

33rd Annual Salmonid Restoration Federation Conference

March 11-14, 2015, Santa Rosa, CA



Coho Salmon Workshop

***'Innovative Trans-Boundary Approaches to
Coho Salmon Recovery'***

**Conveners: Stephen Swales, Fisheries Branch, California
Department of Fish & Wildlife,
Charlotte Ambrose, NOAA Fisheries, West Coast Region.**

Workshop Outline

Coho salmon populations in central and northern California coastal watersheds are in severe decline and are listed as threatened or endangered under both the state and federal Endangered Species Acts. Many coho populations are extirpated, and many others may be heading towards extirpation in the near future. While coho populations appear to be declining throughout the Pacific Northwest and southern British Columbia, those in California are at the southernmost limit of the geographic range of the species, and are the most threatened. Coho recovery plans, developed by both state and federal governments, aim to restore populations to viable levels.

This workshop was intended to stimulate discussions on recovery efforts and assemble specialists in coho salmon recovery from California, British Columbia and the Pacific Northwest. The workshop focused on innovative, trans-boundary approaches to recovery that can prevent further population extirpations and lead to full recovery. It is hoped the fresh perspectives and lessons learned will help with the development and implementation of new approaches to the recovery of coho salmon in California.

The goals of the workshop were as follows: i) to have participants exchange regional and national information on the current status of coho salmon populations and the major stresses, ii) to share information on various approaches to the recovery of coho salmon populations – what does or does not work, and iii) to develop proposals that will lead to the implementation of innovative approaches to the recovery of coho salmon populations.

MAIN SUMMARY POINTS OF PANEL DISCUSSION

1. Need to understand (particularly under an extinction scenario) the importance of planning ahead for recovery.
2. Protect 'stronghold' watersheds e.g. Smith River, to maintain the best and viable populations.
3. An implementation framework is an important (vital) element of recovery plans.
4. Importance of planning on a local scale within a sub-watershed (e.g. within Sproul Creek, SF Eel River) not just 'population wide' - needed to put recovery plans into action on the ground.
5. Importance of working with both landowners and stakeholders – need to be mindful of landowner assurances.
6. A multi-pronged approach to recovery is needed – including habitat protection, habitat restoration and population supplementation, where necessary.
7. Population monitoring is important to assess the success, or otherwise, of recovery programs.
8. Need to develop an experimental approach to determine the effectiveness of habitat restoration.
9. Focus on priority watersheds and where to best invest limited resources - a smaller number of populations, the "priority" populations for listed species recovery.
10. Need to move away from the 'fund something everywhere' approach to the 'fund lots of things in these places' approach.
11. Need to develop a more 'holistic' approach to coho recovery in which the restoration of ecosystem processes in watersheds is a key element.

Workshop Presentations

1. *California Coho Salmon - A Species 'at the edge' – An Assessment of Current Recovery Status*. Presenters: Stephen Swales, California Department of Fish & Wildlife, Charlotte Ambrose NMFS, Julie Weeder NMFS.
2. *Are California Coho Salmon Doomed? How to Improve Their Prognosis by Applying Lessons Learned from Studies on Canadian Coho Salmon*. Presenter: Jim Irvine, Pacific Biological Station, Fisheries and Oceans Canada.
3. *Use of System Dynamic Modeling as a Tool for Coho Recovery in Olema Creek, Point Reyes National Seashore, Marin County, California*. Michael Reichmuth, National Park Service.
4. *Creating Rearing Habitat for ESA Listed Coho Salmon With Multiple Life History Strategies*. Michael Wallace. California Department of Fish & Wildlife.
5. *Investigation of the Relationship Between Physical Habitat and Salmonid Abundance in Two Coastal Northern California Streams*. Sean Gallagher. California Department of Fish & Wildlife.
6. *The Effectiveness of Artificial Upstream Migration Flows for Coho Salmon*. Eric Ettlinger. Marin Municipal Water District.
- 7.¹ *Coho Salmon in a Spring Creek: Life history tactics of coho salmon in the Shasta River and a method for quantifying survival to evaluate and prioritize restoration efforts*. Chris Adams. California Department of Fish & Wildlife.
8. *Population Spatial Structure is an Essential Metric for Defining and Prioritizing Coho Salmon Restoration Projects*. Justin Garwood, California Department of Fish & Wildlife.
- 9.² *Juvenile Coho Salmon (*Oncorhynchus kisutch*) Exhibit Compensatory Mechanisms in a Large Volcanic Spring-fed River*. Robert Lusardi, UC Davis Center for Watershed Sciences.
10. *What You Do Matters: The Latticework of Federal Listing Factors*. Charlotte Ambrose, NOAA Fisheries.

