they interact is essential for interested agencies, non-profits, and other potential partners to be involved in project scoping and nomination to address wildlife barriers.

The State Highway Operation Protection Program (SHOPP) funds highway repair and preservation, emergency repairs, safety improvements, and some operational improvements. Planned transportation improvement projects can provide opportunities for integrating wildlife crossings and directional fencing to improve driver safety and roadway permeability to wildlife. Not all projects provide equal opportunities. For example, projects where there are existing facilities (e.g., bridges or culverts) or safety issues provide better opportunities than projects related to pavement activities. The SHOPP is constantly evolving and is formally updated quarterly.

An overlay of planned transportation improvement projects with the top hotspots for deer-vehicle collisions and deer carcasses (Huijser and Begley 2019) could identify projects that may be good candidates for including features that improve wildlife connectivity (Figure 11). An example of the

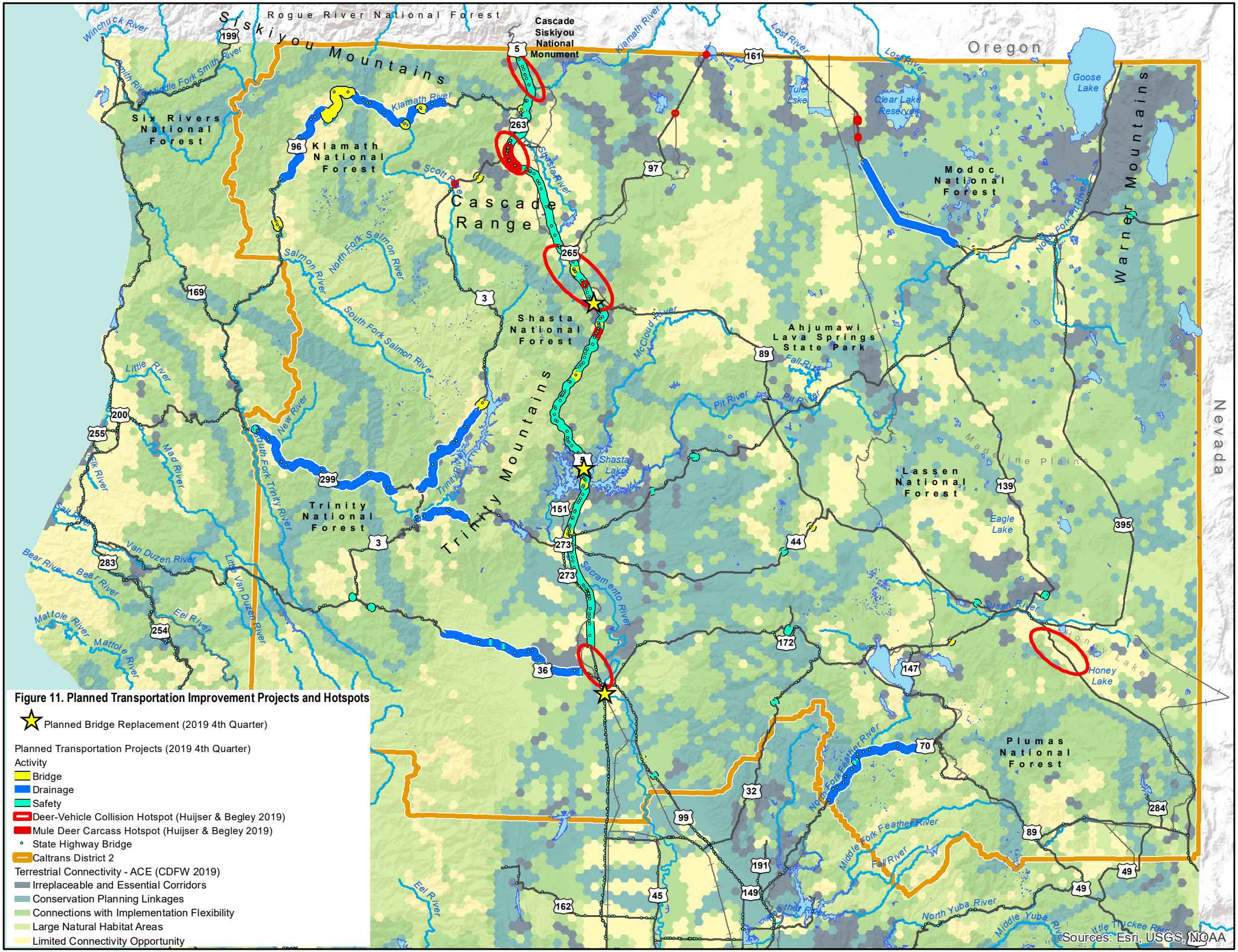

Figure 11. Planned Transportation Improvement Projects and Hotspots

★ Planned Bridge Replacement (2019 4th Quarter)

Planned Transportation Projects (2019 4th Quarter)

Activity

- Bridge
- Drainage
- Safety
- Deer-Vehicle Collision Hotspot (Huijser & Begley 2019)
- Mule Deer Carcass Hotspot (Huijser & Begley 2019)
- State Highway Bridge
- Caltrans District 2

Terrestrial Connectivity - ACE (CDFW 2019)

- Irreplaceable and Essential Corridors
- Conservation Planning Linkages
- Connections with Implementation Flexibility
- Large Natural Habitat Areas
- Limited Connectivity Opportunity

output of such an analysis is provided in Table 4. A total of 6 of the projects intersected hotspots for deer-vehicle collisions or deer carcasses, including three for safety and three for bridges with one bridge replacement. Five of the projects that intersect hotspots are associated with Interstate 5, while the other is associated with State Route 36. Overall, nine of the planned projects are associated with Interstate 5, the most substantial impediment to wildlife movement in the focus area, including six for bridges, and three for safety that collectively cover 141 linear miles.

Table 4. Example of State Highway Operation Protection Program (SHOPP; 4th Quarter 2019) planned bridge, safety, and drainage projects in District 2 identifying projects that overlap hotspots.

SHOPP ID	County	Route	Begin Mile	End Mile	Activity	HOT SPOT
13288	Trinity	3	58.7	60.7	Bridge	
13699	Trinity	3	30.4	57.9	Drainage	
11244	Siskiyou	5	R15.3	R16.5	Bridge	WVC
13255	Siskiyou	5	0	R69.2	Safety	Carcass / WVC
14182	Siskiyou	5	2.5	3	Bridge	
15793	Shasta	5	R32.2R		Bridge Replacement	
15794	Siskiyou	5	R8.3		Bridge Replacement	WVC
21064	Shasta	5	56.6	58.1	Bridge	
9181	Shasta	5	0	67	Safety	Carcass
9198	Tehama	5	R25.4		Bridge Replacement	
9205	Tehama	5	36.3	41.6	Safety	WVC
15602	Tehama	32	8.6	9.3	Safety	
19489	Tehama	36	41.95	41.95	Bridge	WVC
11245	Siskiyou	89	20.9	21.2	Bridge	
11261	Siskiyou	96	23.4	54.5	Drainage	
17234	Siskiyou	96	R7.9	R9.4	Bridge	
9290	Modoc	139	R3.5	30.3	Drainage	
17347	Modoc	299	51.9	52.5	Safety	
19969	Trinity	299	59	70	Drainage	
21390	Shasta	299	44.3	44.9	Safety	
21700	Shasta	299	57.5	58.7	Safety	
9192	Modoc	299	23.1	23.6	Bridge	

Individuals and organizations wishing to partner with Caltrans District 2 to advance efforts to plan for and construct wildlife crossings on the State Highway System should provide comments during the public comment period during each new SHOPP cycle.

