

PLANNING FOR SPECIES ADAPTATION AND CLIMATE RESILIENCE IN  
CALIFORNIA'S PRIMARY SOURCE HEADWATERS

FINAL REPORT FOR WCB GRANT WC-1835JG

THE PACIFIC FOREST TRUST

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Introduction and Summary: the purpose and context of this project

The 7-million-acre Sacramento River Headwaters Region, and its surrounding 3-million-acre buffer zone, has an extraordinarily important role for biodiversity as well as water supply in California. Delineated by three mountain ranges (the northern Sierra, southern Cascade and Klamath-Trinity) it has a widely varied topography, range of soil types and geology that support an extraordinarily wide variety of plants and habitats. The region contains over 80% of California's natural habitat types and hosts over 60% of its vertebrate species, 62 of which are imperiled. One of 33 globally recognised biodiversity "hot spots", it is also the source of the vast majority of California's utilized water, supplying the largest reservoirs which are the backbone of the state water system.

Many species and habitats are already under assault in California due to habitat loss, cover type and land use conversion and habitat degradation. Climate change is clearly exacerbating this trend. This region has more intact habitats than most in California, and presents more opportunity to stem habitat loss and reverse degradation, due to its relatively lower human settlement footprint and population. Meta-analyses show that this region has remained cooler and wetter than the rest of the state over the past 100-125 years, providing a reliable context for consistent habitat function. With such a major role in supporting California's biodiversity, the focus of this project was to evaluate how persistent this habitat service might be in the future 100 years as climate change intensifies.

We utilized the two more plausible Representative Concentration Pathway (RCP) climate change scenarios, the RCP 4.5 and the RCP 8.5, and modelled these under both of the two leading global climate change models: the MIROC—which projects a warmer and drier future—and the CRNM—which projects a wetter and warmer future—downscaled to California. Our project identified where the models agree that conditions supporting refugia—and connecting corridors/safe passage to them—will be 2040, 2070 and 2100. Specifically, we identified where there was a consensus outcome of both models identifying where temperature and precipitation regimes would continue to support the natural habitats—and the amazing array of biodiversity they contain—currently existing in the region. These are critical areas for conservation and restoration, as they will likely continue to support current habitats even under climate change.

Additionally, we identified where exposure to precipitation and temperature changes was relatively more moderate, and thus these areas have a strong potential for being able to be resilient under climate change, especially if these areas had been managed to have more natural resilience. These also have high value for conservation and restoration, as they may serve as buffers and risk mitigation allowing more opportunity for species to survive.

Finally, we identified those areas where the projected changes in precipitation and temperature will cause environmental stress so great as to likely no longer support the existing habitats, and thus the biodiversity they support. These areas may have high value for conservation for a variety of reasons, but the habitats they support currently are not projected to persist.

The overall trajectory of climate change impacts under our present pattern is indeed grim; for example, models project the virtual disappearance of some key habitat types such as wet meadows in the region by 2100. Yet the analysis also illustrated ways in which our actions in the nearer term can change that trajectory, as well as buffer the likely impacts of climate change. Importantly, we identified that the region will likely support almost 5 million acres of consensus refugia, with an additional 1.5 million acres of probable or possible refugia under moderate stress, by 2040. A clear focus on conserving and restoring the private ownerships in these areas, as well as a focus on restoration in the public lands therein, will greatly enhance the likelihood of habitat persistence and species survival. Tables containing all the data on likely persistence over the three time periods analysed (2040, 2070 and 2100) as compared to the present, by habitat type and ownership, are included Appendices.

Amongst the takeaways of particular note in the project are the following:

- 1) Under the RCP 8.5 scenario, we stand to lose twice as much of our current habitat area as under the RCP 4.5 scenario. We are currently on or exceeding the 8.5 scenario. A key way to reduce emissions is through land conservation and restoration, especially in forest types. Dominated as it is by forest habitat, and with much of the privately owned forest quite young relative to its natural age range and thus under its natural carbon sequestration capacity, the region is a potentially very strategic one for biodiversity conservation, increased forest carbon sequestration, and reducing the probability of continuing on the 8.5 scenario.
- 2) There is significant checkerboarded ownership in the region between federal and private lands. Conserving and restoring private lands will be key in ensuring these habitats persist functionally across the landscape overall. It is also essential to ensuring that there are viable connections to and from refugia on public lands, especially those in lower elevations and with high productivity and water resources, where private ownership is more prevalent. Species are already moving upslope from the Central Valley to this region.
- 3) While this region overall shows a higher likelihood of persistent habitats on the landscape as contrasted with the state writ large, two watersheds within it really stand out as critical refugia: the Upper Trinity and McCloud watersheds. Higher elevation areas within the Pit, Feather and Upper Sacramento watersheds are also significant refugia. Additionally there are key north-south corridor regions and areas that are identified as particularly valuable as connectors to those refugia. These include from the northern extent of the Central Valley into the Upper Trinity, Sacramento and McCloud watersheds, and east west from the Warner Mountains across to the Siskiyou Crest, Mt Shasta and the Upper Trinity and McCloud watersheds, as well as upslope west east movement from the Central Valley into the Sierra.
- 4) The project identifies the critical role of “microrefugia”, smaller scale areas that tend to be cooler because of their topographic positions. These microrefugia have persistent habitat conditions over time within larger landscapes that will likely no longer support those habitats, essentially providing buffering capacity under climate change. Conserving these as

spatial stepping stones to larger refugia within and across less hospitable landscapes will be a valuable conservation strategy. The project allows identification of temporal “refugia” that may shrink or potentially disappear by end century, but will be key in the nearer term decades.

- 5) Actions in the region for enduring species adaptation and climate resilience meet multiple state goals. Conserving and restoring those areas which rank as refugia and lower/moderate exposure regions today will meet multiple state goals in addition to those identified in the state Wildlife Action Plan and Adaptation Plan. Doing so would have an enduring impact for Governor’s Executive Order N-82-20 , the “30x30”. As this region includes much of the state’s most productive conifer forest and forest carbon sink, this would also increase the state’s chances of meeting its goals of being carbon neutral by 2045. The same actions that promote and retain resilient habitat will have a positive impact for water, extending release times for cold water in the summer months, increasing retention time during major precipitation events and increasing overall inflow as well as natural storage by hundreds of thousands of acre feet of water. These also reduce threats of catastrophic wildfire and increase net resilient carbon sequestration, amplifying the social and economic benefits of these actions further.

The project has a wide variety of applications for land managers in addition to those managing for species survival. Potential end-users include land owners and managers, land use planners, county, regional, state and federal natural resource decision-makers. A series of “use cases” are included in the report illustrating some of these applications. As the first climate change analysis that includes the impact of the intensity of climate change that a habitat is exposed to across the landscape, and with the analysis scaled down to units of 25 acres, the results are useful both on a specific property and to assess that property’s habitat & biodiversity role in the larger landscape over time as well as space. This is directly applicable in developing conservation, restoration and management plans over the next several decades.

In addition to the use cases described in the report developed at the region-wide scale, PFT is currently applying this analysis and decision support tool within the region on a specific 11,000-acre property to assess key management and conservation actions, integrating property specific data. Factors we are assessing include:

- the long-term refugia role the property can play and for which species
- the likely long-term value of wet meadow restoration to historic natural extent;
- the role the property may play as a “receiving site” for specific species moving with climate change, and
- the potential to reestablish enduring functional connectivity over time within forest habitats of the property that currently show as not serving that function but provide bridges to refugia outside as well as within the property.

This analysis will aid significantly in planning for the management and conservation actions on that property, and as a template for further use.

While the project has been completed with data sets that cover the entire area, it can be customized with more specific site data, as it will be for the application noted above, which extends the applicability, and increases the fine grain of the tool. Additionally, the analysis could be extended to other regions of the state, enabling a statewide picture and allowing for broader planning for species migration.

## Regional Assessments

We combined maps to identify priority areas for a range of land management objectives. The three top-level maps are: Climate refugia and areas of expected high climate stress; Landscape and climate connectivity; and potential terrestrial species richness. We also incorporated regional metrics for climate microrefugia, vegetation structure, land use intensity, and species distribution models for analyses targeting different management objectives. In turn these maps were built upon a set of input maps detailed in the methods, but including California state’s vegetation map (CAL FIRE 2015), a 10 m digital elevation map, land tenure, climate data, fire metrics and hydroclimatic variables from the Basin Characterization Model (BCM; Flint & Flint 2012; Flint et al. 2013; Thorne et al. 2015).

This results section features 2 categories of results – overall selection of areas in response to the 3 primary maps, and a series of use cases, demonstrating how different combinations of the assembled data can be used to address different land management questions.

The GIS layers compiled for this effort will be available in the form of 2 geodatabases, called “Hexagon Data” and “Input Data”, and associated documentation that will be delivered to the Wildlife Conservation Board for further use. The structure of the GIS is intended to permit others to use the outputs to assess the regional context for both site-specific and watershed-scale climate change adaptation and mitigation planning and projects.

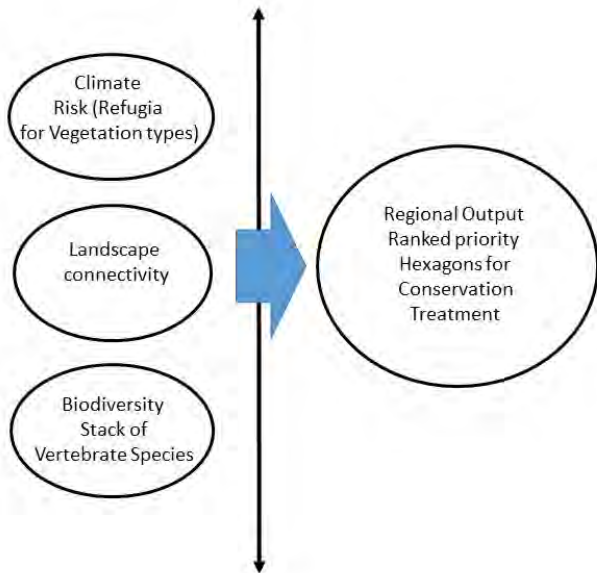
Because tables associated with the results are voluminous, we cite tables in the text as digital appendices. The appendices are a series of excel tables, most with multiple tabs. Each Excel Table has a Read Me tab, and each tab has the equivalent of a short caption listed at the top of the its page. There are 4 Digital Table Appendices:

- Climate Refugia Appendix Table 1
- WHR and Climate Exposure Appendix Table 2
- Connectivity and Climate Exposure, Appendix Table 3
- Potential Species Richness and Climate Exposure, Appendix Table 4

Finally, methods are provided in two places. The primary descriptions of analyses are in a methods section in this main body of the report, after the results. Those are further supported by a Methods appendix. These two sections follow the same data sequence, and can be related to the GIS files.

## 1) Regional Assessment Results

The overall rankings combine maps of end-century climate refugia based on vegetation types with high priority areas for landscape connectivity and high potential species richness to derive relative rankings for each of the >408,945 hexagons.



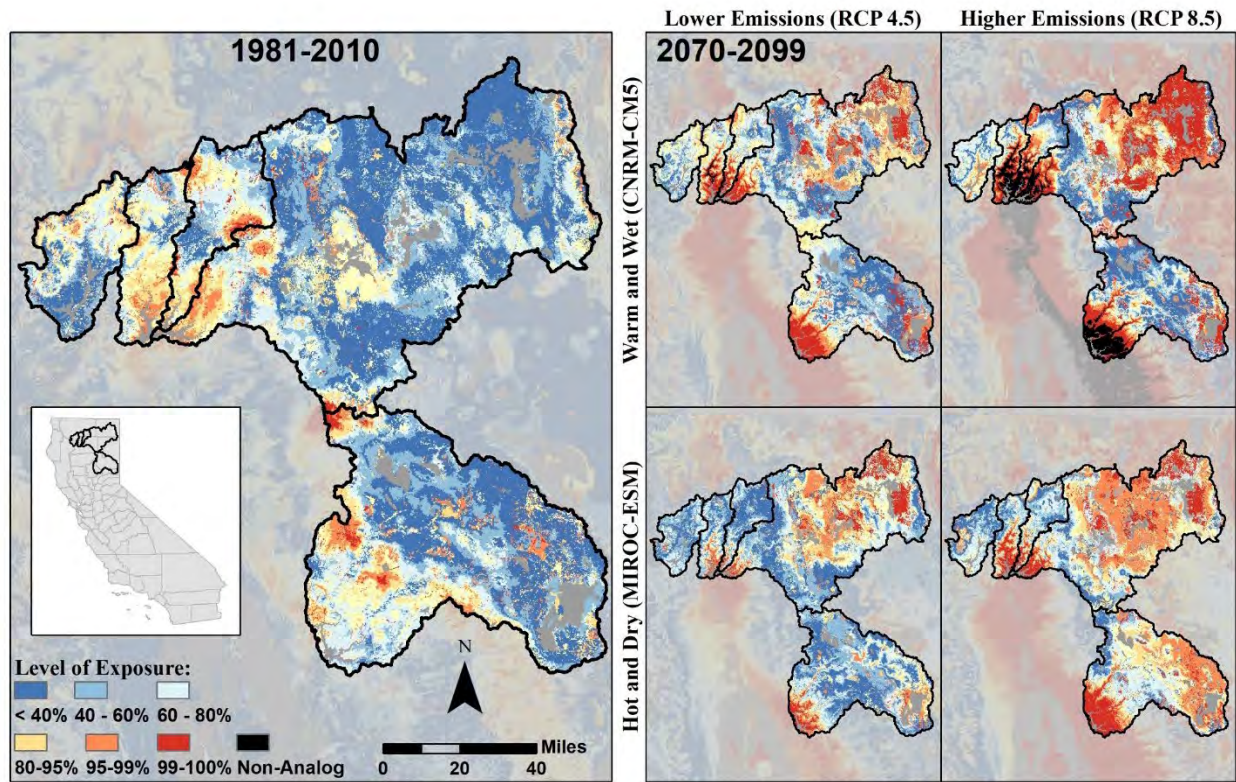
We identified climate refugia and areas of high climate stress across the region. Both biodiversity and connectivity were mapped across the entire region. These two were each ranked from 1 – 5, with higher numbers indicating either greater species richness or more critical linkages.

These three metrics can be combined in various ways to highlight different parts of the landscape.

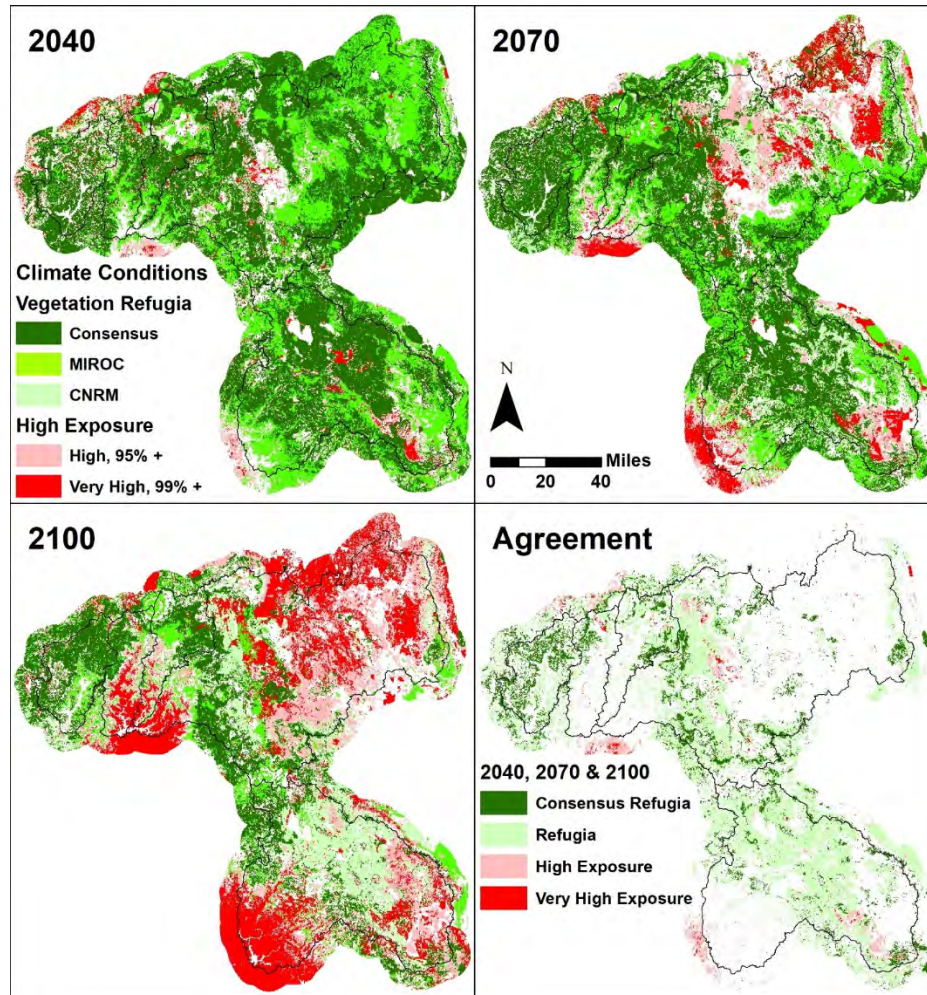
### Vegetation Refugia / Climate Exposure

We used a place-based climate exposure method that identifies the relative level of climatic stress across all locations of each vegetation type found in the state (Thorne et al. 2016, 2017). The level of exposure in current time (we used a baseline of 1980-2010), is then used as a classification to identify future levels of stress for the vegetation, without predicating where a vegetation type might move to. The image below shows how climatic stress is expected to change for the SRHR by the end of century under a wetter and a drier future climate projection. The column on the right shows future exposure under current rates of emissions (RCP8.5), while the left column shows future exposure if lower, near-Paris accord rates of emissions are achieved (RCP4.5). Blue areas are where the current vegetation remains in climatic conditions that it currently occupies up to 80% of the time, and are considered not-stressful. Orange and red areas are climates that the vegetation currently occupies only 5% of the time, while black areas represent future climates that do not currently occur in California (Non-analog).





Consensus refugia are areas that are expected to remain climatically suitable for existing vegetation under both the wetter and the drier future (Thorne et al. 2020), and are the areas where we have the highest confidence that existing vegetation could be managed for retention. Consensus refugia make up 49% of the SRHR by 2040, 37% by 2070, and 19% by 2100. The consensus refugia areas that overlap in the 3 time periods occupy 706,000 acres, 7.5% of the region (Climate Refugia Appendix Table 1). The shifting location of consensus refugia suggests that a stepping stone approach for movement of populations of some species across the landscape may be a good strategy. However, some areas are consensus refugia in all three time periods, as shown in the ‘Agreement’ panel in the image below. The Agreement consensus refugia comprise 759,307 acres (7.6% of the SRHR) under RCP8.5, and 2,527,218 acres (24.4%) under RCP4.5. The difference is one of the largest indications of the urgency of reducing global emissions that emerged from this work.

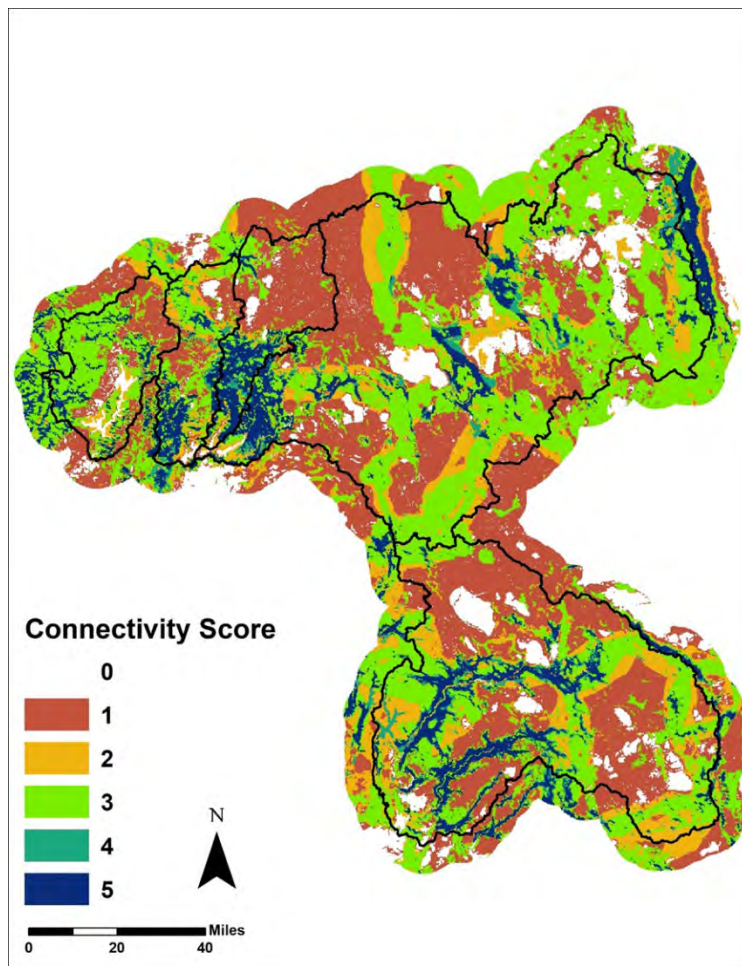


The SRHR contains 49 CWHR landcover types, including 35 natural terrestrial vegetation types that are the focus of this paragraph (WHR and Climate Exposure Appendix Table 2). Among these, the five retaining the greatest extent in consensus refugia are: Sierran Mixed Conifer, Montane Chaparral, Klamath Mixed Conifer, Ponderosa Pine, and Douglas fir (descending order). Among the types with the greatest areas in high end-century exposure are: Eastside Pine, Low Sage, Sierran Mixed Conifer, Montane

Hardwood, and Sagebrush. In some cases, types with relatively limited extent, either within the region or across the state, but that have significant habitat value appear highly exposed, including those with >90% high-to-very-high end century exposure: Alpine Dwarf Scrub, Chamise-Redshank Chaparral, Freshwater Emergent Wetland, Bitterbrush, Valley Oak Woodland, Blue Oak woodland, & Low Sage. Two types that we considered to be misclassified in the region, with very limited extents, had 100% high exposure by end century, Coastal Oak Woodland, and Coastal Scrub. Some types have relatively higher proportion within end-century consensus refugia, including Montane Riparian (80%), Montane Chaparral (64%) and Klamath Mixed Conifer (56%). Wet Meadows, an important landscape feature of limited extent show 31% in high exposure and 1% in consensus refugia by end century. The 59% in moderate levels of exposure suggest that there may be opportunities to increase the resilience of this type. A similar finding is true for Red Fir, which has 17% in high exposure and 2% in consensus refugia, meaning about 81% of its 323,261 acres may be suitable for some treatments to increase resilience.

### Connectivity & Climate Risk

Landscape connectivity is essential for species movement, and that need is amplified as land use and climate change further disrupts the natural patterns of vegetation (Keeley et al. 2021). Natural resource managers and transportation planners need standardized measures of connectivity for their planning purposes. We reviewed connectivity models for the region, and selected two models that cover the entire region. A number of species-specific models, such as for fisher and martin, were not included because they did not cover the entire region. Those are candidates for use in conjunction with what is presented here. We used the California Essential Habitat connectivity (CEHC) model that estimates connectivity in for current time, and an Omniscape-based model produced by The Nature Conservancy, that links analog climates through time. We combined these models (Methods) and ranked the landscape from 0- 5 as a



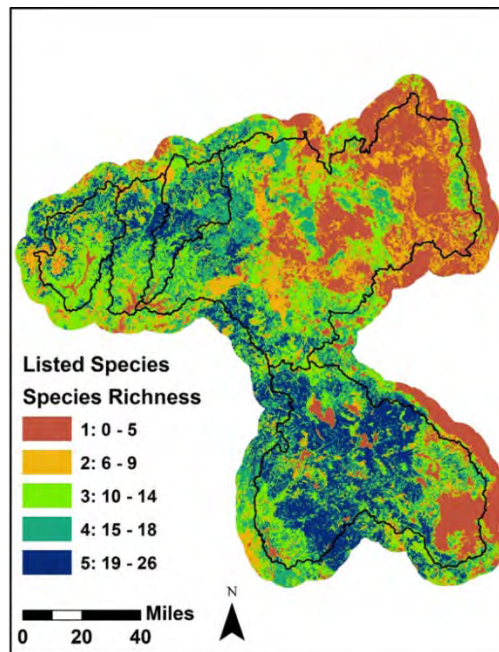
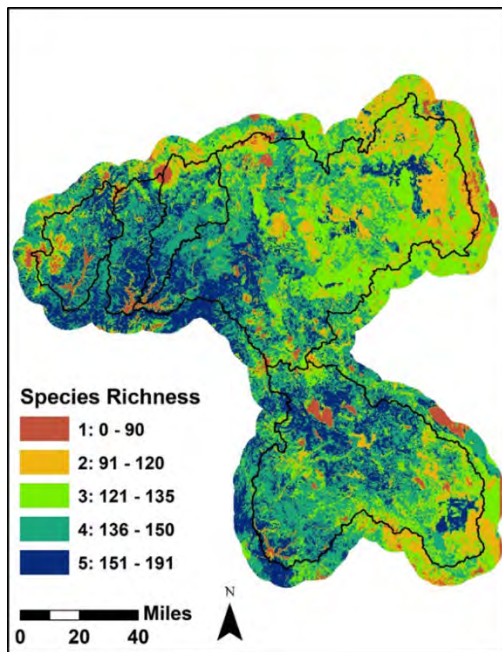
rough measure of connectivity importance with the majority value in hexagon assigned to that hexagon. About 8% of the region has the highest connectivity ranking. Much of these lands also prove to terminate in end-century climate refugia.

	Acres	%
<b>Connectivity Ranking</b>		
5	826,067	8.31
4	322,793	3.25
3	3,302,900	33.21
2	1,270,580	12.78
1	3,352,438	33.71
0	871,030	8.76
<b>Total:</b>	<b>9,945,808</b>	

In 2040, 53% of the highest ranking connectivity is in consensus refugia and 5% is consensus highly exposed. However, by end-century, 15% of the highest priority connectivity ranking is in consensus refugia, 6% is in consensus moderate exposure, and 24% is in consensus high climate

exposure (Connectivity and Climate Exposure, Appendix Table 3). The decline in high-ranked connectivity areas in consensus refugia points to the need to maintain sufficient traversable space to permit access to refugia, which in some cases will call for a stepping stone approach (Albert et al. 2017).

### Biodiversity / Species Richness



We aligned our models of biodiversity with California Department of Fish and Wildlife (CDFW) that uses the California Wildlife Habitat Relationship (CWHR) model to identify suitable

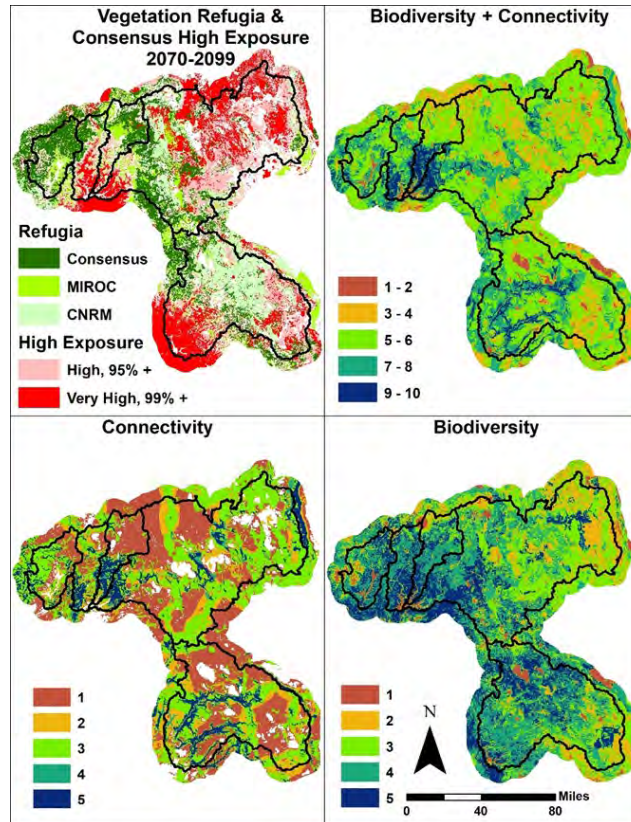
habitats for each terrestrial vertebrate in the state, and also has a range map for each species. Using the state's 30 m resolution map for CWHR types (FVeg: <https://frap.fire.ca.gov/mapping/gis-data/>), we mapped the suitable range for all vertebrates whose range covers any of the SRHR. We then added all species on a per grid cell basis and identified the mean potential species richness for each hexagon. We identified 417 species and 62 listed species to be potentially present in the region.

About 71% of the current extent of highest ranked potential species richness areas are in refugia zones in the baseline time period. Consensus refugia, only measurable in future conditions, contain 47% of current highest species richness areas by 2040, declining to 45% by 2070, and 25% by end-century. There is a corresponding increase in rank 5 species richness area under consensus climatic stress, from 4% by 2040, to 13% by 2070 and 21% by end-century (Potential Biodiversity and Climate Exposure, Appendix Table 4).

