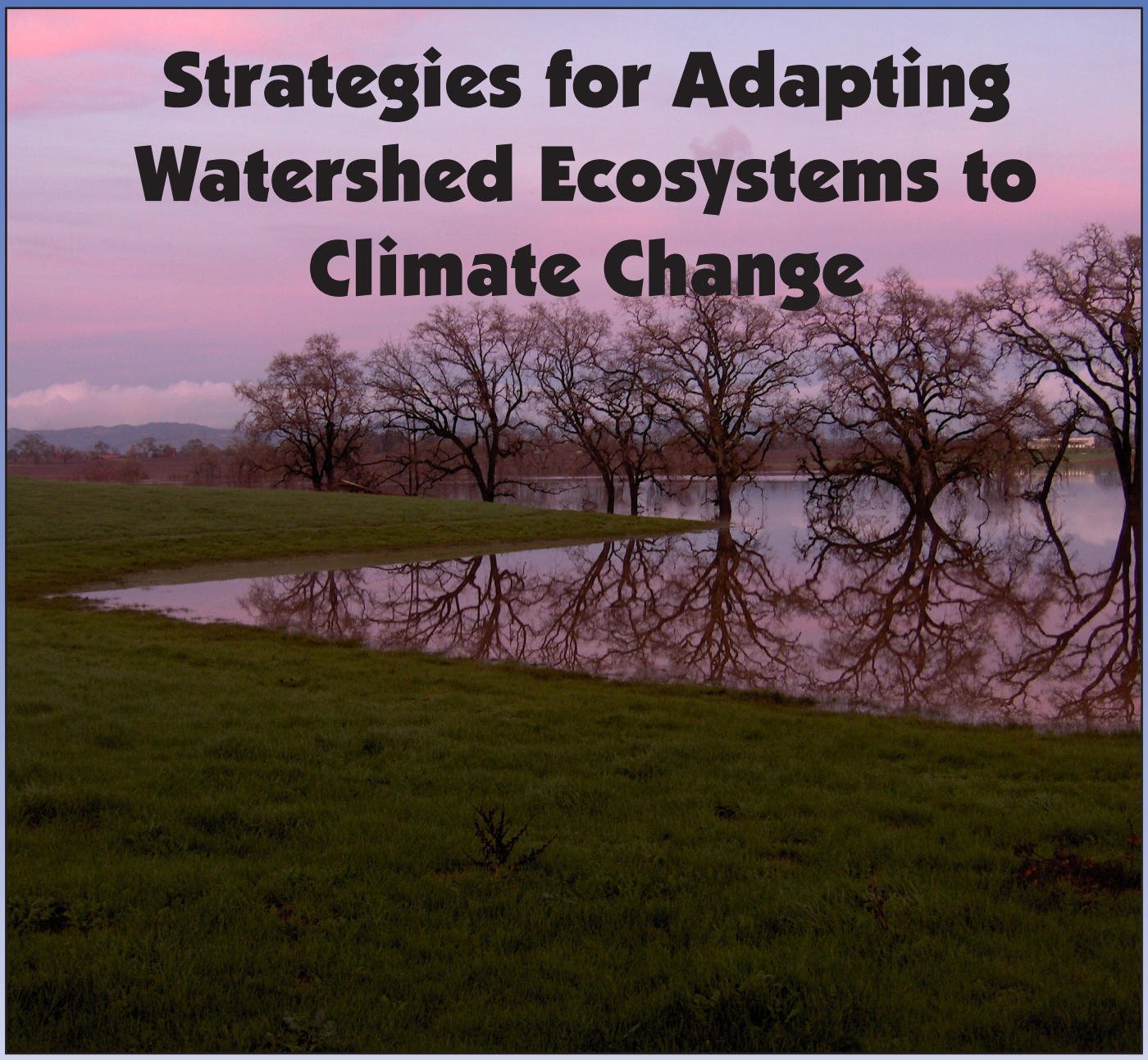
Meeting the Challenge



Strategies for Adapting Watershed Ecosystems to Climate Change

Proceedings of the 2009 State of the Laguna Conference and Science Symposium

October 14-16, 2009
Sonoma County, California

Meeting the Challenge

Strategies for Adapting Watershed Ecosystems to Climate Change

Proceedings of the 2009 State of the Laguna Conference and Science Symposium

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Cover photo by Joe Honton

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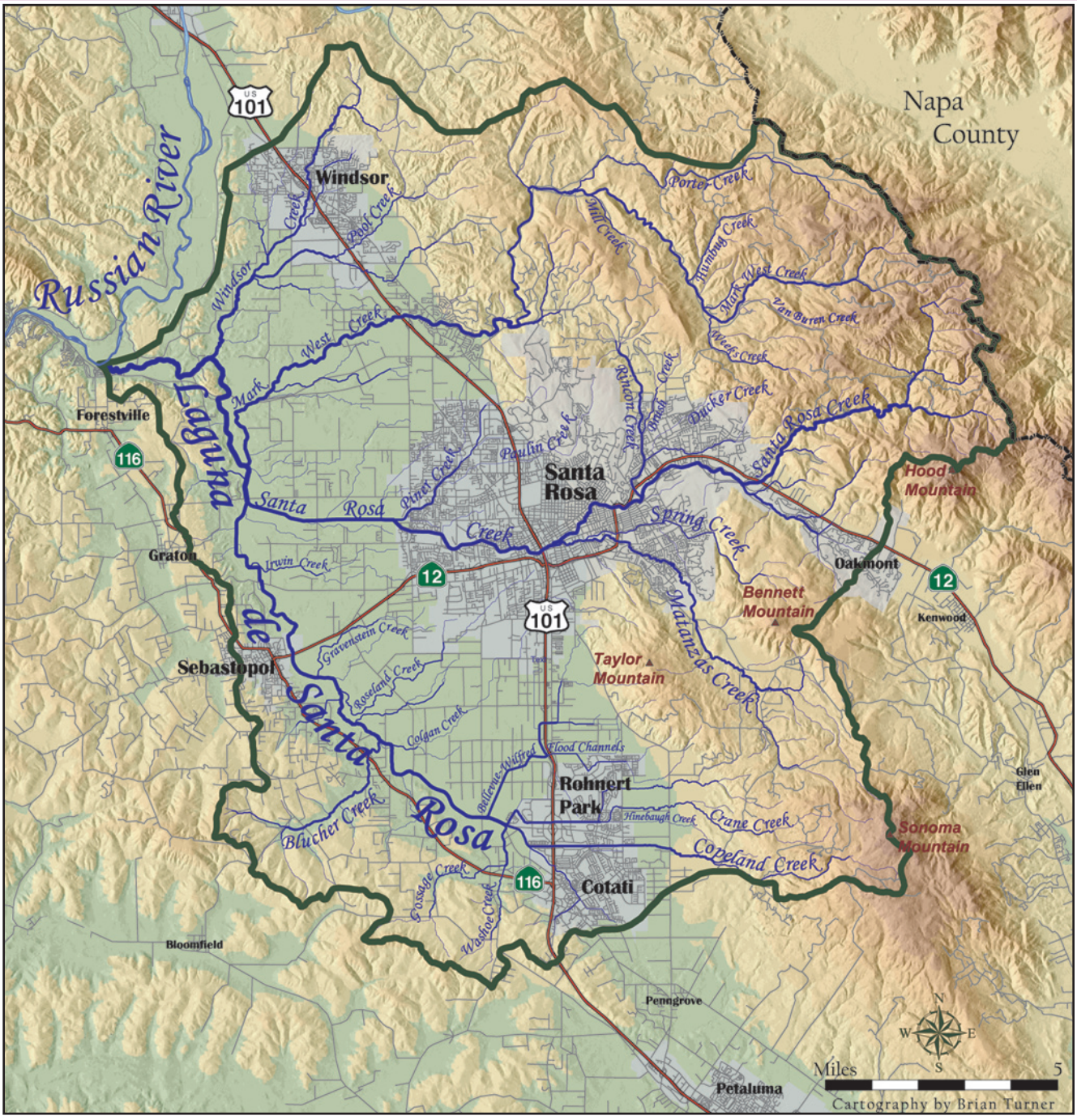
photo Joe Honton

Sunrise in the Laguna.

The Laguna Watershed



Letter from the Steering Committee Chair

Christina Sloop, Ph. D.
Conference Steering
Committee Chair

In my role as the conservation science director of the Laguna de Santa Rosa Foundation, a small non-profit in Northern California, I have been seeking to contribute to effective habitat restoration and conservation management, by integrating science, applied land management, and economic realities. In 2008, the Laguna science advisory committee and I developed a draft five-year strategic conservation research plan to investigate and address the pertinent ecological issues of the 250 square mile Laguna de Santa Rosa watershed, located in the North San Francisco Bay area, California. In January 2009, at the final draft report stage, we realized that the plan failed to adequately address global change, particularly in the form of climate change. We recognized that these forces fundamentally affect land management, habitat restoration, agricultural practices, and everything we plan to do in the coming years. Yet no one was able to grasp and suggest ways to effectively address this 'elephant in the room!' We realized we need to find ways to tackle this issue to successfully move forward.

Call to Action

Global change is driven by a variety of forces that have combined into a major world challenge as a globalizing human population is continually expanding, and its technological advances of the past centuries have begun bearing unwanted fruit.

- The **continued destruction and degradation of natural habitats** and the exploitation of ecosystems for human benefits have caused a biodiversity crisis that is unprecedented and unmatched even by the great Cambrian mass extinctions ~540 million years ago.
- Increased global travel and commerce have allowed the **dispersal of species and pathogens at an unprecedented rate**, causing non-native species to invade and compete with native species, and in many cases permanently changing native ecosystems.
- Most importantly, **the excessive release of greenhouse gases** globally are causing the Earth's climate to change, in turn amplifying all other global change factors, and challenging the evolutionary adaptive capacity of species at unparalleled rates (e.g. can polar bears really adapt quickly enough as their main hunting grounds - the polar ice caps - disappear faster and faster?). This rapid global change is unavoidably causing more extinctions, and permanently reshuffling the playing field as we know it today, restructuring natural communities and ecosystems according to new micro- and macroclimates.

Global change is driven by:

1. **Destruction and degradation of natural habitats**
2. **Dispersal of species and pathogens at unprecedented rate.**
3. **Excessive release of greenhouse gases.**

The effects of a changing climate on natural systems are a reality and already measurable in many natural systems. Therefore **the implementation of climate adaptation strategies,** such as minimizing additional system stressors (e.g.. invasive species, habitat degradation), and informed response strategies for restoration and land management are imperative. In order to guide our work as conservation practitioners, scientists, land managers and agricultural operators we need to openly face this major change and come together to formulate solutions.

Sonoma County leads the nation's local governments in the development of a coordinated climate **mitigation** strategy (actively reducing greenhouse gases known to cause climate change), and we realized that a parallel County coordination effort focused on climate **adaptation** (implementing preventative measures aimed at reducing the eventual cumulative impact of climate change on resources of concern) is imperative.

The implementation of climate adaptatation strategies and informed response strategies for restoration and land management are imperative.

The Conference

Members of the Laguna Science Advisory Council and I formed the conference planning committee in early 2009. We invited the scientific and land management communities throughout the San Francisco Bay area to come together in October 2009 in a three-day forum in Rohnert Park to start 'Meeting the Challenge' and develop 'Strategies for Adapting Watershed Ecosystems to Climate Change.'

The main questions at the start of the conference were how to reliably predict the effects of climate change at a local, ecologically meaningful scale, *(i.e. how to effectively downscale global and regional climate models*), and how to go about balancing the economic and ecological challenges in agricultural and conservation land management *(i.e. how to adequately evaluate and implement conservation strategies in working landscapes)*? In this process, uncertainty as the major element needs to be minimized, and the scientific and land management communities must come together to address the many challenges for our natural systems as we face global change and the climate challenge.

During this three day conference we hosted ~150 participants: scientists and resource managers from major San Francisco Bay Area universities and national and state agencies, public and private land managers, wine growers, agricultural representatives, funding agency representatives, conservation professionals, students, and public stakeholders. Besides professional presentations and panels the conference included **participant discussions and encouraged input** during a variety of World Café sessions, and discussion forums professionally facilitated by Global Genesis.

During the conference, we aimed to determine **potential climate change impacts to the Laguna watershed, as a case study.** Then we brainstormed associated response strategies and developed the first elements of a framework for guiding their implementation, especially the commitment to develop management, conservation and restoration action plans. In this context we then sought to **develop partnerships, funding support, and commitments for action on the part of participants**, building a community in the process and **inspiring action amongst decision-makers** who have influence over the future of the Laguna watershed.

Lastly, we produced this proceedings document to serve as a reference and a tool for watershed-scale climate change response decision-making in this community and in other regions, again using the Laguna watershed as an example.

Next Steps

Preparing for climate change requires **decreasing uncertainty** to acceptable levels by effectively estimating potential changes to climate, hydrology, and ecosystems based on the best science available at an ecologically meaningful scale *(e.g. the size of a watershed rather than the size of a state)*. This information is a critical starting point for understanding potential impacts to many sectors, including habitat restoration *(e.g. what trees to plant during restoration that will survive in a changing climate?)*, conservation and natural resource management *(i.e. where to preserve and manage land providing effective wildlife corridors into the future?), and agriculture (e.g. which crop varieties to plant that will be most drought tolerant?)*. Once impacts are foreseeable, strategies of minimizing or preventing them can be identified and realized.

State of the Laguna Conference Working Groups:

1. **Habitat Conservation & Stewardship**
2. **Science, Technology & Land Management Nexus**
3. **Policy and Funding Development**

The conference **culminated in the creation of the North Bay Climate Adaptation Initiative (NBCAI)** aimed at implementing the main climate adaptation strategies identified by conference participants at a local level. Currently, this initiative is composed of three working groups, all formed on Day 3 of the conference.

These working groups are:

1. Habiat Conservation & Stewardship
2. Science, Technology & Land Management Nexus
3. Policy and Funding Development

These working groups have just started setting specific goals and determine the needed actions towards implementation of specific climate change adaptation strategies. Each working group has a dedicated section on the new North Bay Climate Adaptation Initiative (NBCAI) website (http://www.nbcai.com) where conference attendees and

working group participants can continue to participate in discussions, learn about in-person meetings, and share supporting materials and documents. **We welcome new members**, who can join the working groups in the effort of creating a community and inspiring action amongst decision-makers who have influence over the future of the Laguna.


Christina Sloop, Ph. D.

The support the Sonoma County Water Agency as our main conference sponsor was critical to the success of the conference, as well as the sponsorships generously provided by the Sonoma County Agricultural Preservation and Open Space District, West Coast Watershed, Pyxis Technologies, Curry Landscaping, Sonoma State University Field Stations and Nature Preserves, Winifred & Harry B. Allen Foundation, and Goldridge Resource Conservation District. The high-level participation of our distinguished group of speakers and panelists, and the involvement of the many local and regional partners made the conference a success: Sonoma Ecology Center, Pepperwood Foundation, Climate Central, Audubon Canyon Ranch, PRBO Conservation Science, Climate Protection Campaign, UC Berkeley, UC DAvis, UC Santa Cruz, and California Invasive Plant Council (Cal-IPC). Finally, our utmost gratitude to the conference planning committee, the Laguna de Santa Rosa Foundation staff and board, and the Laguna Science Advisory Council.


Deanne Dipietro

With Gratitude,

Christina Sloop, Ph. D.
Conference Planning Committee, Chair
Conservation Science Program Director, Laguna de Santa Rosa Foundation


Claudia Luke, Ph. D.

Conference Planning Committee:

Deanne DiPietro, Sonoma Ecology Center
Claudia Luke, Ph.D., Sonoma State University Field Stations & Nature Preserves
Lisa Micheli, Ph.D., Pepperwood Foundation
Genevieve Taylor, Global Genesis


Lisa Micheli, Ph.D.


Genevieve Taylor

The Laguna de Santa Rosa Foundation

Restoration

Education

Conservation Science

The Laguna de Santa Rosa Foundation (Laguna Foundation) was founded in 1989 to preserve, restore and enhance the Laguna de Santa Rosa and its watershed. The Laguna Foundation works through its Education, Restoration, and Conservation Science programs to fulfill this mission.

The Laguna de Santa Rosa is a 14 mile waterway with an associated complex of wetlands and surrounding floodplain – the Santa Rosa Plain. The greater Laguna watershed drains the major urban centers of Sonoma County, California including the cities of Santa Rosa, Rohnert Park, Cotati, Sebastopol, and the town of Windsor. Like many watersheds in California, the Laguna has experienced significant impacts from urban growth. While the water quality of the Laguna main channel and habitat of the Santa Rosa Plain have been impaired over the past 150 years, the Laguna and its tributaries remain one of Sonoma County's most abundant wetland areas, and is prioritized by local, state and federal regulatory agencies for preservation and restoration. The Laguna de Santa Rosa Wetland Complex will be designated as the 28th U. S. Wetland of International Significance under the Ramsar Convention in 2010.

