WORKSHOP #4 SUMMARY | VULNERABILITY ASSESSMENTS

CENTRAL VALLEY LANDSCAPE CONSERVATION PROJECT

October 8th and 9th, 2015

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General information and all workshop materials are available at http://californialcc.org/central-valley-landscape-conservation-project.
For questions please contact Debra Schlafmann, CA LCC Coordinator, at Debra_Schlafmann@fws.gov or (916) 278-9414.

MEETING SYNOPSIS

Thirty-seven experts in Central Valley species and habitats from 18 Central Valley resource management or scientific organizations and agencies were invited to participate in a two day-long workshop on October 8-9, 2015, with the goal of completing vulnerability assessments for a set of cooperatively identified Central Valley "high priority" natural resources.

Participants were split into Habitat Groups (Riparian/Riverine, Upland, Wetland, and Desert/Grassland) based on their expertise, and asked to collectively complete separate vulnerability assessment worksheets for each of their group's identified sub-habitats, species groups and individual species. Following group work, discussions were held with all the participants to clarify and cross-check decisions across the groups, and provide general feedback.

ACTION ITEMS

1. **All Participants:** If someone is missing from these workshops that should be here, inform the Project Team by emailing Deb Schlafmann at Debra_Schlafmann@fws.gov.
2. **All Participants:** If your contact information is missing from the attendee list, please email Andrea Graffis at andrea_graffis@fws.gov for inclusion in the updated list.
3. **Project Team** to post workshop slideshow presentations to workshop website.
4. **Project Team** to complete remaining "high priority" vulnerability assessment worksheets with the appropriate experts, including:
    a. Large Wide-ranging Mammals
    b. Amphibians
    c. Mast-Associated Species
    d. Wetland Obligate Plants

1. Welcome and Opening Remarks

Debra Schlafmann, California Landscape Conservation Cooperative (CA LCC) Coordinator, opened the Central Valley Landscape Conservation Project (CVLCP) fourth workshop. She thanked attendees for their participation, and noted that the workshop would focus on conducting Vulnerability Assessments for high Priority Natural Resources that were identified at the previous workshop. Ms. Schlafmann also thanked the project staff for their dedicated and thorough efforts to develop the materials for use at this workshop, including the worksheets and the myriad preparatory resources found on the workshop webpage.

Ms. Schlafmann introduced project staff, including special consultant Jessi Kershner of EcoAdapt, noting that Ms. Kershner brings significant experience to this workshop as she has

led the development of vulnerability assessments for the Sierra Nevada, Gulf of the Farallones, and several other areas. Next, attendees introduced themselves and their organizational or agency affiliation.

Following participant introductions, Dorian Fougères, facilitator from the Center for Collaborative Policy (CCP), California State University Sacramento, reviewed the agenda and materials, including the following workshop goals:

Workshop Goals:

1. Assess the vulnerability to climate change of a suite of stakeholder-identified priority natural resources, with the intention of subsequently developing adaptation strategies for these resources and addressing key management questions of our partners.
2. Provide vulnerability assessment training, resources, support and tools to participants to extend this process to similar efforts in their own work.

Rebecca Fris, CA LCC, provided a review of the project goals, objectives, and outcomes. Ms. Fris reviewed the context of this workshop in relation to both the previous workshops on scenario planning and priority natural resource selection, and the next workshop which will focus on adaptation strategies. (Please refer to slides available on the project website at http://californialcc.org/central-valley-landscape-conservation-project.)

Topics reviewed were:

- Central Valley Project Goal, the three Central Valley Conservation Objectives and their associated outcomes.
- **Goal**: Identify actions that will maximize the adaptive capacity of priority species, habitats, and ecosystems to support an ecologically connected Central Valley landscape.
    - **Objective 1:** Conserve resilient and adaptable ecosystems that sustain future Central Valley biodiversity.
        - **Outcome 1:** A broad set of partners are working under common understanding of goals and objectives for priority natural resources.
        - **Outcome 2:** Assessment of current and anticipated future natural resource conditions.
    - **Objective 2:** Promote landscape-scale connectivity and ecological and physical processes
        - **Outcome 1:** A spatially explicit description of desired future natural resource conditions.
        - **Outcome 2:** Associated maps depicting climate smart actions.
    - **Objective 3:** Reduce the impacts of climate change and other co-occurring stressors.
        - **Outcome 1:** A partnership-led set of adaptive strategies and actions for achieving desired future conditions.
        - **Outcome 2:** Online toolbox containing integrated data and locations where actions can be taken by organizations.

- How the project seeks to align and support ongoing planning and programs
- How the project can answer management questions, such as:
    - Considering vulnerability to future conditions, where do we invest in land protection, restoration?
    - What are critical areas for connectivity?
    - What type of resource management is necessary in face of climate change?
- Steps of the iterative climate-smart landscape conservation process
  This workshop is related to Step #2
- The outcomes of the Future Scenarios Workshop and how the future scenarios will be applied to the Vulnerability Assessments
- How the list of Central Valley Priority Natural Resources was developed and refined, and the resulting list of "high" and "medium" priority natural resources that will be used for the Vulnerability Assessments

Following her presentation slides, Ms. Fris requested participants to:

- Please complete the vulnerability assessment worksheets to the best of their collective ability, but do not be concerned if the group has a low level of confidence in the response. A low confidence value simply indicates an area where additional research is required.
- If participants have not done so already, they are strongly encouraged to review the project website. It includes materials and meeting summaries from previous workshops including documents like the comprehensive priority natural resources list and rationale for selecting the "high" and "medium" priority resources that the vulnerability assessments are focused on.

2. Climate Trends in the Central Valley

To provide participants with background information for their discussions, Erin Chappell, California Department of Water Resources (DWR), presented on historical and projected changes in habitat due to climate chance in the Central Valley. (Please refer to slides available on the project website at http://californialcc.org/central-valley-landscape-conservation-project.)

Topics reviewed were:

- **General overview** of recently observed changes in global climate, and projected changes
    - Associated with overall warming trend is: loss of snowpack, increased precipitation and variability in precipitation, earlier snow-fed stream flow, decrease in coastal fog of ~33%, animals moving north, earlier "green-up" dates (when trees put on leaves), more tree mortalities and increased wildfires

    - Longer effective dry season in the Sierras will also result in decreases in soil moisture, increased wildfire risk, etc.
- Shifts in **Runoff Timing**
    - Occurring up to three weeks earlier on average
    - Significant implications for water management in CA with need to balance flood/water supply operations at major reservoirs.
- Central Valley **Land Use Changes**, and **Habitat Changes** in the Sacramento-San Joaquin Delta
    - Land use changes in the Central Valley over the last 150 years have had significant impacts on habitat
    - High channelization resulting from levees built for agriculture
    - Increase in open water and grassland habitat that favors non-native species over native species
- Projected Changes in Climate
    - These projections developed using various climate models and emissions scenarios.
- Project Changes: **Temperature**
    - Increase in mean temperature of 5-6^{o}F by 2100
    - Summer warming more significant that winter warming
    - Increase in frequency, intensity, and length of heat waves
- Projected Changes: **Precipitation**
    - Projections nearly evenly split between more precipitation and less
    - Trend toward more extreme years
    - Southern California tending drier, Northern California maybe slightly wetter
- Projected Changes: **Snowpack**
    - 30-40% Reduction in Snow Water Equivalent across the Sierras by mid-century
    - 48-65% Less snowpack by end of century
    - Changed runoff patterns lead to less summer runoff
    - Associated with loss of snowpack is 15-20% lower soil moisture
- Projected Changes: **Hydrology**
    - Instrumental period has been extremely variable in the long-term hydroclimatic context, but current drought is most severe in the millennial context
    - Range of natural climate variability likely to continue
    - Anticipate droughts similar to those in past 1,000+ years but with added effects of climate change, including more and larger flood events
- Projected Changes: **Water Demand**
    - Increase in urban water demand
    - Decrease in irrigated crop acreage as population increases resulting in decrease in agriculture water demand
- Projected Changes: **Water Reliability**
    - Higher supply reliability in northern portion of the Central Valley
    - Significantly lower agricultural supply reliability in Tulare Hydrologic Region
    - Declines in groundwater storage highest in Tulare Hydrologic Region (though their dependency on groundwater supply will increase)