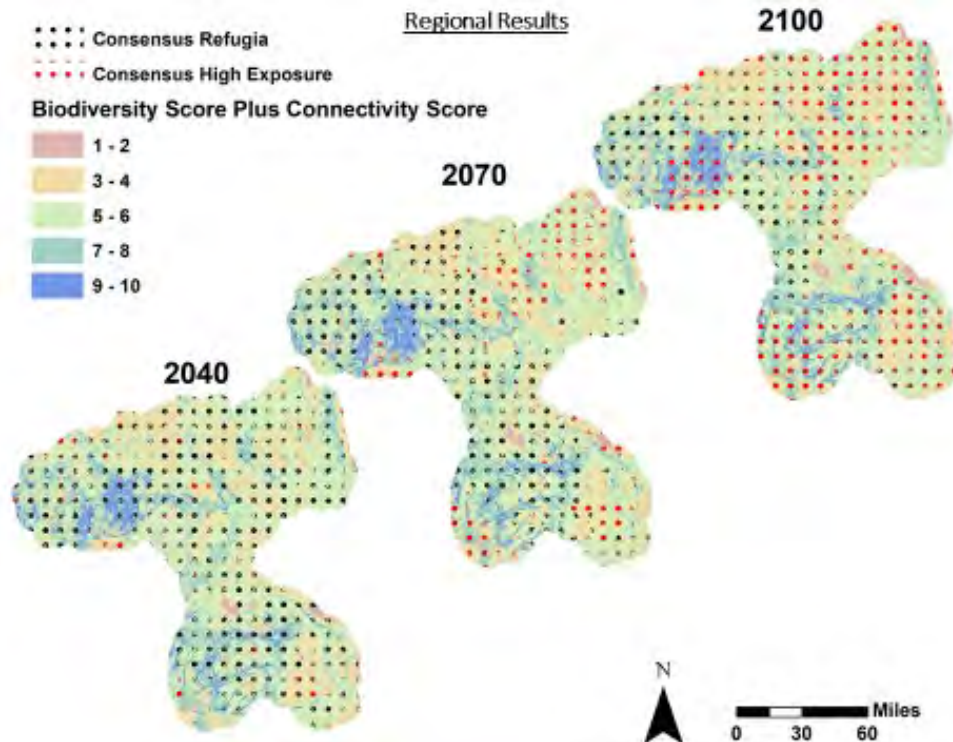
### Climate, Connectivity & Biodiversity

We combined the connectivity and species richness scores to rank the landscape into 5 levels. The summary layer provides a rough view of relative weighting among the hexagons of the region.

We then overlaid the consensus refugia and consensus high exposure areas as dots over the resulting map. The sequence of time shows the increasing spread of high climate exposure and is informative with regards to potential stressors on the underlying landscape. Areas in blue are highly ranked for both potential species richness and connectivity. Blue areas in the Trinity watershed show relative stability, with consensus refugia remaining in the area. However, the large blue area that lies around Lake Shasta has a different

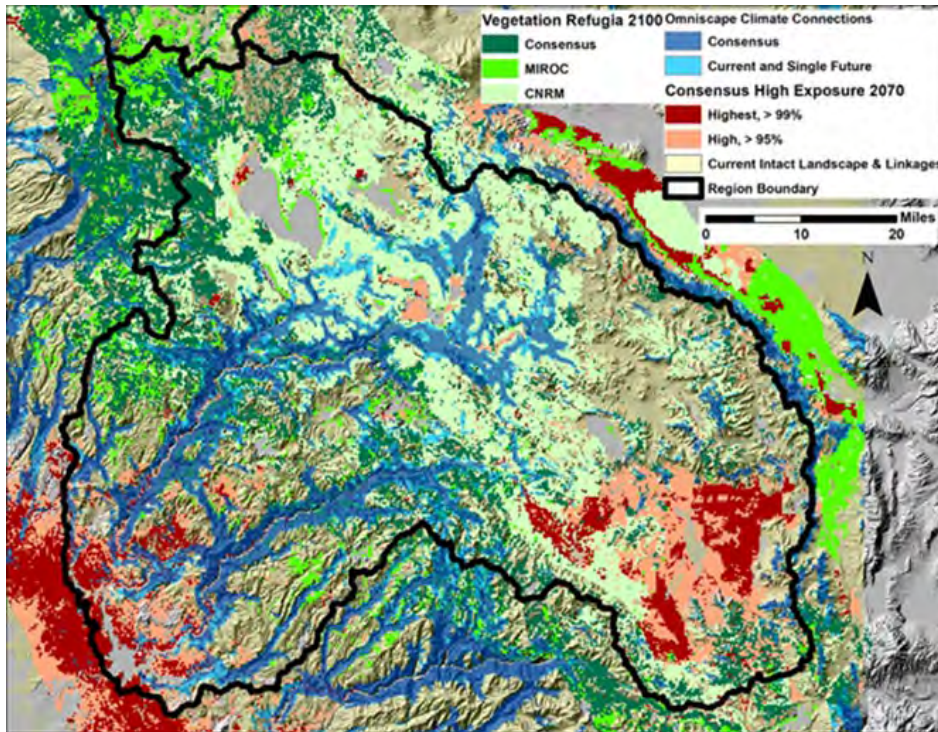


pattern. It starts with extensive refugia coverage, but by 2100, most of the highest-ranked area is under high climate exposure. Note however, that the largest consensus refugia zone in the SRHR lies in a horseshoe shape around the currently highly ranked zone. This suggests there



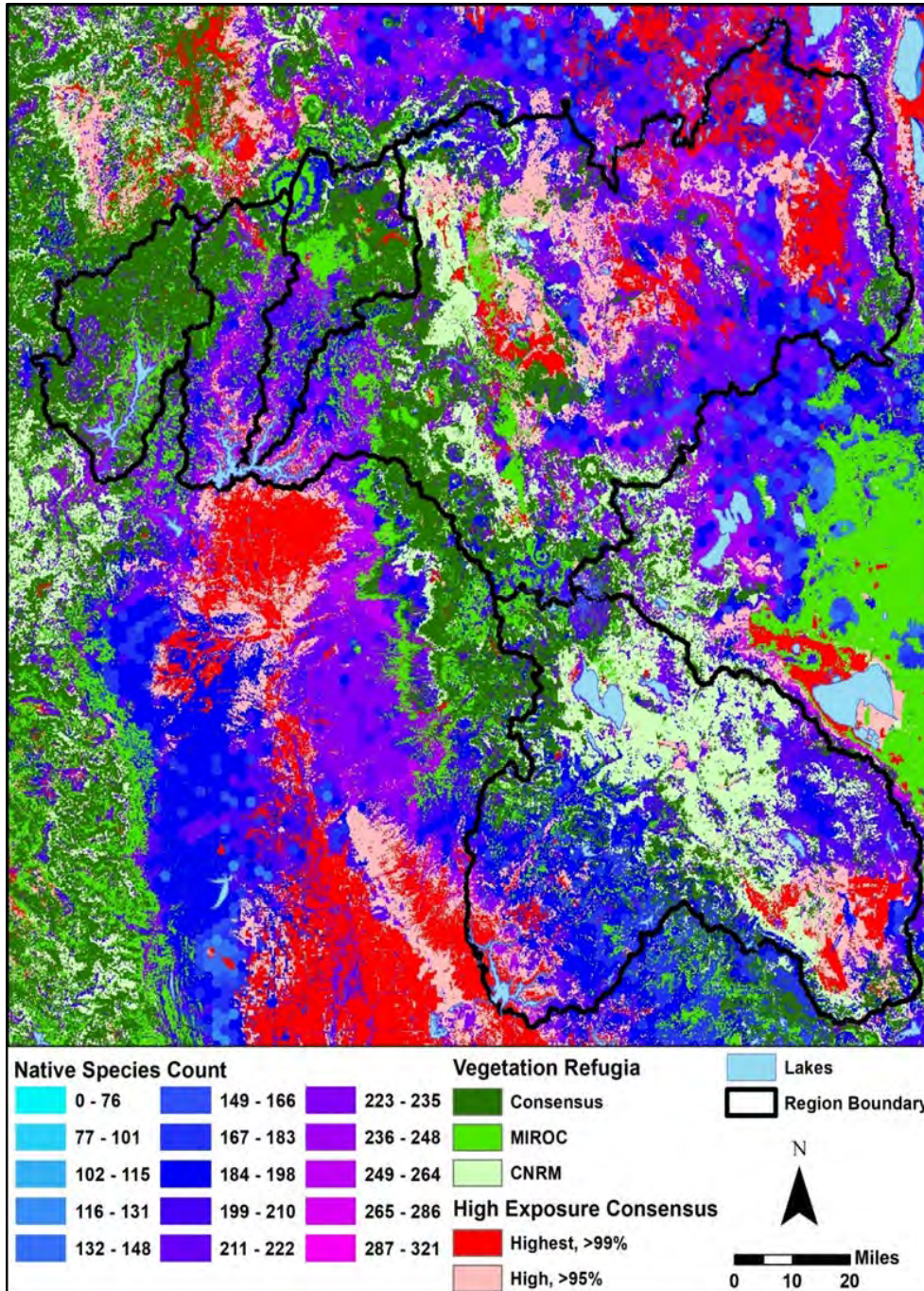
may be suitable areas that species could move towards, out of the high potential species richness and connectivity areas, over the next 80 years.

A somewhat similar pattern can be seen in the Feather River watershed to the east, where high-ranking connectivity follows the branches of the river. Much of the blues areas remain in consensus refugia condition to 2070, but by 2100, most of the refugia has disappeared. The northern central part of the watershed is not dotted in 2100, suggesting that although not a consensus refugia, the area may be somewhat amenable to current habitats and species.



The image to the left shows how climatic pressure areas in 2070 (reds) might provide some landscape level impetus to refugia areas in 2100 (in green).

Similarly, an impetus for movement can be seen in this detail around Lake Shasta. In this case the red-to-purple hexagons are CDFW's ACE III measures of species richness (\*\*), with purple areas showing high levels of species richness. Overlaid on their map are the 2100 measures for

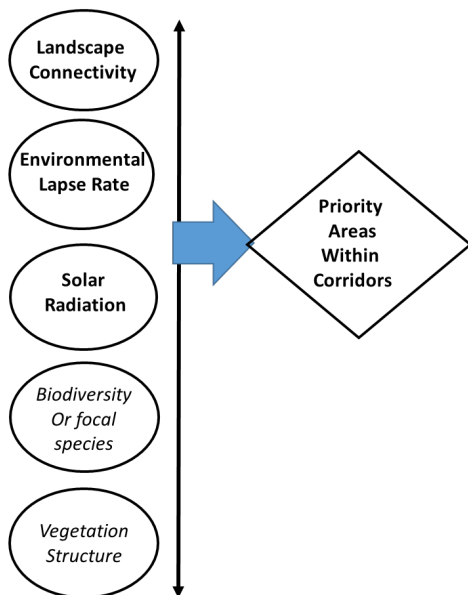


consensus high exposure areas (dark red) and consensus refugia areas (dark green). This again illustrates the potential for species to have to move from lower elevations around the edges of the central valley to higher ground. Indeed, this is already occurring with neotropical songbirds in our region, which are declining below 1515 m but increasing above this elevation, based on monitoring over the past 14 years (Furnas et al. 2020).

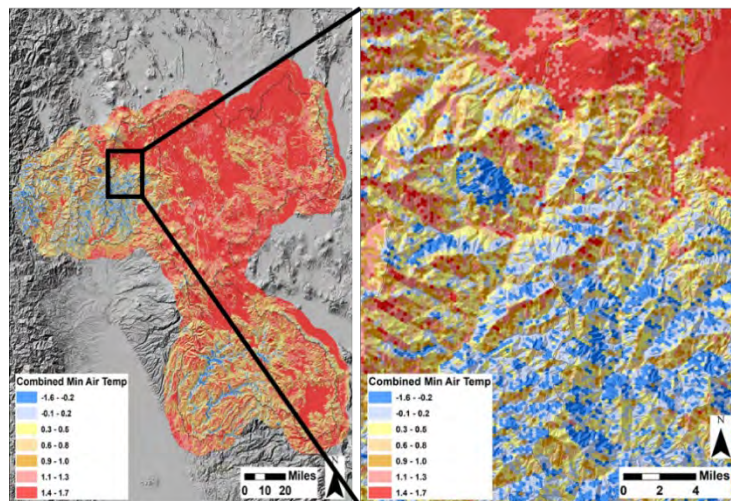
## Microrefugia

We defined microrefugia as areas that due to topographic position can retain cooler temperatures longer than the surrounding landscape. We calculated the thermal buffering capacity of all hexagons in the region by calculating the level their range of air temperatures associated with environmental lapse rate, and the level of open-air warming that solar radiation will cause, as derived from transfer functions developed for a study that included parts of our region (Curtis et al. 2014). The value of a hexagon-based portrayal of microrefugia is that it permits a local assessment of when the mean conditions that plants may be adapted to within a hexagon will disappear from that hexagon. Until that happens, local populations might be able to shift within the 25 acres and still find the same mean temperatures.

Both these values were calculated from a 10 m digital elevation model, which provided 900 values within each 25 acre hexagon. We took the mean elevation in each hexagon, and assigned the mean annual air temperature values calculated from our 1980-2010 baseline climate as the temperature at mean elevation of each hexagon. Elevations that were higher, had cooler temperatures, within the hex, and areas that were lower had warmer temperatures (Methods). The benefit of linking each hexagon to current temperatures is that it allows future warming, and the buffering microrefugia provide against such warming to be explicit.

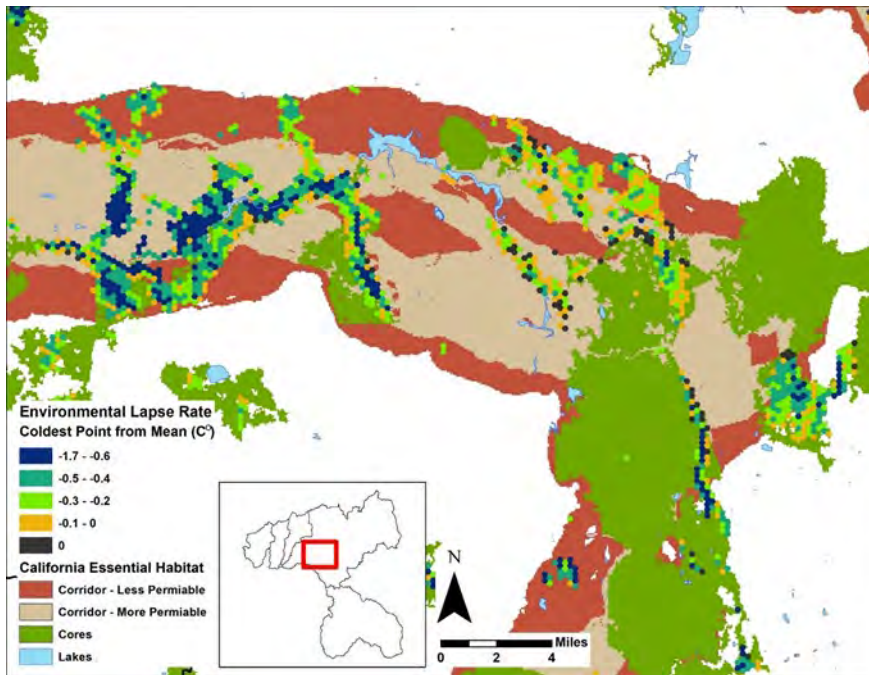


We found that across the region, the maximum cooling capacity within a hexagon was  $-1.62\text{ }^{\circ}\text{C}$ , found in the upper Sacramento Watershed, a rock outcrop. The first hexagon with vegetation is  $-1.47\text{ }^{\circ}\text{C}$  with cover type Subalpine Conifer, in the upper Trinity Watershed. Across the region, 112 hexagons have a buffer equal to or greater than  $1\text{ }^{\circ}\text{C}$ . Solar radiation never produces a negative value, and reduced the cooling capacity of many hexagons, particularly in the Modoc plateau region.





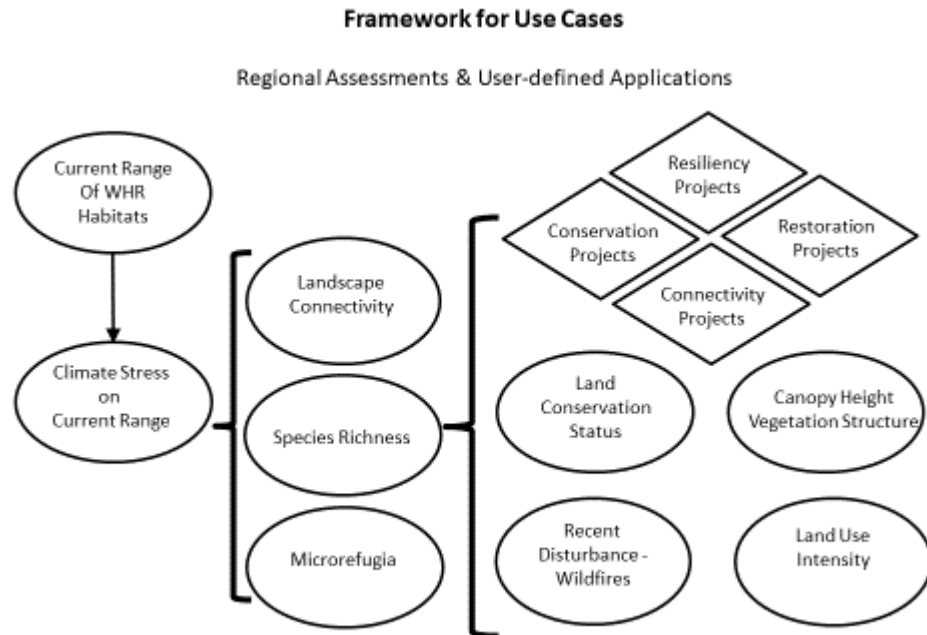
We can use the thermal buffering capacity of microrefugia to identify areas within landscape connectivity zones that will retain their mean baseline temperature the longest as the climate warms.



In the image on the left, a corridor in the Pit River watershed shows the hexagons for the two highest connectivity ranks (4 & 5). The hexagons are colored according to their buffering capacity. Note that our climate maps also capture cold air pooling dynamics, but they appear to seasonally and topographically dependent, so a single buffering value may not accurately portray what benefits they may provide, and we did not include a spatially explicit measure of their potential benefits under climate change.

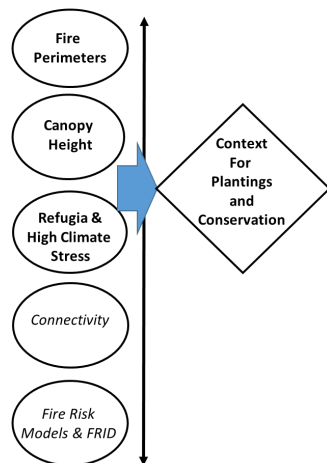
## 2) Use Cases

The GIS assembled for this project is intended to be flexible, so it can be incorporated into other aspects of landscape planning or management. The image to the right illustrates how the major categories of data can be considered as data elements, and can be combined with other spatial data (circles on the right)



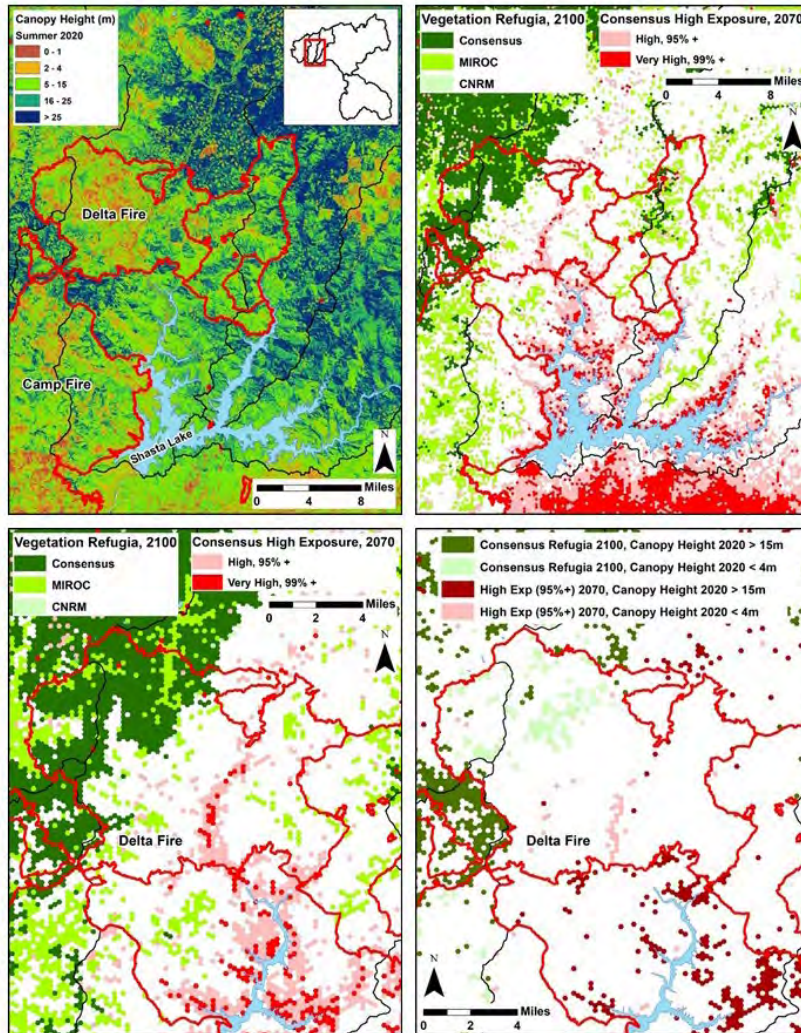
in various sequences to provide context for a range of objectives, examples of which are shown in the diamonds. While conservation planning may seek optimal solutions, in this study we recognized that different groups in the region may have differing objectives, and the flexibility to combine the results in different ways may provide a more accessible framework for general utility. Each of the examples below can be rendered as spatially explicit maps with associated area metrics. However, we show them in graphic form only, for brevity's sake.

### Vegetation Structure and Wildfire



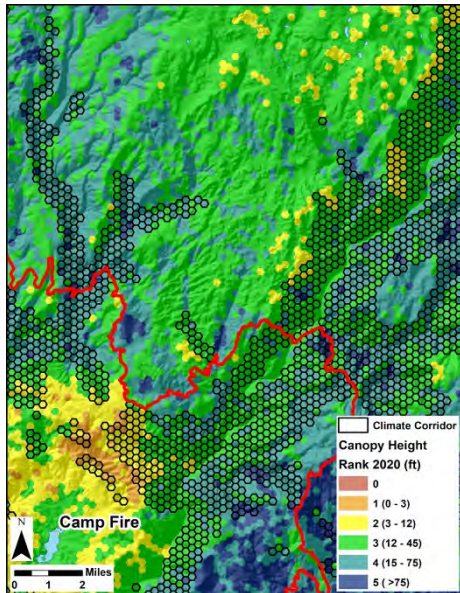
Wildfire ignitions and severity are amplified by climate change. In addition to overstocking of forest stands, this has led to communities and agencies trying to reduce risk through forest thinning, prescribed burns and improved land management, and to deploying post-fire recovery strategies that includes modified reforestation methods. Incorporating long-term perspectives of climate risk can help inform selection of strategies for these goals.

We combined wildfire perimeters with measures of canopy height and climate stress to identify potential areas with different post-wildfire optimal strategies.



The 2018 Delta fire provides an example combining the data to identify different strategies. The upper left map shows the perimeter of the fire with canopy height as measured from summer 2020, using data from the California Forest Observatory (2020). The upper right shows the hexagons that are classes as consensus refugia and high climate stress areas by 2070. By zooming in (lower left) we see the areas within the fire footprint with the same climate exposures. The lower right image shows the climate classes now colorized by seral conditions. Several hexagons appear in dark green within the fire perimeter. These are areas predicted as climate refugia, and that have canopies >15 m. These locations could serve as seed trees or sources of natural reseeding. Areas in pale green are expected to remain climatically suitable for what was there prior to the fire, but that

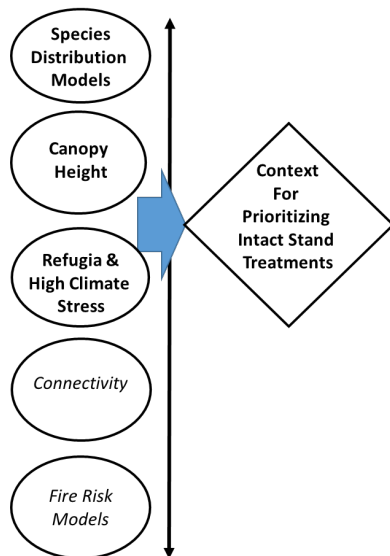
are in the process of early recovery. These are locations with higher potential for successful reforestation, by these metrics. Areas in bright red have canopies > 15 m but are predicted to have climate stress, while areas in pale red have early seral conditions and are expected to have high climate stress, indicating they may be poorer candidates for reforestation.



One more example using wildfire perimeters comes from the Camp fire of 2019. In this case the reforestation planning is underway. Here we display vegetation canopy height from 2020, the fire perimeter, and outlined as hollow hexagons, the areas with the highest regional rank for connectivity. Plantings that target forest recovery can use their site locations to additionally consider if a planting will enhance regional connectivity.

Other data that could be used to further define areas includes landscape connectivity and models of potential risk such as the Fire Return Interval Departure (FRID; Safford & Van de Water 2014), models of potential annual tree mortality and, maps of fire severity zones and fire threat, and the locations of areas that have been treated to reduce fuel loads.

### Forest Dynamics & Conservation



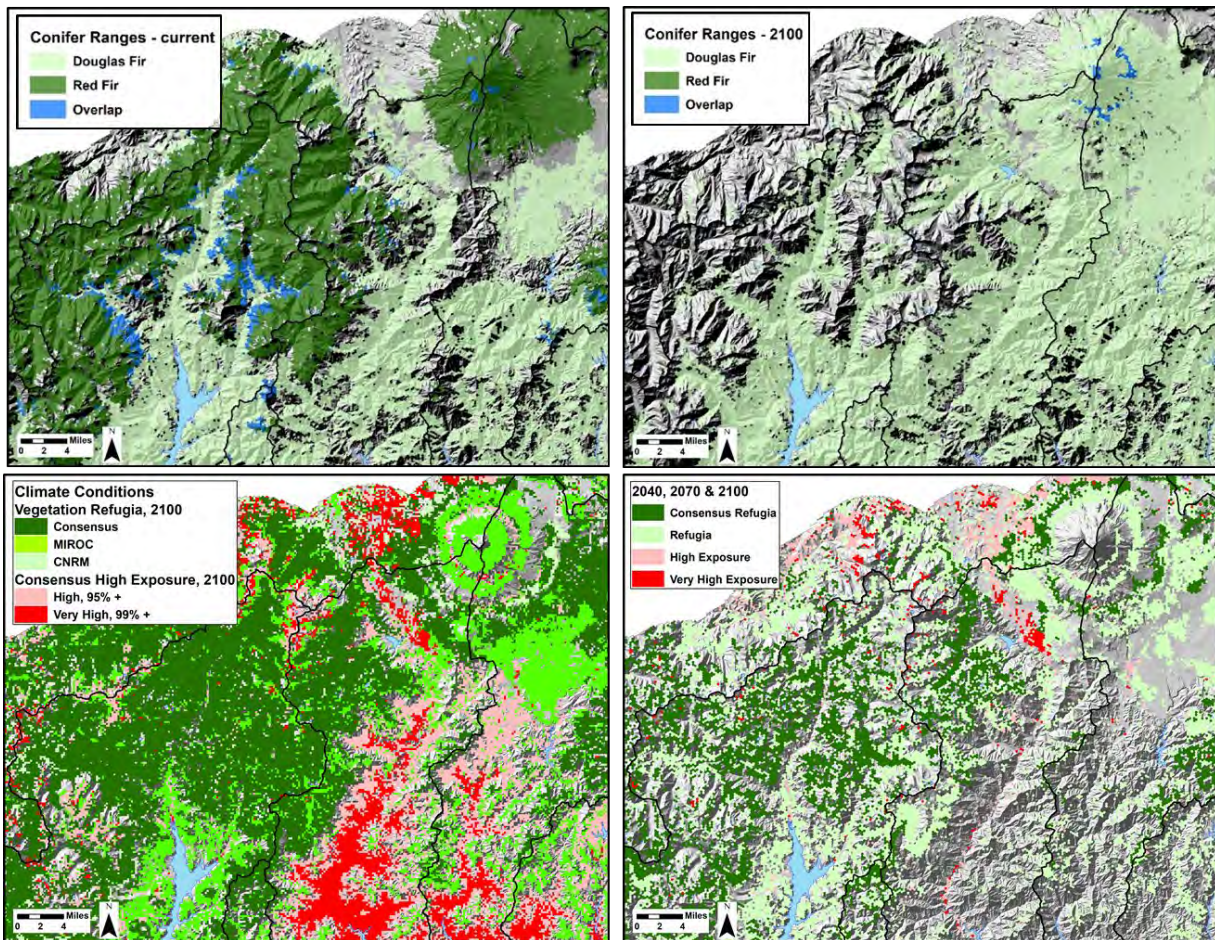
It is impractical to only plan the movement of species and habitats for logistical and other reasons. In addition, preserving existing vegetation, ecosystem functions, and habitats is a major conservation goal.

Forest management at the stand level can promote preservation, particularly when informed by climate change assessments. This use case focuses on two component tree species that make up important conifer forest types in the SRHR: Douglas fir (*Pseudotsuga menziesii*) and red fir (*Abies magnifica*).