Laguna de Santa Rosa Foundation

http://www.lagunafoundation.org

Conference and Proceedings Summary

The Laguna Foundation, in partnership with other non-profits, agency partners, and sponsors coordinated the State of the Laguna Conference and Science Symposium (conference). The three day conference was held on October 14-16, 2009 at Sonoma Mountain Village in Rohnert Park, California. In response to the global climate change crisis the theme of the conference was: **Meeting the Challenge – Strategies for Adapting Watershed Ecosystems to Climate Change.** Approximately 150 conference attendees - State and local officials, scientists, graduate students, landowners & managers, grant funding organizations and other stakeholders - gathered from around Sonoma County and the greater San Francisco Bay Area to discuss climate change adaptation, using the Laguna de Santa Rosa Watershed as a case study (http://www.pyxisweb.net/conference/). The conference was organized around daily themes and structured in an interactive Watershed (World) Café format to encourage attendee participation and document attendee input.

General Conference Outcomes

1. To generate a list by all participants of potential climate change impacts to the Laguna watershed.

2. To establish strategies for response to the climate change challenge, and a process framework for guiding their implementation, especially the commitment to develop management, conservation and restoration action plans.

3. To produce a proceedings document that would serve as a reference and a tool for watershed-scale climate change response decision-making in this community and in other regions, using the Laguna watershed as a case study.

4. To develop partnerships, funding support, and commitments for action on the part of participants.

5. To build a community and inspire action amongst decision-makers who have influence over the future of the Laguna watershed.

We addressed three broad questions over three days:

- (Day 1) What are the likely ***impacts*** of climate change on watershed goals?
- (Day 2) What are the response ***strategies*** we need to develop to address these likely impacts?
- (Day 3) What ***action*** can we take to effectively implement these strategies within the watershed context?

Conference Process

The Laguna Foundation engaged Global Genesis, a local firm with international reach specializing in collaboration and facilitation to foster a conversational atmosphere. Conference participants gathered at small round tables, and were given time to engage speakers and meet other participants, moving between groups throughout the day. Everyone was encouraged to share their ideas and thoughts by making notes on paper table cloths and by asking questions and contributing to open discussions. By changing tables often, participants had ample opportunity to "cross-pollinate" their ideas with others, creating an ongoing conversation. By the end of the three days, the walls of the conference room was covered with the ideas of the participants, written during small group discussions, large group "town hall" meetings, and working sessions.

By designing the conference to engage the audience in helping to reach the conference outcomes, groundwork was laid for a wide array of results, the impact of which is still in full swing. The fruits of this process will be evident throughout these proceedings.

Conference Results

Results of the conference were extensive in the form of:

Conference Results

1. **A list of likely climate change impacts to the Laguna watershed and agriculture.**
2. **Possilbe response strategies.**
3. **Working groups.**

1. A list of likely climate change impacts to the Laguna de Santa Rosa watershed and agriculture (pages 15-16).

2. A listing of possible response strategies (pages 23-27).

3. Three working groups focused on (1) Habitat Conservation & Stewardship (page 39), (2) the nexus between Science, Technology, and Land Management (page 41), and (3) Policy and Funding Development (page 43).

A significant realization was the lack of meaningful comparable scientific data within the North Bay, and many of the conversations within the working groups centered around lessening that gap.

Less tangible but no less meaningful were the many opportunities for conversations between people who don't often have a chance to dialogue on some of the most important – and nebulous – topics of the times.

Proceedings Overview

The conference was structured to gather the stakeholders of the Laguna de Santa Rosa and discuss, plan, and finally act to tackle the challenges associates with climate change adaptation, using the Laguna de Santa Rosa watershed as a practical case study. This proceedings document is organized in three sections:

- Section 1 summarizes each day of the conference including the desired daily outcomes, daily agenda, daily themes and insights, and results.
- Section 2 describes the North Bay Climate Adaptation Initiative (NBCAI) and its efforts to continue the momentum of the conference.
- Section 3 contains a complete list of conference presentation abstracts.
- Section 4 contains acknowledgements & appendices.
    - Appendix A contains a list of conference participants that can be used to continue developing partnerships, funding support, and commitments for action.
    - Appendix B includes vocabulary and abbreviations.
    - Appendix C is a list of website links.
    - Appendix D contains notes from Action Planning Meetings from Day 3.

This document should serve as a reference and a tool for watershed-scale climate change response decision-making in this community and elsewhere.

This document should serve as a reference and a tool for watershed-scale climate change response decision-making in this community and elsewhere.

Day 1 - Agenda

8:00 – 8:30 am	**Registration and Continental Breakfast**			
8:30– 9:30 am	**Getting Started**			
	Welcome **David Bannister** Laguna Foundation	**Conference Overview** **Christina Sloop** Laguna Foundation	**Climate Change Context** **Ann Hancock** Climate Protection Campaign	**Watershed Café Format Intro** **Genevieve Taylor** Global Genesis
	Keynote Speaker – John Wiens, PRBO Conservation Science			
9:30 -10:25 am	**Session 1: Climate Change Challenge**			
	William Sydeman Farallon Institute *Coastal Climate Effects*	**Lorraine Flint** US Geological Survey *Hydrologic Modeling*	**Diana Stralberg** PRBO *Species Adaptations*	**Marc Kramer** UC Santa Cruz *Plant & Insect Modeling*
10:25 -10:50 am	**Watershed Café**			
10:50 – 11:00 am	**Break**			
11:00 – 11:55 am	**Session 2: Maintaining Ecosystem Health**			
	David Ackerly UC Berkeley *Climate on the Landscape Level*	**Elizabeth Brusati** California Invasive Plant Council *Invasive Species*	**Caroline Christian** Sonoma State University *Species Interactions*	**Christina Sloop** Laguna Foundation *Species Adaptation & Genetic Variation*
11:55am – 12:30 pm	**Watershed Café**			
12:30 – 1:30 pm	**Lunch**			
1:30 – 2:30 pm	**Session 3: Laguna Watershed**			
	Christopher Potter NASA-Ames *Modeling River Flows & Soil Dynamics in Laguna Watershed*	**Christopher Potter** NASA-Ames *Predicting Water Discharge Rates on the Russian River*	**Steve Butkus** North Coast Regional Water Quality Control Board *Laguna TMDLs*	**Marcus Trotta** Sonoma County Water Agency *Santa Rosa Plain Groundwater Assessment*
2:30 – 2:40 pm	**Break**			
2:45 – 3:45 pm	**Teejay O'Rear** UC Davis *Laguna Aquatic Food Webs*	**Brenda Grewell** USDA Agriculture Research Service *Ludwigia restoration in face of climate change*	**Michael Cohen** Sonoma State University *Invasive Weeds and Bioenergy*	**James McElvaney** BioConverter International *Ludwigia Harvesting for Bioenergy Production*
3:45 – 5:00 pm	**Climate Change Impacts on the Laguna**			
	Watershed Café			
	Concluding Statements			
5:00 – 6:00 pm	**Mixer and Poster Session**			

Copies of all presentations are available at:
http://www.lagunafoundation.org/knowledgebase/

The opening day of the conference illuminated the current scientific understanding of the climate change challenge and climate change adaptation at global, regional, and watershed scales. Morning sessions illuminated the current state of climate change predictive modeling, and expected responses of natural systems to changing climate. Afternoon sessions specifically focused on recent scientific investigations in the Laguna de Santa Rosa watershed.

Day 1 - Desired Outcomes

1. To set an interactive tone of learning, exploration, collaboration, and articulate desired results for the conference.
2. To understand why climate change *adaptation vs. mitigation* is the focus of the conference.
3. To create a common understanding of the climate change challenge, including the element of uncertainty.
4. To present current Laguna resource management goals as a baseline for formulating climate change impacts and adaptation strategies.

photos Hattie Brown

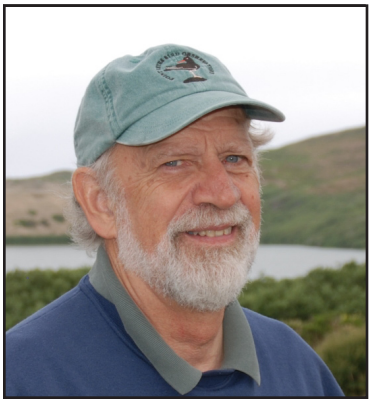
Conference participants gathered in a watershed cafe discussion.

5. To prepare a list of likely climate change impacts affecting the Laguna watershed.

6. To explore the technology and tools available to help us better understand the full range of climate change scenarios and their related impacts at the local level.

7. To highlight examples of climate change-related processes affecting the health of North Bay ecosystems and learn about possible solutions to support a bio-diverse, resilient Laguna.

Day 1 - Keynote Address



Keynote Speaker for conference Day 1 - Dr. John Wiens, Chief Conservation Officer, Point Reyes Bird Observatory Conservation Science

Dr. John Wiens, Chief Conservation Science Officer at PRBO Conservation Science, presented the initial keynote address. He discussed the need to act "in an anticipatory rather than a reactive mode" and how the "combination of uncertainty and urgency also threaten to blur the distinction between science and advocacy at a time when clear, objective, and relevant science is desperately needed." He pointed out that "we have entered an era of uncivil discourse in which advocacy, driven by fear, misinformation, or agendas, drives the debate."

Dr. Wiens urged the scientific community to engage in informing public policy, since "decisions and policies that are based on science are better than those made in the absence of such information," and "the issue is not ***whether*** science should be a part of advocacy, but ***how***." He highlighted the importance of local conservation action and the link to local policy.

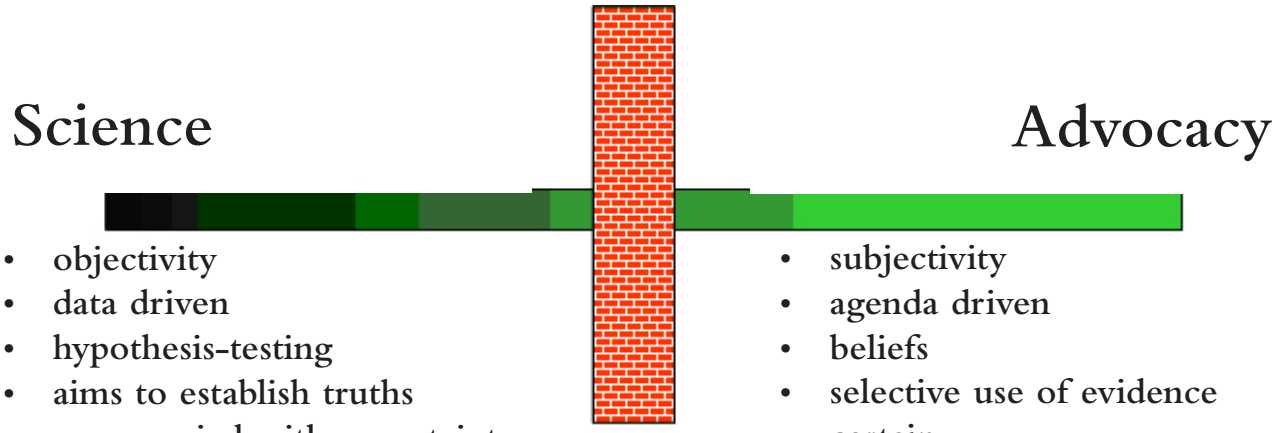
Dr. Wiens' presentation exemplified many of the themes and insights discussed during the day – chiefly, that while there is still great uncertainty about the effects of climate change, particularly at the watershed level, the tools and resources available are powerful and increasingly provide finer and finer scale resolution. As scientists, land managers, and community members, we must act now and act collaboratively to implement 'anticipatory adaptive management.' In order to make this work we should "be alert and honest to recognize bias and agendas; use proactive communication; and lighten up & recognize what is "good enough" in the face of uncertainty.

"Decisions and policies that are based on science are better than those made in the absence of such information. The issue is not *whether* science should be a part of advocacy, but *how*."

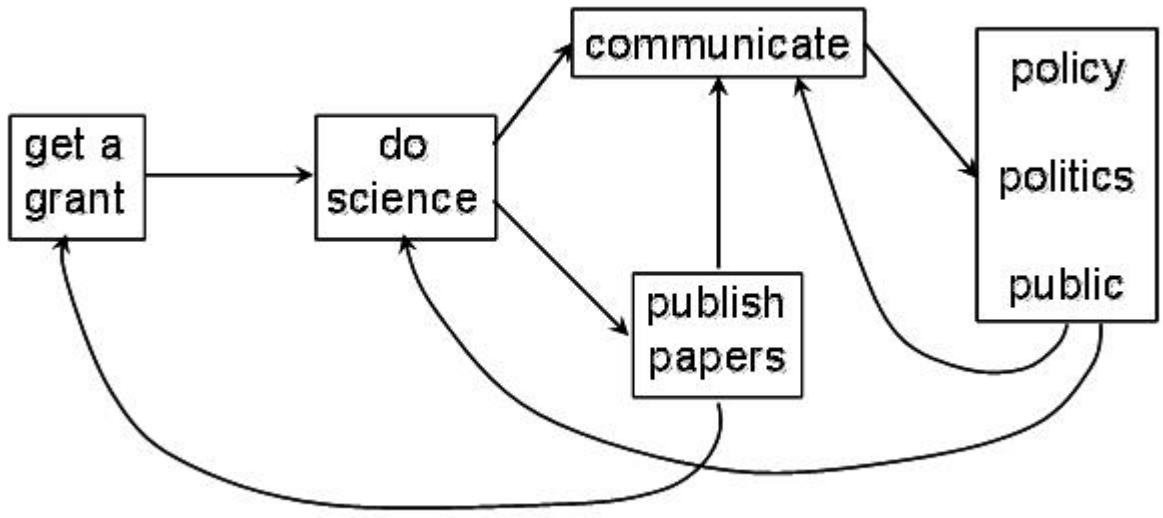
John Wiens, PRBO Conservation Science

Decreasing Uncertainty using:

- Climate models
- Distribution models
- Data
- Scale
- Stationarity



Science and Advocacy. Excerpt from Dr. Wiens' keynote address.



Scientific work flow. Excerpt from Dr. Wiens' keynote address.

Day 1 - Themes and Insights

We set the stage by creating a common understanding of the likely climate change ***impacts*** to the Laguna and other watersheds throughout the day. Eight morning session speakers addressed the climate change challenges and how to maintain ecosystem health into the future by examining breakthrough modeling techniques to incorporate microclimate effects at the local scale, examining the functional ecosystem dynamics affected by climate change, such as invasive species, breaking up species interactions (e.g. pollinators & plants) and population genetics, and exploring predictions of how ranges of species will contract or expand.

To establish a local Laguna watershed context, eight afternoon session speakers focused on results from recent and ongoing studies on water quality, biodiversity, and invasive species control and related bio-energy production.

Throughout the day, participant discussions highlighted some common insights:

Watershed Café Themes

Urgency

- We don't have time. We need to move more quickly.
- Uncertainty leads to paralysis. We need to make a best guess and move forward.
- What can we do to reduce the climate change problem? It is important to understand now how this underlies all that we do.

Communication

- Adaptive management is going to be very useful. We must keep an explanation of what we are doing very simple.
- Scientists and land managers are not aware of relevant studies because journal access is too expensive.
    - As scientists, we need to provide information in a way that is accessible to the lay community.
    - Several of us are doing similar things but not comparing studies or results as we are not aware of other's work.
    - An online 'knowledgebase' has much potential because it is too expensive to stay up to date with literature and scientific studies if not connected to a university.
    - We have to rethink how we conceive of restoration and conservation lands. Our concept in the future might be something new.
- We can change how we think about restoration activities (e.g. carbon off-sets for planting native trees).

Themes & Insights

1. **Urgency**
2. **Communication**
3. **Human and Watershed Impacts**

- We are not talking enough about carbon and the potential of carbon credits to support restoration activities.

Human and Watershed Impacts

- The Earth has seen species eradication and re-population before, yet at a lower rate. The subtext here is that humans are being threatened and the unmatched scale of the extinction crisis and its repercussions for humanity.
- A collision of cultures is happening. Climate change is a result of not living within limits.
- Climate change is to a large degree man-made, and simple solutions (e.g. biomethane converters) may lead to results.
- The hydrology of the Laguna relative to future flood control measures and rising sea levels is unknown. What will happen to people with increased flooding?

