Climate Change & Natural Resources: Legislation, Impacts, and Responses

Whitney Albright
California Department of Fish & Wildlife
UC Davis lecture
March 3, 2016

Outline

Part 1: State-wide focus

- CA Climate legislation (legislative drivers)
- Driving documents/initiatives

Part 2: Fish and Wildlife

- Climate impacts to fish and wildlife
- Vulnerability assessments
- Adaptation strategies

Part 3: Climate change & CDFW

- CDFW background
- Overview of CDFW climate work
- Project examples
  - Vulnerability assessment of California vegetation
  - CDFW cap and trade program implementation

Definitions

- **Mitigation**: Human intervention to reduce GHG emissions or to increase sinks (e.g., carbon sequestration in forests).

- **Adaptation or Preparedness**: Adjustments in human or natural systems to expected changes in the environment. Preparation for climate change refers to adjustments made in response to experienced or anticipated changes in the climate. California has adopted the term "safeguarding" for this concept.

- **Vulnerability**: The degree to which a system is sensitive to, and able to respond to, the impacts associated with a changing climate, including climate variability and extreme events. Vulnerability depends on the rate and character of climate change, exposure to that change, the sensitivity of the system, and its capacity to adapt.

- **Resilience**: The amount of change a system can be exposed to without irreversible damage and the ability of that system to bounce back after impact. Current research thinking on resilience includes the ability of systems to self-organize, to learn and adapt and thus to change to some extent so that the system can still be viable in changing conditions.

Sampling of California Climate Legislation

Executive Orders (EO), Assembly Bills (AB), and Senate Bills (SB)

2005

EO-S-3-05 Established greenhouse gas emission reduction targets, created the Climate Action Team

2006

AB 32 Global Warming Solutions Act of 2006

EO-S-20-06 Established responsibilities and roles of state agencies in climate change

2007

SB 97 Incorporated greenhouse gas mitigation into CEQA guidelines

2008

SB 375 Sustainable Communities & Climate Protection Act of 2008

EO-S-13-08 Sea level rise planning and the CA Climate Adaptation Strategy

2012

AB 1532 Greenhouse Gas Reduction Fund in the Budget

SB 535 Greenhouse Gas Reduction Fund and Disadvantaged Communities

2015

AB 1482 Requires CA climate adaptation strategy updates, and directs the Strategic Growth Council to address climate change

SB 246 Establishes the Integrated Climate Adaptation and Resiliency Program

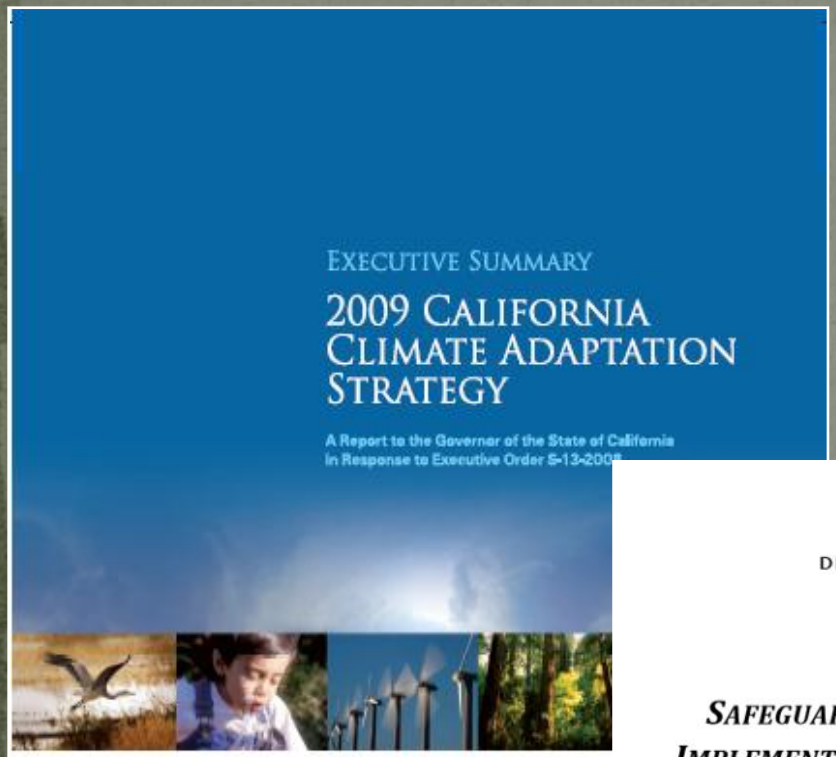
Additional legislative resources

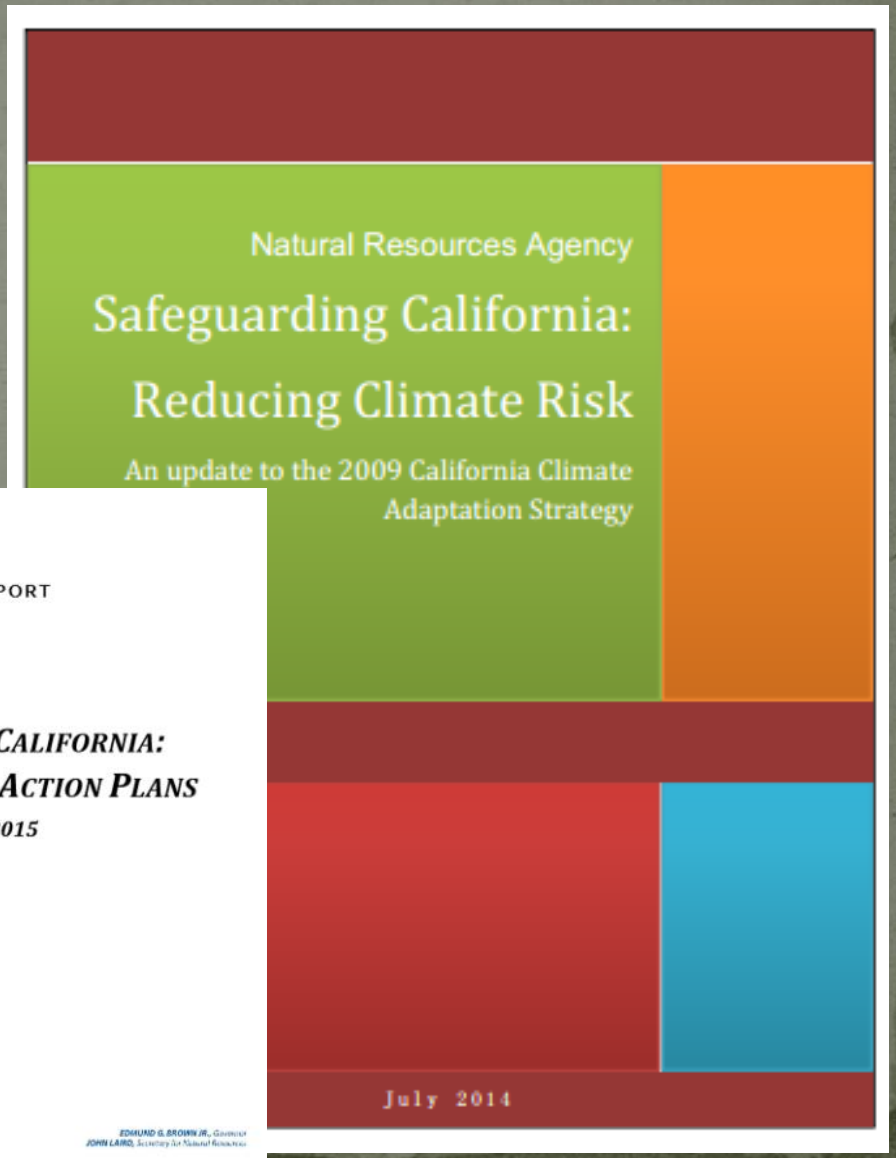
California Climate Change Legislation

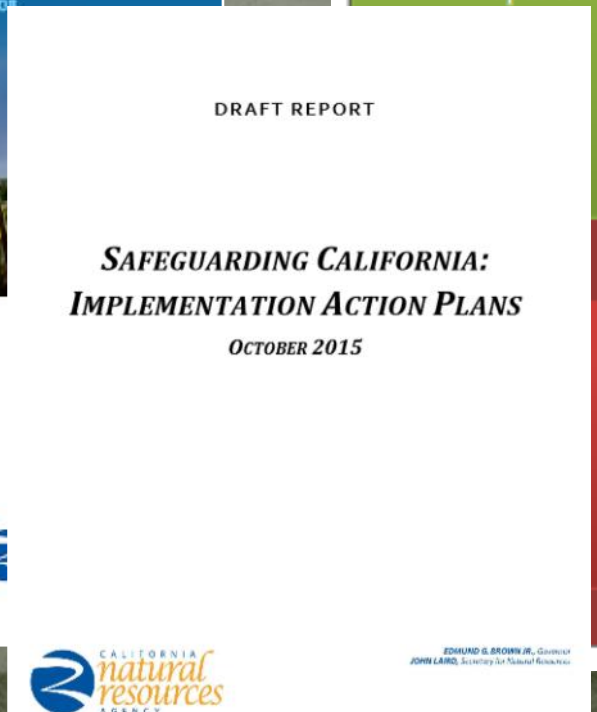
Date	Legislation	Description
October 7, 2015	Senate Bill 350 (De León, Chapter 547, Statutes of 2015)	**Clean Energy and Pollution Reduction Act of 2015** Establishes targets to increase retail sales of renewable electricity to 50 percent by 2030 and double the energy efficiency savings in electricity and natural gas end uses by 2030.
September 21, 2014	Senate Bill 605 (Lara, Chapter 523, Statutes of 2014)	**Short-lived climate pollutants** Requires the State Air Resources Board to complete a comprehensive strategy to reduce emissions of short-lived climate pollutants by January 1, 2016.
September 21, 2014	Senate Bill 1275, (De León, Chapter 530, Statutes of 2014)	**Charge Ahead California Initiative** Establishes a state goal of 1 million zero-emission and near-zero-emission vehicles in service by 2020. Amends the enhanced fleet modernization program to provide a mobility option. Establishes the Charge Ahead California Initiative requiring planning and reporting on vehicle incentive programs, and increasing access to and benefits from zero-emission vehicles for disadvantaged, low-income, and moderate-income communities and consumers.