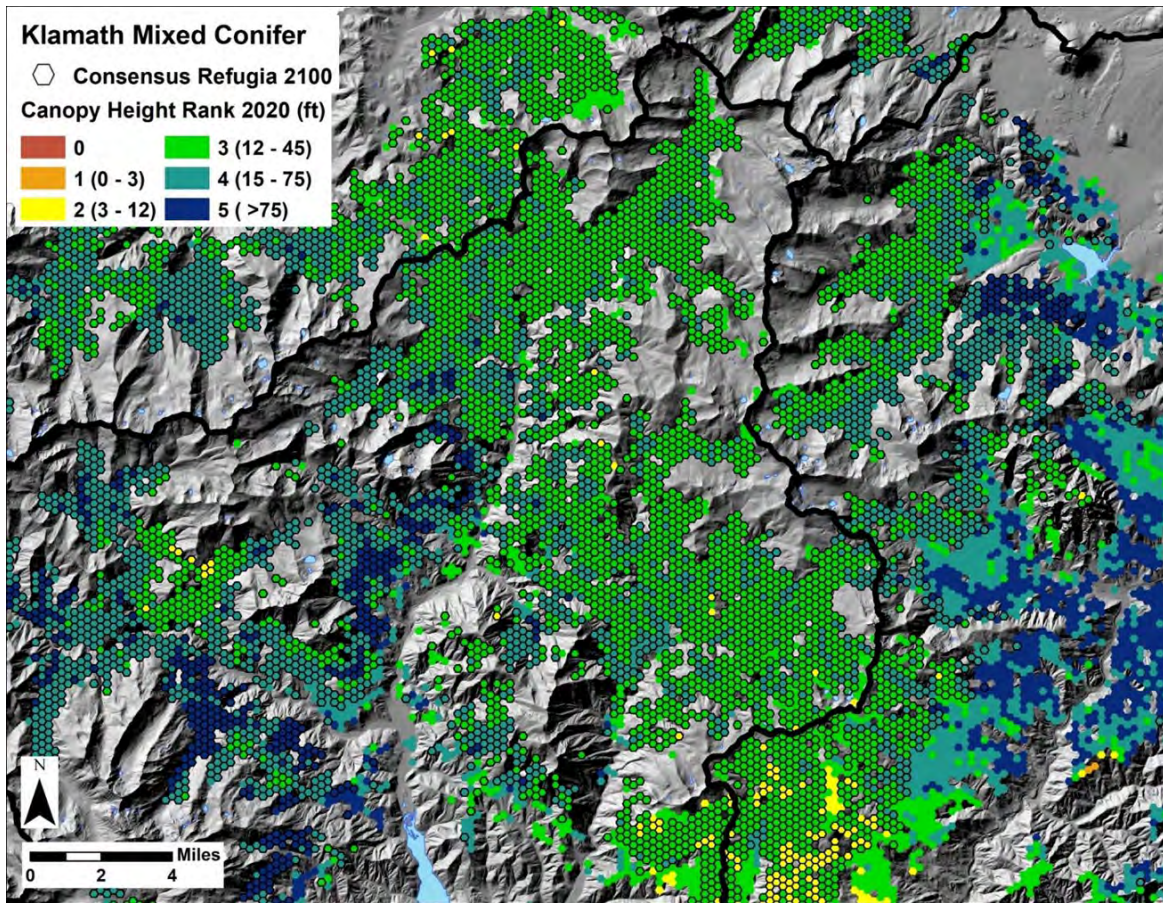
For this example, we used species distribution models, canopy height, and climate exposure to provide spatial context to identify priority areas for forest thinning treatments. The regional connectivity and fire risk models could also be brought into use to further stratify area selections.

The time series of the potential range for Douglas and red fir shows the potential for Douglas fir to move upslope, and the increasing retreat of red fir's current distribution under the hotter and drier GCM tested (upper row, image below).

However, the place-based climate exposure projections (lower row, image below) suggest a large area of consensus refugia in the region. These areas are potential areas where current forests could persist, if protected from stand-replacing disturbances. We can also consider which areas are refugia in each of the three future time periods (lower right panel image).



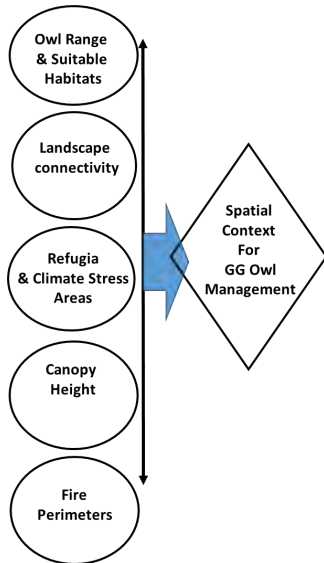
We used canopy height to examine the mixed conifer forest in this region, which includes Douglas fir, considering whether it occurs in consensus refugia areas or not. This map shows the extent of the type, colored according to canopy height in 2019. Refugia areas are outlined by the 25 acre hexagon boundaries, while non-outlined areas are not refugia. Areas in the tallest height class are possibly areas with less accumulated fuels, if they have late seral structure. Areas in ranks 3 & 4, from 12- 75 feet tall, are candidate areas for management to promote late seral condition. Areas in yellow are early seral stands that may be recovering from recent fires. These may be areas in which successful establishment of conifer tree species could offer long-term forest stands.



### Focal Species

Planning for conservation or recovery of individual species has long been practice for biologists and is an integral part of the regulatory process for both federal and state agencies. This use case demonstrates how a focal species approach can use the data matrix. We selected the great grey owl (*Strix nebulosi*). This species uses late seral condition coniferous forests and wet meadows. It appears to have short-term resilience to wildfires, as it continued to occupy most meadow sites after the Rim Fire (Siegel et al. 2019). There are between 100-200 pairs in the state.

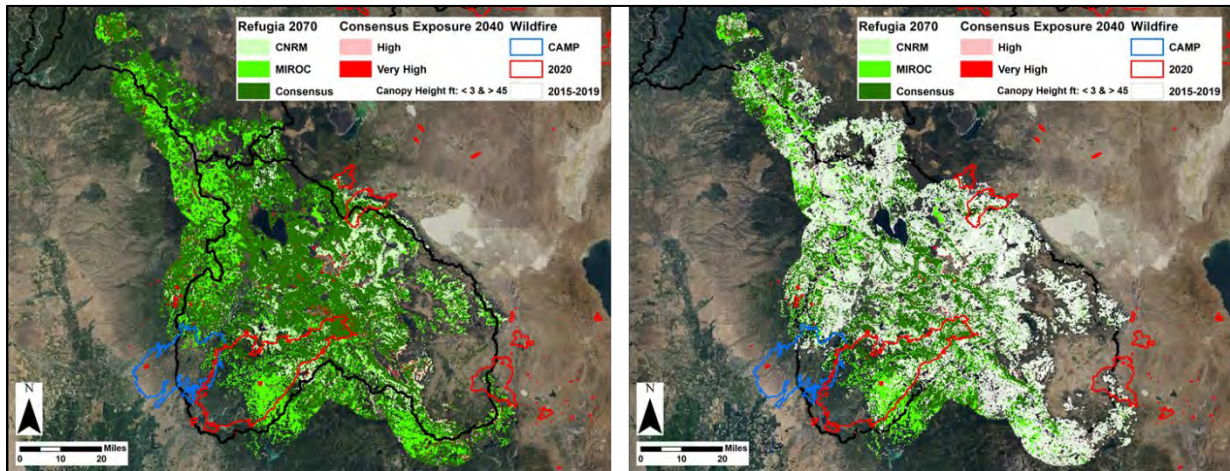




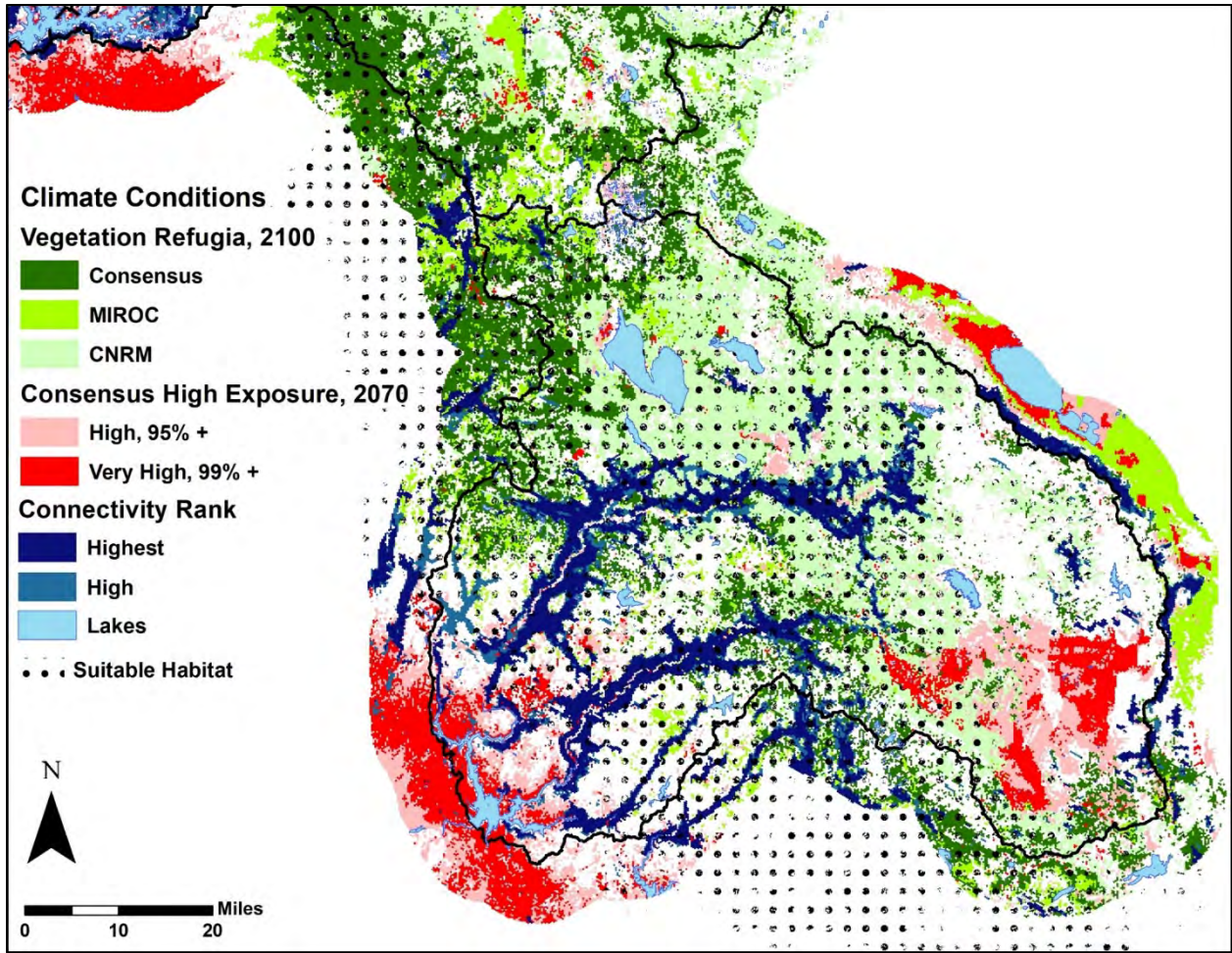
We used the CWHR range map and model to identify the suitable habitats for great grey owl in the SRHR. We examined how the potential range intersected with landscape connectivity, climate refugia, the area of recent wildfires, and measures of canopy height.

We found suitable habitat in the Feather River watershed, and 816,100 acres of it is in mid-century consensus refugia, decreasing by end century to 230,215 acres. When considering vegetation structure, consensus refugia area within the owl’s range with trees over 45 feet tall total 345,775 acres by 2070 decreasing to 80,925 acres by 2100. This analysis excluded younger conifer stands (<45 feet) that could be managed for late seral condition, particularly if they are in consensus refugia areas.

Of those, 2000 acres are remnant stands over 45 feet tall in 2070 consensus refugia, but that decreases to no >45 ft stands by end century. Additionally, within the Feather River watershed consensus refugia for 2070, 55,250 acres of canopy >45 ft occurred within the 2020 Claremont-Bear Fire (the largest part of the North Complex Fire). The canopy height data we used predated the North Complex fire, but the analysis could be updated when the next edition of the forest canopy data is released.

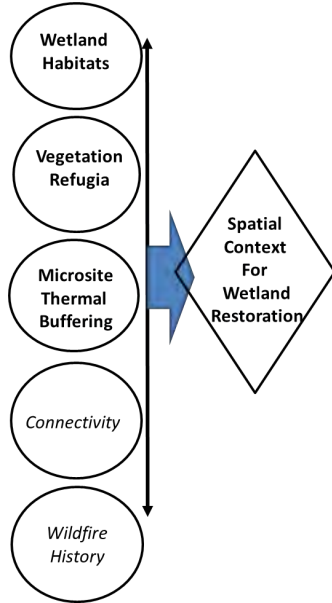


We also examined the ranked connectivity for the region. A number of high-ranking corridors pass through the range of the owl. By 2070, considerable climatic stress in the elevations around Lake Oroville suggest that there may be extensive species movement along these corridors. Selecting areas within them to strengthen site resilience may prove to be a good bet.





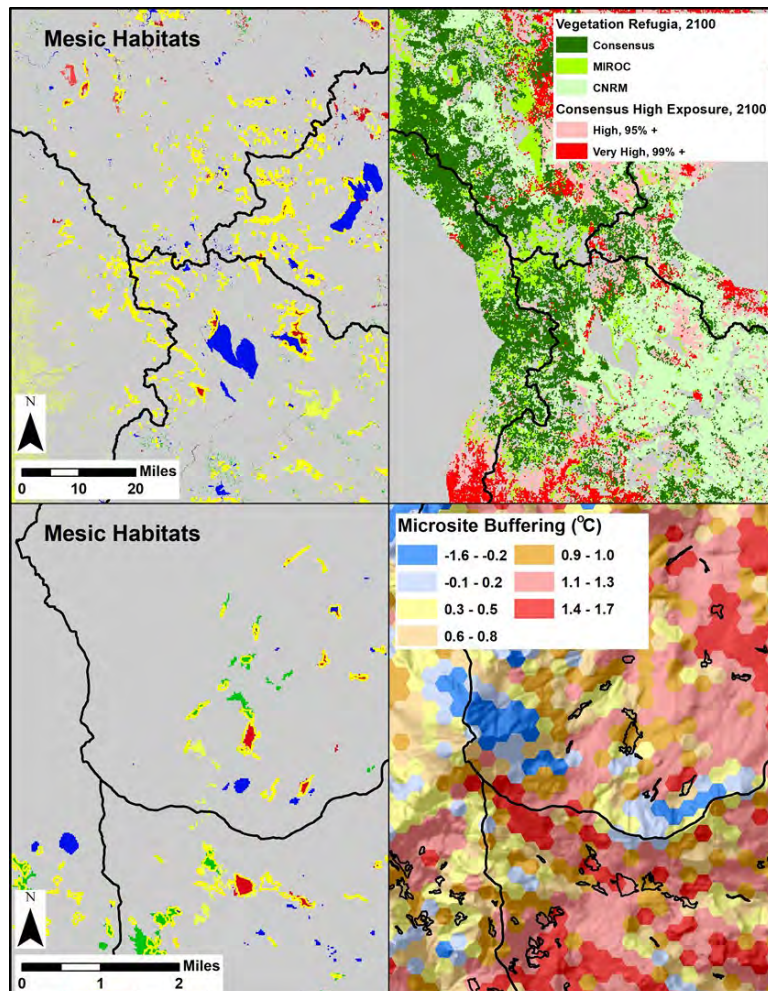
## Targeting habitats for water retention



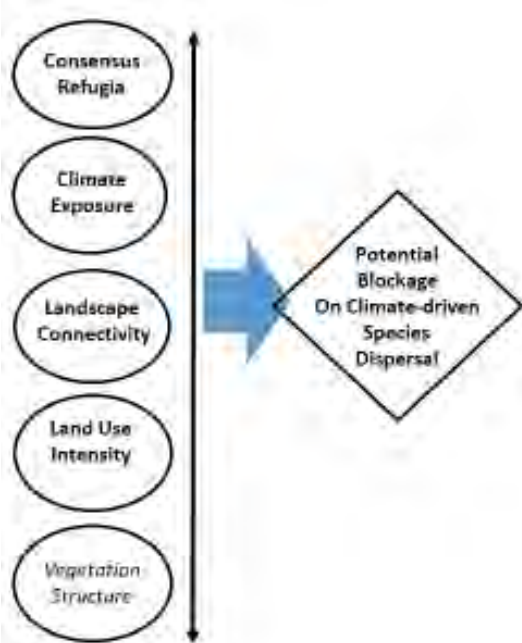
Maintaining hydrological functions is a major issue as climate change progresses, and riparian conservation and restoration is already widely practiced in the SRHR, with the Pacific Forest Trust having conserved 4209 acres in the SRHR region.

However, as snowpack declines with climate change, changes in the hydrology of the SRHR is of increasing concern. Some areas, such as the Modoc National Wildlife Refuge are already incorporating climate change projections into their water management strategies (Esralew et al. 2015). And, the volcanic soils of the Modoc Plateau may be able to provide infiltration functions for ground water for longer in each year before freezing (Thorne et al. 2015).

In this example we look at mapped wet meadows and other mesic habitats. We overlaid them with the consensus refugia maps for the area between the Feather and the Pit rivers. The panel image shows their locations and the corresponding refugia (upper row). We then zoomed in and examined the distribution of the mesic features and how they relate to thermal buffering capacity within each hexagon (lower row).

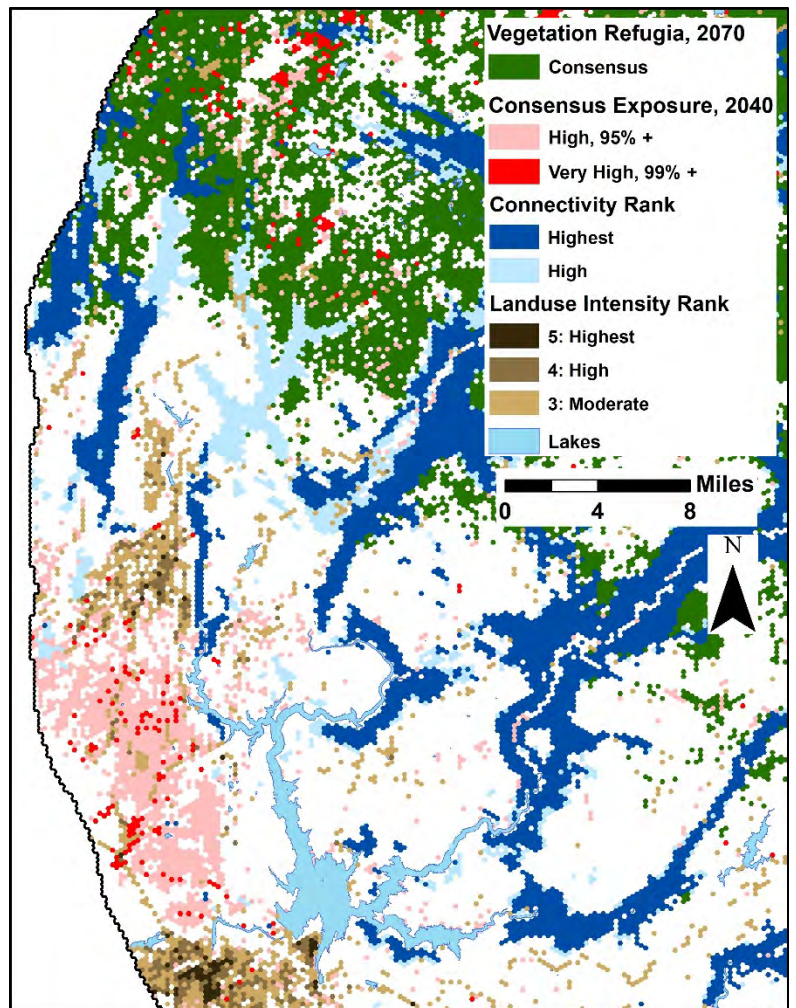


### Assessing land use blockages to connectivity



While land use and connectivity are somewhat opposite, and tend not to intersect, land use is a major factor just east and north of the largest area of high climate exposure. In addition, there is a considerable amount of moderate land use shown that is interspersed within the refugia area, and at the terminus of some of the high level connectivity corridors.

Species needs for climate-driven dispersal can be blocked by human land use. This example illustrates how the assembled data can be used to evaluate impediments to movement towards mid-term climate refugia from near-term high climate exposure areas. We use the western boundary of the Feather river watershed and show the 2070 consensus refugia (areas in green) and the 2040 high climate exposure areas (areas in red). We then layered on the two highest connectivity ranks (blue colors). Finally we brought in the three highest levels of land use intensity (brown colors).



## Methods

### Final Report Model Description: Model description, methods, data, assumptions

The goal of this study was to identify key areas within the region for a variety of climate-adaptive conservation and resilience objectives. Particularly, we were interested in what areas ranked highly as refugia for existing vegetation; critical landscape linkages for species movement; locations of high potential biodiversity; and areas with high potential as climatic microrefugia. We also wanted to consider the current structure of existing vegetation and identify forest areas that could be treated in a climate change-anticipating way, such as managing mid-seral forests for old growth conditions in areas that are climate refugia, and priority post-wildfire areas to restore to maintain landscape connectivity for future biodiversity movement.

To accomplish these goals, we compiled a large collection of geographic data, and considered which components and what sequence of analyses were needed to answer different landscape management objectives. We selected a 25 acre (10 hectare) hexagon as the unit for spatial analyses for two reasons: first, it provides a basis for comparisons across the entire extent of the study; and second, because this level of detail is relevant for land managers considering different treatments such as riparian restoration, forest thinning, conservation easements, etc. We created a hexagon grid layer in GIS consisting of 282,687 hexes in the 5 watersheds (6,985,348 acres) and 408,948 hexes (10,105,325 acres) across the watersheds and including a 6 mile (10 km) buffer.

We sampled different data into the framework. Geographic input data resolution ranged from 10 m topography to 270 m climate data to polygon maps of different resolutions. For five primary data layers, we ranked the hexagons into 5 classes, from low to high, creating weights that could then be combined in various ways, as described below for different objectives. We also used some reference data as overlays, but without incorporating them into the hexes to evaluate or further define some objectives.

This section describes the datasets collected, how they were sampled into the hexagon framework, and the methods for prioritizing areas for the major objectives. Additional information is located in the methods appendix.

### INPUT MAPS – ORIGIN AND MANUFACTURE

This section describes the creation of maps that were used in the analysis. The majority of these maps represent a compilation of existing data. Here we provide the source and steps used for the primary and secondary maps. Uses and processing of input reference maps are described in the appendix.

<u>Primary Maps</u>	<u>Secondary Maps</u>	<u>Input Reference Maps</u>
Vegetation Refugia / Climate Exposure	Land Use Intensity	Vegetation Map
Landscape & Climate Connectivity	Vegetation Structure & Wildfire	10 m DEM
Biodiversity /Species Richness	Future Ranges of Selected Species	Land Tenure
Microrefugia		Climate Data
		Fire Return Interval
		Hydroclimatic Model

The list above also is the order in which the map methods are presented below. The following table describes the data that went into each analysis and map, followed by

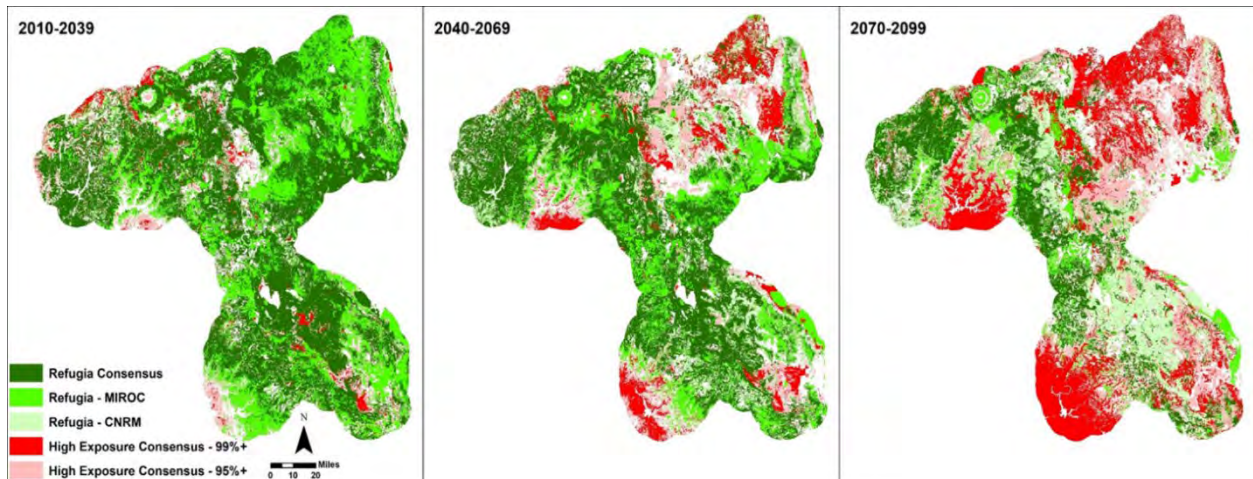
<b>Vegetation Refugia &amp; Climate Exposure</b>		
Climate and Hydrology Data	Downscaled Baseline & Future Climate (USGS)	Raster - 270m
FVEG - CalFire (FRAP)	<a href="https://frap.fire.ca.gov/mapping/gis-data/">https://frap.fire.ca.gov/mapping/gis-data/</a>	Rasster - 30m
Vegetation and Climate Refugia	Vegetatiave Climate Exposure (UCD Modeling)	Raster - 270m
<b>Landscape &amp; Climate Connectivity</b>		
California Essential Connectivity	Caltrans/CDFW	Polygon
Omniscape Climate Connectivity	The Nature Conservancy	90 m
CDFW Land Facet Connectivity	<a href="https://wildlife.ca.gov/data/BIOS">https://wildlife.ca.gov/data/BIOS</a>	Polygons
<b>Biodiversity / Species Richness</b>		
Habitat Suitability Within Species Range - CDFW rules	UC Davis Modelling	Raster - 30m
Tree Species Distribution Models	UC Davis Modelling - Thorne & Choe	Raster - 270m
California Natural Diversity Database (CNDDB) - CDFW	<a href="https://wildlife.ca.gov/Data/CNDDB/Plants-and-Animals">https://wildlife.ca.gov/Data/CNDDB/Plants-and-Animals</a>	Point & Polygo
<b>Microrefugia</b>		
National Elevation Dataset	<a href="http://www.usgs.gov/core-science-systems/ngp/tnm-delivery">www.usgs.gov/core-science-systems/ngp/tnm-delivery</a>	Raster - 10m
Solar Radiation Model	UCD - Modeling by Hollander	Raster - 25m
Environmental Lapse Rate Model	UCD - Modeling by Boynton	Raster - 10m
Cold Air Pooling	USGS Flint & Flint BCM Model	Rasgter - 270m
<b>Vegetation Structure, Wildfire, and Recovery</b>		
Canopy Height - SALO Sciences	<a href="https://forestobservatory.com/">https://forestobservatory.com/</a>	Raster - 10m
FVEG - CalFire (FRAP)	<a href="https://frap.fire.ca.gov/mapping/gis-data/">https://frap.fire.ca.gov/mapping/gis-data/</a>	Raster - 30m
Bulk Density & Number of Canopies - SALO Sciences	<a href="https://forestobservatory.com/">https://forestobservatory.com/</a>	Raster - 10m
Forest Tree Mortality Model - SALO Sciences	Not public yet	Raster - 1km
Fire Perimeters - CALFIRE, Nat'l Interagency Fire Center	<a href="https://frap.fire.ca.gov/mapping/gis-data/">https://frap.fire.ca.gov/mapping/gis-data/</a> ; <a href="https://data-nifc.opendata.arcgis.com/datasets/wildfire-perimeters">https://data-nifc.opendata.arcgis.com/datasets/wildfire-perimeters</a>	Polygon
<b>Land Use Intensity</b>		
FVEG - CalFire (FRAP)	<a href="https://frap.fire.ca.gov/mapping/gis-data/">https://frap.fire.ca.gov/mapping/gis-data/</a>	Raster - 30m
ESRI Roads	Esri	Polyline
<b>Initial Conservation Assessment</b>		
California Protected Areas Database (CPAD)	GreenInfo Network	Polygon
California Conservation Easement Database (CCED)	GreenInfo Network	Polygon
State Refuge Boundaries	California Department of Fish and Wildlife	Polygon
American Indian Reservations/Federally Recognized Tribal Entities	Governor's Office of Emergency Services	Polygon
<b>Input Reference Maps</b>		
National Elevation Dataset	<a href="http://www.usgs.gov/core-science-systems/ngp/tnm-delivery">www.usgs.gov/core-science-systems/ngp/tnm-delivery</a>	Raster - 10m
Landscape Management Units	Information Center for the Environment - UCD	Raster - 30m
Basin Characterization Model	USGS	Raster - 270m
Fire Return Interval Departure (FRID)	<a href="http://www.fs.usda.gov/main/r5/landmanagement/gis">http://www.fs.usda.gov/main/r5/landmanagement/gis</a>	Raster - 30m
Fire Threat	<a href="https://frap.fire.ca.gov/media/9792/fthrt14_2.zip">https://frap.fire.ca.gov/media/9792/fthrt14_2.zip</a>	Raster - 30m
CalFire Priority Projects	<a href="https://frap.fire.ca.gov/media/9630/calfire_priorityprojets">https://frap.fire.ca.gov/media/9630/calfire_priorityprojets</a> <a href="#">19_4.zip</a>	Polygon

## Primary Maps

### Vegetation Refugia / Climate Exposure

We used the CAL FIRE’s 2015 vegetation map to calculate what areas of each mapped vegetation type remain in frequently occupied current climate conditions. We mapped vegetation exposure by vegetation type under two GCMs - a hotter and drier (MIROC-ESM) and a warmer and wetter future (CNRMCM), and under two emission scenarios, RCP4.5 and RCP8.5 (Thorne et al. 2017a, b). Areas of vegetation refugia from the two GCMs that intersect are considered consensus vegetative refugia (Thorne et al. 2020). We mapped these areas within the SRHR for three future times 2010-2040; 2040-2070; and 2070-2100. We also mapped areas considered to have high climate stress, defined as the last

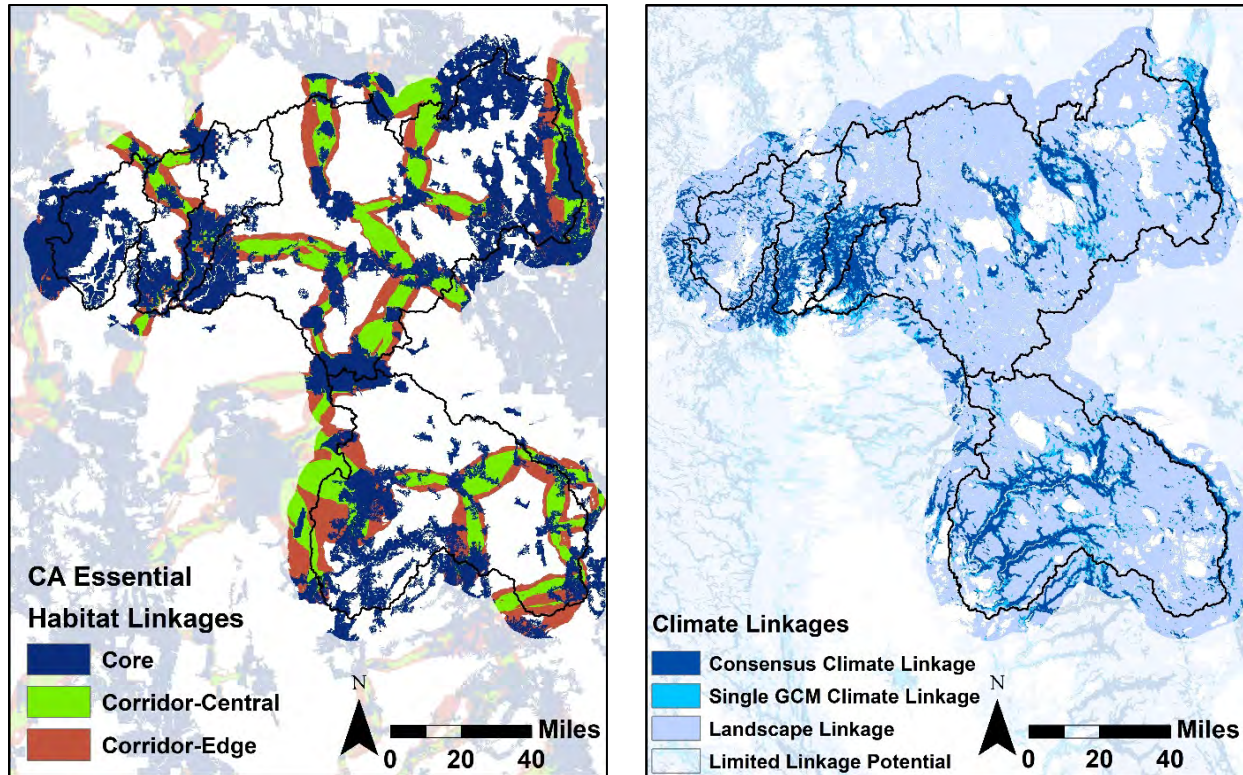
5 and 1% of the climate frequency distribution for each vegetation type (Methods Appendix). These climate exposure data are used in a wide range of analyses described below.