Recommendations:

- **Develop an action plan** for addressing the list of barriers in the region; this plan should be based on scientific data, expert opinion, and stakeholder input. The action plan could include the following:
    - A map of documented wildlife barriers in District 2that flags which ones need to be researched further.
    - A map showing wildlife barriers in relation to planned and programmed transportation improvement projects.
    - A list of potential barriers that need further study.
    - A summary of the process to identify and reach consensus on criteria for assessing and prioritizing wildlife barriers for remediation, complete the systematic assessment of each barrier, and produce the final results of the prioritization.
    - A priority list of the most biologically significant barriers.
    - Detailed summaries on the ecological significance, threats and opportunities, and priority rankings for each barrier.
    - Strategies for addressing the list of priority barriers based on transportation plans and funding sources.

- **Prioritize barriers for remediation.** The initial prioritization of barriers for remediation should focus on existing roadkill hotspots and wildlife-vehicle collisions (Huijser and Begley 2019) that are known to pose a threat to the safety of motorists and wildlife.

- **Evaluate opportunities to implement wildlife connectivity improvement** recommendations for the top hot spots (Table 5) based on analyses for deer-vehicle crashes and carcass data per Huijser and Begley (2019).

- **Collect all GPS collar data for migrating ungulates in the state.**
    - Use Migration Mapper, a custom GIS tool developed by the Wyoming Migration Initiative to map winter and summer ranges, stopover sites, and key crossing locations on the State Highway System in California, as well as transboundary connections to neighboring states. (https://migrationinitiative.org/content/migration-mapper)
    - Integrate the results into the Terrestrial Connectivity dataset in CDFW's ACE.

Table 5. Remediation recommendations for the top deer-vehicle collisions and mule deer carcass hotspots in Caltrans District 2 (from Huijser and Begley 2019).

Hot spot ID#	County	Route	Total length miles	# of Lanes	Existing Structure	AADT	Rank	Recommend-ations
2a-V	Siskiyou	5	2.5	4	Yes	16,200	4	Fence, modify existing bridge
2e-V	Tehama	5	0.5	5	Yes	42,750	2	Fence, modify existing bridge
2f-V	Tehama	5	0.5	4	Yes	38,500	2	Fence, modify existing bridge
2g-V	Lassen	395	5.6	3	Yes	6,950	1	Fence, upsize existing culverts and livestock underpass, designated structures
2h-V	Siskiyou	5	0.4	4	No	24,800	3	Fence, designated structures
2A-C	Siskiyou	5	6.3	4	Yes	19,000	1	Fence, upsize existing culverts and livestock underpass, designated structures
2D-C	Siskiyou	5	1.1	4	No	20,350	2	Fence, designated structures
2G-C	Siskiyou	395	0.2	2	No	1,190	3	Fence, designated structures
2H-C	Modoc	139	0.6	2	No	1,625	5	Fence, designated structures
2I-C	Modoc	139	0.3	2	No	1,625	4	Fence, designated structures

Note: Hot spot ID# V = Vehicle; C = Carcass; AADT = Annual Average Daily Traffic

- **Roadkill data collection.** During the Q and A period following the morning presentations, a participant asked if Caltrans had a system in place for the public to submit roadkill data. Dr. Pincetich responded

that the Caltrans or the state does not currently have its own system and referred participants to the California Roadkill Observation System https://www.wildlifecrossing.net/california/, which is a publicly available tool hosted by UC Davis that collects and maps photographs and observations of roadkill along California's roads and highways.
    - CDFW and Caltrans field staff should be encouraged to record roadkill to a central spatial database.
    - Senate Bill 395 directs CDFW to develop a pilot program to record roadside carcasses for salvage permitting, which should also include entering data into a central system.

11.1.2 Identifying Partners and Funding Sources

Background

The primary objectives of the Identifying Partners and Funding Sources breakout session were to have participants discuss successful partnerships, and to identify different types of programs, policies, projects, and planning efforts that may contribute to maintaining and restoring connectivity in the focus area.

There is an immediate partnership opportunity in Caltrans District 2. District 2 is currently looking for partners to help raise additional grant funds for a wildlife overcrossing on US Highway 97 near Grass Lake.

Recommendations:

- **Identify partnership opportunities.** Evaluate the spatial extent of existing conservation and connectivity related planning efforts in the focus area in section 8.4 to identify potential opportunities for addressing barriers, data gaps and research needs in the Areas of Interest.

- **Alert symposium participants to public planning processes related to wildlife connectivity.** All symposium participants should be considered interested stakeholders and potential partners, and alerted when there are opportunities for public engagement in transportation planning processes in District 2 that may relate to wildlife connectivity.

- **Develop partnerships for priority hotspots.** Put a call out for partners for each of the priority hotspots where transportation

improvement projects are planned using the symposium participant contact list.
    - Schedule meetings to identify partnership opportunities and funding sources to:
        - Support design and construction of wildlife crossings.
        - Fill data gaps and research needs.
        - Target any key parcels for conservation easements or acquisition.
        - Conduct outreach to affected communities to gather support and raise public awareness.

- **Develop Connectivity Working Groups.** Develop ongoing connectivity working groups with partners for each hotspot and Area of Interest.

- **Integrate traditional ecological knowledge to improve connectivity.** Host meetings with each Native American Tribe in the focus area to gather essential traditional ecological knowledge and to:
    - Collaboratively develop Best Management Practices for engaging and working with tribes to address barriers, data gaps, and research needs on tribal lands.
    - Develop historical range reconstruction for porcupine and other species of cultural interest.
    - Develop historical range and migratory maps for ungulates.

- **Partner with Native American Tribes.** Partner with tribes and others to develop joint grant applications to the Tribal Transportation Program for connectivity improvements on the State Highway System that directly benefit tribal members and species of cultural interest.

11.1.3 Focal Species Selection

Background

The primary objective of the Focal Species Selection breakout session was to identify species that are sensitive to habitat loss and fragmentation, and that represent a diversity of habitat requirements and movement needs. Symposium participants identified a taxonomically diverse suite of potential focal species including seven mammals, nine birds, three amphibians, three reptiles, one fish, five invertebrates, and four plant communities. These 28 focal species capture a diversity of movement needs and ecological requirements, and provide a solid preliminary list for agency consideration.

Recommendations:

- **Validate focal species selected and supplement as needed.** CDFW and Caltrans should meet to validate the focal species selected with wildlife experts not present on the day of the symposium. For example, not all fragmentation-sensitive birds identified in the Identifying Barriers, Data Gaps and Research Needs session (e.g. roadrunner, sage grouse, waterfowl), which was happening concurrently with this working session, were identified as focal species, and should be considered for inclusion in follow up discussions to finalize focal species.
    - Confirm that sufficient information is known about the selected species to model their habitat requirements (since most species research documents habitat use rather than movement), including the availability of species occurrence data to build the models.
    - Ensure that the final focal species list is fully stratified by species movement needs and taxonomic groups, and includes habitat specialists for all key habitat types in the ecoregion.

- **Conduct connectivity assessment.** Work with partners to develop a comprehensive focal species-based connectivity assessment for the focus area, such as Penrod et al. 2013 and Krause et al. 2015, as called for in the California Essential Habitat Connectivity Project (Spencer et al. 2010).

- **Monitor focal species.** Monitor the selected focal species during connectivity improvements (e.g., wildlife crossings, habitat restoration) in the focus area, as appropriate.

- **Conduct connectivity-related research.** Partner with academic institutions and science-based non-profits to conduct connectivity-related research on the selected focal species.