climatechange.ca.gov/state/legislation.html

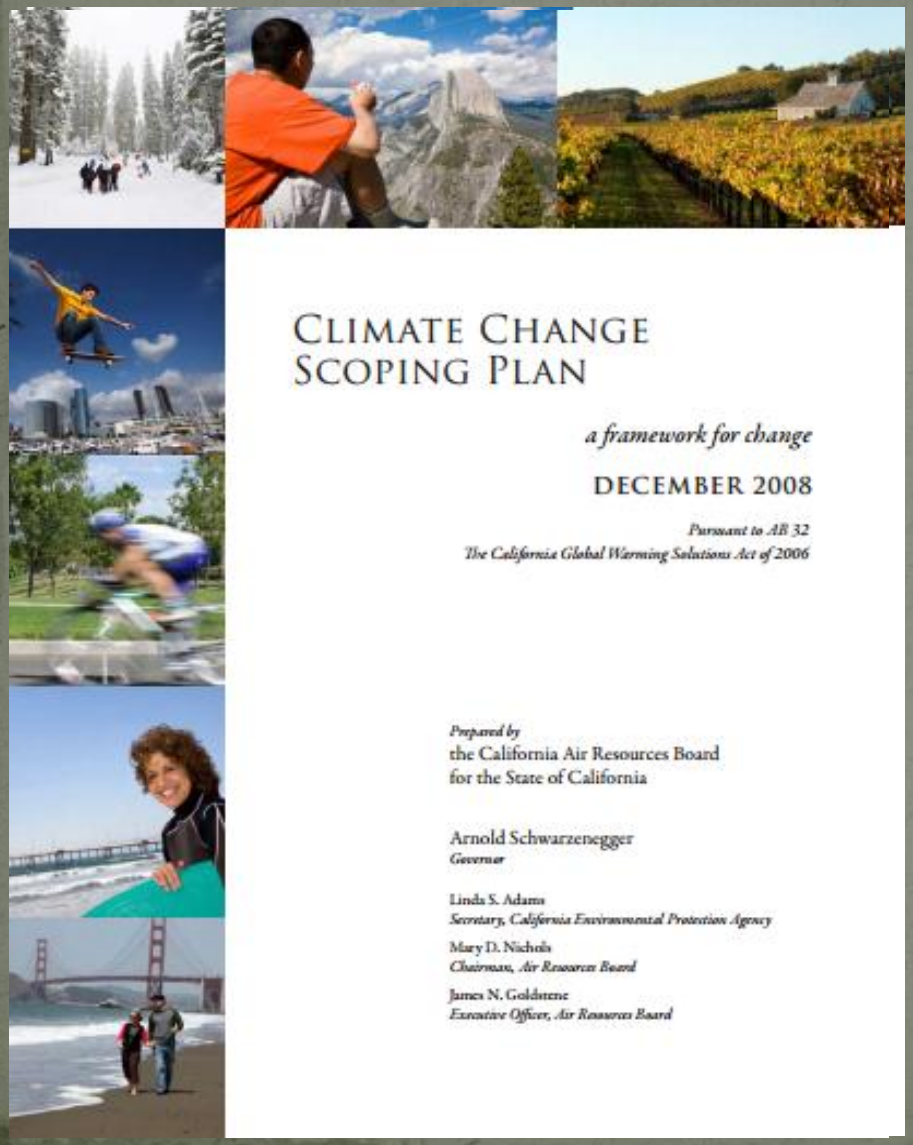
CA Climate Adaptation Strategy







AB 32 Scoping Plan



Climate Change Scoping Plan

a framework for change

DECEMBER 2008

Pursuant to AB 32
The California Global Warming Solutions Act of 2006

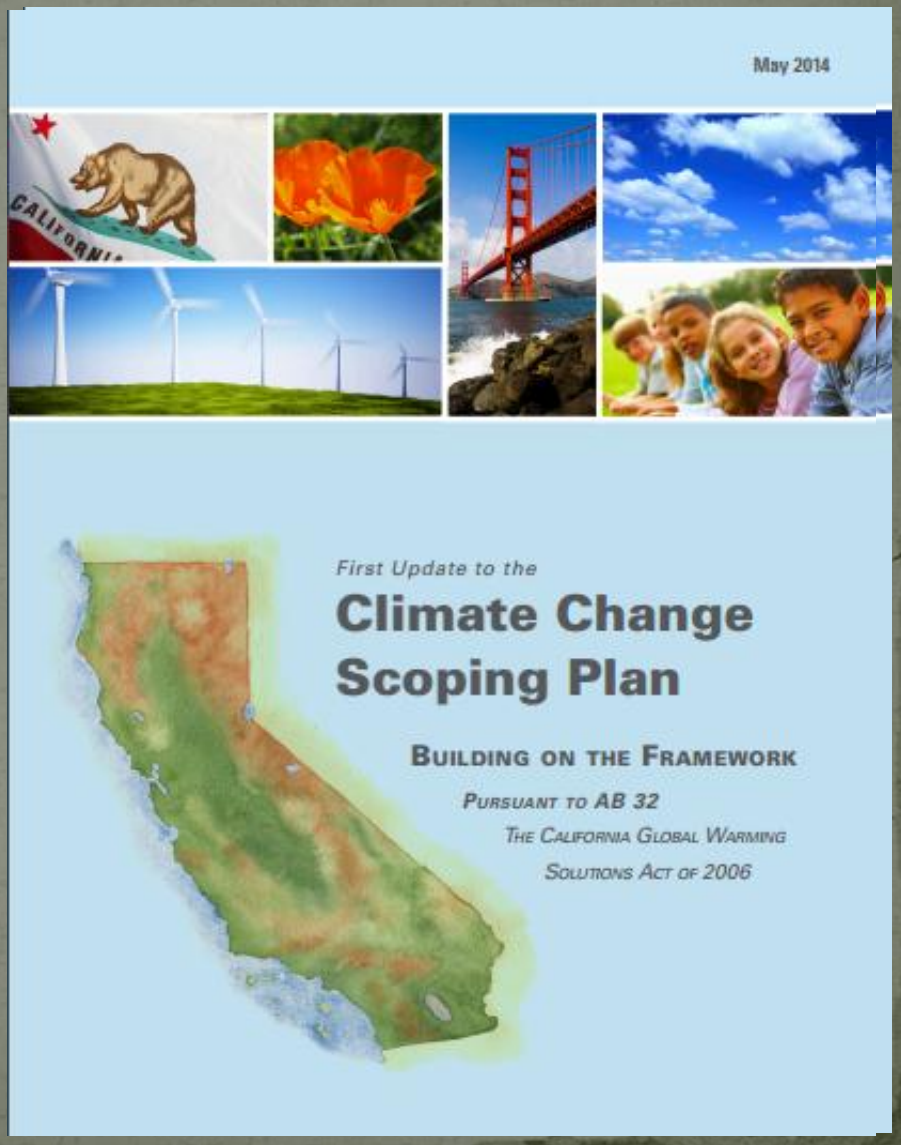
Prepared by
the California Air Resources Board
for the State of California

Arnold Schwarzenegger
Governor

Linda S. Adams
Secretary, California Environmental Protection Agency

Mary D. Nichols
Chairman, Air Resources Board

James N. Goldstene
Executive Officer, Air Resources Board



May 2014

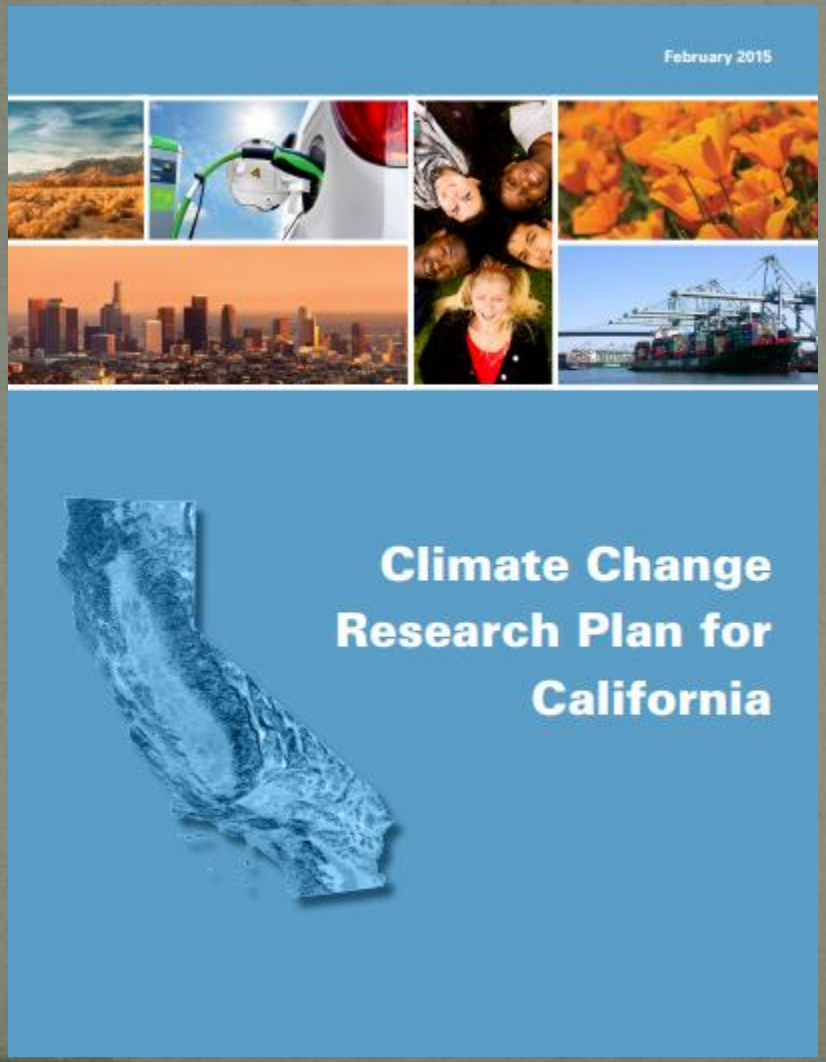
First Update to the

Climate Change Scoping Plan

Building on the Framework

Pursuant to AB 32
The California Global Warming Solutions Act of 2006

CA Climate Change Research Plan



- Monitoring
- Climate projections
- GHG accounting
- Reducing GHG emissions
- Climate impacts and vulnerability
- Socio-economic effects of climate impacts and policy responses

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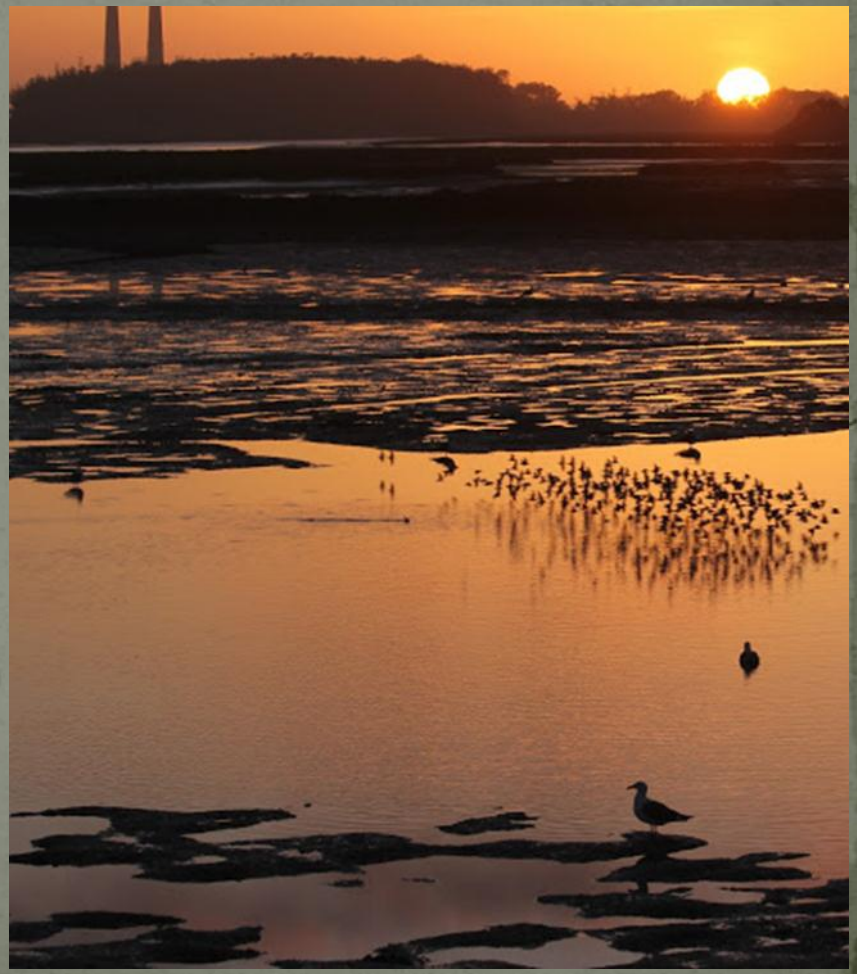
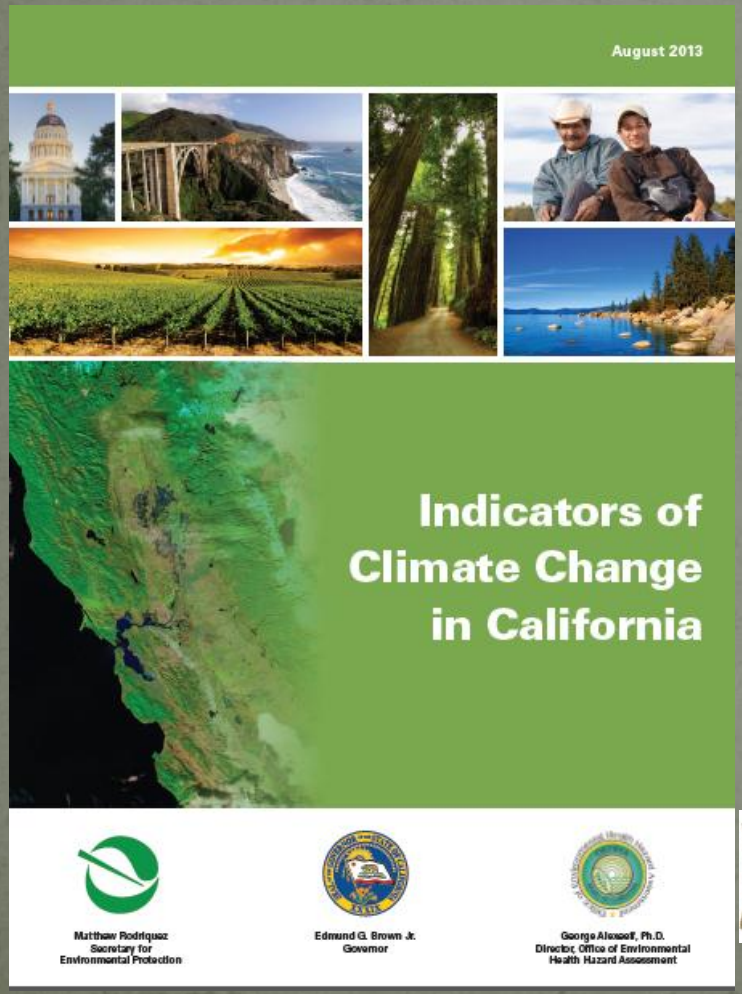
Challenges and Risks