Expected Impacts of Climate Change

The first day of the conference culminated in a participant-generated list of likely climate change impacts to the Laguna de Santa Rosa watershed:

Changes in Climate:

- Increased extreme events or 'flashiness'
- Increased flood frequency, sediment, heat
- Raised evapotranspiration, water and air temperature
- Higher frequency of fires
- More storms that cause more channel complexity (scour)
- Droughts
- Changes in fog dynamics

Invasive laguna weed ***Ludwigia hexapetala.***

Changes in Natural Systems:

- Increased biological invasions
- Decreased soil moisture, water for wildlife & plants, groundwater storage
- Reduced summer stream flow
- Sea level rise impacts hydrology
- Eutrophication
- Land loss may result in more flooding
- Changes in water availability
- Shifting timing of seasons
- Changes in timing disrupt mutualisms

- Decoupling of species migrations
- Shifts in vectors and pathogens
- Some species will move and some won't
- There will be 'winners' and 'losers'
- There are 'no-analogs' for future communities
- Changes in conserved communities and preserves
- Large impacts to habitats with narrow microclimate needs
- Variable adaptation of target species will be tested

Changes in Human Systems:

- Increased pumping of aquifers
- Increased water diversion
- Decreased food production and increased food shortages
- Changes in land use
- Agricultural shifts
- Current goals for preservation and restoration may be no longer applicable
- We will be engaged in stewardship of a moving target
- Restoration plantings may fail
- Humans may be moving around
- There is a risk of over-reaction and over-compensation

photo Hattie Brown

A post-conference guided hike in the Laguna de Santa Rosa.


Cafe Etiquette
HOST
Starts introductions
Helps group:
start the conversation
follow the directions
offer everyone an opportunity to contribute


Cafe Etiquette
Welcome to the Watershed Cafés
Connect ideas
Listen together for patterns, insights & deeper questions
Make notes Draw! Doodle!
HOST
Starts introductions
Helps group:
start the conversation
follow the directions
offer everyone an opportunity to contribute


HOST
Starts introductions
Helps group:
start the conversation
follow the directions
offer everyone an opportunity to contribute
Focus on what matters
Contribute your thinking & experience
Listen to understand
Connect ideas


Cafés
Cafe Framework
Listen to understand

Day 2 - Agenda

8:00 am – 8:30 am	**Registration and Continental Breakfast**		
8:30 – 9:10 am	**Getting Started**		
	Welcome **Christina Sloop**, Laguna Foundation	**Watershed Café Orientation** **Genevieve Taylor**, Global Genesis	
	Session 1: Management Strategies in the Face of Climate Change		
9:10 – 9:55 am	**Nicole Heller** Climate Central *Management Strategies*	**Adina Merenlender** UC Berkeley *Corridor Dynamics*	**Tom Gardali** PRBO Conservation Science *Riparian Restoration*
9:55 – 10:20 am	**Watershed Café**		
10:20 – 10:35 am	**Break**		
10:35 – 11:05 am	**Dan Gluesenkamp** Audubon Canyon Ranch *Invasive Species Early Detection*	**Stuart Weiss** Creekside Center for Earth Observation *Microclimate Effects in Vineyards*	
11:05 – 12:00 pm	**Watershed Café**		
12:00 – 1:00 pm	**Lunch**		
1:00 – 1:30 pm	**Keynote Speaker** – **Paul Dolan**, Mendocino Wine Co. *Wine Industry Approaches to Climate Change Adaptation*		
1:30 – 2:40 pm	**Session 2, Part 1:** **Practitioners View – Restoration & Conservation Challenges in Face of Climate Change**		
	Panel Discussion **Julian Meisler** Laguna Foundation **Denise Cadman** City of Santa Rosa **Leslie Corp** Western United Dairymen	**Wendy Eliot** Sonoma Land Trust **Dave Cook** Sonoma County Water Agency	**Lisa Hulette** Goldridge Resource Conservation District (RCD) **Sierra Cantor** Sotoyome RCD
2:40 – 2:55 pm	**Break**		
2:55 – 4:55 pm	**Session 2, Part 2: Interactive Workshop** **Challenges & Practical Solutions – Strategies for Adaptation at the Watershed Scale**		
4:55 – 5:00 pm	**Concluding Statements**		
5:00 – 6:00 pm	**Mixer and Poster Session**		

Copies of all presentations are available at:
http://www.lagunafoundation.org/knowledgebase/

Having identified *impacts* associated with climate change on day one, the second day of the conference was focused around developing *strategies* to tackle these impacts within the Laguna de Santa Rosa watershed.

Day 2 - Desired Outcomes

1. To explore possible response strategies available for watersheds, such as the Laguna, particularly in light of uncertainty about the way climate change impacts will occur.
2. To identify current challenges that resource managers (land managers, conservation planners, and restoration practitioners) and agricultural producers are facing in our region.
3. To identify the gaps between climate change adaptation strategies and the needs of resource managers in terms of knowledge, plans, tools, etc.
4. To identify opportunities to combine, connect, and leverage efforts in the Laguna and North Bay Area to address resource managers' challenges in the face of climate change.

Day 2 – Keynote Address

Paul Dolan of the Mendocino Wine Company is an industry leader in sustainable grape production. His keynote address discussed the innovations he has brought to the wine industry in Mendocino County and the many ways he practices environmentally and socially conscious farming and winemaking – working from the standpoint of respect for the land and the natural environment.

Predicted Agricultural Impacts of Warming

- Crop Yield Changes
- Changes in Crop Types, Cultivars and varieties
- New Weed Invasions
- New Disease & Pest Invasions
- Flooding and Crop Pollination Changes
- Heat Waves and Stress
  - Loss of Crop Quality and Yields
  - Increased Vulnerability to Pests

"Climate change will challenge continued production of quality wine grapes in Sonoma County."

Stuart Weiss, Precision Viticulture International and Creekside Center for Earth Observation

Agriculture-Predicted Impacts of Precipitation Changes

- Loss of Water Supply and Reliability
- Questionable Food Security
- Lack of Water for Agriculture and Livestock
- Variable Agricultural Crop Yields
- Increased Fire Risk to Rangeland & Woodlands
- Increased Soil Erosion and Sedimentation from Agricultural Lands
- Changes in Pest, Diseases and Invasive Species
- Changes in Ozone and Air Quality - likely adverse affects on crop production?

Mr. Dolan is leading by doing and discussed ways to bring others in the industry along. He answered many questions from the audience regarding shifting practices in response to climate change. Many winemakers, especially those utilizing biodynamic farming practices, are changing the varietals they grow and are using ecological principles in pest and water management. Mr. Dolan's presentation set the tone for the day addressing practical effects of climate change on the wine industry – a major economic driver of Sonoma County - and discussing industry adaptation strategies to cope with changes. Following are some key points he made during his presentation.

Grape Growers will be using some of the following strategies:
Adaptation to Higher Temperatures

- Irrigation
  - Canopy Shading
  - Row Orientation
  - Drought tolerant Varieties
  - Water Cooling
  - Replanting to New Varieties
  - Moving up slope, north and to the coast

photo Hattie Brown

Keynote speaker Paul Dolan of the Mendocino Wine Company.

Adaptation to Variable Precipitation

1. Managing Extremes
   - Larger Catchments
   - Developing Reserves
   - Metering
   - Long Range
   - Planning-Flood Control Districts
   - Flexibility
2. Water Management
   - Conservation

- Rootstock Selection
- Building Organic Matter
- Soil Fertility
- Use of Cultivation
- Dry Farming
- Drip Irrigation

- Recycled Water

3. Securing Adequate Water
   - Regulatory Support
   - Local Water Planning
   - Urban Rural Partnership
   - Larger Catchment

Adaptation to New Pests & Diseases

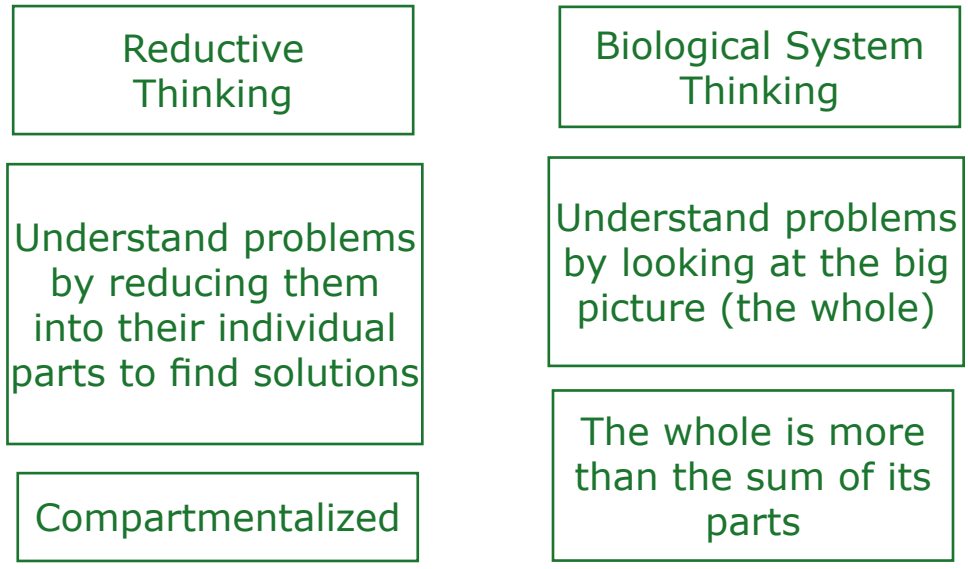
- Contribute to Health of Ecosystem
- Natural Pest Predators
- Expanded Flora & Fauna
- Bug Farms
- Polycultures
- Cover Crops

Adaptation to Changes in Energy Availability & Cost

1. Can't assume that petroleum and natural gas will remain relatively available
2. Move toward regenerative fertility systems that build humus and sequester carbon in soils
3. Reduce use of pesticides, rely on biological controls
4. Renewable energy – Solar, Wind and biomass production
5. Reduce the energy needed to transport food.
6. Support small-scale farming, gardening and agricultural co-ops.

The Art of Farming

Growers will need to to shift to 'Systems Thinking.'



Biological Systems Thinking and Reductive Thinking. Excerpt from Mr. Dolan's keynote address.

Day 2 – Themes and Insights

Five morning speakers considered Management Strategies in the Face of Climate Change, focusing on available management studies, wildlife corridors, restoration challenges, non-native species detection, and linkages to agro-ecological systems. In an afternoon panel, local conservation planners, restoration specialists, and natural resource and agricultural land managers discussed potential management, restoration & conservation challenges and possible response strategies. Conference participants then worked together to develop a watershed scale list of response strategies to facilitate climate change adaptation. The day culminated with an abbreviated list of eight major strategies in response to climate change impacts on watersheds.

Question:
As a conservation community, what should be our geograhic focus?

Answer:
Our focus should be at the scale of...

The North Bay

Participants recognized the value of the conference as a forum for rapid transfer of knowledge and learning. An ongoing theme of discussion was at what frequency, level of organization and, geographic focus such a forum should be held in the future. Audience participants voiced the desire to meet quarterly (as opposed to biennially) due to the immense tasks associated with climate change adaptation, but recognized that a lack of funding prohibited meeting so frequently.

Participants also identified a lack of a central authority on climate change adaptation: no one is yet "minding the shop" on climate change adaptation. Should direction on this come 'top down' from the state, or 'bottom up' from a more local level?

Late in the day, participants voted in an impromptu straw pole to decide what geographic level of centralized effort is needed in terms of information and organization to address the identified impacts of climate change.

Straw Pole Question: As a conservation community, what should be our geographic focus: Should our focus be at the scale of...

- o Watershed - 0
- o Sonoma County - 4
- **o North Bay Region - 13**
- o Bay Area - 9
- o State level – 1
- o No vote – 7

Day 2 – Interactive Workshop: Developing Response Strategies

Throughout the day, participants took on different thematic 'lenses,' using them to focus on a particular theme and to brainstorm for response strategies to related climate change impacts. Participants switched lenses throughout the day and each time discussed their answers to the question, "Given your lens and what you hear in the conference presentations, what ideas were mentioned today that might help the Laguna adapt to climate change?"

The four different "lenses" were:

1. *Water* – Water that flows through or resides in a watershed;
2. *Biodiversity* – the diversity of life on earth consisting of genetic diversity, species diversity and ecosystem diversity;
3. *Ecosystem services* – services provided by ecosystems that benefit humans and are necessary for a healthy planet;
4. *Working landscapes* – any landscape which is being managed for a specific economic benefit i.e., agriculture, ranching, dairy.

Lenses to brainstorm climate change adaptation resonse strategies:

1. **Water**
2. **Biodiversity**
3. **Ecosystem services**
4. **Working landscapes**

Within each lens, the audience prioritized strategies. The next sections illustrate the process participants underwent to develop a targeted list of response strategies utilizing their notes from the lens exercises:

Part A: Full list of Strategies needed to address the likely impacts of climate change organized by themes:

- Part A: Compellation of a list of strategy ideas;
- Part B: Results of the Prioritization exercise;
- Part C: Summary list of Climate Change Adaptation Management Response Strategies.

Scale – Science and Management

- Integrate science & management
- Focus management at the ecosystem, landscape or watershed scale. We should not just address management at the species level
- Integrated regional management with shared regional goals
- We need modeling on a management scale
- But also need to think big – at the landscape level
- Monitor systems – physical, chemical, and biological
- Incorporate 'evolutionarily enlightened' restoration and management – i.e. think about whether the plants you restore

with are genetically diverse, rather than come from limited stock.
- Consider climate change and other stressors in planning.
- Use 'anticipatory' adaptive management in the face of uncertainty.
- Integration climate change with land use change & population growth.

Modeling, land use and research

- Integrate hydrology models and future climate models with agriculture and societal models.
- Incorporate human movement into modeling.
- Protect more land.
- Preserve open space.
- Conserve water.
    - Maximize buffers and riparian set back from streams and creeks.
    - Monitor seed banks.
    - Integrate fog and other microclimate effects into climate models.
    - Use climate predictions in future land use decisions.
    - Determine climate 'trigger points.'
    - Consider wetland classification, historic diversity & importance of understory.
    - Use bio-converters.
    - Analyze existing Potential Evapo-Transpiration data (CIMIC - Center for Information Management, Integration and Connectivity) to develop modeling methods.
- Project future climate conditions with more confidence.
- No-analog communities can still mean conservation of biodiversity.
- Model both top down and bottom up
- Find more money for research.

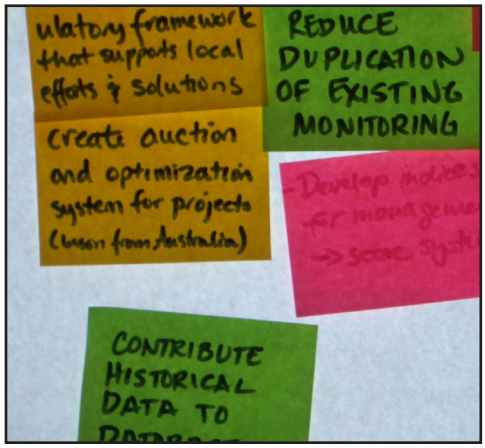


photo Genevieve Taylor

Climate change adaptation strategies.

Communication and action

- Increase availability of standard data sets.
- Communicate with the public in simple and clear terms.
- We need a new message to the public that will dispel fear & misinformation
- We need to change how we think.
- Set clear goals with time frames.
- Take action now. Policy is too slow

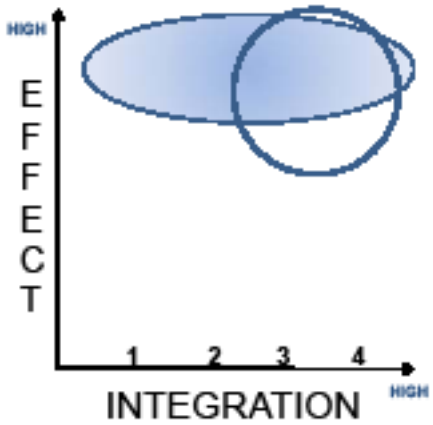
Part B: Prioritization Exercise - High Effect, High Integration

After further brainstorming, climate change response strategies audience members presented their ideas to the group and together classified each strategy with a goal of identifying "high effect" and "high integration,"

i.e. – how big of an effect a strategy would have, as well as how well would it integrate across all four lenses. The greater the number of "lenses" affected, the greater the effect and the impact. Below are the brainstormed ideas, in order of most to least integration.

High-Impact, High Effect Strategies affecting four lenses

- Contribute historical data to database.
- Create auction and optimization system to secure funding for projects (to mirror system in place in Australia).
- Develop indices for management.
- Maintain institutional memory mentoring.
- Create regulatory framework that supports local efforts and solutions.
- Reduce duplication of existing monitoring.
- Fund total adaptive management.
- Develop more creative use of land use planning tools (e.g. the ability of counties to regulate groundwater).
- Enhance collaboration between land management entities and climate change scientists.
- Foster "climate change interns" at local and regional scale
- Experimental factor in restoration
- Implement low impact development
- Guide land use shifts using planning tools (e.g. Transferrable Development Rights (TDRs), Purchasable Development Rights (PDRs)).



Highly effective and highly integrative (impacting multiple lenses) strategies are those to pursue. Figure from Genevieve Taylor, Global Genesis.