- Projected Changes: **Wetland Habitat**
    - Overall reduction in water availability
    - Marked decreases in waterbird habitat availability by mid-century
    - Shifts in wetland species due to changing salinity regime (Delta)
    - 90% of historical wetlands lost and what is left is highly fragmented. Nearly 90% of remaining wetland is highly managed on a seasonal basis and ~2/3 is privately owned
    - Highly dependent on snowpack and winter precipitation for water supplies – amount of water stored in reservoirs is crucial to determining the amount of waterbird habitat in Central Valley
- Projected Changes: **Riparian Habitat**
    - Altered floodplain inundation frequency and duration due to changing hydrology
    - Increase in thermal stress for native fish species
    - Change in riparian bird distribution, especially for southern Central Valley
    - Increases in number of days above temperature causing high mortality (especially in Sacramento) and shift in thermal conditions shifting spawning earlier in the year
- Project Changes: **Upland Habitat**
    - Increase in climatic water deficit (up to 44% for Oak Woodlands)
    - Increase in wildfire risk in terms of frequency, total acreage burnt, and/or return interval
    - Range shifts or contraction due to warmer conditions
- Projected Changes: **Desert/Grassland Habitat**
    - Decrease in grassland habitat due to changing hydrology/ land use
    - Accelerated conversion of grasslands to desert associated with drought
    - Changes in water availability predominant factor for wildlife populations

Questions and Discussion

- Where is the geographical delineation for “south” and “north” Central Valley used in this presentation?
    - **Ms. Chappell:** The boundaries are those identified by DWR, at the Sacramento River Basin and the San Joaquin River Basin.

- What operational regime for water supply is being referenced for these projections?
    - **Ms. Chappell:** The operational regime assumes there are no changes in water supply from the current situation.

- Please provide additional detail related to the statement “grasslands begin to trend towards desert.”
    - **Ms. Chappell:** Decreases in precipitation amount is projected to lead to desiccation in grassland areas, which in turn results in the expansion of desert regions. This will likely be especially prevalent in the southern part of the Central Valley.

- Will a decrease in wetland habitat have a greater effect on grassland birds?
  - **Ms. Chappell:** Riparian bird species are more sensitive to changes in precipitation than grassland bird species.

- Did the projections discussed in this presentation consider species that use cropland for habitat? With climate change, there will also be changes in cropland size and pattern.
  - **Ms. Chappell:** These projections considered currently available cropland used as habitat (primarily rice fields) and winter foraging of birds. Projections indicate a decrease in foraging habitat for these winter migratory species. None of these projections assumes mitigation measures have taken place in the time period.

- Do the projections consider shifts in cropping patterns?
  - **Ms. Chappell:** The work conducted for the DWR Water Plan did not go into that level of detail, therefore that consideration is not included here. However, University of California Davis (UCD) and the United States Department of Agriculture (USDA) are looking into this. For example, a conversion of croplands to orchards will remove available habitat from the region. This is a complicated scenario, as cropland conversion is not only driven by water availability but also by market demands and other resources.

- Some projections estimate an increase in oak woodland habitat around the perimeter of the Central Valley due to increases in forest fire. Do DWR projections indicate an increase or a decrease in oak woodland habitat within the Central Valley?
  - **Ms. Chappell:** DWR projections indicate a contraction of this habitat type within the Central Valley area, and an expansion of the range of oak woodlands outside of the Valley. Changes in both precipitation and fire regime are causing habitat shifts. The remaining historical habitats are already highly fragmented, which poses another challenge for species relying on these habitat types. Future urbanization will be yet another difficulty they face.

3. Introduction to Vulnerability Assessments and Case Studies

Ms. Kershner provided an introduction to vulnerability assessments, presented several case study examples, and summarized key steps for conducting the vulnerability assessments. (Please refer to slides available on the project website at http://californialcc.org/central-valley-landscape-conservation-project.)

Topics reviewed were:

- Adaptation Planning Framework
  - Step 2 focuses on assessing vulnerability to climate change by looking at sensitivity, exposure and adaptive capacity of priority natural resources
- **Defining Vulnerability**

  - Climate change vulnerability refers to the extent to which a species, habitat, or ecosystem process is susceptible to change as a result of climate change
    - *What* things are most vulnerable and least vulnerable
    - *Why* they are vulnerable or not vulnerable
- **Why Assess Vulnerability?**
  - Vulnerability assessments can help:
    - Prioritize species and systems for management actions
    - Develop management strategies to address climate change
    - Efficiently allocate resources
  - What vulnerability assessments cannot do:
    - Make a conservation decision for you
- Vulnerability Assessment Steps
  - **Step 1: Determine objectives and scope**
    - Audience/user needs
    - Goals and objectives
    - Assessment targets (species, habitats, ecosystems)
    - Scale (temporal and spatial)
    - Appropriate approach (no "one size fits all")
  - **Step 2: Gather relevant data and expertise**
    - Review existing literature
    - Reach out to experts
    - Obtain/develop climate and ecological response projections
    - Can find information through:
      - California Climate Commons
      - Data Basin
      - Template for Assessing Climate Change Impacts and Management Options (TACCIMO)
  - **Step 3: Assess component of vulnerability**
    - Assess sensitivity, exposure, and adaptive capacity
    - Estimate overall vulnerability
    - Document confidence levels and uncertainties
  - **Step 4: Apply results of vulnerability assessment in adaptation planning**
- Assessing Sensitivity
  - Measure of whether and how a species or habitat is likely to be affected by a given change in climate.
  - Factors affecting sensitivity of habitats or species:
    - Climate factors
    - Disturbance regimes (e.g. fire, wind, flooding, drought, insects and disease)
    - Non-climate stressors (e.g. residential/commercial development; agriculture; energy production, transportation; invasive species; timber harvest, dams and water diversions)
    - Dependencies
    - Life history

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- Assessing Exposure
    - Measure of how much of a change in climate or other environmental factor a species or habitat is likely to experience.
        - Climate variable examples: air temperature, extreme heat events, perception, snowpack, streamflow, aridity, drought
- Assessing Adaptive Capacity
    - Ability to accommodate or cope with climate change impacts with minimal disruption.
    - Factors affecting adaptive capacity of habitats or species:
        - Geographic extent, status, dispersal ability
        - Dispersal barriers/habitat availability
        - Life history or habitat diversity
        - Management potential
- Putting the Pieces Together: How to Assess Vulnerability Components
    - Detailed modeling efforts
        - In-house or commissioned
    - Vulnerability indices
        - e.g. NatureServe Index
    - Expert elicitation
    - Supplement and/or supplant modeling
- Today's Vulnerability Assessment workshop
    - Worksheets will require number scores and narratives for assessing sensitivity, exposure and adaptive capacity
    - Confidence ratings help to identify future literature review priorities to supplement the expert elicitations done here
    - Scores and narratives will be combined to generate an overall vulnerability score per identified priority natural resource
- Apply assessment results in adaptation planning (Step 4)
    - Reduce Sensitivity
        - Example: Reducing or eliminating invasive species that outcompete native species for limited water resources
    - Reduce Exposure
        - Example: Protecting resources and infrastructure from flood damage
    - Enhance Adaptive Capacity
        - Example: Maintaining or enhancing biological diversity across a range of functional groups
    - Many additional examples are provided on the workshop support webpage.
- **Case Study #1: Sierra Nevada, California**
    - Key Vulnerabilities:
        - Increased water deficit leading to lower seedling survival
        - Continued grazing/browsing of planted seedlings leading to decreased survival, making it more difficult to restore sites and enhance recruitment
    - Adaptation Strategies:

        - Plant native bunch grasses to reduce spread of invasive species that outcompete oak seedlings for limited water supply (*reduce sensitivity)*
        - Maintain and enhance landscape habitat connectivity to support top predators in order to help reduce/control herbivore numbers (*enhance adaptive capacity*)
- **Case Study #2: TomKat Ranch, California**
    - Key Vulnerabilities:
        - Altered precipitation patterns
        - Increased drought
    - Adaptation Strategies:
        - Increasing cover of native perennial grasses (*reduce sensitivity*)
        - Undertaking water budget assessment to develop water conservation plan (*reduce sensitivity*)
        - Measuring carbon storage of management practices (*reduce exposure*)
- Addressing Uncertainty
    - Natural resource management has always faced uncertainty. We make decisions despite uncertainty in conservation and our lives all the time.
        - Anxiety about uncertainty often leads to "analysis paralysis"
        - Don't deny it, embrace it
    - How is other uncertainty dealt with?
            - Document where/why there is uncertainty
            - Three types of uncertainty
                - Climate projections
                - Ecological responses
                - Management effectiveness
        - Distinguish between uncertainty in trend vs. rate and magnitude

Questions and Discussion

- For purposes of this workshop, how should the working groups consider places outside of the Central Valley?
    - **Ms. Kershner:** There are certain questions in the worksheets that encourage participants to consider how processes occurring in areas outside of the Central Valley might impact or influence the Central Valley. There is particular emphasis on this in the *adaptive capacity* sections of the worksheets. For example, a fire upstream of the Central Valley might have downstream impacts within the Central Valley. Participants should make note of things like this in the narrative section. Also, the *exposure* section is heavily focused on what occurs within the Central Valley.

- Should participants consider exotic species/communities if these exotics represent non-invasive, functional communities? Or, should the participants focus only on purely native habitats and species?

- **Ms. Kershner:** Participants may consider naturalized non-native habitats and species. It is only requested that they indicate these species in the narrative section in the worksheets.

4. Vulnerability Assessment of SUB-HABITATS

A. Sub-Habitat Vulnerability Assessment Worksheets

Participants were pre-assigned to one of four working groups based on their area(s) of expertise. These working groups were:

- Upland
- Riparian/Riverine
- Wetland
- Desert/Grassland

Each of the working groups had three to four "high priority" sub-habitat types for which they were to complete separate Vulnerability Assessment worksheets. These "high priority" sub-habitats were identified at the project's *Priority Natural Resources* workshop held in June, 2015.

Copies of the **Priority Natural Resources List and Group Assignment** spreadsheet, and the **Sub-Habitat Vulnerability Assessment Worksheets** can be found here: http://climate.calcommons.org/cvlcp/CentralValleyVAWorkshop

Ms. Kershner walked participants through the sub-habitat vulnerability assessment worksheet components and instructions. She noted that:

- *Sensitivity* questions involve factors that currently shape the habitat.
- *Exposure* questions involve future climate changes that could affect the habitat.
- All written comments will be considered and included in the final vulnerability assessment scores.
- Confidence rankings help to identify areas where more information is needed. There is nothing negative about listing a low confidence level.
- The gray boxes in each section were to be prioritized for completion. If there is not enough time for participants to complete the white boxes, the project team may populate these after the workshop and ask participants to review answers later.
- If the working groups for any reason decide to combine or revise their sub-habitat lists for vulnerability assessment completion, please provide the rationale for doing so somewhere in the "notes" section.

Working groups were allocated approximately two hours to complete vulnerability assessment worksheets for the "high priority" sub-habitats.

B. Worksheet Report-Outs

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Each of the four habitat groups reported on their high-level findings to the full group. They were asked to specifically provide feedback on what they determined to be the:

- Overall vulnerability scores of each sub-habitat (scale 1 – 5)
- Overall confidence levels on these vulnerability scores (scale 1 – 3)
- Key contributing factors to the sub-habitats' vulnerabilities

Plenary discussion followed after all groups had the opportunity to provide a report-out.

UPLAND GROUP

- **Chaparral and Serpentine Shrublands**
  - Overall Vulnerability: 3
  - Overall Confidence: 3
  - Key Contributing Factors: Fire, though this can be managed for.
- **Oak Woodland & Oak Foothill Pine Woodland**
  - Overall Vulnerability: 4
  - Overall Confidence: 4
  - Key Contributing Factors: Development; water deficit and drought
  - This group elected to combine these two sub-habitat types for this assessment.

WETLANDS GROUP

- **Seasonal Wetlands and Saline Playas**
  - Overall Vulnerability: 3
  - Overall Confidence: 3
  - Key Contributing Factors: Precipitation including snowpack (with snowpack of higher importance than overall precipitation rates)
- **Permanent Wetlands**
  - Overall Vulnerability: 3
  - Overall Confidence: 3
  - Key Contributing Factors: Precipitation including snowpack (with snowpack of higher importance than overall precipitation rates)
- **Flooded Cropland**
  - Overall Vulnerability: 4
  - Overall Confidence: 1
  - Key Contributing Factors: Precipitation including snowpack (with snowpack of higher importance than overall precipitation rates)
- While overall the sub-habitats are similar in vulnerability, flooded cropland is ranked higher because it is more likely to be impacted by land use changes, including commodity pricing and water availability, whereas wetlands already have protection from development.

DESERT/GRASSLANDS GROUP

- **Annual Grasslands**
  - Overall Vulnerability: 3
  - Overall Confidence: 3

    - Key Contributing Factors: Drought, fire, invasive species, energy development, grazing
- **Dunes**
    - Overall Vulnerability: 5
    - Overall Confidence: 3
    - Key Contributing Factors: Invasive species, energy mining, recreation, roads, fires
- **Vernal Pools and Swales**
    - Overall Vulnerability: 4
    - Overall Confidence: 2
    - Key Contributing Factors: Urban development, climate change, agriculture
    - Note: Agriculture can have negative impacts, but rangeland and cattle can be beneficial to this sub-habitat
- **San Joaquin Desert**
    - Overall Vulnerability: 4
    - Overall Confidence: 3
    - Key Contributing Factors: high fragmentation of sub-habitat, high number of endangered species, drought impacts (e.g. precipitation and soil moisture), grazing, energy development

RIPARIAN/RIVERINE GROUP

- **Stream Channel**
    - Overall Vulnerability: 5
    - Overall Confidence: 3
    - Key Contributing Factors: Altered hydrology (e.g. timing of snow melts, frequency of floods), land use conversion, habitat fragmentation
- **Floodplain & Riparian Vegetation**
    - Overall Vulnerability: 5
    - Overall Confidence: 3
    - Key Contributing Factors: Altered hydrology (e.g. timing of snow melts, frequency of floods), land use conversion, habitat fragmentation
    - This group elected to combine these two sub-habitat types for this assessment.
- The group was not especially confident in their responses to the question "what is this sub-habitat's capacity for recovery."

C. Plenary Discussion

- **Ms. Kershner**: Every sub-habitat is rated high or moderate for overall vulnerability. At a previous workshop hosted by EcoAdapt focused on the Sierra Nevada area, participants there did not believe the Central Valley was as vulnerable as this group is indicating.
    - **Comment:** The Central Valley is one of the largest areas being converted for development. Regeneration of certain sub-habitat types are particularly sensitive to changes in precipitation as well as grazing.

  - **Comment:** The Sierra Nevada region is gaining oak woodland habitat at the expense of conifer habitat.
  - **Comment:** Massive fires have burned tens of thousands of acres of oak chaparral this summer.

- **Ms. Kershner**: Would any participants like to expand on non-climate drivers of vulnerability?
  - **Comment:** It is a complicated consideration for wetlands, as water allocation is more often than not a human decision. Similarly, there are urban pressures to consider beyond basic building structures. For example, an increase in demand for solar energy may result in further development over natural habitat.
  - **Comment:** Vernal pools are fairly resilient to climate change, but land conversion is a major threat.
  - **Comment:** For riparian areas, decreasing groundwater supplies and urban development pose threats. Water politics will continue to play a large role in determining the future of the Central Valley.
  - **Comment:** Even if wetlands are secure if protected by an easement, for example, the management of those wetlands contributes to its vulnerability. Many are managed specifically for duck hunting. If popularity of duck hunting declines, so will the management and protection of those areas.

- There is a historical relationship between wetlands and floodplain/riparian zones. This process is making a distinction between what exists now versus the historical habitat distribution of the Central Valley, and perhaps what managers would like to revert back to.