¹, Presentations not included as studies are ongoing

²

Slide 1

SRF Workshop, 2015
Innovative Trans-Boundary Approaches to Coho Salmon Recovery

Workshop Coordinators
Stephen Swales, CDFW & Charlotte Ambrose, NMFS

Slide 2

in·no·va·tive
adjective: introducing or using new ideas or methods
: having new ideas about how something can be done

INNOVATION

KNOWLEDGE RESEARCH IDEAS





Slide 3



Slide 4

“People who refer to ‘out-of-the-box’ see the box ... People who don't know the box even exists are the innovative thinkers”

Trans-Boundary Approaches to Coho Recovery

 <p>Disciplinary</p>	 <p>Multidisciplinary</p>
 <p>Interdisciplinary</p>	 <p>Transdisciplinary</p>

Transdisciplinary:
Focus on an issue, such as pollution or species recovery, both **within and beyond discipline boundaries** with the possibility of **new perspectives**

Go against the flow....



Title: California coho salmon - a species 'at the edge' – an assessment of current recovery status.

Presenters: Stephen Swales, Fisheries Branch, California Department of Fish & Wildlife.
Stephen.swales@wildlife.ca.gov.

Charlotte Ambrose, NOAA Fisheries, charlotte.a.ambrose@noaa.gov. Julie Weeder, NOAA Fisheries, julie.weeder@noaa.gov.

Abstract:



In California, coho salmon populations can be considered to be 'at the edge' from two perspectives; 1. They are situated at the southernmost limit of the global geographic range of the species, 2. Recent population declines in many of California's coastal watersheds has resulted in the species being listed, under both the state and federal Endangered Species Acts, as either threatened or endangered, and many populations may be at the edge of local extinction. As a result of these listings, state and federal agencies recently produced separate coho salmon recovery plans. In 2004, California Department of Fish & Game produced the Recovery Strategy for California Coho Salmon, while more recently, in 2012, the NOAA National Marine Fisheries Service produced the Final Recovery Plan for Coho Salmon in the CCC ESU. In 2014, NOAA Fisheries also released the Final Recovery Plan for Coho Salmon in the SONCC ESU. However, coho salmon populations in many of California's coastal watersheds continue to decline, some to the point of extirpation. The plight of the species is further compounded by on-going severe drought conditions across most of California, which leads to reduced stream flows and increased water temperatures, potentially increasing fish mortality across the range of distribution. The situation of California coho salmon at the southernmost edge of the natural range of the species may also make fish more susceptible to any adverse effects of climate change. In this paper it is intended to review the current status of coho salmon recovery in California's coastal watersheds, including habitat restoration, inter-agency collaborations, captive rearing programs and other recovery efforts.

Slide 1

California Coho Salmon A Species at the Edge

Stephen Swales
California Department of Fish & Wildlife.


Charlotte Ambrose & Julie Weeder
NOAA Fisheries.



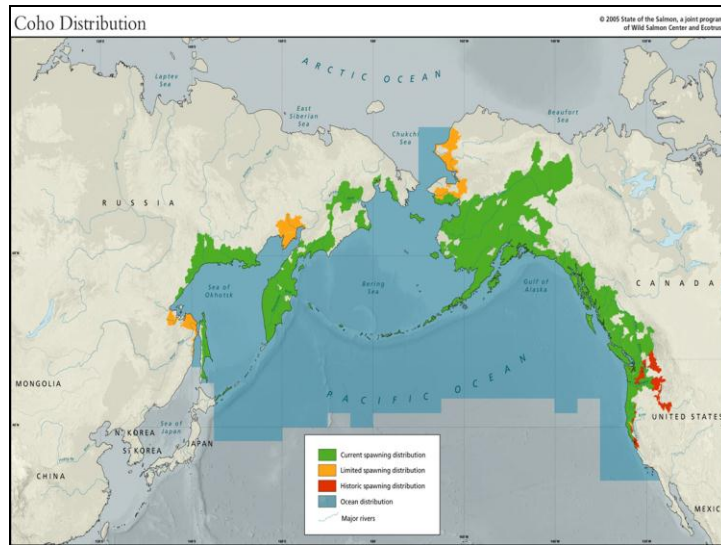
Slide 2

Talk Outline

- Range and distribution – Global & California
- Population status
- Conservation status
- CDFW Coho Recovery Strategy & Update
- NOAA Fisheries Coho Recovery Plans