- Manage all surface and ground water.
- Create a collective resource center for adaptation to access overall monitoring data and climate change information.
- Enlist Bay Area Open Space Council to become a clearinghouse for

regional climate change information for conservation practitioners.
- Talk about goals first. Answer the question, what do we want to accomplish?
- Establish the economic value of ecosystem services.
- Perform a cost/benefit analysis of ecosystem resources.
- Internalize previously considered external costs of ecosystem services.
- Realize that everything is constantly changing.
- Develop monitoring around potential human reactions to change (e.g. water diversions)
- Determine how humans are going to respond to ecosystem services changes.
- Determine impacts to social agricultural communities.

Strategies affecting three lenses

- Revolutionize the California Natural Diversity Database (CNDDB).
- Collect seed from across climate gradients in watersheds for restoration. Couple this with greenhouse experiments that manipulate anticipated climate change.
- Avoid monoculture as a strategy to buffer change.
- Consolidate data for all indicator and special concern species via workshops and use these data in zoning and planning.
- Avoid mixing of extreme/disparate genotypes to avoid loss of genetic information and negative impacts on species fitness.
- Make dairy nutrient management plans.
- Build flexibility into regulatory mitigation and adaptive management.
- Secure easements and landowner participation for lands that cannot be purchased.
- Start and continue coordinated and standardized monitoring in the long-term.
- Identify appropriate spatial and temporal scales for monitoring.
- Create climate change monitoring group.

Strategies affecting two lenses

- Link public investment to public trust (e.g. line ditches for in stream flow)
- Use catchment board model from Australia (http://www.tucs.org.au/~cnevill/Model_catchment_management_plan.htm)
- Create distributed network of small-scale catchment systems.
- Preserve outliers and edge occurrences to maximize genetic diversity.
- Conserve agricultural water through economic incentives.
- Make PG&E pay for extra energy into grid from renewable energy sources.
- Take caution that managed relocation of species may backfire.

Strategies affecting one lens

- Create alternative income strategies (e.g. agricultural tourism, organic conversion, product diversity).
- Investment subsidy programs (e.g. methane digesters, cost share).
- Define roles for varying timeframes, including propagating seeds for keystone plant species.

Part C: Summary Management Response Strategies

At the end of the day, the conference planning committee took the "High Effect, High Integration" strategies and created a list that broadly reflected all of those ideas. This list was used to organize conversation on Day 3.

Climate Change Adaptation Response Strategies

1. **Field based monitoring.**
2. **Consolidate the Knowledgebase.**
3. **Implement adaptive management.**
4. **Invest in diversity.**
5. **Strengthen collaboration.**
6. **Use market forces.**
7. **Create centralized data centers for planning and implementation.**
8. **Engage private landowners.**

photo Hattie Brown

Conference particpant John Herrick presents strategies to the group.

Day 3 – Agenda

8:00 – 8:30 am	**Registration and Continental Breakfast**		
8:30 – 9:10 am	**Getting Started**		
	Welcome **Christina Sloop**, Laguna Foundation	**Watershed Café Orientation** **Genevieve Taylor**, Global Genesis	
9:10 – 9:35 am	**Keynote Speaker** – **Grant Davis**, Sonoma County Water Agency *Human Dimension and Economic Constraints*		
9:35 – 10:40 am	**Session 1: Developing Tools**		
	Christina Sloop Laguna Foundation *Framework for Assessing and Forecasting Watershed Ecosystem Status*	**Claudia Luke** Sonoma State University Reserves *Protocol Standardization & Data Gathering Networks*	**Deanne DiPietro** Sonoma Ecology Center *Conservation Commons and Watershed Knowledgebases*
	Watershed Café		
10:40 – 10:55 am	**Break**		
10:55 am – 12:00 pm	**Session 2: Developing Initiatives – the Nexus with Policy**		
	Ryan Branciforte Bay Area Open Space Council *Upland Goals Process*	**Karen Gaffney** Sonoma County Agricultural Preservation & Open Space District (SCAPOSD) *SCAPOSD Climate Change Initiative*	**Lisa Micheli** Pepperwood Foundation *Framework for Cooperation*
	Watershed Café		
12:00 – 1:00 pm	**Lunch**		
	Session 3: Working Session on Funding Strategies		
1:00 – 1:30 pm	**Report Out: Ideas for Strategy Implementation**		
1:30-2:15 pm	**Gary Knoblock**, Gordon & Betty Moore Foundation *Funding Strategies Round Table Discussion* **Grant Davis** Sonoma County Water Agency **David Means** Wildlife Conservation Board **Bill Keene** SCAPOSD **Beth Huning** San Francisco Bay Joint Venture		
2:15-2:30 pm	**Lunch**		
2:30-4:50 pm	**Session 3: Action Planning** How Do We Implement Climate Change Adaptation Strategies in the Most Effective Way for the Laguna?		
4:50 – 5:00 pm	**Conference Closing Statements** – **David Bannister**, Laguna Foundation		
5:00-6:00 pm	**Mixer and Meet and Greet with Local Officials**		

Copies of all presentations are available at:
http://www.lagunafoundation.org/knowledgebase/

The final day of the conference focused on ***action*** and ***implementation***. Presenters suggested tools to implement response strategies and discussed existing initiatives incorporating or related to climate change adaptation. All participants explored ways to implement the strategies developed on Day 2, and consulted a panel of funding agency representatives on possible mechanisms to obtain needed funding support.

Day 3 - Desired Outcomes

1. To present the current initiatives and tools available to make and evaluate progress toward watershed-scale resource management goals, and match them to strategies generated on Day 2.
2. To discuss the importance and interdependencies of different climate change adaptation strategies to help prioritize strategies for climate change adaptation for the Laguna in the future.
3. Given the tools presented, to brainstorm ways to implement the climate change adaptation strategies generated during the conference, including new policy, initiatives, collaborations, and research needs.
4. To develop commitments for action to sustain the momentum.
5. To explore the available opportunities within the funding circles to meeting this challenge.

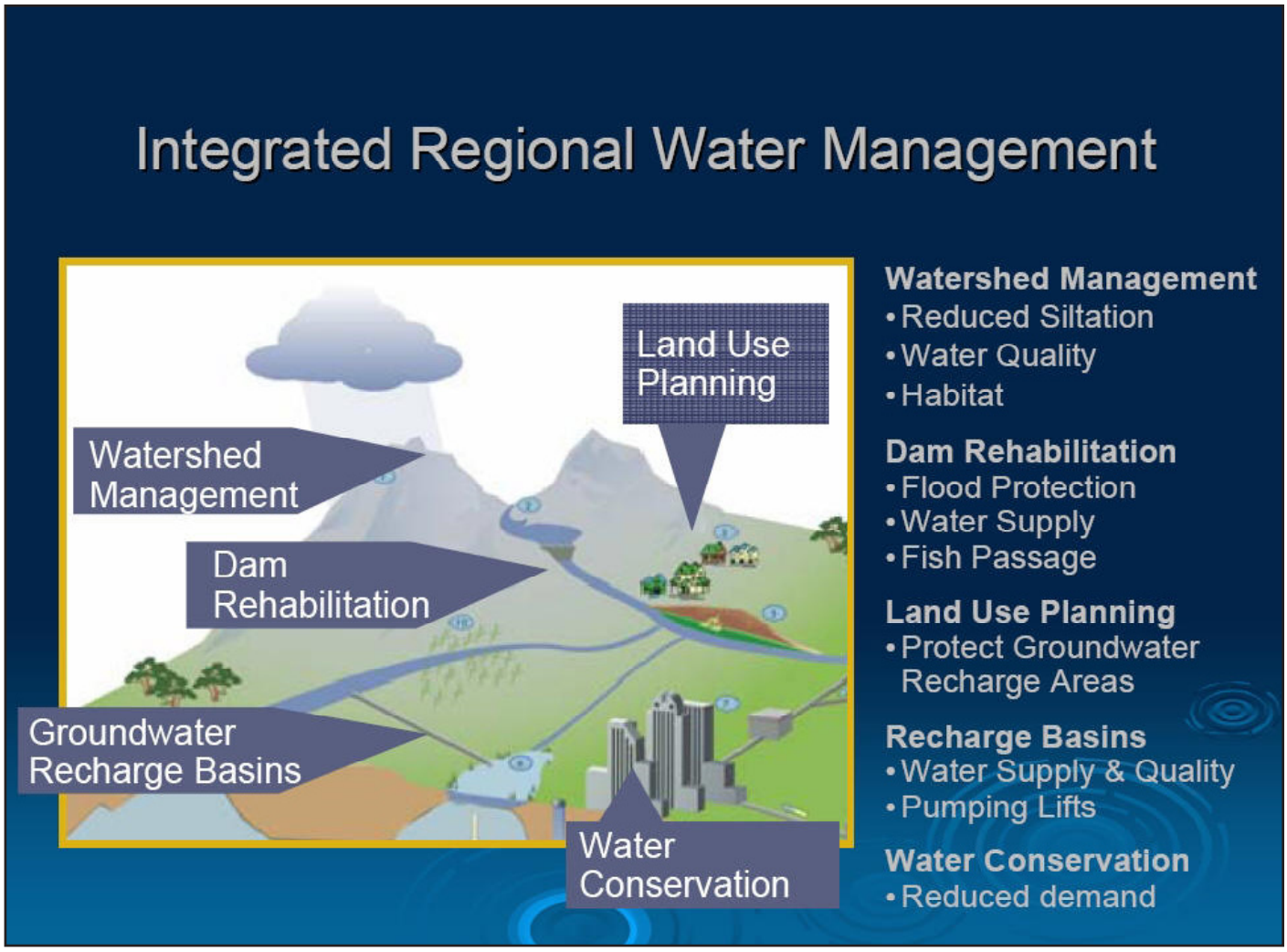
Day 3 - Keynote Address

Grant Davis, Assistant General Manager of the Sonoma County Water Agency (SCWA), gave the Day 3 keynote address. Mr. Davis' responsibilities span all management activities related to the Agency's core functions of water delivery, wastewater management, flood protection, and environmental sustainability. In his presentation he discussed the importance of a healthy Laguna de Santa Rosa wetland ecosystem to provide stormwater conveyance and flood protection, especially in extreme storm events, and serve as migration habitat for endangered salmonid

photo Hattie Brown

Keynote speaker Grant Davis of the Sonoma County Water Agency.

species. He discussed SCWA's Integrated Regional Water Management, and the initiatives related to climate change. He challenged conference participants to join him in a goal recently voiced by Paul Kelley, 4th District Sonoma County supervisor, to restore riparian cover on all streams throughout Sonoma County.



Components of Sonoma County Water Agency's Integrated Regional Water Management. Excerpt from Mr. Davis' keynote address.

Day 3 - Themes and Insights

Day three charted a course of ***action***. Presenters identified tools to implement response strategies and participants started discussions focused on strategy integration into potentially fundable initiatives.

Morning conversations concentrated on creating SMART (specific, measurable, attainable, relevant, time-bound) goals for each of the identified response strategies. These goals ranged from creating clear guidelines for adaptive management that is accessible to land

managers, to creating a regional environmental data center. Among other things, gaps became apparent in available data to aid appropriate strategic decisions that directly affect successful habitat restoration and conservation management, and many of the goals revolved around ameliorating that gap.

The afternoon was spent on action planning, beginning with a conversation with local funding agency representatives, and culminating in the formation of three integrated working groups to carry the effort of creating a climate change adaptation initiative in the San Francisco North Bay.

Participants explored how policy decisions and funding priorities should effectively support the climate change adaptation challenge and the proposed response strategies. And finally, participants identified major areas for potential collaborations and opportunities to leverage efforts.

Day 3 – High Effect, High Integration Response Strategies and Related SMART Goals

1. **Implement Adaptive Management**
    a. By October 2010, collaborate and work with funding agencies to secure sustainable climate adaptation initiative funding.
    b. By December 2010, launch an outreach campaign throughout Sonoma County to engage landowners respectfully to develop trust and collaboration in adaptive management.
    c. By January 1, 2011 redefine adaptive management to incorporate system complexity and need for incorporation of multiple scales.
    d. By January 2011, establish clear guidelines for adaptive management implementation for 50% of landowners/ agencies (by habitat type).
    e. By January 2012, incorporate adaptive management into 90% of project budgets as line item.
    f. By January 2013, develop and implement integrated framework for adaptive management including continued assessments of conserved habitats and working landscapes
    g. By December 2015, establish Sonoma County as leader in adaptive management implementation
    h. By 2015, build a Sonoma county knowledgebase to identify the species and vegetation associations most imperiled by climate change.
    i. By December 2020, restore 100% of Sonoma County creeks & riparian zones.

2. **Field-Based Monitoring**
    a. By 2013, gather relevant data to relate variation in local climate to the distribution of organisms.
    b. By 2015, establish distribution and climate tolerance baselines for common and indicator species.
    c. By 2014, create a regional environmental sensor network and data center to monitor changes in significant local climate variables (e.g. fog) including reference stations.
    d. By 2011, identify and by 2013, monitor and create database for indication target species, specifically recruitment, dispersal, death, that is
        i. Comprehensive in space and time.
        ii. Achieved through a network of locations within region.
        iii. Use standardized methods.
    e. By 2015, implement monitoring regimes for both the resource and the management pressure on resources (water, biodiversity, ecosystem services, working landscapes).

3. **Invest in Diversity**
    a. By 2015, for 90% of restoration plantings, increase number of local genotypes collected for restoration within project scale (taking caution not to move seeds at large scale.)
    b. By 2015, develop county-wide program to effectively increase accessibility to properties with diverse seed sources (e.g. create a public "seed drive.")
    c. By 2015, maximize physical (e.g. topographic) diversity of conservation lands by easement and fee title means.
    d. By 2015, increase the cultural diversity of participating stakeholders.
        i. Partner with organizations that have already established a connection to increase headcount and set a firm goal of attendance.
    e. By 2015, establish a working collaboration with the local agricultural community to work with them to diversify agricultural products, services, and processes.
    f. By 2015, implement the following guidelines for ecosystem restoration and effective conservation in light of climate change:
        i. Avoid monoculture and maximize native diversity in restoration.
        ii. Maximize genetic diversity (molecular scale).
        iii. Maximize biological diversity (species & community scales)
        iv. Maximize ecosystem diversity (landscape scale)

v. Diversity portfolio of water projects and resources.

g. By 2015 maximize land preservation within Sonoma County (in agriculture, parks, and preserves) with the following guidelines:
    i. Preserve the Laguna uplands as well as lowlands.
    ii. Purchase land with partners.
    iii. Capitalize on soil as a carbon sink.

4. Consolidate Knowledgebase.

a. By 2015, compile all available historical data for all watersheds within Sonoma County.
b. By 2015 develop a comprehensive spatially explicit and temporally comprehensive database for Sonoma County biodiversity resources to facilitate analysis.
c. By 2015, update existing GIS coverage and increase spatial resolution to parcel scale.
d. By 2013, compare climate model outputs and prepare consolidated results.

photo Hattie Brown

Participants discuss implementation of action strategies.

5. Strengthen Collaboration

a. By 2015, have a conservation commons established with 80% of participating stakeholders (NGO's, government, academia).
b. By 2010, implement quarterly, or at minimum annual meetings of conference participants and conservation commons members - researchers, policy makers, planners, etc.
c. By 2015, implement measures that incorporate dissemination, recording, and follow-up into climate adaptation collaboration and outreach.

SMART Goals

Specific
Measureable
Attainable
Relevant
Time-bound

d. By 2015, establish a program that teaches skills of effective collaboration and conflict resolution in K-12 for next generation of decision makers.
    i. By 2015, reach 25% of 6th grade Sonoma County students.
e. By 2011, set clear objectives to be achieved from collaborations; map collaborations needed between scientists, land managers, public institutions, private land owners; build commitment from NGO's to schedule paid staff time for partnering.
f. By 2011, disseminate and promote this document through established channels – website, meetings, newsletters, etc.
g. By 2011, obtain commitment to collaborate from organizations in writing via MOU's, mission statements and job descriptions.
h. By 2012 convince funding organizations and agencies to fund this science-based strategic planning process in addition to related projects.
i. By 2015, perform economic analysis of the collaborative process vs. no collaboration.
j. By 2011 encourage immediate adoption of the North Bay Watershed Climate Change Adaptation Initiative by a majority of 2009 conference attendees.
k. By 2015, disseminate this conference format throughout the region (e.g. watersheds, Counties)
l. By 2012, consolidate a list of web sites that are supporting northern California collaboration (e.g. www.irwmp.org)
m. By November 2009, distribute conference attendee contact information and send to each participant (name; email; phone; and organization)
n. By 2015, implement practices that tighten the gap between researchers and managers, and apply experimental methods to a majority to restoration projects in the county.
o. By 2015, create a policy initiative by funding agencies to create incentives for collaboration on climate adaptation. Draft adoption by 2013.
p. By 2010, establish effective way via web forum to communicate funding sources and cost share opportunities (NRCS/EQIP, CSPP).