- There is a north/south gradient for overall vulnerability of the San Joaquin Desert sub-habitat, where the situation is more severe in the south. Does this gradient affect other sub-habitat types?
  - **Comment:** This is also true for the desert sub-habitats and those desert-dwelling organisms who survive in this extreme environment. Drought and heat affect these species disproportionately.
  - **Comment:** Northern vernal pools can act as localize refuge areas compared to Southern vernal pools.
  - **Comment:** Precipitation gradients decrease from north to south, and from the coast, inland. Productivity for wetlands declines on both of these gradients. The California Rapid Assessment Method demonstrated a decline in wetland conditions from northwest to south, to the extent that some are arguing for a reclassification of certain wetland areas due to low water level.
  - **Comment:** There are differences in overall vulnerability of wetlands in the three areas of the Central Valley. In the north, permanent wetlands may turn to seasonal wetlands, and in the south, the valley may lose seasonal wetlands completely.

  - **Comment:** There is also a difference in the distribution of urban development pressures north to south.

- The northern part of the valley is a precipitation-influenced system, and the southern part is a snowmelt-influenced system. Do participants have perceptions on what type of impact this may have to the hydrologic regime?
  - **Comment:** For wetland areas, this differentiation is not significant to be a major driver of vulnerability, as the sub-habitat depends primarily on precipitation.
  - **Comment:** Snowpack projections are higher in the northern Sierras than the southern Sierras. Because of the high elevation of the southern Sierras, however, it will take longer to see the effects of the changes in snowpack down in the Central Valley.
  - **Comment:** In precipitation-influenced systems, increases in episodic rain events (e.g. due to El Nino weather) make it more challenging to capture and distribute water throughout the region.

5. Vulnerability of INDIVIDUAL SPECIES

A. Individual Species Vulnerability Assessment Worksheets

Each of the working groups had two to four "high priority" individual species for which they were to complete separate Vulnerability Assessment worksheets for. These "high priority" species were identified at the project's *Priority Natural Resources* workshop held in June, 2015, and are species that participants felt were not adequately covered by a species group or sub-habitat. Rationale on these selections is included in the final *Priority Natural Resources* list.

Copies of the **Priority Natural Resources List and Group Assignment** spreadsheet, and the **Individual Species Vulnerability Assessment Worksheets** can be found here: http://climate.calcommons.org/cvlcp/CentralValleyVAWorkshop

Participants generally remained in their pre-assigned working groups for this exercise, but were encouraged to temporarily relocate to another group if they had expertise regarding a particular species that was not included in their group's list.

Ms. Kershner walked participants through the individual species vulnerability assessment worksheet components and instructions. Working groups were allocated approximately two hours to complete vulnerability assessment worksheets for the "high priority" individual species.

B. Worksheet Report-Outs

Each of the four working groups reported on their high-level findings to the full group. They were asked to specifically provide feedback on what they determined to be the:

- Overall vulnerability scores of each individual species (scale 1 – 5)
- Overall confidence levels on these vulnerability scores (scale 1 – 3)
- Key contributing factors to the individual species' vulnerabilities

Plenary discussion followed after all groups had the opportunity to provide a report-out.

UPLAND GROUP

- **Red-Legged Frog**
  - Overall Vulnerability: 3
  - Overall Confidence: 3
  - Key Contributing Factors: land use change and reduced vulnerability somewhat because have several management options that have been proven to be successful
- **Yellow-Legged Frog**
  - Overall Vulnerability: 5
  - Overall Confidence: 3
  - Key Contributing Factors: sensitivity to dams and water temperatures, chemicals, and drought
- **Yellow-billed Magpie**
  - *Overall Vulnerability*: 3.5
  - Overall Confidence: 2.5
  - Key Contributing Factors: drought (precipitation drives habitat); disease and development
- **Valley Oak**
  - Overall Vulnerability: 5
  - Overall Confidence: 3
  - Key Contributing Factors: land use (particularly grazing and development); water deficit

WETLANDS GROUP

- **Tricolored Blackbird**
  - Overall Vulnerability: 4
  - Overall Confidence: 3
  - Key Contributing Factors: increase extreme events flooding and drought; non-climate factors: primarily agricultural practices and land use changes.
  - Species specific factor: They are colonial species and very susceptible to both natural and anthropogenic disturbance. When disturbed they will abandon nests quickly, which increases their vulnerability. Furthermore, they have site fidelity so even if their habitat is built for them, they will not necessarily use it.
  - Tricolored Blackbird was given a 4 instead of a 5 for vulnerability because they have a variety of insect species they will eat, and they are able to breed in different types of habitat (behavioral plasticity). If farmers delay harvest until their nesting is complete, they can have great success as a species. However, harvesting during nesting could result in a decimation of an entire colony.

- Mallard was removed from the list, as this group felt this species was adequately covered under the breeding waterfowl species group analysis.

DESERT/GRASSLANDS GROUP

- **Blunt-notes Leopard Lizard**
  - Overall Vulnerability: 5
  - Overall Confidence: 3
  - Key Contributing Factors: air temperature, precipitation amount, soil moisture; invasive vegetation species
  - Notes: Air temperature drives when individuals are above ground, and soil moisture is important for where they lay their eggs. Invasive vegetation species take over some of the bare ground that is habitat for this lizard.
- **California Tiger Salamander**
  - Overall Vulnerability: 5
  - Overall Confidence: 3
  - Key Contributing Factors: water temperatures (warmer waters favoring eastern Tiger Salamander (water dogs) that are hybridizing with species); drought; habitat fragmentation; agriculture, urban development and other incompatible land uses, as the tiger salamander does not travel very far unless excavating burrows near vernal pools in which it spawns
  - Drought is significant because it takes the Tiger Salamander 4-5 years to reach maturity for reproduction
- California Tiger Salamander was added to this list.
- Burrowing Owl was removed from the list. It references as an ecosystem engineer and is covered in the grassland section by addressing ground squirrel densities that excavate burrows.
- Atriplex and Ephedra were removed from the medium priority list as they were covered by desert sub-habitat analyses.

RIPARIAN/RIVERINE GROUP

- **Pacific Lamprey**
  - Overall Vulnerability: 4
  - Overall Confidence: 3
  - Key Contributing Factors: water projects and barriers to fish passage. They cannot make it over 90^{o} angles where there are high rates of water flow.
  - They are not targeted by commercial fisheries, though Native Americans used them heavily in the Klamath for food. Local tribes do not rely on these fish. Most of their decline is thus due to human water projects and alteration of environment.
  - It is possible they may face problems with sediment toxicity due to their long life history and ability to spend 3-7 years buried in sediment. More research is required to answer this question.

  - Another possible threat to lamprey are changing ocean condition affects on other species. They are parasitic and require other species to survive in the ocean. Thus if other species suffer a decline or changing distribution, then adult life stage of lamprey is also impacted by that climate change effect.
- **Green Sturgeon**
  - Overall Vulnerability: 4
  - Overall Confidence: 3
  - Key Contributing Factors: water projects and barriers to fish passage (main issue is rim dams). Also increases in water temperature. They are cold water fish with very narrow requirements and require cold water for early stages before spawning.
  - This species is listed under the Endangered Species Act (ESA) and is not targeted by commercial fisheries. Green Sturgeon is an ancient species (400 million years old) and is very resistant to drought and climate change. Their primary threat is human water projects.

C. Plenary Discussion

- **Ms. Kershner:** Given sturgeon and lamprey do not have a lot of fish harvesting value, what is the management potential for mitigation of climate or other impacts?
  - **Comment:** The main issue is loss of habitat, so habitat preservation effort is an important management action. Floodplains are also important nursery habitat for this species, similar to salmonids.
  - **Comment:** Adult green sturgeons will get stranded when migrating upriver due to development. Changing engineer approaches to dam construction, etc. offers mitigation potential. Managers should work to reconnect habitat, avoid strandings, and increase nursing habitat.
  - **Comment:** Both Green Sturgeon and Pacific Lamprey are ancient species who have survived a range of climate change. They are successful colonizers. Human development poses the greatest threat to their survival.
  - **Comment:** Sturgeon in the Central Valley have experienced recruitment issues. These species migrate during periods of high water flow, and there has not been a period of high flow in the last six years due to the prolonged drought. However, if there is an increase in massive episodic flooding events, areas where they spawn in upper Sacramento may be washed out. Their recruitment depends on water management. This is difficult in California as more reservoirs are being built and less water is allowed to flow. Biologist are hoping for an intense El Nino, where flood managers are not.
  - **Comment:** White Sturgeon is not listed as a “high priority” individual species because any management action taken for Green Sturgeon will benefit them, though in some ways they are more vulnerable than Green Sturgeon. Management for White Sturgeon will likely drive many decisions in the Central Valley because there is a fishery for this species.