11.1.4 Brainstorming Criteria to Prioritize Barriers for Remediation

Background

The primary objective of the Brainstorming Criteria to Prioritize Barriers for Remediation breakout session was to assist CDFW and Caltrans in identifying potential criteria that could be used to develop a barrier prioritization framework to addresses connectivity in transportation planning processes.

Recommendations:

- **Reach consensus on criteria.** CDFW and Caltrans could meet to reach consensus on criteria and develop a wildlife barrier prioritization framework. The meeting should focus on:
    - Refining the list of criteria developed at the symposium based on biological significance, threats to connectivity function, and opportunities.
    - Vetting each criterion identified to ensure it can be measured across all barriers being assessed using a systematic, transparent and repeatable approach.
    - Discussing spatial data that could be used and an approach to assess each criterion.
    - Ranking each criterion in order of importance to determine how the criteria should be weighted.

- **Research Existing Prioritization Frameworks.** Research how other scientists and state DOTs (e.g., Idaho, Utah, Montana, Colorado) have gone about prioritizing data on wildlife movement barriers, and incorporate these findings into criteria, as appropriate.

11.2 Summary of Participant Recommendations

Background

Following the symposium, an evaluation was emailed to all participants, asking questions including which presentations were most valuable and relevant to their work, how they would improve the interactions and participation, what additional stakeholders should be included in future meetings, and requesting any additional suggestions for CDFW and Caltrans to help the agencies address wildlife connectivity moving forward.

Responses on what was most valuable:

- Opportunity to meet and connect with other stakeholders.
- Sharing of successful projects.
- Having both CDFW and Caltrans representatives at the symposium. Participants appreciated the opportunity to engage directly with staff and both agencies' commitment to the issue.
- Breakout sessions.
- Sharing of new information by participants.
- Discussions with other professionals about methods and considerations to prioritize locations most essential to improve for wildlife connectivity.

Responses on what went well:

- Level of interactions by participants.
- Symposium was well-run and productive.
- Having designated note-takers at each break out session.
- Having representation from tribal governments in attendance with expertise and irreplaceable knowledge about large animal migration patterns.

Participant recommendations for improvements to the workshop:

- Fewer lectures and more interactive workshops.
- Invite additional landowners in the area, especially those that border problem areas; invite more timber and agricultural interests.
- Engage local and regional elected officials as well as policy advocates to drive policy for funding.
- Have breakout session leaders do more to encourage non-agency participants to contribute to discussions.
- Continue to include tribal governments, lean on their knowledge base, and include them in decision-making processes.

Other recommendations from participants:

- Wildlife crossings should be expedited.
- Agencies should develop a prioritization matrix that is flexible to allow for use across California, and include ways to determine the value of lives saved when wildlife crossings are constructed. This would allow the conservation value and species preservation value to be factored instead of just access to habitat or other 'connectivity' parameters.
- An information gap for non-game species was noted as likely to be important for managing species of conservation concern, including state and federally listed species in other regions.

11.3 Recommendations for Future Connectivity Symposiums

Development

- Prioritize involvement of local staff. Continue to involve Caltrans District and CDFW Regional staff in planning and design of similar symposia in the future.
- Initiate map development and production earlier.

Format

- Evaluate the format of the focal species selection process, and whether we would include this, and/or modify it, in future regional symposia. Determine if there should be a focal species session; this would depend on if one has been done in that particular region.

- Provide more information on fragmentation-sensitive species to guide focal species selection process.
- If a focal species session is planned, ensure that invitees capture expertise across taxonomic groups.

Logistics & Delivery

- Bundle all breakout session materials (e.g., maps, datasheets, colored pens) prior to event so that everything is ready to go.
- Instruct breakout session leaders to gather all datasheets, maps and other materials in between sessions, and have a target person to whom everyone should deliver their materials.

12. Closing

This one-day symposium was a success. Participants contributed a tremendous amount of information and data related to wildlife movement barriers and research needs in the region; identified focal species for connectivity planning and monitoring; suggested criteria for prioritizing barriers for remediation; and discussed partnership ideas and funding opportunities for maintaining and restoring habitat connectivity and wildlife movement corridors in the focus area. The symposium provided an opportunity for participants from diverse sectors to connect with wildlife and transportation agencies to collectively further connectivity planning in northeast California.

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Appendix 1. Symposium Agenda

Northeastern California Wildlife Connectivity Symposium

January 8, 2020
8:30am to 5pm
Red Lion Hotel
1830 Hilltop Drive, Redding, California, 96002

7:45-8:30	**Register and Networking**
8:30	**Event Welcome and Meeting Purpose** Stafford Lehr, California Department of Fish & Wildlife Kelly Kawsuniak, California Department of Transportation (Caltrans)
8:45	**Introductions**
9:00	**Wildlife Migration Initiatives** Laurel Williams, The Pew Charitable Trusts
9:10	**The Big Picture: Science & Tools of Wildlife Migration** Arthur Middleton, University of California Berkeley Hall Sawyer, Western Ecosystems Technology, Inc.
9:40	**Identifying Movement Barriers for Pronghorn in the Modoc Plateau** Brian Hudgens, Institute for Wildlife Studies
10:00	**Morning Break**
10:20	**Abundance and Population Characteristics of Elk in Northern California** Erin Nigon, California Department of Fish & Wildlife Christine Found-Jackson, California Department of Fish & Wildlife
10:40	**Connectivity and the California Biodiversity Initiative** Melanie Gogol-Prokurat, California Department of Fish & Wildlife

11:00 **Wildlife Connectivity and Transportation Project Planning at Caltrans**
Lindsay Vivian, Caltrans Headquarters
Chris Pincetich, Caltrans Headquarters

11:20 **Caltrans Case Studies: Twin Gulches Project & Highway 139**
Kelly Kawsuniak, Caltrans District 2
Julie Owen, Caltrans District 2

11:40 **Speaker Panel Q&A**

12:00 **Lunch (provided)**

12:45 **Afternoon Overview**

1:00 – 3:00 **Breakout Session #1**
One hour in each breakout. All participants will be able to participate in each session.

1. Identifying barriers, data gaps and research needs - Siskiyou/Cascade Room
2. Focal species selection - Sierra Room

3:00 **Afternoon Break**

3:20 – 4:20 **Breakout Session #2**
Participants pick one session to attend.

1. Partnership and funding opportunities - Sierra Room
2. Brainstorming criteria to prioritize barriers for remediation - Siskiyou/Cascade Room

4:20 **Results Sharing**

4:50 **Meeting Wrap-up & Next Steps**
Karen Miner, California Department of Fish & Wildlife

