California Department of Food and Agriculture
ENVIRONMENTAL FARMING ACT SCIENCE ADVISORY PANEL

MEETING AGENDA

April 23, 2013
9 AM to 1 PM

1220 N Street
Room 333
California Department of Food and Agriculture
Sacramento, CA 95833
(916) 654-0433

Call in information:
Please call 1-877-238-3859
Participant passcode - 3964856#

Jeff Dlott, PhD, Member and Chair
Mark Nechodom, PhD, Member — Don Cameron, Member
Mike Tollstrup, Member — Ann Thrupp, PhD, Member
Luana Kiger, MSc, Subject Matter Expert
Louise Jackson, PhD, Subject Matter Expert

Amrith Gunasekara, PhD, CDFA Liaison

1.	Introductions (10 minutes)	Jeff Dlott
2.	Incentives/Pilot Projects update (10 minutes) a. White paper b. NRCS CIG proposal	Jeff Dlott
3.	EDF Pilot Project – Parametrix (75 minutes)	Kevin Halsey Ashley Rood
4.	Analysis of case studies using Qualitative Assessment Model (75 minutes)	Jeff Dlott
5.	Next meeting and agenda topics (10 minutes)	Jeff Dlott

All meeting facilities are accessible to persons with disabilities. If you require reasonable accommodation as defined by the American with Disabilities Act, or if you have questions regarding this public meeting, please contact Amrith Gunasekara at (916) 654-0433.
More information at: http://cdfa.ca.gov/Meetings.html and http://www.cdfa.ca.gov/EnvironmentalStewardship/Meetings_Presentations.html

PROJECT TITLE:
ECOSYSTEM SERVICE BENEFITS FROM BUNDLED MANAGEMENT PRACTICES IN THE SAN JOAQUIN VALLEY, CALIFORNIA

PRIMARY AREAS FOR CONSIDERATION:

Nutrient Management

Demonstrate and quantify the effectiveness of bundling conservation measures to avoid, control, and trap nutrient losses from the field. Demonstrate the applicability and utility of in-season nitrogen management tools for determining additional nutrient needs.

Wildlife

Develop regional, crop-specific guidance providing the vegetative species, landforms, and necessary acreage to support appropriate populations of managed and wild pollinators per unit area of pollinated crops (e.g., describe the components of the landscape).

Economics

Projects designed to stimulate the development of environmental markets.

PROJECT DURATION: 2 years (9/1/2013 to 9/1/2015)

PROJECT DIRECTOR NAME AND CONTACT

Doug West, PhD, Environmental Scientist California Department of Food & Agriculture 2800 Gateway Oaks Dr., Sacramento, CA 95833 916-900-5022 dwest@cdfa.ca.gov	Amrith Gunasekara, PhD, Science Advisor California Department of Food & Agriculture 1220 N Street, Sacramento, CA 95814 916-654-0433 Amrith.gunasekara@cdfa.ca.gov

NAMES AND AFFILIATIONS OF PROJECT COLLABORATORS

Karen Buhr, Executive Director California Resource Conservation Districts Sacramento, CA 95814 916-524-2100 Karen-buhr@carcd.org	Hank Giclas, Senior Vice President Western Growers P.O.Box 2130, Newport Beach, CA 92658 949-885-2205 hgiclas@wga.com
Mace Vaughan, Pollinator Program Director The Xerces Society for Invertebrate Conservation 628 NE Broadway, Portland, OR, 97232 503-232-6639 mace@xerces.org	Doug Parker, PhD, Director Office of the Vice President University of California 1111 Franklin St., Oakland, CA 94607 510-987-0036 doug.parker@ucop.edu
Joe Karkoski, PE, MPPA, Supervising Engineer Central Valley Water Quality Control Board 11020 Sun Center, Rancho Cordova, CA 95670 916-464-4668 Joe.Karkoski@waterboards.ca.gov	Jonathan Kochmer, Director Research Earth Economics 107 N. Tacoma Avenue, Tacoma, WA 98403 253-539-4801 jkochmer@eartheconomics.org
Danny Merkley, Director Water Resources California Farm Bureau Federation 1127 11th St., Suite 626, Sacramento, CA 95814 916-446-4647 dmerkley@cfbf.com	Valerie Calegari, Director Audubon California P. O. Box 733, Winters, CA 95694 530-795-2921 vcalegari@audubon.org

PROJECT PURPOSE:
The purpose of this project is to monitor and quantify, using quantitative and qualitative tools, the many Ecosystem Service benefits of using multiple conservation management practices, together, on farms in the San Joaquin Valley California. The multiple Ecosystem Service benefits from nested or bundled management practices have not been evaluated in California and have the potential to be widely adopted in the Central Valley, if demonstrated on grower fields.

PROJECT AREA/LOCATION: The project will be implemented on several tree crop and field crop agricultural farms in the San Joaquin Valley (part of the Central Valley), California.

PROJECT SUMMARY
This project will monitor and quantify the many Ecosystem Service benefits of nitrogen fertilizer budget worksheets (NFBW) and multiple existing conservation management practices on several individual farms. Ecosystem services have been defined by the California Department of Food and Agriculture (CDFA) Environmental Farming Act Science Advisory Panel as "the multiple benefits we obtain from farming". The multiple Ecosystem Service benefits from nested or bundled management practices have not been qualitatively evaluated nor quantified in California.

The project will demonstrate the multiple Ecosystem Service benefits on grower fields in the San Joaquin Valley using a NFBW as an in-season tool. NFBW are on-farm worksheets that growers can use to determine the nutrient requirements for their crop in consideration of petiole, water, and soil testing, cover crop management practices, expected crop yields, comparison of manure-amended vs non manure amended systems, and irrigation schedules. Use of NFBW in qualitatively and quantitatively assessing the Ecosystem Services of multiple or bundled conservation measures is feasible since it can take into account numerous management practices that have been implemented at the farm level. The NFBW can be effectively used to query growers about cover crops which fix nitrogen as well as other nitrogen-based management practices, thereby optimizing nitrogen fertilizer use. If effectively designed, the NFBW can be used as a fundamental grower in-season tool for the monitoring and quantifying of nested or "bundled" management practices. The NFBW designed and used in this project will be implemented on approximately 20 grower fields where other management practices have already been applied using EQIP cost-share funds. The other management practices that will be monitored, qualified, and quantified as a bundle include hedgerows, riparian zones, native habitats that have been implemented in grower fields to trap nutrient losses from surface water runoff, support appropriate populations of wild pollinators, increase native plants and biodiversity, and limit surface sediment movement. CDFA will use the recently developed Qualitative Assessment Model to visually show the Ecosystem Service benefits of using these multiple NRCS management practices on working lands. The assessment is more effective when more than one management practice or "bundling" is used on a single farm since there are several ecosystem service categories beyond food, fiber, fuel, and economic benefits to farming. Other ecosystem categories include wildlife habitats, biodiversity conservation, water quality, nutrient cycling, pollination services and soil health. Many farmers, including those that can be categorized as early innovators, in the San Joaquin Valley California, have already implemented native pollination management practices to enhance the overall environmental quality of their working land. The demonstration sites in this project will also be used to quantify the pollination services from established hedgerows/wildlife habitats systems and show the Ecosystem Services

of those systems as bundled conservation measures. Through this process of qualitative and quantitative assessment of the hedgerows/wildlife habitats for native pollinators, general guidelines, including potential acreage, will be established on the appropriate vegetative species for native pollinators on a regional scale. This work is consistent with primary areas of consideration for funding titled “Demonstrate the applicability and utility of in-season nitrogen management tools for determining additional nutrient needs”, “Demonstrate and quantify the effectiveness of bundling conservation measure to avoid, control and trip nutrients losses from the field” and “Develop regional, crop-specific guidance providing the vegetative species, landforms, and necessary acreage to support appropriate populations of managed and wild pollinators per unit area of pollinated crops”.

The CDFA is also interested in using the NTT in concert with NFBW to determine how much nitrogen is available for a potential nitrogen trading market in California. The NTT has not been applied, tested, and calibrated for farms in the San Joaquin Valley, California. It is a fundamental tool that can be used in nitrogen trading markets. The trading market will be between non-point source entities (e.g., farms) and point-source entities (water treatment facilities) in California. There is evidence in other states that such trading markets are providing an incentive to growers to optimize plant nutrient use. Management practices used to optimize fertilize use contribute to protecting water ways from nutrients. In addition to the NTT, the value of the management practices as an ecosystem service will be evaluated using the Ecosystem Valuation Toolkit (EVT). The EVT provides spatially explicit monetary assessment of benefits beyond food, fiber, fuel to include up to 23 ecosystem services including habitat, pollination, water filtration and supply. This kind of valuation can be used to understand and communicate the economic importance of our farms to the local/regional economy beyond traditional agro-economics to a wide audience including other regional growers. The economic value of these services will be compared to the cost of implementing the management practices which will provide an economic evaluation of the bundled services. These components of the project are consistent with the economics funding area for consideration titled “Projects designed to stimulate the development of environmental markets”. Overall, this project is designed to be an innovate examination of on-the-ground bundled conservation practices on farms in California that has the potentially to be widely used on a regional level.

PROJECT DELIVERABLES

The proposed work in this project is designed to provide the following deliverables:

1. Qualitatively assess the Ecosystem Services of using bundled management practices.
2. Quantify the Ecosystem Services from using bundled management practices on working lands in the San Joaquin Valley, California.
3. Demonstrate the applicability and use of NFBW as an important in-season tool for determining plant nutrient needs and collecting information on multiple management practices.
4. Evaluate the information collected in the NFBW with use of the NTT to develop nitrogen trading environmental markets.
5. Develop California Central Valley general guidance information on vegetative habitats that will support wild and native pollinators.

EQIP ELIGIBLE PRODUCER INVOLVEMENT

The pilot project will be implemented in collaboration with growers that are EQIP eligible in the San Joaquin Valley, California. Grower contributions include providing the field site for demonstration, sharing historic information such as management practices used, and assisting in implementation of NFBW and hedgerow/wildlife habitat monitoring.

BUDGET NARRATIVE

The project will monitor, using quantitative (NTT and EVT) and qualitative (CDFA Qualitative Assessment Model) tools, the many Ecosystem Service benefits of using multiple or bundled conservation management practices on several farms. These demonstrations will involve implementing NFBW, monitoring and assessing the Ecosystem Service benefits from already established native hedgerow/wildlife habitats and evaluating pollination services. The nature of this project relies heavily on field assessment of Ecosystem Service and therefore, a multidisciplinary team will be used to implement this project over two years. CDFA will rely on the expertise and experience of several collaborators to implement the project. The work associated with this project primarily responsibilities of the collaborators for different components of the project are described below.

Project administration - organizational meetings, reports, budget allocation

CDFA will be responsible for all administrative aspects of this project with 1 FTE of which 0.5 FTE is in-kind support. In-kind support of 0.4 FTE/year for the administrative component and 0.1 FTE/year for the science-based evaluation of bundled Ecosystem Services have been allocated by the Department.

Project implementation - grower engagement, NFBW implementation on farms, hedgerow/wildlife habitat monitoring, Ecosystem Service assessment of management practices

Staff from the Resource Conservation Districts (1.5 FTE/year) will be supported by 0.75 FTE CDFA cash contribution for the implementation of NFBW, grower engagement and other field level activities. The field level activities will also be supported by the Xerces Society (0.75 FTE/year of which 0.50 FTE is in-kind and cash contributions) for pollination services, University of California Agricultural Extension (0.55 FTE of which 0.30 FTE is in-kind and cash contributions) for agronomic expertise, and the Audubon Society (1 FTE/year of which 0.5 FTE is in-kind) for hedgerow/native wildlife habitats.

Project locations – identification of growers and fields

The grower fields of this project are required to have established EQIP funded hedgerows and wildlife habitats for native pollination services. Also, the growers should be willing to implement NFBW to evaluate bundled conservation practices. Growers will be reimbursed for costs associated in participating in this project ($40,000 indirect cost). Several collaborators will assist in the component of this project including the California Farm Bureau (0.05 FTE/year in-kind), Western Growers (0.05 FTE/year in-kind), Almond Board (0.10 FTE/year in-kind), University of California Agricultural Extension (0.55 FTE/year of which 0.30 is in-kind and cash contributions), and Audubon Society (1 FTE/year of which 0.5 FTE is in-kind).

Quantitative and qualitative analysis – assessing bundled conservation measures

CDFA will be responsible for qualitatively evaluating the Ecosystem Services of bundled management practices and has dedicated staff for this component of the project (0.5 FTE in-kind). Consultation costs will be used to provide an economic perspective for the bundled services through Earth Economics ($70,000 of which 50% is cash contributions) and also for calibration of the quantitative NTT tool by CDFA and external experts ($10,000 of which 50% is cash contributions).

Project design – design of project specific NFBW to capture bundled conservation measures

All collaborators will engage in this activity with in-kind support through several project meetings held early in the funding cycle.

Project outreach and education

All collaborators will engage in this activity.

QUALITATIVE ASSESSMENT MODEL

USDA NRCS AWEP – January 2011
Northern San Joaquin River Water Quality Project

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

Analysis completed on: 9/20/2012
Analysis completed by: Amrith Gunasekara, PhD
Additional information:
ftp://ftp-fc.sc.egov.usda.gov/CA/news/Stories/area_2/no_sjr_water_project.pdf
http://www.ca.nrcs.usda.gov/news/stories/Areas/area_2/no_sjr_water_project.html
http://www.ca.nrcs.usda.gov/programs/awep.html
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/

Documentation Reviewed

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Agricultural Water Enhancement Program

AWEP

HELPING PEOPLE HELP THE LAND

January 2011

"Securing this USDA funding shows the power that comes when agricultural and environmental interests combine their energies to help growers solve water quality problems."

— Parry Klassen, CURES Executive Director

Project Partners: Partnership for Agriculture and the Environment

- Almond Board of California
- California Dairy Campaign
- Coalition for Urban and Rural Environmental Stewardship (CURES)
- East San Joaquin Water Quality Coalition (ESJWQC)
- East Stanislaus Resource Conservation District (ESRCD)
- Environmental Defense Fund's (EDF) Center for Conservation Incentives (CCI)
- Stanislaus County Department of Agriculture
- Merced County Department of Agriculture
- Stanislaus County Farm Bureau
- Tuolumne River Trust
- University of California Cooperative Extension (UCCE)
- Western United Dairymen (WUD)
- Westside San Joaquin River Watershed Coalition (WSJRWC)
- West Stanislaus Resource Conservation District (WSRCD)

Northern San Joaquin River Water Quality Project

Addressing Water Quality Concerns in the Northern San Joaquin River Watershed

Stanislaus, Merced, and San Joaquin counties are three of the nation's highest producing agricultural counties, generating $7.5 billion in agricultural output annually. Since the 1990s, waterways in the three counties were impaired by sediment, nutrients and pesticides from agricultural, urban and other sources. State regulators imposed strict new requirements on farmers in 2003 that included developing management plans on many regional waterways due to impairments originating from agriculture.