- **Ms. Kershner:** Did any other groups have a similar discussion on how a species may benefit if particular management efforts are instated?
    - **Comment:** Wetlands species would benefit by the allocation of refuges, easements and acquisitions. However, there is a bigger issue of drought and water allocation to refuges. Planned water distribution and maintaining water for habitat use is critical, and may become more difficult in the face of climate change.
        - **Comment:** This is also the reasoning the Tricolored Blackbird was designated a 4 and not a 5. There is decent habitat available, but the competition for water is fierce. Blackbirds need more water in spring and summer months, when agriculture fields need this water as well.
    - **Comment:** Frequency and duration of precipitation will significantly impact wetlands. If there is a lot of water at once, the land will not be able to absorb it all. Semi-permanent wetlands may change to permanent wetlands and vice versa.
    - **Comment:** There is strong management potential for Red-legged Frogs in the upland areas, which is why this species was designated a 3 instead of 4.

- **Comment:** The Red-Legged Frog and Western Toad were considered two of the most declining reptiles in the Central Valley, with their primary threat being invasive predators (bullfrogs and fishes). Changes in water management and water distribution will result in translocation of these invasive predators, which would be beneficial to these threatened species.
    - **Comment:** Allowing breeding ponds to dry every few years helps to eliminate bullfrogs. This is hydro-period management, and one reason the frogs received a lower vulnerability score than expected.
    - **Comment:** Conversations about returning native Sacramento Perch to the Central Valley are ongoing with Ranchers and farmers. This would disallow draining of stock ponds, which is the current tool for managing invasives. This is something to continue considering.

- **Ms. Schlafmann:** Are higher confidence levels for individual species versus sub-habitat types typical for these analyses?
    - **Ms. Kershner**: The groups' sub-habitat confidence levels were generally high as well. However, this is the first time overall confidence levels were requested during the report-out period. Some vulnerability values may shift once the completed worksheets are thoroughly analyzed.

- **Ms. Kershner:** Were there any particularly challenging to answer questions the groups would like to mention or discuss?
    - **Comment:** The questions regarding societal support and human behavior were difficult to answer. For example, confidence levels for flooded cropland vulnerability were low because no easements or acquisitions exist to protect these lands and they are under the control of the land owners. And that the

Tricolored Blackbird is dependent upon is under the influence of the dairy industry, which is in decline.
    - **Ms. Kershner:** A lot of information stemming from the future scenarios document was pulled into the worksheet questions for this reason, and will help provide the ability to do integrated regional planning.
    - **Comment:** It might have been helpful to distinguish between regulatory support and general public support in the question set.
  - **Comment:** The life history diversity versus genetic diversity versus phenotypic diversity question set was difficult to answer. One group spent ample time trying to determine which traits would fall into the various categories.
  - **Comment:** Questions around plasticity and resistance were difficult to answer, even with species experts in the conversation. Responses are more of an educated guess, and confidence levels were low. The more time the groups discussed these questions, the lower the confidence ratings became.

- **Comment:** Regarding the Valley oak evaluation, one participant did not expect it would have ranked a 4 for vulnerability, but perhaps might have been given a 3. The Valley Oak has high adaptive capacity, major refugia where it is reproducing well, it is easy to use in restoration and liked in suburban settings, cub scouts plant them, etc.

- **Comment:** The Yolo Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP) is close to becoming public document. By allowing some take of species under the federal ESA and HCP act, involved agencies attempted to incorporate a management program that considered current farming practices as part of the plan. U.S. Fish and Wildlife Service (FWS) and California Department of Fish and Wildlife (DFW) would not allow the incorporation of uncertainty into a plan where there are permits that allow people to take these listed species. Modelers were hired to demonstrate that normal farming practices generate ample habitat to benefit the 10 listed species, and farmers should be encouraged to grow crops that provide additional habitat value, but FWS and DFW deemed this unacceptable. Incorporating decision-making for farmers is a major challenge for biologists. Agencies are very tentative to accept uncertainty in planning.

6. Vulnerability of SPECIES GROUPS

A. Species Groups Vulnerability Assessment Worksheets

Each of the working groups had three to six “high priority” species groups for which they were to complete Vulnerability Assessment worksheets for. These “high priority” species groups were identified at the project’s *Priority Natural Resources* workshop held in June, 2015.

Copies of the **Priority Natural Resources List and Group Assignment** spreadsheet, and the **Species Groups Vulnerability Assessment Worksheets** can be found here: http://climate.calcommons.org/cvlcp/CentralValleyVAWorkshop

Participants generally remained in their pre-assigned working groups for this exercise, but were encouraged to temporarily relocate to another group if they had expertise regarding a particular species group that was not included in their group's list.

Ms. Kershner walked participants through the associated vulnerability assessment worksheet instructions. She also reminded participants to consider the species groups' vulnerabilities for the entire Central Valley, not just the umbrella habitat where the species group happens to be listed.

It was further noted that an additional species group, *wide-ranging mammals*, was added to the Priority Natural Resources list at the request of the Data Management Team. As the subject matter expert for this species group was unable to attend the workshop, the Project Team will follow up with him and other volunteers to complete the vulnerability assessment. Any other high priority species groups that did not have respective experts at the workshop were noted for similar follow-up by the Project Team.

Working groups were allocated approximately 2.5 hours to complete vulnerability assessment worksheets for the "high priority" species groups.

B. Worksheet Report-Outs

Each of the four working groups reported on their high-level findings to the full group. They were asked to specifically provide feedback on what they determined to be the:

- Overall vulnerability scores of each individual species (scale 1 – 5)
- Overall confidence levels on these vulnerability scores (scale 1 – 3)
- Key contributing factors to the individual species' vulnerabilities

Plenary discussion followed after all groups had the opportunity to provide a report-out.

UPLAND GROUP

- **Cavity Nesters and Roosters**
  - Overall Vulnerability: 3 to 4
  - Overall Confidence: 2
  - Key Contributing Factors: Air temperature; fire; development
  - Considerations heavily focused on bats, and some owls.
  - Had difficulty considering species group vulnerability without considering the vulnerability of habitat.
- **Western Bumblebee and Pollinators**
  - Overall Vulnerability: 5
  - Overall Confidence: 3
  - Key Contributing Factors: Precipitation timing; invasives; pesticides

  - Considerations heavily focused on invertebrates and bees, some discussion around Monarch Butterflies.
  - While overall vulnerability was a 5, pesticides have strong management potential.
  - This was another difficult worksheet to complete due the diversity of the species within the group.
- Unable to complete worksheet for ***Mast-Associated Species*** vulnerability assessment.

WETLANDS GROUP

- Note: There is a strong north-to-south variability gradient for all wetland species groups, where it is higher the farther south one looks.
- **Wetland-Dependent Mammals**
  - Overall Vulnerability: 2 (overall)
  - Overall Confidence: 3
  - Key Contributing Factors: Drought; urban development
  - Species considered included otters, beavers, mink, muskrats. The assessment was very close to the sub-habitat assessments. Overall vulnerability was lower because mammals have flexibility and ability to use other habitat types aside from wetlands.
  - The exception to this assessment is the ***Saltmarsh Harvest Mouse***, which are highly vulnerable (Vulnerability =5, Confidence =3). One factor contributing to their vulnerability is sea-level rise. They will need uphill refugia in the future.
- **Wetland-Dependent Reptiles**
  - Overall Vulnerability: 4 – 5
  - Overall Confidence: 2
  - Key Contributing Factors: Sensitive habitats (e.g. flood cropland); water availability; water and air temperature (as reptiles are ectotherms); endemism; poor dispersal; low societal support
  - Species considered included giant garter snakes, less valley garter snakes, and western pond turtles. Vulnerabilities and confidence varies slightly between species. Snakes are perhaps more vulnerable as they are endemic and more dependent on marsh habitat, whereas turtles can use streams and other habitat types.
  - Giant garter snakes are essentially gone from the San Joaquin Valley area.
  - Overall this species group in not very adaptable or resilient. There is also low societal support as they provide no economic benefit, and snakes are vilified.
- **Wintering Waterfowl and Shorebirds**
  - Overall Vulnerability: 3
  - Overall Confidence: 3
  - Key Contributing Factors: habitat vulnerability (e.g. irrigated cropland) and high dependency on sensitive habitat; high plasticity; migrations considerations (over-winter here but breed elsewhere)
  - These birds have high mobility and a wide variety in diet, which lowered their vulnerability score to a 3.