- Species migration, range shifts, and novel combinations of species
- Changes in the timing of seasonal life-cycle events
- Food web disruptions
- Pathogens, parasites, and disease
- Extinction risks



Observed impacts



- Species range shifts
- Change in migration patterns
- Impacts to marine food web – and salmon abundance
- Auklet breeding
- Sea lion pup mortality

oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsReport2013.pdf

Assessing vulnerability

Vulnerability: The degree to which a system is sensitive to, and able to respond to, the impacts associated with a changing climate

Exposure	Sensitivity	Adaptive Capacity

- Vulnerability assessments help us to identify which species/systems are vulnerable and why

CA Climate vulnerability: Birds

OPEN ACCESS Freely available online

PLoS one

A Climate Change Vulnerability Assessment of California's At-Risk Birds

Thomas Gardali[1]*, Nathaniel E. Seavy[1], Ryan T. DiGaudio[2], Lyann A. Comrack[3]

1 Pacific Coast and Central Valley Group, PRBO Conservation Science, Petaluma, California, United States of America, **2** Emerging Programs and Partnerships Group, PRBO Conservation Science, Petaluma, California, United States of America, **3** Nongame Wildlife Program, California Department of Fish and Game, Sacramento, California, United States of America

Abstract

Conservationists must develop new strategies and adapt existing tools to address the consequences of anthropog
change. To support statewide climate change adaptation, we developed a framework for assessing clim
vulnerability of California's at-risk birds and integrating it into the existing California Bird Species of Special Con
defined climate vulnerability as the amount of evidence that climate change will negatively impact a pop
quantified climate vulnerability by scoring sensitivity (intrinsic characteristics of an organism that make it vuln
exposure (the magnitude of climate change expected) for each taxon. Using the combined sensitivity and exposu
an index, we ranked 358 avian taxa, and classified 128 as vulnerable to climate change. Birds associated with wetla
largest representation on the list relative to other habitat groups. Of the 29 state or federally listed taxa, 21 were a
as climate vulnerable, further raising their conservation concern. Integrating climate vulnerability and California's
of Special Concern list resulted in the addition of five taxa and an increase in priority rank for ten. Our process
simple, immediate action that can be taken to inform climate change adaptation strategies for wildlife.

Citation: Gardali T, Seavy NE, DiGaudio RT, Comrack LA (2012) A Climate Change Vulnerability Assessment of California's At-Risk Birds. PLoS ON
doi:10.1371/journal.pone.0029507

Editor: David Hyrenbach, Hawaii Pacific University, United States of America

Received August 5, 2011; **Accepted** November 29, 2011; **Published** March 2, 2012

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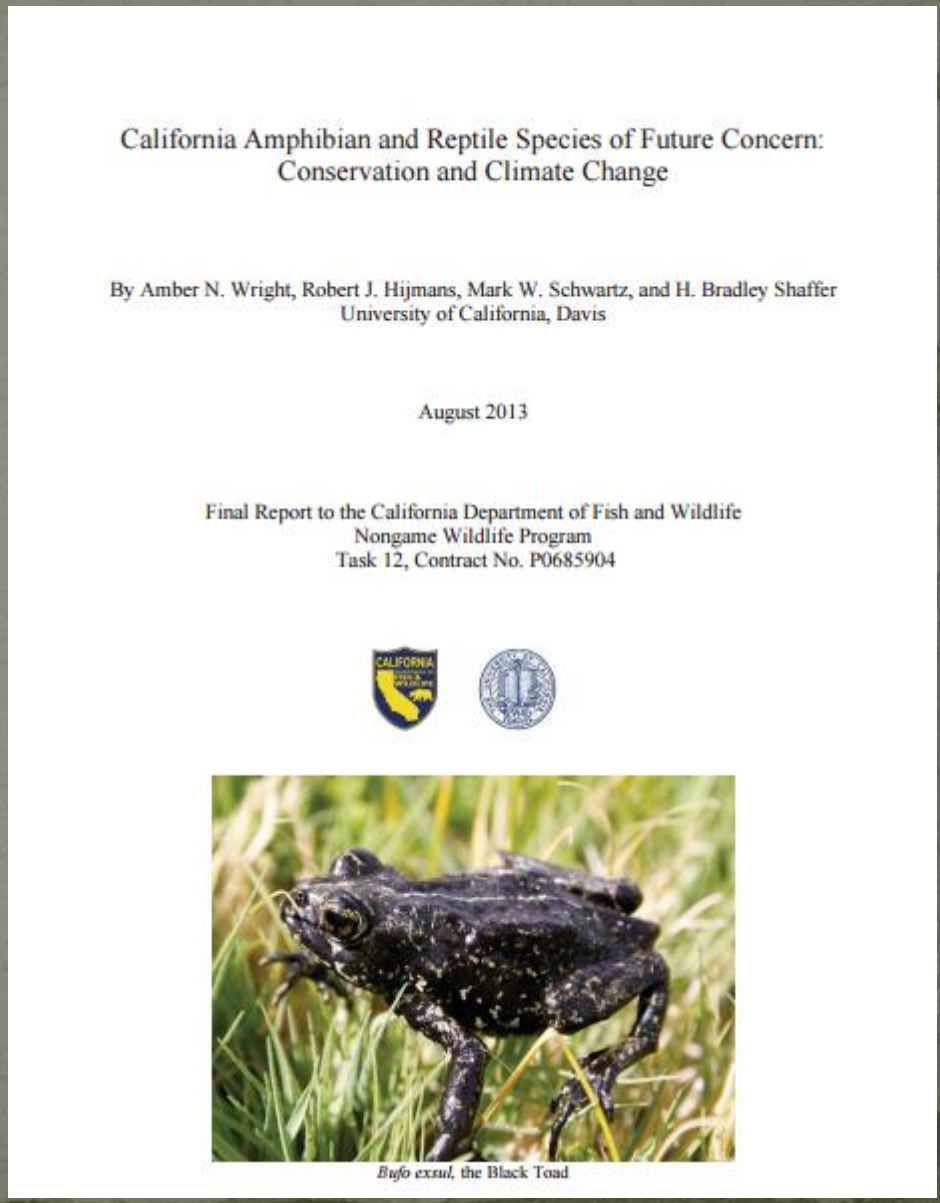
funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have read the journal's policy and have the following conflicts. Author L. Comrack is an employee of the fu
Department of Fish and Game. This does not alter the authors' adherence to all the PLoS ONE policies on sharing data and materials.

CA Climate vulnerability: Reptiles and amphibians

- Reductions in climatic habitat suitability were predicted to be largest for reptiles in the southern mountains and deserts
- Highest risk species tended to be endemic species with small ranges, such as the black toad, Bufo exsul

www.dfg.ca.gov/wildlife/nongame/



California Amphibian and Reptile Species of Future Concern:
Conservation and Climate Change

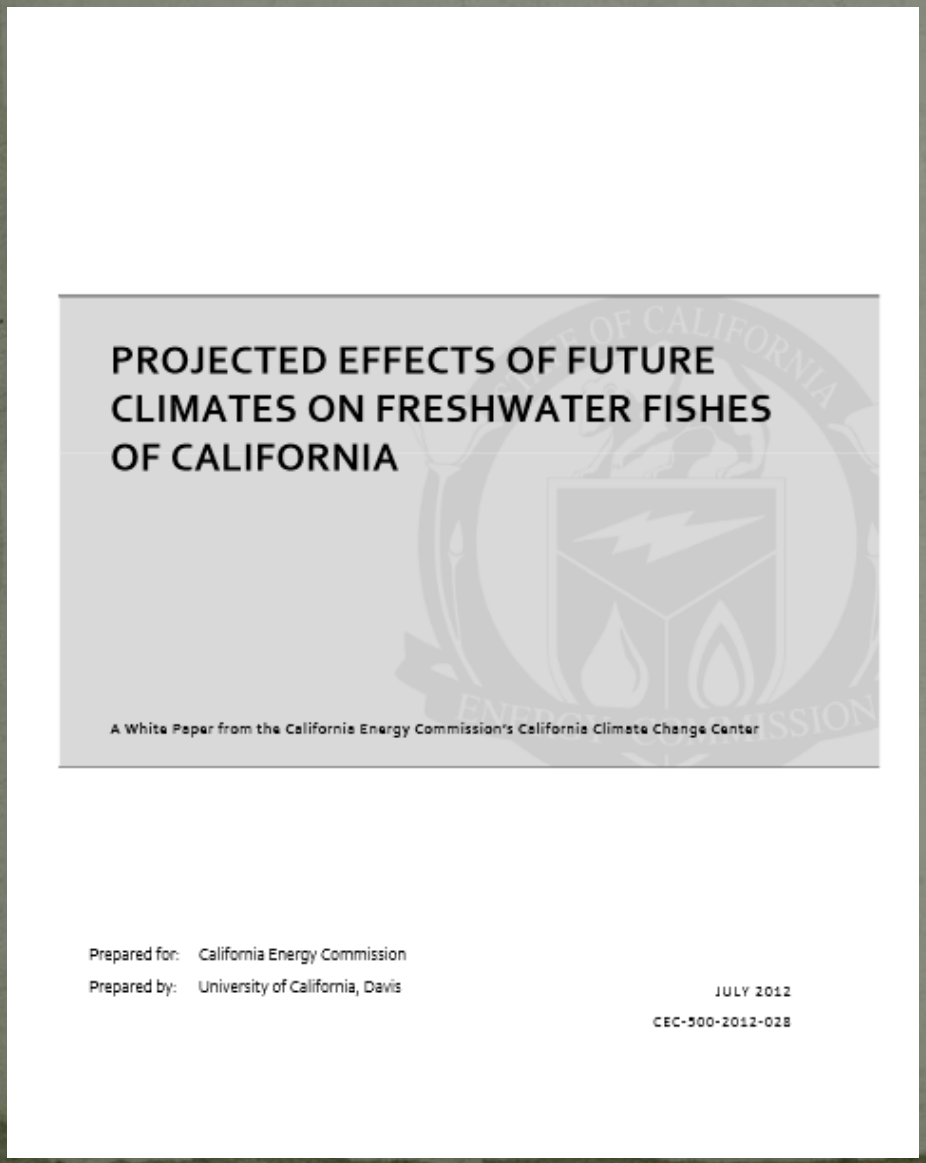
By Amber N. Wright, Robert J. Hijmans, Mark W. Schwartz, and H. Bradley Shaffer
University of California, Davis

August 2013

Final Report to the California Department of Fish and Wildlife
Nongame Wildlife Program
Task 12, Contract No. P0685904

Bufo exsul, the Black Toad

CA Climate vulnerability: Freshwater fish



PROJECTED EFFECTS OF FUTURE CLIMATES ON FRESHWATER FISHES OF CALIFORNIA

A White Paper from the California Energy Commission's California Climate Change Center

Prepared for: California Energy Commission
Prepared by: University of California, Davis

JULY 2012
CEC-500-2012-028

- Climate change impacts to freshwater fishes in CA (121 native species, 43 alien)

www.energy.ca.gov/2012publications/CEC-500-2012-028/CEC-500-2012-028.pdf

Strategies to Safeguard Biodiversity and Habitat

- Improve understanding of climate risks to biodiversity and habitats
- Develop management practices to help safeguard species and ecosystems
  - E.g., reducing existing stressors, improving habitat connectivity, and protecting climate refugia
- Enhance biodiversity monitoring in CA to detect climate impacts and inform responses
- Support environmental stewardship across sectors
- Information sharing and education

www.resources.ca.gov/climate_adaptation/

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California Department of Fish and Wildlife (CDFW)

- Mission: Manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend for their ecological values and for their use and enjoyment by the public.

- Public Trust Doctrine: Wildlife is owned by no one and held in trust by governments for the benefit of present and future generations.





CDFW Mandates

- Biodiversity Conservation
- Hunting, Fishing, and Public Use
- Management of Dept. Lands & Facilities
- Law Enforcement
- Communication, Education & Outreach
- Oil Spill Prevention & Response

CDFW Climate Science Program

How do we address climate change?

- Planning (CAS, SWAP)
- Research (Vulnerability assessments)
- Education (Climate College)
- Collaboration (LCCs, NFWPCAS)
- On the ground action (Hatchery operations, Elkhorn slough restoration, cap and trade projects, etc.)