5:00 **Adjourn**

Appendix 2. List of Participants

First Name	Last Name	Affiliation
Ray	Alvarez	Pit River Tribe
Andrew	Amacher	California - Department of Fish and Wildlife
Ginger	Amoroso	Pit River Tribe
Amy	Bailey	California Department of Transportation
Jake	Barlow	California Deer Association
Maia	Black	Selberg Institute
Trina	Blanchette	California - Department of Transportation
Cidney	Bowman	Oregon - Department of Transportation
Justin	Brashares	University of California, Berkeley
Ross	Brazil	W M Beaty & Associates
Rennie	Cleland	California Deer Association
Don	Crocker	California - Department of Fish and Wildlife
Jennifer	Diamond	California - Department of Fish and Wildlife
Leslie	Duncan	The Pew Charitable Trusts
Russell	Eleck	Pit River Tribe
Jenny	Ericson	US Fish and Wildlife Service
Pete	Figura	California - Department of Fish and Wildlife
Pamela	Flick	Defenders of Wildlife
Mike	Ford	Rocky Mountain Elk Foundation
Oliver	Forrest Sr.	Pit River Tribe
Oliver	Forrest Jr.	Pit River Tribe
Christine	Found-Jackson	California - Department of Fish and Wildlife
Lupita	Franco	California - Department of Transportation
Arwen	Freeman	Bureau of Land Management
Aaron	Freitas	California - Department of Fish and Wildlife
Shaughn	Galloway	US Fish and Wildlife Service
Jennifer	Garrison	California - Department of Fish and Wildlife
Brian	Geiger	The Pew Charitable Trusts
Renee	Gemmill	Pit River Tribe
Bill	George	Pit River Tribe
Jennifer	Gillies	California - Department of Transportation
Melanie	Gogol-Prokurat	California Department of Transportation
Agnes	Gonzalez	Pit River Tribe
Hanna	Harrell	California - Department of Transportation
Jill	Harris	Pacific Forest Trust
Ryan	Henson	California Wilderness Coalition
Kristin	Hubbard	California - Department of Fish and Wildlife
Patrick	Huber	UC Davis Agricultural Sustainability Institute
Brian	Hudgens	Institute for Wildlife Studies
Josiah	Jacobs	Pit River Tribe
Kelly	Kawsuniak	California - Department of Transportation
Kenwa	Kravitz	Pit River Tribe
Russell	Kuhlmann	Backcountry Hunters and Anglers
James	Lee	Trinity County Fish and Game Advisory Commission
Stafford	Lehr	California - Department of Fish and Wildlife
Richard	Lis	California - Department of Fish and Wildlife
Dale	MacDougall	California Deer Association
Brandy	McDaniels	Pit River Tribe
Arthur	Middleton	University of California, Berkeley
Mariam	Mike	Pit River Tribe
Paul	Molder	Modoc County Fish, Game & Recreation Commission
Florence	Moran	Pit River Tribe
Ken	Morefield	California - Department of Fish and Wildlife
Randy	Morrison	Mule Deer Foundation
Erin	Nigon	California - Department of Fish and Wildlife
Garrett	Noles	U.S. Forest Service
Julie	Owen	California - Department of Transportation
Kristeen	Penrod	Science and Collaboration for Connected Wildlands
Chris	Pincetich	California - Department of Transportation
Eric	Rulison	California - Department of Transportation
Hall	Sawyer	Western Ecosystems Technology, Inc.
Charlie	Schelz	Bureau of Land Management
Jack	Singer	Pacific Forest Trust
Laura	Snell	University of California Cooperative Extension Modoc
Susan	Studer	Pit River Tribe
Kimberly	Tenggardjaja	California - Department of Fish and Wildlife
Brooke	Thompson	Bureau of Land Management
John	Tull	US Fish and Wildlife Service
Michael	van Hattem	California - Department of Fish and Wildlife
Kendee	Vance	California - Department of Transportation
Lindsay	Vivian	California Department of Transportation
Lauren	Volgenau-Knapp	The Volgenau Foundation
Donn	Walgamuth	California Deer Association
Landon	Watah	Pit River Tribe
Laurel	Williams	The Pew Charitable Trusts

Appendix 3. Datasheets for Breakout Sessions

Barriers, Data, and Research Needs – Location Description Log

Location ID: _____ (your 3 initials and a sequential number, eg. "ABC–##"). Make sure to write this Location ID at the corresponding location on the map on the reverse.

Map #: _____ (Enter Map # if you drew on a large map, else draw on map on reverse)

Name: _____ County: _____

Affiliation: _____ Route: _____

Phone: _____ Post-miles: _____ — _____

Email: _____

Please provide your contact information so we may contact you for further information

1. What are the target wildlife species or species groups, and the desired outcome for connectivity improvement at this location (e.g., access to habitat/food/shelter; accommodate movement of wide-ranging species; reduce vehicle interactions; improve gene flow)?

_____

_____

2. What are the potential justifications for connectivity improvements (*circle all that apply*):

listed species | big game | habitat choke point | safety | movement barrier | existing safe passage

More/Other: _____

3. Are there any existing features (e.g. creeks, riparian habitat, dirt roads) or structures (e.g. underpasses, large culverts) that might help facilitate movement:

_____

_____

4. Describe any existing data that does/could support the need for connectivity improvements:

_____

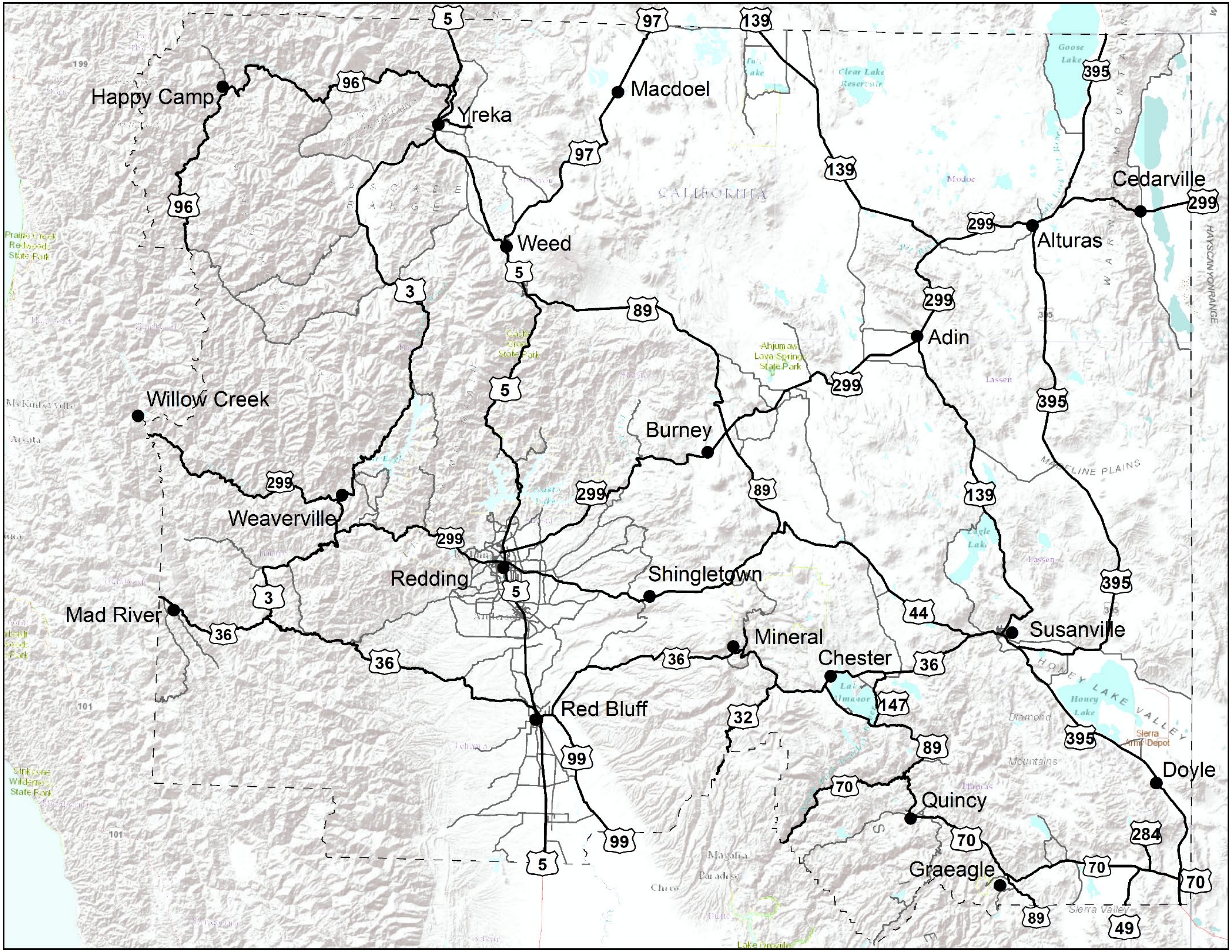
_____

5. Describe any research or data needs for connectivity improvements:

_____

_____

6. Please list any other relevant information below. Thank you for your time.


Happy Camp
Yreka
Macdoel
Weed
Willow Creek
Weaverville
Redding
Mad River
Burney
Shingletown
Mineral
Chester
Red Bluff
Adin
Alturas
Cedarville
Susanville
Quincy
Graeagle
Doyle
CALIFORNIA
HAYSCANYONRANGE
MADELINE PLAINS
HONEY LAKE VALLEY
5
96
97
139
3
89
299
36
44
32
99
395
147
70
284
49