The water quality of the San Joaquin River is of critical interest because it flows to the delta. Both the Delta-Mendota Canal, which supplies irrigation water to farms in the western San Joaquin Valley, and the California Aqueduct, which supplies drinking water to southern California, originate in the delta. Photo: USGS

Local watershed coalitions and the non-profit group CURES (Coalition for Urban Rural Environmental Stewardship) began working on correcting agricultural water quality problems in 2004. They knew that a combination of farm management practices would be needed to keep pollutants out of the San Joaquin River and its numerous tributaries. Infrastructure improvements such as irrigation tailwater recirculation systems and conversion from furrow to micro irrigation systems offered ways to prevent water pollution. These measures are considered best management practices (BMPs) that keep pesticides and sediments contained on farms, but are cost prohibitive for farmers to install even in profitable years.

In 2009, CURES, in coordination with Partnership for Agriculture and the Environment (a broad coalition of agricultural and environmental interests), successfully applied for AWEP funding to help farmers in the northern San Joaquin Valley implement these practices to improve water quality. The USDA approved $2 million annually in AWEP funding over a 5-year period for projects to improve water quality in the three county region.

A tailwater recirculation system in Stanislaus County. Photo: CURES

THE NATURAL RESOURCES CONSERVATION SERVICE IS AN EQUAL OPPORTUNITY EMPLOYER AND PROVIDER

The AWEP funding is directed to farms and dairies located along waterways shown to be impaired by farm inputs through water monitoring performed by the East San Joaquin Water Quality Coalition and Westside San Joaquin River Watershed Coalition, both members of the Partnership for Agriculture and the Environment. These two watershed coalitions represent landowners under the Irrigated Lands Regulatory Program (ILRP) mandated by the Central Valley Regional Water Quality Control Board. The Westside coalition region encompasses approximately 500,000 acres and the Eastside coalition approximately 1,000,000 acres of irrigated cropland.

Thousands of acres of farmland along waterways in the two coalition regions require some form of agricultural water quality mitigation. Growers must make changes to irrigation and farming practices to meet requirements of the ILRP and are using AWEP funding to assist in installing micro-irrigation systems and irrigation tailwater recirculation systems, among other practices. More than 250 crops are grown within the two Coalition watersheds, ranging from fruit and nuts to melons, field crops such as alfalfa and cotton.

Practices to protect water quality have been installed on thousands of acres of irrigated cropland since project funding began in 2009. Priorities for the first year were Ingram and Hospital Creeks in the Westside Coalition area and Dry Creek, Duck Slough and Prairie Flower Drain in the East San Joaquin Coalition area. Because watershed management plans had already been established by the two watershed coalitions, many "shovel-ready" projects had already been identified by the local NRCS offices. As a result, AWEP funds were immediately used for several priority projects.

A micro-irrigation sprinkler system minimizes or eliminates runoff and can also boost production. Photo: NRCS

In FY 2009, 21 projects were implemented on 4,458 acres. A total of 26 contracts were funded in FY 2010, with conservation practices implemented on 5,229 acres. Completed work includes installation of 19,217 feet (3.6 miles) of underground pipeline, four tailwater recovery systems, land leveling on 838 acres, and irrigation system improvements on 992 acres. Irrigation water management is a part of every AWEP contract.

Although water quality monitoring was not directly funded by AWEP, both of the watershed coalitions in the project area have in place comprehensive water sampling programs which allow monitoring of post-installation water quality improvements.

Today, several of the priority waterways that exceeded state standards of agricultural inputs between 2004 and 2008 have shown dramatic improvements. Of three priority waterways identified by the water coalitions in 2009, two meet state standards for pesticides and toxicity and the third meets water quality regulations for all but one pesticide.

In addition to AWEP funding, project partners are providing in-kind services including grower outreach, education, water quality monitoring and project evaluation and reporting. In-kind monitoring costs are an estimated $200,000/ year per waterway. Some of the partners are also contributing in-kind consultation on project implementation, habitat, fish and wildlife issues, as needed.

A drip system for tomatoes in Stanislaus County. Photo: CURES

Nearly $8 million in state funded grants will be available in 2011 to Central Valley farmers to help improve water quality in local streams and rivers. At least $3 million of these funds are anticipated for cost sharing in the AWEP project area on water quality projects such as irrigation recirculation systems and micro irrigation systems. Project partners are confident these funds will spur many more applications for AWEP.

Shown above and below, holding ponds for recirculation systems in Stanislaus County. Tailwater recirculation systems facilitate the reuse of drainage water and help keep pesticide residues out of waterways. Photos: CURES

Qualitative Assessment Model for;
USDA NRCS AWEP: Northern San Joaquin River Water Quality Project

BEFORE

CLICK ON THE BLUE ICONS T N

"Stanislaus, Merced, and San Joaquin counties are three of the nation's highest producing agricultural counties." (AWEP, 2011)

"Since the 1990s, waterways in the three counties were impaired by sediment, nutrients and pesticides from agricultural, urban and other sources." (AWEP, 2011)

Agriculture in the three counties enerate "$7.5 billion in agricultural utput annually." (AWEP, 2011)

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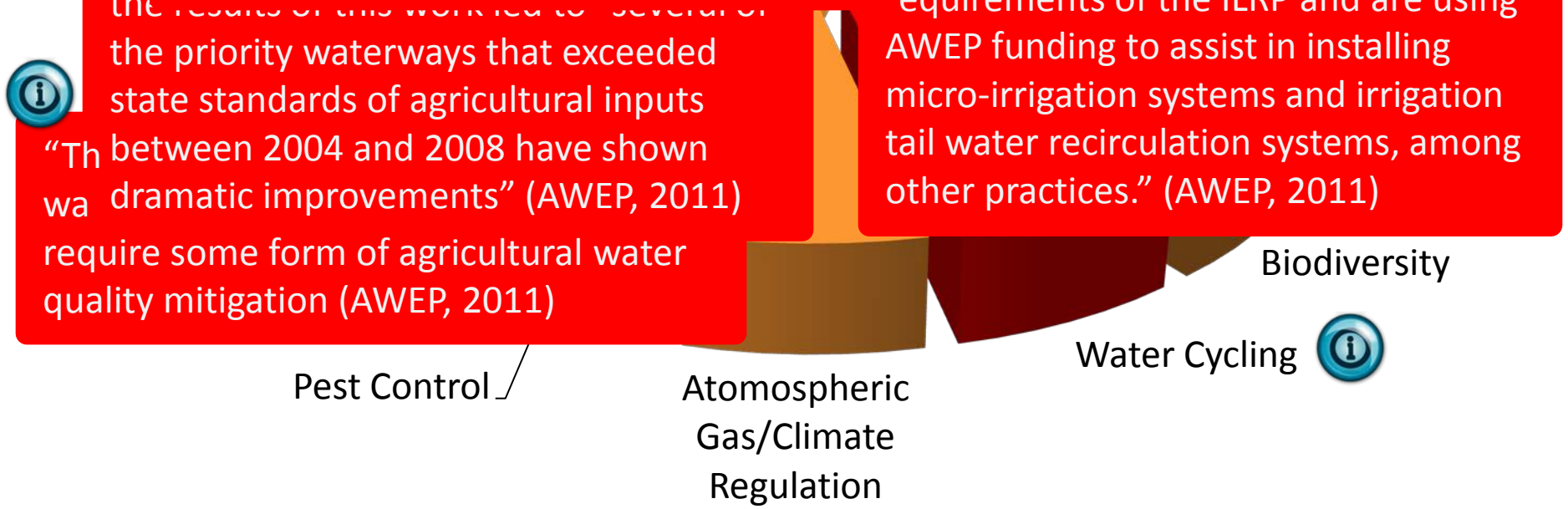
"Th wa require some form of agricultural water quality mitigation (AWEP, 2011)



Qualitative Assessment Model for;
USDA NRCS AWEP: Northern San Joaquin River Water Quality Project

AFTER

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"Stanislaus, Merced, and San Joaquin counties are three of the nation's highest producing agricultural counties." (AWEP, 2011)

Completed work included installation of underground pipeline, tail water recovery systems, land leveling and irrigation system improvements (AWEP, 2011)

Agriculture in the three counties generate "$7.5 billion in agricultural output annually." (AWEP, 2011)

aquatic wildlife habitats benefit as a result of the three priority waterways meeting water quality regulations (AWEP, 2011)

Of
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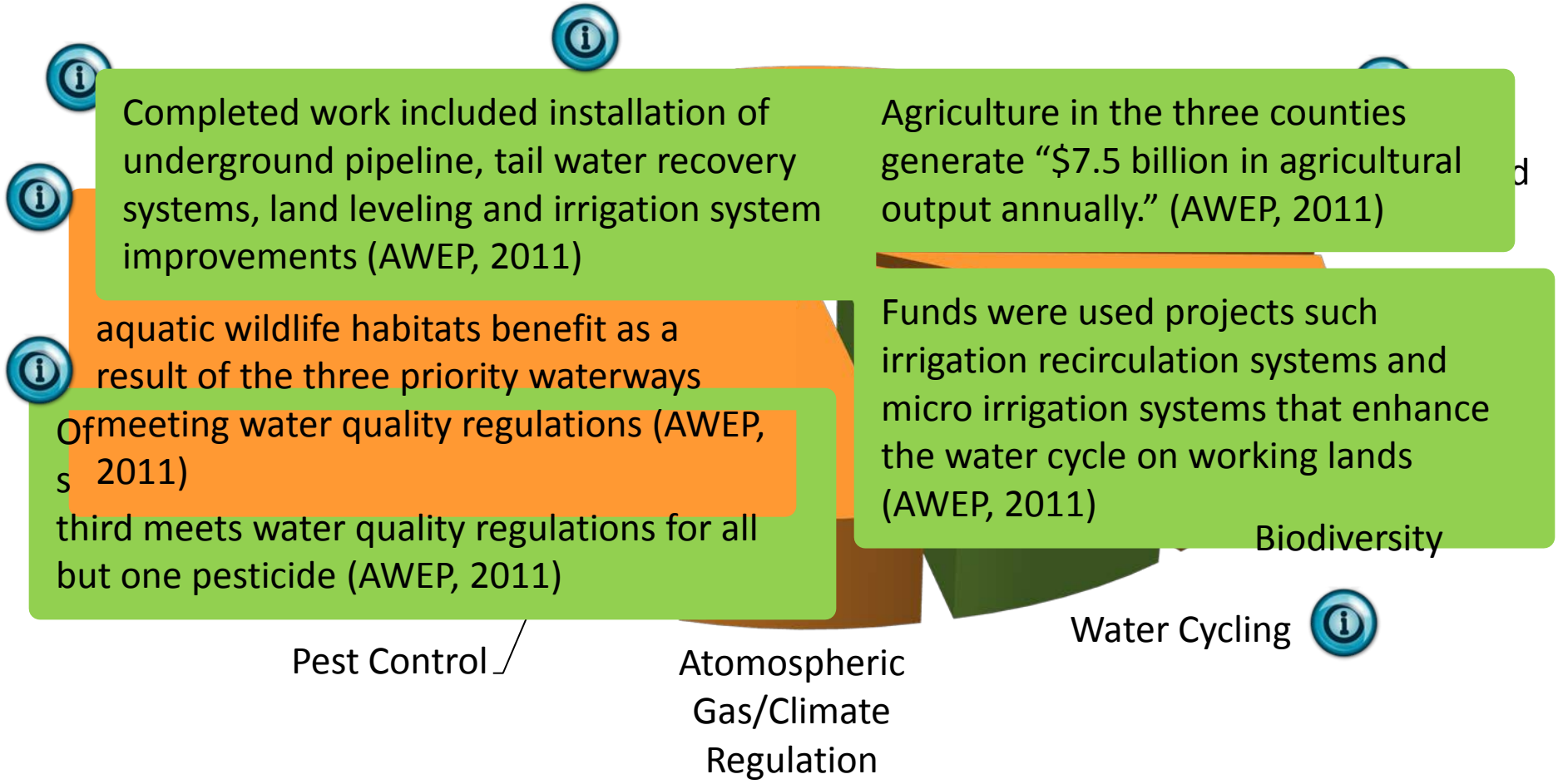
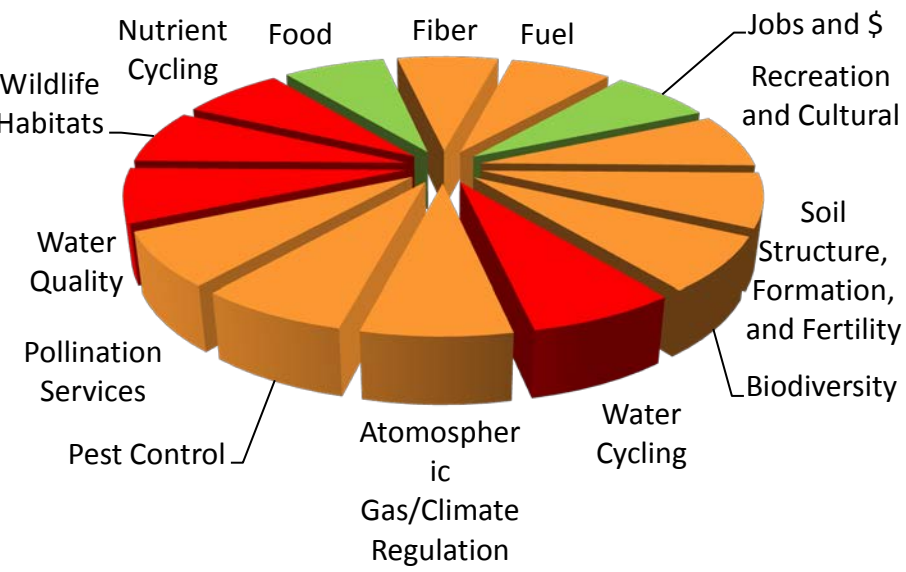
third meets water quality regulations for all but one pesticide (AWEP, 2011)

Funds were used projects such irrigation recirculation systems and micro irrigation systems that enhance the water cycle on working lands (AWEP, 2011)



Qualitative Assessment Model for;
USDA NRCS AWEP: Northern San Joaquin River Water Quality Project

BEFORE



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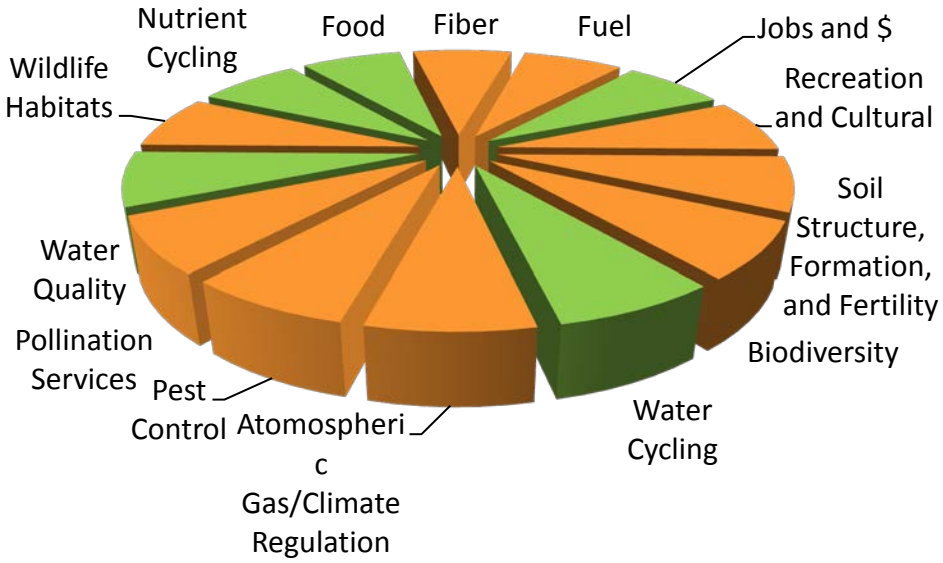

QUALITATIVE ASSESSMENT MODEL

Performance-Based Conservation Incentives in the Pajaro Valley
Santa Cruz County Resource Conservation District

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

Analysis completed on: 2/15/2013
Analysis completed by: Amrith Gunasekara, PhD
Additional information:

Performance-Based Conservation Incentives in the Pajaro Valley: Lessons from a public-private partnership, Nik Strong-Cvetich, Resource Conservation District of Santa Cruz County, 2012

Annual Report 2010-2012, Resource Conservation District of Santa Cruz County

Documentation Reviewed

Performance-Based Conservation Incentives in the Pajaro Valley: Lessons from a public-private partnership

Nik Strong-Cvetich

Program Development Manager
RCD of Santa Cruz County
November 8th, 2012

RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

Documentation Reviewed

Pajaro River Watershed Integrated Regional Water Management Plan Update
Project Solicitation Form

PROJECT OVERVIEW

General Project Information

Project Title:	Integrated Aquifer Enhancement Program for the Pajaro Valley
Project Location:	Pajaro Valley (cities of Watsonville and Pajaro, counties of Santa Cruz and Monterey)
Estimated Cost:	$1,500,000

Brief Project Description (1 to 2 sentences):

This project implements aquifer enhancement projects through storm water capture and returning of excess surface flows to the aquifer, convening stakeholders to implement community-based water supply projects, and implement an incentive-based program for demand management. Increasing groundwater recharge would help to reduce overdraft, thereby decreasing saltwater intrusion occurring along the coast. Projects can also help to reduce nutrient and sediment flows to surface water systems, and improve hydrologic function in support of stream and wetland systems.