Slide 3

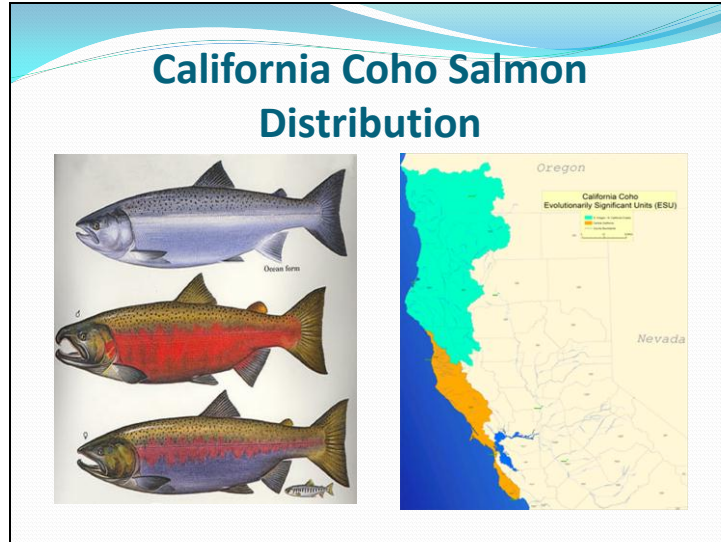


Slide 4

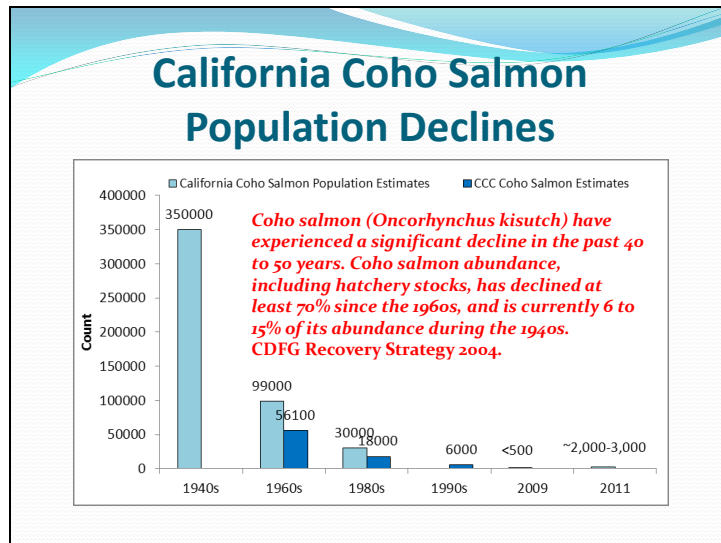
The Current Situation

- ❖ In California, we are experiencing the steepest decline in coho salmon populations on the west coast of North America
- ❖ As the footprint of humans continues to expand, the issues we face here in California will become more common across the entire range of wild coho salmon.
- ❖ On-going drought conditions, together with climate change, are likely to greatly exacerbate the situation

Slide 5



Slide 6



California Coho Salmon – A Listed Species

Currently listed as **Endangered** in the **Central California Coast** Evolutionarily Significant Unit (ESU)

Currently listed as **Threatened** in the **Southern Oregon Northern California Coast** ESU

- **1997** – coho in CCC and SONCC ESUs listed as ESA **threatened**
- **2004** – **CDFG Coho Recovery Strategy** approved by Fish & Game Commission
- **2005** – CCC coho listed as **Endangered** under ESA and CESA
- **2012** – **CCC Coho Recovery Plan** released by NOAA Fisheries
- **2014** – **SONCC Coho Recovery Plan** released by NOAA Fisheries
- **2015** – CDFW Progress Report to Fish & Game Commission on Status of Recovery Strategy is finalized

California Coho Salmon – heading towards extinction?

Figure 2. Visual Representation of Extinction Vortex of Coho Salmon (Peter Moyle, pers. comm.)