6. Create Centralized Data Centers for Planning and Implementation

a. By 2015, establish a regional data center with resolution at the watershed scale such as the SF Conservation Commons (http://sfcommons.org).
    i. The "center" does not have to be a physical place but a concept or program.

b. By 2010 create and utilize web-based interactive forums, and schedule in-person or Web-based meetings to create a nexus for community engagement.
c. By December 2010 map the "territory," by establishing a matrix of projects/initiatives researchers and institutions are working on within Sonoma County and the North Bay (Bay Area) region.
    i. This will help to avoid duplication of efforts and inform participants.

photo Hattie Brown

Brainstorming by writng on tableclothes.

7. Use Market Forces to Drive Change

a. By 2011, hire a resource economist to evaluate the economic value of ecosystem services in Sonoma County and the North Bay region. Finish evaluation by 2014.
b. By 2015, establish a county-wide program that will provide incentives (prices) to encourage desired behaviors related to climate change mitigation and adaptation strategies.
c. By 2013, effectively evaluate and establish active restoration practices as invaluable carbon sequestration measures.
d. By 2014, establish an outreach program that will utilize marketing slogans similar to "organic" or "fish friendly farming," as for example "carbon-neutral" or "watershed friendly" to help consumers support sustainable businesses.
e. By 2013, establish a portfolio of creative funding resources:
    i. Create a list of forward-thinking business leaders and sustainable businesses willing to collaborate on the implementation of climate adaptation strategies and funding development

ii. Auction off restoration opportunities
iii. Impose five cent fee on bottled water to support preservation ecosystem services.
iv. Vote for increased sales tax to sustain restoration and ecosystem benefits.

f. By 2014, establish an educational outreach program aimed at the urgency and importance of both climate change mitigation and adaptation, in order to educate the public for buy-in.
g. By 2010, present integrated proposal including the outcomes of this conference to relevant funding agencies.

8. Engage Private Landowners

photo Hattie Brown

Brainstorming by writing on tableclothes.

a. By December 2010, launch an outreach campaign throughout Sonoma County to engage landowners respectfully to develop trust and collaboration in restoration, conservation, and adaptive management.
b. By 2013, develop a landowner communication plan, including existing incentives (e.g. easements, cost-share programs) and create new ones (e.g. direct payments, carbon markets).
c. By 2014, develop a program that establishes effective outreach collaborations with existing non-regulatory organization and community groups that have relationships with landowners (e.g. Resource Conservation Districts, winegrower groups, landowner groups, etc.).
i. Educate landowners on the benefits of restoration.
ii. Engage people properly to develop trust.
iii. Respect local knowledgebase of farmers.

d. By December 2010, the Laguna Foundation will secure funding to formulate a strategic plan to achieve the goal of 100% riparian restoration of Sonoma County streams. This plan will bring together the Sonoma County Water Agency, other Conservation NGO's, and landowners to implement restoration along all degraded county channels. This plan will help to solicit funding to implement this restoration.
e. By 2015, implement a requirement to use 50% of local contractors, suppliers, or work forces in restoration/ construction projects.
f. By 2020, develop a way that will pay landowners for property that is removed from agricultural production at an economically meaningful level for Sonoma County's land values.

Day 3 - Funding Development Panel Discussion

Funding Panel participants (from left): Gary Knoblock (Gordon & Betty Moore Foundation), David Means (Wildlife Conservation Board), Beth Huning (San Francisco Bay Joint Venture), Grant Davis (Sonoma County Water Agency), Bill Keene (Sonoma County Agricultural Preservation & Open Space District)

A panel of representatives from local philanthropies and government agencies explored how policy decisions and funding priorities would need to change to effectively address the climate change adaptation challenge.

They also addressed the opportunities for coordinated funding development for climate adaptation and discussed the need to present an integrated approach to ensure success.

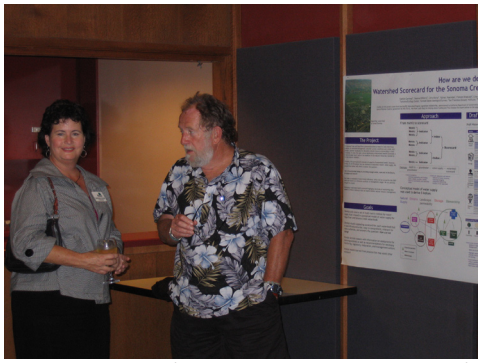
The panel participants and audience further identified areas for potential collaboration and opportunities to leverage existing, more regionally focused efforts.

Day 3 - Meet & Greet with Local Officials

David Bannister (Laguna Foundation), Shirlee Zane (3rd District Supervisor), and Debora Fudge (Windsor, Councilmember)

Local officials mingled and visited with participants during the concluding Day 3 conference poster session. They discussed the implications and needed actions to address climate adaptation in the local Sonoma County and North Bay policy arena. This set the stage for future interactions between the newly formed Sonoma County Regional Climate Protection Authority and the NBCAI policy working group.

David Bannister (Laguna Foundation) and Ann Hancock (Climate Protection Campaign)



Debora Fudge (Windsor, Councilmember) and Jake MacKenzie (Rohnert Park, City council)

Kathleen Shaffer (Sebastopol, City council), Maddy Hershfield (1st District Assemblyman Wes Chesbro's office), and Guy Smith (Laguna Foundation Board of Directors)

Section 2 - North Bay Climate Adaptation Initiative

To meet the climate challenge in the Laguna watershed and beyond conference participants formed three working groups on Day 3 to effect the integration and implementation of climate adaptation strategies and goals. These working groups represent the 1) science & technology, 2) policy, and 3) conservation & stewardship aspects of responding to climate change on a local scale.

1. The **Science, Technology & Management Nexus** working group will track the state of the science and develop a data sharing network by strengthening collaboration and consolidating the available knowledgebase, conducting and developing baseline and ongoing monitoring of ecosystem change.
2. The **Policy & Funding Development** working group will create a broader awareness of climate change adaptation within public agencies, resolve policy issues, develop a local or market take to climate change adaptation, and find available funding for coordinated projects in collaboration with the other two working groups.
3. The **Habitat Conservation and Stewardship** working group will reach out to the public, educate and engage landowners, and focus on the maximizing restoration and stewardship of streams, creeks and riparian cover.

Initiative Working Groups

1. Science, Technology & Land Management Nexus
2. Habitat Conservation and Stewardship
3. Policy & Funding Development

These working groups have evolved from the conference into the **North Bay Climate Adaptation Initiative (NBCAI). NBCAI** is an effort to advance the goals of the conference, to highlight the challenges associated with climate change adaptation, to focus the efforts of the three working groups, to become a model for a coordinated local scale effort, and to implement strategies developed in the conference.

Initiative Goals

One of the strategies for climate change adaptation is to maximize the sharing of relevant information. This is why the North Bay Watershed Climate Change Adaptation Initiative is linked in with the San Francisco Bay Area Conservation Commons (http://sfcommons.org), a data sharing platform to maximize information exchange. One of the first actions of

the Science, Technology & Land Management Nexus working group will be to establish a database of recent, ongoing, and planned research and restoration projects. It will also establish a forum for land managers to share their research and restoration needs.

Through the actions and outcomes of these working groups and the utilization of the SF Conservation Commons the San Francisco North Bay community of resource managers, scientists, farmers and private stakeholders can begin to collaborate on implementing climate adaptation strategies tailored to protect the hydrology, habitats, and local communities of Sonoma County watersheds.

Vist the North Bay Climate Adaptation website:

(**http://www.nbcai.com**)

Habitat Conservation and Stewardship

The Habitat Conservation and Stewardship working group aims to develop, implement, and provide outreach around innovative and proven strategies for habitat restoration and management in North Bay ecosystems that promote ecosystem services and conservation of biological diversity in a changing climate.

The purpose of this working group is to engage in advocacy, education , community engagement, technical guidance on the importance of restoring and protecting ecosystem services and biodiversity conservation, stream & riparian protection and enhancement/restoration, landowner compliance and buy in, establishing values & benefits to protect and natural systems, developing high leverage and becoming a comprehensive catalyst for positive change.

The 5 year vision of the group is to have secured funding to perform restoration on impaired ecosystems (e.g. streams, riparian zones), develop a network of landowners demonstrating best management practices, build a firm commitment by landowners to enhance and restore e.g. stream and creek resilience, and form working partnerships within the agriculture and dairy industries to integrate working landscapes into climate adaptation.

The group will engage key players within different industries and land owner constituencies (e.g. wine, dairy, public) to act as spokespeople for habitat conservation and stewardship. The group will promote case studies and success stories, before and after examples, and work with the values of all landowners to achieve goals and objectives. The group is currently developing a clearly defined set of goals, objectives, outcomes, and meeting structure.

Restore 100% of available Sonoma County Riparian zones by 2020.

Group Objectives

1. Convince the Sonoma County Regional Climate Protection Authority to prioritize policy and work related to the stream and riparian system by 2011.
2. Create a Regional North Bay (by county) Climate Change Adaptation Plan by 2015.
3. Have a firm participation commitment from 30-50% of streamside landowners (e.g. SCWA) by 2010.
4. Secure participation of at least 50% of agricultural stakeholders by 2015.
5. Secure funding for at least 25% of the needed restoration work by 2015.
6. Engage natural resources economist and initiate economic analysis of potential climate change impacts by county by 2015.
7. Create a series of case studies and success stories for stream restoration and stewardship by 2015.
8. Engage key participants from all North Bay counties by 2011.
9. Develop and implement a stewardship outreach/education program (implemented by the various existing education programs (NGO's) by 2015.

Group Outcomes

1. 100% of available Sonoma County Riparian zones restored by 2020.
2. A network of landowners demonstrating stream & riparian stewardship best management practices by 2012.
3. Engaged private landowners actively participating in county-wide stream-stewardship groups.
4. Diverse conditions created for implementing restoration and within the working group.

Current working group participants include representatives from the Laguna de Santa Rosa Foundation, Cotati Creek Critters, Sonoma Ecology Center, CIty of Santa Rosa, Sonoma County Water Agency, North Coast Regional Water Quality Control Board, Sonoma Land Trust, Sonoma County, Azonde Inc., and private stakeholders.

Policy and Funding Development Working Group

The Policy and Funding Development focuses on providing an expert forum to connect North Bay decision-makers with policy and technical resources, in order to support climate adaptation strategies that integrate natural resources and ecosystem services concerns.

Participants will be working with County agencies and the Sonoma County Regional Climate Protection Authority to provide input and tools to help develop a strategic planning framework that incorporates both climate mitigation and adaptation. The group's roles are to provide a nexus to the conservation, restoration, land management, scientific, agricultural, and private stakeholder communities, influence policy, and to develop a coordinated county-wide plan and funding support to reflect and implement climate change adaptation strategies.

A major outcome of the conference was the realization that California Assembly Bill 881 (AB 881) created the Sonoma County Regional Climate Protection Authority (SCRCPA) (under the Sonoma County Transportation Authority) as the body in Sonoma County with the authority "to assist those agencies in meeting their greenhouse gas emission reduction goals and develop, coordinate, and implement programs and policies to comply with the California Global Warming Solutions Act and other federal or state mandates and programs designed to respond to greenhouse gas emissions and climate change." The bill, approved by the Governor on October 11, 2009 – days before the conference, grants authority to SCRCPA to receive grant funding to carry out is goals.

This new body will begin meeting in January 2010, and early goals of the Policy and Funding Development working group focus on influencing and engaging with SCRCPA to incorporate climate change adaptation in addition to mitigation into their planning process. SCRCPA may become the future conduit for state and federal grant funding to flow to initiatives such as those created by the working groups. Long-term goals of this working group focus on securing funding for future adaptation related studies and activities.

The purpose of this group is to:

- Act on opportunities to integrate adaptation into climate policy processes such as those of the Sonoma County Regional Climate Protection Authority.
- Provide analysis and feedback on policy planning alternatives.
- Engage with Sonoma County departments and programs that have the greatest capacity to meet the Initiative goals.
- Offer educational outreach to the public and decision-makers.

- Facilitate forums and informational exchange.
- Serve as a conduit for funds, information, concepts, and partnerships related to climate change adaptation in Sonoma County.
- Develop a coordinated county-wide plan to reflect climate change adaptation.
- Develop funding opportunities for the implementation of climate adaptation response strategies identified by the conference.

Climate Change Adaptation Strategies identified at the conference that this group will directly address include: Strengthening Collaboration, and Using Market Forces.

The group is currently developing a clearly defined set of goals, objectives, outcomes, and meeting structure.

Group Objectives

1. Create an integrated North Bay regional vision for climate change adaptation by 2011.
2. Integrate existing watershed climate change response strategies to develop and leverage funding support by 2011.

Group Outcomes

1. Climate Change policy in Sonoma County (& other North Bay counties) reflects strategies for both climate mitigation and adaptation.
2. A county-level climate change adaptation plan guides policy, conservation, restoration, and management decisions.

Group Tasks and Objectives

1. Create a 5-page problem statement to present to the Sonoma County Regional Climate Protection Authority by Aug 2010.
2. Provide advice on linkages and trade-offs between mitigation and adaptation.
3. Create integrated regional vision.
4. Determine capacity for leveraging funding.
5. Integrate with existing Bay Area initiatives.

Current working group participants include representatives from the Laguna de Santa Rosa Foundation, Sonoma County Agricultural Preservation and Open Space District, Sonoma County Water Agency, Sonoma Ecology Center, Pepperwood Foundation, Sonoma Land Trust, Sonoma County, PRBO Conservation Science, and California Coastal Conservancy.

Science, Technology & Land Management Nexus Working Group

The Science, Technology, and Land Management Nexus working group aims to provide those making land and resource management decisions in the North Bay region the information, methods, and guidance needed to address the challenges of climate change on natural and agricultural systems.

The group is to develop a framework and tools for cross-discipline collaboration and scientific, technical, and land management related information exchange to facilitate progress toward the implementation of climate adaptation strategies identified at the conference.

Building and utilizing the varied data capabilities of the San Francisco Bay Area Conservation Commons (http://www.sfcommons.org/) will facilitate the exchange of information and will allow the streamlining of projects, and increase active collaboration, helping to leverage resources. This group also focuses on the interface between scientific and technical capabilities and findings and the on-the-ground needs of the land management community, in order to effectively implement appropriate actions to facilitate climate adaptation actions.

The group is currently developing a clearly defined set of goals, objectives, outcomes, and meeting structure.

Group Objectives

1. Develop a conceptual model of available and needed information regarding watershed scale climate adaptation (start Sonoma County-wide pilot) by Aug 2010.

2. Create a collaborative framework to effectively share information through the SF Conservation Commons - develop funding proposal by Aug 2010.

3. Map special indicator/target occurrences and assess needs to inform community on what has been done, what new research is needed, and to inform practitioners and policy development by 2011.

4. Develop biotic, physical, and chemical indicators on the watershed scale to use in standardized assessment framework by 2011.

5. Inventory available tools and resources (e.g. models, databases etc) and identify gaps by 2011.

6. Obtain funding support and implement coordinated field-based indicator surveys in a majority of Sonoma County watersheds by 2012.

7. Develop an integrated model program of data gathering, sharing, and dissemination to practitioners and decision-makers by 2012.

8. Develop a network of habitat-specific reference sites (e.g. permanent research plots) for climate change adaptation assessment by 2011.

9. Formulate a series of relevant research questions that analyze climate change at an ecologically meaningful scale by 2011.

10. Develop a plan on how to plug into existing Bay Area initiatives, leverage and develop research funding by 2011.

Group Outcomes

1. Existing integrated & standardized monitoring framework, using a suite of physical, chemical & biotic indicators to assess natural system function over time.

2. Active community utilizing capabilities of SF Conservation Commons to facilitate information exchange and collaboration across disciplines and interest groups.

Group Tasks and Deadlines

1. Develop funding proposal to start building relevant online GIS database in SF Conservation Commons - Jun 2010.

2. Develop relevant indicators for integrated & standardized monitoring framework for Sonoma County (as pilot), using physical, chemical & biotic indicators to assess natural system function over time - Aug 2010.

3. Develop plan for the placement of environmental and climate sensors and the type of sensors needed - Aug 2010.

5. Collect & consolidate list of projects under way in Sonoma County & the North Bay region - Aug 2010.

Group Vision

This working group envisions a collaborative framework in which to work where local scientists and experts recruited from outside the county can scientists can know what data and resources are available, what has been done, and how to fill identified knowledge gaps. Long-term monitoring would be in place, and tools, information and data would be easily accessible including a series of maps and GIS data layers. Others would visit the county to learn how to run an integrated, cohesive scientific program and practitioners in the North Bay would understand how climate is changing locally and how it affects the environment.

To achieve this vision, the group identified the need to (1) develop a network of reference sites, (2) assess available resources (i.e. data inventory, models, etc.), (3) leverage current funding, (4) assess stakeholder needs with regard to land and water convenience, (5) formulate research questions or issues to be solved, (6) analyze climate at ecological scale, and (7) establish network of permanent plots.