Project Proponent Information

Contact Name:	Kelli Camara
Affiliation:	Resource Conservation District of Santa Cruz County (RCDSCC)
Address:	820 Bay Ave, Suite 136, Capitola, CA 95010
Phone Number:	831-464-2950
Email:	kcamara@rcdsantacruz.org

Other participating agencies/organizations (if applicable):

University of Santa Cruz, Pajaro Valley Water Management District, Natural Resources Conservation Service, California State University Monterey Bay, Community Water Dialogue (regional stakeholders)

DETAILED PROJECT INFORMATION

Description

Please provide a description of your project (including the location) and its purpose, what will be constructed and/or implemented, how the project will function, the area(s) and/or entities that will be affected by or will benefit from the project, and any potential obstacles to implementation.

This project focuses on the role of Managed Aquifer Recharge, and supporting components, as a part of the Integrate Aquifer Enhancement Program in the Pajaro Valley. This project works in collaboration with the efforts of the Community Water Dialogue in furthering conversation and innovative projects that address the water supply issue in the Pajaro Valley. This project also recognizes the other projects that are occurring in conjunction with this project such as the Irrigation Efficiency projects proposed by the Agricultural Water Quality Coalition, and the specific Harkins Slough project proposed by the Coalition and PVWMA. At the heart of this project is an expansion of MAR with support from the efforts of the Community Water Dialogue and their, and others, research into how to better incentivize these types of efforts that address the water supply issue.

RESOURCE
CONSERVATION DISTRICT
OF SANTA CRUZ COUNTY

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- Program Highlights
- Results
- Future Directions
- Partners and Funding
- Tools and Assistance
- Workshops and Trainings
- Funding Opportunities

Contact Info
Arianne Rettinger
Agricultural Water Quality Program Manager
831.464.2950 ext. 11

Agriculture

Introduction

The Agricultural Water Quality Program currently is focused on the Pajaro Watershed. The Pajaro River Watershed encompasses an area of over 1,200 square miles that drain into the Monterey Bay National Marine Sanctuary. The mouth of the Pajaro River forms the Pajaro River Lagoon, which is connected to one of the most important wetland habitats in California, the Watsonville Slough Complex.

The Monterey Bay National Marine Sanctuary, which receives waters from the Pajaro Watershed and other coastal streams, is the largest marine protected area in the United States, including an area of more than 5,000 square miles along the Central Coast of California. The Sanctuary is one of the

Native, Brown-headed Rush grass begins its comeback at a Harkin's Slough grasslands restoration project.

Source: RCDSCC Ag Water Quality Program Form, http://www.rcdsantacruz.org/pages/programs/agriculture.php

Project Summary

Pilot project initiated by the RCD of Santa Cruz County to examine the effectiveness of performance-based incentives for water stewardship efforts in agriculture. Partnership between the RCD, Driscoll's and Sustainable Conservation. Project is funded by a CDFA Specialty Crop Block Grant (includes cost-share) and is a 2 year study.

- The project recognizes the unique and important role that California farmers play in water conservation and aims to create economic opportunities/incentives
- Goals at the farm level include reducing water demand from aquifers and reducing nitrates in runoff and groundwater
- Farm specific management practices include irrigation efficiency technology, nutrient budgeting, grass waterways, constructed wetlands and flow meters
- The project rewards farmers based on outcomes rather than practices, allowing farmers to customize their conservation efforts to fit their working landscape needs
- Incentives for farmers include cost share for practices, peer to peer education opportunities, direct payments, industry contacts, water rebates and regulatory relief

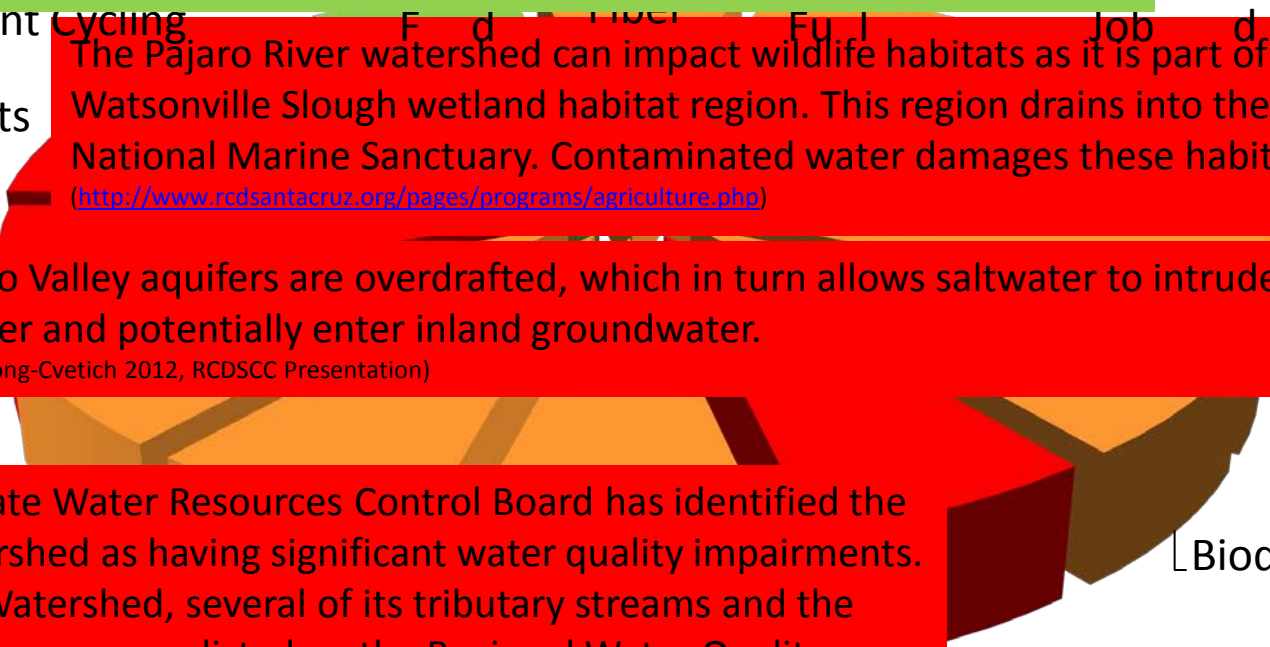
Sources: Nik Strong-Cvetich 2012, Resource Conservation District of Santa Cruz County, "Performance-Based Conservation Incentives in the Pajaro Valley: Lessons from a public-private partnership."
2010-2012 Annual Report, Resource Conservation District of Santa Cruz County

Qualitative Assessment Model
Performance-Based Conservation Incentives in the Pajaro Valley

CLICK ON TH

The Pajaro Valley produces a wide variety of agricultural commodities, including berries, tree crops, wine grapes, vegetables, nursery crops, and livestock (http://www.rcdsantacruz.org/pages/programs/agriculture.php)

The total value of agricultural production in Santa Cruz County in 2005 was $418,114,000. (http://www.rcdsantacruz.org/pages/programs/agriculture.php)



The Pajaro River watershed can impact wildlife habitats as it is part of the Watsonville Slough wetland habitat region. This region drains into the Monterey Bay National Marine Sanctuary. Contaminated water damages these habitats. (http://www.rcdsantacruz.org/pages/programs/agriculture.php)

Pajaro Valley aquifers are overdrafted, which in turn allows saltwater to intrude into the aquifer and potentially enter inland groundwater. (Nik Strong-Cvetich 2012, RCDSCC Presentation)

"The California State Water Resources Control Board has identified the Pajaro River Watershed as having significant water quality impairments. The Pajaro River Watershed, several of its tributary streams and the Watsonville Sloughs, are now listed on the Regional Water Quality Control Board (RWQCB) prioritized 303d list of water bodies impaired from nutrients, sediments, and pesticide pollution." (http://www.rcdsantacruz.org/pages/programs/agriculture/resource-concerns.php)

Qualitative Assessment Model
Performance-Based Conservation Incentives in the Pajaro Valley

The Pajaro Valley produces a wide variety of agricultural commodities, including berries, tree crops, wine grapes, vegetables, nursery crops, and livestock.
(http://www.rcdsantacruz.org/pages/programs/agriculture.php)

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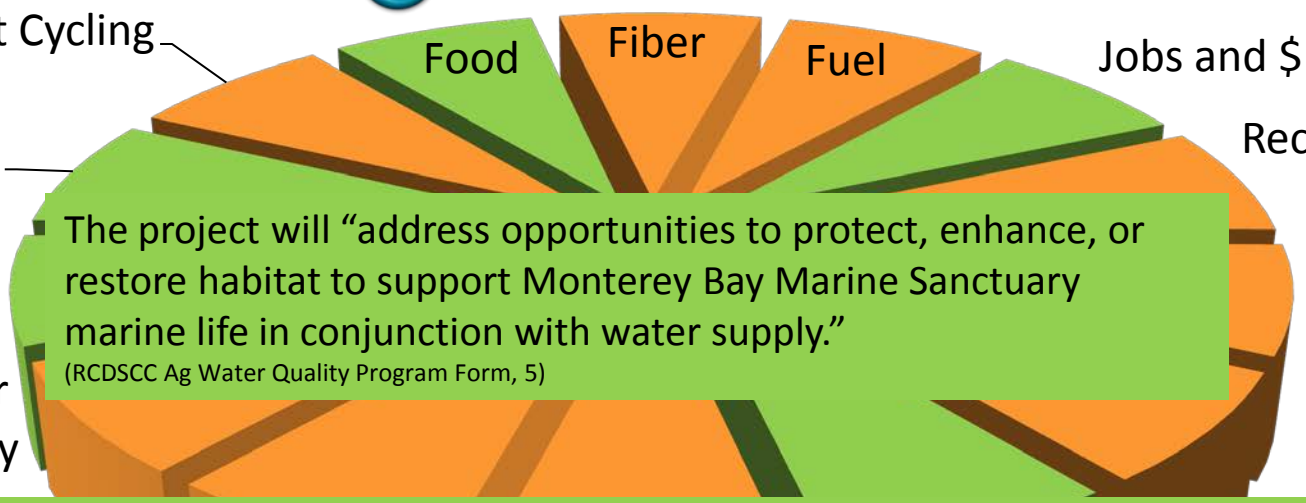
The total value of agricultural production in Santa Cruz County in 2005 was approximatly $4.2 million (http://www.rcdsantacruz.org/pages/programs/agriculture.php)



The project will "address opportunities to protect, enhance, or restore habitat to support Monterey Bay Marine Sanctuary marine life in conjunction with water supply."
(RCDSCC Ag Water Quality Program Form, 5)

The program will protect groundwater from salt and nitrate contamination and "meet groundwater, surface water, wastewater, and recycled water quality regulatory standards." (RCDSCC Ag Water Quality Program Form, 3)

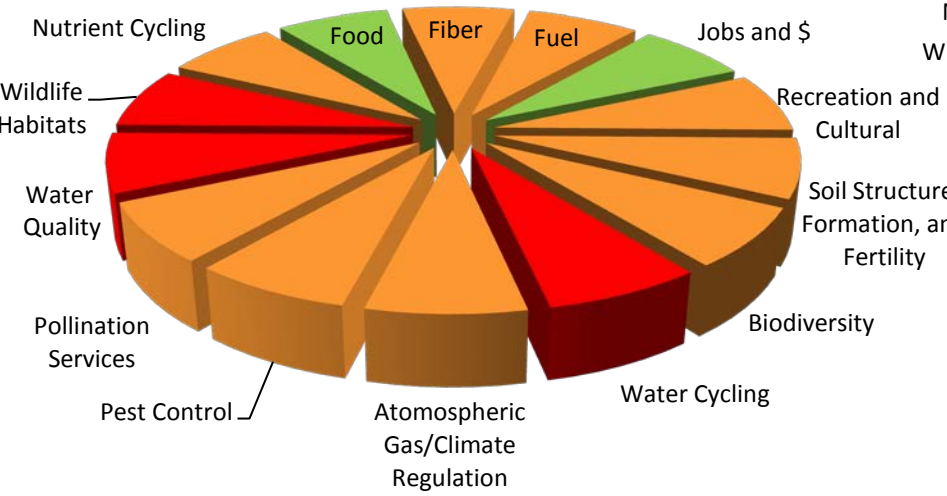
The project will reduce water demand through implementation of agricultural water use efficiency. Winter surface water collection and recharge of groundwater systems will help reduce salt water intrusion. (RCDSCC Ag Water Quality Program Form, 5)

Qualitative Assessment Model
Performance-Based Conservation Incentives in the Pajaro Valley
Management Practices

Ecosystem Service Category	Management Practice	Reference
Wildlife Habitats	• Restore wetland areas • Reduce nutrient runoff in order to preserve marine habitats	RCDSCC Ag Water Quality Program Form, 5
Water Quality	• Nutrient budgeting • Reduce nutrient runoff by planting grass waterways or wetlands	Nik Strong-Cvetich 2012, RCDSCC Presentation
Water Cycling	• Implement irrigation efficiency technology • Use flow meters	Nik Strong-Cvetich 2012, RCDSCC Presentation

Qualitative Assessment Model
Performance-Based Conservation Incentives in the Pajaro Valley

BEFORE



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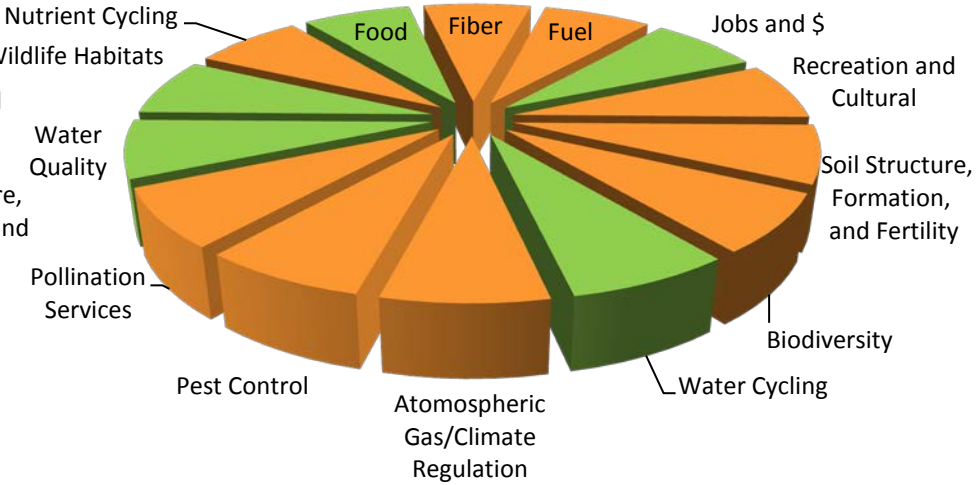

CDFA QUALITATIVE ASSESSMENT MODEL

Wildlife Habitats on Working Lands

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

Analysis completed on: 2/10/2013

Analysis completed by: Erica Anderson and Amrith Gunasekara, PhD

Additional information:

http://ca.audubon.org/working-lands

http://ca.audubon.org/landowner-stewardship-program

Audubon California Working Waterways, EFA SAP Presentation, Valerie Calegari, 2012

Documentation Reviewed

Audubon CALIFORNIA

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Working Lands

Audubon California is increasingly working with the owners and operators of working lands throughout the state to increase the value of these properties for birds and wildlife. We do this by working with landowners to modify land management practices and encouraging restoration of native habitats in these landscapes.