Focal Species Selection

Taxonomic Group Worksheet

Taxonomic Group:

Participant List:

Name	Affiliation	Species or Area of Expertise

Species Selection Considerations:

The gut reaction is usually is to “conserve habitat first, ask questions later,” so you may be reluctant to engage in this focal species selection process. But without focal species, we would be designing linkages solely based on habitat remaining, with no way of knowing whether such a connection succeeds in serving biodiversity in any way besides adding a few acres of habitat. Without focal species, we have no way to argue whether the linkage should be narrow or wide, which habitats it should include, or whether both riparian and upland habitat is required. Future generations will assess the success of each linkage based on whether the connection serves the focal species you identify.

Select focal species that meet one or more of the following statements:

- Dispersal is vital to metapopulation persistence of the species.
- The species has a localized distribution at the spatial scale of this planning area.
- The species has limited dispersal ability and would likely require generations to move between core areas.
- The species is sensitive to fragmentation and edge effects (e.g., noise, light, invasive species).
- The species has specialized habitat requirements and or dispersal is habitat restricted.
- The species represents an ecological process (e.g., predation, pollination) or a disturbance regime (e.g., requires frequent low-intensity fires) that you want to conserve.
- The species might become locally extirpated due to fire or other catastrophic events in a core area and would need connectivity to recolonize.
- The species needs habitat connectivity to maintain genetic diversity (migratory birds probably make poor focal species).
- This may be a locally abundant species that may become rare in the natural community if connectivity were severed.

- The plant could suffer reproductive failure due to the loss of a fragmentation-sensitive pollinator or seed disperser.
- The species is known to be reluctant to use culverts under roads and is a useful umbrella species for the many (but unknown) species that probably share this trait.

Please include focal species that vary with respect to these factors. Thus, if you have selected 1 species because it is a habitat specialist for grasslands, and you are considering other habitat specialists, try to select a specialist for another habitat type. Try to include species at the shortest and longest dispersal distances relevant to the landscape under consideration. Please limit your selections to a maximum of 5 focal species for each taxonomic group, if possible. It is better to do a more complete job on 3 or 4 species, than a cursory effort for 5 species.

Species 1 Justification for selection of this focal species:

Species 2 Justification for selection of this focal species:

Species 3 Justification for selection of this focal species:

Species 4 Justification for selection of this focal species:

Species 5 Justification for selection of this focal species:

Focal Species Worksheet

Scientific/Common Name:

Location ID: _____ (your 3 initials and a sequential number, eg. "ABC–##").
Make sure to write this Location ID at the corresponding location on the map on the reverse.

Map #: _____ (Enter Map # if you drew on a large map, or draw on map on reverse)

Name: _____ County: _____

Affiliation: _____ Route: _____

Phone: _____ Post-miles: _____ — _____

Email: _____

Please provide your contact information so we may contact you for further information

1. How far does an adult individual of this species commonly move on a daily basis (?), or what is its home range/territory size? What is its dispersal distance (from birthplace to place it reproduces)? Does this species exhibit seasonal migration, and if so, what is the approximate migration distance? If your estimate is not species-specific (the information is based on congeneric species or allometric relationships), please indicate that.

Citations (author, date, title, source – or whatever you can recall):

Contact information for person who MAY have this information:

2. What does this species need to move (physically or genetically) between core areas? Describe what type of features would form a barrier or impediment to movement. If the species would have no difficulty crossing a road or other plausible barrier, please state this. Please indicate if any papers or persons might yield information on the movement needs of this species. (Your goal is to guide investigators in field reconnaissance – your response will be used!)

Citations (author, date, title, source – or whatever you can recall):

Contact info for person who researches this species or who MAY have this information:

3. On the available map, please use a unique color for this species to indicate:

- Specific linkages, barriers, or crossing locations for this species. Describe and/or list sources of information:

- Areas where populations of this species occur (both within protected blocks and potential linkage areas). Describe and/or list sources of information:

- Anecdotal observations or known occurrences of the species in potential connective areas between core areas. Describe and/or list sources of information:

- Documented movements from telemetry studies or sign surveys. List sources of information:

4. List any assumptions that underlie your recommendations. For example, “We assume that with climate change, fire intensity will increase and chaparral will shift to lower elevations, therefore we broadened the linkage to the 750-ft contour.” Or, “We assume that this species can disperse for 1.5 km through urban areas, and 10 km through all native vegetation types.”

5. Do you know of individuals who have expert knowledge about this species or a closely related species?

6. Additional comments or other points of discussion:

Identifying Partners and Funding Sources

Location ID: _____ (your 3 initials and a sequential number, eg. "ABC–##"). Make sure to write this Location ID at the corresponding location on the map on the reverse.

Map #: _____ (Enter Map # if you drew on a large map, or draw on map on reverse)

Name: _____ County: _____

Affiliation: _____ Route: _____

Phone: _____ Post-miles: _____ — _____

Email: _____

Please provide your contact information so we may contact you for further information

Please draw the jurisdictional boundary of where you work on the map on the flip side of this datasheet. On the available large format map, please identify focal projects, current efforts or projects you'd like to get started.

What conservation or connectivity related efforts does your organization/agency work on in the planning area? Are other agencies, organizations involved? Which ones?