CDFW project examples

Reducing Emissions	Preparing for Impacts	Research to Inform Policy
Wetland restoration for GHG reduction – grant program		A climate change vulnerability assessment of California's terrestrial vegetation

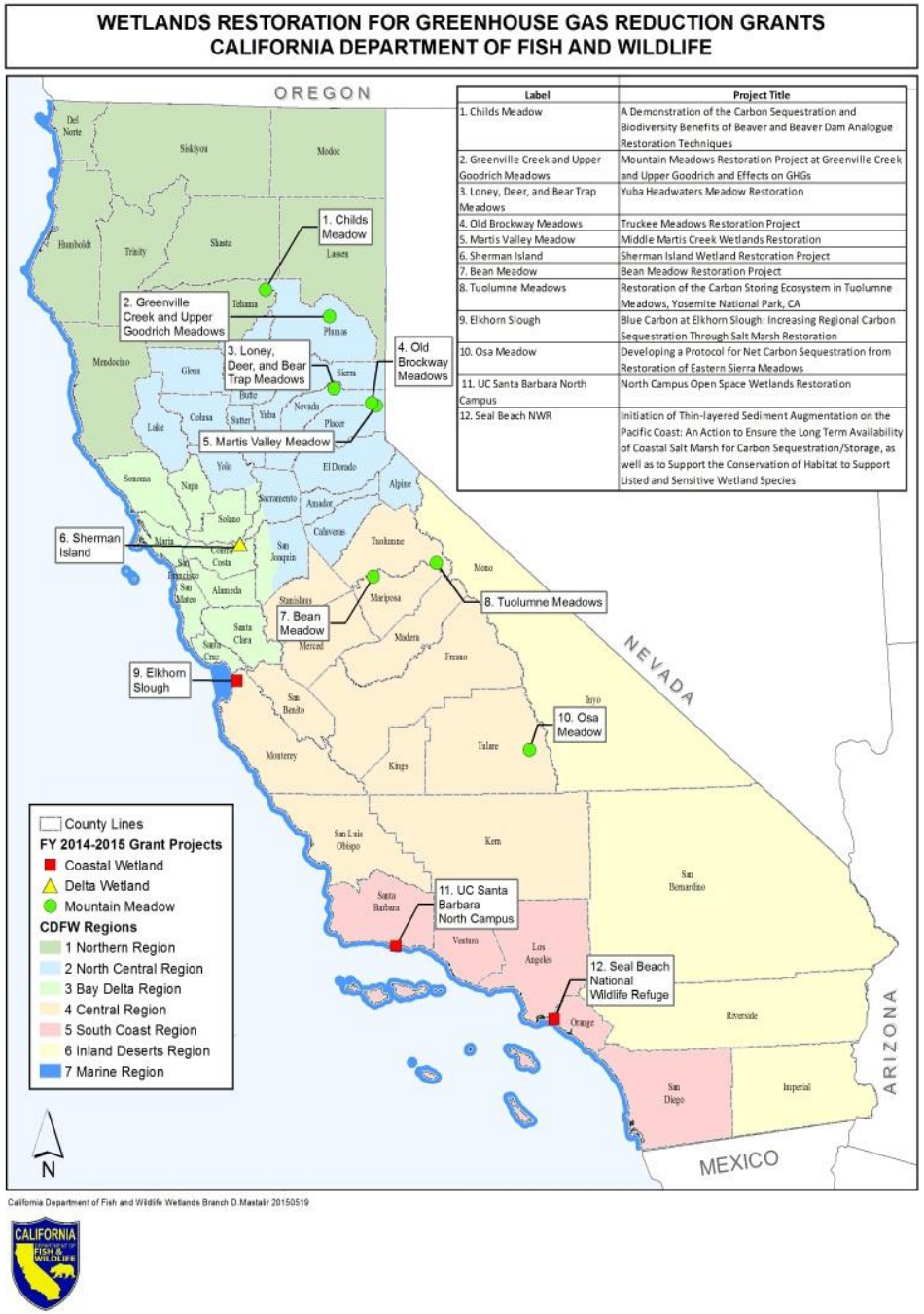
CDFW Wetland Restoration for GHG Reduction: Background

- Grant program established in 2014, now part of "Watershed Restoration Grants Branch"
- Funding source: State's Greenhouse Gas Reduction Fund
- Purpose: Support on-the-ground wetland restoration for the primary purpose of GHG reduction
  - Delta wetlands, coastal wetlands state-wide, & mountain meadows
- FY 2014-2015 Solicitation released in November 2014
  - Project selection announced in April 2015

wildlife.ca.gov/Conservation/Wetlands-Restoration

CDFW Wetland Restoration for GHG Reduction: Projects funded

- $21 million in funding awarded for 12 projects
  - Projects will restore or enhance approximately 2,500 acres of wetlands and mountain meadows



Label	Project Title
1. Childs Meadow	A Demonstration of the Carbon Sequestration and Biodiversity Benefits of Beaver and Beaver Dam Analogue Restoration Techniques
2. Greenville Creek and Upper Goodrich Meadows	Mountain Meadows Restoration Project at Greenville Creek and Upper Goodrich and Effects on GHGs
3. Loney, Deer, and Bear Trap Meadows	Yuba Headwaters Meadow Restoration
4. Old Brockway Meadows	Truckee Meadows Restoration Project
5. Martis Valley Meadow	Middle Martis Creek Wetlands Restoration
6. Sherman Island	Sherman Island Wetland Restoration Project
7. Bean Meadow	Bean Meadow Restoration Project
8. Tuolumne Meadows	Restoration of the Carbon Storing Ecosystem in Tuolumne Meadows, Yosemite National Park, CA
9. Elkhorn Slough	Blue Carbon at Elkhorn Slough: Increasing Regional Carbon Sequestration Through Salt Marsh Restoration
10. Osa Meadow	Developing a Protocol for Net Carbon Sequestration from Restoration of Eastern Sierra Meadows
11. UC Santa Barbara North Campus	North Campus Open Space Wetlands Restoration
12. Seal Beach NWR	Initiation of Thin-layered Sediment Augmentation on the Pacific Coast: An Action to Ensure the Long Term Availability of Coastal Salt Marsh for Carbon Sequestration/Storage, as well as to Support the Conservation of Habitat to Support Listed and Sensitive Wetland Species

CDFW Wetland Restoration for GHG Reduction: Project example

US Fish and Wildlife Service, San Diego National Wildlife Refuge Complex – Initiation of Thin-Layer Sediment Augmentation on the Pacific Coast at Seal Beach National Wildlife Refuge

Provide foraging opportunities

Additional cap and trade resources

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Air Resources Board

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Tuesday, March 1, 2016

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This page last reviewed December 23, 2015

Auction Proceeds Budget Appropriations

The Legislature and Governor appropriate auction proceeds from the Greenhouse Gas Reduction Fund to State agencies and programs through the Budget process, consistent with the implementing legislation.

Summary of Appropriations

ARB has created a summary table of programs and state agencies that have been appropriated GGRF monies for investments in projects that reduce GHG emissions.

- Funding Summary Table
- More information on individual programs

Fiscal Year 2015-16

As part of the budget process, the Legislature and Governor appropriated $1.4 billion for Fiscal Year 2015-16. For State agencies with continuous appropriations, the Fiscal Year 2015-16 values are based on their assigned perentages applied to a total proceeds amount of $2.237 billion. For agencies without continuous appropriations, the Fiscal Year 2015-16 values are based on two 2015 statutes: SB 101 and AB 93.

- $500 million for high-speed rail
- $400 million for sustainable communities
- $395 million for clean transportation
- $139 million for energy efficiency and clean energy programs
- $8 million for natural resources and waste diversion programs

Fiscal Year 2014-15

The enacted State Budget for FY 2014-15 appropriates $862 million in auction proceeds to 12 state agencies to begin funding programs that will reduce GHG emissions, provide direct investments and benefits in disadvantaged communities, and provide additional environmental and economic co-benefits. The Legislature and the Governor also enacted Senate Bill 862, which

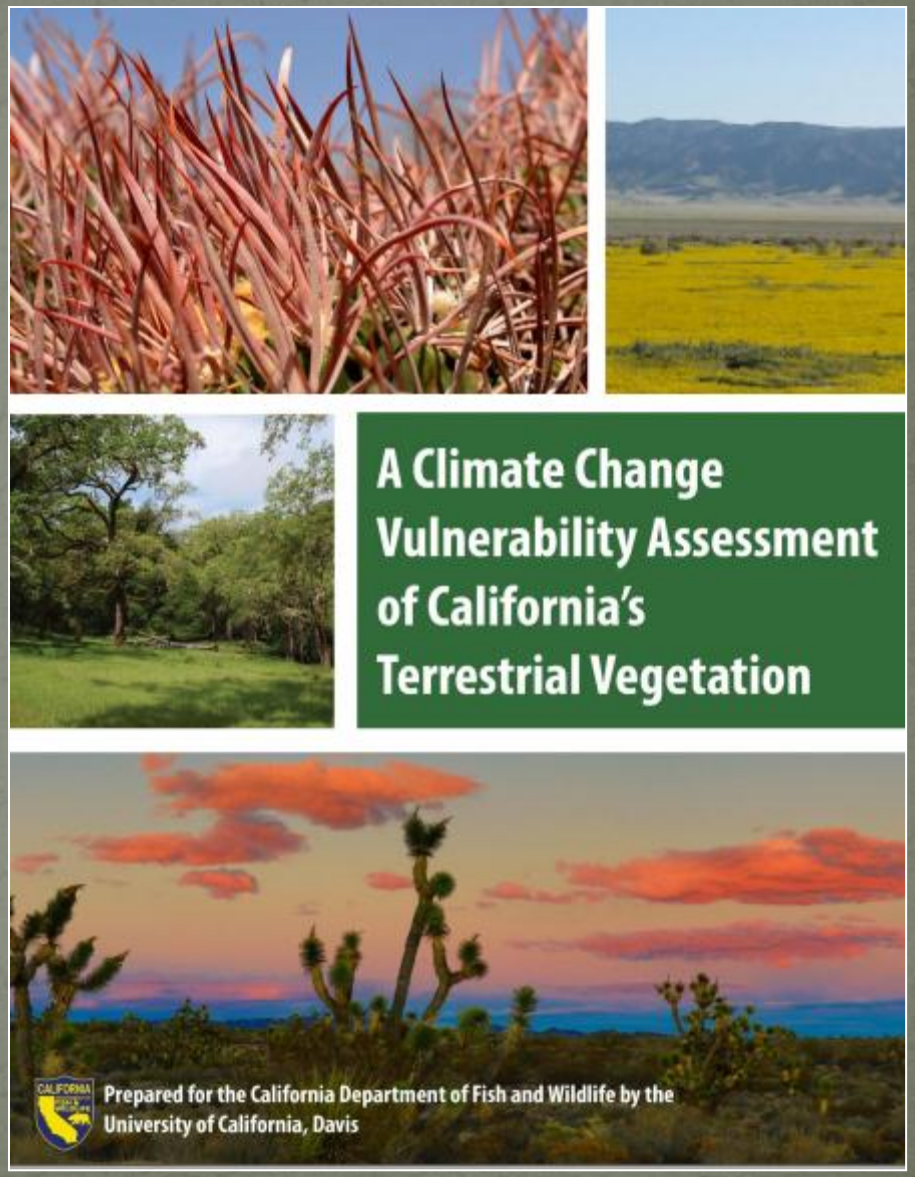
www.arb.ca.gov/cc/capandtrade/capandtrade.htm

CDFW project examples

Reducing Emissions	Preparing for Impacts	Research to Inform Policy
Wetland restoration for GHG reduction – grant program		A climate change vulnerability assessment of California's terrestrial vegetation

Veg vulnerability assessment: Background

- Conception: Filling an information gap
- Competitive RFP
- Completed in 2015



Veg Vulnerability Assessment: Project Overview

- What?
  - Vulnerability assessment of veg communities in CA
- Where?
  - California focused, state-wide coverage
- How?
  - Exposure, sensitivity and adaptive capacity, spatial disruption combined to arrive at a vulnerability score for each vegetation community type

Veg Vulnerability Assessment: Data

- Climate data
  - 2 Global Climate Models
    - Miroc_esm (hot and dry)
    - CNRM_CM6 (warm and wet)
  - 2 emissions scenarios (RCPs)
    - 4.5
    - 8.5
  - 4 total climate scenarios/futures
- Vegetation data
  - Macrogroup vegetation classification

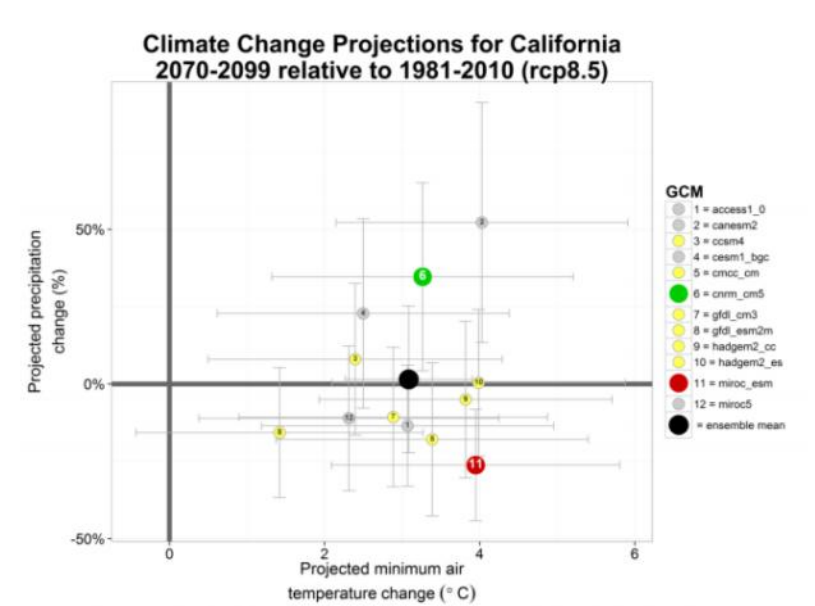


Figure 6. Projected and Historical Climate Comparison for California Under the RCP 8.5 Emissions Scenario. The difference between the 1981-2010 mean annual minimum temperatures and precipitation for California, and the 2070-2099 projections for 12 CMIP5 GCM projections and the RCP 8.5 emission scenario. The origin of the axes represents mean California conditions for the 1981-2010 timeframe, used as the baseline. The x axis refers to changes in temperature, and the y axis to changes from the % of current precipitation.