One of the biggest transformations in California over the last 150 years was the conversion of millions of acres of natural wetlands, grasslands, and stream-side forest to create one of the world's most productive agricultural landscapes. While this resulted in the irreparable loss of habit for birds and wildlife, the reality is that we must find ways for conservation and agriculture to coincide. Private agricultural lands encompass 25 million acres of open space in California – fully one-quarter of the state. Fortunately, we are learning that farms and ranches can be effective

Home › Conservation › Working Lands › Landowner Resources ›

Hedgerows turn farm edges into bird habitat

Farmers have long understood that planting hedgerows around the edges of their properties can produce a number of benefits to their farming operations. These hedgerows, if consisting of native trees and shrubs can be an important way for farmers to support local bird populations in areas where natural habitat can be scarce.

The overall benefits of native hedgerows to farming operations include:

- Attracting beneficial insects
- Improving water quality
- Providing windbreaks
- Suppressing weeds
- Stabilizing soil

Hedgerows and birds

Recent preliminary research shows that farm edges with hedgerows can host as many as four times the number of bird species as farm edges without hedgerows. One of the reasons for this is that a properly developed hedgerow provides beneficial habitat throughout the seasons, as opposed to roadside weeds which only blossom once a year.

Source: http://ca.audubon.org/working-lands, http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat

Documentation Reviewed

Agroforest Syst (2009) 76:195–206
DOI 10.1007/s10457-008-9168-8

Factors affecting adoption of hedgerows and other biodiversity-enhancing features on farms in California, USA

Sonja Brodt · Karen Klonsky · Louise Jackson · Stephen B. Brush · Sean Smukler

Received: 23 December 2007 / Accepted: 19 August 2008 / Published online: 8 September 2008

Audubon CALIFORNIA

fact sheet

July 2012

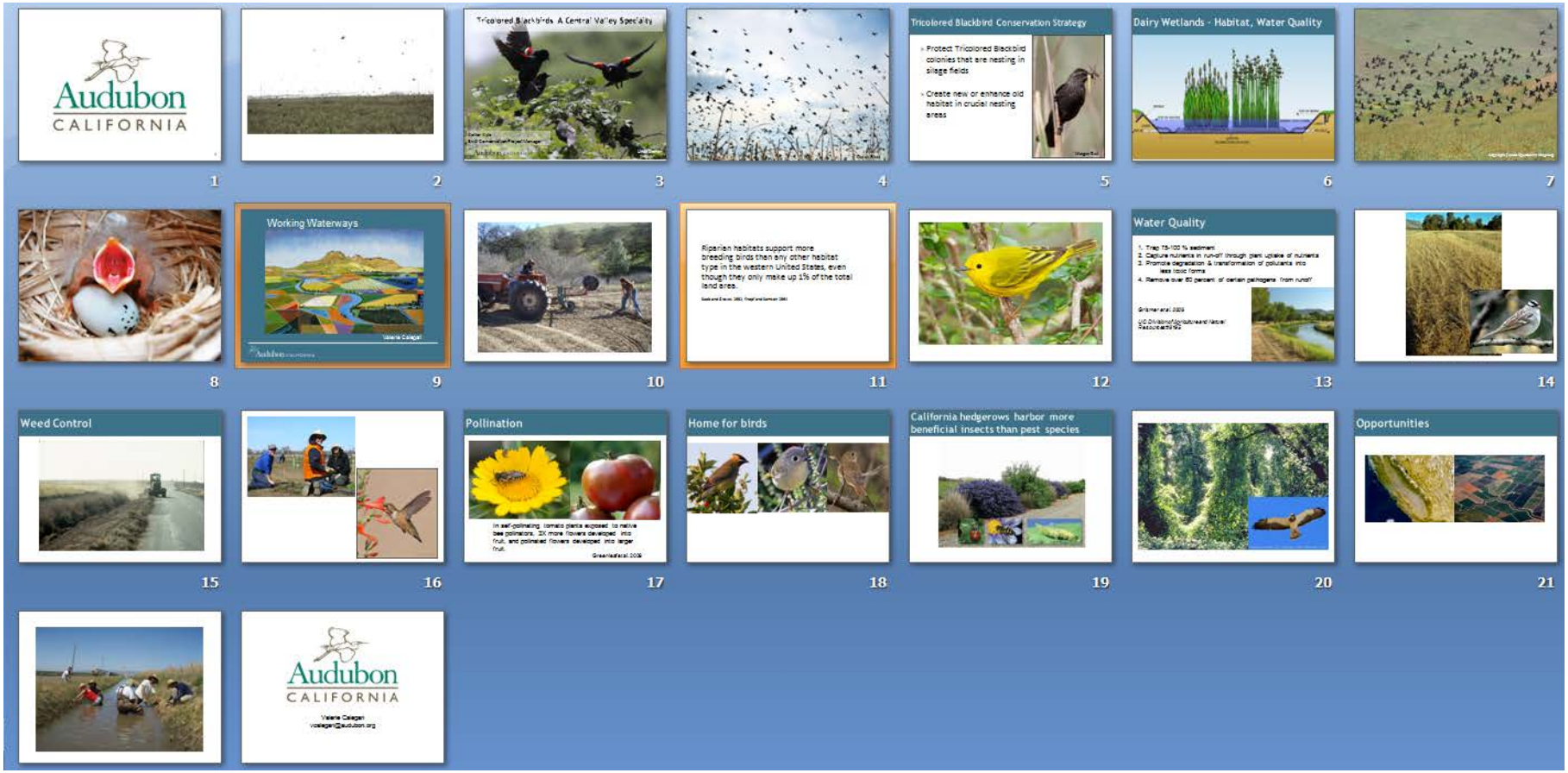
Putting working lands to work for birds

Audubon is proving that we can support wildlife and improve the environment while maintaining the healthy agricultural industry that produces a quarter of America's fresh produce, grains, and other crops.

In the Central Valley, the rapid transformation to agriculture resulted in the loss of over 95% of natural wetlands and grasslands. But hundreds of bird species now use these farms

Documentation Reviewed

Valerie Calegari, Presentation to EFA SAP members, November 8, 2012



Project Summary

Audubon California, through its Landowner Stewardship Program (LSP), is engaged in numerous projects on private agricultural lands to enhance natural wildlife habitats. The program aims to implement and preserve riparian, oak woodland and grassland habitats given their numerous ecological benefits. The work completed through this program offers numerous Ecosystem Service benefits including habitats for wildlife, enhanced pollination services, and water quality improvements.

- The LSP assists in the design and implementation of conservation projects on private working agricultural lands

- LSP provides habitat for many bird species, including endangered and threatened bird species

- Wildlife habit enhancement practices consist of hedgerow planting, oak tree planting and stream bank reinforcements, among others.

- Ecosystem services provided include water quality improvement, erosion control, pest control, pollination services, wildlife habitats and biodiversity.

Source: http://ca.audubon.org/landowner-stewardship-program

Q li i A M del

Audubon California has worked on habit restoration projects on diverse farms raising a wide variety of crops and livestock, including almonds, walnuts, wheat, rice, tomatoes, sheep and cattle. (http://ca.audubon.org/working-land-story-series)

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Environmental conservation projects take place on farms that raise sheep as their principal endeavor, making wool a primary output. (http://ca.audubon.org/working-land-story-series)

The farms and lands on which Audubon California's habit restoration takes place are working lands that produce agricultural products and provide employment and income to many. (http://ca.audubon.org/working-land-story-series)

"In the Central Valley, the rapid transformation to agriculture resulted in the loss of over 95% of natural wetlands and grasslands." (AC fact sheet July 2012)

Jobs and $

Recreation and Cultural

Soil Structure, Formation, and Fertility

diversity

Water Quality

According to the California water quality monitoring council, 70% of California streams in agricultural areas are very degraded, contaminated with nitrogen, chloride and phosphorous. (http://www.waterboards.ca.gov/mywaterquality/eco_health/streams/condition/landuse.shtml)

Pest Control

Private lands provide critical habitats for a diversity of animals, including 60% of the threatened and endangered species in the U.S. (http://ca.audubon.org/working-lands)

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Audubon California has worked on habit restoration projects on diverse farms raising a wide variety of crops and livestock, including almonds, walnuts, wheat, rice, tomatoes, sheep and cattle. (http://ca.audubon.org/working-land-story-series)

Environmental conservation projects take place on farms that raise sheep as their principal endeavor, making wool a primary output. (http://ca.audubon.org/working-land-story-series)

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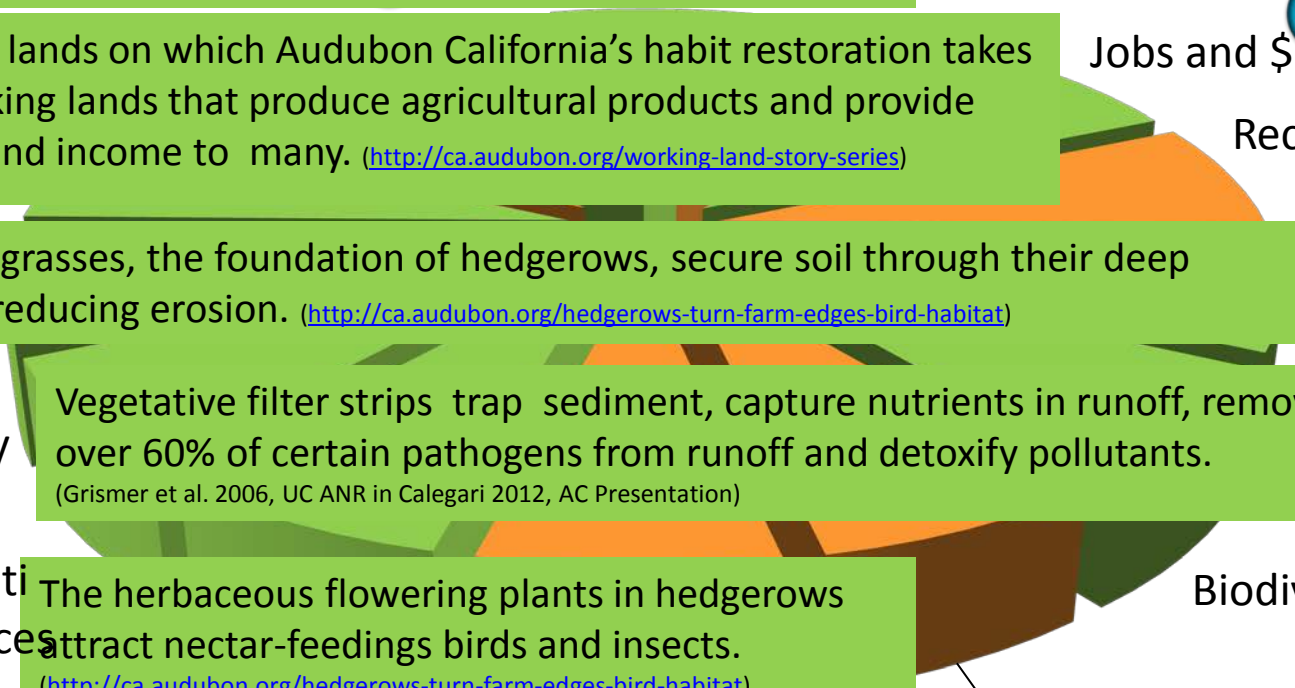
Riparian habitats provide homes to more breeding birds than any other habitat. (Saab and Groves 1992 in Calegari 2012, AC Presentation)

The farms and lands on which Audubon California's habit restoration takes place are working lands that produce agricultural products and provide employment and income to many. (http://ca.audubon.org/working-land-story-series)



Jobs and $

Recreation and Cultural

Native grasses, the foundation of hedgerows, secure soil through their deep roots, reducing erosion. (http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat)

Soil Structure, Formation, and Fertility

Water Quality

Vegetative filter strips trap sediment, capture nutrients in runoff, remove over 60% of certain pathogens from runoff and detoxify pollutants. (Grismer et al. 2006, UC ANR in Calegari 2012, AC Presentation)

Pollinati Services

The herbaceous flowering plants in hedgerows attract nectar-feedings birds and insects. (http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat)

Biodiversity

W C cli

Pest Contro

"Oak trees and the environment around them . . ., hosting more than 160 species of birds and 2,000 varieties of plants." (http://ca.audubon.org/help-preserve-oak-woodlands)

California hedgerows har species and attract insect http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat)

"Hedgerows can host as many as four times the number of bird species as farm edges without hedgerows." (http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat)

Qualitative Assessment Model
Wildlife Habitat Restoration – Audubon California
Management Practices

Ecosystem Service Category	Management Practice	Reference
Wildlife Habitats	• Establish native vegetation (grasses or oak trees) • Native riparian habitat restoration • Hedgerows	http://ca.audubon.org/working-lands
Water Quality	• Plant vegetative filter strips	Grismer et al. 2006. UC ANR
Pest Control	• Attract beneficial insects and insectivorous birds by planting flowering plants in hedgerows	http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat
Pollination Services	• Attract pollinators by planting flowering plants in hedgerows	http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat
Soil Structure	• Plant native grasses in hedgerows and vegetative strips	http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat
Biodiversity	• Establish hedgerows, riparian habitats, oak woodland habitats	http://ca.audubon.org/hedgerows-turn-farm-edges-bird-habitat http://ca.audubon.org/help-preserve-oak-woodlands