### ***Landscape & Climate Connectivity***

We examined 5 maps of connectivity, and found two that systematically covered the entire region: a version of the California Essential Connectivity (CEC) map that had been updated by CDFW; and The Nature Conservancy's climate linkages map. The other connectivity maps considered were a land facet map (CDFW) that focuses on northern Sierra foothills, and models of connectivity for Fisher and Martin.

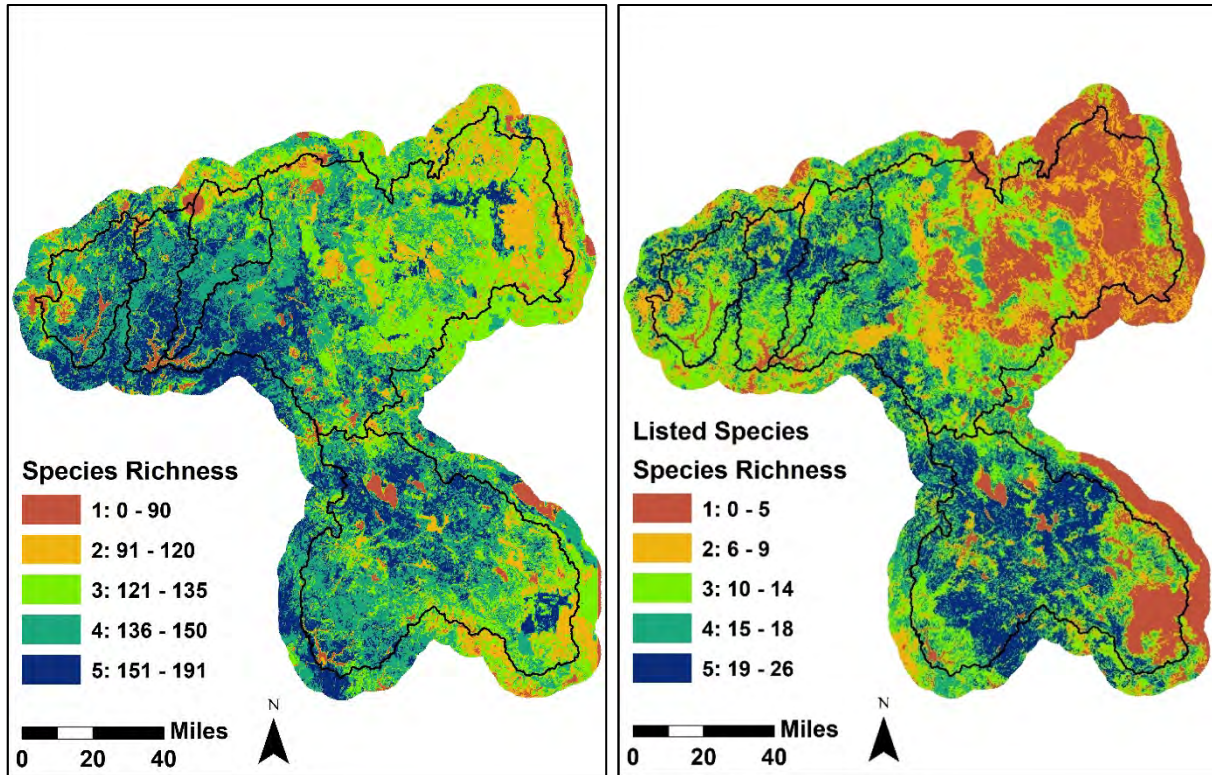
We ranked the CEC maps by core, high-value corridor, peripheral corridor, and not-in-network. We found 13 categories of climate linkages in TNC's maps and classed them into 4 categories: limited regional potential; present-day & intact landscapes; links from current climates to their analogs under a single GCM; and links from current climates to their analogs under projections from the two future climates considered (Methods Appendix).



We then summarized the rank value of each connectivity map in the hexagons, combined the ranks and classed the outputs into 5 levels of connectivity priority.

***Biodiversity / Species Richness***

California’s Wildlife Habitat Relationships model (WHR) identifies what habitats are commonly used by each vertebrate species in the state. The agency uses a statewide map developed in 2015 that provides the spatial pattern of each habitat as a way to map the potential range of each vertebrate species. We identified which vertebrate species have ranges in the study area, and we used the map of the WHRs to identify where in the SVH they may exist. We summarized the potential presence or absence of each of the species in each hexagon. We also identified the listed species and summarized those by hexagon as well. This permits an estimate of the potential vertebrate species richness by hexagon. For the full number of potential species richness (left, below) the rank numbers refer to: 1 = 0-90; 2 = 91-120; 3 = 121-135; 4 = 136-150; 5 = 151-191. For potential species richness of listed species (right, below) the rank numbers refer to: 1 = 0-5; 2 = 6-9; 3 = 10-14; 4 = 15-18; 5 = 19-26.



The species richness maps can be used with the vegetation refugia, as in the example below that shows listed species richness in vegetation refugia and in areas with high future climate exposure.

### Microrefugia

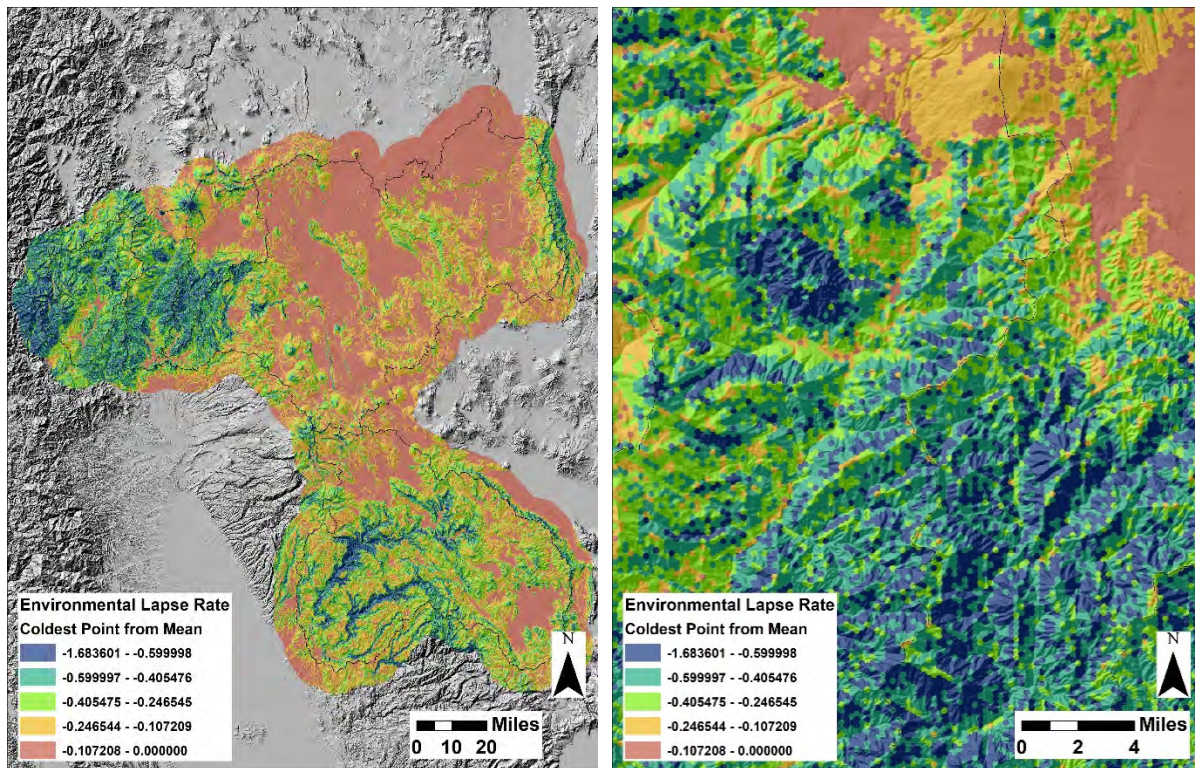
The extent to which management units may retain current climate conditions is of interest for Conservationists. A challenge for calculating the strength, or buffering capacity, of microrefugia is identify the strength of the phenomenon, and then link it to projected climate change. We were able to model two types that are occurring within a 25 acre area, which could be considered true micro-scale refugia. The third, cold air pooling, is active across larger spatial scales, but not across the entire region. We consider cold air pooling to be a meso-scale phenomenon. We mapped the extent of cold air pooling and it's relative strength across the landscape. But we did not summarize the effect into hexagons because it is fundamentally a process-driven metric, is stronger at some times of year than others, and therefore requires dynamic modeling to capture how it will perform under future warming.

We identified two types of physical microrefugia (Dobrowski 2011) that could be mapped and summarized into the hexagon framework, Environmental Lapse Rate and Solar Radiation influence on air. Additionally, cold air pooling (CAP) was observed in the air temperature, but was not quantified for regional modeling because of its temporal (seasonal) variability. Further modeling is necessary to capture the thermal buffering CAP can provide in a warming climate (Methods Appendix).

### *Environmental Lapse Rate*

We identified the mean elevation of each hexagon using a 10 m digital elevation model, which provides an average of 976 grid cells per hexagon. We calculated and then assigned the annual mean temperature from our baseline temperature maps of annual mean minimum and maximum temperatures, 1981-2010 (Thorne et al. 2017). We used the range of elevation to identify the highest and lowest points within the hexagon and then applied the environmental lapse rate to calculate the range of temperature values within the hexagon. The highest point is cooler than the mean elevation, based on the lapse rate. That point represents the last location within a hexagon that will retain the mean temperature as climate warms.

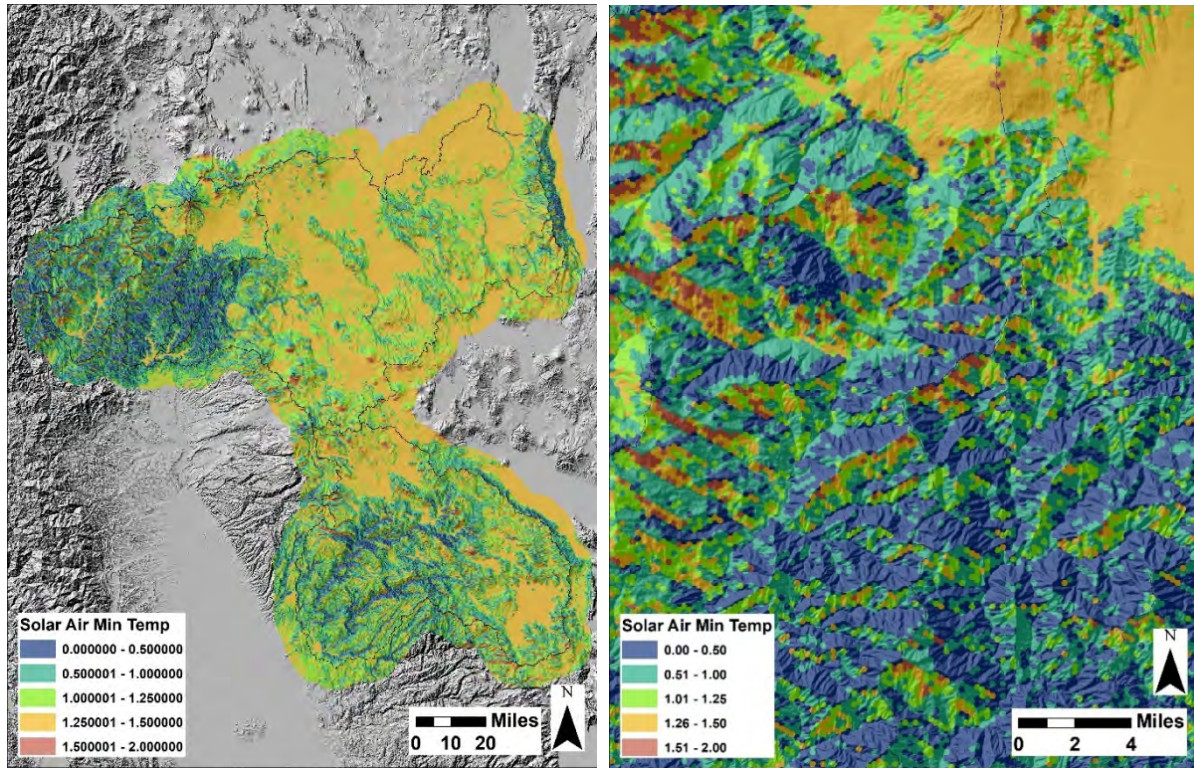
Negative effect = (Average Elevation – Maximum Elevation) x 0.00649606  
 Areas with steep topography have the highest buffering capacity.



### *Solar Radiation*

We modeled solar radiation using a 25 m DEM and converted the solar loading from MJ/second to degrees C using a table of conversion values determined in an independent study (Curtis et al. 2014; Methods appendix). Air temperature was never cooled by lack of solar radiation, and values ranged from 0 -2.5 °C. We use the lowest value found in each hexagon to represent the buffering (or lack thereof) from solar loading.





## Secondary Maps

### Vegetation Structure

David Marvin and Christopher Anderson of SALO Sciences provided an early release of data they also provide via their website, the California Forest Observatory (2020; <https://forestobservatory.com/>). They provided gridded data at 10 m resolution for five of the metrics that they measure statewide: canopy base height, canopy bulk density, canopy cover, canopy height, and ladder fuels. We used mean canopy height in each hexagon as a rough index for forest seral condition. Bulk density and canopy layers can be used in conjunction with other data to prioritize forest thinning.

### Fire Perimeters

We used two sources of data to map fire perimeters. CALFIRE’s fire perimeter data was used for all years up to 2019. Fire perimeters for 2020 were downloaded from the National Interagency Fire Center.

### Land Use Intensity

We summarized land use intensity in each 25 acre hexagon using the weighted linear extent of 3 types of roads (U.S. Streets – part of StreetMap USA – the “ESRI road layer” ) and the extent of human-altered landcover types that represent landuse.

We weighted the road types and measured the length of each road type, ranging from dirt roads to divided interstate highways within each hexagon. We classed the 3 road types into three levels of impact. Large roads were given highest impact (1 foot = 1 foot); moderate impact roads were down-weighted to 1 foot = 0.5 feet, and dirt roads were weighted to 1 foot = 0.33 feet. We then summed the overall road lengths in each hexagon. We classed the road lengths into 5 levels of road impact (Methods

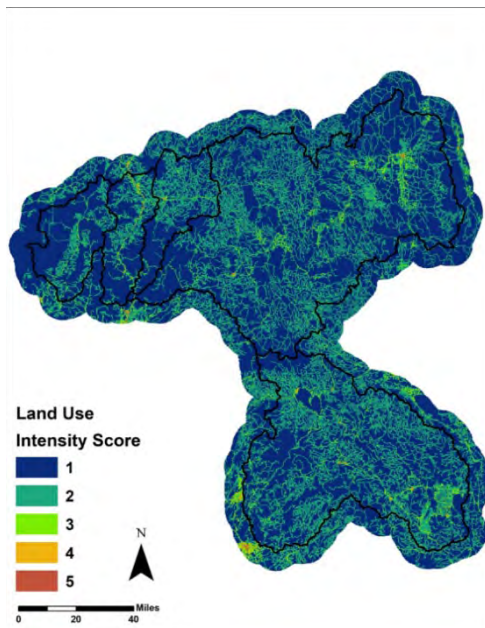
Appendix). From 0-10' length of road we considered to have no impact (weighting of 1; 65.1% of all hexagons), while the highest levels impact level were for hexagons in which road length could completely split a hexagon (weighting 4; 0.1% of all hexagons), or where hexagons could be transected two or more times by the roads within them (weighting 5; 5 hexagons).

We measured the area of landuse in each hexagon, according to the WHR classification of landcover types. We considered Urban (URB) and Eucalyptus (EUC) the most impacting. Ten types that indicate agriculture types were down-weighted to 1 square meter = 0.33 square meter, because these types are useable by some wildlife species. The ten agricultural types are:

Crop (CRP); Dryland Grain Crops (DGR); Irrigated Grain Crops (IGR); Irrigated Hayfield (IRH)  
Irrigated Row and Field Crops (IRF); Rice (RIC); Orchard - Vineyard (OVN); Deciduous Orchard (DOR); Evergreen Orchard (EOR); Vineyard (VIN)

We summed the area of each type within each hexagon and multiplied it by its weightings. We classed the output values into four levels of impact: No Impact (weight 1; 93.2% of hexagons); 0.1-33% of hexagon occupied (weight 2; 4.5%); 33-65% of hexagon occupied (weight 3; 2.1%) and >65% area occupied (weight 4; 0.2%).

We combined the road and landuse metrics, creating 20 classes that we then simplified to 5 levels ranging from 1 (No Impact; combined scores 11) to 5 (High; combined scores Roads 4 & 5; Landuse 2-4) (Methods Appendix).



## Future Ranges of Selected Species

We selected four species; Douglas Fir, Red Fir, Black Oak, and Ponderosa Pine, to examine for potential shifts in range.

Species distribution models for 4 species were obtained from previous work done for CAL FIRE (Thorne et al. 2016b) statewide and clipped to our region.

In the end we only used two species to examine their overlapping range dynamics: Douglas fir, with an expanding upwards range, and red fir with a retreating upslope range.

We compared their ranges in one of the use case graphics.

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## Methods Appendix

This appendix is meant to support the methods in the primary report. It provides additional information on data sources, processing, and analyses. It has two sections.

- 1) How we processed material into the hexagon framework
- 2) Description of the input maps and how they were processed.

### 1) How we processed material into the hexagon framework

We created a hexagon map for the region to summarize a wide variety of data into spatial units that are comparable across the region and also to represent an area that is relevant for site-level plans such as restoration or forest thinning. The hexagon layer has 282,687 hexes within the 5 watersheds, and 408,948 hexes in the 5 watersheds plus the 10 km buffer area.

Integrating data into the hexes

Data from a variety of grid scales including 10, 30, 90, and 270m was added using the sample tool with Hexagon centroids for those at the 270m scale and by using the zonal statistics tool with Hexagon boundaries for the ones with smaller cell sizes.

Some data types, such as vegetation were simply sampled for the majority type found in each hexagon. Other data used for analyses, such as the digital elevation model, were sampled for mean, minimum and maximum values.

The order of data types presented is the same as in the report's main methods section. If there is no additional information, the data type name is still included, but the section is blank.

### 2) Description of the input maps and how they were processed

This section follows the same organization as presented in the main report's sequence of maps described, with primary, secondary and input maps documented in turn.

#### Primary Maps

##### ***Vegetation Refugia / Climate Exposure***

These values were calculated for the mapped extent of each vegetation type found in the region. Exposure was based on the extent of the vegetation types as found in all California, and for two GCMs that bracket precipitation forecasts by +/- about 25% annual precipitation (Thorne et al. 2017).

What were the inputs:

1. Vegetation Map (described in Reference map section)
2. Climate Exposure data
  - a. GCMs: CNRMCM & MIROC-ESM

- b. RCPs: 4.5 & 8.5
- c. Time periods
  - i. Current: 1981-2010
  - ii. Future: 2010-2039 (“2040”), 2040-2069 (“2070”), 2070-2099 (“2100”)
- d. Data values sampled:
  - i. We analyzed the spatial distribution of each vegetation type from the vegetation map independently, as noted below, and then reassembled the output maps for each type to visualize climate exposure across the entire region.
  - ii. For all time periods
    - 1. Continuous climate exposure (21 frequency classes); classified exposure (5 classes) (Thorne et al. 2016; 2017; 2020);
  - iii. For Future time periods
    - 1. refugia, high exposure, very high exposure, and moderate exposure; both consensus and single model results (10 classes)

How was each input reclassified

- 1. Original data has climate exposure in 21 frequency classes ranging from 0 to 100 (100 being the most exposed areas) and non-analog
  - a. For all time periods we reclassified this into 5 Exposure Classes:
    - i. 1: 0-80%: Non-stressful conditions
    - ii. 2: 80-95%: uncertain
    - iii. 3: 95-99%: stressful conditions
    - iv. 4: 99-100%: very stressful conditions
    - v. 5: Non-Analog: climate conditions not seen within current distribution

How were they combined

- b. For future time periods we reclassified this into 10 classes:

CNRM Exposure Class	MIROC Exposure Class	Future Exposure Score	Future Exposure Score Description
1	1	A	Refugia - Consensus
1	2	D	Refugia - CNRM Only
1	3	D	Refugia - CNRM Only
1	4	D	Refugia - CNRM Only
1	5	D	Refugia - CNRM Only
2	1	E	Refugia - MIROC Only
2	2	H	Moderate Exposure - Consensus
2	3	I	Moderate Exposure - CNRM Only
2	4	I	Moderate Exposure - CNRM Only
2	5	I	Moderate Exposure - CNRM Only
3	1	E	Refugia - MIROC Only

3	2	J	Moderate Exposure - MIROC Only
3	3	B	High Exposure - Consensus
3	4	G	Very High Exposure - MIROC Only
3	5	G	Very High Exposure - MIROC Only
4	1	E	Refugia - MIROC Only
4	2	J	Moderate Exposure - MIROC Only
4	3	F	Very High Exposure - CNRM Only
4	4	C	Very High Exposure - Consensus
4	5	C	Very High Exposure - Consensus
5	1	E	Refugia - MIROC Only
5	2	J	Moderate Exposure - MIROC Only
5	3	F	Very High Exposure - CNRM Only
5	4	C	Very High Exposure - Consensus
5	5	C	Very High Exposure - Consensus

How were they inputted to the hexagons

Sample tool with Hexagon centroids to select the 270m frequency value from a climate grid, and assign the current and future climate exposure, or risk, to that cell.

***Landscape & Climate Connectivity***

What were the inputs

1. The Nature Conservancy (TNC): Omniscape
2. California Essential Habitat Connectivity (CEHC), a map product originally developed by Caltrans, and updated by CDFW.

How was each input reclassified

1. Omniscape/TNC
  - a. Received Connectivity rasters from The Nature Conservancy (can also be viewed at <https://omniscape.codefornature.org/>)
    - i. 90m raster with 13 categories
  - b. Crosswalked the 13 categories to 4 and ranked them 0-3 (3 is high, 1 is low, 0 is limited connectivity)
    - i. Connectivity Score      Description
    - ii. 0      Limited regional connectivity potential
    - iii. 1      Intact landscape
    - iv. 2      Climate linkage (HADGEM2-ES) through an intact landscape
    - v. 2      Climate linkage (CNRM\_CM5) through an intact landscape
    - vi. 3      Climate linkage (both climate models) through an intact landscape
    - vii. 1      Multiple present-day linkage options

- viii. 2 Climate linkage (HADGEM2-ES) among multiple present-day linkage options
- ix. 2 Climate linkage (CNRM\_CM5) among multiple present-day linkage options
- x. 3 Climate linkage (both climate models) among multiple present-day linkage options
- xi. 1 Present-day linkage
- xii. 1 Climate linkage (HADGEM2-ES) within a present-day linkage
- xiii. 1 Climate linkage (CNRM\_CM5) within a present-day linkage
- xiv. 3 Climate linkage (both climate models) within a present-day linkage

## 2. CEHC

- a. Used General Natural Landscape Blocks and Essential Connectivity Areas from the 8 layers available.
- b. Core areas were defined as areas within the Natural Landscape Blocks
- c. Corridor areas were defined as areas within the Essential Connectivity Areas
  - i. These areas were split into 2 groups based on permeability
    - 1) Permeable areas identified using layer from CDFW
      - a. Layer name:  
ds620\_EssentialConnectivityAreas\_CaliforniaEssentialHabitatConnectivity
      - b. Areas in the top 2 categories (score 0-33 of 100) were classified as “more permeable”.
- d. Resulting 4 categories:
  - i. Core Areas
  - ii. Corridor – More Permeable
  - iii. Corridor – Less Permeable
  - iv. All other Areas



How were they combined

1. Combining TNC and CEHC datasets
  - a. Created a Connectivity Ranking scale between 0-5, with 0 being limited connectivity, and areas identified by either input layers getting a score ranging from low (1) to high (5).
  - b. Crosswalk to overall Connectivity Score

		CEHC			
		Other areas	Corridor - Less Permeable	Corridor - More Permeable	core
TNC	0	0	1	2	2
	1 (low)	1	2	3	3
	2	2	3	4	4
	3 (high)	3	4	5	5

How were they inputted to the hexagons

Zonal statistics - Majority

***Biodiversity / Species Richness***

What was the input

1. Received species range maps and the weightings for each species of which habitat types they use. (CDFW). We selected all vertebrates whose ranges intersected with our region.  
 We scored the WHR types in the 30m raster vegetation map to identify the suitable habitat of each species, within its range in our area.

How was each input reclassified

1. Resampled raster to retain only areas where habitat score > 0
  - a. These are areas of suitable habitat within the range of each species

How were they combined

1. Summed up the suitable habitat for all species that overlapped with the study area, by 30 m grid cell.
  - b. 261 birds, 105 mammals, 21 amphibians and 31 reptiles
2. Used natural breaks to divide the distribution into 5 groups – called Biodiversity Rankings, with 1 being low and 5 being high.
  - a. 1 = 0-90
  - b. 2 = 91-120
  - c. 3 = 121-135
  - d. 4 = 136-150
  - e. 5 = 151-191

How were they inputted to the hexagons

3. Performed zonal statistics, used the average number of potential species per hexagon to assign the hexagon a Potential Species Richness (Biodiversity) Score using the table above. For example, a hexagon with an average of 160 species, get a score of 5 (high biodiversity).