The native inland fish fauna of California is in rapid decline and many species are likely to disappear from the state within the next century if present trends continue.
Peter Moyle, U.C. Davis

Summary of Coho Population Status

- **CCC ESU South of San Francisco Bay** – most populations are extirpated or approaching extirpation
- **CCC ESU North of San Francisco Bay** – populations are declining in most streams – highest numbers recorded in Lagunitas Creek and Mendocino streams e.g. Pudding Creek, S.F. Noyo River
- **SONCC ESU** – Most of the 19 independent populations are at high risk of extinction and subject to compensatory effects, e.g., Shasta River, Mattole River
- **SONCC ESU** – There is a moderate risk of extinction in Upper Trinity River, Scott River, South Fork Eel River, and Humboldt Bay Tributaries.

Major Threats to Coho

<ul style="list-style-type: none">• Human factors- Overfishing- Agriculture- Forestry- Flow impoundment (dams)- Water diversion & regulation- Wetland drainage- Mining- Livestock grazing- Marijuana cultivation- Urbanization- Introduced species- Hatcheries	<ul style="list-style-type: none">• Natural factors- Climate change<ul style="list-style-type: none">* Droughts, WildfiresFloods- Ocean conditions<ul style="list-style-type: none">* El Nino changes- Disease, predation – birds/mammals- Landform change/agricultural development
---	---

= **Legacy Effects**
= **Current & Emerging**

Drought effects on coho

- Lower than normal streamflows
- Higher water temperatures
- Reduced survival of eggs/juveniles, reduced recruitment
- Exacerbates adverse effects of human induced habitat loss and water diversions
- Even though the drought poses significant challenges, salmon can recover as long as we are proactive about managing water effectively.

U.S. Drought Monitor
California

September 2, 2014
(Revised Thursday, Sep. 4, 2014)
10:49 a.m. EDT

Drought Conditions (Percent Area)

	None	Light	Mod	Severe	Ext	Total
Current	0.00	100.00	0.00	0.00	0.00	100.00
Last Week	0.00	100.00	0.00	0.00	0.00	100.00
1-Month Run	0.00	100.00	0.00	0.00	0.00	100.00
3-Month Run	0.00	100.00	0.00	0.00	0.00	100.00
6-Month Run	0.00	100.00	0.00	0.00	0.00	100.00
12-Month Run	0.00	100.00	0.00	0.00	0.00	100.00
Year to Date	0.00	100.00	0.00	0.00	0.00	100.00
Year to Date	0.00	100.00	0.00	0.00	0.00	100.00
Year to Date	0.00	100.00	0.00	0.00	0.00	100.00

Legend:

- No Drought
- Light Drought
- Moderate Drought
- Severe Drought
- Extreme Drought

The drought data is based on the Palmer Drought Index and is not a measure of water availability. For all conditions, see the accompanying text summary of the data.

Author:
David D. Mielke
Western Regional Climate Center

USDA
http://droughtmonitor.unl.edu/

2004 CDFW Coho Recovery Strategy

Produced in February 2004 for the **Fish & Game Commission** in response to a directive from the Commission

The document includes **85 range-wide recommendations**

For coho in the CCC ESU, and SONCC ESUs there are **205 & 320 watershed recommendations**, respectively. Total cost of Strategy implementation - **\$4.5 billion**.

Recovery Strategy for California Coho Salmon
Report to the California Fish and Game Commission
February 2004

STATE OF CALIFORNIA RESOURCE AGENCY DEPARTMENT OF FISH AND GAME



Recovery Strategy Update

- From 2004 to 2012, the **Fisheries Restoration Grants Program** allocated a total expenditure of approximately **\$100 million** to coho salmon recovery projects in California.
- During this period, a total of **433 projects** benefiting coho salmon recovery was completed, addressing **287 recovery tasks**, listed in the 2004 Recovery Strategy.


2011 Report to Congress
Pacific Coastal Salmon Recovery Fund
NATIONAL MARINE FISHERIES SERVICE

Priorities and innovations needed to recover coho


- **Scale of recovery efforts** – need to rethink time-scales needed to implement species recovery
- **Strategic investment** – how to increase funding allocations to fully implement recovery plans?
- **Environmental stochasticity** – how can we better plan for and incorporate such changes?
- **Habitat restoration** – need for new, innovative, watershed scale, holistic, process-based restoration – prioritizing areas for restoration, narrowing scope of efforts etc.
- **Scientific communication** – need for better understanding of the processes involved in species recovery – ‘out of the box’ thinking – improved dialog between science/academia and the restoration community.