Qualitative Assessment Model
Wildlife Habitat Restoration – Audubon California

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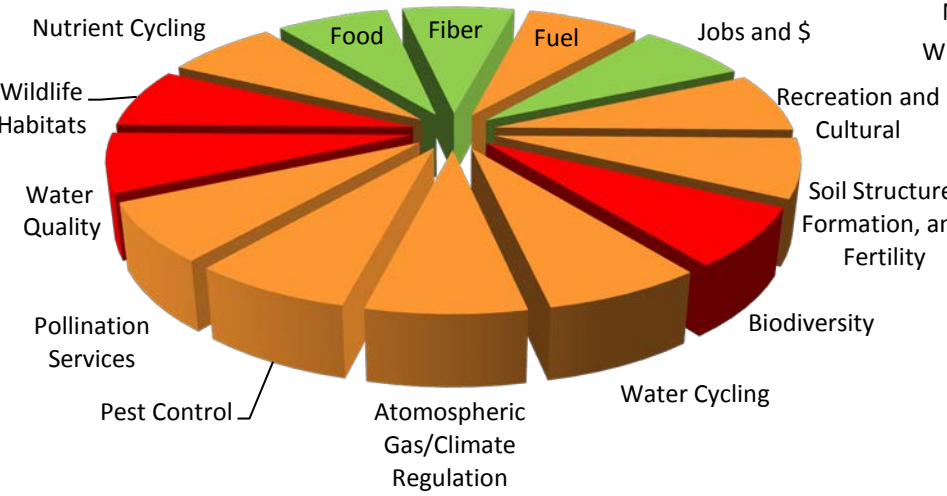

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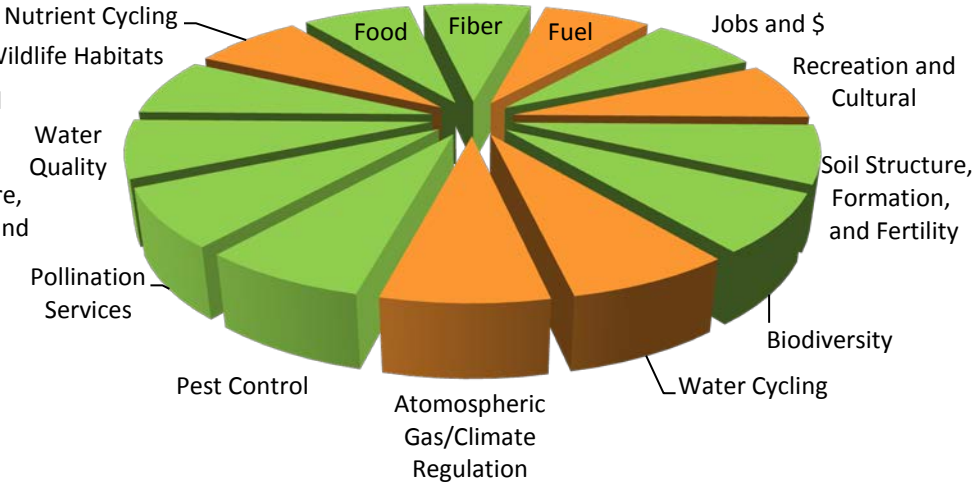


QUALITATIVE ASSESSMENT MODEL

Pollinator Conservation

Xerces Society

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

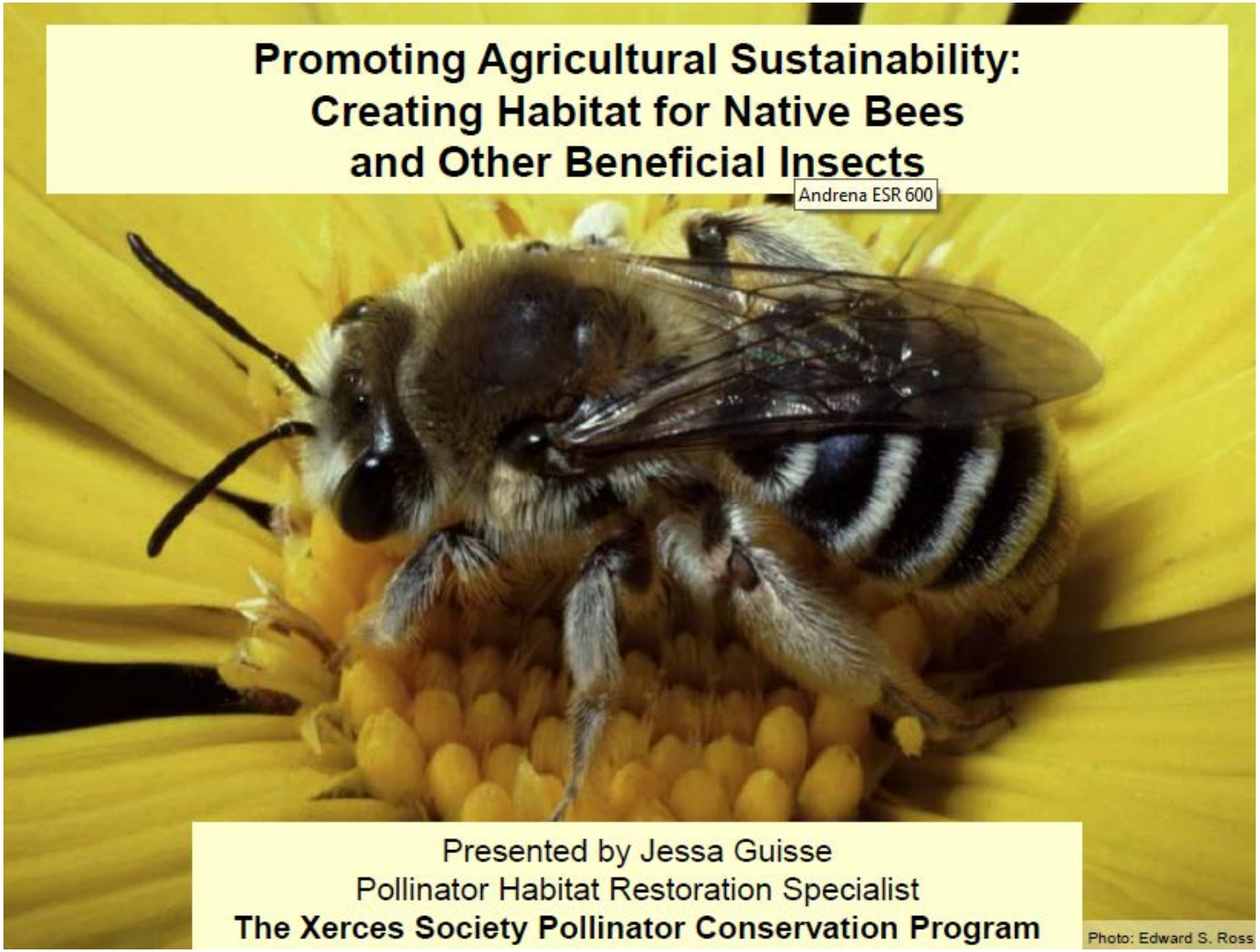
Analysis completed on: 3/1/2013

Analysis completed by: Amrith Gunasekara, PhD

Additional information:

Promoting Agricultural Sustainability: Creating Habitat for Native Bees and Other Beneficial Insects, Jessa Guisse, Xerces Society, 2012.

Documentation Reviewed



Documentation Reviewed

Patterns of widespread decline in North American bumble bees

Sydney A. Cameron[a,1], Jeffrey D. Lozier[a], James P. Strange[b], Jonathan B. Koch[b,c], Nils Cordes[a,2], Leellen F. Solter[d], and Terry L. Griswold[b]

[a]Department of Entomology and Institute for Genomic Biology, University of Illinois, Urbana, IL 61801; [b]United States Department of Agriculture-Agricultural Research Service Pollinating Insects Research Unit, Utah State University, Logan, UT 84322; [c]Department of Biology, Utah State University, Logan, UT 84321; and [d]Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois, Champaign, IL 61820

Edited* by Gene E. Robinson, University of Illinois, Urbana, IL, and approved November 24, 2010 (received for review October 3, 2010)

Bumble bees (*Bombus*) are vitally important pollinators of wild plants and agricultural crops worldwide. Fragmentary observations, however, have suggested population declines in several North American species. Despite rising concern over these observations in the United States, highlighted in a recent National Academy of Sciences report, a national assessment of the geographic scope and possible causal factors of bumble bee decline is lacking. Here, we report results of a 3-y interdisciplinary study of changing distributions, population genetic structure, and levels of pathogen infection in bumble bee populations across the United States. We compare current and historical distributions of eight species, compiling a database of >73,000 museum records for comparison with data from intensive nationwide surveys of >16,000 specimens. We show that the relative abundances of four species have declined by up to 96% and that their surveyed geographic ranges have contracted by 23–87%, some within the last 20 y. We also show that declining populations have significantly higher infection levels of the microsporidian pathogen *Nosema bombi* and lower genetic diversity compared with co-occurring populations of the stable (nondeclining) species. Higher pathogen prevalence and reduced genetic diversity are, thus, realistic predictors of these alarming patterns of decline in North America, although cause and effect remain uncertain.

Bumble bees (*Bombus*) are integral wild pollinators within native plant communities throughout temperate ecosystems (1–5), and recent domestication has boosted their economic importance in crop pollination to a level surpassed only by the honey bee (6). Their robust size, long tongues, and buzz-pollination behavior (high-frequency buzzing to release pollen from flowers) significantly increase the efficiency of pollen transfer in multibillion dollar crops such as tomatoes and berries. Disturbing reports of bumble bee population declines in Europe have recently spilled over into North America, fueling environmental and economic concerns of global decline (7–9). However, the evidence for large-scale range reductions across North America is lacking. Many reports of decline are unpublished, and the few published studies are limited to independent local surveys in northern California/southern Oregon (10), Ontario, Canada (11), and Illinois (12).

Furthermore, causal factors leading to the alleged decline of bumble bee populations in North America remain speculative. One compelling but untested hypothesis for the cause of decline in the study in the United States identified lower genetic diversity and elevated genetic differentiation (F_{ST}) among Illinois populations of the putatively declining *B. pensylvanicus* relative to those of a codistributed stable species (19). Similar patterns have been observed in comparative studies of some European species (8), but most investigations have been geographically restricted and based on limited sampling within and among populations.

Although the investigations to date have provided important information on the increasing rarity of some bumble bee species in local populations, the different survey protocols and limited geographic scope of these studies cannot fully capture the general patterns necessary to evaluate the underlying processes or overall gravity of declines. Furthermore, valid tests of the *N. bombi* hypothesis and its risk to populations across North America call for data on its geographic distribution and infection prevalence among species. Likewise, testing the general importance of population genetic factors in bumble bee decline requires genetic comparisons derived from sampling of multiple stable and declining populations on a large geographic scale. From such range-wide comparisons, we provide incontrovertible evidence that multiple *Bombus* species have experienced sharp population declines at the national level. We also show that declining populations are associated with both high *N. bombi* infection levels and low genetic diversity.

Results

Geographic Range Analysis. To assess large-scale geographic range reductions and changes in relative abundance (RA), we compared historical collection records with those from current field surveys. Current data are based on surveys (details provided in *SI Methods*, *Contemporary Field Surveys of US Bumble Bees*) conducted at 382 sites throughout the United States between 2007 and 2009 (Fig. S14 and Table S1). We netted and identified a total of 16,788 bumble bees, including four focal target species suspected of recent population declines (west: *B. occidentalis*, $N = 129$; east: *B. affinis*, $N = 22$; *B. pensylvanicus*, $N = 532$; *B. terricola*, $N = 31$) (10, 12, 20) and four thought to have relatively stable populations (west: *B. bifarius*, $N = 2{,}760$; *B. vosnesenskii*, $N = 902$; east: *B. bimaculatus*, $N = 1{,}033$; *B. impatiens*, $N = 3{,}128$) (11, 12, 21). Historical data are based on the assembly of a 73,759-specimen database (*SI Methods*, *US Bumble Bee Natural History Collection Database*) of the eight target species recorded from natural history

ECOLOGY

Ecology Letters, (2004) 7: 1109–1119 doi: 10.1111/j.1461-0248.2004.00662.x

REPORT

The area requirements of an ecosystem service: crop pollination by native bee communities in California

Claire Kremen,[1]* Neal M. Williams,[2] Robert L. Bugg,[3] John P. Fay[4] and Robin W. Thorp[5]

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[2]*Department of Biology, Bryn Mawr College, 101 N. Merion Ave, Bryn Mawr, PA 19010, USA*
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Abstract

Managing ecosystem services is critical to human survival, yet we do not know how large natural areas must be to support these services. We investigated how crop pollination services provided by native, unmanaged, bee communities varied on organic and conventional farms situated along a gradient of isolation from natural habitat. Pollination services from native bees were significantly, positively related to the proportion of upland natural habitat in the vicinity of farm sites, but not to any other factor studied, including farm type, insecticide usage, field size and honeybee abundance. The scale of this relationship matched bee foraging ranges. Stability and predictability of pollination services also increased with increasing natural habitat area. This strong relationship between natural habitat area and pollination services was robust over space and time, allowing prediction of the area needed to produce a given level of pollination services by wild bees within this landscape.

Keywords

Agriculture, *Apis mellifera*, Apoidea, bee community, bee foraging distance, conservation planning, landscape ecology, pollination service, scale effects.

INTRODUCTION

Ecosystem services, including climate regulation, soil production, water purification, pest control and crop pollination are critical to human survival (Daily 1997). Management of services could also provide incentives for biodiversity conservation (Daily & Ellison 2002), particularly in human-dominated landscapes where such services are most needed (Scheer & McNeely 2002). Nonetheless, few natural areas are managed or valued for the services they provide, although many are managed to produce ecosystem goods (e.g. wood, wildlife, fish). In large measure, this is because the ecology of ecosystem services is poorly known, limiting our ability to understand their value and to plan their conservation and management (Palmer *et al.* 2004). Developing such plans require knowledge of the relationship between the services provided and the area of habitat conserved. This relationship has been estimated for services from plant communities like carbon sequestration and storage (Niles *et al.* 2002) and water flow regulation provided by different vegetation types (Guo *et al.* 2000), but not for any animal-based ecosystem service.

One such service is crop pollination. Thirty per cent of the US food supply by volume depends on animal pollinators (McGregor 1976), of which bee species (Apoidea) are the most important (Roubik 1995; Nabhan & Buchmann 1997). Many farmers rely on colonies of the European honeybee (*Apis mellifera*) that they import temporarily to crop fields to provide pollination during bloom (Free 1993; Delaplane & Mayer 2000). Honeybees are not always the most effective pollinators of a given crop (Parker *et al.* 1987; Kevan *et al.*

Project Summary

Pollinators are vital to agricultural production, and yet they are becoming scarcer. Bee populations, in particular, are on the decline, and the Xerces Society is working to change that. The Society aims to augment invertebrate conservation through habitat restoration. The Pollinator Conservation Program provides resources, education, research and advocacy for pollinators and their habitat.