Other notes:

4. Repeated the previous 3 steps for listed species only
  - a. Listed species = ones from CDFW extraction
    - i. 26 birds, 24 mammals, 11 amphibians and 2 reptiles

**Microrefugia**

What was the input

10m and 25m DEMs

How was each input reclassified

Solar radiation to Degree C

1. We ran a solar radiation model with the 25m DEM (2 days per month x 12 months)
2. Solar radiation raster units = Yearly total in watt-hours/m<sup>2</sup>

Convert yearly watt-hours to daily megajoules

$$\frac{\text{Watt} - \text{hours}}{\text{year}} \times \frac{1 \text{ year}}{365 \text{ days}} \times \frac{3600 \text{ J}}{\text{Watt} - \text{hour}} \times \frac{1 \text{ MJ}}{10^6 \text{ J}}$$

3. Convert daily MJ to degree C using a conversion table from Curtis et al. (2014).

Daily MJ/sec	Degree C
< 7.5	0
7.5 - 10.5	0.25
10.5 - 12.5	0.5
12.5 - 15	0.75
15 - 17.5	1
17.5 - 20	1.25
20 - 22.5	1.5
22.5 - 25	1.75
25 - 27.5	2
27.5 - 30	2.25
> 30	2.5

Elevation range to Degree C

- 1) Zonal Statistics was performed on 10m DEM for each hex
  - a. Range was used with environmental lapse rate to calculate “buffering capacity” within the Hex

How inputted into hexagons:

1. Solar Radiation (25m raster)
  - a. The minimum solar radiation value was used with conversion table to calculate the temperature equivalent of lowest Solar Radiation load within the hex
2. Elevation (10m raster)
  - a. Range of elevation within the hex was used with environmental lapse rate to calculate the coldest point within the hex
    - i.  $(\text{Average Elevation} - \text{Maximum Elevation}) \times 0.00649606$
3. Microsite buffering capacity was calculated by adding the temperature equivalent of lowest Solar Radiation load with the coldest point within the hex

## **Secondary Maps**

### **Vegetation Structure**

### **Fire Perimeters**

### **Land Use Intensity Score**

1. Roads
  - a. Used Esri Road Class (0-9) and converted to 3 impact ranks

<b>ESRI Road Class</b>	<b>Road Class Impact Rank</b>	<b>Description</b>
0	1	Major Highway
1	1	Major Highway Connector
2	1	Highway
3	1	Major Road
4	2	Local Road
5	3	Minor Road or Vehicular Trail
6	1	Special Road Features (Roundabouts, Service drives)
7	1	Ramps
8	1	Ferries
9	3	Private Road

- b. Summed road feet per hex per impervious road class (1-3)
- c. Calculated Weighted Road Length within each hexagon

- i.  $\text{Weighted Road Length} = 1 \times \text{RoadFeet}(\text{Impervious Road Class 1}) + 0.5 \times \text{RoadFeet}(\text{Impervious Road Class 2}) + 0.33 \times \text{RoadFeet}(\text{Impervious Road Class 3})$
- d. Classified Weighted Road Lengths into 5 weight classes

Road Weight	WeightCls	label	# hexs	
0-10	1	no	266288	65.1%
10-1300	2	low	134692	32.9%
1300-2600	3	med	7581	1.9%
2600-5218	4	high	382	0.1%
>5218	5	highest	5	0.0%

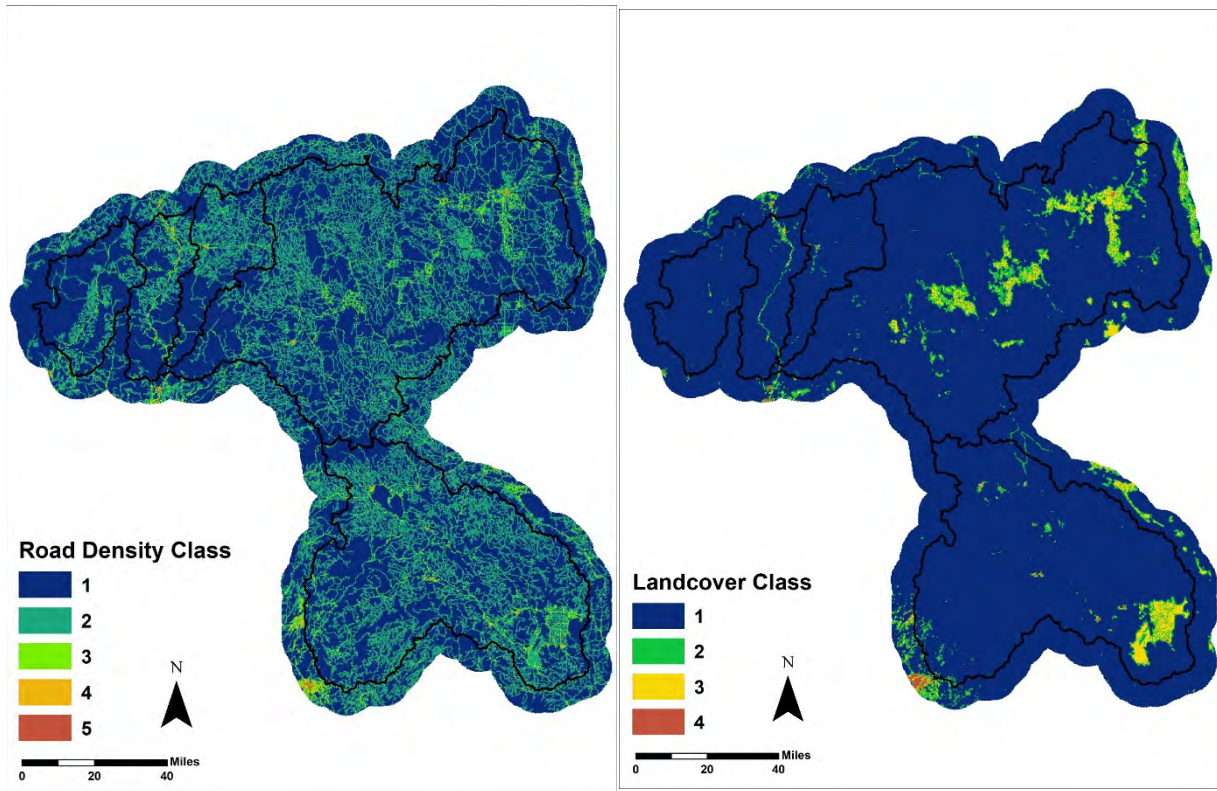
2. Landuse

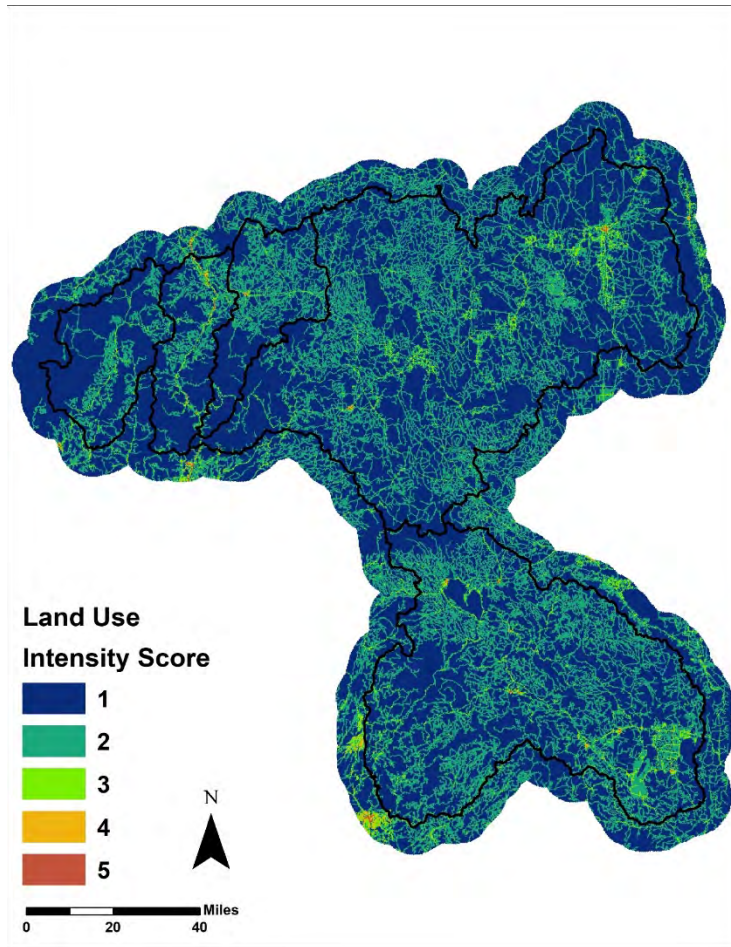
- a. Have WHR percentage (0-100) by Hex
- b. Calculated Weighted Landcover Percent within each hexagon
  - i.  $\text{Weighted Landcover Percent} =$   
 $100\% (\text{Urban} + \text{Eucalyptus Percent Cover})$   
 $+ 33\% (\text{Cropland} + \text{Dryland Grain Crop} + \text{Deciduous Orchard} + \text{Evergreen Orchard} + \text{Irrigated Grain Crop} + \text{Irrigated Row and Field Crop} + \text{Irrigated Hayfield} + \text{Pasture} + \text{Rice} + \text{Vineyard Percent Cover})$
- c. Classified Weighted Landcover Percent into 4 weight classes

Weighted Landcover Percent	Weighted Landcover Class	# hexs	
0-0.1 %	1	381207	93.2%
.1-33 %	2	18562	4.5%
33-65 %	3	8418	2.1%
65-100 %	4	761	0.2%

3. Combined Roads and Landuse to get Land Use Intensity Score  
 a. Combine Score = 10 x (Weighted Road Class) + (Weighted Landcover Class)

Combine Score	Weighted Road Class	Weighted Landcover Class	Land Use Intensity Score	# hex	
11	No Roads	Natural Lands	1	252439	61.7%
12	No Roads	Low Human Impact	1	8692	2.1%
13	No Roads	Med Human Impact	2	5127	1.3%
14	No Roads	High Human Impact	2	30	0.0%
21	Low-density Roads	Natural Lands	2	123305	30.2%
22	Low-density Roads	Low Human Impact	2	8369	2.0%
23	Low-density Roads	Med Human Impact	3	2751	0.7%
24	Low-density Roads	High Human Impact	3	267	0.1%
31	Medium-density Roads	Natural Lands	3	5373	1.3%
32	Medium-density Roads	Low Human Impact	3	1432	0.4%
33	Medium-density Roads	Med Human Impact	4	463	0.1%
34	Medium-density Roads	High Human Impact	4	313	0.1%
41	High-density Roads	Natural Lands	4	90	0.0%
42	High-density Roads	Low Human Impact	5	69	0.0%
43	High-density Roads	Med Human Impact	5	72	0.0%
44	High-density Roads	High Human Impact	5	151	0.0%
51	Highest-density Roads	Natural Lands	n/a	0	0.0%
52	Highest-density Roads	Low Human Impact	n/a	0	0.0%
53	Highest-density Roads	Med Human Impact	5	5	0.0%
54	Highest-density Roads	High Human Impact	n/a	0	0.0%





### Canopy Height Score

Received Fall 2019 Canopy Height Raster from Salo Sciences (California Forest Observatory 2020). Performed zonal statistics to get the average canopy height per hexagon. Used natural breaks to classify the heights into 5 classes.

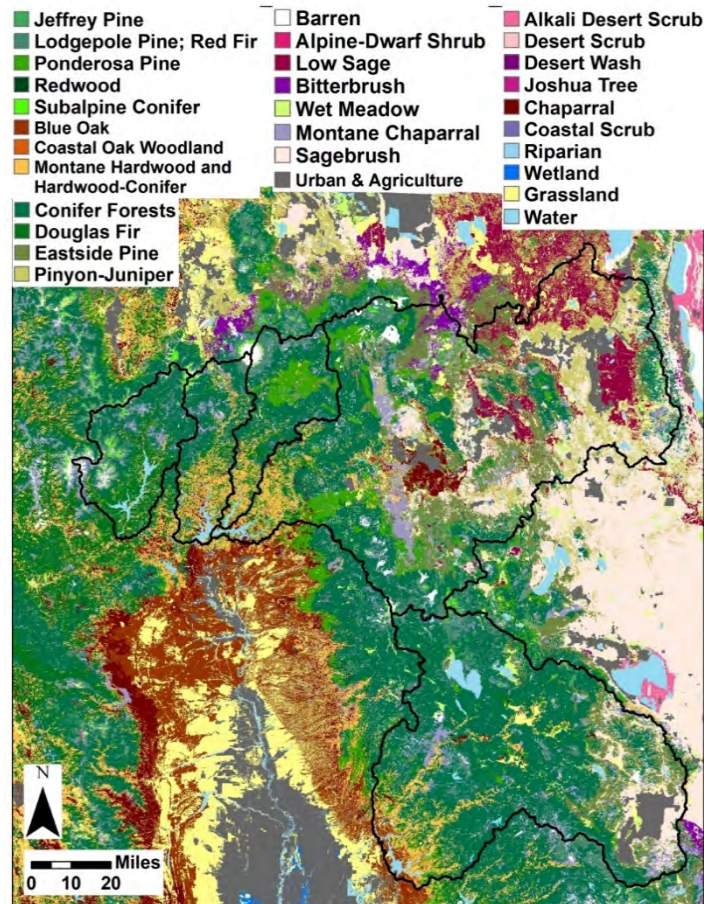
### Future Ranges of Selected Species

Received the species range maps and habitat models for all vertebrate species in California from CDFW. For the xxx vertebrate species that overlapped with our study area, we selected just the suitable habitats within their range (defining suitable as having a WHR based landcover score greater than 0), then spatially added them.

## Input Reference Maps

### Vegetation Map

1. FVEG (30m raster) converted to polygon and unionized to Hex grid to calculate:
  - a. Percentage of each WHR type within each Hexagon (0-100)
  - b. The WHR type that had the majority coverage within each Hexagon



### 10 m DEM

Zonal statistics were performed on a 10m DEM to get the average and range of elevation within each hexagon. These statistics were used when examining the microrefugia characteristics (section XX)

### Land Tenure

1. Tribal land
  - a. Source: [https://gis-calema.opendata.arcgis.com/datasets/23348a6fb3e44322a0c0a862aba62a24\\_0](https://gis-calema.opendata.arcgis.com/datasets/23348a6fb3e44322a0c0a862aba62a24_0)
  - b. Description: The American Indian Reservations / Federally Recognized Tribal Entities dataset depicts feature location, selected demographics and other associated data for the 561 Federally Recognized Tribal entities in the contiguous U.S. and Alaska.



Categories included are: American Indian Reservations (AIR), Federally Recognized Tribal Entities (FRTE) and Alaska Native Villages (ANV).

2. Public Land

a. CPAD

- i. Version: 2020a
- ii. Source: <https://www.calands.org/cpad/>
- iii. Description: The California Protected Areas Database (CPAD) is a GIS dataset depicting lands that are owned in fee and protected for open space purposes by over 1,000 public agencies or non-profit organizations. CPAD depicts the wide diversity of parks and open spaces in California, ranging from our largest National Forests and Parks to neighborhood pocket parks.

3. Easements

a. CCED

- i. Version: 2020a
- ii. Source: <https://www.calands.org/cced/>
- iii. Description: CCED is a GIS database defining easements and deed-based restrictions on private land. These restrictions limit land uses to those compatible with maintaining it as open space. Lands under easement may be actively farmed, grazed, forested, or held as nature reserves. Easements are typically held on private lands with no public access. CCED represents California in the National Conservation Easement Database (NCED), a national inventory of lands conserved as easements. NCED is managed by a consortium of non-governmental organizations including: Ducks Unlimited, the Trust for Public Land, Defenders of Wildlife, Conservation Biology Institute, and NatureServe.

4. State Refuges

- a. Publication date: 8/21/20 by CDFW
- b. Source: <https://wildlife.ca.gov/Data/GIS/Clearinghouse>
- c. Description: Boundaries of California State Fish and Game Refuges, Fish Refuges, Game Refuges, Waterfowl Refuges, Quail Refuges, Marine Life Refuges, and Burro Sanctuary as defined in the Fish and Game Code Division 7 Chapter 2. Special rules of take and possession apply to the areas designated (see Division 7 Chapter 1).

Goal: Classify the study area into 3 Land Ownership classes: Public, Private, and Tribal

Processing steps:

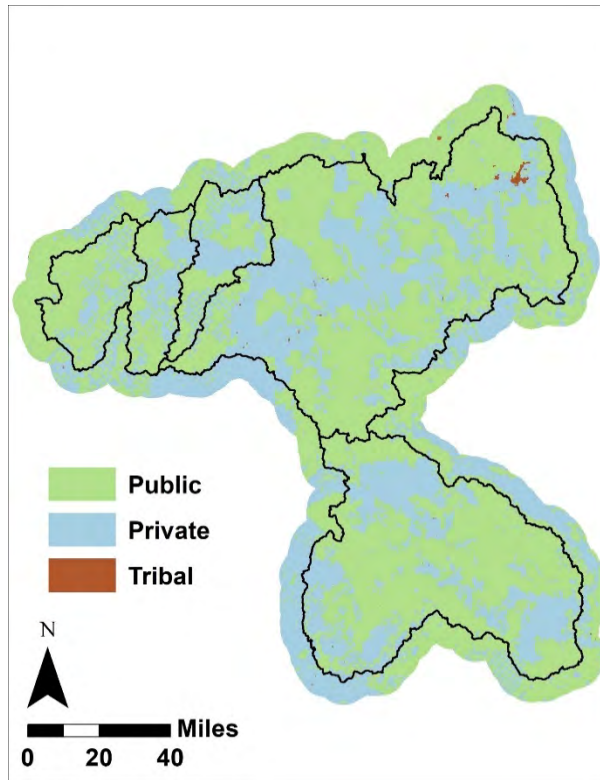
- 1. CPAD and State Refuge areas were added as Public
- 2. Easements were added as Private
- 3. Tribal Land was added as Tribal

Result:

PubLandCode	PubLandDesc	area_acres
1	Public	6214007
2	Private	3877791
3	Tribal	13635

Result by watershed (acres)

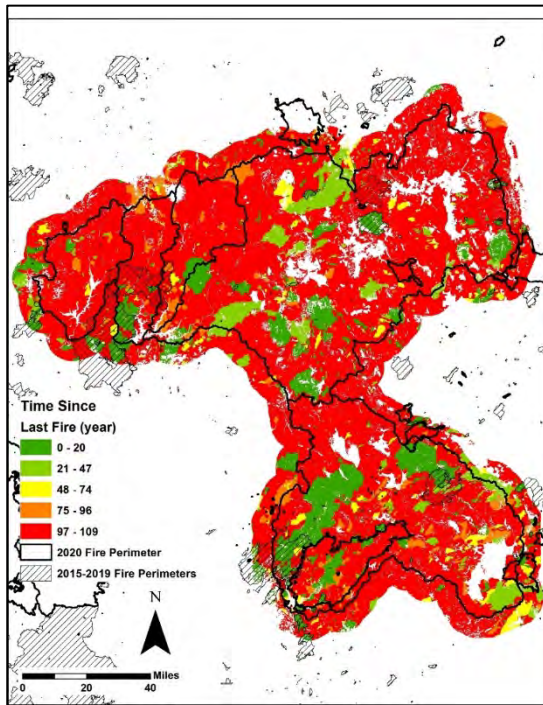
	Public	Private	Tribal
Feather	1515860	790184	427
McCloud	233924	201805	0
Pit	2085733	1307449	11004
Upper			
Sacramento	216298	162603	3
Upper Trinity	331909	128022	0
Buffer	1830283	1287729	2201



Climate Data

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## Fire Return Interval Departure



We used the Fire Return Interval Departure (FRID; Safford & Van de Water 2014) to evaluate seral condition and fire risk in some of the use cases.

### Hydroclimatic Model (Basin Characterization Model)

We used the outputs from the Basin Characterization Model (BCM). The model uses downscale PRISM climate data (Tmax, Tmin, PPT) at 270 m grid scale for historical data. It then uses bias-corrected future projections also downscaled to 270 m to output a series of variables including April 1<sup>st</sup> snowpack, Runoff, Recharge, Potential Evapotranspiration, Actual Evapotranspiration, and Climatic Water Deficit (Flint & Flint 2012, Flint et al. 2013, Thorne et al. 2015). We used 30-year summaries of annual values to assess change from a baseline period of 1981-2010.

## **Results Table Appendices**

This section is comprised of 4 Excel tables that are zipped and available as a separate download.

The values were derived in the following manner:

We converted all rasters of different grid scale to 270m and use the Combine tool.

Exported the raster value attribute tables (VAT) to MS Access to perform crosstab queries that summarize the count of cells in each category. The cell count was then converted to area using a conversion factor of:

18.013982 acres per 270m grid cell.

The results were formatted in Excel.

## **GIS Appendices**

This section is comprised of 2 geodatabases that are available as a separate download.

The first geodatabase, "Hexagon Data", contains the values we embedded in the hexagons.

The second geodatabase, "Input Data" contains input and contextual data.

**These are the final extents of the climate exposure analysis**

There are 2 tabs

SumByRefugiaAndConsensusHighExp  
SummariesBy5ExposureClasses

Refugia (both consensus and by GCM) & Consensus High Exposure  
Summary by the 5 Exposure Classes

	RCP8.5										RCP4.5										
	Total	Refugia - Consensus	High Exposure - Consensus	Very High Exposure - Consensus	Refugia - CNRM Only	Refugia - MIROC Only	Refugia - Consensus	High Exposure - Consensus	Very High Exposure - Consensus	Refugia - CNRM Only	Refugia - MIROC Only	Refugia - Consensus	High Exposure - Consensus	Very High Exposure - Consensus	Refugia - CNRM Only	Refugia - MIROC Only	Refugia - Consensus	High Exposure - Consensus	Very High Exposure - Consensus	Refugia - CNRM Only	Refugia - MIROC Only
Statewide	100,937,008	12,442,211	11,589,818	36,782,029	7,997,997	14,845,030	12%	11%	36%	8%	15%	21,626,193	9,818,704	15,128,466	10,200,388	16,471,783	31%	10%	15%	10%	16%
Study Area	9,945,808	1,879,723	1,765,803	2,295,236	1,255,466	845,432	19%	18%	22%	13%	9%	3,280,634	1,061,168	1,046,648	818,305	1,903,559	33%	11%	11%	8%	19%
5 Watersheds	6,862,048	1,273,372	1,321,290	1,416,692	982,248	527,035	19%	19%	21%	14%	8%	2,351,203	754,768	664,284	623,914	1,237,633	34%	11%	10%	9%	18%
Pt	3,374,433	489,818	754,642	803,406	350,264	222,581	15%	22%	24%	10%	7%	845,234	478,740	452,079	343,761	530,458	25%	14%	13%	10%	16%
Feather	2,248,271	303,554	423,833	483,838	600,244	98,807	14%	19%	22%	27%	4%	866,238	212,529	176,195	249,890	385,733	39%	9%	8%	11%	17%
McCloud	431,507	144,562	50,835	34,046	16,339	87,728	34%	12%	8%	4%	20%	188,967	15,168	11,295	5,927	163,045	44%	4%	3%	1%	38%
Upper Trinity	442,171	255,690	22,644	6,413	12,177	69,210	58%	5%	1%	3%	18%	320,757	8,593	2,342	23,742	50,385	73%	2%	1%	5%	11%
Upper Sacramento	365,666	79,748	69,336	88,989	3,225	48,710	22%	19%	24%	1%	13%	130,007	39,739	22,373	594	108,012	36%	11%	6%	0%	30%
Statewide	100,937,008	35,243,293	9,767,739	13,515,657	10,831,375	14,414,356	35%	10%	13%	11%	14%	43,726,509	8,647,810	7,319,333	9,796,760	13,758,701	43%	9%	7%	10%	14%
Study Area	9,945,808	3,673,367	933,250	859,339	784,383	1,852,675	37%	9%	9%	8%	19%	4,303,113	749,418	532,367	592,390	2,022,015	44%	8%	5%	6%	20%
5 Watersheds	6,862,048	2,634,635	682,730	533,214	598,947	1,218,826	38%	10%	8%	9%	18%	3,133,406	510,480	306,472	443,234	1,323,884	46%	7%	4%	6%	19%
Pt	3,374,433	985,581	425,292	377,069	335,204	541,068	29%	13%	11%	10%	16%	1,232,282	281,342	221,230	343,346	599,920	37%	8%	7%	10%	18%
Feather	2,248,271	945,302	204,783	132,024	233,840	389,859	42%	9%	6%	10%	17%	1,144,320	187,490	64,850	68,111	490,359	51%	8%	3%	3%	22%
McCloud	431,507	214,420	12,123	9,025	3,963	152,128	50%	3%	2%	1%	35%	246,539	9,637	8,485	522	121,252	57%	2%	2%	0%	28%
Upper Trinity	442,171	332,160	8,953	2,324	25,418	36,046	75%	2%	1%	6%	8%	319,910	8,971	2,936	30,552	31,488	72%	2%	1%	7%	7%
Upper Sacramento	365,666	157,172	31,579	12,772	522	99,725	43%	9%	3%	0%	27%	190,354	23,040	8,971	703	80,865	52%	6%	2%	0%	22%
Statewide	100,937,008	51,284,852	5,902,227	2,702,241	5,525,221	18,926,967	51%	6%	3%	5%	19%	55,102,249	6,449,312	3,213,568	4,293,002	13,959,467	55%	6%	3%	4%	14%
Study Area	9,945,808	4,870,332	486,504	228,417	160,703	2,795,013	49%	5%	2%	2%	28%	5,516,566	592,156	298,582	113,542	1,874,139	55%	6%	3%	1%	19%
5 Watersheds	6,862,048	3,483,508	274,389	140,473	86,089	1,952,734	51%	4%	2%	1%	28%	3,931,498	346,535	174,303	63,788	1,318,786	57%	5%	3%	1%	19%
Pt	3,374,433	1,642,371	97,546	43,864	38,730	1,115,372	49%	3%	1%	1%	33%	2,024,087	144,094	62,977	28,516	630,489	60%	4%	2%	1%	19%
Feather	2,248,271	1,185,338	116,550	64,940	11,205	603,270	53%	5%	3%	0%	27%	1,212,665	139,500	79,027	14,411	488,071	54%	6%	4%	1%	22%
McCloud	431,507	220,779	13,420	10,592	3,639	106,589	51%	3%	2%	1%	25%	225,445	13,961	11,475	6,773	93,114	52%	3%	3%	2%	22%
Upper Trinity	442,171	258,465	25,021	10,754	25,688	34,100	58%	6%	2%	6%	8%	275,920	25,940	10,250	7,998	33,578	62%	6%	2%	2%	8%
Upper Sacramento	365,666	176,555	21,851	10,322	6,827	93,402	48%	6%	3%	2%	26%	193,380	23,040	10,574	6,089	73,533	53%	6%	3%	2%	20%



**These are the final land cover tables. They show climate exposure of the vegetation by land cover (WHR) type.**

There are 6 tabs: 2 main tables and 5 appendix tabs.