Resources needs to achieve this vision include: (1) funding, (2) careful planning, (3) time, (4) data and a data framework, (5) a well organized GIS with consistent features, (6) a system administrator, (7) technical support.

Current working group participants include representatives from the Laguna de Santa Rosa Foundation, Sonoma Ecology Center, Pepperwood Foundation, Sonoma State University FIeld Stations & Nature Preserves, Audubon Canyon Ranch, PRBO Conservation Science, Creekside Sciences, UC Berkeleym, USGS, Sonoma County Agricultural Preservation and Open Space District, and Sonoma County Water Agency.

photo Hattie Brown

Panelist Leslie Corp of the Western United Dairymen addresses the audience.

Section 3 – Presentation Abstracts

Numerous resources are available on the Laguna Knowledgebase (http://www.lagunafoundation.org/knowledgebase/) including the following conference presentation abstracts, biographies of presenters, copies of presentations, and posters. Conference abstracts are listed here alphabetically by presenter for each day.

Day 1 – Abstracts

Climate Diversity and Protected Areas

Ackerly, David, **Ph. D.**, Department of Integrative Biology, University of California Berkeley

Climate changes poses new and formidable challenges for the design and management of protected area networks. In the face of uncertainty, in both the magnitude of climate change and its biotic impacts, how can decisions be made now? I will present one approach to this problem, focusing on the role of climatic diversity across landscapes. In the Bay Area, coastal, elevational and topographic features generate high levels of spatial variability in temperature and rainfall. In the face of changing climates, spatially heterogeneous landscapes are expected to support greater biological diversity and provide more opportunities for small-scale migration and local climatic refugia. These patterns can be evaluated at a range of spatial scales, from small-scale topoclimate variability (tens of meters) to elevational and regional climatic variability (tens of kilometers). I will present quantitative and GIS-based methods to evaluate and visualize this heterogeneity, and the potential value of new and expanded reserves, and connectivity between reserves. These methods merit consideration as a basis for short-term decision-making, and pose a related set of research questions to test underlying assumptions and identify appropriate spatial scales in relation to the demography and dispersal capacity of different species.

Predicting the Future Spread of Invasive Plants in California

Brusati, Elizabeth, Ph. D.[1]; Johnson, D.[1]; DiTomaso, J.[2], 1. California Invasive Plant Council; 2. UC Davis Dept. of Plant Sciences

Distribution of invasive plant populations in California is dynamic, and effectively protecting native flora requires knowledge about where invasive plants are and where they may spread in the future. We determined statewide distribution of 36 invasive plants in California by surveying local resource managers in all counties. Using CLIMEX modeling software, we estimated climatic suitability for each plant throughout California based on its known distribution elsewhere in the world. Combined, these data provide information on potential future spread in the state. This information will be disseminated to support early detection efforts by helping local managers determine which invasive

plants are most likely to move into their area. Next, to determine how climate change might affect invasive plant distribution in California, we ran the models again using parameters adjusted for a 3°C increase in annual temperature. Results indicate that overall climatic suitability in California for the 36 combined species would alter little with climate change. However, certain species may be "winners" or "losers." For example, our models predict that climate suitability will nearly double for castor bean (***Ricinus communis***) and fountaingrass (***Pennisetum setaceum***), while decreasing substantially for other species. We will present examples of projected range shifts and changes in suitability for several widespread invasive plants as well as incipient invaders that show potential to expand to new areas of California, with a focus on plants of concern in Sonoma County.

Consequences of Climate Change for Mutualistic Interactions

Christian, Caroline, Ph. D., Department of Environmental Studies and Planning, Sonoma State University

Mutualisms represent some of the most tightly-linked species interactions and have been shown to have profound effects on the structure of populations and communities and provide important ecosystem services. Recent meta-analyses indicate that many species engaged in mutualistic interactions are responding to climate change through modifications in their geographic distributions, phenology, and organizational hierarchies. In addition, other components of global change, especially biological invasions, interact with changes in climate to affect mutualisms. Here I explore the evidence for altered mutualisms due to climate change and present a framework for predicting the mutualistic interactions most susceptible to alterations. Using a case study approach, I explore approaches to mitigating the impacts of altered mutualisms through land management and conservation planning.

Integrating Invasive Weed and Nutrient Management with Bioenergy Production

Cohen, Michael, Ph. D. [1]; Hare, C.; Kozlowski, J[1].; McCormick, R.[2,4].;Chen, L.[2]; Nelson, T.[3]; Tredinnick, D.[4], 1. Department of Biology, Sonoma State University; 2. Department of Biology, San Francisco State University; 3. Department of Biology, Seattle Pacific University; 4. Utilities Department, City of Santa Rosa

Constructed wetlands can be used to lower levels of residual contaminants and nutrients in water, while biogasification of vegetation harvested from the wetlands can generate usable energy. Two gravity-flow 400 ft^2 Channelized Aquatic Scrubbers (CAS) were constructed at the City of Santa Rosa Laguna Treatment Plant, each composed of three channels ranging in depth from 5 to 20 inches and stocked with native floating aquatic plants and algae common in the Laguna de Santa Rosa. The CAS displayed a high efficiency of nitrate removal (1.0 ± 0.5 g N/m^2/d from July 2008 to June 2009; mean ± SD), primarily owing to denitrification. Additionally, results from juvenile trout bioassays demonstrated that the CAS substantially decreased levels of estrogen-mimicking compounds in the water. Net productivity of the CAS, estimated from regular harvests, averaged from 1.3 to 13.7 g dry weight/m^2/d. CAS could potentially be applied in the Laguna watershed for scrubbing nutrient-rich tributaries. Energy generation from harvested biomass would enhance the cost effectiveness of larger scale applications of CAS. Currently, the most technically feasible procedure for extracting usable energy from the biomass is anaerobic digestion, which produces methane-rich biogas that can offset fossil

fuel consumption. Anaerobic digestion of harvested biomass at 35 °C in the laboratory yielded 145 ± 22 ml biogas/g dry weight (mean ± SE); an approximate 40% synergistic enhancement of biogas production from the biomass was attained by co-digesting with a mix of winery and dairy waste. Two 1500 gallon digesters, recently built on the treatment plant grounds, will be fed with varying proportions of CAS-harvested vegetation, Ludwigia from the Laguna, and agricultural wastes. The digested material will be utilized as a soil amendment for an on-site garden. Deployment of this type of integrated nutrient removal/bioenergy system would recycle carbon and nitrogen, support local food production, and reduce the demand for fossil fuels in our community.

Climate Change in the Laguna Watershed: Addressing Hydrologic and Ecologic Impacts

Flint, Lorraine; Ph. D., Flint, A., U.S. Geological Survey.

Climate change in the Laguna de Santa Rosa watershed will be manifested by numerous changes in the surface water and groundwater resources, as well as in the stressors for ecological landscapes and species diversity. Future projections of the changes in air temperature and precipitation from global climate models for the next 100 years are downscaled to fine scale resolution (270-m grid spacing) that captures the differences within habitats and stream drainages. These data are applied to watershed-scale models and translated into hydrologic outcomes and ecologic stressors or drivers in the watershed at that same spatial resolution. Streamflow and groundwater recharge projections for the 21st century, along with changes in evapotranspiration, soil moisture, air temperature, climatic water deficits, and various other environmental drivers will have the potential to impact species distributions and diversity, water availability and competition. Watershed-scale projections and spatially distributed data provide tools and information for land and resource managers to prioritize their resources and actions to approach the task of adaptation to climate change.

Restoration and Management of Ludwigia hexapetala-Invaded Wetlands of the Laguna in the Face of Climate Change

Grewell, Brenda, Ph. D. [1] and Futrell, C. J.[2, 1.] USDA-ARS; 2. Department of Plant Sciences, UC Davis

The successful invasion of the Laguna de Santa Rosa by ***Ludwigia hexapetala*** (Uruguayan primrose-willow) has challenged watershed goals for restoration of desirable biological communities and ecosystem processes. The abundance of aquatic weeds is regulated by light, hydrology, temperature, nutrients, and biological interactions that may all vary with climate. In South America, L. hexapetala withstands highly fluctuating environmental conditions of a flood-pulse river system. As an exotic weed, L. hexapetala thrives in a broader range of climatic conditions than those experienced in its native range. Management of L. hexapetala requires knowledge of its tolerance to a range of conditions beyond those locally observed. We experimentally evaluated the growth, nutrient allocation and cycling dynamics of L. hexapetala in the Laguna and Russian River. While these factors varied across observed gradients,

this weed is well adapted to both high and low resource environments and to variable hydrologic conditions. Our evaluation of integrated methods for control of L. hexapetala in canals and wetlands show promise, yet research suggests that as atmospheric CO2 levels rise, weeds will be harder to control and efficacy of herbicides will be reduced. Seed banks contribute to wetland community maintenance and to succession following disturbances imposed by weed control actions. Knowledge of how recruitment mechanisms change with environment is essential for weed management. We compared differences in standing vegetation and seed banks among invaded and non-invaded sites within the Laguna, using a seedling emergence assay to determine the reinvasion potential of ***L. hexapetala***, to reveal cryptic taxa, and to test emergence response to inundation regime and sedimentation. Over 12 months, 69 taxa germinated from seed banks including L. hexapetala and several other undesirable weeds. Results signal the need for persistent management to deplete weed seed banks, and for the implementation of comprehensive weed management strategies to meet restoration goals.

High Resolution Modeling of Plant and Insect Response to Climate Dynamics

Kramer, Mark, Ph. D., Carruthers, R.. University of California Santa Cruz

Species /community response and adaptation to localized climate dynamics is a critical area for research, especially when linked with the added threat of exotic species invasion that may be heightened by these changing conditions. By definition, climate change is expected to alter meteorological regimes and thus biological responses of many species. Consequently such change is anticipated to permeate through species changes to significantly impact entire biomes, in ways not yet understood. In particular, impacts in areas with complex terrain, strong climate and edaphic gradients will persist in forms that will exert strong influences on the structure and function of the impacted flora, fauna and entire ecosystems. Currently, few methods exist to explicitly develop continuous high-resolution spatio-temporal data sets that adequately capture the affects of climate and its biological consequence across the landscape. Improved computational approaches, datasets and more importantly, new methods of handling and summarizing large amount of quantitative information, including state-of-the-art numerical weather prediction models, are providing better tools that scientists and managers can apply to the area of invasive species control. Joint efforts between the US Department of Agriculture Agricultural Research Service (USDA-ARS), the National Aeronautics and Space Administration (NASA), the Department of Defense (DOD) and the University of California (UC) are attempting to develop and merge biological assessment needs, with new information collection and processing technologies. Collectively, the integration and coupling of these tools has been developed into a combined environmental modeling system MERCURY. Combined, these systems allow an appropriate level of biological detail and reality to allow resolution of many critical biological problems important for invasive species assessment and control. In this example case, application of the environmental modeling system MERCURY is being pilot tested in Northern California using a well known invasive weed, yellow starthistle (***Centaurea solstitialis***) and an example insect herbivore, *Chaetorellia succinea*.

The Reclamation and Environmental Restoration of Laguna de Santa Rosa

James McElvaney, BioConverter International

A working hypothesis offers a plan to reduce and reverse the effects of Over-Nutrification, Chemical Contamination, and the Overgrowth of Ludwigia in the Laguna, and provides for its sustainable Reconstruction by "terra-forming" portions of the Laguna into deep cold water ponds as the sanctuary it once was, for fish, waterfowl and wildlife, alike, surrounded by easily maintained raised dry flats, achieving tangible results at a cost-savings for Laguna stakeholders.
A unique proven and patented plant harvesting system, the "HMO" Hydro-Mechanical Obliterator uses a small amount of water to cut, macerate and harvest any type of biomass including Ludwigia into a fine particulate slurry. In practice this slurry is then pumped to a tanker truck for delivery and use as feedstock to a high-rate high-solids BioConverter Facility for conversion to biomethane and biohydrogen.
The BioConverter is a proven and patented Anaerobic Digester System and Method that uses a vertically-oriented bioreactor containing a spindle of biofilm panels of a consortia of microbes acclimated to rapidly convert biomass into biogas used to produce a sustainable baseload supply of green electricity and steam on site for its operations while producing a uninterruptible supply of refined 99% pure "green" compressed natural gas a "very low carbon fuel" for use in city and county fleets reducing GHG emissions by more than 97% compared to gasoline and gasoline/ethanol blends.
The biofilm microbial consortia are robust and capable of converting all pathogens, hydrocarbons, herbicides, pesticides and fungicides that may be present in the Laguna biomass, due to over-application and runoff, into benign residues. The system produces refined concentrated extracts of bio-based nutrients including nitrogen, phosphorus, and potassium, calcium, magnesium, sulfur and iron chelated to vitamins, amino acids, long chain fatty acids, chlorophylls, enzymes and polysaccharides. When applied as biostimulants at a 10 to 20 times dilution rate to soils, roots, and plants, these extracts increase agricultural yields, soil fertility, root mass and drought resistance, while permanently sequestering all residual carbon.

The Aquatic Animals of the Laguna de Santa Rosa: Then and Now

O'Rear, TeeJay[1]; Sloop, C.[2]; Karres, N.[3], 1. UC Davis; 2. Laguna de Santa Rosa Foundation; 3. Sonoma State University

The Laguna de Santa Rosa is the focus of many management activities that seek to improve its flood-control and ecological functions. In order for management activities to succeed, their effects on the aquatic community must be both known and measurable. However, with the exception of a study performed in 1988, there is little information on the composition of the Laguna de Santa Rosa's fish and aquatic-invertebrate communities. As a result, we surveyed a number of parameters (water quality, aquatic invertebrates, and fishes) and analyzed the gut contents of fishes in August 2008 to provide baseline data for management activities, to see if the composition of the biotic communities had changed relative to the 1988 study, and to explore the trophic relationships among fishes, invertebrates, and primary producers. Water-

quality measurements revealed that the Laguna de Santa Rosa is a very eutrophic waterway, although orthophosphate levels were lower in 2008 than in 1988. Invertebrate and fish communities were similar to those found in 1988. The invertebrate community was dominated by families (e.g., the Chironomidae) that are both resistant to pollution and common in still-water habitats. Similarly, the fish species caught in 2008 can withstand low dissolved oxygen concentrations and spawn on or in aquatic vegetation, suggesting that water quality and lack of riffle habitat are the major abiotic factors structuring the fish community. Gut-content analyses showed that small and juvenile fishes (e.g., western mosquitofish ***Gambusia affinis***, fathead minnows ***Pimephales promelas***) fed most heavily on zooplankton, while the majority of larger fishes (e.g., bluegill ***Lepomis macrochirus***, common carp ***Cyprinus carpio***) depended more on aquatic insect larvae. As a result, smaller fishes rely on a food source based on phytoplankton, whereas larger fishes are more dependent on food derived from aquatic plants and detritus.

Predicting Past and Future Water Discharge Rates on the Russian River

Potter, Christopher, **Ph. D.,** NASA-Ames Research Center

We have developed modeling applications of the Carnegie-Ames-Stanford Approach (CASA) ecosystem model coupled with a surface hydrologic routing scheme previously called the Hydrological Routing Algorithm (HYDRA) to model river discharge rates across Russian River drainage area. To assess the CASA-HYDRA model's capability to estimate actual water flows in both extreme and non-extreme precipitation years, we have organized all the long-term river gauge records throughout the Russian River drainage for comparisons to monthly model predictions. Preliminary results demonstrate that the model can accurately predict historical discharge rates at the monthly time step at gauging station locations on Santa Rosa Creek, as well at gauging stations on the Russia River near Guerneville, Healdsburg, Cloverdale, Hopland, and Ukiah. Future simulations of river flows under climate change scenarios will be presented, with special attention to alterations of annual and seasonal hydrology on the Santa Rosa Creek drainage.

Laguna de Santa Rosa Total Maximum Daily Load Update

Butkus, Steve; St. John, M., North Coast Regional Water Quality Control Board

The Laguna de Santa Rosa (Laguna) watershed is listed on the current California Section 303(d) list of impaired waterbodies for excessive nutrients (nitrogen and phosphorus) and sedimentation, low dissolved oxygen (DO), high temperature, and mercury contamination. Placement of a waterbody on the Section 303(d) list triggers the development of a Total Maximum Daily Load (TMDL). A TMDL is a framework for assessing the factors and quantifying the sources contributing to the water quality impairment and for developing a strategy for attaining and maintaining

water quality standards. Staff of the North Coast Regional Water Quality Control Board's (Regional Water Board) Total Maximum Daily Load (TMDL) Development Unit are scheduled to complete the technical analyses for the Laguna TMDLs for each of the listed impairment except mercury by 2011. The Laguna is currently being studied to develop the TMDL staff report. California TMDL guidance identifies specific elements that must be included in the TMDL staff report. Many of these TMDL elements require the compilation of existing water quality data, as well as the collection of additional monitoring data. The presentation reviews the new monitoring completed by the Regional Water Board in 2008 and presents the monitoring currently underway in 2009.