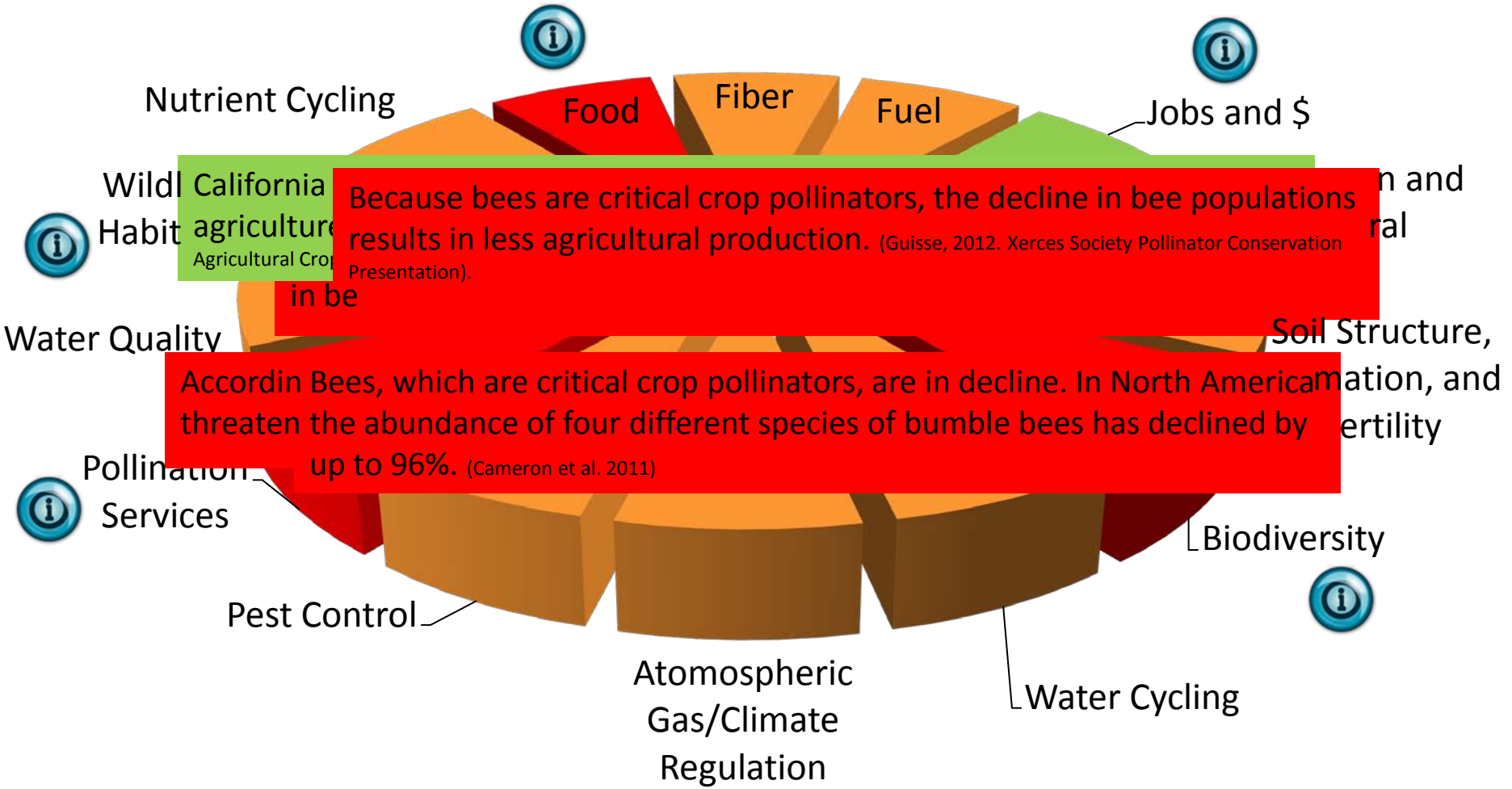
- The program recognizes the unique and important role that California farmers play in habitat creation and aims to provide resources to facilitate their conservation efforts
- The program's primary goal is to increase habitat for native pollinators
- Farmers are encouraged to install flowering plants in hedgerows and insectary strips as well as plant cover crops and restore riparian habitats
- Pollinator habitat creation provides numerous ecological benefits, including improvements in water quality, biodiversity and soil fertility in addition to increasing farmers' yields

Source: Jessa Guisse. 2012. Xerces Society Pollinator Conservation Presentation.

Qualitative Assessment Model
Pollinator Conservation

BEFORE PROJECT IMPLEMENTATION

CLICK ON THE BLUE ICONS TO OPEN AND CLOSE ADDITIONAL INFORMATION



Qualitative Assessment Model
Pollinator Conservation

AFTER PROJECT IMPLEMENTATION

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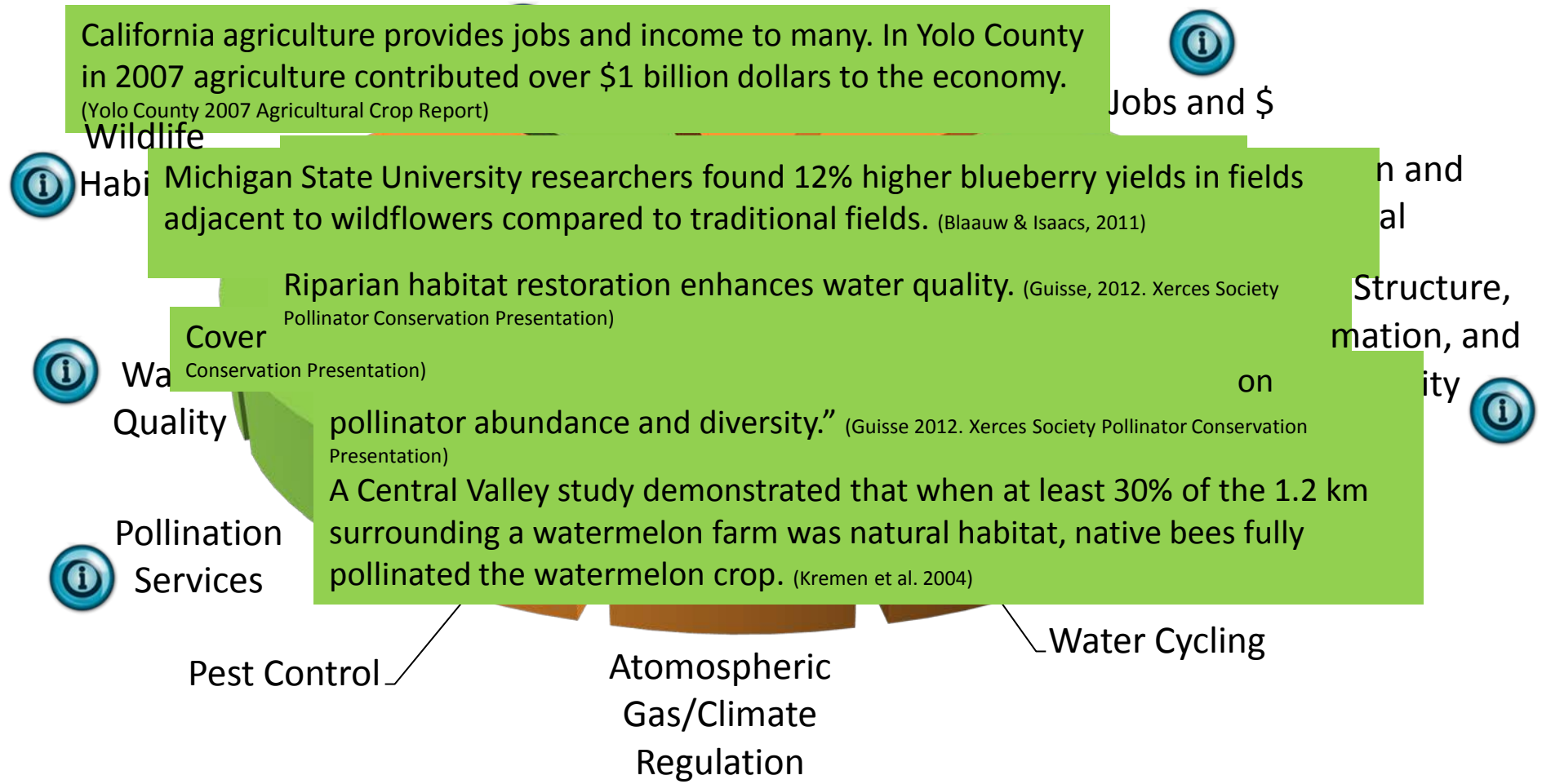

California agriculture provides jobs and income to many. In Yolo County in 2007 agriculture contributed over $1 billion dollars to the economy. (Yolo County 2007 Agricultural Crop Report)

Michigan State University researchers found 12% higher blueberry yields in fields adjacent to wildflowers compared to traditional fields. (Blaauw & Isaacs, 2011)

Riparian habitat restoration enhances water quality. (Guisse, 2012. Xerces Society Pollinator Conservation Presentation)

Cover
Conservation Presentation)

pollinator abundance and diversity." (Guisse 2012. Xerces Society Pollinator Conservation Presentation)

A Central Valley study demonstrated that when at least 30% of the 1.2 km surrounding a watermelon farm was natural habitat, native bees fully pollinated the watermelon crop. (Kremen et al. 2004)

Qualitative Assessment Model
Pollinator Conservation
Management Practices

Ecosystem Service Category	Management Practice	Reference
Wildlife Habitats	• Restore riparian habitats • Plant hedgerows	Jessa Guisse 2012, Xerces Society Pollinator Conservation Presentation
Water Quality	• Restore riparian habitats	Jessa Guisse 2012, Xerces Society Pollinator Conservation Presentation
Soil Structure and Fertility	• Plant cover crops	Jessa Guisse 2012, Xerces Society Pollinator Conservation Presentation
Pollination Services	• Plant flowering plants • Restore natural habitat along farm edges	Jessa Guisse 2012, Xerces Society Pollinator Conservation Presentation Kremen et al., 2004
Food	• Attract pollinators through natural habitat restoration and wildflower planting along farm edges	Blaauw & Isaacs, 2011

Qualitative Assessment Model
Pollinator Conservation

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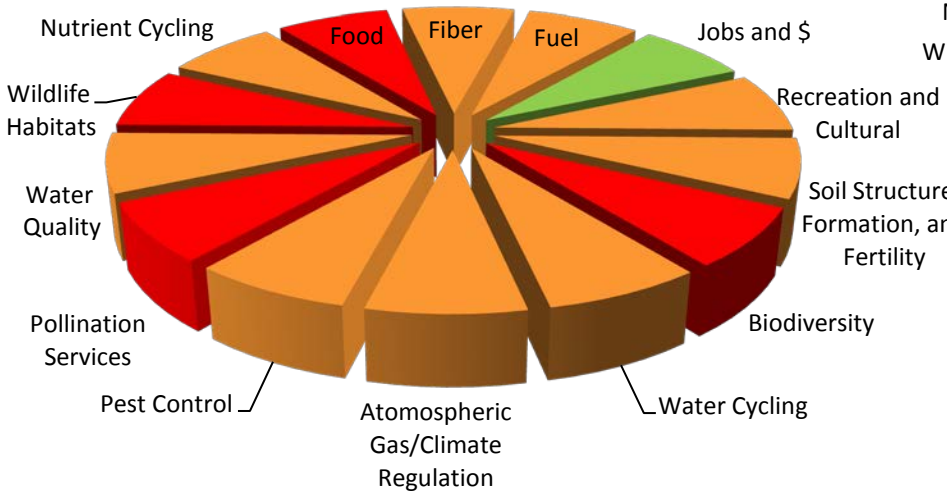

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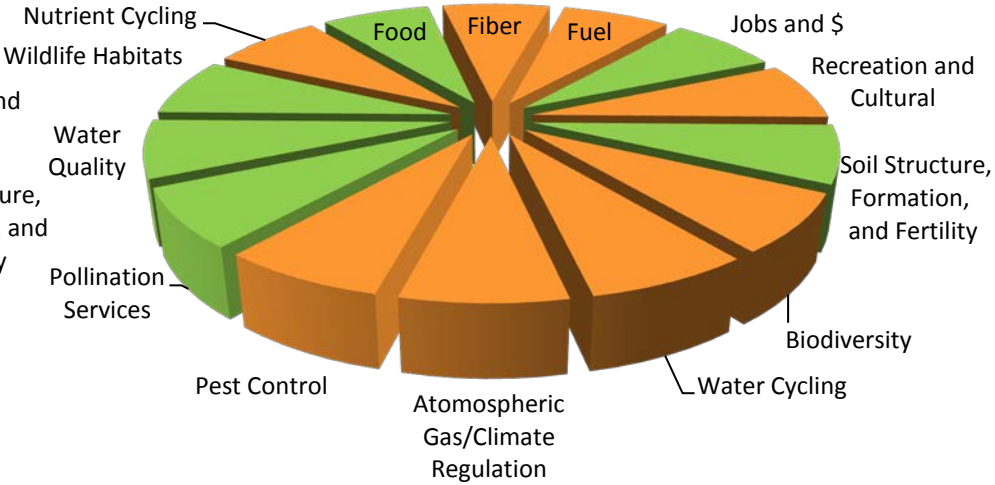

QUALITATIVE ASSESSMENT MODEL

Managed Rangeland

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

Analysis completed on: 2/10/2013
Analysis completed by: Amrith Gunasekara, PhD
Additional information:
CalCAN. Case Study: Climate-Friendly Farming.
http://ucanr.org/news/?uid=926&ds=191
http://www.blm.gov/ca/st/en/fo/bishop/range0/r_benefits.html

Documentation Reviewed

Burroughs Family Farms

A few miles outside of Denair in California's Central Valley, the Burroughs family works a long, narrow piece of land that has been in the family for generations. The overlapping, continuously growing collection of food and farming enterprises that make up Burroughs Family Farms is run by an overlapping, continuously growing collection of children and in-laws.

The property runs along a dry creek and over low rolling hills. It is spotted with small ponds and vibrant oases of vegetation. The Burroughs' farming ethos places a high value on stewardship because the land is seen as a resource for the next generation. Most of that land is either organic or transitioning to organic production, marking their ongoing progress in a journey begun decades ago.

"My husband and I always had a strong responsibility for taking care of the land and passing it down to the next generation in better condition than we inherited it," reflects Rosie. Ward points out that ranchers in particular have an opportunity to impact the environment, including minimizing their climate impacts. Carbon sequestration on farmlands is a promising method of reversing climate change. "Working ground annually doesn't fix much carbon because you lose it when you till," he says. "But the grass farming business, that's the key."

Unlike the majority of dairies in California that use corn-based animal feed with minimal access to pasture, the Burroughs' cattle receive 80 percent of their nutrition from forage. They use a rotational grazing method called Managed Intensive Grazing (MIG) which allows livestock access to relatively small irrigated pasture areas for short durations, striking a balance between providing adequate nutrition for the animals and a recovery period for the grasses. Research indicates that MIG may enhance soil carbon sequestration, while also avoiding the greenhouse gas (GHG) emissions associated with growing and transporting conventional animal feed.

The Burroughs are also working with a biologist to catalogue the types of grasses found in their managed pastures and have found that sound grazing practices are beneficial to native flora. By allowing native grasses to flourish, the Burroughs also increase soil organic matter, reduce soil erosion, and improve the drought tolerance and biodiversity of their native pasture. This better prepares their operation for changing precipitation patterns and increasingly uncertain weather.