- **Breeding Water Birds**
  - Overall Vulnerability: 4
  - Overall Confidence: 3
  - Key Contributing Factors: habitat availability and agricultural practices (this tracks with the vulnerability of permanent and semi-permanent wetlands as this habitat is required for breeding birds); reduced snowpack; limited reliability of water and water competition with agriculture and instream flows (especially in spring and summer months); increased temperatures.
  - Studies show that for breeding bird increased temperatures can reduce hatchability of egg, causing reproductive issues. This is likely true for other water birds as well.
- **Dragonflies and Damselflies**
  - Overall Vulnerability: 3.5
  - Overall Confidence: 3
  - Key Contributing Factors: drought; extreme and/or extended dry periods; water pollution and poisons/pesticides; high sensitivity to water quality
  - This species group was difficult to assess as they have a complex life history. They spend a period of their life underwater and are reliant on permanent aquatic habitat for this life stage, then as adults they develop wings and use land habitat. Some species are migratory and others are not.
  - There is also low societal recognition of the importance of this species group, resulting in low societal support.
  - Pesticide application is controllable.
- Unable to complete ***Wetland Obligate Plants*** vulnerability assessment due to time constraints. Members of this working group will work collaboratively to complete the worksheet after the workshop.

DESERT/GRASSLANDS GROUP

- **Burrowing Mammals**
  - Overall Vulnerability: 4
  - Overall Confidence: 3
  - Key Contributing Factors: Flooding; drought; precipitation timing and amount; habitat fragmentation; land use changes
  - Species considered included kangaroo rats, ground squirrels, badgers, and San Joaquin kit fox.
  - There are varying degrees of plasticity between species of this species group. The ground squirrel and kit fox are more adaptable than badgers and kangaroo rats.
- **Vernal Pool Crustaceans**
  - Overall Vulnerability: 4
  - Overall Confidence: 2
  - Key Contributing Factors: Temperature; precipitation; frequency and severity of extreme events (e.g. flooding and drought); habitat fragmentation; land use conversion.

    - Confidence level was 2 because of the myriad projections about longer timeframes versus immediate impacts and distribution/recolonization of sites.
- Did not complete ***Grassland Shorebirds*** vulnerability assessment as the working group felt they were covered by the grasslands habitat assessment.

RIPARIAN/RIVERINE GROUP

- **Riparian Nesting Birds**
    - Overall Vulnerability: 3 +/- 0.5
    - Overall Confidence: 2.5
    - Key Contributing Factors: Development and agriculture; alterations to hydrology; changes to their wintering habitat outside of the United States
    - Both breeding riparian species and wintering riparian species were considered in this assessment. These two categories of birds are comprised of somewhat different species and have slightly varying scores indicated in the actual worksheet.
    - Riparian birds are dependent on proximity for water, and there is high competition for water by residential developers and agriculture in the Central Valley. Their habitat is connected to the hydrology of the area. Any alterations in hydrology likely result in loss of habitat.
    - Positive factors include the high adaptability in changes to localized habitat by most bird species; some behavioral plasticity; high restorability in riparian habitat (if restored, birds are likely to be able to come back quickly)
- **Salmonids**
    - Overall Vulnerability: 5
    - Overall Confidence: 3
    - Key Contributing Factors: Barriers to distribution; extreme events (e.g. flows, runoff timing, snowmelt); water temperature; flow regime alterations.
    - Water management facilities and flood control through water supply systems play a large role in Salmonids vulnerability.
    - Vulnerability for Salmonids as a species group is approximately consistent Valley wide. If individual species were considered, then there may be gradients in vulnerability north-to-south.
- Unable to complete ***Amphibians*** vulnerability assessment.

High priority species groups that the Project Team will work with experts to complete vulnerability assessment worksheets for post-workshop include:

- **Wide-ranging Mammals.** *Identified experts include:*
    - Patrick Huber
    - Jim Quinn
    - Steve Greco
- **Amphibians.** *Identified experts include:*
    - Brian Halstead

- **Mast-Associated Species**

C. Plenary Discussion

- *Breeding Water Birds* was a hugely diverse species groups that considered black terns, cranes, shorebirds, etc. If the individual species were analyzed for vulnerability the results would differ.
    - **Comment:** Some birds, such as black terns, avocets, tricolored blackbirds, mallards, etc. have an affinity for rice fields. **Rice** as a sub-habitat could be worth conducting a vulnerability assessment for with consideration to water birds.
        - In spring, summer and fall, rice fields provide flooded cropland habitat. In fall and winter months, wheat and corn fields are also flooded.
        - Flooded cropland is also a surrogate habitat for the giant garter snake.
    - **Comment:** Red-billed curlews and several other species are dependent on alfalfa fields for habitat. Point Blue has conducted studies on this.
    - **Comment:** Cranes are a winter water bird species that may be vulnerable to sea level rise, especially with respect to the precarious nature of Delta levees.

- **Ms. Kershner:** Many species groups had lower vulnerabilities than the sub-habitats.
    - **Comment:** The wetlands group looked at vulnerabilities of species groups under the assumption that the baseline habitat would be intact. Climate impacts on habitat, habitat impacts on species, and the distinction of specific stressors to species versus habitat is impossible to tease out entirely.
    - **Comment:** The Uplands group had a similar approach, and similar struggle.
    - **Comment:** The Riparian/Riverine group noted differences in riparian species-dependent responses to stressors compared to the sub-habitat Responses completed earlier. Distinctions were made in part because of the mobile nature of birds and their high reproductive capacity. If there is restoration of a riparian habitat, birds will be likely to return at a high success probability.

- **Comment**: Fishes were generally considered for analyses under Salmonids, though some species transcend the Valley so reported numbers are generalities. Salmonids have maximum vulnerability, so things could not be worse for them. If individual species were reviewed, some would fare better than others. For example, steelhead is much more tolerant for temperature than salmon. To have credibility with this process some species should be broken out from groups.
    - **Comment**: The Desert/Grasslands groups included extensive notes in the worksheets about species that deviated from the group's generalities.
    - **Ms. Kershner:** Any species groups housing individual species that have exceptions to vulnerability generalities will be recognized in separate paragraphs in the assessments.
    - **Comment:** For wetland-dependent mammals, those considered were all mobile with high plasticity. The exception to consider is the Cosumnes Shrew.

- **Comment**: The next steps of determining management actions and adaptive strategies may require the group to further split the species group. Pond turtles and garter snakes have similar management actions, which provides simplicity to the management actions.
    - **Ms**. **Kershner:** Many adaptive strategies are habitat-based.

- **Comment:** Regarding north-south gradients in vulnerability, there is a very distinct productivity gradient in the California plant associations. There are higher northern productivities that decline to the Tulare Lake Basin.
    - **Comment**: Gradients will be compounded by climate change.
    - **Comment:** There are important differences in water supply between the north and south of the Valley. In the Sacramento Valley, rivers themselves are used as water conveyance. In the San Joaquin Valley, water conveyance occurs by canals. Natural channels there only move spillwater. There are three large reservoirs in Sacramento that are multi-year reservoirs and still release water even during drought years. This is not the case south of Sacramento, where all water is annual water. Thus, the plant productivity might have been different before 1940. Current differences in productivity could be partly due to the development of this water supply infrastructure rather than latitude.
        - **Comment:** There is a correlative relationship of productivity with precipitation north to south that should be considered.