Heritable Genetic Diversity and Gene Glow – Main Ingredients in the Recipe for Managing Micro-evolution to Foster Climate Change Adaptation

Sloop, Christina, **Ph. D.,** Laguna de Santa Rosa Foundation

In the face of global climate change, ecologists forecast unprecedented species range shifts and disassociations of ecological communities. While climate change prediction modeling is applied to tackle uncertainty as to species' and ecosystem response within various climate change scenarios, we also need to incorporate the evolutionary potential for rapid species adaptation to avoid local extinction and resist range shifts.

Contrary to popular belief, evolutionary change arises not only over millennia, but can occur rapidly, in decades, within ecological time scales. This micro-evolutionary potential of species has been demonstrated by investigations into species adaptations to new environments and to rapid human-induced change.

Changing climatic conditions such as drought, timing shifts, and increased moisture will select for appropriate adaptations within species, and are applied e.g. in studies to breed more drought tolerant crops. Such genomic approaches and species translocation studies are essential in showing us the possibilities, limits for, and rates of species adaptations, and will allow us to model these within climate change scenarios.

The raw materials for adaptation at the population level are: heritable genetic variation, trait correlations, gene flow, plasticity, and demography. Considering these factors and the relevant evolutionary processes, restoration biologists will be able to manipulate the genetic structure of source populations to maximize the adaptive potential of restored populations.

To increase the short- and long-term success of conservation and restoration efforts in the face of global climate change an understanding of the micro-evolutionary processes affecting species are crucial. Therefore, micro-evolutionary thinking needs to be incorporated into management decisions in conservation and restoration ecology.

Predicting Effects of Climate Change on Bird Distributions Across Scales and Ecosystems: How Species-based Modeling can Inform Management and Decision Making

Stralberg, Diana; Jongsomjit, D.; Howell, C.; Wiens, J., PRBO Conservation Science

Species distribution modeling (SDM) has become an important tool for projecting climate-related shifts in species' geographic distributions and community composition. Most of these efforts have focused on broad continental scales that are not necessarily relevant for land managers, however. This presentation will provide examples of SDMs at statewide (California) and local (San Francisco Bay) scales, and discuss appropriate uses for managers, given various types of uncertainty.

Sea to Sky: Marine Climate Impacts and the Laguna

Sydeman, William, Ph. D. Farallon Institute

Despite the fact that 71% of the earth is covered in salt water, and >90% of all habitats on the planet are marine, we know despairingly little about marine ecosystems and climate change impacts. The warmest global ocean temperatures on record were observed in summer 2009. In our region, upwelling, sea level, currents, temperature, salinity, to name a few, have changed, often unexpectedly, precipitating dramatic ecological and socioeconomic damage; for example, as of 2009 costs to the state of California for the "salmon crisis" alone have exceeded $1B. Is a "no-analog" environment resulting in "no-analog" biological communities? Do normal variations in the environment now result in abnormal biological responses? These and other perspectives from the coastal ecosystems of Northern California will be discussed relative to linked watersheds and watershed science and management in the region., William

Update on the U.S. Geological Survey Santa Rosa Plain Cooperative Groundwater Study

Trotta, Marcus, Sonoma County Water Agency

The Santa Rosa Plain groundwater basin covers an area of approximately 80,000 acres and is home to approximately half of the population of Sonoma County. The groundwater system beneath the Santa Rosa Plain provides numerous benefits to the region, including rural residential and municipal water supplies, irrigation water for agriculture, and baseflow to streams and surface water bodies. As part of a technical study program intended to enhance the current knowledge regarding groundwater resources within Sonoma County, the United States Geological Survey (USGS) initiated a five-year cooperative study of groundwater resources within the Santa Rosa Plain Groundwater Basin in 2005. The cooperative study is being conducted by the USGS in partnership with the Sonoma County Water Agency, County of Sonoma, City of Santa Rosa, City of Rohnert Park, City of

Sebastopol, City of Cotati, Town of Windsor, and Cal-American Water Company. The study has four principal elements: (1) a comprehensive geographic information system (GIS) to compile, analyze and visualize hydrologic and related data; (2) collection of new data, with a focus of water-quality sampling; (3) data interpretation and hydrogeologic characterization – including refining hydrologic budgets, and updating conceptual models of the groundwater flow system based on the new data and the results of ongoing USGS geologic and geophysical studies in the basin; and (4) the development of a fully-coupled numerical surface water/groundwater flow model for Santa Rosa Plain.
Results from the study will provide stakeholders with tools to assist in evaluating the hydrologic impacts of future climate-change scenarios and alternative groundwater management strategies for the basin. Additionally, the study could potentially form the technical foundation for a local non-regulatory groundwater management planning process.

Climate Change, Uncertainty, and Advocacy

Wiens, John, **Ph. D.,** PRBO Conservation Science
Environments throughout the world are changing rapidly, driven by the factors underlying climate change and land-use change. To be successful, conservation and environmental management must look toward the future. Models are an effective way to do this, but they are plagued by uncertainties. Despite these uncertainties, the rate of environmental change and the magnitude of the potential impacts require that actions be taken now. Doing this calls for implementing adaptive management, but in an anticipatory rather than a reactive mode. The combination of uncertainty and urgency also threaten to blur the distinction between science and advocacy at a time when clear, objective, and relevant science is desperately needed.

Day 2 - Presentation Abstracts

Wine Industry Approaches to Climate Change Adaptation

Dolan, Paul, Mendocino Wine Co.

Doing Restoration in a Climate Change Context: Examples for Riparian Systems

Gardali, Thomas and Seavy, N. E. , PRBO Conservation Science

The threats of climate change have put a spotlight on the goals and strategies of ecological restoration. Theory and practice must consider alternative restoration goals in light of high levels of uncertainty associated with rapidly changing environmental conditions and the likelihood of emerging novel ecosystems. As a basic starting point, we recommend that restoration ecologists consider both historical conditions and projected changes when developing goals and measurable objectives. Restoring historic conditions is frequently not possible or even desirable. Given the likelihood for novel ecosystems, restorationists should consider ecosystem function, structure, and services as targets. Riparian systems possess great opportunity and many challenges with respect to restoration in a changing climate. Historically, riparian ecosystems covered vast areas of California, but have suffered severe degradation over the last

century. In the future, climate models project increases in air and water temperatures and changes in the magnitude and temporal patterns of run-off events. Given these projections, what will riparian restoration provide? Riparian ecosystems are naturally resilient, provide linear habitat connectivity, link aquatic and terrestrial ecosystems, and create thermal refugia for wildlife: all characteristics that can contribute to ecological adaptation to climate change. On-the-ground examples of how to do riparian restoration in a climate change context include planning for more extreme environmental variability, increasing genetic diversity in horticultural restoration decisions, expanding connectivity, and emphasizing the restoration of private lands.

Modernizing Natural Areas Management: Outlines of the Efficacy Revolution

Gluesenkamp, Daniel, **Ph. D.,** Audubon Canyon Ranch

Californians have managed natural systems for ten millennia, employing a relatively simple set of tools to favor desirable species and select against unwanted taxa. Contemporary natural resource management is significantly more complicated, as we manage an expanding list of desirable species and a growing diversity of unwanted taxa in a changing environment. Fortunately, conservation has undergone a burst of innovation in recent decades, and we are developing an array of tools which can be applied to protect important biodiversity.

However, in many ways conservation practice has remained stagnant. It is not always clear what we are trying to achieve with our actions, and it is often difficult to know whether we have succeeded or failed. This situation is comparable to that seen in human obstetrics; until recently, and in spite of an array of advanced tools available in hospitals, mortality of mothers and babies was often lower when birth occurred at home. Obstetrics was improved by an efficacy revolution in which practitioners began measuring outcome, adopting best practices, and improving training. Now, natural areas managers are talking about the need for ambitious new tools to counter effects of climate change: assisted migration, breeding neo-natives or selecting for change-tolerant traits. Before adding these "power tools" to our toolbox, it is imperative that we improve our practice, become clear about our objectives, and undergo our own efficacy revolution.

The Bay Area Early Detection Network (BAEDN) is an initiative which coordinates and organizes Early Detection and Rapid Response to plant invasions across the nine counties which contact the San Francisco Bay. We predict which species will be most harmful, coordinate detection of infestations, and prioritize the most harmful outbreaks for eradication. BAEDN then works with agencies and citizens to proactively deal with the highest priority outbreaks before they grow into large and costly threats. This "stitch-in-time"approach minimizes the environmental and economic damage caused by these invaders; educates citizens; and dramatically reduces the need for planning and resources required to control large,

established invasive plant populations. With strategic goals, clear numeric objectives, and evaluation of outcome, we hope the BAEDN will serve as an example of the change we need if we are to succeed in our conservation commitment.

Management Strategies for Climate Change Adaptation

Heller, Nicole, Ph. D., Climate Central

Climate change creates new challenges for biodiversity management. Species ranges and ecological dynamics are already responding to recent climate changes, as well as other global changes. Current management strategies may not maintain the species they were designed to protect. Scholarly articles recommending measures to adapt conservation to climate change have proliferated over the last 23 years. This literature was systematically reviewed to explore what potential solutions have been identified and what consensus and direction is offered to cope with climate change. In this talk, I will discuss the options that emerge the most often, and their applicability to the management community. I will show that the application of the recommendations is limited by a number of gaps, including (1) a lack of specific, operational examples of adaptation principles that are consistent with unavoidable uncertainty about the future; (2) the absence of a practical adaptation planning process to guide selection and integration of recommendations into existing policies and programs; and (3) a lack of effort at integrating social science into an endeavor that, although dominated by ecology, necessitates extension beyond reserves and into human-occupied landscapes. These gaps can begin to be addressed through collaborative action by scientists, practitioners, and decision-makers. Together, these actors can translate gross adaptation themes into specific tactics in ways that incorporate an experimental approach, monitoring, and reflect the limits of funds, staffing, and management and community traditions. Progress in developing robust adaptation programs will emerge most rapidly if groups broadcast widely their efforts at developing and implementing these tactics.

Habitat Connectivity: Mayacmas Mountains and Surrounds

Merenlender, Adina, Ph. D. [1]; Reed S.[1]; Robinson, T.[2]; Reynolds, M.[3]
1. University of California Berkeley, 2. Sonoma Co. Ag Preservation and Open Space, 3. The Nature Conservancy

In recent years, land use planners and conservation scientists have become interested in how to measure, model and map landscape connectivity for plant and wildlife species. Broadly defined, connectivity is a measure of the ability of organisms to move among patches of suitable habitat in the landscape. Conserving connectivity is increasingly important due to rapid land use change, which has led to habitat loss and fragmentation and threatens the persistence of many species. The guiding objectives of our current research on habitat connectivity are to determine how landscape metrics can be used to derive a continuous measure of connectivity across the landscape for large scale habitat connectivity. Work using this approach in the Mayacmas Mountains ecosystem of California will be presented. We plan to combine our landscape connectivity model with existing land use change, economic, species habitat suitability models, and examine how resilient various reserve network scenarios will be to climate change.

From Changing Atmospheric Circulation to Berry Temperature: Macro-, Meso-, Topo-, and Microclimate in Vineyards

Weiss, Stuart, Ph. D., Creekside Center for Earth Observation and Precision Viticulture International

Climate change will challenge continued production of quality wine grapes in Sonoma County. In order to effectively consider climate change in vineyard design and management, a multi-scale approach to climate is required. Macroclimate refers to broad-scale atmospheric circulation over scales of 100+ kilometers, such as the rainfall – temperature gradient along the entire Pacific Coast. Mesoclimate operates over scales of 1-100 km, such as the coastal-inland gradient in temperature and rainshadows across mountain ranges. Topoclimate refers to phenomena across local topography, down to scales of 10 meters, where solar exposure (i.e. N- versus S-facing slopes), wind exposure, and cold-air drainage operate. At the finest scale, microclimate encompasses the effects of vegetation canopies on solar radiation, humidity, and temperature, such as the effects of trellis design on berry temperature on either side of the trellis.

In this presentation, I describe the various tools available for understanding climate and climate change at these multiple scales. Climate stations, and interpolated surfaces such as PRISM (www.prism.oregonstate.edu/), account for macroclimatic and mesoclimatic gradients down to a scale of 800 m. Historical interpolations from WESTMAP (www.cefa.dri.edu/Westmap/) at 4 km provide monthly mean, maximum, and minimum temperatures and precipitation from 1895 to the present and form a basis for examining climate changes to date. Topoclimatic gradients are derived from digital elevation models (DEMs) using solar radiation models (Solar Tools in ArcGIS), and topographic position and slope. At the finest microclimatic scales, hemispherical photography quantifies trellises from a "grapes' eye view," allowing estimation of solar radiation on grape clusters at half hourly intervals for each month of the growing season. By combining all of these methods, the temperatures of grape clusters can be tracked through growing seasons using local weather station data, with numerous key insights into vineyard design and management in a variable and changing climate.

Day 3 - Presentation Abstracts

Regional Conservation Plan for Biodiversity in the San Francisco Bay Area – Upland Habitat Goals

Branciforte, Ryan[1], Weiss, S.[2]
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The San Francisco Bay Area Upland Habitat Goals Project is determining how many acres of what types of terrestrial habitats and in what configuration are necessary to preserve biodiversity in the nine-county Bay

Area. Initiated by the Bay Area Open Space Council to address the lack of a scientific vision for biodiversity preservation, the Upland Goals Project will recommend several options for a network of conservation lands identifying core areas, linkages and compatible use lands. The project applies the coarse filter/fine filter approach to conservation planning. The coarse filter analysis sets protection goals for all vegetation types while the fine filter analysis selects specific conservation targets to refine the coarse filter recommendations. The project is using a Marxan modeling base supplemented with expert opinion to arrive at conservation land network options. The final report will not only make recommendations for habitat protection goals, but will also address stewardship, implementation and evaluation criteria. The planning process will create a framework to allow for the goals to be updated as new data becomes available, progress is made in accomplishing the goals or finer-scale planning is desired. The GIS database compiled for the Upland Goals Project is available via the internet.

Putting Our Information To Work: A Regional Conservation Commons

DiPietro, Deanne, Sonoma Ecology Center

Research and monitoring provide lenses into the health of our watersheds and guide our work to conserve, restore, and educate. Often data and materials are difficult to find and use beyond the original project that produced it, and it can be a time-consuming endeavor to assemble data for a larger view.

There are many efforts in our region to standardize and coordinate data collection, improve data quality and access, and aggregate datasets for analysis, but there is a pressing need for a more coordinated, community approach to information management. The San Francisco Bay Area Conservation Commons (SF Commons) is an initiative dedicated to making our collective environmental information accessible and more useful for purposes of climate change research, regional conservation planning, and local stewardship. By supporting an actively involved community and bringing the information together in a relevant user environment, the SF Commons will allow us to leverage our collective knowledge toward collaborative solutions and respond effectively to environmental challenges of the present and future. I will describe the vision of the SF Commons, plans for addressing data management challenges we face in our organizations and as a community, the status of the effort, and how you can be involved in building the Commons.

Sonoma County Agricultural Preservation and Open Space District Strategic Plan and Climate Change Initiatives

Gaffney, Karen, Sonoma County Agricultural Preservation and Open Space District

The Sonoma County Agricultural Preservation and Open Space District (District) is implementing its strategic plan - a suite of integrated initiatives that includes climate change mitigation and adaptation. In addition to the climate initiative, the strategic plan focuses on the protection of natural infrastructure, community health, connecting communities with the land, and the preservation of agriculture. In the interest of gaining economies

of scope and scale, and achieving a more substantial impact in each initiative area, the District is integrating all of these initiatives into a multi-objective implementation framework. Projects that will be implemented under this framework will address several or all of the strategic plan initiatives. One example project might include watershed and riparian corridor enhancement that sequesters carbon, increases climate adaptation and resiliency, attenuates flood flows, provides natural filtering of drinking water supplies, and engages the community in a collaborative stewardship project. Another example might include working with private landowners, NGO and RCD partners to enhance sequestration on agricultural lands in the context of native habitat restoration/afforestation. A final example might include acquiring lands for parks and greenways that provide access to economically disadvantaged communities while encouraging alternative transportation routes.

What Foundations Are Doing About Climate Change

Knoblock, Gary, Gordon and Betty Moore Foundation

In this interactive session we will discuss how funders are currently wrestling with the question of funding climate change adaptation and guiding principles for developing strategies to secure funding for watershed level or county level projects. Bring your best thinking about strategies you have under way or elements you have been considering and collectively we will see if we can move some ideas forward. We will try to consider foundations, public sources and others.

Climate Change Monitoring in Sonoma County: What To Do?