In addition to sequestering carbon in the soil, grass farmers like the Burroughs reduce their overall GHG emissions by using grazing. Conventional beef and dairy operations that confine animals indoors typically emit large amounts of ammonia and methane from lagoons that store decomposing waste and via the anaerobic fermentation process associated with grains that have been chopped and stored in large silage pits. Methane is a potent GHG with over 20 times the climate change impact of carbon dioxide. Grass-based beef and dairy operations like the Burroughs' neatly sidestep this problem, as manure is deposited directly on pastures where it contributes to nutrient cycling as it fertilizes pastures, feeds soil microorganisms and improves soil structure and nutritional value.

Carbon sequestration in agriculture:
The removal of carbon dioxide from the atmosphere by storing the carbon in soils or woody plant material, thereby slowing the effects of climate change.

Some practices that increase carbon sequestration include:

- Cover crops
- Reduced synthetic fertilizer inputs
- Composting and adding organic amendments
- Planting perennial crops, trees or other woody vegetation into rangeland or farm landscapes
- Conservation tillage
- Rotational grazing

Bay Area's April showers may not bring May flowers

Carl Nolte, Chronicle Staff Writer
Published 4:00 am, Monday, April 4, 2011

VIEW: LARGER | HIDE 3 of 3 ◄ PREV NEXT ►

Two orange wild flowers grow next to a path leading to the top of Grand View Park on Friday, April 1, 2011. Botanists say that April showers may not bring May flowers as tall grass and non native plants crowd out the wild flowers. Photo: Anna Vignet, The Chronicle



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Larger | Smaller Font

This year's unusually wet spring could have unintended consequences: April showers may not bring the flowers that bloom in May.

The reason, botanists say, is that the downpours that soaked the Bay Area in March have produced

Sources: http://calclimateag.org/wp-content/uploads/2012/02/Burroughs-farmer-profile-small.pdf ;
http://www.sfgate.com/green/article/Bay-Area-s-April-showers-may-not-bring-May-flowers-2376217.php

Documentation Reviewed

The Potential of U.S. Grazing Lands to Sequester Carbon and Mitigate the Greenhouse Effect

R.F. Follett • J.M. Kimble • R. Lal

LEWIS PUBLISHERS
Boca Raton London New York Washington, D.C.

February 1, 2007

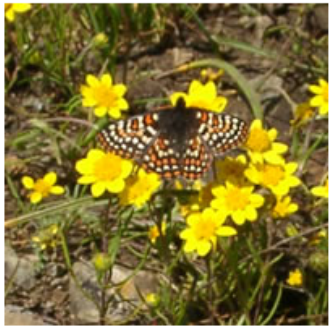
CONTACT: Jeannette Warnert, (559) 646-6074, jewarnert@ucdavis.edu

UC Cooperative Extension helps bring cattle grazing back to Bay Area grassland

To conservationists, it seemed like a good idea. Pull lumbering, voracious cattle from grasslands acquired for preservation, and the land will return to its primeval glory.

However, natural California has changed in the last 200 years – changes that have given non-native plants an edge over native species when there are no cattle grazing the land.

University of California Cooperative Extension (UCCE) natural resources farm advisor Sheila Barry has researched the modern evolution of California grassland and low-impact rangeland management techniques. She works closely with land managers in the Bay Area, which is now witnessing a resurgence of managed grazing on open land.



Bay Checkerspot Butterflies thrive in areas managed with cattle grazing.

A major benefit of grazing open grassland is fire fuel management, Barry said. However, she believes an even more important driver is improving the habitat for threatened and endangered species, such as the red-legged frog, the California tiger salamander, the Western burrowing owl and the golden eagle.

Even insects profit from grazing. Barry considers the Bay Checkerspot Butterfly to be the "poster child of grazing benefits."

"It's a classic story," she said. "The only remaining populations of this butterfly are on grazed lands. In areas that were specifically set up for conservation and where cattle grazing was eliminated, the butterfly populations have disappeared."

Sources:http://eco.ibcas.ac.cn/group/baiyf/pdf/gxzy/9_The_Potential_of_U.S._Grazing_Lands_to_Sequester_Carbon_and_Mitigate_the_Greenhouse_Effect.pdf; http://ucanr.org/news/?uid=926&ds=191

Project Summary

Lands allocated for ranching in California have been converted to non-working protected conservation lands in hopes of preserving natural habitat for wildlife. However, the overall health of the ecosystems on these non-working lands has declined in some cases. As scientific research continues to fully evaluate rangeland ecosystems, preliminary finding suggest that managed rangelands provide numerous Ecosystem Services beyond food production. These benefits include:

- Biodiversity: grazing on public and private lands help control the spread of non-native invasive species and proliferation of native plant species
- Wildlife Habitat: many endangered or threatened species rely on California's rangelands for habitat
- Climate and Atmospheric Regulation: grazing lands are capable of sequestering soil carbon. Grazing also reduces wildfire threats and improves air quality
- Water Quality: Rangeland management practices enhances riparian areas and limits erosion of sediment into surface water bodies
- Nutrient Cycling: Manure deposited on pastures increases soil health

Sources: Follett, R. F., Kimble, J. M., & Lal, R. (2001). *The Potential of U.S. Grazing Lands to Sequester Carbon and Mitigate the Greenhouse Effect*. Boca Raton, Florida: CRC Press.
Bureau of Land Management. http://www.blm.gov/ca/st/en/fo/bishop/range0/r_benefits.html
CALCAN. Case Study: Climate-Friendly Farming. Burroughs Family Farms.
Nolte, C. (2011, Apr. 4). Bay Area's April Showers May Not Bring May Flower. *San Francisco Chronicle*. http://www.sfgate.com/green/article/Bay-Area-s-April-showers-may-not-bring-May-flowers-2376217.php

Qualitative Assessment Model
Managed Rangeland

BEFORE PROJECT IMPLEMENTATION

CLICK ON THE BLUE ICONS TO OPEN AND CLOSE ADDITIONAL INFORMATION

Removing rangelands would eliminate the only remaining habitat for the endangered Bay Checkerspot Butterfly. (http://ucanr.org/news/?uid=926&ds=191)

bs and $

Wildlife Habitats

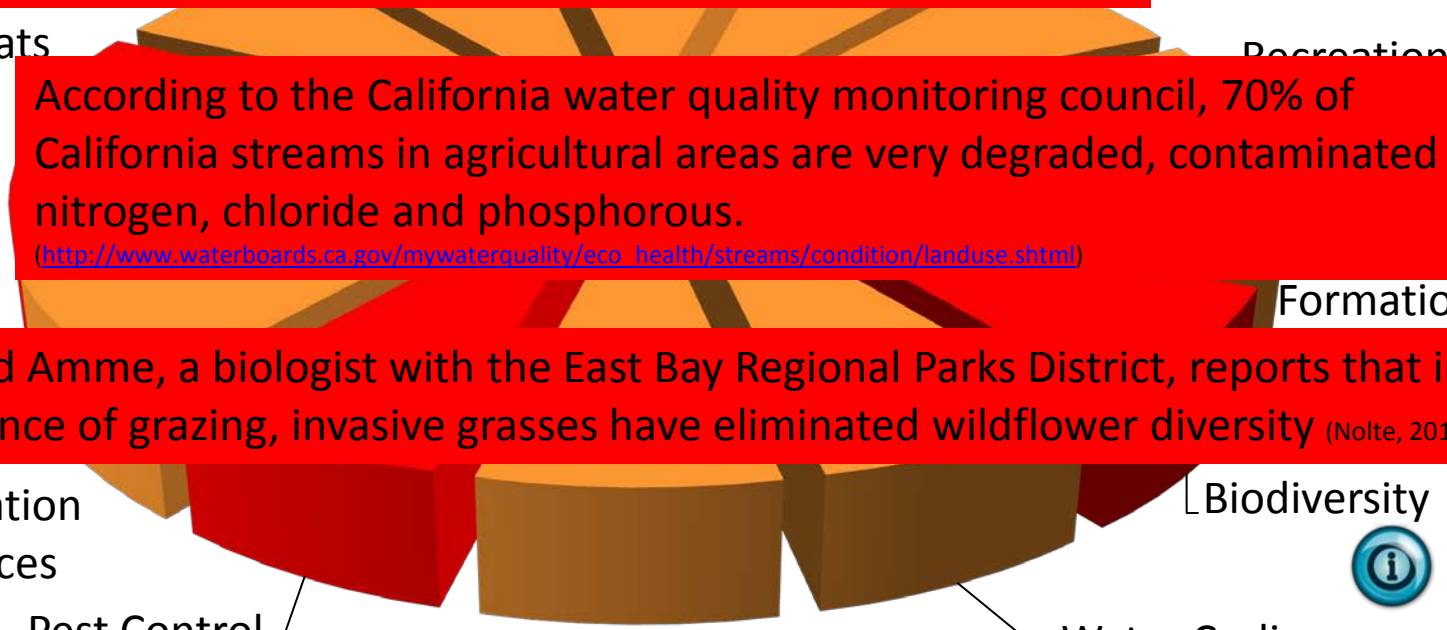
Recreation and

According to the California water quality monitoring council, 70% of California streams in agricultural areas are very degraded, contaminated with nitrogen, chloride and phosphorous.
(http://www.waterboards.ca.gov/mywaterquality/eco_health/streams/condition/landuse.shtml)

Water Quality

Formation, and

David Amme, a biologist with the East Bay Regional Parks District, reports that in the absence of grazing, invasive grasses have eliminated wildflower diversity (Nolte, 2011).



Pollination Services

Biodiversity

Pest Control

Water Cycling

Atomospheric Gas/Climate

Without grazing, invasive, non-native grasses predominate. (Nolte, 2011)

Q li i A M del

Ranching in California consists of thousands of ranches, employing nearly 28,000 people. (http://www.labormarketinfo.edd.ca.gov/Content.asp?pageid=158)

"According to the Economic Research Service of USDA, approximately 85% of all land is not suitable for agricultural crops. As a result, by grazing animals on this land, ranchers double the land area that can be used to produce food." (http://www.calcattlemen.org/Cattle_101/Cattle_and_the_Environment.aspx)

CL

Nutrient Cycling

Manure depo d on pastures increases nutrient availability for soil microrganisms. (Michael Fields Agricultural Institute as cited in CalCAN. Case Study: Climate-Friendly Farming. Burroughs Family Farms)

Wildlife Habitats

UCCE advisor Sheila Barry explains that many endangered or threatened species, such as the California Tiger Salamander and the red-legged frog rely on California's rangelands for habitat. Grazing lands are in fact the only remaining ha (http://ucanr.org/news/?u = =

reation and Cultural

Many ranches provide recreation services, including nature viewing opportunities, hiking, horseback riding trails and sites for events. (http://www.rangelandtrust.org)

Water Quality

Grazing on native grass pastures reduce soil erosion and installing drains in the pasture reduces runoff and thus water contamination. (CALCAN. Case Study: Climate-Friendly Farming) Grazing also promotes healthy riparian areas which can limit erosion and improve water quality. (http://www.blm.gov/ca/st/en/fo/bishop/range0/r_benefits.html)

Fertility

Pollination Services

ersity

Gr i l nds duc nho i i b t i il carbon both in ca Grazing controls the growth of invasive, non-native plants. (http://ucanr.org/news/?uid=926&ds=191)

ands to Sequester

C bo and Mitigate the G eenho Eff t B Rat , Fl ida: CRC P)

Pest Control

David Amme, a biologist with the East Bay Regional Parks District, contends that grazing contributes to the proliferation of native wildflowers by controlling invasive grass growth. (Nolte, 2011).

Qualitative Assessment Model
Managed Rangeland
Management Practices

Ecosystem Service Category	Management Practice	Reference
Wildlife Habitats	• Pasture lands provide habitats for plant and animal species	http://ucanr.org/news/?uid=926&ds=191
Water Quality	• Restore riparian habitats • Establish pasture lands to reduce soil erosion	CalCAN Case Study Bureau of Land Management
Pest Control	• Grazing controls growth of invasive, non-native grasses	http://ucanr.org/news/?uid=926&ds=191
Climate Regulation	• Grazing lands sequester soil carbon in its organic and inorganic forms	Follett, Kimble, & Lal, 2001
Nutrient Cycling	• Manure deposited on pasture land increases nutrient availability for soil microorganisms	Michael Fields Agricultural Institute as cited in CalCAN
Biodiversity	• Grazing controls invasive species, allowing native species to flourish • Grazing lands provide habitats for endangered species	Nolte, 2011 http://ucanr.org/news/?uid=926&ds=191

Qualitative Assessment Model
Managed Rangeland

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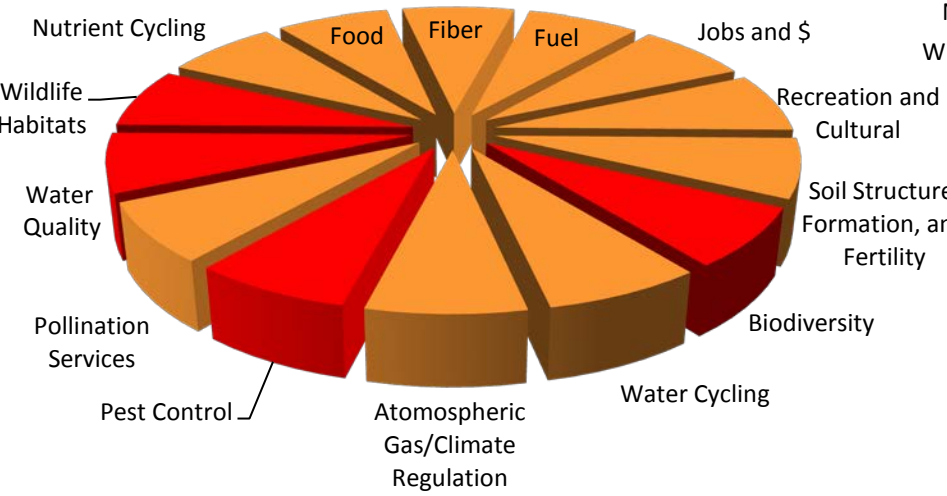

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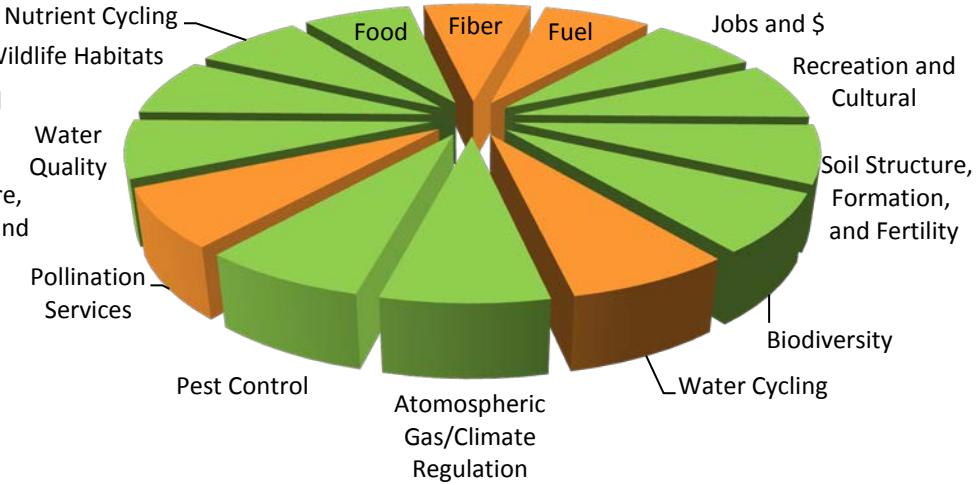