- **Comment:** Staff at San Luis National Wildlife Refuge stated that typical managed wetland is irrigated only once or twice during the summer. There was very little irrigation in the San Joaquin area, but the Sacramento areas were irrigated liberally this summer. This is a management consideration – to use irrigation water in the hot summer months or to use it in fall for flood-up.

- **Comment:** DWR is looking at extreme heat days and impacts to the southern parts of the state and the Central Valley. Increases in drier, higher temperatures exacerbate the north-south gradient. Impacts are high in the north, and they happen with more frequency in the south.

- **Comment:** Alongside water supply impacts is the level of groundwater loss and level of land subsidence in the lower San Joaquin Valley, and the resulting loss of soil moisture.

- **Comment:** The climate change gradients that impact fishes run west-east. This likely does not impact the Central Valley a great deal. However, elevation does affect fishes because certain species require colder waters. Elevational gradient in relation to climate change may be a consideration.

7. Practical Applications and Upcoming Workshops

A. Case Study Examples and Applied Adaptation Strategies

Ms. Kershner shared several slides on moving from vulnerability assessments to adaptation strategies, and provided several practical examples. (Please refer to slides available on the project website at http://californialcc.org/central-valley-landscape-conservation-project.) She also noted that as a next step, completed worksheets will be analyzed and scores tallied to obtain overall vulnerability scores. EcoAdapt will prepare a full report that will be peer reviewed, and the full report appendix will list the individual scores generated at this workshop. EocAdapt will also conduct mapping of sensitivity, exposure and adaptive capacity values.

Topics reviewed in the presentation included:

- Vulnerability Assessment Products
    A. Excel spreadsheet with vulnerability and confidence rankings and overall scores
    B. Vulnerability report that includes:
        - Rankings for each species/habitat/species group
        - Summary figures
        - Narratives describing key sensitivities, exposure, and adaptive capacity
- Using Vulnerability Assessment reports to begin to Identify Management Options
    A. **Adaptation** refers to efforts to reduce the negative effects of or respond to climate change
    B. **Adaptation actions** explicitly incorporate climate considerations, and aim to alleviate the impacts of climate change by increasing resilience and/or decreasing vulnerability.
- Adaptation Strategies include three primary strategic methods:
    1. Resistance Strategies
    2. Resilience Strategies
    3. Transition Strategies
- Increasing Knowledge and Engagement/Coordination are also important Adaptation Strategies
- **Resistance Strategies**: Prevent the effects of climate change from reaching or affecting you. Examples include:
    - Manage forest vegetation, and reduce fire severity and patch size
    - Increase proactive management to prevent invasive weeds
    - Reduce erosion potential to protect municipal water supplies
    - Identify and protect aquifer recharge zones
- **Resilience Strategies:** Weathering the impacts of climate change by avoiding the effects of or recovering from changes. Examples include:
    - Repair, replace, and reroute trails and trail bridges to increase resilience to higher peak flows
    - Promote native genotypes and adapted genotypes of native species

    - Employ a risk-diversification approach to forest management and silvicultural practices
- **Transition Strategies:** Intentionally accommodate change and enable resources to adaptively respond to changing and new conditions. Examples include:
    - Facilitate change to desired species assemblages
    - Promote connected landscapes that can facilitate species migration along climatic gradients
    - Identify and protect refugia
    - Accept loss of recreation sites and/or adjust the timing or route of access
- Applying Vulnerability Assessment Results in Adaptation Planning
    - **Reduce Sensitivity**
        - *Example:* Actively plant drought-tolerant native species in an area projected to get drier (*resilience)*
    - **Reduce Exposure**
        - *Example:* Replant riparian vegetation to limit water temperature increases (*resistance*)
    - **Enhance Adaptive Capacity**
        - *Example:* Support connectivity across the landscape between different populations (*transition*)
- **Case Study #1:** Gunnison Basin sage-grouse
    - Sage-grouse is highly vulnerable to climate change such as drought, increased erosion from intense precipitation events, and invasive species
    - Goal: Build the resilience of riparian areas/wet meadows – priority brood-rearing habitat – to help the Gunnison Sage-grouse and other wildlife species adapt to climate change in the Gunnison Basin.
    - Working together at the Adaptation Workshop, participants identified a long list of potential adaptation strategies and then voted on the top three adaptation strategies for each focal area. For sage-grouse, they identified:
        - (1) maintain and restore seeps and springs
        - (2) improve nesting and winter habitat
        - (3) policy options to protect private grouse habitat
    - They also built a conceptual model to diagram factors that affect Gunnison sage-grouse population size and habitat condition (also called a “situation diagram”)
    - Strategies implemented included:
        - One rock dams
        - Media Luna (spreading out flow)
        - Vegetation monitoring
        - Prioritized restoration sites by GIS analysis
- **Case Study #2:** Seeps and Springs in the Sky Islands
    - Sky Islands are isolated forested mountain ranges that are surrounded by desert and grassland, and are located at the confluence of multiple bioregions.

- Disruptions in the amount, timing, and intensity of precipitation combined with increased temperatures and fire events are already having considerable, visible impacts on springs and associated species
- Priority Adaptation Strategies identified at their highly collaborative workshop included:
  - (1) Create climate-smart spring restoration methodologies
  - (2) Restore upland habitat to increase recharge and decrease erosion
  - (3) Improve infrastructure at spring sites to conserve water and provide habitat
- Strategy Actions Implemented Included:
  - Conducted spring inventories and assessments using trained volunteers and professional staff and instituted a citizen scientist "Adopt-A-Spring" monitoring
  - Repaired a spring-fed pond and installed native plants
  - Installed fencing around perennial spring on private property
  - Installed wildlife entry/exit ramps at developed springs for endangered frogs
  - Developed a spring restoration guidebook for the region

Questions and Discussion

- If the working group noted a positive response to a species group sensitivity factor, how will that value affect the final vulnerability rating?
  - **Ms. Kershner:** That species group will have an overall low sensitivity factor.

- Did the two case studies presented on Adaptation Strategies begin their efforts with vulnerability assessments in the same fashion as this workshop?
  - **Ms. Kershner:** Yes. Sky Island had a very similar process to this with a two-day workshop. The Gunnison Basin effort included a project team that worked behind the scenes to develop draft vulnerability assessments, then hosted a workshop to validate their findings.

- Will there be a second review of the findings documented during this project's workshop?
  - **Ms. Kershner:** Yes. The information collected at this workshop will first be complied. Then a draft compilation will be circulated to ensure the findings were interpreted correctly. The vulnerability assessments will be supplemented with peer review literature, followed by another expert review cycle.

- Will this project incorporate folks into the adaptation strategy stage other than the resource managers and folks participating in the vulnerability assessment workshop? Implementation of adaptation strategies will likely need to involve decision makers, though there are pros and cons to engaging decision makers in this process.
  - **Ms. Schlafmann:** The primary audience for this project is resource managers in the Central Valley. That category can extend to include city and local planner

personnel. Over the next six months while the project team works to compile the results of this workshop, the project team will also be conducting significant outreach to engage more folks in the next stages. The methods for engagement will be very deliberate.

- **Mr. Fougeres**: The need for engaging folks other than professional resource managers has been indicated at other workshops. Some have been invited but unable to attend. At the upcoming workshops, liaisons to ranchers, land owners, etc. may be invited.
- **Ms. Schlafmann:** Any suggestions on participants for future workshops are welcome.
- **Comment:** In the Central Valley, non-resource managers should be included in the strategy design process. The opinions of others are also valid as they have stakes in what is done. This may mean more difficult work initially but will garner longer lasting results.
- **Comment:** The discussion on outreaching our project to a larger community is important, though a large component will be just educating resource managers in other parts of the Central Valley about climate change adaptation. Many folks do not have the time or resources to participate in a planning workshop such as this, but they should not be neglected.

B. Open Discussion on how Adaptation Strategies can be Most Useful for Resource Managers' Decision Making

Participants were posed two questions for consideration to frame the open discussion on how adaptation strategies can be tailored to be most most useful for resource managers' decision making:

1. What are the major management decisions that you have to make?
2. How can we make adaptation strategies most helpful to your decision-making?