Luke, Claudia, Ph. D., and Halle, C., Sonoma State University Field Stations & Nature Preserves

One of the largest environmental issues of our time is upon us and we are bewildered by what we should be monitoring and studying to inform land use decisions. As we move forward in developing a coordinated effort in climate change monitoring and its related effects, we recommend focusing on three areas: (1) geographic identity, (2) multidisciplinary collaborations, and (3) existing and new resources. Firstly, we need to begin with a thorough understanding not only of our local climate, but also how we compare to other areas on earth. Unique climatic features of Sonoma County include adjacency to one of the earth's four most consistent upwelling sites, the narrowest coastal atmospheric boundary layer measured in the world, dramatic spatial variability in microclimate, flooding events driven by tropical atmospheric "rivers", and a dry regional climate compared to other areas of California's north coast range. Secondly, the study of climate change is inherently a multi-disciplinary process. We need to transcend historical constructs such as marine vs terrestrial, agricultural vs ecological, and especially physical vs biological. Thirdly, some notable technological areas to start focusing on are the establishment of long-term research sites, data quality

and archival systems, new developments in citizen science programs, and emerging environmental technologies.

Towards a Watershed-Based Sonoma County Climate Adaptation Strategy

Micheli, Lisa, Ph. D., Pepperwood Foundation

Preparing our watersheds for climate change (in terms of water supply, water quality, flooding, and habitat) requires estimating potential changes to climate, hydrology, and ecosystems based on the best science available at the watershed scale. This information is a critical starting point for understanding potential impacts to many sectors, including biodiversity, agriculture and transportation infrastructure. While Sonoma County leads the nation's local governments in the development of a coordinated greenhouse gas mitigation strategy (reducing greenhouse gases known to cause climate change), we need a parallel County coordination effort focused on climate adaptation (preventative measures aimed at reducing the eventual cumulative impact of climate change on resources of concern). This presentation will review new initiatives by the North Bay Watershed Association and The Sonoma County Water Agency to generate future climate scenarios by partnering with scientists working on cutting-edge climate change assessments. With these results, Sonoma County's community of resource managers can begin to collaborate on climate adaptation strategies tailored to protect the hydrology, habitats, and local communities of Sonoma County watersheds.

Assessing and Forecasting Watershed Ecosystem Status within a Consistent Bay Area Wide Framework

Sloop, Christina, **Ph. D.,** Laguna Foundation

A changing climate will alter watershed ecosystems by affecting species distributions, community composition, habitat connectivity, water quality & quantity, and ecosystem services. Assessing and forecasting ecosystem status will become an important and necessary tool within and across watersheds as climate change unfolds. Coordination of a standardized framework for implementation of regular on-going watershed assessments and the development of annual or biennial health score cards and reports will not only allow scientific evaluation over time, but will also serve to inform the public and watershed stakeholders on the status and progress toward watershed goals. I will share models of ecosystem assessments implemented elsewhere and discuss an initial vision of a Bay Area wide framework for standardized, watershed-focused evaluations. Such a framework will have to be supported by consistent data collection networks, including appropriate indicator thresholds, data gathering protocols, and data sharing.

Section 4 – Acknowledgements

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Section 5 – Appendices

Appendix A. Conference Participants

This contact list was compiled as a tool for conference and working group participants to continue the momentum generated at the conference. It's intended use is to further the goals of the conference to facilitate partnerships, find funding support, and build a community resolved to prepare watersheds for climate change.

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Appendix B. Vocabulary

Vocabulary and abbreviations for words and phrases used throughout the conference and defined in a climate change context.

Adaptation

The initiatives and measures to reduce the vulnerability and increase the resilience of natural and human systems against actual or expected climate change effects.

Adaptive capacity

The ability of a system to change if the environment where the system exists is changing. As applied to ecological systems, the adaptive capacity is determined by:

genetic diversity of species;
biodiversity of ecosystems; and
heterogeneous ecosystem mosaics as applied to specific landscapes or biome regions.

Adaptive management

The structured, iterative process of decision making in the face of uncertainty.

Biodiversity

The diversity of life on earth, consisting of genetic diversity, species diversity and ecosystem diversity.

Ecosystem

A community of plants, animals and microorganisms, along with their environment, that function together as a unit. An ecosystem can be as large as a rain forest or as small as a rotting log.

Ecosystem services

Functions provided by ecosystems that benefit humans and are necessary for a healthy planet like oxygen production, water purification, pollination, soil formation and nutrient recycling.

Impact

How climate change will affect (have an effect upon) natural and agricultural systems.

Implementation

The process of moving an idea from concept to reality.

Mitigation

Taking actions to reduce greenhouse gas emissions and to enhance carbon sinks aimed at reducing the extent of climate change.

Resilience
The capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary.

Strategy
A plan of action designed to achieve a particular goal.

CNDDB
California Natural Diversity Database

SCRCPA
Sonoma County Regional Climate Protection Authority

SMART
Specfic. Measureable. Attainable. Relevant. Time-bounded.

NBCAI
North Bay Climate Adaptation Initiative

NCRWQCB
North Coast Regional Water Quality Control Board (NCRWQCB)

PET
Potential Evapo-transpiration

CIMIC
Center for Information Management, Integration and Connectivity

TDR
Transferrable Development Rights

NRCS/EQIP
Natural Resources Conservation Service's Environmental Quality Incentives Program

CSPP
Cost Sharing Plus Program

Appendix C. Links

2009 State of the Laguna Conference and Science Symposium
http://www.pyxisweb.net/conference/

North Bay Watershed Climate Change Adaptation Initiative
http://www.nbcai.com

Laguna Watershed Knowledgebase
http://www.lagunafoundation.org/knowledgebase/

San Francisco Bay Area Conservation Commons
http://sfcommons.org/

Central Califorina Integrated Regional Water Management Plan (IRWMP)
www.irwmp.org

Conference Partners and Sponsors

Audubon Canyon Ranch
http://www.egret.org/

California Invasive Plant Council (Cal-IPC)
http://www.cal-ipc.org/

Climate Protection Campaign
http://www.climateprotectioncampaign.org/

Curry Landscaping
http://www.currylandscaping.com/

Global Genesis
http://www.ggenesis.com/

Goldridge Resource Conservation District
http://www.goldridgercd.org/

Laguna de Santa Rosa Foundation
http://www.lagunafoundation.org/

Point Reyes Bird Observatory (PRBO) Conservation Science
http://www.prbo.org/

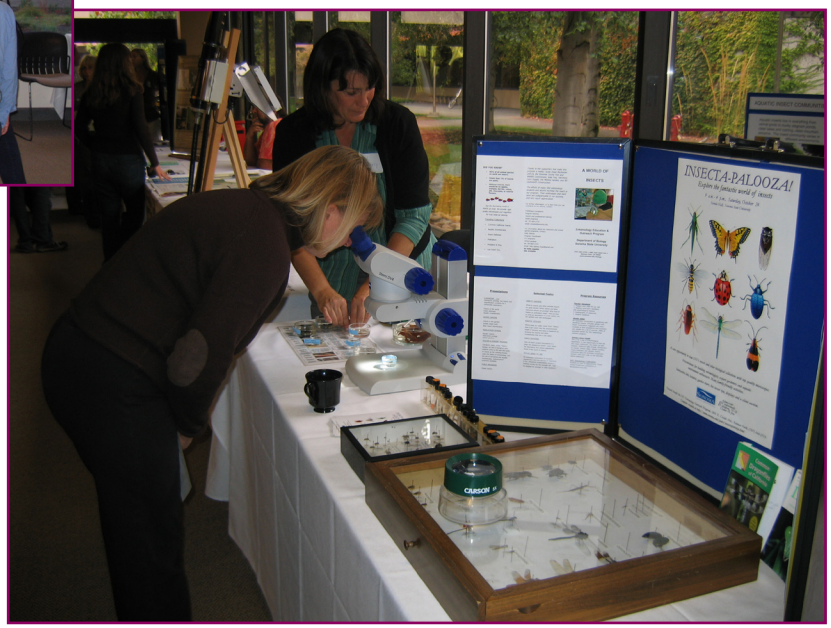
Pyxis Technologies
http://www.pyxisweb.net/

Sonoma County Water Agency
http://www.scwa.ca.gov/

Sonoma Ecology Center
http://www.sonomaecologycenter.org/

Sonoma State University Field Stations and Nature Preserves
http://www.sonoma.edu/scitech/preserves.shtml

West Coast Watershed
http://www.westcoastwatershed.com/



Appendix D. Action Planning Notes

The following are notes generated by each working group; these 90 minute conversations formed the foundation of action for the conference participants and launched the NBCAI (see page 38).

Group 1: Stream & Riparian Stewardship

- Water system not just streams
- Land owners
- Actionable

Vision – 5 years out

1. Case statement
   Economic analysis with definitions and targets
2. Regional county adaptation plan
3. Secured funding
4. Network of land owners demonstrating BMP's
5. Diverse conditions
6. Firm commitment and % completion by landowners for example SCWA
7. Ag stakeholders, dairy partners

Evidence of implementation

- Sustainable… restoration defined
- Maximized corridor function
- Respect and restore

Purpose of this group

- Advocacy
- Education (setbacks)
- Community engagement
- Technical guidance
- Protection/enhancement
- Restoration
- Compliance and buy in from private landowners
- Values
- Benefits of taking care of stream system
- High leverage/comprehensive catalyst… most benefits… biggest bang for buck

What will we do?

- Work with generation that 'gets it'
- Finding key people/spokespeople
- Case studies, success stories
- Before and after examples
- Capture examples of downstream owners
- Involve dairy
- Work with other values

Action plan

What	Resources	When	Who	Notes
Practitioners field tour and training	Julie Jehly, Julian Meisler, Kim Batchelder, Chris Engle		Wade Belew	
Case statement	Julie Jehly, Julian Meisler	Before January	Caitlyn Cornwall	Economic analysis definitions and targets
Landowner liaison. Start dialogue, convey case statement	Julie Jehly, Chris Engle		Guy Smith	Crafting message and talking points
Economic anal. And funding	Ken Churchill, Julian Meisler, Karen Gaffney (funding)		Ken Churchill	

Group 2: Policy and Funding

What's Needed? What does Success Look Like?

- Sonoma County Regional Climate Protection Authority (SCRCPA)
- Transportation authority
- 20 year history
- Citizen's advisory
- Annual climate protection conference
- Climate protection congress
  1. Bring in the tribes, see how we've done
  2. Suggest Direction for forward progress
- Laguna tribe
- Citizen's advisory committee?
- Ad-hoc adaptation group
- How to get a county coordinated plan to reflect adaptation?
- Funders look at biological significant landscape
- SCRCPA attracts funding dollars
- We tell them what is done regionally
- Proposals to them – what would a county wide adaptation plan look like?
- Nexus/conservation sic/restoration/community/highly bureaucratic authority
- Open space district could play conduit role

Why do this?

- Influence SCRCPA
- Serve as conduit for funds and information, concepts, partnership
- Influence policy
- Including outside the transportation authority
- Help chart territory
- Where are opportunities to leverage
- Tools to develop their strategic planning framework

- Create design to give to transportation authority/white paper with problem statement and guidelines

Who should be involved?

- Not hardcore advocacy
- Major NGO's
- Transp. land use coalition

Action Plan

What	Resources	When	Who	Notes
Name for group/ draft purpose statement/convene and add members	Contact list, Caitlyn Cornwall, Karen Gaffney	Nov. 4 Wednesday lunch at Open Space District Office in Santa Rosa	Richard Dale, David Bannister, Lisa Micheli, Carolyn Johnson, Tom Robinson (pending approval)	
Ratify purpose	Draft climate plan		Same as above plus Grant Davis	
Discuss possible product White paper strategy outline by Jan. 1	Sit with Suzanne and Dave Bannister before Jan. 1			
Funding for NGO support				
Invite Grant Davis and Bill Keene			Richard Dale	
Compile email list		October 21, 2009	David Bannister, Hattie Brown	

Group 3: Science, Technology & Management Nexus

What does success look like?

- Understand what is available and developing a conceptual model so we know what is missing
- Have the tools (e.g. climate model downscaling)
- Have a working framework in which we can work collaboratively
- Know what we have, use it well, and develop a way to present it so others can use it
- Using conceptual model is to represent different scales and a good representation of what we have done
- Mapping special target occurrences so that: 1. scientists can come to county and know what is available to use and know what is already being done 2. recruit research into changing areas with data gaps 3. Generating sufficient information regarding policy and adaptation for practitioners to check against scorecards
- Have monitoring working well enough
- Including series of maps and study areas for example GIS data layers
- Monitoring targets and conservation
- Look at outliers (in the context of adaptation)
- Others come to county to learn how to run an integrated program
- How climate is changing and how it effects the environment and we can generate useful recommendations because we have tools in place and we have a way to recognize the rate of climate change impact on species

What do we need to do?

- develop a network of reference sites
- assess our resources (i.e. data inventory, models, etc.)
- leverage current funding
- assess stakeholder needs with regard to land and water convenience
- formulate research questions or issues to be solved
- need to analyze climate at ecological scale
- establish network of permanent plots

Resource needs

- money
- careful planning to address issue
- time
- data and data framework
- well organized GIS with constant features
- good systems administrator
- core tech support person

Who should be involved?

- people with data
- builders of the system
- folks that need help to contribute their data
- NEON (national ecological observatory network)
- Invite to county, leverage what they have
- Climate science team
- Check in with National phenology network

Action Plan:

- develop climate surface layers and analyze (Stu Weiss, Lorrie Flint, Alan Flint) (in process r. river basin)
- leverage conservation commons with a forum for this group (Deanne Dipietro, Christina Sloop to facilitate dialogue)
- Inventory data (start)
- Workshop gathering to discuss quarterly to discuss what has been done (quarterly) (Christina Sloop to develop agenda and invite landowners)

Next steps

- start building GIS data online through the commons (Deanne Dipietro)
- need the funding to do
- need organization meeting to determine what we are going after and how
- determine where sensors should be place and the types of sensors needed (Claudia Luke)
- need a meaningful veg. map, field data based, sub of GIS
- consolidate/collect list of projects underway and help with prioritization (Christina Sloop)

Participants: Deanne Dipietro, Christina Sloop, Lorrie Flint, Alan Flint, Ayzik Solomesch, Juncko Hoshi, Laura Saunders, Claudia Luke
Resource: Richard Dale, Alan Flint, Claudia Luke

Audience Discussion: Final Conclusions and Learnings

- Can climate authority take in the kind of info discussed here?
- Need to have a place for large sums of Money to be fiscal sponsor
- Pressure elected officials to deal not only with mitigation but adaptation, biodiversity.
- Groups like this need to be led.
- Leverage existing process shown to be successful to prioritize projects.
- Key is the partnership with agreed to criteria and prioritization.
- Is it working at a scale that is credible/ecosystem level?
- Leverage every dollar and aggregate climate change "savings" → take more broadly
- Should we expand our scale to include north and south regions (prioritization is time consuming)
- Work at county level before going on to regional level (suggestion)
- Message to funders is: we have some prior experience!
- Rather than prioritizing, we may need to follow-up on decision-making process to be more in depth
- We should look at integrating more
- Need to have a diversity of items and include gradients of mountainous topography
- Much of this needs to be integrated and opportunity driven to get connectivity, etc.
- Connect with the Regional climate protection effort
- Carrots/incentives for collaboration
- Push policy for funders to insist on collaboration
- Built into authorizing language
- What is the appropriate scale for action?
- How do others prioritize?
- Need replicable models for local govt.
- Need to say - This is what we do, this is how we will do it better
- Embrace uncertainty of climate change
- Identify what new funding sources you need
- How does it contribute to the greater plan of hydrologic, biologic function
- Think regionally
- ID organization strengths and lead from those
- Decrease duplication
- Develop network map of organizations and who is doing what and their competency
- Have a can do attitude
- Recognize how to do things. Recognize that we need to the same stuff that we've need to do in other disciplines
- Most integrated things are creeks (restoration of creeks)
- What strategy would give biggest bang for the buck?
- Know what climate is in county for the next 20 years
- Integration of measurements and modeling so we understand the system and can so overlay and project the impact from an integrated

view.

- Funding group to work with transportation authority
- Are we working at a scale that has a biological impact?
- Existing in two different regions is both a hindrance and help. (Laguna is southern end of north coast region and northern end of bay delta region). Maximize both.
- Possible integration of North Bay and basin.
- Ideal is regional. Now is only County.
- We need to broaden audience to micro-scale.
- Need authority where large dollars can be dumped and allocated.
- Authorities overlook biodiversity.
- Groups like this can drive effort.

State of the Laguna
2009 Conference Sponsors

Sonoma County Agriculture &
Open Space District

Winifred & Harry B.
Allen Foundation

West Coast Watershed

Sonoma County
Water Agency

Pyxis Web
Development

Sonoma Ecology Center

California Invasive
Plant Council

Gold Ridge Resource
Conservation District

Sonoma State University
Field Stations & Nature
Preserves

PRBO Conservation
Science

Curry Landscaping

Climate
Protection
Campaign

Global
Genesis

Audubon Canyon
Ranch