Main1_WHR_ConsensusRefHighExp	Consensus Refugia & High Exposure: Summaries
Main2_WHR_ConsensusModExp	Consensus Moderate Exposure: Summaries
Apx1_WHR_ConRefHighExp_5Watshd	Consensus Refugia & High Exposure: By Watershed
Apx2_WHR_ConModExp_5Watshd	Consensus Moderate Exposure: By Watershed
Apx3_WHR_RefHighExp	Single Model Refugia & High Exposure: Summaries and by Watershed
Apx4_WHR_ModExp	Single Model Moderate Exposure: Summaries and by Watershed
Apx5_WHR_AreaByRank	Total Area by WHR Type



This is the Consensus Refugia & High Exposure by land cover (WHR) type table for use in the main text. Refugia & High Exposure by watershed tables are in appendix 1, single climate model tables are in appendix 3.  
 Extent = Entire Study Area (5-Watersheds plus 10km buffer)  
 RCP8.5 area = acres

Land Cover Type (WHR)	Refugia -			Consensus High Exposure - Consensus			Very High Exposure - Consensus			Land Cover Type (WHR)	Refugia -			Consensus High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal		Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
ALKALI DESERT SCRUB							522	8,917		ALPINE DWARF-SHRUB									
ALPINE DWARF-SHRUB							594	36		ANNUAL GRASSLAND	306	324		11,403	9,169		3,080	6,431	36
ANNUAL GRASSLAND	306	324		15,042	15,006		7,764	56,330	54	ASPEN				3,387	252		252	450	
ASPEN				4,540	504		360	594		BARREN				1,387	1,909		2,000	1,027	
BARREN	36	18		1,603	2,270		2,576	4,107		BITTERBRUSH							26,120	3,495	
BITTERBRUSH				18			72,038	19,869	144	BLUE OAK WOODLAND	54						973	4,684	
BLUE OAK WOODLAND	54						3,441	70,237		BLUE OAK-FOOTHILL PINE	1,117	919		18			7,242	15,186	18
BLUE OAK-FOOTHILL PINE	1,135	1,153		18			13,024	55,681	18	CLOSED-CONE PINE-CYPRESS	5,350	180		36			793	162	
CHAMISE-REDSHANK CHAPARRAL							685	811		COASTAL OAK WOODLAND									
CLOSED-CONE PINE-CYPRESS							1,135	522		CROPLAND				1,117	24,265		54	1,549	
COASTAL OAK WOODLAND	5,404	234		36			54	126		DOUGLAS FIR	30,354	24,949		883	72		40,946	34,353	
COASTAL SCRUB								72		DRYLAND GRAIN CROPS					54		144	6,665	
CROPLAND				1,171	28,912		126	19,329		EASTSIDE PINE							232,651	113,560	324
DECIDUOUS ORCHARD								180		EVERGREEN ORCHARD									
DOUGLAS FIR	56,942	32,317		1,946	2,216		50,079	47,197		FRESH EMERGENT WETLAND									
DRYLAND GRAIN CROPS							144	7,836		IRRIGATED GRAIN CROPS									
EASTSIDE PINE							320,217	139,734	324	IRRIGATED HAYFIELD				18	973		2,828	65,175	180
EUCALYPTUS								36		IRRIGATED ROW AND FIELD CROPS									
EVERGREEN ORCHARD								18	757	JEFFREY PINE	13,456	7,980							
FRESH EMERGENT WETLAND								72	558	JUNIPER									
IRRIGATED GRAIN CROPS								883		KLAMATH MIXED CONIFER	191,813	73,101							
IRRIGATED HAYFIELD				18	973		2,828	94,465	180	LACUSTRINE	9,007	14,483							
IRRIGATED ROW AND FIELD CROPS								414		LODGEPOLE PINE									
JEFFREY PINE	13,456	7,980		72	36		955	90		LOW SAGE							230,525	57,609	360
JUNIPER				11,709	7,458		17,167	4,720	54	MIXED CHAPARRAL	30,318	17,798					10,934	6,539	
KLAMATH MIXED CONIFER	191,813	73,101		20,320	21,869		8,737	6,053		MONTANE CHAPARRAL	280,027	74,037					162	72	
LACUSTRINE	9,007	14,483		18	90		15,870	793		MONTANE HARDWOOD	32,858	21,112	72	108	126		195,073	53,754	72
LODGEPOLE PINE				6,539	288		15,474	4,900		MONTANE HARDWOOD-CONIFER	31,741	24,751	18	126	54		79,478	54,312	
LOW SAGE							331,944	67,697	1,225	MONTANE RIPARIAN	14,195	8,070					15,870	1,351	
MIXED CHAPARRAL	30,318	17,798		775	847		17,383	29,435		PASTURE									
MONTANE CHAPARRAL	280,027	74,037		6,773	2,828		6,017	3,567		PERENNIAL GRASSLAND	13,114	4,107							
MONTANE HARDWOOD	32,858	21,112	72	108	126		56,582	77,514	72	PONDEROSA PINE	104,769	74,146	18						
MONTANE HARDWOOD-CONIFER	31,741	24,751	18	126	54		34,947	32,443		RED FIR	5,728	649		21,959	3,477		27,039	3,206	
MONTANE RIPARIAN	14,195	8,070						4,990		RICE									
PASTURE				162	1,639					RIVERINE		18							
PERENNIAL GRASSLAND	13,114	4,107								SAGEBRUSH									
PONDEROSA PINE	104,769	74,146	18				16,609	37,289	36	SIERRAN MIXED CONIFER	362,910	265,022		23,436	15,330	54	70,453	61,212	
RED FIR	5,728	649		21,959	3,477		27,039	3,206		SUBALPINE CONIFER				1,351	54		27,003	306	
RICE								360		URBAN				72	58		811	23,670	90
RIVERINE							486	486		VALLEY FOOTHILL RIPARIAN							288	1,819	
SAGEBRUSH							81,765	32,353	36	VALLEY OAK WOODLAND							72	1,261	
SIERRAN MIXED CONIFER	362,910	265,022		23,436	15,330	54	70,453	61,212		VINEYARD									
SUBALPINE CONIFER				1,351	54		27,003	306		WET MEADOW	865	126		4,107	22,373	252	108	865	
URBAN				72	58		811	23,670	90	WHITE FIR	83,261	20,518		7,890	2,180		62,274	11,511	
VALLEY FOOTHILL RIPARIAN								1,819		<b>Total:</b>	<b>1,237,939</b>	<b>641,298</b>	<b>108</b>	<b>139,500</b>	<b>132,187</b>	<b>306</b>	<b>1,267,662</b>	<b>935,322</b>	<b>2,234</b>
VALLEY OAK WOODLAND								90											
VINEYARD								90											
WET MEADOW	865	126		4,107	22,373	252	108	865											
WHITE FIR	83,261	20,518		7,890	2,180		62,274	11,511											

Land Cover Type (WHR)	Refugia -			Consensus High Exposure - Consensus			Very High Exposure - Consensus			Land Cover Type (WHR)	Refugia -			Consensus High Exposure - Consensus			Very High Exposure - Consensus			
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal		Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	
ALKALI DESERT SCRUB							667	10,628		ALPINE DWARF-SHRUB										
ALPINE DWARF-SHRUB							90			ANNUAL GRASSLAND							36			
ANNUAL GRASSLAND							7,530	23,472	54	ASPEN							6,305	17,293	54	
ASPEN							432	216		BARREN							288	108		
BARREN	883	18		1,927	4,251		757	1,531		BITTERBRUSH	594			1,621	3,657		1,621	3,657	234	
BITTERBRUSH	270	54		5,080	1,117		1,459	4,594		BLUE OAK WOODLAND	198	36		5,080	1,045		811	342		
BLUE OAK WOODLAND							2,864	64,166		BLUE OAK-FOOTHILL PINE							18	90		
BLUE OAK-FOOTHILL PINE	144			1,189	612		7,980	44,639		CLOSED-CONE PINE-CYPRESS							1,081	540	5,260	
CHAMISE-REDSHANK CHAPARRAL							90	72		COASTAL OAK WOODLAND							468	396	18	
CLOSED-CONE PINE-CYPRESS							36			CROPLAND							3,116	44,711	504	
COASTAL OAK WOODLAND							54	108		DOUGLAS FIR	65,157	55,951		1,063	432		6,701	2,576		
COASTAL SCRUB										DRYLAND GRAIN CROPS										
CROPLAND				3,927	54,168	504	1,567	106,499	216	EASTSIDE PINE	36,514	12,304		69,696	22,247		20,662	19,978	198	
DECIDUOUS ORCHARD								180		EVERGREEN ORCHARD										
DOUGLAS FIR	106,120	72,776	108	2,918	1,225		7,728	3,351		FRESH EMERGENT WETLAND										
DRYLAND GRAIN CROPS							180	9,151		IRRIGATED GRAIN CROPS										
EASTSIDE PINE	49,863	21,851		87,530	36,046		22,734	22,391	198	IRRIGATED HAYFIELD							432	34,947	144	
EUCALYPTUS								36		IRRIGATED ROW AND FIELD CROPS										
EVERGREEN ORCHARD								18	757	JEFFREY PINE	33,416	15,924								
FRESH EMERGENT WETLAND								72	576	JUNIPER	28,804	10,286								
IRRIGATED GRAIN CROPS								919		KLAMATH MIXED CONIFER	216,510	138,059		1,567	1,009		829	126		
IRRIGATED HAYFIELD				432	46,944	144	18	23,076		LACUSTRINE	5,476	16,465		4,612	144		36			
IRRIGATED ROW AND FIELD CROPS								414		LODGEPOLE PINE	1,946	36		2,990	919		72	829		
JEFFREY PINE	33,416	15,924		126	18			36		LOW SAGE	360	54		1,747	3,819		302,707	63,247	1,225	
JUNIPER								1,765	1,153	54	MIXED CHAPARRAL	18						3,170	2,594	
KLAMATH MIXED CONIFER	216,510	138,059		1,567	1,009		829	126		MONTANE CHAPARRAL	391,516	109,435	72	2,144	829		2,432	1,549		
LACUSTRINE	5,476	16,465		4,612	144		36			MONTANE HARDWOOD	43,990	32,173	54	1,657	1,207		4,413	6,737	18	
LODGEPOLE PINE	1,946	36		2,990	919					MONTANE HARDWOOD-CONIFER	58,726	44,711	18	1,333	703		649	396		
LOW SAGE	360	54		1,747	3,819					MONTANE RIPARIAN	7,530	6,989								
MIXED CHAPARRAL								4,990		PASTURE										
MONTANE CHAPARRAL	391,516	109,435	72	2,144	829					PERENNIAL GRASSLAND	61,428	28,930	144							
MONTANE HARDWOOD	43,990	32,173	54	1,657	1,207		4,413	6,737	18	PONDEROSA PINE	98,446	104,175	342	378	1,279		2,000	3,044	36	
MONTANE HARDWOOD-CONIFER	58,726	44,711	18	1,333	703		649	396		RED FIR	180,068	26,823		144	54		721			
MONTANE RIPARIAN	7,530	6,989								RICE										
PASTURE								4,990		RIVERINE										
PERENNIAL GRASSLAND	61,428	28,930																		



This is the Moderate Exposure by land cover (WHR) type table for use in main text. Moderate exposure by watershed tables are in appendix 2, single climate model tables are in appendix 4.  
 Extent = Entire Study Area (5-Watersheds plus 10km buffer)  
 RCP8.5 area = acres

Land Cover Type (WHR)	Moderate Exposure - Consensus			Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal		Public	Private	Tribal
ALKALI DESERT SCRUB				ALPINE DWARF-SHRUB			
ALPINE DWARF-SHRUB				ANNUAL GRASSLAND	7,206	28,318	18
ANNUAL GRASSLAND	8,016	33,974	18	ASPEN			
ASPEN				BARREN	35,614	6,737	
BARREN	65,949	13,186	18	BITTERBRUSH	18		
BITTERBRUSH	18			BLUE OAK WOODLAND	36		
BLUE OAK WOODLAND	36			BLUE OAK-FOOTHILL PINE	721		
BLUE OAK-FOOTHILL PINE	937	162		CLOSED-CONE PINE-CYPRESS	558	90	
CHAMISE-REDSHANK CHAPARRAL				COASTAL OAK WOODLAND			
CLOSED-CONE PINE-CYPRESS	775	324		CROPLAND		14,447	
COASTAL OAK WOODLAND				DOUGLAS FIR	7,692	2,270	
COASTAL SCRUB				DRYLAND GRAIN CROPS			
CROPLAND		14,934		EASTSIDE PINE			
DECIDUOUS ORCHARD				EVERGREEN ORCHARD			
DOUGLAS FIR	13,456	10,754		FRESH EMERGENT WETLAND			
DRYLAND GRAIN CROPS				IRRIGATED GRAIN CROPS			
EASTSIDE PINE	360	90		IRRIGATED HAYFIELD			
EUCALYPTUS				IRRIGATED ROW AND FIELD CROPS			
EVERGREEN ORCHARD				JEFFREY PINE	216	90	
FRESH EMERGENT WETLAND				JUNIPER	6,773	2,378	
IRRIGATED GRAIN CROPS				KLAMATH MIXED CONIFER	27,183	29,111	
IRRIGATED HAYFIELD				LACUSTRINE	4,918	2,270	
IRRIGATED ROW AND FIELD CROPS			2100	LODGEPOLE PINE			
JEFFREY PINE	378	396		LOW SAGE			
JUNIPER	20,464	5,152		MIXED CHAPARRAL	3,170	1,405	
KLAMATH MIXED CONIFER	31,885	31,092		MONTANE CHAPARRAL	12,177	5,728	72
LACUSTRINE	8,160	2,792		MONTANE HARDWOOD	486	630	
LODGEPOLE PINE				MONTANE HARDWOOD-CONIFER	1,045	252	
LOW SAGE				MONTANE RIPARIAN	847	54	
MIXED CHAPARRAL	3,333	1,513		PASTURE		72	
MONTANE CHAPARRAL	13,763	7,404	72	PERENNIAL GRASSLAND	32,533	24,481	54
MONTANE HARDWOOD	3,225	1,441		PONDEROSA PINE			
MONTANE HARDWOOD-CONIFER	2,810	955		RED FIR	34,515	1,171	
MONTANE RIPARIAN	1,909	162		RICE			
PASTURE		522		RIVERINE		18	
PERENNIAL GRASSLAND	48,944	29,399	144	SAGEBRUSH			
PONDEROSA PINE		18		SIERRAN MIXED CONIFER	21,833	9,890	
RED FIR	58,617	4,269		SUBALPINE CONIFER			
RICE				URBAN		54	
RIVERINE		18		VALLEY FOOTHILL RIPARIAN			
SAGEBRUSH				VALLEY OAK WOODLAND			
SIERRAN MIXED CONIFER	31,092	21,761		VINEYARD			
SUBALPINE CONIFER				WET MEADOW	1,855	811	
URBAN		54		WHITE FIR	15,366	9,962	
VALLEY FOOTHILL RIPARIAN				<b>Total:</b>	<b>214,763</b>	<b>140,239</b>	<b>144</b>
VALLEY OAK WOODLAND							
VINEYARD							
WET MEADOW	5,891	4,359					
WHITE FIR	22,391	12,231					
<b>Total:</b>	<b>342,410</b>	<b>196,965</b>	<b>252</b>				

Land Cover Type (WHR)	Moderate Exposure - Consensus			Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal		Public	Private	Tribal
ALKALI DESERT SCRUB				ALPINE DWARF-SHRUB			
ALPINE DWARF-SHRUB				ANNUAL GRASSLAND	3,098	10,610	
ANNUAL GRASSLAND	4,089	13,601		ASPEN	2,342	198	
ASPEN	3,423	378		BARREN	52,745	8,701	18
BARREN	83,621	16,537	36	BITTERBRUSH	324	54	
BITTERBRUSH	3,873	2,630	126	BLUE OAK WOODLAND			
BLUE OAK WOODLAND				BLUE OAK-FOOTHILL PINE	36	198	
BLUE OAK-FOOTHILL PINE	685	540		CLOSED-CONE PINE-CYPRESS	2,990	288	
CHAMISE-REDSHANK CHAPARRAL				COASTAL OAK WOODLAND			
CLOSED-CONE PINE-CYPRESS	4,107	522		CROPLAND			
COASTAL OAK WOODLAND				DOUGLAS FIR	2,198	1,964	
COASTAL SCRUB				DRYLAND GRAIN CROPS			
CROPLAND	36	2,792		EASTSIDE PINE	72,110	13,222	54
DECIDUOUS ORCHARD				EVERGREEN ORCHARD			
DOUGLAS FIR	12,610	5,512		FRESH EMERGENT WETLAND			
DRYLAND GRAIN CROPS				IRRIGATED GRAIN CROPS			
EASTSIDE PINE	126,728	17,221	54	IRRIGATED HAYFIELD		1,873	
EUCALYPTUS				IRRIGATED ROW AND FIELD CROPS			
EVERGREEN ORCHARD				JEFFREY PINE	1,207	234	
FRESH EMERGENT WETLAND				JUNIPER	79,946	65,661	5,242
IRRIGATED GRAIN CROPS				KLAMATH MIXED CONIFER	15,978	8,485	
IRRIGATED HAYFIELD		2,756	2070	LACUSTRINE	4,341	7,548	
IRRIGATED ROW AND FIELD CROPS				LODGEPOLE PINE	6,125	180	
JEFFREY PINE	1,261	775		LOW SAGE	180	36	
JUNIPER	101,058	71,173	5,440	MIXED CHAPARRAL	33,470	19,635	
KLAMATH MIXED CONIFER	22,373	10,953		MONTANE CHAPARRAL	4,143	1,477	
LACUSTRINE	5,728	8,160		MONTANE HARDWOOD	2,270	2,756	
LODGEPOLE PINE	12,322	955		MONTANE HARDWOOD-CONIFER	3,243	1,765	
LOW SAGE	1,513	558		MONTANE RIPARIAN	4,377	1,081	

MIXED CHAPARRAL	33,614	19,851		PASTURE		1,225	
MONTANE CHAPARRAL	4,810	2,360		PERENNIAL GRASSLAND	1,333	4,540	
MONTANE HARDWOOD	3,152	3,279		PONDEROSA PINE	739	775	
MONTANE HARDWOOD-CONIFER	6,611	3,206		RED FIR	8,232	883	
MONTANE RIPARIAN	6,251	1,729		RICE			
PASTURE	54	2,090		RIVERINE	36	36	
PERENNIAL GRASSLAND	5,314	6,431		SAGEBRUSH	6,359	1,982	
PONDEROSA PINE	811	829		SIERRAN MIXED CONIFER	8,214	7,170	
RED FIR	17,311	2,792		SUBALPINE CONIFER	5,296		
RICE				URBAN			
RIVERINE	36	36		VALLEY FOOTHILL RIPARIAN			
SAGEBRUSH	11,547	2,504		VALLEY OAK WOODLAND			
SIERRAN MIXED CONIFER	8,791	10,394		VINEYARD			
SUBALPINE CONIFER	7,980	306		WET MEADOW	306	2,900	
URBAN				WHITE FIR	15,870	2,648	
VALLEY FOOTHILL RIPARIAN				Total:	337,510	168,233	5,314
VALLEY OAK WOODLAND							
VINEYARD							
WET MEADOW	360	4,323					
WHITE FIR	18,410	3,170					
Total:	508,481	218,365	5,656				

Land Cover Type (WHR)	Moderate Exposure - Consensus				Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal			Public	Private	Tribal
ALKALI DESERT SCRUB					ALPINE DWARF-SHRUB			
ALPINE DWARF-SHRUB					ANNUAL GRASSLAND	703	1,693	18
ANNUAL GRASSLAND	1,459	5,945	18		ASPEN	72		
ASPEN	90				BARREN	37,415	10,610	36
BARREN	54,276	12,826	36		BITTERBRUSH	216	198	
BITTERBRUSH	216	198			BLUE OAK WOODLAND			
BLUE OAK WOODLAND					BLUE OAK-FOOTHILL PINE	811	1,009	
BLUE OAK-FOOTHILL PINE	3,008	15,114			CLOSED-CONE PINE-CYPRESS	4,558	216	
CHAMISE-REDSHANK CHAPARRAL					COASTAL OAK WOODLAND			
CLOSED-CONE PINE-CYPRESS	4,612	270			CROPLAND		685	
COASTAL OAK WOODLAND					DOUGLAS FIR	13,943	13,204	
COASTAL SCRUB					DRYLAND GRAIN CROPS			
CROPLAND		1,441			EASTSIDE PINE	6,521	1,117	
DECIDUOUS ORCHARD					EVERGREEN ORCHARD			
DOUGLAS FIR	22,229	14,249			FRESH EMERGENT WETLAND			
DRYLAND GRAIN CROPS					IRRIGATED GRAIN CROPS			
EASTSIDE PINE	7,890	2,990			IRRIGATED HAYFIELD	378	38,262	180
EUCALYPTUS					IRRIGATED ROW AND FIELD CROPS			
EVERGREEN ORCHARD					JEFFREY PINE	2,486	306	
FRESH EMERGENT WETLAND					JUNIPER	3,819	216	
IRRIGATED GRAIN CROPS					KLAMATH MIXED CONIFER	32,569	11,691	
IRRIGATED HAYFIELD	378	65,247	180	2040	LACUSTRINE	18,572	4,503	
IRRIGATED ROW AND FIELD CROPS					LOGGPOLE PINE	4,107	306	
JEFFREY PINE	2,882	1,675			LOW SAGE	1,081	378	
JUNIPER	3,873	252			MIXED CHAPARRAL	24,391	10,376	
KLAMATH MIXED CONIFER	50,043	15,618			MONTANE CHAPARRAL	3,279	1,063	
LACUSTRINE	21,184	5,116			MONTANE HARDWOOD	8,034	4,936	
LOGGPOLE PINE	4,377	324			MONTANE HARDWOOD-CONIFER	7,908	7,242	36
LOW SAGE	3,008	757			MONTANE RIPARIAN	4,648	2,234	
MIXED CHAPARRAL	26,138	12,916			PASTURE		36	
MONTANE CHAPARRAL	4,576	1,765			PERENNIAL GRASSLAND	1,081	3,639	
MONTANE HARDWOOD	8,881	5,782			PONDEROSA PINE	42,711	27,796	
MONTANE HARDWOOD-CONIFER	10,394	9,007	36		RED FIR	1,027	144	
MONTANE RIPARIAN	5,332	2,468			RICE			
PASTURE		36			RIVERINE	72		
PERENNIAL GRASSLAND	2,738	5,188			SAGEBRUSH	7,098	342	
PONDEROSA PINE	56,960	37,397			SIERRAN MIXED CONIFER	56,456	25,526	
RED FIR	2,126	252			SUBALPINE CONIFER	7,944	18	
RICE					URBAN			
RIVERINE	72	36			VALLEY FOOTHILL RIPARIAN			
SAGEBRUSH	12,610	396			VALLEY OAK WOODLAND			
SIERRAN MIXED CONIFER	98,302	39,739			VINEYARD			
SUBALPINE CONIFER	10,484	54			WET MEADOW	450	1,946	
URBAN					WHITE FIR	11,169	2,756	
VALLEY FOOTHILL RIPARIAN					Total:	303,518	172,448	270
VALLEY OAK WOODLAND								
VINEYARD								
WET MEADOW	522	2,684						
WHITE FIR	17,257	3,405						
Total:	435,920	263,148	270					

Land Cover Type (WHR)	Moderate Exposure 95%				Land Cover Type (WHR)	Moderate Exposure 80-95%		
	Public	Private	Tribal			Public	Private	Tribal
ALKALI DESERT SCRUB	1,873	11,853			ALPINE DWARF-SHRUB			
ALPINE DWARF-SHRUB					ANNUAL GRASSLAND	6,863	26,354	36
ANNUAL GRASSLAND	12,250	56,888	36		ASPEN	162	72	
ASPEN	342	198			BARREN	51,772	14,483	36
BARREN	74,308	18,464	36		BITTERBRUSH	1,351	667	
BITTERBRUSH	6,323	5,638			BLUE OAK WOODLAND	757	2,306	
BLUE OAK WOODLAND	1,837	36,154			BLUE OAK-FOOTHILL PINE	1,855	7,476	18
BLUE OAK-FOOTHILL PINE	4,233	22,680	18		CLOSED-CONE PINE-CYPRESS	8,485	306	

CHAMISE-REDSHANK CHAPARRAL	144	216			COASTAL OAK WOODLAND			
CLOSED-CONE PINE-CYPRESS	9,529	685			CROPLAND	108	21,545	
COASTAL OAK WOODLAND	18	18			DOUGLAS FIR	39,973	28,264	
COASTAL SCRUB		18			DRYLAND GRAIN CROPS		468	
CROPLAND	252	42,657			EASTSIDE PINE	73,947	25,544	162
DECIDUOUS ORCHARD					EVERGREEN ORCHARD			
DOUGLAS FIR	50,529	34,875			FRESH EMERGENT WETLAND			
DRYLAND GRAIN CROPS		468			IRRIGATED GRAIN CROPS			
EASTSIDE PINE	96,951	35,127	162		IRRIGATED HAYFIELD	2,828	69,660	180
EUCALYPTUS					IRRIGATED ROW AND FIELD CROPS			
EVERGREEN ORCHARD					JEFFREY PINE	3,783	216	
FRESH EMERGENT WETLAND					JUNIPER	19,617	5,368	18
IRRIGATED GRAIN CROPS					KLAMATH MIXED CONIFER	41,919	24,895	
IRRIGATED HAYFIELD	2,828	98,915	180	2010	LACUSTRINE	17,708	8,737	
IRRIGATED ROW AND FIELD CROPS					LODGEPOLE PINE	12,123	2,126	
JEFFREY PINE	5,837	2,522			LOW SAGE	14,717	5,692	
JUNIPER	31,380	9,331	18		MIXED CHAPARRAL	37,073	18,699	18
KLAMATH MIXED CONIFER	54,006	28,336			MONTANE CHAPARRAL	40,712	13,150	
LACUSTRINE	23,418	10,808			MONTANE HARDWOOD	67,606	40,712	36
LODGEPOLE PINE	16,537	4,143			MONTANE HARDWOOD-CONIFER	34,929	22,535	18
LOW SAGE	25,598	8,340			MONTANE RIPARIAN	5,656	1,927	
MIXED CHAPARRAL	41,955	36,334	18		PASTURE	18	2,774	
MONTANE CHAPARRAL	54,042	15,942			PERENNIAL GRASSLAND	2,270	5,242	
MONTANE HARDWOOD	78,505	57,501	36		PONDEROSA PINE	51,106	44,278	
MONTANE HARDWOOD-CONIFER	41,342	29,147	18		RED FIR	27,075	1,495	
MONTANE RIPARIAN	6,665	2,468			RICE			
PASTURE	18	4,828			RIVERINE	270	126	
PERENNIAL GRASSLAND	4,359	8,340			SAGEBRUSH	79,352	15,546	
PONDEROSA PINE	70,128	58,185			SIERRAN MIXED CONIFER	136,294	104,355	72
RED FIR	43,089	4,485			SUBALPINE CONIFER	10,916	36	
RICE					URBAN			
RIVERINE	360	144			VALLEY FOOTHILL RIPARIAN			
SAGEBRUSH	109,669	20,050			VALLEY OAK WOODLAND			
SIERRAN MIXED CONIFER	202,081	151,065	72		VINEYARD			
SUBALPINE CONIFER	23,995	522			WET MEADOW	1,387	3,603	
URBAN	72	11,295	90		WHITE FIR	49,574	12,592	
VALLEY FOOTHILL RIPARIAN	18	486						
VALLEY OAK WOODLAND		306						
VINEYARD								
WET MEADOW	2,306	5,746						
WHITE FIR	60,275	14,087						
<b>Total:</b>	<b>1,157,074</b>	<b>849,269</b>	<b>685</b>		<b>Total:</b>	<b>842,208</b>	<b>531,250</b>	<b>594</b>



This is supplementary table 2 for land cover (WHR) types, showing areas of consensus moderate exposure in each of the 5 watersheds  
 Extent = Pi Watershed  
 RCP5.5 area = acres

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB	3,098	6,449	18
ANNUAL GRASSLAND			
ASPEN	21,599	5,710	
BARREN			
BITTERBRUSH	18		
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE	721		
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS	324		
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			9,385
DECIDUOUS ORCHARD			
DOUGLAS FIR	72		
DRYLAND GRAIN CROPS			
EASTSIDE PINE			
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE			
JUNIPER	6,773	2,378	
KLAMATH MIXED CONIFER	1,810	1,549	
LACUSTRINE	1,565	216	
LOGPOLE PINE			
LOW SAGE			
MIXED CHAPARRAL	2,198	1,405	
MONTANE CHAPARRAL	5,170	2,018	72
MONTANE HARDWOOD	432	540	
MONTANE HARDWOOD-CONIFER	737	216	
MONTANE RIPARIAN	72		
PASTURE	72		
PERENNIAL GRASSLAND	32,407	24,373	54
PONDEROSA PINE			
RED FIR	15,816	126	
RICE			
RIVERINE			
SAGEBRUSH			
SIERRA MIXED CONIFER	2,792	4,179	
SUBALPINE CONIFER			
URBAN			36
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	1,387	594	
WHITE FIR	3,297	3,711	
Total:	101,275	63,091	144

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB	4,053	20,932	
ANNUAL GRASSLAND			
ASPEN	5,981	847	
BARREN			
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE			
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS			
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			5,062
DECIDUOUS ORCHARD			
DOUGLAS FIR			18
DRYLAND GRAIN CROPS			
EASTSIDE PINE			
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE	54	72	
JUNIPER			
KLAMATH MIXED CONIFER	1,351	1,711	
LACUSTRINE			
LOGPOLE PINE			
LOW SAGE			
MIXED CHAPARRAL	883	90	
MONTANE CHAPARRAL	4,702	522	
MONTANE HARDWOOD	288	18	
MONTANE HARDWOOD-CONIFER	90		
MONTANE RIPARIAN			
PASTURE			
PERENNIAL GRASSLAND	72		
PONDEROSA PINE			
RED FIR	4,017		
RICE			
RIVERINE			18
SAGEBRUSH			
SIERRA MIXED CONIFER	18,969	5,620	
SUBALPINE CONIFER			
URBAN			18
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	468	216	
WHITE FIR	5,837	1,351	
Total:	46,764	36,406	0

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB	18	234	
ANNUAL GRASSLAND			
ASPEN	8,034	162	
BARREN			
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE			
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS			
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			
DECIDUOUS ORCHARD			
DOUGLAS FIR	7,602	2,180	
DRYLAND GRAIN CROPS			
EASTSIDE PINE			
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE	144	18	
JUNIPER			
KLAMATH MIXED CONIFER	6,431	6,305	
LACUSTRINE	1,582		
LOGPOLE PINE			
LOW SAGE			
MIXED CHAPARRAL	90		
MONTANE CHAPARRAL	450	522	
MONTANE HARDWOOD	54		
MONTANE HARDWOOD-CONIFER	18		
MONTANE RIPARIAN	649	54	
PASTURE			
PERENNIAL GRASSLAND	54		
PONDEROSA PINE			
RED FIR	12,970	414	
RICE			
RIVERINE			
SAGEBRUSH			
SIERRA MIXED CONIFER			
SUBALPINE CONIFER			
URBAN			
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	270	54	
WHITE FIR	38,712	10,016	
Total:	270	54	

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB			
ANNUAL GRASSLAND			
ASPEN			
BARREN			
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE			
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS			
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			
DECIDUOUS ORCHARD			
DOUGLAS FIR			
DRYLAND GRAIN CROPS			
EASTSIDE PINE			
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE			
JUNIPER			
KLAMATH MIXED CONIFER	9,818	8,647	
LACUSTRINE			
LOGPOLE PINE			
LOW SAGE			
MIXED CHAPARRAL			
MONTANE CHAPARRAL	991	234	
MONTANE HARDWOOD			
MONTANE HARDWOOD-CONIFER			
MONTANE RIPARIAN	36		
PASTURE			
PERENNIAL GRASSLAND	36	54	
PONDEROSA PINE			
RED FIR	558	540	
RICE			
RIVERINE			
SAGEBRUSH			
SIERRA MIXED CONIFER	72	90	
SUBALPINE CONIFER			
URBAN			
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	4,089	4,341	
WHITE FIR	15,834	16,447	
Total:	4,089	4,341	

