DRAFT REDWOODS WORKSHOP SUMMARY

January 16, 2014

On September 6-7, 2013, 30 redwoods researchers, managers, and experts attended a workshop cosponsored by Geos Institute, the North Pacific Landscape Conservation Cooperative (LCC) and California LCC of the U.S. Fish & Wildlife Service, the Environmental Protection Information Center (EPIC), and the Society for Conservation Biology – Humboldt State University Chapter. The purpose of the workshop was to share information between researchers and practitioners (land managers) about redwood conservation and management needs in a changing climate and develop preliminary strategies to manage redwoods for persistence under climate change. Our discussion revolved around existing management approaches, current and future trends in redwood status (including climate change projections), and how to manage redwoods for resilience, resistance, and transition. After the workshop, participants were invited on a field trip sponsored by the National Park Service to learn about efforts in Redwood National Park aimed at restoring previously logged areas to conditions resembling mature redwood forest composition over time.

Part 1. Current Goals and Objectives

Participants had diverse goals and objectives for redwood systems. Many were focused on restoring old-growth composition and function in both young and mature stands. Others had research goals intended to support managers in their decision-making processes. Some were focused on conservation of existing redwoods for cultural purposes. And others had goals related to sustainable harvest of redwoods.

While some participants indicated that their goals and objectives are viable under climate change, most reported that they might not be over longer time scales, as climate change progresses. For instance, the National Park Service has a mandate for maintaining a "naturally" functioning ecosystem, yet the interactions of past management practices, invasive species, and future climate change trends may result in a system that is far from "natural," with little resemblance to intact or historical old-growth systems. Future changes in where redwoods become established due to drought stress, heat stress, or other climate impacts may reduce harvest opportunities for redwood on private lands. These same changes in climate are likely to alter redwood forest composition and ecosystem function. Finally, cultural resources from redwood ecosystems could become less abundant, changing cultural traditions and livelihoods for tribal people in the region.

Part 2. Stressors to Redwood ecosystems

Participants brainstormed a list of ongoing stressors to redwood ecosystems and their associate species. Ongoing stressors are expected to reduce the resilience of redwoods in the face of climate change, and many stressors are expected to be exacerbated by climate change. Targeting stressors for management will allow increased resilience as climate change accelerates. Those stressors identified during the workshop include:

- Air pollution impacts
- Air and water temperature increases with climate change

- Black bear damage to trees in some areas
- Cultural species management (or lack of), declines and losses from climate change
- Economics driving management and conservation
- Fern mats affected by changes in moisture and temperatures
- Fire suppression leading to potentially higher severity wildfire
- Fire mortality increases with drought stress and Sudden Oak Death
- Fog declines affecting tree growth, lichen, tree vole and upper canopy species
- Fragmentation (lack of connectivity) among patches of old growth and restored areas
- High density Douglas fir regrowth, causing poor growth rates
- Homogeneous stands affected by a lack of disturbance
- Hydrology changes from human use and land use
- Illegal marijuana growing and pesticides, herbicides
- Invasive species, including fungus affecting amphibians and exacerbated by warming
- Management focused on single species and policies that lead to prohibitive complexity
- Management not integrated or collaborative across the region
- Ocean acidification
- Overgrazing
- Pests and pathogens increase with climate change
- Population growth and land use change pressures
- Predation by corvids increase (due to changes in habitat), affecting protected species
- Riparian area buffer size not protective enough
- Road erosion and sedimentation of streams increase with climate change
- Seed availability from different zones shifting with climate change
- Species composition changes with climate change
- Storm severity increases with climate change, causing flooding and windstorms
- Timber harvest management leading to slash, point source pollution, and soil damage
- Young age classes dominate the region and are more prone to fire and invasive species

Part 3. Resilience, Resistance, and Transition

We talked at length about the need to plan for resistance, resilience, and transition in response to climate change. ***Resistance*** is the ability to withstand impacts without major change in plant and wildlife communities. ***Resilience*** is the ability to bounce back after perturbations, such as fire or drought. Finally, ***transition*** is the change from one type of system to another in response to climate change. Most managers and researchers agreed that focus on resilience, at this time, makes the most sense for redwood ecosystems due to their very long lifespans and high uncertainty about whether redwoods will be able to be established in the future. In certain situations, they suggested that resistance strategies might be called for to protect specific stands. An example from outside the region would be the protection of some of the largest sequoias during 2012 wildfires, when sprinklers were used to reduce fire risk in specific stands. Managing for transition was thought to be a strategy more appropriate in the future, once ecological and climatic trajectories are better understood.

During the morning session, we asked researchers and managers to write down their preferred strategies for managing redwoods ecosystems for resistance, resilience, and transition. The results are compiled in Table 1.