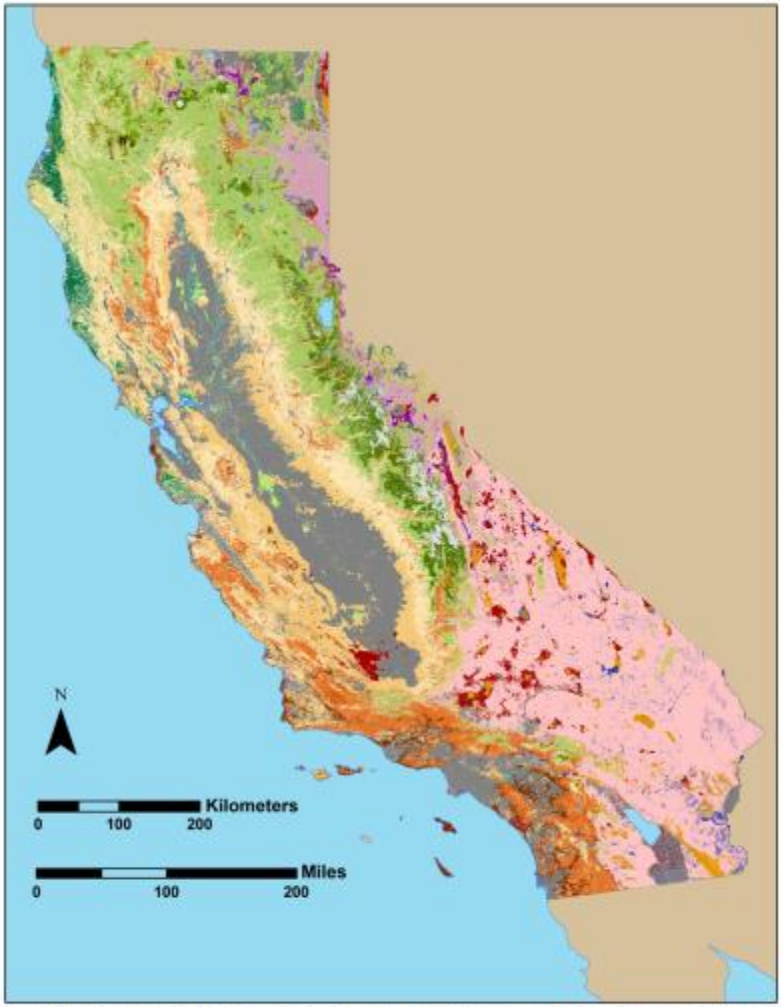


Figure 9. Statewide Vegetation (Macrogroup) Map. The statewide vegetation map used for the climate exposure analysis in this report. This image portrays the distribution of macrogroups which are analyzed. Note that some areas in the central valley and urban centers are in grey, indicating zones that were excluded from this analysis. The natural vegetation in the central valley that is mapped is visible as small extents of vegetation.

MacroVeg Type

- 101. Alpine Vegetation
- 25. Northwest Subapline Forest
- 20. Subalpine Aspen Forests and Pine Woodlands
- 24. Pacific Northwest Conifer Forests
- 23. North Coastal Mixed Evergreen and Montane Conifer Forests
- 9. California Foothill and Valley Forest and Woodlands
- 45. California Grasslands and Flowerfields
- 43. Chaparral
- 52. Montane Chaparral
- 44. Coastal Sage Scrub
- 50. North Coast Deciduous Scrub and Terrace Prairie
- 58. Coastal Dune and Bluff Scrub
- 88. Mojave and Sonoran Desert Scrub
- 92. Desert Wash Woodland and Scrub
- 117. Sparsley Vegetated Desert Dune
- 93. Shadscale-Saltbush Scrub
- 96. Big Sagebrush Scrub
- 26. Great Basin Piñyon-Juniper Woodland
- 97. Great Basin Dwarf Sagebrush Scrub
- 98. Great Basin Upland Scrub
- 48. Western Upland Grasslands
- 110. Foothill, Alpine and Coastal Rock Outcrop
- 114. Northwest Coast Cliff and Outcrop
- 36. American Southwestern Riparian Forest and Woodland
- 34. North Coastal and Montane Riparian Forest and Woodland
- 47. Mountain Riparian Scrub and Wet Meadow
- 73. Freshwater Marsh
- 106. Brackish (Estuarine) Submerged Aquatic Vegetation
- 75. Wet Mountain Meadow
- 81. Salt Marsh
- 27. Non-Native Forest and Woodlands
- Urban and Agriculture

Figure 10. Macrogroup Map Legend. The legend for the macrogroup map.

Veg Vulnerability Assessment: Methods

SENSITIVITY

- Sensitivity to Temperature
- Sensitivity to Precipitation
- Fire Sensitivity
- Germination Agents
- Mode(s) of dispersal
- Reproductive lifespan

ADAPTIVE CAPACITY

- Adaptive capacity to fire
- Mode and level of recruitment
- Seed longevity

CLIMATE EXPOSURE

SPATIAL DISRUPTION

Veg Vulnerability Assessment: Methods

SENSITIVITY

ADAPTIVE CAPACITY

CLIMATE EXPOSURE

- The level of climate change expected in the areas where each macrogroup is dominating

SPATIAL DISRUPTION

Veg Vulnerability Assessment: Methods

SENSITIVITY

ADAPTIVE CAPACITY

CLIMATE EXPOSURE

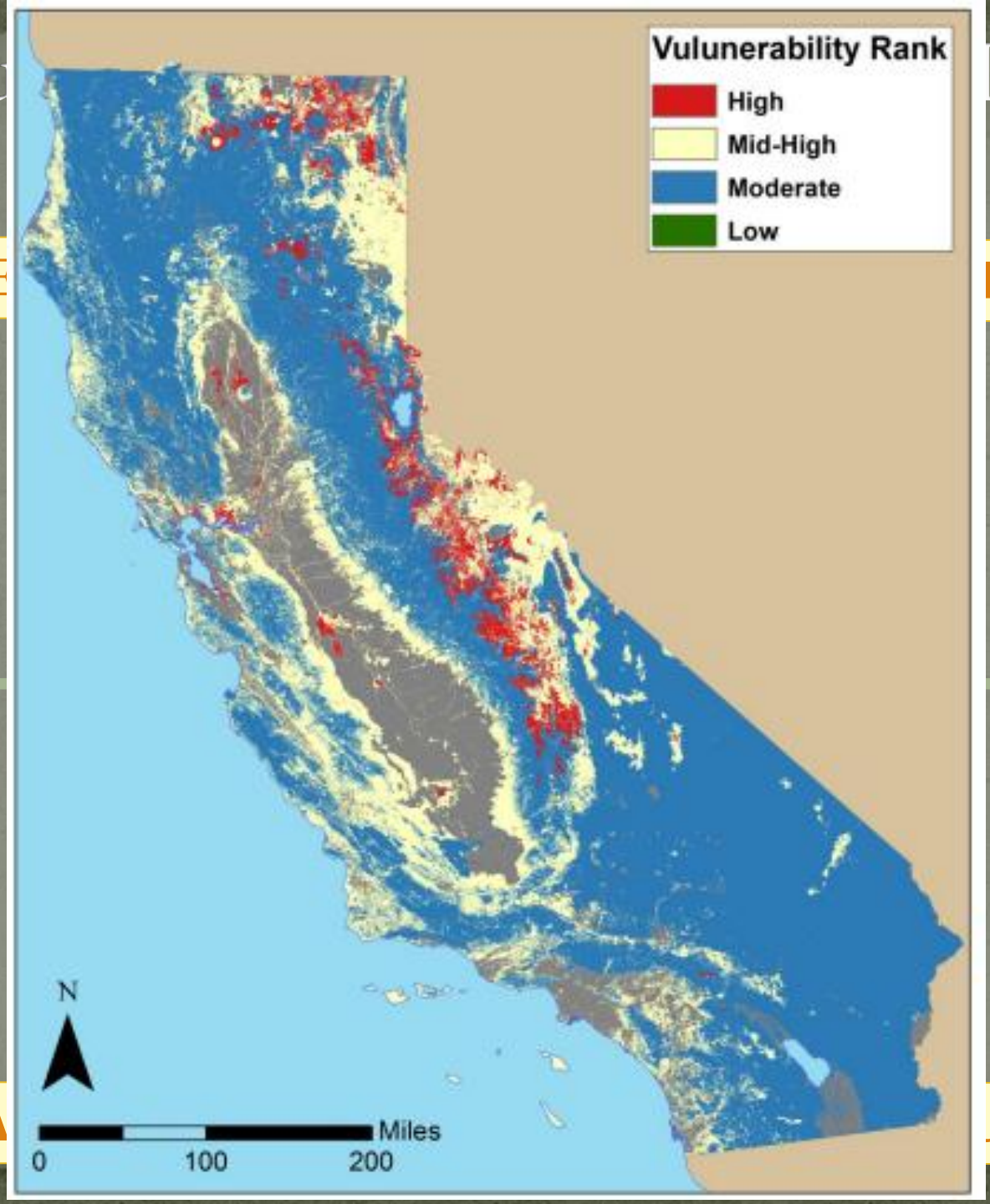
- The level of climate change expected in the areas where each macrogroup is dominating

SPATIAL DISRUPTION

- An estimate of the spatial disruption that could be expected for each macrogroup (the difference in current and projected future extent of the MG)

Veg Vu ... lethods

SE ... PACITY



CLIMA ... UPTION

Veg Vulnerability Assessment: Results

Macrogroup (Common Name)	Climate Scenario	S&A Score	S&A Rank	Climate Exposure (% >95%)	Spatial Disruption (% No Longer Suitable)	Mean Climate Exposure & Spatial Disruption Score	Climate Exposure & Spatial Disruption Rank	Combined Vulnerability Rank	Mean Combined Vulnerability Rank
9. California Foothill and Valley Forests and Woodlands	CNRM CM5 - RCP 4.5	3.12	Moderate	32%	24.50%	28.25%	Moderate	Moderate	Moderate
	CNRM CM5 - RCP 8.5	3.12	Moderate	54%	31.70%	42.85%	Moderate	Moderate	
	MIROC ESM - RCP 4.5	3.12	Moderate	17%	39.80%	28.40%	Moderate	Moderate	
	MIROC ESM - RCP 8.5	3.12	Moderate	47%	59.50%	53.25%	Mid-High	Mid-High	
20. Subalpine Aspen Forests & Pine Woodlands	CNRM CM5 - RCP 4.5	2.50	High	19%	33.80%	26.40%	Moderate	Mid-High	High
	CNRM CM5 - RCP 8.5	2.50	High	53%	66.70%	59.85%	Mid-High	High	
	MIROC ESM - RCP 4.5	2.50	High	33%	72.20%	52.60%	Mid-High	High	
	MIROC ESM - RCP 8.5	2.50	High	84%	94.90%	89.45%	High	High	
23. North Coastal Mixed Evergreen and Montane Conifer Forests	CNRM CM5 - RCP 4.5	2.86	Mid-High	11%	10.90%	10.95%	Low	Moderate	Moderate
	CNRM CM5 - RCP 8.5	2.86	Mid-High	22%	18.80%	20.40%	Low	Moderate	
	MIROC ESM - RCP 4.5	2.86	Mid-High	12%	43.50%	27.75%	Moderate	Mid-High	
	MIROC ESM - RCP 8.5	2.86	Mid-High	34%	69.40%	51.70%	Mid-High	Mid-High	
24. Pacific Northwest Conifer Forests	CNRM CM5 - RCP 4.5	2.89	Moderate	51%	26.80%	38.90%	Moderate	Moderate	Mid-High
	CNRM CM5 - RCP 8.5	2.89	Moderate	89%	48.70%	68.85%	Mid-High	Mid-High	
	MIROC ESM - RCP 4.5	2.89	Moderate	24%	53.00%	38.50%	Moderate	Moderate	
	MIROC ESM - RCP 8.5	2.89	Moderate	53%	81.30%	67.15%	Mid-High	Mid-High	
25. Pacific Northwest Subalpine Forest	CNRM CM5 - RCP 4.5	2.63	Mid-High	1%	60.10%	30.55%	Moderate	Mid-High	Mid-High
	CNRM CM5 - RCP 8.5	2.63	Mid-High	10%	67.50%	38.75%	Moderate	Mid-High	
	MIROC ESM - RCP 4.5	2.63	Mid-High	6%	84.90%	45.45%	Moderate	Mid-High	
	MIROC ESM - RCP 8.5	2.63	Mid-High	44%	93.50%	68.75%	Mid-High	Mid-High	
26. Great Basin Pinyon-Juniper Woodland	CNRM CM5 - RCP 4.5	2.22	High	26%	50.30%	38.15%	Moderate	Mid-High	Mid-High
	CNRM CM5 - RCP 8.5	2.22	High	72%	69.30%	70.65%	Mid-High	High	
	MIROC ESM - RCP 4.5	2.22	High	16%	38.90%	27.45%	Moderate	Mid-High	
	MIROC ESM - RCP 8.5	2.22	High	28%	50.80%	39.40%	Moderate	Mid-High	
27. Non-Native Forest and woodlands	CNRM CM5 - RCP 4.5	3.56	Low	71%	17.40%	44.20%	Moderate	Moderate	Moderate
	CNRM CM5 - RCP 8.5	3.56	Low	97%	10.50%	53.75%	Mid-High	Moderate	
	MIROC ESM - RCP 4.5	3.56	Low	36%	12.00%	24.00%	Low	Low	
	MIROC ESM - RCP 8.5	3.56	Low	74%	6.20%	40.10%	Moderate	Moderate	