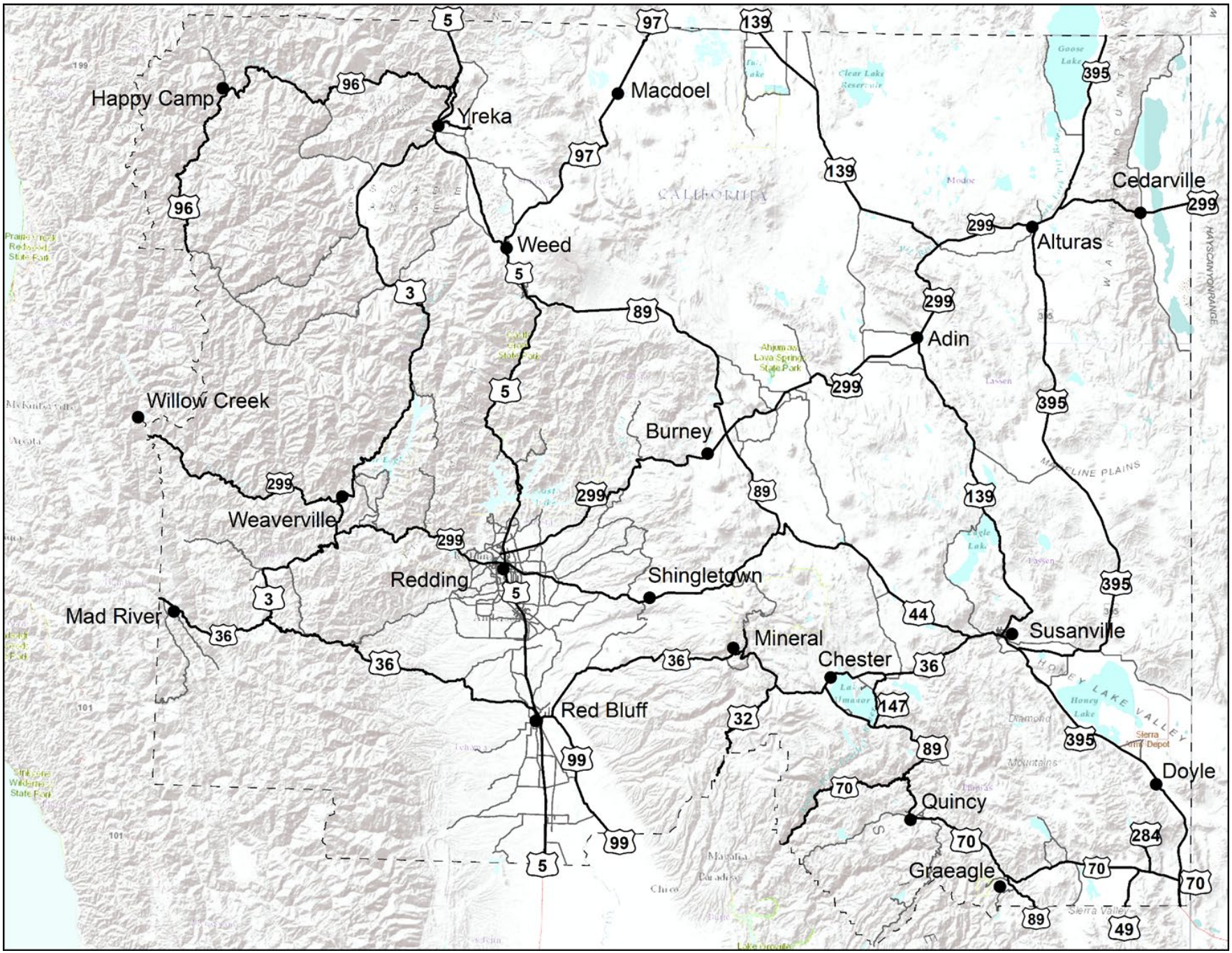
What other agencies and organizations are actively engaged in connectivity or conservation related efforts in the planning area?

Are you aware of any active inter-agency collaborations in the planning area?

What funding programs are available to address improvements to fish and wildlife passage in the planning area?

How were existing transportation and infrastructure related connectivity projects funded? Ex. Transportation related project funding/mitigation features, local measures, partnerships, California Pilot Wildlife Crossing Mitigation Credit System.

Are you aware of any creative funding approaches that could be used to improve fish and wildlife passage in the planning area?


Happy Camp
Yreka
Macdoel
Weed
Willow Creek
Weaverville
Redding
Burney
Shingletown
Mad River
Red Bluff
Mineral
Chester
Susanville
Adin
Alturas
Cedarville
Quincy
Doyle
Graeagle
5
97
139
96
3
89
299
395
36
44
147
32
99
70
284
49

Brainstorming Criteria for Prioritizing Barriers for Remediation

Name: _____

Affiliation: _____

We'd like your assistance identifying potential criteria for prioritizing barriers for remediation. Please add to or remove draft criteria from the list below. You are not limited to the major categories described below. The DRAFT criteria could be grouped into major categories, such as:

BIOLOGICAL IMPORTANCE/IRREPLACEABILITY assesses the biological value of a linkage bisected by a barrier (e.g., highway, freeway, rail, canal), and includes terrestrial and aquatic criteria.

VULNERABILITY / THREATS, which assesses potential threats to a linkage caused by current or potential habitat conversion or other stressors, such as roadkill.

OPPORTUNITY, which assesses the feasibility of remediating barriers to wildlife movement, and whether there are existing stakeholder initiatives to protect or conserve the linkage, or funding prospects to assist with implementation of wildlife crossing improvements.

BIOLOGICAL IMPORTANCE

Size of Both Protected Areas or Wildland Blocks Served by the Linkage

Quality of Habitat in Linkage Bisected by Barrier (e.g., highway, freeway, rail, canal)

Conservation Status of Species

Linkage is Key to Ungulate Migrations

Facilitates Species Movements Driven by Climatic Change

Adds value for freshwater features or catchments

Scientific evidence the corridor is used by species

VULNERABILITY/THREATS

Habitat conversion in linkage bisected by barrier

Distance between protected areas bisected by barrier

Wildlife-Vehicle Collisions

OPPORTUNITES

Transportation & Infrastructure Related Opportunities

Partnership opportunities and funding prospects

Appendix 4. Areas of Interest

The following table was compiled from the datasheets completed by participants in the Barriers, Data Gaps and Research Needs breakout session. Following is a brief explanation of how the fields were populated. For more detailed information, the datasheet is included in Appendix 3.

ID: Participants were asked to write their initials and a sequential number for each datasheet and at the corresponding location on the map. Changed to sequential numbers to protect participant's privacy.

Listed Species: Species listed as threatened, endangered, or proposed for listing. Field checked if circled on datasheet.

Big Game: Field checked if circled on datasheet. Field also checked if not circled but ungulates or bear was mentioned on datasheet.

Choke-point: Field checked if circled on datasheet.

Safety: Field checked if circled on datasheet. Field also checked if not circled but collision, roadkill, hotspot, or carcass was mentioned on datasheet.

Existing Safe Passage: Field checked if circled on datasheet.

Movement Barrier: Field checked if circled on datasheet. Field also checked if not checked but term indicative of movement barrier (e.g., barrier, deer-vehicle collisions, roadkill, hotspot, carcass data) was mentioned on datasheet.

Research Need: Field checked if research or data needs for connectivity improvements were referenced on datasheet.

Data: Field checked if data that does/could support the need for connectivity improvements was referenced on datasheet.

Roadkill: Field checked if wildlife-vehicle collision, roadkill, hotspot, or carcass was mentioned on datasheet.

Notes: Brief summary of information provided on datasheet.

County: County in which the Area of Interest is located.

Route: Interstate, Route or Highway associated with the Area of Interest.

Begin post mile, End post mile, and Post mile range: Caltrans location marker system indicates distance route travels through individual counties.

Species: List of species mentioned on datasheet.