During the latter half of the workshop, we worked in breakout groups of 6-8 people each. These groups discussed potential adaptation strategies and helped to prioritize them. Some proposed management strategies received much support from the participants. These are highlighted in blue in Table 1. At the end of the report is a list of all of the suggested strategies for increasing resilience, resistance, and managing for transition that were provided by participants.

Part 4. Information Needs

Workshop participants brainstormed information needs and prioritized them. Those information needs that gained the more support (4+ votes) included a clearinghouse for information on research, data, and information about the redwood region. This should also incorporate sharing and integration of data collection and monitoring efforts. Participants also prioritized finding out more about carbon credits and the potential to use them to fund conservation efforts, such as strategically reducing fragmentation in specific areas through set asides and improved forest management practices. They also prioritized a need for additional scientific information that can inform harvest and restoration management to increase forest resilience. Other information needs are listed in Appendix C.

Conclusions

The redwood region of Northern California has a complex history, with a legacy that will continue to influence future conditions and actions for decades to come. This workshop brought together many people who are closely involved in charting a path for this important ecosystem in the future. Participants voiced appreciation for the opportunity to share information and have constructive and low-pressure discussions about legacy conditions, current stressors, and potential future trends.

Overall, most experts and managers recommended focusing on resilience strategies at this time. As redwood response to climate change becomes clearer over time, resistance and transition strategies may become warranted. Some of the strategies receiving the greatest support were those that speed up the transition from dense, young forest to a mature forest structure. Further assessment of the most effective restoration techniques and approaches would be welcomed. Many participants communicated a need for information sharing and collaboration across the redwood ecoregion for more cohesive management efforts.

Participants requested future opportunities to continue the discussion and more rigorously develop adaptation strategies. As a next step, Geos Institute is in the process of integrating this information into a scientific paper on maintaining redwoods in the face of climate change that will be circulated to workshop participants and submitted to a science journal for peer-review and future publication and presentations. We are also interested in holding additional workshops that can further efforts to incorporate climate change information into redwoods planning and management.

Table 1. Strategies recommended by workshop participants are listed in the first column. The number of individuals recommending each strategy for building resilience, increasing resistance, or facilitating transition is shown in columns 2-5. During the afternoon session, participants prioritized strategies and those with higher support (4 or more votes) are highlighted in blue. Some strategies were added during the prioritization process and received 4 or more votes, but were not on the list from the morning session so they have no values in columns 2-5.

Strategies	**Resilience**	**Resistance**	**Transition**	**Total**
Increase use of prescribed fire, especially in old growth	5	5		10
Thinning as a restoration tool to hasten old growth structure in young forest	5	4		9
Return to historic structure and condition	2	3		5
Reduce stressors, including roads, conversion to agriculture, fragmentation, harvest practices, invasive species, etc.	2	2	1	5
Increase connectivity among intact forest patches (incentives for landowners)	3	1		4
Manage at a range-wide scale, across land ownership (regulatory reform, where needed)	1	2	1	4
Retain and protect biological diversity	2	1		3
Increase education and outreach	1	1	1	3
Manage for a different type of old growth than what was previously there	1		2	3
Use adaptive management approach	1	1		2
Apply a variety of different treatments across the landscape	1		1	2
Monitor to determine when to transition			2	2
Plant new species and genotypes			2	2
Protect ecosystem processes	1			1
Protect areas that are intact (especially northern portion of the range)	1			1
Policy change for better management	1			1
Embrace change		1		1
Identify refugia (areas expected to retain species and/or habitats)			1	1
Incorporate climate change into forest planning processes and timeframes				
Paradigm change throughout the region in how people use and manage resources and relate to others				

Appendix A. All recommended resilience, resistance, and transition strategies for redwood ecosystems

Resilience strategies:
Develop landscape/regional objectives and cohesive management for connectivity
Localized management specific to each site based on historic/current/future conditions
Adaptive management (monitor results and reassess management strategies)
Identify and reduce other stressors to redwood ecosystems
Mature redwood is quite resilient already - stump sprouting, long lived, has experienced climate change
More collaboration and communication among different types of land ownership/management
Make good management and harvest techniques more profitable than bad management
Emphasize importance and management of cultural resources for Tribes
Enforce management decisions- make sure the changes are actually made
Forest treatments, such as thinning, that increase drought tolerance
Incentivize good management (leaving large tracts intact, creating connectivity, storing carbon, etc.)
Increase predictability of regulations
Use redwood ecosystem as an educational tool
Prioritize areas for conservation and restoration based on resilience factors such as resistance to invasive species (roadless areas) and connectivity
Prioritize areas for conservation and restoration based on vulnerability
Promote and conserve mature forest characteristics that lead to stable microclimates
Promote larger tree sizes that are better able to store water and withstand perturbation
Protect/connect areas of topographic complexity
Reassess objectives and management strategies in light of climate change
Reduce forest and hydrologic fragmentation across landscape
Restore harvested areas
Strategic coordination and distribution of funds