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB			
ANNUAL GRASSLAND			
ASPEN			
BARREN			
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE			
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS			
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			
DECIDUOUS ORCHARD			
DOUGLAS FIR			
DRYLAND GRAIN CROPS			
EASTSIDE PINE			
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE			
JUNIPER			
KLAMATH MIXED CONIFER	8,124	12,610	
LACUSTRINE			
LOGPOLE PINE			
LOW SAGE			
MIXED CHAPARRAL			
MONTANE CHAPARRAL	865	2,432	
MONTANE HARDWOOD			
MONTANE HARDWOOD-CONIFER			
MONTANE RIPARIAN			
PASTURE			
PERENNIAL GRASSLAND			
PONDEROSA PINE			
RED FIR			
RICE			
RIVERINE			
SAGEBRUSH			
SIERRA MIXED CONIFER			
SUBALPINE CONIFER			
URBAN			
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	1,873	504	
WHITE FIR	12,177	16,339	
Total:	1,873	504	

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB	775	7,440	
ANNUAL GRASSLAND	2,342	198	
ASPEN	39,379	6,485	18
BARREN	324	54	
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE	162		
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS	2,648	162	
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			108
DECIDUOUS ORCHARD			
DOUGLAS FIR	594	793	
DRYLAND GRAIN CROPS			
EASTSIDE PINE	49,971	9,079	54
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE			
JUNIPER	79,892	65,643	#####
KLAMATH MIXED CONIFER	2,564	863	
LACUSTRINE	1,621	2,504	
LOGPOLE PINE	1,297	72	
LOW SAGE	180	36	
MIXED CHAPARRAL	33,434	19,635	
MONTANE CHAPARRAL	90		
MONTANE HARDWOOD	1,225	1,567	
MONTANE HARDWOOD-CONIFER	937	937	
MONTANE RIPARIAN	54	90	
PASTURE			
PERENNIAL GRASSLAND	1,297	4,395	
PONDEROSA PINE	18		
RED FIR	216		
RICE			
RIVERINE	18		
SAGEBRUSH	4,738	1,891	
SIERRA MIXED CONIFER	504	54	
SUBALPINE CONIFER			
URBAN			
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	234	1,153	
WHITE FIR	594		
Total:	224,562	#####	#####

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB	2,180	1,837	
ANNUAL GRASSLAND			
ASPEN	8,989	1,675	
BARREN			
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE			
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS			
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			
DECIDUOUS ORCHARD			
DOUGLAS FIR	162	378	
DRYLAND GRAIN CROPS			
EASTSIDE PINE	22,139	4,143	
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE	973	144	
JUNIPER	54	18	
KLAMATH MIXED CONIFER	955	4,918	
LACUSTRINE	4,828	108	
LOGPOLE PINE			
LOW SAGE			
MIXED CHAPARRAL			
MONTANE CHAPARRAL	2,738	685	
MONTANE HARDWOOD	486	324	
MONTANE HARDWOOD-CONIFER	937	90	
MONTANE RIPARIAN	3,747	739	
PASTURE			
PERENNIAL GRASSLAND	18	108	
PONDEROSA PINE	18	198	
RED FIR	8,070	216	
RICE			
RIVERINE	18	18	
SAGEBRUSH	1,621	90	
SIERRA MIXED CONIFER	8,214	7,116	
SUBALPINE CONIFER			
URBAN			
VALLEY FOOTHILL RIPARIAN			
VALLEY OAK WOODLAND			
VINEYARD			
WET MEADOW	54	1,747	
WHITE FIR	15,276	2,648	
Total:	81,495	27,201	0

Land Cover Type (WHR)	Moderate Exposure - Consensus		
	Public	Private	Tribal
ALKALI DESERT SCRUB			
ALPINE DWARF-SHRUB	90	829	
ANNUAL GRASSLAND			
ASPEN	3,945	216	
BARREN			
BITTERBRUSH			
BLUE OAK WOODLAND			
BLUE OAK-FOOTHILL PINE	36	36	
CHAMISE-REDSHANK CHAPARRAL			
CLOSED-CONE PINE-CYPRESS			
COASTAL OAK WOODLAND			
COASTAL SCRUB			
CROPLAND			
DECIDUOUS ORCHARD			
DOUGLAS FIR	919	324	
DRYLAND GRAIN CROPS			
EASTSIDE PINE			
EUCALYPTUS			
EVERGREEN ORCHARD			
FRESH EMERGENT WETLAND			
IRRIGATED GRAIN CROPS			
IRRIGATED HAYFIELD			
IRRIGATED ROW AND FIELD CROPS			
JEFFREY PINE	36	36	
JUNIPER			
KLAMATH MIXED CONIFER	3,981		

WET MEADOW	18	1,315	
WHITE FIR	2,198	1,153	
Total:	132,691	50,881	234

WET MEADOW	162	630	
WHITE FIR	1,783	306	
Total:	72,813	31,488	36

WET MEADOW	270	
WHITE FIR	4,648	1,117
Total:	45,701	22,049

WET MEADOW	72	18
WHITE FIR		
Total:	26,553	19,365

WET MEADOW	2,468	162
WHITE FIR		
Total:	21,761	8,665







This supplementary table to the Annual Report provides information on the financial performance of the Group's operations.

Land Cover Type (DMS)	2019			2018		
	Area (ha)	Volume (m³)	Value (€)	Area (ha)	Volume (m³)	Value (€)
Forest	1,120	1,210	1,210	1,120	1,210	1,210
Grassland	210	1,210	1,210	210	1,210	1,210
Arable land	140	1,210	1,210	140	1,210	1,210
Water	140	1,210	1,210	140	1,210	1,210
Other	140	1,210	1,210	140	1,210	1,210
<b>Total</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>

This supplementary table to the Annual Report provides information on the financial performance of the Group's operations.

Land Cover Type (DMS)	2019			2018		
	Area (ha)	Volume (m³)	Value (€)	Area (ha)	Volume (m³)	Value (€)
Forest	1,120	1,210	1,210	1,120	1,210	1,210
Grassland	210	1,210	1,210	210	1,210	1,210
Arable land	140	1,210	1,210	140	1,210	1,210
Water	140	1,210	1,210	140	1,210	1,210
Other	140	1,210	1,210	140	1,210	1,210
<b>Total</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>

This supplementary table to the Annual Report provides information on the financial performance of the Group's operations.

Land Cover Type (DMS)	2019			2018		
	Area (ha)	Volume (m³)	Value (€)	Area (ha)	Volume (m³)	Value (€)
Forest	1,120	1,210	1,210	1,120	1,210	1,210
Grassland	210	1,210	1,210	210	1,210	1,210
Arable land	140	1,210	1,210	140	1,210	1,210
Water	140	1,210	1,210	140	1,210	1,210
Other	140	1,210	1,210	140	1,210	1,210
<b>Total</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>

This supplementary table to the Annual Report provides information on the financial performance of the Group's operations.

Land Cover Type (DMS)	2019			2018		
	Area (ha)	Volume (m³)	Value (€)	Area (ha)	Volume (m³)	Value (€)
Forest	1,120	1,210	1,210	1,120	1,210	1,210
Grassland	210	1,210	1,210	210	1,210	1,210
Arable land	140	1,210	1,210	140	1,210	1,210
Water	140	1,210	1,210	140	1,210	1,210
Other	140	1,210	1,210	140	1,210	1,210
<b>Total</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>

This supplementary table to the Annual Report provides information on the financial performance of the Group's operations.

Land Cover Type (DMS)	2019			2018		
	Area (ha)	Volume (m³)	Value (€)	Area (ha)	Volume (m³)	Value (€)
Forest	1,120	1,210	1,210	1,120	1,210	1,210
Grassland	210	1,210	1,210	210	1,210	1,210
Arable land	140	1,210	1,210	140	1,210	1,210
Water	140	1,210	1,210	140	1,210	1,210
Other	140	1,210	1,210	140	1,210	1,210
<b>Total</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>

This supplementary table to the Annual Report provides information on the financial performance of the Group's operations.

Land Cover Type (DMS)	2019			2018		
	Area (ha)	Volume (m³)	Value (€)	Area (ha)	Volume (m³)	Value (€)
Forest	1,120	1,210	1,210	1,120	1,210	1,210
Grassland	210	1,210	1,210	210	1,210	1,210
Arable land	140	1,210	1,210	140	1,210	1,210
Water	140	1,210	1,210	140	1,210	1,210
Other	140	1,210	1,210	140	1,210	1,210
<b>Total</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>	<b>1,710</b>	<b>5,040</b>	<b>5,040</b>

This is supplementary table 5 for landcover, showing total area in each WHR type

area = acres

WHR Description	Study Area	5-Watersheds	Pit	Feather	Upper Trinity	McCloud	Upper Sacramento
ALKALI DESERT SCRUB	19,149						
ALPINE DWARF-SHRUB	703	396				252	144
ANNUAL GRASSLAND	194,623	110,101	30,282	67,661	4,684	4,431	3,044
ASPEN	6,827	4,774	4,017	721		36	
BARREN	179,095	111,164	54,078	24,895	13,150	10,124	8,917
BITTERBRUSH	95,564	31,056	30,822			234	
BLUE OAK WOODLAND	74,308	6,161	540	5,620			
BLUE OAK-FOOTHILL PINE	84,359	29,939	6,665	19,491	252	865	2,666
CHAMISE-REDSHANK CHAPARRAL	1,639						
CLOSED-CONE PINE-CYPRESS	15,888	12,141	7,350		775	2,648	1,369
COASTAL OAK WOODLAND	180	18		18			
COASTAL SCRUB	72						
CROPLAND	241,135	184,950	114,371	70,561			18
DECIDUOUS ORCHARD	180						
DOUGLAS FIR	403,603	267,364	41,072	38,172	115,596	25,994	46,530
DRYLAND GRAIN CROPS	9,331	7,620	7,242	378			
EASTSIDE PINE	899,060	656,736	452,241	196,803	360	3,567	3,765
EUCALYPTUS	36						
EVERGREEN ORCHARD	775	36	18	18			
FRESH EMERGENT WETLAND	667	216	144	72			
IRRIGATED GRAIN CROPS	919	901	901				
IRRIGATED HAYFIELD	111,471	76,559	66,832	9,674			54
IRRIGATED ROW AND FIELD CROPS	414	396	396				
JEFFREY PINE	73,857	43,954	21,923	21,275	414		342
JUNIPER	441,451	328,611	327,818	793			
KLAMATH MIXED CONIFER	474,596	363,306	27,760		140,743	78,289	116,514
LACUSTRINE	108,264	57,897	26,733	17,383	5,909	2,306	5,566
LODGEPOLE PINE	82,720	44,170	25,472	14,105	90	4,503	
LOW SAGE	404,288	289,719	289,016	703			
MIXED CHAPARRAL	152,236	96,735	72,344	13,006	1,333	1,837	8,214
MONTANE CHAPARRAL	553,083	420,626	197,848	124,657	51,070	20,968	26,084
MONTANE HARDWOOD	325,873	226,994	71,479	79,442	4,035	25,886	46,152
MONTANE HARDWOOD-CONIFER	271,417	216,276	59,842	75,875	11,061	24,535	44,963
MONTANE RIPARIAN	27,633	21,635	5,530	14,051	937	1,081	36
PASTURE	16,014	7,260	7,043	90		90	36
PERENNIAL GRASSLAND	144,652	95,816	89,529	2,936	1,964	1,081	306
PONDEROSA PINE	477,803	345,220	212,061	54,132	2,504	70,273	6,251
RED FIR	323,171	186,355	47,701	66,724	33,614	29,219	9,097
RICE	360	360	360				
RIVERINE	2,054	1,207	396	811			
SAGEBRUSH	864,077	502,608	376,186	126,350	18	54	
SIERRAN MIXED CONIFER	2,124,803	1,617,295	567,080	957,155		79,478	13,583
SUBALPINE CONIFER	60,869	30,552	8,899	1,549	16,032	1,351	2,720
URBAN	36,568	12,844	2,378	6,881	198	558	2,828
VALLEY FOOTHILL RIPARIAN	2,666	811	234	252		54	270
VALLEY OAK WOODLAND	1,369	36	18	18			
VINEYARD	90	36	18		18		
WET MEADOW	89,566	52,367	30,606	19,113	1,153	414	1,081
WHITE FIR	545,463	398,794	89,457	217,086	35,812	41,288	15,150
<b>Total:</b>	<b>9,944,943</b>	<b>6,862,012</b>	<b>3,374,703</b>	<b>2,248,469</b>	<b>441,721</b>	<b>431,417</b>	<b>365,702</b>

**These are the final connectivity tables. They cross rank connectivity with climate exposure of the vegetation.**

There are 6 tabs: 2 main tables and 5 appendix tabs.

Main1_Conn_ConsensusRefHighExp	Consensus Refugia & High Exposure: Summaries
Main2_Conn_ConsensusModExp	Consensus Moderate Exposure: Summaries
Apx1_Conn_ConRefHighExp_5Watshd	Consensus Refugia & High Exposure: By Watershed
Apx2_Conn_ConModExp_5Watshd	Consensus Moderate Exposure: By Watershed
Apx3_Conn_RefHighExp	Single Model Refugia & High Exposure: Summaries and by Watershed
Apx4_Conn_ModExp	Single Model Moderate Exposure: Summaries and by Watershed
Apx5_Conn_AreaByRank	Total Area by Connectivity Rank

This is the Consensus Refugia & High Exposure by Connectivity Ranking table for use in the main text. Refugia & High Exposure by watershed tables are in appendix 1, single climate model tables are in appendix 3.  
 Extent = Entire Study Area (5-Watersheds plus 10km buffer)  
 RCP8.5 area = acres

Connectivity Ranking	Refugia -			Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	109,345	13,727		21,365	3,621		133,069	42,063	18			
4	41,864	7,368		6,251	2,234		41,666	25,310				
3	503,022	106,571		47,863	25,868	54	568,035	191,218	1,243			
2	162,450	74,073		18,374	19,383	36	171,079	144,652	126			
1: Low	389,534	375,826	54	42,639	51,502	54	323,729	285,468	432			
0: Not Selected	31,723	63,733	54	3,008	29,579	162	30,083	246,611	414			
<b>Total:</b>	<b>1,237,939</b>	<b>641,298</b>	<b>108</b>	<b>139,500</b>	<b>132,187</b>	<b>306</b>	<b>1,267,662</b>	<b>935,322</b>	<b>2,234</b>			

Extent = 5-Watersheds  
 RCP8.5 area = acres

Connectivity Ranking	Refugia -			Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	66,291	10,448		17,744	2,450		107,850	31,651				
4	27,507	5,620		5,134	1,765		34,839	17,726				
3	345,977	71,642		36,172	13,601	54	382,761	110,678	360			
2	116,424	44,026		14,988	14,105	36	129,232	71,281	126			
1: Low	249,494	267,976		26,607	38,874	54	241,712	157,712	324			
0: Not Selected	24,283	43,396	54	2,216	22,535	162	18,554	111,633	306			
<b>Total:</b>	<b>829,976</b>	<b>443,108</b>	<b>54</b>	<b>102,860</b>	<b>93,330</b>	<b>306</b>	<b>914,948</b>	<b>500,681</b>	<b>1,117</b>			

Connectivity Ranking	Refugia -			Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	259,041	46,260		14,483	4,828		14,862	6,125	18			
4	101,779	26,913	36	5,368	3,243		5,620	4,395				
3	917,740	242,612	144	49,899	17,005		256,069	89,638	1,081			
2	304,400	161,657	18	26,066	19,419		43,936	73,587	126			
1: Low	759,001	681,127	432	63,860	64,382	234	75,262	109,759	360			
0: Not Selected	54,042	117,145	324	7,278	99,473	468	11,133	167,224	216			
<b>Total:</b>	<b>2,396,004</b>	<b>1,275,714</b>	<b>955</b>	<b>166,954</b>	<b>208,350</b>	<b>703</b>	<b>406,882</b>	<b>450,728</b>	<b>1,801</b>			

Connectivity Ranking	Refugia -			Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	189,831	34,064		10,898	3,765		11,205	4,197				
4	76,289	21,401	36	4,540	2,090		4,576	2,288				
3	645,009	147,913	72	35,019	13,042		184,445	46,818	342			
2	237,334	120,964		23,256	14,663		33,560	36,262	126			
1: Low	509,525	527,738	270	53,970	40,351	234	58,023	58,185	252			
0: Not Selected	38,046	85,656	324	5,116	83,026	468	8,358	84,359	216			
<b>Total:</b>	<b>1,696,034</b>	<b>937,736</b>	<b>703</b>	<b>132,799</b>	<b>156,938</b>	<b>703</b>	<b>300,167</b>	<b>232,110</b>	<b>937</b>			

Connectivity Ranking	Refugia -			Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	352,065	84,972	90	24,391	3,999		9,583	1,315				
4	139,338	49,953	54	6,647	1,585		3,513	937				
3	1,260,546	360,784	1,045	44,927	15,024		32,785	17,239	36			
2	388,183	211,016	450	16,447	11,511		15,096	18,212				
1: Low	958,092	806,342	2,414	31,759	30,119		27,633	38,604				
0: Not Selected	66,093	187,291	1,315	3,098	22,968	36	3,495	59,933	36			
<b>Total:</b>	<b>3,164,318</b>	<b>1,700,358</b>	<b>5,368</b>	<b>127,269</b>	<b>85,206</b>	<b>36</b>	<b>92,105</b>	<b>136,240</b>	<b>72</b>			

Connectivity Ranking	Refugia -			Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	271,993	66,273		14,249	3,243		4,972	991				
4	111,092	40,604	54	4,215	1,243		2,198	486				
3	871,120	218,311	775	24,175	11,403		18,014	9,457	36			
2	310,363	150,417	432	12,069	7,818		8,467	11,061				
1: Low	658,501	627,895	2,270	25,778	20,698		14,123	23,094				
0: Not Selected	45,774	106,445	1,315	2,414	15,132	36	2,738	44,837	18			
<b>Total:</b>	<b>2,268,843</b>	<b>1,209,945</b>	<b>4,846</b>	<b>82,900</b>	<b>59,536</b>	<b>36</b>	<b>50,511</b>	<b>89,926</b>	<b>54</b>			

Connectivity Ranking	Refugia			< High Exposure 99%			95- Very High Exposure > 99%		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	420,915	99,978	162	56,942	9,313		20,194	3,333	
4	164,233	59,680	72	18,194	5,476		5,530	1,711	
3	1,857,980	544,779	2,486	146,111	52,277	126	50,547	15,150	
2	567,512	321,910	829	43,216	40,387	54	13,997	12,250	
1: Low	1,409,000	1,158,155	5,224	60,437	84,053	54	17,780	27,129	
0: Not Selected	108,786	416,681	3,225	5,945	79,370	72	1,801	24,859	
<b>Total:</b>	<b>4,528,427</b>	<b>2,601,183</b>	<b>11,997</b>	<b>330,845</b>	<b>270,876</b>	<b>306</b>	<b>109,849</b>	<b>84,432</b>	<b>0</b>

Connectivity Ranking	Refugia			< High Exposure 99%			95- Very High Exposure > 99%		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	302,671	76,451		32,191	6,053		11,709	2,108	
4	129,214	48,332	72	10,700	3,747		3,243	757	
3	1,281,785	338,285	1,333	97,960	30,660	126	32,407	9,295	
2	442,946	215,501	811	30,372	22,265	54	10,016	6,953	
1: Low	942,005	847,900	4,954	43,360	51,268	54	13,583	19,851	
0: Not Selected	75,551	276,172	3,206	3,963	40,261	54	1,369	16,393	
<b>Total:</b>	<b>3,174,172</b>	<b>1,802,641</b>	<b>10,376</b>	<b>218,546</b>	<b>154,254</b>	<b>288</b>	<b>72,326</b>	<b>55,357</b>	<b>0</b>

This is the Moderate Exposure by Connectivity Ranking table for use in main text. Moderate exposure by watershed tables are in appendix 2, single climate model tables are in appendix 4.

Extent = Entire Study Area (5-Watersheds plus 10km buffer)

Extent = 5-Watersheds

RCP8.5 area = acres

RCP8.5 area = acres

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	43,071	6,287	18
4	12,051	2,954	36
3	164,233	42,009	144
2	38,424	27,940	18
1: Low	68,165	70,579	36
0: Not Selected	16,465	47,197	
<b>Total:</b>	<b>342,410</b>	<b>196,965</b>	<b>252</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	23,382	4,774	
4	8,521	2,360	36
3	105,022	24,049	72
2	26,553	20,860	
1: Low	42,117	50,475	36
0: Not Selected	9,169	37,721	
<b>Total:</b>	<b>214,763</b>	<b>140,239</b>	<b>144</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	59,122	12,610	144
4	17,402	6,575	18
3	253,871	57,807	1,063
2	56,762	29,939	594
1: Low	111,326	66,273	2,810
0: Not Selected	9,998	45,161	1,027
<b>Total:</b>	<b>508,481</b>	<b>218,365</b>	<b>5,656</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	35,397	9,655	
4	13,943	5,224	18
3	165,999	43,035	865
2	41,738	22,572	594
1: Low	72,470	49,863	2,810
0: Not Selected	7,962	37,883	1,027
<b>Total:</b>	<b>337,510</b>	<b>168,233</b>	<b>5,314</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	41,558	5,746	
4	15,438	2,612	
3	190,912	41,919	18
2	56,384	29,453	
1: Low	115,289	111,344	108
0: Not Selected	16,339	72,074	144
<b>Total:</b>	<b>435,920</b>	<b>263,148</b>	<b>270</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	22,121	4,485	
4	9,619	1,747	
3	137,915	25,562	18
2	41,324	16,519	
1: Low	80,000	72,740	108
0: Not Selected	12,538	51,394	144
<b>Total:</b>	<b>303,518</b>	<b>172,448</b>	<b>270</b>

Connectivity Ranking	Moderate Exposure 95%		80-95%
	Public	Private	
5: High	175,006	40,117	
4	50,998	16,861	
3	474,578	158,523	108
2	150,345	120,045	
1: Low	277,884	312,254	234
0: Not Selected	28,264	201,468	342
<b>Total:</b>	<b>1,157,074</b>	<b>849,269</b>	<b>685</b>

Connectivity Ranking	Moderate Exposure 80-95%		Tribal
	Public	Private	
5: High	127,449	33,794	
4	38,190	13,330	
3	351,074	96,159	108
2	111,903	68,849	
1: Low	194,641	200,279	234
0: Not Selected	18,951	118,838	252
<b>Total:</b>	<b>842,208</b>	<b>531,250</b>	<b>594</b>

This is a supplementary table for connectivity, showing area of consensus referrals & high exposure in each of the 5 subnetworks

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	16,541	4,854	13,333	885	10,399	9,536	21,871	955	12,229	627	45,611	15,709	4		
4	6,215	2,806	1,508	260	10,800	5,214	13,024	1,826	2,225	627	10,861	9,267	4		
2	151,970	26,488	15,132	4,900	147,880	47,266	16,625	15,024	15,588	84,377	51,266	18	2160	2	
2	16,700	10,000	6,980	2,818	10,970	30,266	41,226	11,007	4,688	8,771	64,850	31,264	18	2	
S Low	79,424	122,874	11,116	10,570	14	168,886	63,637	12,101	16,177	15,651	84,836	40,820	18	2	
0 Not Selected	6,467	21,648	54	885	1,740	203	1,368	1,873	1,008	11,645	18,163	90	0 Not Selected		
Total	280,042	209,719	54	31,893	24,644	212	151,922	27,658	0	53,119	48,550	18	27,623	207,071	144

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	36,246	18,158	14,976	2,214	1,008	17,447	32,044	7,854	3,810	855	4,467	2,188	4		
4	18,078	7,122	20	1,864	1,207	1,488	39,254	17,764	1,509	702	14,802	1,281	4		
2000	244,630	10,417	72	21,094	7,873	168,840	24,371	214	207,559	27,979	16,212	3,711	12,146	21,491	18
2	104,085	48,704	10,562	10,275	18,478	124,862	19,429	10,275	16,429	10,275	16,880	11,120	18	2	
S Low	17,082	20,562	270	45,738	20,484	214	43,930	26,208	214	282,234	165,607	6,447	6,447	13,810	18
0 Not Selected	15,688	18,075	200	1,961	87,271	459	1,608	172,008	198	1,629	20,706	90	797	15,121	18
Total	591,218	201,858	632	84,718	118,844	700	221,962	174,206	865	685,756	228,599	90	27,064	32,083	0

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	75,144	18,078	27,708	1,027	1,512	117	118,241	15,856	6,467	775	1,180	221	4		
4	48,246	18,158	54	885	424	376	102,729	10,024	2,108	306	730	180	4		
2000	426,204	109,761	775	5,800	8,211	7,818	1,468	1,468	361,202	181,818	6,796	3,817	4,700	5,002	2000
2	105,079	10,280	420	5,480	3,756	4,900	1,900	1,900	133,813	16,771	6,213	3,659	2,448	7,200	2
S Low	271,274	107,610	2,270	3,095	7,500	4,637	4,634	4,634	397,244	169,619	11,574	6,648	1,008	11,180	4
0 Not Selected	33,719	16,480	1,121	751	8,834	18	685	15,112	12,214	16,279	146	395	3,702	24,700	18
Total	1,007,134	489,762	4,700	23,204	21,844	36	164,800	24,138	36	872,151	181,817	148	24,400	48,200	18

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	16,820	18,078	12,022	2,108	1,210	757	12,022	15,856	6,467	1,410	1,410	142	4		
4	16,824	15,112	72	2,801	1,617	840	400	400	12,022	15,856	6,467	1,410	142	4	
2000	786,204	109,761	1,210	20,207	9,452	14	1,671	1,671	301,467	161,818	14,620	10,206	17,702	4,210	2000
2	237,280	109,761	700	11,837	8,577	14	3,759	1,511	183,823	77,792	18	14,481	11,862	1,038	3,475
S Low	449,827	109,712	4,850	10,570	10,210	14	1,828	1,828	382,789	201,944	18	22,566	14,788	4,570	3,800
0 Not Selected	48,412	109,712	2,872	1,495	18,211	14	122	617	20,719	20,719	247	17,447	17,447	34	6,511
Total	1,620,075	489,762	10,000	48,212	48,212	200	31,110	22,681	0	744,816	161,818	14,627	24,140	19,800	0

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	16,824	2,000	300	50	820	18	1,824	600	300	50	300	18	4		
4	16,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824
2100	2	16,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824
2	16,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824
S Low	48,214	48,214	1,824	1,824	48,214	48,214	48,214	48,214	48,214	48,214	48,214	48,214	48,214	48,214	48,214
0 Not Selected	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824	1,824
Total	184,500	71,300	4,700	5,200	8,500	144	144	144	144	144	144	144	144	144	144

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	21,810	7,122	362	72	360	14	21,810	7,122	362	72	360	14	4		
4	7,122	7,122	362	362	362	362	7,122	7,122	362	362	362	362	362	362	362
2000	21,810	10,280	306	144	647	108	21,810	10,280	306	144	647	108	4		
2	1,621	1,621	108	108	108	108	1,621	1,621	108	108	108	108	108	108	108
S Low	15,107	77,944	707	1,113	3,677	2,018	15,107	77,944	707	1,113	3,677	2,018	4		
0 Not Selected	3,162	11,761	344	252	1,121	1,121	3,162	11,761	344	252	1,121	1,121	4		
Total	66,283	127,982	2,261	1,480	5,484	1,511	66,283	127,982	2,261	1,480	5,484	1,511	4		

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	11,817	1,817	362	72	360	14	11,817	1,817	362	72	360	14	4		
4	1,817	1,817	362	362	362	362	1,817	1,817	362	362	362	362	362	362	362
2000	11,817	10,280	306	144	647	108	11,817	10,280	306	144	647	108	4		
2	1,621	1,621	108	108	108	108	1,621	1,621	108	108	108	108	108	108	108
S Low	15,107	77,944	707	1,113	3,677	2,018	15,107	77,944	707	1,113	3,677	2,018	4		
0 Not Selected	3,162	11,761	344	252	1,121	1,121	3,162	11,761	344	252	1,121	1,121	4		
Total	83,139	173,487	2,261	1,480	5,484	1,511	83,139	173,487	2,261	1,480	5,484	1,511	4		

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	22,000	9,000	1,000	1,000	1,000	14	22,000	9,000	1,000	1,000	1,000	14	4		
4	9,000	9,000	1,000	1,000	1,000	1,000	9,000	9,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2000	22,000	10,280	306	144	647	108	22,000	10,280	306	144	647	108	4		
2	1,621	1,621	108	108	108	108	1,621	1,621	108	108	108	108	108	108	108
S Low	15,107	77,944	707	1,113	3,677	2,018	15,107	77,944	707	1,113	3,677	2,018	4		
0 Not Selected	3,162	11,761	344	252	1,121	1,121	3,162	11,761	344	252	1,121	1,121	4		
Total	68,190	140,000	2,261	1,480	5,484	1,511	68,190	140,000	2,261	1,480	5,484	1,511	4		