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QUALITATIVE ASSESSMENT MODEL

Managed Rangeland:

Case Studies

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

Analysis completed on: 3/28/2013
Analysis completed by: Amrith Gunasekara, PhD
Additional information:
http://www.workranch.com/; http://www.tvrgrassfed.com/index.htm
http://www.marinorganic.org/producers/producers_nicasio_native.html
http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx

Documentation Reviewed

Sources: http://www.workranch.com/; http://www.tvrgrassfed.com/index.htm

Documentation Reviewed

Previous Farm | Next Farm

:: NICASIO NATIVE GRASS RANCH

John Wick & Peggy Rathmann
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Fax: 415.662.9827
johnwick@sonic.net
www.marinclimateinitiative.org

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The Farmer

When John Wick and Peggy Rathmann moved to their 539 acre ranch in 1998, their intention was to find a way to ranch that cared for the environment and nurtured the wild lands. Today, they are doing just that. Rotational grazing, bailing silage, preserving native bunch grasses and building top soil with their biodiesel tractors are all just part of a thrilling day on the farm for Peggy and John. High on their list of priorities is their dedication to reversing the worldwide trend of global warming by building the topsoil on their property and using their extensive grasslands as a means of sequestering carbon; in fact, Nicasio Native Grass Ranch was previously known as Carbon Farm. As part of the project, they are working with scientists to test their site as well as others to calculate the amount of carbon their grasslands are currently holding. In addition, their devotion to native plants is impressive. Just mention the word Danthonia to Peggy and her eyes light up and the native grass ecology lesson begins. The California oat grass stores it seeds in the stems of the plant and the plant itself can live for up to 300 years. Plus, cows just love it. Their other brainstorm: wondering if a u-pick wild foods farm would take off... they are currently offering local hazelnuts, bay nuts and all the gophers you can catch

California Ranches Wins Environment Award

Leavitt Lake Ranches of Vina and Susanville, Calif., is a 2009 Environmental Stewardship Award winner. Representing the National Cattlemen's Beef Association Region VI, family was recognized at the 2009 Cattle Industry Summer Conference for their innovative approaches to land management and conservation.

Owned and operated by Darrell Wood, his wife Callie, son Ramsey and daughter Dallice, Leavitt Lake Ranches has family ranching ties dating back to the 1860's. When Darrell and Callie wed in 1981, they were working in segments of the agriculture industry and didn't own any cattle or land. With a goal to acquire ranches that had been owned by Darrell's family, they began buying

Sources: http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx;
http://www.marinorganic.org/producers/producers_nicasio_native.html

Project Summary

Ranches are being recognized for environmental stewardship in California. As the following examples demonstrate, working ranch lands provide numerous ecosystem services, including biodiversity, wildlife habitats, climate regulation, water quality, pest control and recreation services. Below are some ranches that have taken measures to provide Ecosystem Services beyond crop production.

- **Nicasio Native Grass Ranch**: This 539-acre cattle ranch in Marin provides biodiversity, climate regulation and recreation Ecosystem Services. It is the home of the Marin Carbon Project, which is researching the carbon storage potential of rangeland through compost application.
- **Thompson Valley Ranch**: Cattle graze on grasses and legumes that enrich the soil. The land owners have restored riparian areas and provided over 10 acres of wetland habitat.
- **Leavitt Lake Ranches**: The ranch owners restored vernal pools, providing habitat for threatened species, and enhanced creek beds to facilitate salmon migration.
- **Work Family Ranch**: Grazing has allowed native grasses to return to this ranch. Buffer strips of grasses were installed along stream banks, improving water quality. Recreation and educational programs are also offered.

Sources: http://www.marinorganic.org/producers/producers_nicasio_native.html; http://www.tvrgrassfed.com/index.htm; http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx; http://www.workranch.com/

Qualitative Assessment Model
Managed Rangeland Case Studies

BEFORE PROJECT IMPLEMENTATION

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Removing rangelands would eliminate habitat for the endangered species such as the Bay Checkerspot Butterfly. (http://ucanr.org/news/?uid=926&ds=191)

and $

Wildlife Habitats

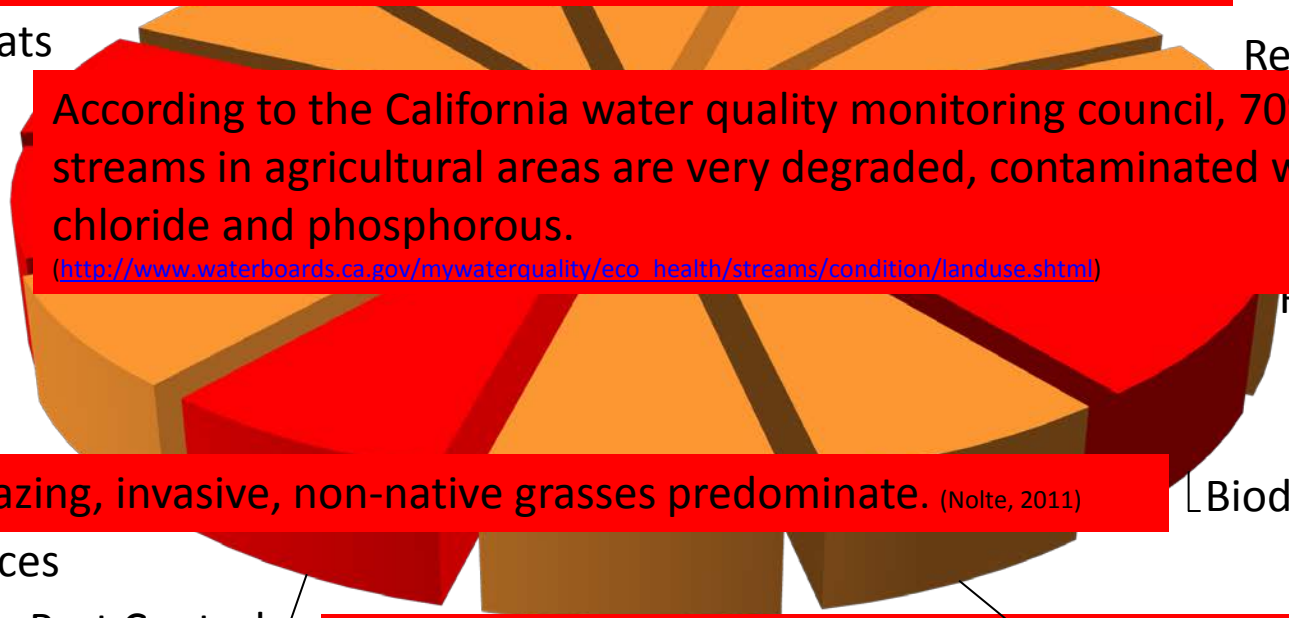
Recreation and

According to the California water quality monitoring council, 70% of California streams in agricultural areas are very degraded, contaminated with nitrogen, chloride and phosphorous.
(http://www.waterboards.ca.gov/mywaterquality/eco_health/streams/condition/landuse.shtml)

Water Quality

Formation, and

Fertility



Without grazing, invasive, non-native grasses predominate. (Nolte, 2011)

Biodiversity

Services

Pest Control

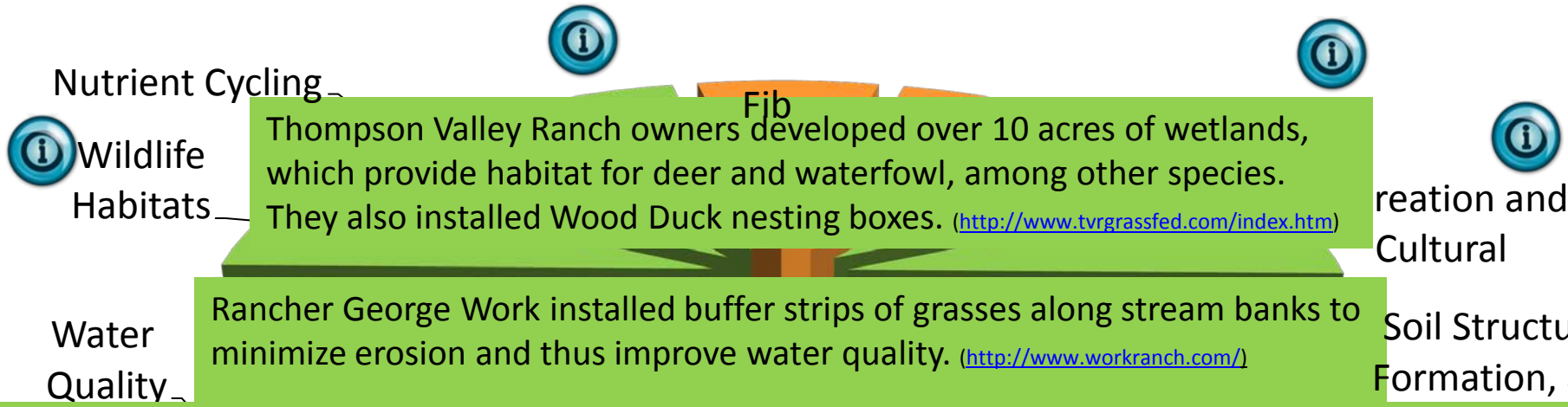
David Amme, a biologist with the East Bay Regional Parks District, reports that in the absence of grazing, invasive grasses have eliminated wildflower diversity (Nolte, 2011).

Managed Rangeland Case Studies

Thompson Valley Ranch produces grass-fed Angus beef rich in vitamins and fatty acids due to their diet of native grasses. (http://www.tvrgrassfed.com/index.htm)

Work Family Ranch offers farm stays, trails, horseback riding and environmental stewardship workshops. (http://www.workranch.com/)

Leavitt Lake Ranches has provided livelihoods for the Leavitt family for generations, since the 1860's, as is the case for many ranching operations. (http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx)



Thompson Valley Ranch owners developed over 10 acres of wetlands, which provide habitat for deer and waterfowl, among other species. They also installed Wood Duck nesting boxes. (http://www.tvrgrassfed.com/index.htm)

Rancher George Work installed buffer strips of grasses along stream banks to minimize erosion and thus improve water quality. (http://www.workranch.com/)

Grazing on the Work Family Ranch has allowed a diverse array of native grasses to flourish. (http://www.workranch.com/) Restoration of vernal pools at Leavitt Lake Ranches has provided habitats for threatened species. (http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx)

At Nicasio Native Grass Ranch, native grasses sequester carbon. The Marin Carbon Project is currently conducting a research project on site evaluating carbon storage potential. (http://www.marinorganic.org/producers/producers_nicasio_native.html; http://marincarbonproject.org/programs.php)

Grazing controls the growth of invasive, non-native plants. (http://www.workranch.com/)

Qualitative Assessment Model
Managed Rangeland Case Studies
Management Practices

Ecosystem Service Category	Management Practice	Reference
Wildlife Habitats	• Develop wetland habitats • Restore riparian areas • Restore vernal pools	http://www.tvrgrassfed.com/index.htm http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx
Water Quality	• Restore riparian habitats to reduce soil erosion	http://www.workranch.com/
Pest Control	• Grazing controls growth of invasive, non-native grasses	http://www.workranch.com/
Climate Regulation	• Grazing facilitates growth of native grasses, which sequester soil carbon.	http://www.marinorganic.org/producers/producers_nicasio_native.html
Recreation	• Provide trails for horseback riding and hiking • Host events and visitors • Offer workshops	http://www.workranch.com/
Biodiversity	• Grazing controls invasive species, allowing native species to flourish • Restore vernal pools to provide habitats for endangered species	http://www.environmentalstewardship.org/regionvi-leavittlakeranches.aspx http://www.tvrgrassfed.com/index.htm

Qualitative Assessment Model
Managed Rangeland Case Studies

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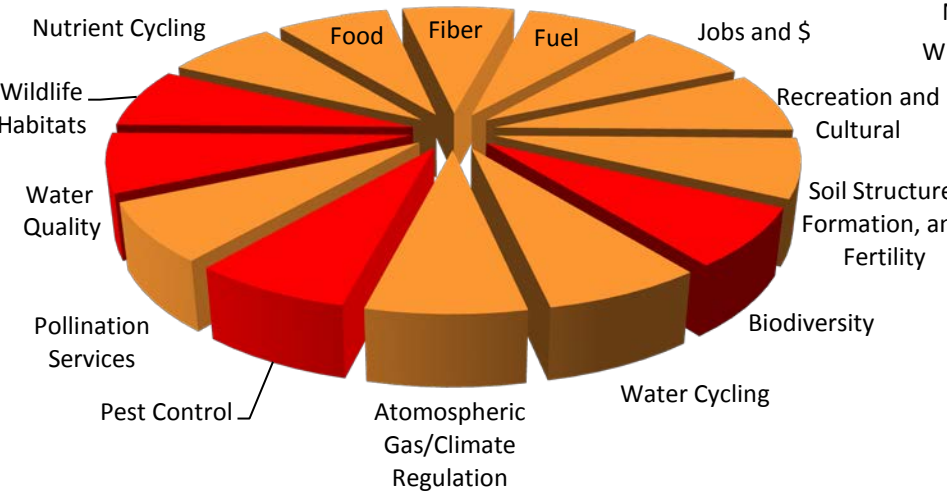

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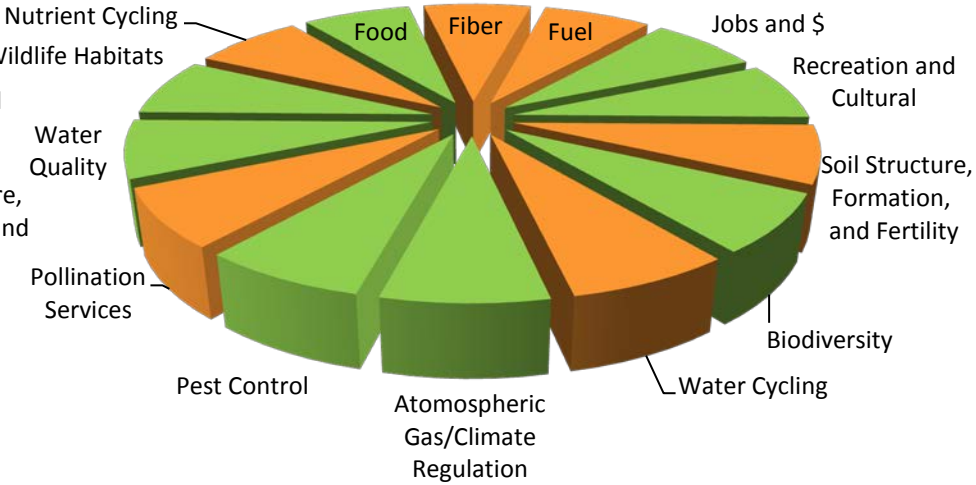

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