Resistance strategies:
In general, the workshop participants preferred resilience strategies over resistance strategies because they were more realistic and reflect the important natural disturbance elements of redwood ecosystems. However, a few strategies for increasing resistance in specific stands were identified. These included:
Increase resistance to fire
Manage for large trees that have more water storage capacity to withstand drought
Promote redwood over Douglas fir because its more resistant to disturbance, including fire, drought, pests, disease, and invasive species

Transition strategies:
Workshop participants did not recommend transition strategies. Because redwoods are so long-lived, and become more resistant and resilient with age, most participants felt that managing for transition was unwarranted at this time or in the near future.

Appendix B. Potential strategies for reducing specific stressors to redwood ecosystems

In order to reduce the impact of reduced water availability and water quality, the following management strategies were suggested:

- Protecting uplands and minimizing land conversion to agriculture
- Restoring floodplains
- Encouraging water conservation, rainwater capture
- Promoting conservation easements for water
- Reintroducing beavers in the northern part of the redwood range
- Encourage retention (of water?)
- Decrease in harvest rate (potentially through regulation)
- Revise forest practices that affect water temperature in streams
- Communicate the urgency of changing management approach due to climate change
- Increase stream buffers to provide more shading through regulation or incentives
- Decrease water withdrawals, leaving more water for natural resources
- Manage the flow of cold water
- Remove dams and other in-stream barriers
- Manage for upstream snowpack

In order to mitigate the effects of fragmentation, the following management strategies were suggested:

- Identify priority areas for corridors/connectivity, including different seral stages
- Protect areas of groundwater infiltration
- Remove roads, reduce road density, and improve stream crossings
- Identify priority areas for climate change refugia
- Conduct landscape level triage as climate change progresses
- Develop community forests in strategic areas
- Develop working groups to plan connectivity at regional scales
- Identify current forest conditions using geospatial analysis – need map of region

In order to reduce the likelihood of redwood declines due to changes in fog and maritime climate, the following strategy was recommended:

- Retain legacies/forest structure for the long term

In order to reduce the influx of invasive species with management and climate change, the following strategies were suggested:

- Retain canopy to shade out invasive species
- Manage human vectors of invasive species

In order to reduce the impacts of changes in the fire regime from historical suppression, changes in forest composition, and climate change, the following recommendations were made:

- Use prescribed fire
- Use silvicultural treatments to thin unnaturally dense stands

- Create snags using mechanical means in young managed forests

In order to develop common goals among agencies and other landowners, as well as create integrated management across the region, participants recommended the following:

- Outreach and education to get public "buy-in" and knowledge about the local impacts of climate change, including education for kids and policy makers
- Increase transparency and openness to increase collaboration
- Build new coalitions and partnerships
- Manage at larger scales, to acknowledge the interconnectedness of the landscape
- Move away from single species management, instead focusing on systems
- Develop carbon credits to benefit management and conservation in the region
- Develop incentives for other ecosystem services, such as subsistence resources, water quality and quantity, and wildlife
- Plan for longer timeframes (over 100 years) and across larger spatial scales
- Regulatory reform that leads to a common vision among agencies and policies
- Paradigm change at the agency, manager, and community level
- Maintain diversity regionally, as a buffer (insurance) against climate change

Appendix C. Areas in need of more research and information

Participants identified a variety of needs for more information, tools, and research, including:

Science

- Modeling to identify areas of higher and lower vulnerability to climate change
- Science to inform harvest management, including rotation age, etc.
- Research results to inform silvicultural treatments for restoration, including best practices, scale and timeframe
- Information on expected changes in precipitation and fog
- Information on physiological thresholds and water requirements for plants and animals
- Information on thresholds for when management action is required
- More information on stressor effects and interactions
- Canopy monitoring
- Soil microbe community research

Assessment

- Geospatial analysis (mapping) of what is where, now (forest age, forest ownership, management, etc.)
- Identification of priority stands and surrounding wetlands and drainages
- Synthesis and assessment of management techniques

Tools

- Clearinghouse for information pertinent to the region, including who is monitoring what, where
- Online tools for sharing information and communication across entities

Approach and Collaboration

- Reconciliation of restoration efforts and timber management
- Prioritization strategy and regional plan for funding and effort
- Identify commonalities among neighbors that have different objectives
- More resources (money) for restoration and management
- Ongoing communication and collaboration across land ownerships
- Integrate monitoring efforts

Information

- Information and clarity on opportunities and limitations of carbon credits
- Information on how to create incentives for restoration