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
1		x		x		x	x			bears looking for food, more signage, deer crossing; need fencing to keep bears off roads. Need data to justify adding a fence.	SHA	89	40			deer, bear
2	x					x	x	x		FYLF getting trapped in culverts along I-70, has been inspected by a team of CDFW biologists; need culvert designs to stop entrapment. CDFW Laura Patterson, Suzanne Gilmore, Isaac Chellman, and Rick Macala know locations	PLU	70	0	5		FYLF, small mammals
3	x			x		x		x		access to habitat, riparian habitat Little Brown's Creek, FYLF data - see USB drive	TRI	299	50	55	55-50	foothill yellow-legged frog
4		x		x		x	x	x	x	bald and golden eagles; rim rock that could be used for overpass structure support. Observed roadkill locations. Need defined deer crossing routes.	MOD	139	35	45	35-45	deer
5		x								elk		89	15			elk
6		x								bear		5	75			bear
7																
8	x	x	x	x			x	x		need to create safe passage to known migratory and habitat pathways. Need input from local native tribes regarding historical migratory pathways and habitats.	SHA, MOD, LAS, SIS	299	25	75	25-75	deer, bear, fox, rabbit, bobcat
9	x	x					x	x		road segment, have observed the species on either side of the hwy during surveys since 2011; shapefiles of observations		299	20	65		Pacific Fisher, black bear, deer
10	x	x					x	x		have observed the species on either side of the hwy during surveys since 2011; shapefiles of observations		299	20	65		Pacific Fisher, black bear, deer
11		x				x		x		location data of collared animals show roadside fences prevent movement. There is an existing culvert MM10-395-MOD at Alturas Ranches		395				pronghorn
12		x				x		x		location data of collared animals show roadside fences prevent movement. There is an existing culvert MM10-395-MOD at Alturas Ranches		395				pronghorn
13		x		x		x		x		US 97 corridor, WA/OR/CA; I-5 corridor, Siskiyou movement	various	97	0	54	0-54	mule deer, elk
14		x		x		x		x		US 97 corridor, WA/OR/CA; I-5 corridor, Siskiyou movement	various	5	0	69	0-69	mule deer, elk

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
15		x		x		x	x	x	x	many many collisions. Need gps movement data.	PLU	70	65	95		ungulates
16		x		x		x	x	x	x	elk high mortality area (Grass Lake area on Hwy 97), elk movement area. Have gps collar data and some roadkill mortality data. Need to ID hotspots along road to mitigate. mortality/public safety and promote road crossings. See reverse map for rough mark	SIS, MOD, LAS, SHA, TRI					elk
17	x	x		x		x		x	x	hazardous turns, range cattle sometimes wandering onto hwy, loggers speeding, impact of population from prefab houses traveling on A19 McArthur Rd; need to slow traffic and add slow signs - 40 mph. Observed roadkill of deer, bear, turkeys, woodpeckers	SHA	89	McArthur Rd, Glenburn Rd			deer, elk, bears, coyolte, fox, grey wolf, cattle, wild turkey, dogs
18		x		x		x	x	x	x	mule deer are the main species of concern killed crossing the hwy during migration. Need to provide safe passage over and between federal and private land. Deer primarily cross private land (alfalfa and other crops) during migration. There is a large emba	MOD	139	30	40	30-40	mule deer
19	x		x				x	x		Connecting core area with translocation of fishers. CBI/USFWS connectivity model, need ground-truthing of model. There are possible existing bridges and culverts.	SHA	299	38	45		pacific fisher
20	x						x	x		CBI/USFWS connectivity model, eastern Klamath study area, need research on post-fire use of habitat. There is existing river and road, may be a culvert	SIS	96	85	97		pacific fisher
21	x	x	x	x	x	x	x			Private lands on both sides of I5, and farther out is public land. Some land in this area is recent conservation easement with PFT, and PFT is interested in talking about creating wildlife infrastructure here and other locations. Need more research on species	SIS	5	10	15		

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
22		x	x			x		x		construction of Trinity Reservoir blocked migration routes and inundated winter range of deer that summer in the Trinity Alps. Authority to mitigate was placed in two congressional acts. See data sheet for references.	TRI					deer and elk
23	x	x	x	x	x	x	x	x	x	hotspot according to Fraser Schilling report. Research needed on animal movement patterns	TRI	299				deer, bear, ringtail, elk, raccoon, fox, western pond turtle
24		x		x		x	x	x	x	reduce vehicle interactions, access to habitat and water Sac River. Pacific Forest Trust is currently working on a grant from WCB to create a model/mapping tool for this region, to combine spatially explicit climate risk maps with target species habitat	SIS	5	63	69	63-69	elk
25		x		x		x	x	x			SIS					bear
26		x	x	x		x	x	x	x	Data: Caltrans Dist 2 road kill data, CHP collision data, CDFW telemetry data. Need mapping of vegetation/habitat that attract wildlife (preferred habitat). Area was identified as a #1 Caltrans priority, but was not included in teis map.	SIS	97	15	30		deer and elk
27		x	x	x	x		x	x		Tribal elders/historic data/observations. CDFW historical migratory/range data over the past 60 years. Need a collaborative effort to collect and produce an historical assessment to show where we've been. Historical data from CDFW regional/county biologis	SHA, SIS, LAS, MOD, PLU		X	X	X	deer and pronghorn
28		x								deer crossing	MOD	299	30	40	30-40	deer
29		x								animal crossing - deer and antelope	MOD	395	50	60	50-60	deer, pronghorn
30		x								major deer crossing	MOD	Casino Rd (Cnty rd 56/58)				deer
31		x								major deer crossing	MOD	395	10	20	20-10	deer and pronghorn
32		x			x					common crossing area for deer - not a connectivity issue. USFS roads on either side.	TRI	36	15ish			deer

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
33		x						x		pronghorn summer gathering area, 7-10 herd size, along edge of alfalfa fields on E side of road	LAS	395	112	115	155-112	pronghorn
34		x			x			x		near Honey Lake. Pronghorn summer location, 7-10 herd size. Not a connectivity issue. Observed regular presence since 1995.	LAS					pronghorn
35					x			x		pacific fisher and fox observed crossing road here on multiple occasions	TRI	3	0	3	0-3	fisher, fox
36		x		x		x		x	x	Caltrans maintenance reports about 1 kill per month since the median barrier was placed about 10 yrs ago. Common crossing location for mom bear with cubs.	SHA	5	SHA-5-62 - SHA-5-65, SIS-5-0 - SIS-5-2	65	SHA-5-62 - SHA-5-65, SIS-5-0 - SIS-5-2	bear
37		x						x		Small elk herd. Observed track and scat. Hunters have observed 3-5 individuals.	SHA					elk
38	x	x			x	x	x	x		maintain existing habitat integrity, avoid fragmentation, imrpove fence impediments or mark fences, reduce juniper, create Brownian bridge movement models to better understand pronghorn movement. CDFW has sage grouse data	MOD					sage grouse, pronghorn, possibly pygmy rabbits
39		x		x		x		x	x	milemarkers unknown, but across from Davis Rest Area; deer movement is obstructed (PLU-70), needs revised fencing near Davis Rest Area, modify fencing to improve connectivity; large 20 ft culverts are being used, but fencing needs to be extended and modified. D2 has roadkill data	PLU	70				deer
40		x					x			need to look more closely at migratory patterns and habitats of deer. Include tribes, local Caltrans maintenance folk, and community groups	TEH	36	50	55		deer, bobcat, coyote, skunk, fox
41		x		x		x	x		x	high incidence of roadkill, especially in fall and winter, need collar data	SHA	44	5	35	5-35	deer and bear
42		x		x		x	x		x	roadkill "day bench" to "big valley mtn", oak woodland and ag, need collar data	SHA	299	90	95	90-95	deer