Veg Vulnerability Assessment: Results

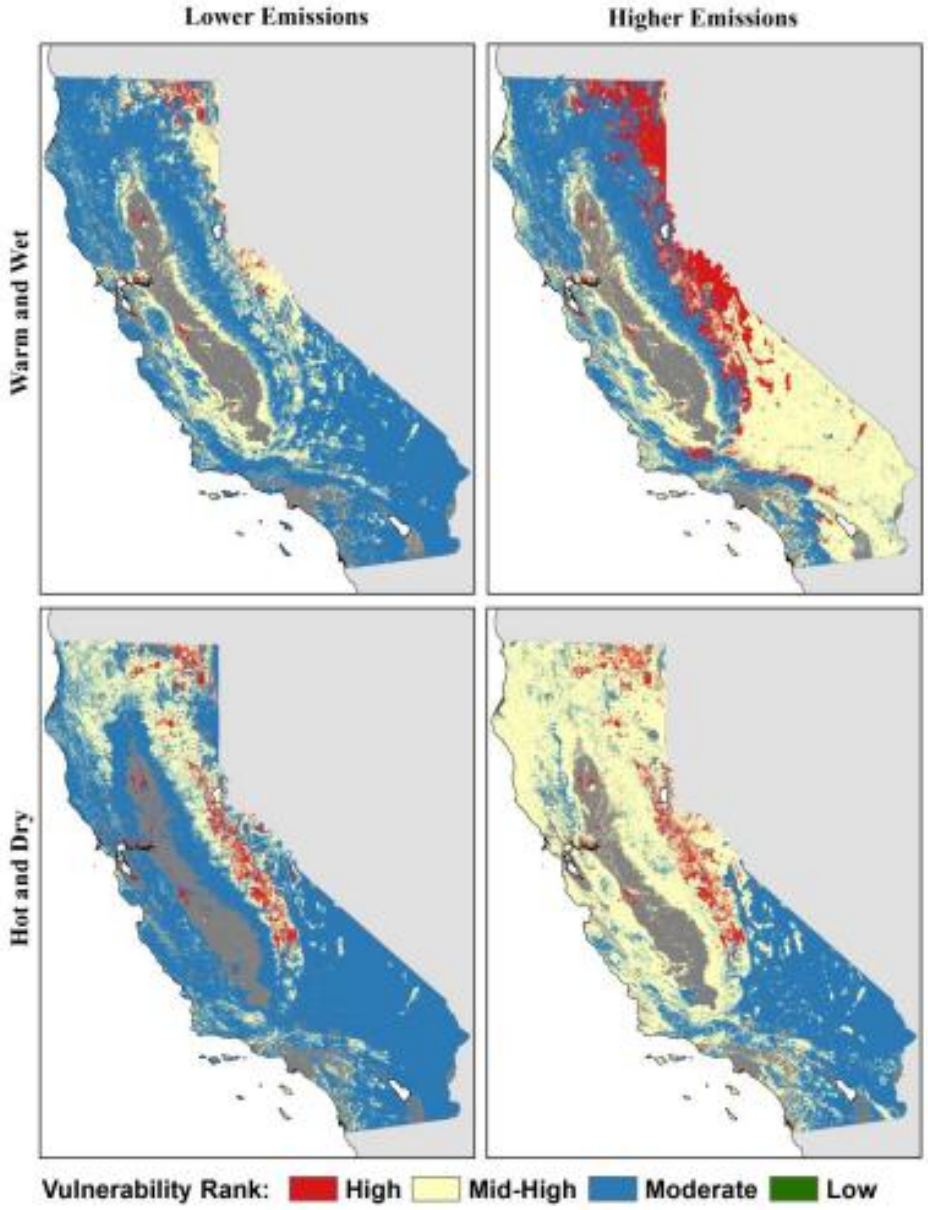


Figure 2. Mapped End-of-Century Vulnerability Rankings Under Four Climate Projections. A map of the end century vulnerability rankings for macrogroups under the four climate projections. "Warm and Wet" = CNRM CM5, "Hot and Dry" = MIROC ESM, Lower Emissions = RCP 4.5, and Higher Emissions = RCP 8.5. Grey areas on the map represent urban and agricultural areas and were not evaluated.

Project Overview: Results

- MG009: Macrogroup California Forest and Woodland
- Common Name: California Foothill and Valley Forests and Woodlands

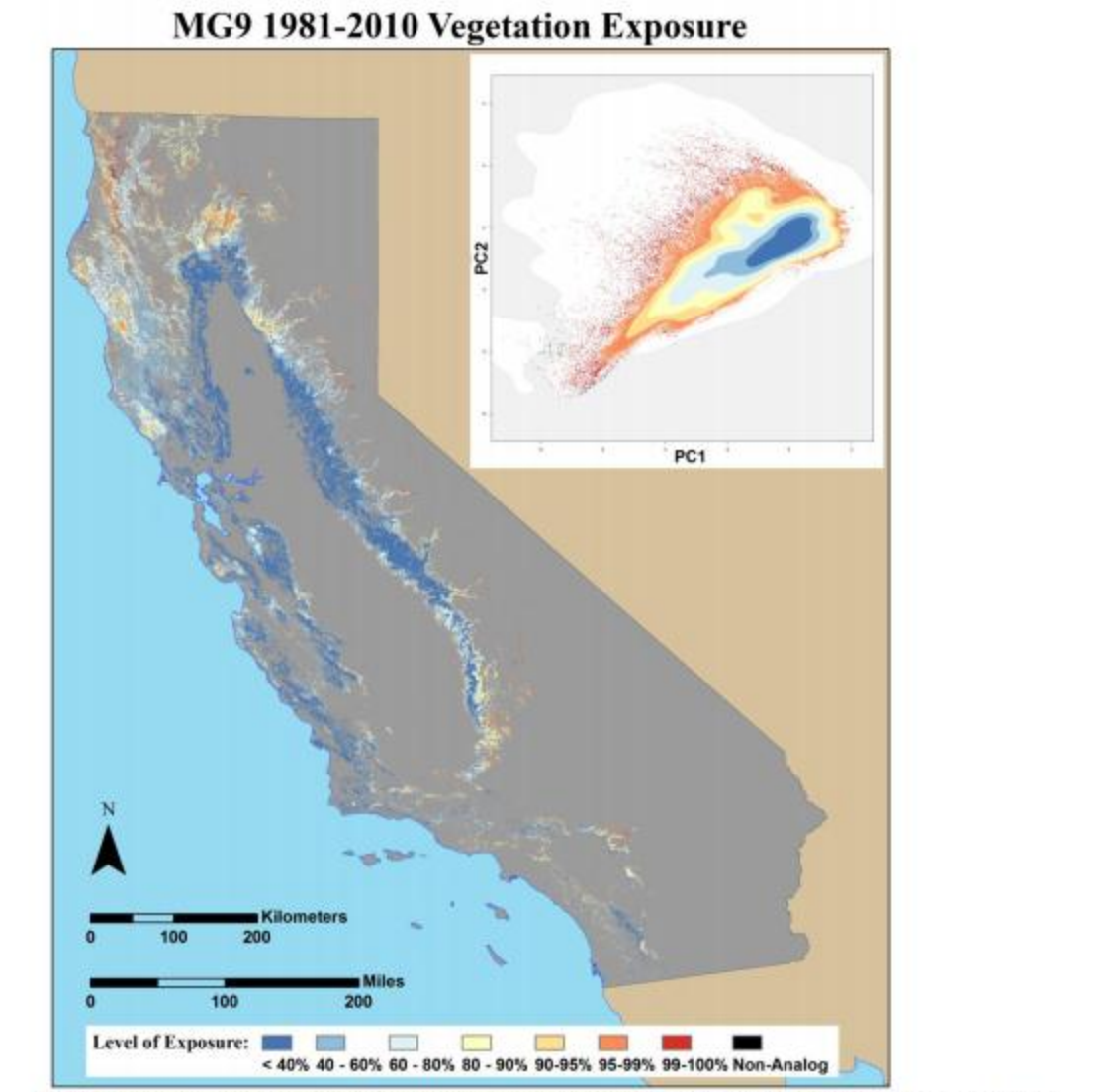


Figure 15. Map of Current Climate Suitability for Macrogroup 9. The 2015 mapped extent of macrogroup 9, classed into varying levels of current climate suitability. Locations in the <40 category are those where this vegetation type most commonly occurs, and therefore thought to be the least stressed locations. Vegetation at locations in the 95-99% and higher classes is occurring in areas that are already on the climatic margins of where the type occurs. The inset represents the distribution of the vegetation when the climate conditions are reduced to two dimensions using a principal components analysis. Colors in the inset and the map refer to the same categories of climate exposure.

CLIMATE EXPOSURE

Veg Vulnerability Assessment: Results

- MG009: Macrogroup California Forest and Woodland
- Common Name: California Foothill and Valley Forests and Woodlands

SENSITIVITY

ADAPTIVE CAPACITY

Table 7. Sensitivity and Adaptive Capacity Rankings for Magrocroup 9. Sensitivity and Adaptive Capacity rankings for the dominant species comprising macrogroup 9. Two species, *Pinus sabiniana* and *Pinus attenuate*, are known to sprout after a fire, so sensitivity in germination is not as low as general scoring for the agents listed.