ECPI 1 area + access

Connectivity Ranking	Refugee + Communitarian					High Exposure - Communitarian					Very High Exposure - Communitarian				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
S High	11,817	1,817	362	72	360	14	11,817	1,817	362	72	360	14	4		
4	1,817	1,817	362	362	362	362	1,817	1,817	362	362	362	362	362	362	362
2000	11,817	10,280	306	144	647	108	11,817	10,280	306	144	647	108	4		
2	1,621	1,621	108	108	108	108	1,621	1,621	108	108	108	108	108	108	108
S Low	15,107	77,944	707	1,113	3,677	2,018	15,107	77,944	707	1,113	3,677	2,018	4		
0 Not Selected	3,162	11,761	344	252	1,121	1,121	3,162	11,761	344	252	1,121	1,121	4		



This is supplementary table 2 for connectivity, showing areas of consensus moderate exposure in each of the 5 watersheds

Extent = Pit Watershed  
RCP8.5 area = acres

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	6,269	1,891	
4	2,234	685	36
2100 3	59,860	12,069	72
2	14,285	8,340	
1: Low	13,853	21,022	36
0: Not Selected	4,774	19,023	
<b>Total:</b>	<b>101,275</b>	<b>63,031</b>	<b>144</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	17,077	7,728	
4	8,431	2,972	18
2070 3	126,548	35,884	865
2	26,048	15,510	594
1: Low	41,126	36,604	2,810
0: Not Selected	5,332	28,084	1,027
<b>Total:</b>	<b>224,562</b>	<b>126,782</b>	<b>5,314</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	7,242	2,558	
4	3,513	991	
2040 3	70,399	14,159	18
2	21,383	10,214	
1: Low	26,030	25,886	108
0: Not Selected	4,125	37,073	108
<b>Total:</b>	<b>132,691</b>	<b>90,881</b>	<b>234</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	45,026	14,916	
4	14,591	4,666	
2010 3	160,937	43,396	108
2	50,709	28,444	
1: Low	59,644	80,378	234
0: Not Selected	5,350	81,081	198
<b>Total:</b>	<b>337,228</b>	<b>252,880</b>	<b>540</b>

Extent = Feather Watershed  
RCP8.5 area = acres

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	6,323	216	
4	2,540	180	
2100 3	14,267	5,638	
2	5,764	7,170	
1: Low	16,375	8,178	
0: Not Selected	1,495	15,024	
<b>Total:</b>	<b>46,764</b>	<b>36,406</b>	<b>0</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	10,898	937	
4	3,477	1,585	
2070 3	25,886	4,413	
2	12,934	5,296	
1: Low	26,751	7,512	
0: Not Selected	1,549	7,458	
<b>Total:</b>	<b>81,495</b>	<b>27,201</b>	<b>0</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	8,322	630	
4	4,035	198	
2040 3	36,190	5,458	
2	8,593	4,612	
1: Low	14,411	13,817	
0: Not Selected	1,261	6,773	36
<b>Total:</b>	<b>72,813</b>	<b>31,488</b>	<b>36</b>

Connectivity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	38,352	4,666	
4	15,150	3,783	
2010 3	113,452	28,912	
2	43,756	31,795	
1: Low	79,081	57,591	
0: Not Selected	4,377	24,121	54
<b>Total:</b>	<b>294,168</b>	<b>150,867</b>	<b>54</b>

Extent = Upper Trinity Watershed  
RCP8.5 area = acres

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	5,170	594
4	721	36
2100 3	21,815	2,000
2	3,639	919
1: Low	4,954	5,080
0: Not Selected	2,414	1,387
<b>Total:</b>	<b>38,712</b>	<b>10,016</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	2,504	180
4	396	
2070 3	9,061	757
2	1,369	288
1: Low	2,450	1,387
0: Not Selected	901	504
<b>Total:</b>	<b>16,681</b>	<b>3,116</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	4,017	649
4	775	216
2040 3	22,770	3,963
2	3,693	703
1: Low	14,357	13,943
0: Not Selected	4,089	2,576
<b>Total:</b>	<b>49,701</b>	<b>22,049</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	10,394	667
4	1,243	126
2010 3	42,675	3,044
2	4,341	739
1: Low	12,033	9,169
0: Not Selected	4,161	1,405
<b>Total:</b>	<b>74,848</b>	<b>15,150</b>

Extent = McCloud Watershed  
RCP8.5 area = acres

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	4,035	1,315
4	1,891	450
2100 3	4,540	2,054
2	775	1,081
1: Low	4,251	8,791
0: Not Selected	342	757
<b>Total:</b>	<b>15,834</b>	<b>14,447</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	3,026	270
4	811	180
2070 3	1,171	342
2	162	180
1: Low	667	1,711
0: Not Selected	126	811
<b>Total:</b>	<b>5,963</b>	<b>3,495</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	1,009	342
4	234	90
2040 3	1,873	685
2	919	324
1: Low	20,104	14,069
0: Not Selected	2,414	3,855
<b>Total:</b>	<b>26,553</b>	<b>19,365</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	14,357	7,656
4	3,279	2,378
2010 3	14,303	6,143
2	3,134	1,855
1: Low	33,632	35,361
0: Not Selected	4,251	8,395
<b>Total:</b>	<b>72,957</b>	<b>61,788</b>

Extent = Upper Sacramento Watershed  
RCP8.5 area = acres

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	1,585	757
4	1,135	1,009
2100 3	4,540	2,288
2	2,090	3,351
1: Low	2,684	7,404
0: Not Selected	144	1,531
<b>Total:</b>	<b>12,177</b>	<b>16,339</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	1,891	540
4	829	486
2070 3	3,333	1,639
2	1,225	1,297
1: Low	1,477	2,648
0: Not Selected	54	1,027
<b>Total:</b>	<b>8,809</b>	<b>7,638</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	1,531	306
4	1,063	252
2040 3	6,683	1,297
2	6,737	667
1: Low	5,098	5,026
0: Not Selected	649	1,117
<b>Total:</b>	<b>21,761</b>	<b>8,665</b>

Connectivity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	18,320	5,891
4	3,927	2,378
2010 3	19,707	14,663
2	9,962	6,017
1: Low	10,250	17,780
0: Not Selected	811	3,837
<b>Total:</b>	<b>62,977</b>	<b>50,565</b>





This is supplementary table 5 for biodiversity, showing total area in each biodiversity rank

area = acres

Connectivity Ranking	Study Area	5-Watersheds	Pit	Feather	Upper Trinity	McCloud	Upper Sacramento
<b>5: High</b>	825,959	592,426	198,496	217,537	40,207	73,263	62,923
<b>4</b>	322,757	247,584	105,544	91,439	6,197	21,473	22,932
<b>3</b>	3,302,665	2,239,192	1,242,154	610,746	204,152	67,012	115,127
<b>2</b>	1,270,544	909,670	452,349	350,858	29,093	17,293	60,077
<b>1: Low</b>	3,352,204	2,318,129	1,056,196	823,617	133,412	217,717	87,188
<b>0: Not Selected</b>	870,814	555,011	319,964	154,272	28,660	34,659	17,456
<b>Total:</b>	<b>9,944,943</b>	<b>6,862,012</b>	<b>3,374,703</b>	<b>2,248,469</b>	<b>441,721</b>	<b>431,417</b>	<b>365,702</b>

**These are the final biodiversity tables. They cross rank biodiversity with climate exposure of the vegetation.**

There are 6 tabs: 2 main tables and 5 appendix tabs.

Main1_Bio_ConsensusRefHighExp	Consensus Refugia & High Exposure: Summaries
Main2_Bio_ConsensusModExp	Consensus Moderate Exposure: Summaries
Apx1_Bio_ConRefHighExp_5Watshd	Consensus Refugia & High Exposure: By Watershed
Apx2_Bio_ConModExp_5Watshd	Consensus Moderate Exposure: By Watershed
Apx3_Bio_RefHighExp	Single Model Refugia & High Exposure: Summaries and by Watershed
Apx4_Bio_ModExp	Single Model Moderate Exposure: Summaries and by Watershed
Apx5_Bio_AreaByRank	Total Area by Biodiversity Rank

This is the Consensus Refugia & High Exposure by Biodiversity Ranking table for use in the main text. Refugia & High Exposure by watershed tables are in appendix 1, single climate model tables are in appendix 3.  
 Extent = Entire Study Area (5-Watersheds plus 10km buffer)

RCP8.5 area = acres

Biodiversity Ranking	Refugia - Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	322,648	286,945	72	15,798	46,278	270	187,129	246,828	180
4	489,836	233,894	18	43,828	44,981		265,598	272,624	288
2100 3	337,888	86,665	18	29,309	19,707	36	228,940	234,506	306
2	69,120	13,961		44,350	15,906		532,746	142,869	1,459
1: Low	18,446	19,833		6,215	5,314		53,249	38,496	
Total:	1,237,939	641,298	108	139,500	132,187	306	1,267,662	935,322	2,234

Extent = 5-Watersheds RCP8.5 area = acres

Biodiversity Ranking	Refugia - Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	234,812	200,460	18	13,150	36,857	270	154,992	107,489	180
4	325,044	171,277	18	35,415	33,668		196,226	127,377	198
2100 3	214,222	57,699	18	21,293	11,979	36	170,088	149,336	270
2	42,207	5,548		28,714	7,314		358,118	103,580	468
1: Low	13,691	8,124		4,287	3,513		35,524	12,898	
Total:	829,976	443,108	54	102,860	93,330	306	914,948	500,681	1,117

Biodiversity Ranking	Refugia - Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	550,742	523,180	667	41,054	63,463	486	20,338	176,447	324
4	913,453	483,964	234	30,912	27,075	36	38,766	92,178	36
2070 3	662,464	187,201	18	47,701	85,260	180	19,527	57,951	126
2	242,720	56,348	36	27,165	23,562		322,288	90,917	1,315
1: Low	26,625	25,021		20,122	8,989		5,963	33,236	
Total:	2,396,004	1,275,714	955	166,954	208,350	703	406,882	450,728	1,801

Biodiversity Ranking	Refugia - Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	434,695	398,523	576	36,118	50,313	486	16,123	82,072	324
4	687,215	383,950	108	19,131	12,250	36	28,138	33,560	36
2070 3	431,003	121,648	18	41,468	66,868	180	16,393	34,353	108
2	125,954	25,148		23,670	20,302		235,929	71,029	468
1: Low	17,167	8,467		12,412	7,206		3,585	11,097	
Total:	1,696,034	937,736	703	132,799	156,938	703	300,167	232,110	937

Biodiversity Ranking	Refugia - Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	591,777	542,401	1,027	38,388	25,562		14,681	15,960	
4	1,030,796	606,080	468	43,432	19,617		25,184	35,271	18
2040 3	1,027,644	378,762	3,116	23,778	22,283	36	12,718	18,644	18
2	446,098	120,207	757	14,519	5,981		36,208	51,448	36
1: Low	68,003	52,907		7,152	11,763		3,315	14,916	
Total:	3,164,318	1,700,358	5,368	127,269	85,206	36	92,105	136,240	72

Biodiversity Ranking	Refugia - Consensus			High Exposure - Consensus			Very High Exposure - Consensus		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	482,937	417,312	955	24,355	15,762		9,223	9,493	
4	806,000	465,932	306	25,562	13,006		11,637	20,824	18
2040 3	701,645	244,738	2,918	18,194	17,365	36	6,539	12,195	18
2	237,785	71,029	667	9,728	4,035		21,094	40,351	18
1: Low	40,477	10,934		5,062	9,367		2,018	7,061	
Total:	2,268,843	1,209,945	4,846	82,900	59,536	36	50,511	89,926	54

Biodiversity Ranking	Refugia 80%			< High Exposure 95-99%			Very High Exposure > 99%		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	809,584	883,460	2,360	69,174	75,857	126	19,869	16,591	
4	1,340,565	774,817	649	82,072	71,516	36	30,426	20,986	
2010 3	1,405,055	621,356	6,485	51,052	42,189	72	13,979	12,700	
2	870,976	248,989	2,468	91,529	45,431	72	22,752	22,229	
1: Low	102,247	72,560	36	37,019	35,884		22,824	11,925	
Total:	4,528,427	2,601,183	11,997	330,845	270,876	306	109,849	84,432	0

Biodiversity Ranking	Refugia 80%			< High Exposure 95-99%			Very High Exposure > 99%		
	Public	Private	Tribal	Public	Private	Tribal	Public	Private	Tribal
5: High	644,234	649,080	2,270	45,611	37,091	126	15,690	9,800	
4	955,101	545,788	486	58,401	42,045	36	20,014	13,979	
2010 3	975,385	414,051	6,215	29,273	21,905	72	8,683	8,827	
2	539,411	172,376	1,387	61,157	34,443	54	15,150	15,456	
1: Low	60,041	21,347	18	24,103	18,771		12,790	7,296	
Total:	3,174,172	1,802,641	10,376	218,546	154,254	288	72,326	55,357	0

This is the Moderate Exposure by Biodiversity Ranking table for use in main text. Moderate exposure by watershed tables are in appendix 2, single climate model tables are in appendix 4.

Extent = Entire Study Area (5-Watersheds plus 10km buffer)

Extent = 5-Watersheds

RCP8.5 area = acres

RCP8.5

area = acres

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
	5: High	48,151	37,865
4	99,689	82,756	162
2100 3	54,438	30,083	18
2	64,706	27,958	36
1: Low	75,425	18,302	18
<b>Total:</b>	<b>342,410</b>	<b>196,965</b>	<b>252</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
	5: High	31,831	21,238
4	72,650	64,760	108
2100 3	38,820	22,752	18
2	29,831	20,932	
1: Low	41,630	10,556	
<b>Total:</b>	<b>214,763</b>	<b>140,239</b>	<b>144</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
	5: High	60,545	25,310
4	123,882	58,599	180
2070 3	142,941	75,244	4,215
2	81,928	30,912	1,171
1: Low	99,185	28,300	54
<b>Total:</b>	<b>508,481</b>	<b>218,366</b>	<b>5,656</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
	5: High	47,287	19,563
4	78,505	46,116	180
2070 3	107,778	63,211	4,053
2	40,423	21,383	1,009
1: Low	63,517	17,960	36
<b>Total:</b>	<b>337,510</b>	<b>168,233</b>	<b>5,314</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
	5: High	116,118	85,566
4	145,013	64,256	54
2040 3	51,610	84,432	162
2	35,884	8,719	
1: Low	87,296	20,176	36
<b>Total:</b>	<b>435,920</b>	<b>263,148</b>	<b>270</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
	5: High	81,315	55,645
4	97,167	47,305	54
2040 3	36,010	48,350	162
2	24,355	4,684	
1: Low	64,670	16,465	36
<b>Total:</b>	<b>303,518</b>	<b>172,448</b>	<b>270</b>

Biodiversity Ranking	Moderate Exposure 80-95%		
	Public	Private	Tribal
	5: High	237,496	271,543
4	338,519	262,662	342
2010 3	214,907	195,488	198
2	234,974	66,021	36
1: Low	131,178	53,556	36
<b>Total:</b>	<b>1,157,074</b>	<b>849,269</b>	<b>685</b>

Biodiversity Ranking	Moderate Exposure 80-95%		
	Public	Private	Tribal
	5: High	189,075	166,197
4	268,697	163,891	252
2010 3	144,941	131,196	198
2	154,380	39,252	36
1: Low	85,116	30,714	36
<b>Total:</b>	<b>842,208</b>	<b>531,250</b>	<b>594</b>

This is a supplementary table 1 for Biodiversity, showing the area of consensus habitats & high exposure in each of the 5 watershed RCP2.1 area's acres

Excerpt - Feather Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus		
	Public	Private	Public	Private	Public	Private	Public	Private	
S High	75,087	88,139	18	4,871	7,607	216	83,187	26,461	144
M High	119,192	85,206	18	9,331	6,500	72,289	28,261	144	
L High	72,668	24,715	18	16,177	7,688	180,734	98,083	234	
M Low	15,438	2,614	18	10,612	3,381	181,729	78,401	420	
L Low	13,341	8,939	18	1,061	1,513	14,842	8,827	18	
Total	282,094	209,714	54	34,063	24,484	544,964	246,567	973	

Excerpt - Feather Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus		
	Public	Private	Public	Private	Public	Private	Public	Private	
S High	68,881	33,434	18	3,340	2,774	54	18,230	18,230	36
M High	75,087	28,816	18	13,881	13,027	181,918	77,064	144	
L High	79,759	10,790	18	14,337	2,226	17,643	47,053	36	
M Low	21,264	1,627	18	17,861	3,248	161,621	23,117	18	
L Low	2,841	360	18	1,045	508	8,222	2,344	144	
Total	247,832	84,028	90	54,365	45,338	54	276,613	207,071	144

Excerpt - Upper Trinity Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	57,032	45,442	187	703	54	14	126	126
M High	75,087	21,641	2,664	3,038	72	126	126	126
L High	44,817	1,189	180	72	188	36	188	36
M Low	1,627	627	126	36	1,188	36	1,188	36
L Low	8,222	402	630	630	4,377	72	4,377	72
Total	192,385	71,902	4,377	1,430	1,861	504	1,861	504

Excerpt - Upper Trinity Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	57,780	19,124	702	36	14	14	14	14
M High	69,435	34,249	829	642	144	54	144	54
L High	41,121	7,243	54	162	180	36	180	36
M Low	12,774	4,471	90	360	1,176	576	1,176	576
L Low	4,648	621	2,376	862	108	144	108	144
Total	211,137	66,445	1,476	1,860	1,638	684	1,638	684

Excerpt - McCloud Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	13,810	25,241	144	540	9,232	4,500	144	144
M High	75,087	37,241	5,044	7,824	9,385	4,500	144	144
L High	18,248	14,025	306	847	504	774	144	144
M Low	801	721	306	1,117	2,468	774	144	144
L Low	170	309	144	180	1,044	144	144	144
Total	43,132	77,939	18,166	23,774	23,774	10,744	144	144

Excerpt - McCloud Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	12,710	20,118	180	1,110	1,110	144	144	144
M High	54,186	38,177	234	378	1,441	450	144	144
L High	19,167	21,233	54	626	630	687	144	144
M Low	9,035	4,495	126	234	2,340	2,108	144	144
L Low	644	648	180	180	108	171	144	144
Total	96,320	101,263	3,180	3,486	5,694	3,561	144	144

Excerpt - Upper Sacramento Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	24,837	9,611	558	721	21,248	18,194	144	144
M High	24,232	10,808	4,018	7,882	18,842	18,271	144	144
L High	7,711	1,515	72	188	1,009	1,839	144	144
M Low	707	80	54	72	1,188	1,297	144	144
L Low	305	308	448	847	4,341	961	144	144
Total	57,483	22,303	1,422	1,818	45,229	34,746	144	144

Excerpt - Upper Sacramento Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	23,377	20,214	534	731	1,837	1,564	144	144
M High	48,817	42,116	1,348	504	2,805	2,805	144	144
L High	4,848	2,308	72	188	1,468	2,805	144	144
M Low	2,848	300	90	252	1,584	1,117	144	144
L Low	1,528	304	1,473	234	324	324	144	144
Total	80,230	67,643	4,387	2,654	6,125	6,647	144	144

Excerpt - Feather Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus		
	Public	Private	Public	Private	Public	Private	Public	Private	
S High	302,657	242,793	486	13,869	48,491	186	676	30,201	288
M High	274,651	170,344	108	7,420	7,656	36	9,475	14,471	36
L High	204,361	62,107	18	13,614	14,660	180	7,480	18,278	60
M Low	54,624	12,387	18,132	5,314	23,418	18,132	400	400	
L Low	1,564	4,654	1,534	2,253	1,873	9,826	1,873	9,826	
Total	593,518	391,658	612	34,718	118,466	703	211,842	104,567	805

Excerpt - Feather Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	218,642	205,651	90	3,841	1,421	676	18,114	36
M High	204,471	74,660	3,305	1,649	14,177	17,225	18	
L High	138,005	27,767	7,702	11,407	7,973	13,311	18	
M Low	48,234	4,756	7,254	14,051	1,382	8,411	18	
L Low	3,362	1,909	1,300	922	1,241	922	18	
Total	486,716	294,608	20	27,944	33,833	60	57,864	72

Excerpt - Upper Trinity Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	62,116	22,708	126	1,495	902	1,305	1,371	
M High	340,881	352,682	18	9,395	3,909	4,379	11,802	18
L High	205,953	20,847	81,018	9,927	2,973	2,008	1,802	18
M Low	79,481	7,862	1,776	2,494	7,548	20,874	1,802	18
L Low	6,288	1,827	2,915	1,473	612	1,477	1,477	18
Total	675,219	593,187	144	24,209	16,879	19	34,672	36,204

Excerpt - Upper Trinity Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	62,116	22,708	126	1,495	902	1,305	1,371	
M High	67,488	27,227	4,339	1,705	3,008	991	11,802	18
L High	54,816	6,211	449	414	682	721	1,802	18
M Low	13,238	1,121	126	234	1,911	1,675	1,802	18
L Low	12,156	488	886	1,315	144	60	1,477	1,477
Total	186,446	78,781	16,211	7,060	6,591	4,379	19,802	19,802

Excerpt - McCloud Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	62,116	22,708	1,218	1,371	1,371	1,371	1,371	1,371
M High	63,225	14,827	1,218	1,051	1,117	703	1,117	703
L High	19,098	22,277	306	829	400	1,049	400	1,049
M Low	11,147	8,951	234	326	1,009	2,612	1,009	2,612
L Low	124	540	214	222	77	214	77	214
Total	133,208	100,487	4,212	3,485	5,132	5,340	5,132	5,340

Excerpt - McCloud Watershed RCP2.1 area's acres

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	25,445	25,269	1,703	1,419	951	612	1,419	612
M High	52,482	54,000	1,946	1,180	1,051	2,054	1,051	2,054
L High	17,424	2,115	124	184	706	1,049	706	1,049
M Low	2,446	306	432	144	773	1,049	773	1,049
L Low	990	703	686	246	128	234	128	234
Total	98,789	84,862	4,971	3,827	3,225	7,088	3,225	7,088

Excerpt - Upper Sacramento Watershed

Ranking	Biodiversity		Consensus		High Exposure - Consensus		Very High Exposure - Consensus	
	Public	Private	Public	Private	Public	Private	Public	Private
S High	68,775	32,711	7,084	3,405	2,304	2,304	2,304	2,304
M High	68,015	25,613	1,003	4,111	1,117	1,117	1,117	1,117
L High	8,304	3,188	973	1,549	366	1,009	366	1,009
M Low	1,468	367	1,049	703	1,007	703	1,007	703
L Low	1,009	973	2,006	2,006	3,706	1,469	3,706	1,469
Total	131,108	68,284	14,411	13,078	7,506	7,506	7,506	7,506



This is supplementary table 2 for biodiversity, showing areas of consensus moderate exposure in each of the 5 watersheds

Extent = Pit Watershed  
RCP8.5 area = acres

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	15,852	11,385	18
4	26,445	27,814	108
2100 3	20,176	13,709	18
2	15,276	3,188	
1: Low	23,526	6,935	
<b>Total:</b>	<b>101,275</b>	<b>63,031</b>	<b>144</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	35,055	11,223	36
4	40,045	29,723	180
2070 3	83,837	58,077	4,053
2	22,842	17,329	1,009
1: Low	42,783	10,430	36
<b>Total:</b>	<b>224,562</b>	<b>126,782</b>	<b>5,314</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	27,615	20,536	18
4	36,316	20,608	18
2040 3	13,330	35,488	162
2	16,105	3,261	
1: Low	39,325	10,989	36
<b>Total:</b>	<b>132,691</b>	<b>90,881</b>	<b>234</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	77,478	71,047	72
4	84,594	58,581	216
2010 3	61,770	88,323	198
2	74,848	18,771	18
1: Low	38,568	16,159	36
<b>Total:</b>	<b>337,258</b>	<b>252,880</b>	<b>540</b>

Extent = Feather Watershed  
RCP8.5 area = acres

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	8,953	3,423	
4	14,627	8,503	
2100 3	8,845	5,242	
2	6,845	16,375	
1: Low	7,494	2,864	
<b>Total:</b>	<b>46,764</b>	<b>36,406</b>	<b>0</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	6,233	5,080	
4	25,598	8,701	
2070 3	22,914	4,125	
2	16,843	2,666	
1: Low	9,908	6,629	
<b>Total:</b>	<b>81,495</b>	<b>27,201</b>	<b>0</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	18,662	9,151	
4	25,039	9,277	36
2040 3	11,277	8,340	
2	6,287	649	
1: Low	11,547	4,071	
<b>Total:</b>	<b>72,813</b>	<b>31,488</b>	<b>36</b>

Biodiversity Ranking	Moderate Exposure - Consensus		
	Public	Private	Tribal
5: High	42,225	38,982	
4	109,885	52,637	36
2010 3	54,961	30,065	
2	70,705	18,266	18
1: Low	16,393	10,916	
<b>Total:</b>	<b>294,168</b>	<b>150,867</b>	<b>54</b>

Extent = Upper Trinity Watershed  
RCP8.5 area = acres

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	4,810	3,891
4	10,484	4,702
2100 3	6,485	973
2	6,413	252
1: Low	10,520	198
<b>Total:</b>	<b>38,712</b>	<b>10,016</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	4,107	1,441
4	2,000	504
2070 3	594	288
2	180	630
1: Low	9,800	252
<b>Total:</b>	<b>16,681</b>	<b>3,116</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	17,942	13,835
4	21,365	6,485
2040 3	2,990	1,081
2	432	396
1: Low	6,971	252
<b>Total:</b>	<b>49,701</b>	<b>22,049</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	17,329	8,449
4	17,510	3,675
2010 3	13,853	1,909
2	2,432	721
1: Low	23,724	396
<b>Total:</b>	<b>74,848</b>	<b>15,150</b>

Extent = McCloud Watershed  
RCP8.5 area = acres

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	721	1,189
4	11,799	10,232
2100 3	2,468	2,126
2	793	793
1: Low	54	108
<b>Total:</b>	<b>15,834</b>	<b>14,447</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	829	649
4	4,612	1,225
2070 3	108	540
2	36	558
1: Low	378	522
<b>Total:</b>	<b>5,963</b>	<b>3,495</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	8,142	6,827
4	8,557	8,322
2040 3	7,188	2,990
2	1,063	324
1: Low	1,603	901
<b>Total:</b>	<b>26,553</b>	<b>19,365</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	22,211	22,896
4	31,615	27,255
2010 3	11,205	8,737
2	4,666	1,153
1: Low	3,261	1,747
<b>Total:</b>	<b>72,957</b>	<b>61,788</b>

Extent = Upper Sacramento Watershed  
RCP8.5 area = acres

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	1,495	1,351
4	9,295	13,510
2100 3	847	703
2	504	324
1: Low	36	450
<b>Total:</b>	<b>12,177</b>	<b>16,339</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	1,063	1,171
4	6,251	5,963
2070 3	324	180
2	522	198
1: Low	649	126
<b>Total:</b>	<b>8,809</b>	<b>7,638</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	8,953	5,296
4	5,891	2,612
2040 3	1,225	450
2	468	54
1: Low	5,224	252
<b>Total:</b>	<b>21,761</b>	<b>8,665</b>

Biodiversity Ranking	Moderate Exposure - Consensus	
	Public	Private
5: High	29,831	24,823
4	25,093	21,743
2010 3	3,152	2,162
2	1,729	342
1: Low	3,170	1,495
<b>Total:</b>	<b>62,977</b>	<b>50,565</b>



This is supplementary data to the main report, showing areas of moderate exposure for single chemical agents.

Current Status: Moderate (Level 3) - Moderate (Level 3) - Moderate (Level 3)

Table 1: Area 1 Data

Exposure	Moderate Exposure - CMSE				Moderate Exposure - MSEC			
	Public	Private	Total	Ranking	Public	Private	Total	Ranking
High	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Medium	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Low	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Total	30,000	30,000	60,000		30,000	30,000	60,000	

Table 2: Area 2 Data

Exposure	Moderate Exposure - CMSE				Moderate Exposure - MSEC			
	Public	Private	Total	Ranking	Public	Private	Total	Ranking
High	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Medium	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Low	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Total	30,000	30,000	60,000		30,000	30,000	60,000	

Table 3: Area 3 Data

Exposure	Moderate Exposure - CMSE				Moderate Exposure - MSEC			
	Public	Private	Total	Ranking	Public	Private	Total	Ranking
High	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Medium	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Low	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Total	30,000	30,000	60,000		30,000	30,000	60,000	

Table 4: Area 4 Data

Exposure	Moderate Exposure - CMSE				Moderate Exposure - MSEC			
	Public	Private	Total	Ranking	Public	Private	Total	Ranking
High	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Medium	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Low	10,000	10,000	20,000	10	10,000	10,000	20,000	10
Total	30,000	30,000	60,000		30,000	30,000	60,000	

This is supplementary table 5 for biodiversity, showing total area in each biodiversity rank

area = acres

<b>Biodiversity Ranking</b>	<b>Study Area</b>	<b>5-Watersheds</b>	<b>Pit</b>	<b>Feather</b>	<b>Upper Trinity</b>	<b>McCloud</b>	<b>Upper Sacramento</b>
<b>5: High</b>	2,386,132	1,759,245	691,935	667,202	145,787	112,461	141,860
<b>4</b>	2,922,588	2,068,690	766,207	776,421	157,604	194,893	173,565
<b>3</b>	2,563,480	1,740,745	1,128,018	440,658	77,604	72,831	21,635
<b>2</b>	1,605,478	1,033,102	659,384	309,660	20,860	34,461	8,737
<b>1: Low</b>	467,265	260,230	129,160	54,528	39,865	16,771	19,905
<b>Total:</b>	<b>9,944,943</b>	<b>6,862,012</b>	<b>3,374,703</b>	<b>2,248,469</b>	<b>441,721</b>	<b>431,417</b>	<b>365,702</b>