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
43				x		x	x		x	decrease collisions, remove barriers like roads for wide-ranging species. Need large mammal popualtion numbers, Best management practices for wildlife-friendly fencing	MOD					
44		x				x				Ingot, no crossing options, need to put signs up	SHA	299	38	44	38-44	
45		x				x				Round Mountain, no crossing options, need to put signs up	SHA	299	52	57	52-57	
46		x		x	x	x				pronghorn regularly spotted on either side of Hwy 44	LAS	44	22	35	22-35	pronghorn
47		x									MOD	395	20	30		antelope
48	x	x	x	x	x	x	x			McArthur Rd to Dana, from SHA 89 MP35 to SHA 299 MP90; need to slow down traffic for loggers, transport trucks, and add signs. Fall feeding area for turkeys, elk, deer. Eating acorns. Need to clear back overhanging brush and open up roadside		89, 299				turkey, elk, deer
49										100 square mile area is Pit River ancestral area, all sacred to Pit River people including animals						
50	x	x	x	x		x	x	x	x	California/Oregon border. One of the most important linkage corridors in an area world renowned for outstanding biodiversity. There are some smaller culverts that some wildlife may use, but bigger crossings and more are needed to accommodate larger, far-r	SIS	5	59	69	59-69	Pacific Fisher, black bear, deer, coyote, cougar, wolf, elk and many other species.
51	x					x	x			need to accomodate movement upstream, need more studies on amphibian habitat and numbers	BUT	70	43	48	43-48	foothill yellow-legged frog
52		x		x		x			x	elk kill at Bartle	SIS	89	0	15	0-15	elk
53		x		x		x	x			need better assessment of underpasses, often blocked	SHA	5	R30L	60	30-60	deer, bears, possibly elk
54		x		x		x		x	x	high deer mortality; existing bridges	MOD	299	22	30	22-30	deer
55		x		x		x		x	x	personal knowledge of deer and bear carcass data	SHA	5	R55	65	55-65	bear, deer
56		x		x				x		ag attractants, have collar data, need fencing; overlaps RS20	LAS	395	R0	45	0-45	deer, pronghorn, elk
57		x		x			x				SIS	5	5	25	5-25	deer

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
58							x	x		importance shown in models, existing culverts with maintenance, need data on movement and existing culvert use	MOD	299	45	53	45-53	connectivity data
59		x				x	x		x	barrier, lots of calls from public, need data	SHA	5	0	R10	0-10	deer, coyotes, small mammals
60		x		x		x	x			public phone calls, need fencing	TEH	5	R25	35	25-35	deer
61		x								pronghorn migration corridor	MOD	299	40.6	43	40.6-43	pronghorn
62		x		x		x		x	x	deer migration corridor, deer-vehicle collisions	TEH	36	95	100	95-100	deer
63		x		x		x		x	x	deer migration corridor, deer/vehicle collisions	TEH	32	5	10	5-10	deer
64		x		x		x	x	x	x	high road mortality for resident and migratory deer, need collar data	SIS	5	R41	R50L	41-50	deer
65		x					x			data needed on mule deer migration and pronghorn	PLU	284	0	3	0-3	deer, pronghorn
66	x	x		x		x		x		need bridge for amount of migrating deer and antelope. Raymond Alverez sent video and we have a sign but a bridge would be better for safety of human and antelope. Hwy 299, 1 mile out heading to Conby from Alturas	MOD	299	25	35	25-35	deer and antelope
67		x		x		x		x	x	big game and predators, possible train underpass at Perez. See additional map, estimated to be about 30% of the roadkill.	MOD	139	43-15	15	43	mule deer, antelope, raptors, predators
68		x		x		x		x	x	has deer carcass count for past 2 years. Cty R97 west from 139	MOD	97				mule deer
69		x				x		x		existing overpass for train at Perez	MOD	139	30	31		mule deer
70	x	x		x	x			x		wide ranging species movement and increasing safety; existing culvert and bridge over Goodrich Creek (west of SPI's 101 Ranch); Gray Wolf Lassen Pack, CDFW wolf gps collar data.	LAS	36	3	7	3-7	wolf, large ungulates
71			x			x	x	x		linking coast range to Sacramento River. I-5 blocks potential movement. There are some existing bridges over major creeks. Are they too low? Can they be improved? Some data in Huber et al. connectivity models	TEH	5	0	20		mulitple
72						x	x			Neville Rd may or may not constitute a barrier for north/south movement. Needs more research.	TEH, Glenn	Newville Rd.				grassland species

Appendix 4. Areas of Interest

ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
73		x	x			x				has seen lots of deer west of the Lassen Nat Park entrance on the west, down through the canyon. Seems to be an area where deer get caught along hwy and the cliffs.	SHA	44	40	45	40-45	deer
74		x		x		x	x			movement toward Sacramento River and back, some bear crossing signs but concrete barrier is a movement barrier. Need maintenace data or cameras	SHA	5	35	45	35-45	bear
75						x	x		x	lots of traffic, not sure if roadrunner would use surrounding culverts. Although they fly, they tend to run across, and small carcasses are easily lost	THE	5	12	20	12-20	roadrunner
76	x					x	x			seen crossing this stretch of hwy 44 at night. Most culverts are small and not used by animals, may need cameras	SHA	44	20	35	20-35	ringtail cats
77		x				x				exclusionary fences have been erected without corresponding wildlife crossing	LAS	395	0	25	0-25	deer and pronghorn
78		x		x		x			x	need to reduce vehicle interactions. Possible improvement would be flashing trailer signage on both ends showing "deer crossing slow down" and deer death toll numbers within corridor per year.	LAS	395	47	60	47-60	deer
79		x	x	x		x			x	Need to reduce vehicle interactions by constructing overpasses. Three large culverts are present, but "improving" water culverts for deer crossing is highly ineffective. Building an overpass is needed to reduce threat. NV DOT found that deer prefer overpass	LAS	395	50	55		
80	x	x	x	x		x	x	x		need signage, removal of hazard fences and possible underpass. CA Pronghorn foundation has data. Need collar tracking and studies for over or underpass. Traditional ecological knowledge of migration corridors and hunting grounds.	MOD	395-299	25	50		pronghorn, mule deer, elk
81		x									SHA					elk, bear
82		x									SHA	299	35	50		bear

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ID	Listed Species	Big Game	choke Pt	Safety	Existing safe passage	Move-ment Barrier	Research Need	Data	Roadkill	Notes	County	Route	Begin Post Mile	End Post Mile	Post Mile Range	Species
83	x		x				x	x		Hwy 36 east of I-5. Connectivity model, just north of fisher translocation. Need field monitoring to determine if individuals are dispersing north from reintroduced population. If connectivity is impaired, then could possibly limit recovery potential.	TEH	36	75	87	75-87	pacific fisher
84	x						x	x		A few existing culverts and bridges, but they are widely dispersed. Need field verification to determine use post-fire.	SHA	5	30	40		pacific fisher
85		x		x		x		x	x	see SR139 TCR (Transportation Concept Report) for description of deer-vehicle issues. Interested parties include Hwy 39 stewardship team, CA Deer Association, Modoc County, CDFW, local residents.	MOD	139	30			deer
86		x						x		US395 near NV border - reports of antelope. See US395 TCR		395				pronghorn
87		x						x		antelope presence, US 395 SE Goose Lake area		395				pronghorn
88		x								heading westbound from Chester toward Red Bluff - bear crossing road. In foothills rather than mountains		36				bear
89		x		x		x		x	x	Area near Grass Lake is a hot spot per coworkers in Env Division		97				
90				x		x	x		x	Tule Lake/Klamath Lake area, many waterfowl, sometimes killed by vehicles		161				waterfowl
91		x		x		x			x	Map 9, no datasheet, recent deer strike fatality						deer
92		x		x		x			x	"deer kill" on map 1, no data sheet						deer
93		x		x						Bear and deer, Map 1, no datasheet						bear, deer
94						x				Map 14, waterfowl area, no datasheet SR161		161				waterfowl
95	x	x	x	x	x		x			stop building roads wider. Need data, partnership with the Ajumawi/Atsuge Nation AKA Pit River Tribe	SHA, SIS, LAS, MOD	89, 299, 395, 44				