	Sensitivity						Adaptive Capacity			Species Score
Species	**Climate Temp**	**Climate Precip**	**Fire Sensitivity**	**Germination Agents**	**Mode Dispersal**	**Reproductive Lifespan**	**Fire**	**Recruitment Mode /Fecundity**	**Seed Longevity**	
Hardwoods										
Quercus agrifolia	3	3	5	3	2	4	5	3	1	**3.2**
Quercus englemannii	3	3	4	3	2	3	5	1	1	**2.8**
Quercus douglasii	4	4	3	3	2	4	3	1	1	**2.8**
*Pinus sabiniana**	4	3	2	4	5	3	1	4	4	**3.3**
Quercus chrysolepis	3	3	4	3	2	5	5	3	1	**3.2**
Quercus lobata	3	3	5	3	2	5	5	1	1	**3.1**
Quercus wislizeni	4	3	4	3	2	3	5	4	1	**3.2**
Mean	**3.43**	**3.14**	**3.86**	**3.14**	**2.43**	**3.86**	**4.14**	**2.43**	**1.43**	
					Mean	**3.31**		**Mean**	**2.67**	
Conifers										
Pinus radiata	3	3	1	4	3	3	5	4	5	**3.4**
Juniperus californica	3	3	1	2	2	3	5	2	2	**2.6**
Pinus attenuata	4	3	1	4	5	2	5	4	5	**3.7**
Pinus ponderosa	3	3	5	2	4	5	4	4	1	**3.4**
Calocedrus decurrens	3	3	5	2	3	5	1	5	1	**3.1**
Abies concolor	2	2	2	2	4	5	1	5	1	**2.7**
Mean	**3.00**	**2.83**	**2.50**	**2.67**	**3.50**	**3.83**	**3.50**	**4.00**	**2.50**	
					Mean	**3.06**		**Mean**	**3.33**	
Grand Mean	**3.12**									

Veg Vulnerability Assessment: Results

- MG009: Macrogroup California Forest and Woodland
- Common Name: California Foothill and Valley Forests and Woodlands

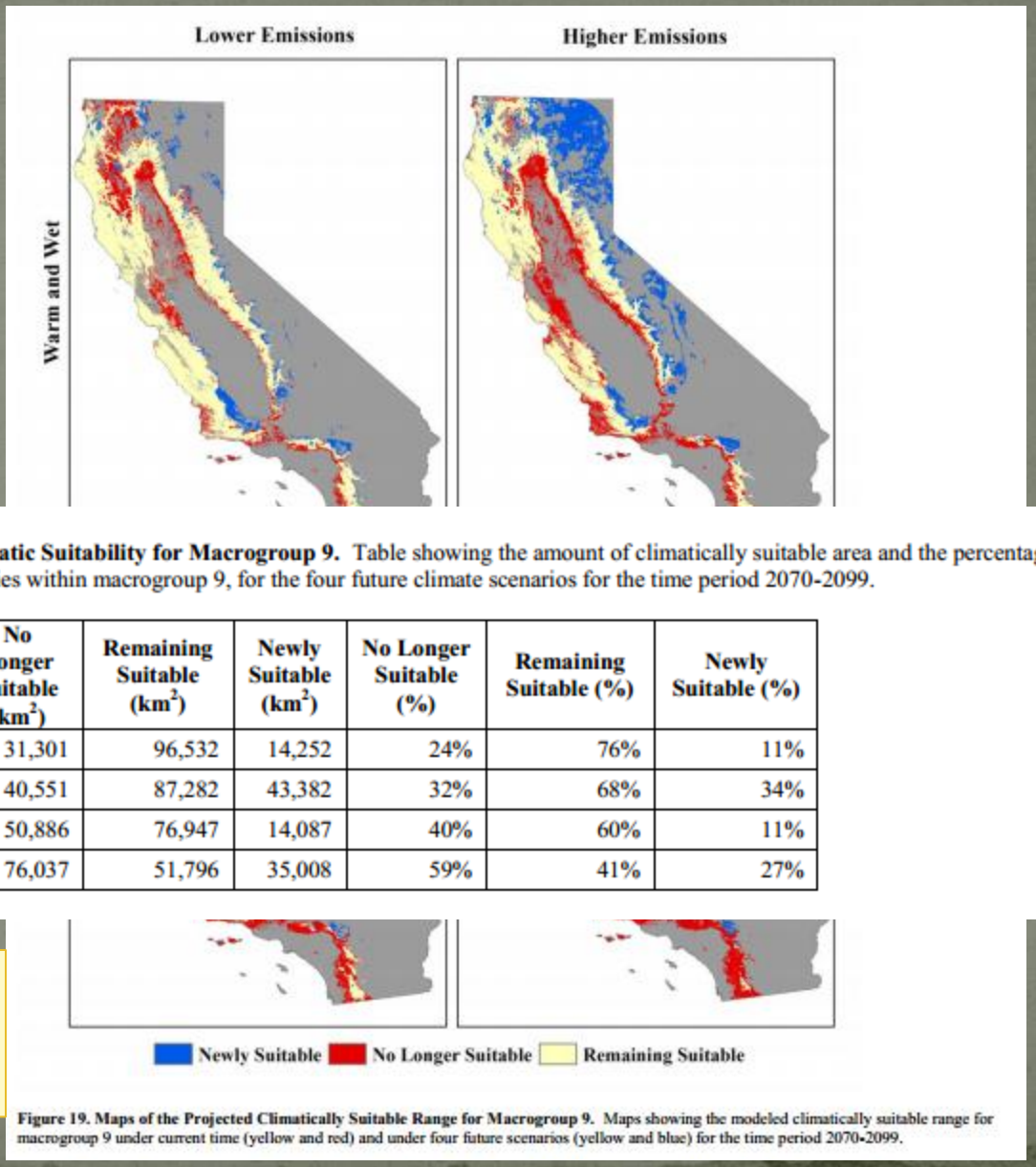


Table 9. Area of Projected Climatic Suitability for Macrogroup 9. Table showing the amount of climatically suitable area and the percentage of climatically suitable area for species within macrogroup 9, for the four future climate scenarios for the time period 2070-2099.

Scenario	No Longer Suitable (km^2)	Remaining Suitable (km^2)	Newly Suitable (km^2)	No Longer Suitable (%)	Remaining Suitable (%)	Newly Suitable (%)
CNRM CM5 - RCP 4.5	31,301	96,532	14,252	24%	76%	11%
CNRM CM5 - RCP 8.5	40,551	87,282	43,382	32%	68%	34%
MIROC ESM - RCP 4.5	50,886	76,947	14,087	40%	60%	11%
MIROC ESM - RCP 8.5	76,037	51,796	35,008	59%	41%	27%

Figure 19. Maps of the Projected Climatically Suitable Range for Macrogroup 9. Maps showing the modeled climatically suitable range for macrogroup 9 under current time (yellow and red) and under four future scenarios (yellow and blue) for the time period 2070-2099.

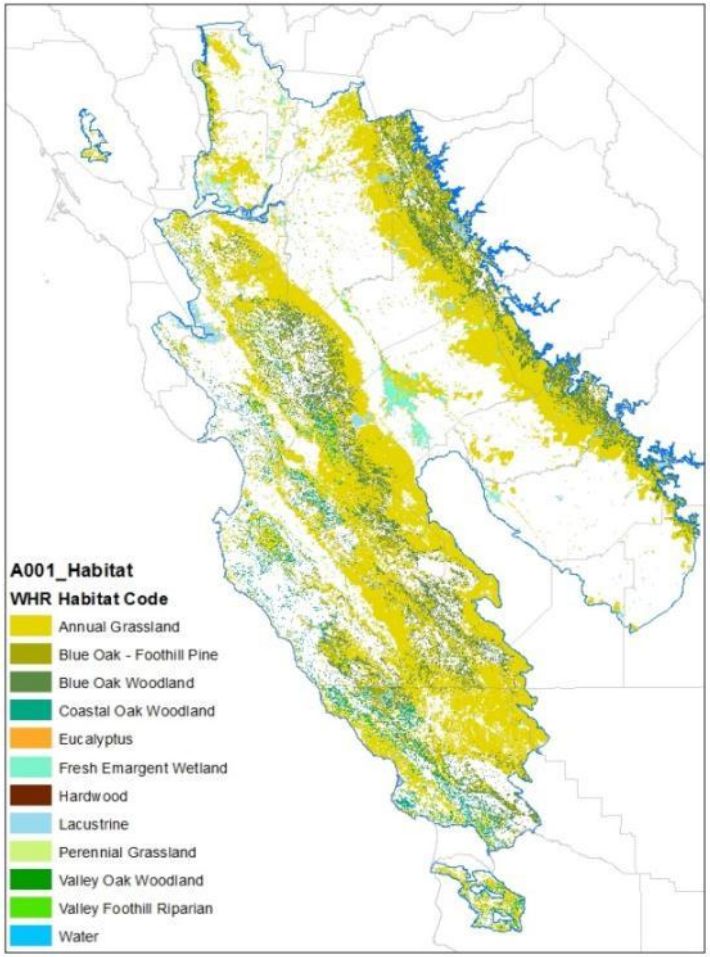
SPATIAL DISRUPTION

Veg Vulnerability Assessment: Application

- Additional analyses
  - Compare multiple vulnerability studies
    - Birds
    - Reptiles and amphibians
    - Mammals
  - Identify climate refugia
  - Vulnerability and WHR (Wildlife Habitat Relationships) comparison

California tiger salamander

Distribution of suitable habitat



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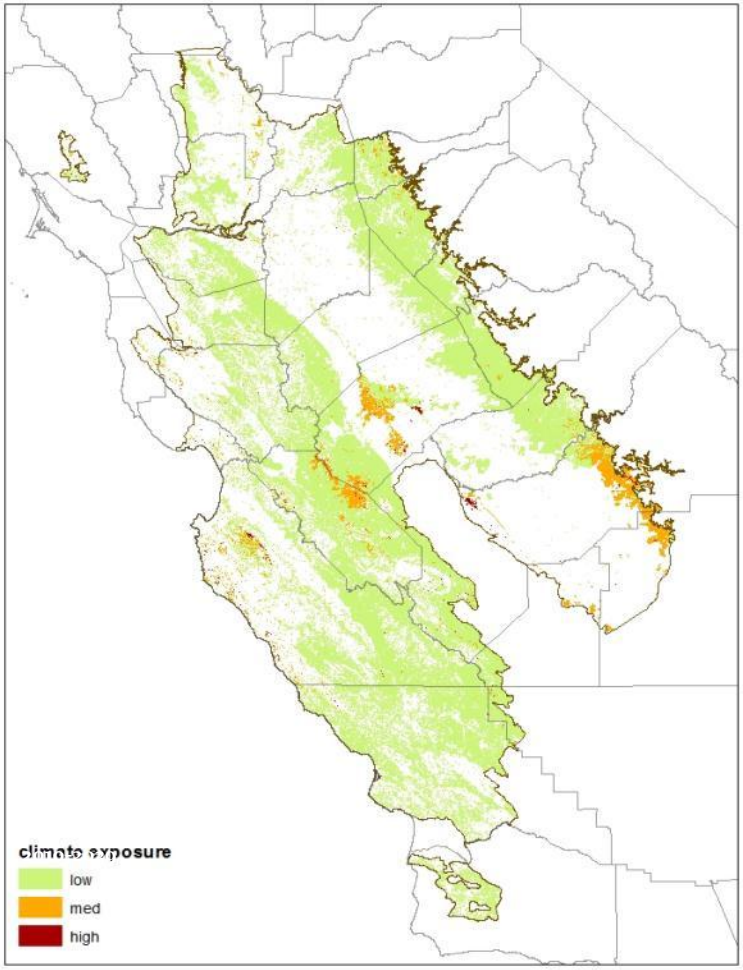
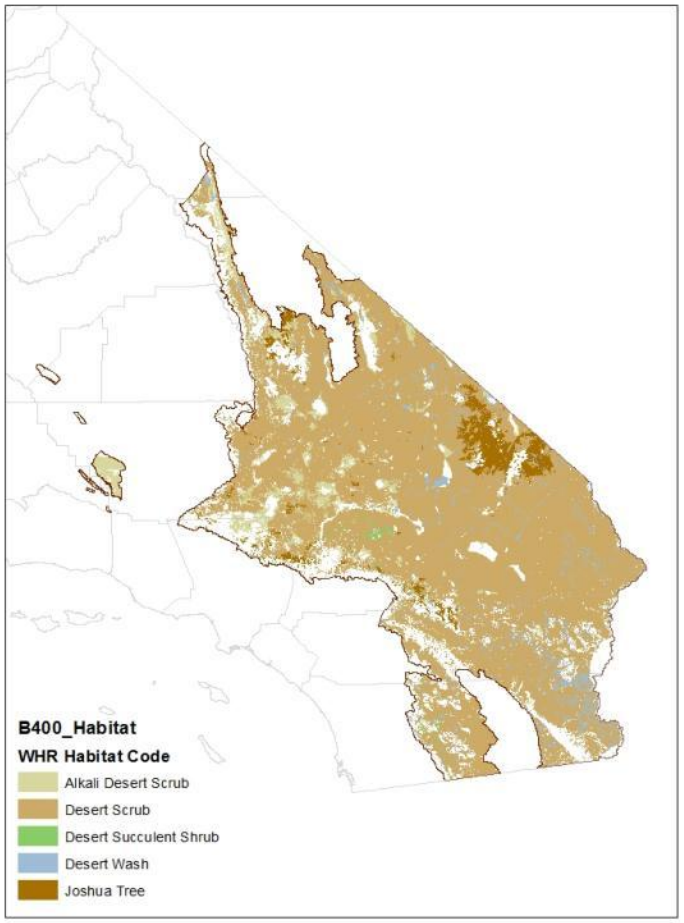
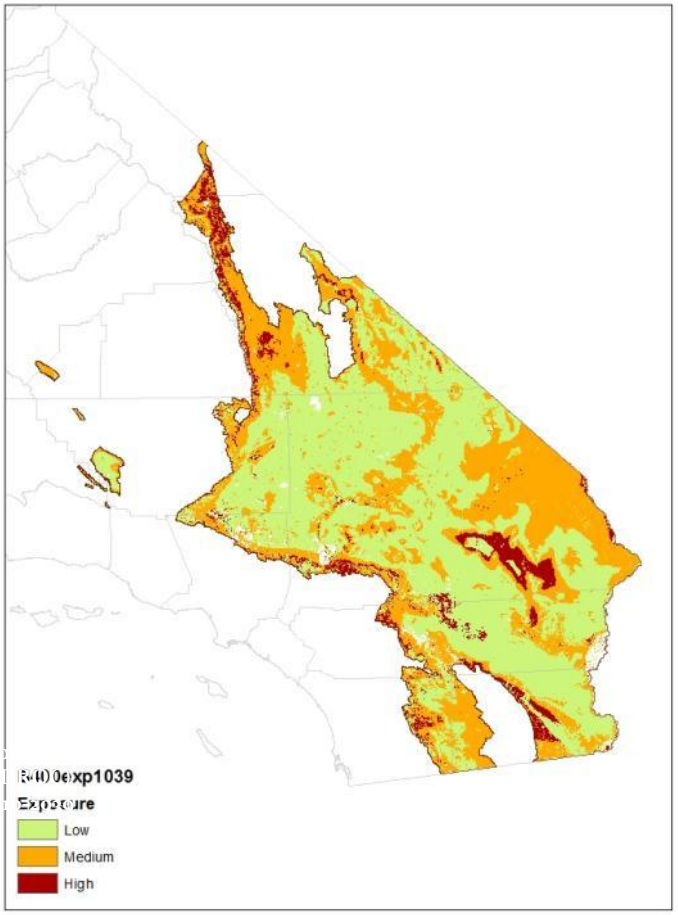