Mr. Fougères also **summarized the adaption strategy design considerations** that were mentioned throughout the two-day workshop:

- Compatibilities might be found across sub-habitat types (e.g. riparian and floodplain)
- Climate and non-climate factors to vulnerability may not necessarily require the same adaptation strategies
- Types of strategies to consider:
  - Resource management
  - Restoration
  - Planning
  - Social, political, regulatory engagement
- Geography is a consideration
  - Entire Central Valley
  - Endemic or regional

    - Across gradients (north-south and west-east)
- Private Lands vs. Public Lands
- Strategies based on sub-habitat, species group, or individual species
    - Private Lands vs Public Lands

Discussion Period

- Please explain the focus of the upcoming workshop.
    - **Ms. Schlafmann:** The upcoming workshops will focus on developing adaptation strategies, associated actions, and completion of some mapping.
    - **Ms. Kershner:** One option for the next workshop is to identify general adaptation strategies for these resources, and from there, prioritize a selection of actions or prioritize an area on which to apply strategies. Then more specific mapping of where adaption strategies can be applied can be completed.
    - **Comment:** The Project Team may consider developing maps before the adaptation strategies workshop, as many efforts are compounded by geography.
    - **Ms. DiPietro**: The Data Management Team has been convened and will be involved in the project from this point forward, helping us with developing maps, decision support tools, access tools, etc.

- Some species guilds that the participants have identified as highly vulnerable live in data-poor environments. How can this data gap be bridged to facilitate adaptation strategies?
    - **Ms. Kershner:** There is a host of criteria that can be considered when prioritizing which adaptation actions might be implemented near-term, and which require more research. There is also an evaluation component including feasibility and effectiveness. It is important to develop a portfolio of adaptation strategies even if they cannot all be implemented in the immediate future such that when data is available, these strategies can be easily identified.

- The situation diagram shown in the presentation is a “reverse causal chain” that allows one to see where a management action might be most effective for obtaining a desired outcome. While very useful for some, for others these diagrams might contain too much information. Participants should just be aware of this when engaging other folks besides scientists and resource managers in adaptation strategy discussions.

- There may be groups not yet identified working on parallel efforts in the Central Valley that could be integrated into this project, either as partners or for idea-sharing.

- **Mr. Fougères:** Considering the intended user groups, tools and materials that could be shared, what beneficial resources or approaches have been historically useful for collaboration? What are other ideas participants may have in this regard?
    - Reviewing academic literature for **operation/conceptual models of adaptation strategies**.

- Following the framework for **Open Standards for Practice and Conservation**.
- Collecting information from all participants about current or completed projects, and **identifying elements that overlap** to generate innovative solutions and maximize resources.
- It would be helpful to map out where people are working and where applied adaption strategies can generate multiple benefits (perhaps accomplished via **online dynamic maps**). In this way the project could empower partnerships across agencies.
    - Maps could include things like hedge rows being built by Resource Conservation Districts (RCDs), and myriad other RCD projects.
- The adaptation strategy report could also include a **map of spatially explicit options of where strategies could be implemented**.
- One consideration for adaptation strategy feasibility and effectiveness is current **budget climate**. Wetland managers are struggling with this currently, as it is expensive to apply water on wetlands in the Valley at this time.
- Regarding project buy-in, the vulnerability of landowners should be assessed.
- Geos Institute conducted a place-based **focus group** study to assess political and social will for implementing certain projects. They may have some successes and challenges they would be willing to share.
- The website for Southern Sierra Partnership on climate-adapted conservation plans includes a vulnerability assessment that may be a useful resource here. A recent paper by Nate Stevenson on the integration of scenario planning and vulnerability assessment is another resource.

8. Next Steps and Closing Remarks

CVLCP Webpage Overview

Deanne DiPietro, CA LCC, provided a brief orientation the Central Valley Landscape Conservation Project website and indicated to participants where various workshop materials were located, including meeting materials, customized maps, reference libraries, etc. She noted that new reference links could be added at any time information is shared for group use. This website will become part of the products and overall toolbox of the CVLCP. She invited participants to sign up for the LCC newsletter which includes periodic news on updates to web material.

Climate Summit

Ms. Schlafmann reminded participants of the upcoming Climate Summit, November 2-3, hosted at the Sacramento Holiday Inn. There will be may agencies there including five LCCs, the Southwest Climate Science Center, the USDA, etc. participating in plenary discussions, interactive sessions with information tools, and interactive discussions. More information and registration can be found here:
http://www.swcsc.arizona.edu/content/2015-southwest-climate-summit

Workshop Feedback

Participants were invited to provide feedback on the workshop structure and various components. Several folks made remarks:

- One participant was very encouraged that so many others are actively dealing with climate change issues.
- Several participants were impressed by the dedication and enthusiasm of all attendees that lasted for both workshop days.
- It was requested that more time be provided the first time participants go through the worksheets to read through the detailed instructions, etc.
- One participant noted it was beneficial to have a member of the project team facilitating each table's discussion.
- The advance materials and website with resources was helpful to some in preparing for the workshop.
- Additional species experts should be confirmed for attendance (e.g. amphibians, resident fish experts, and experts on other species that are unique to the Central Valley).
- There was some redundancy noticed in the worksheets that could be condensed
- Occasionally it was difficult to differentiate the vulnerability of a species without considering the vulnerability of the habitat.

Next Steps

Ms. Fris reviewed the next steps following completion of this workshop:

- The workshop meeting summary will be distributed in approximately two weeks, along with the attendee list at the request of several participants
- The Project Team, along with EcoAdapt, will compile and prepare the vulnerability assessment results over the next 5-7 months
- The next workshop on adaptation strategies will be held in Spring of 2016

Ms. Fris then thanked the participants and the project team for their tremendous efforts that went into to preparing for and completing the vulnerability assessment workshop, and closed the workshop.

9. Attendance

PARTICIPANTS

Riparian/Riverine Habitat Group:

Reyn	Akiona	US Fish and Wildlife Service
Jennifer	Cavanaugh	Natural Resource Conservation Science
Erin	Chappell	CA Department of Water Resources
Ted	Frink	CA Department of Water Resources
Kaylene	Keller	US Fish and Wildlife Service

Javier	Linares-Casenave	CA Fish Passage Forum
Ray	McDowell	CA Department of Water Resources
Chad	Moore	US Bureau of Reclamation
Ruth	Ostroff	Central Valley Joint Venture
Chad	Roberts	Riparian Joint Venture
Kevin	Shaffer	CA Department of Fish and Wildlife
Kim	Webb	US Fish and Wildlife Service

Upland Habitat Group:

Christopher	Gardner	CA Association of Resource Conservation Districts
Cathy	Johnson	US Fish and Wildlife Service
Thomas	Leeman	US Fish and Wildlife Service
Rodd	Kelsey	The Nature Conservancy
Mark	Pelz	US Fish and Wildlife Service
Jim	Quinn	UC Davis

Wetlands Habitat Group:

Dan	Frisk	US Fish and Wildlife Service
Brian	Halstead	US Geological Survey
Matt	Hamman	US Fish and Wildlife Service
Misty	Nelson	CA Department of Fish and Wildlife
Greg	Yarris	Central Valley Joint Venture

Desert/Grassland Group:

Kristin	Byrd	US Geological Survey
Kim	Delfino	Defenders of Wildlife
Bobby	Kamansky	Independent
Ken	Sanchez	US Fish and Wildlife Service
Joe	Silveria	US Fish and Wildlife Service
Justin	Sloan	US Fish and Wildlife Service
Mike	Westphal	US Bureau of Land Management

STAFF

Deanne	DiPietro	CA Landscape Conservation Cooperative
Dorian	Fougères	Center for Collaborative Policy, CSUS
Rebecca	Fris	CA Landscape Conservation Cooperative
Andrea	Graffis	CA Landscape Conservation Cooperative
Debra	Schlafmann	CA Landscape Conservation Cooperative
Zhahai	Stewart	CA Landscape Conservation Cooperative

Meagan	Wylie	Center for Collaborative Policy, CSUS