LeConte's thrasher

Distribution of suitable habitat



Exposure

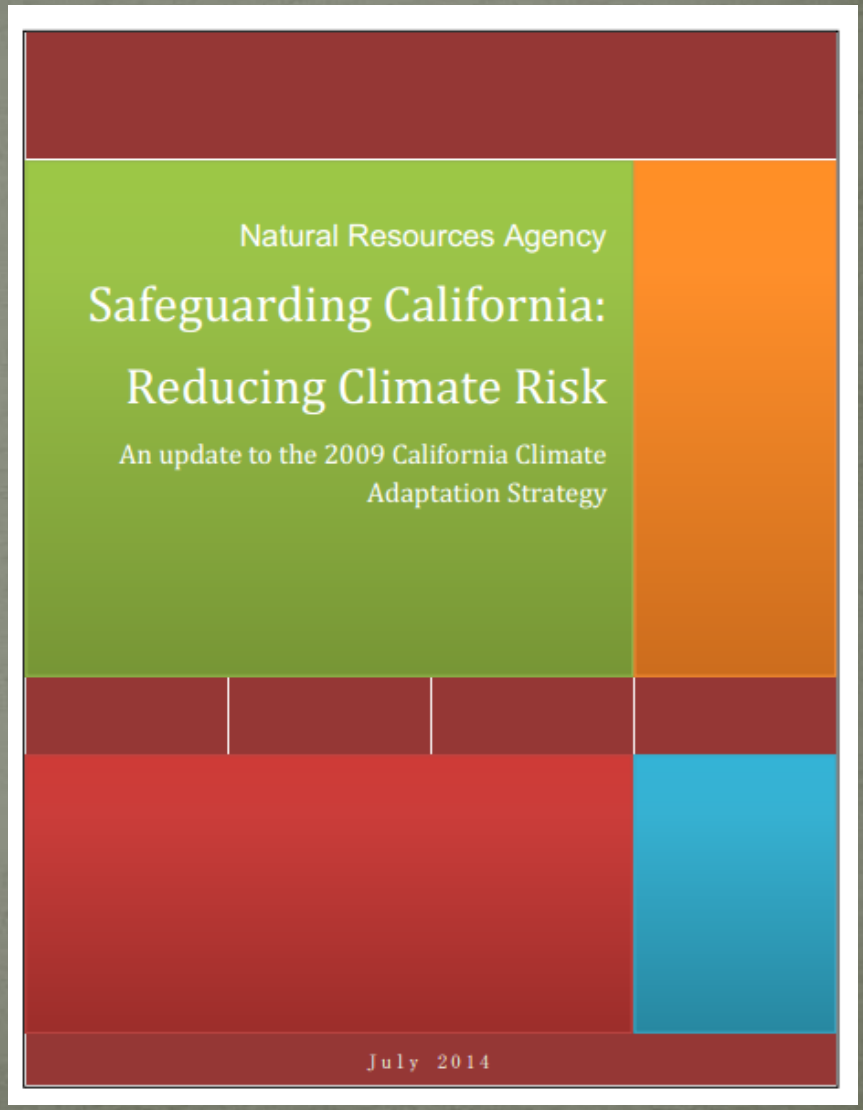


Veg Vulnerability Assessment: Application

- Management and decision-making
  - Land acquisition
  - Grant programs and solicitations
    - Prop 1
    - GGRF (Greenhouse Gas Reduction Fund)
    - Others

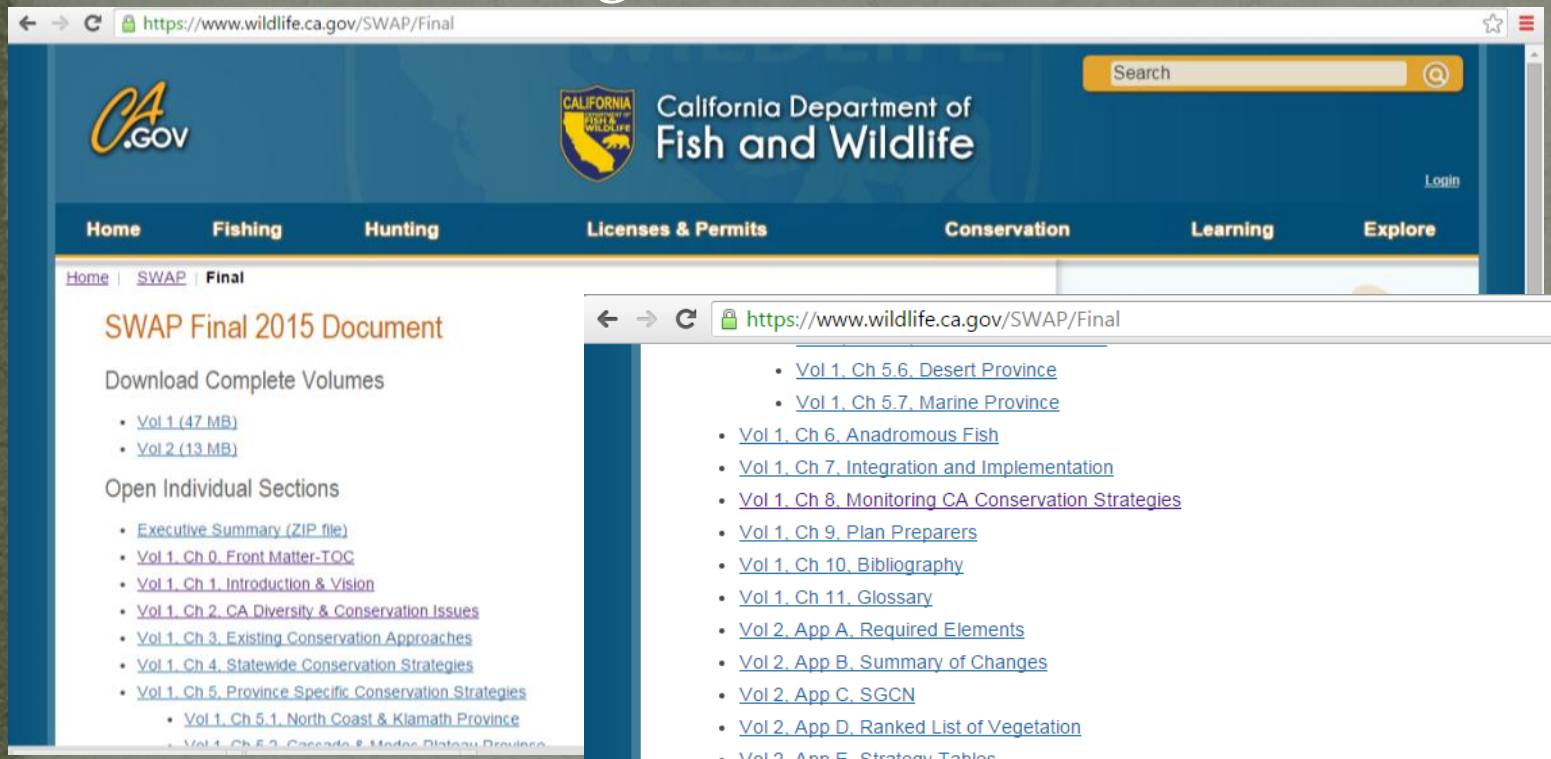
Veg Vulnerability Assessment: Application

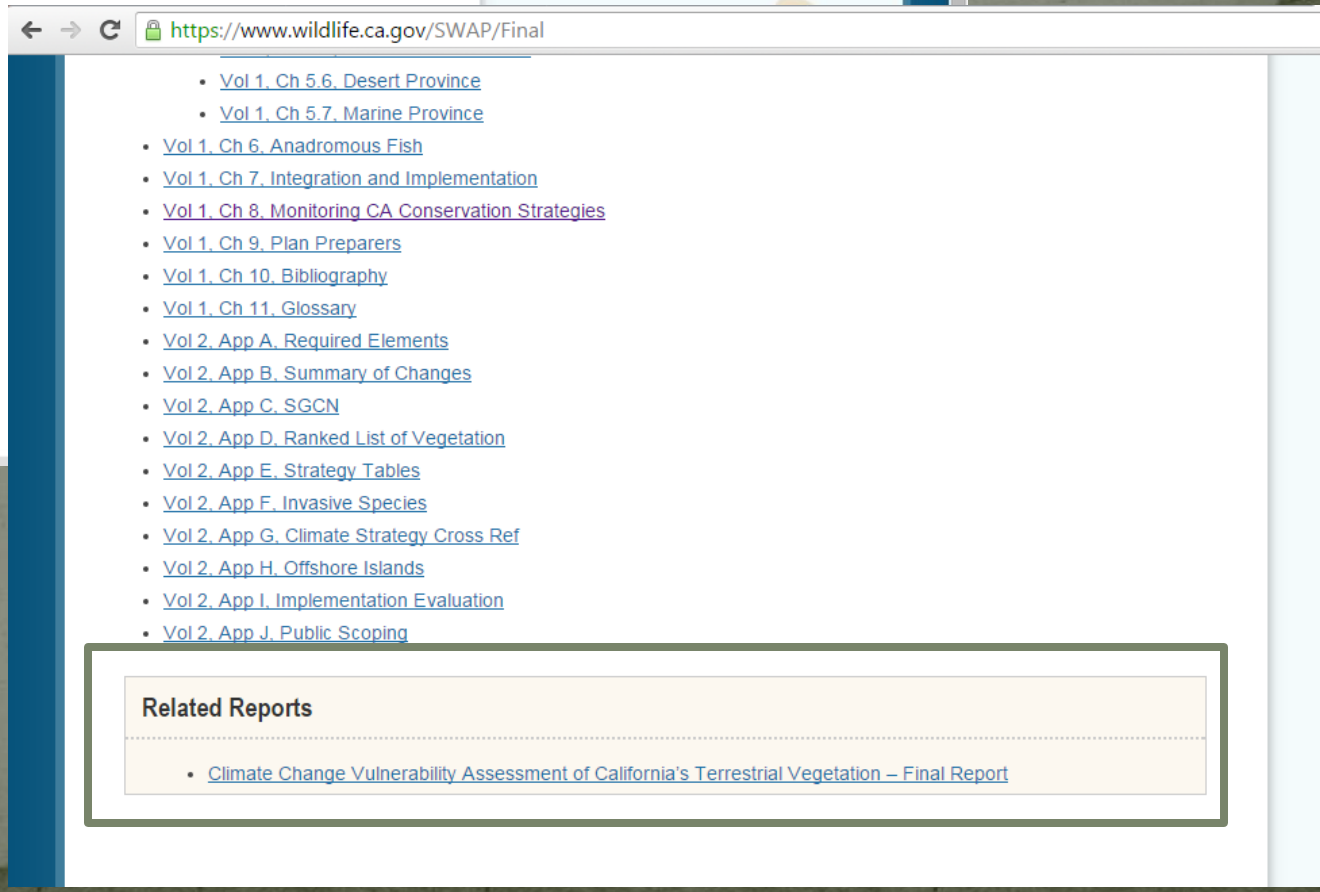
- Feed into state climate adaptation strategy updates
- Other adaptation efforts



Report online at…

www.wildlife.ca.gov/SWAP/Final





Report online at…

climate.calcommons.org/bib/climate-change-vulnerability-assessment-california's-terrestrial-vegetation

Outline – what we covered today

Part 1: State-wide focus

- CA Climate legislation (legislative drivers)
- Driving documents/initiatives

Part 2: Fish and Wildlife

- Climate impacts to fish and wildlife
- Vulnerability assessments
- Adaptation strategies

Part 3: Climate change & CDFW

- CDFW background
- Overview of CDFW climate work
- Project examples
  - Vulnerability assessment of California vegetation
  - CDFW cap and trade program implementation

Thank you!

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