Mapping the way forward

- Increased inter-agency collaboration
- Coho recovery/extirpation prevention in the CCC ESU– P.A.C.T.
- Coho recovery in the SONCC – recovery focus on priority areas e.g. Shasta
- Developing a watershed approach to recovery
- Habitat improvement - restoration of ecosystem processes
- Defining the role of captive breeding for extinction prevention



Slide 17



**NOAA
FISHERIES**
West Coast
Region

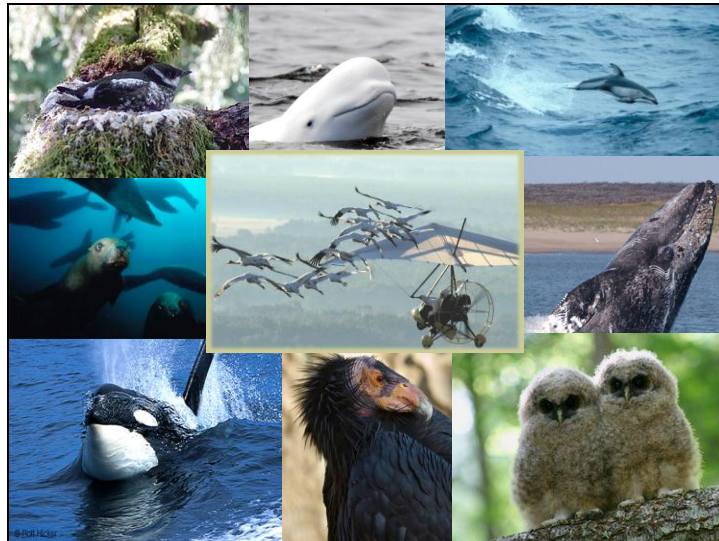
Innovative Tools in Federal Coho Salmon Recovery Plans California

Charlotte Ambrose
Recovery Coordinator
North-Central California

Julie Weeder
Recovery Coordinator
Northern California

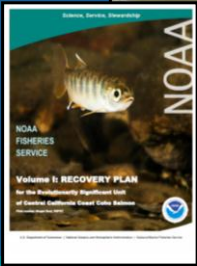
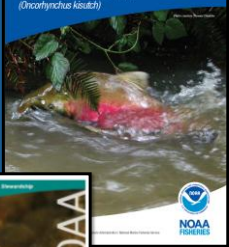


Slide 18



What is a federal recovery plan?

- ❑ Identifies what the problems are, provides solutions in terms of needed actions. Also provides criteria for measuring progress toward recovery.
- ❑ Central organizing tool: roadmap to recovery.
- ❑ Everyone implements it.
- ❑ A guidance document – non-regulatory.
- ❑ Used by some grant programs to prioritize restoration projects.






NOAA FISHERIES

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 7

Benefits of recovery plans

- ❑ Best available science on what should be done to recover coho salmon across California.
- ❑ Identify actions that will lead to recovery.
- ❑ Provides benchmarks to measure progress toward recovery.



Michelle Leicester, CDFW

NOAA West Coast Region

NOAA FISHERIES

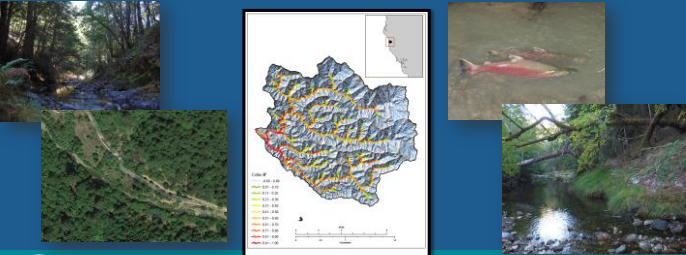
U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 7

Innovative Tools in Recovery Plans

Intrinsic Potential of Streams to Support Salmonids

NOAA Technical Recovery Teams (Agarwal et al. 2005, Bjorkstedt et al. 2005, Spence et al. 2008, Williams et al. 2006)

- Extinction risk increases as populations depart from Historical Structure
- Populations supported by habitats & processes constant over long time scales
- Model used to predict Intrinsic Potential of streams to support salmonids
- Variables of channel gradient, discharge, valley width and air temperature (coho only) were used
- Model output is potential carrying capacity and represents viable conditions (historical setting)



NOAA FISHERIES | U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 5

Historical Extent and of Rearing and Spawning Habitats (IP)

IP and GIS map output estimates the **extent and potential** a stream reach will exhibit suitable habitat for salmonid spawning and rearing

IPkm is a **weighted value**


IP values range 0-1

Mapped values:
0-0.34, 0.35-0.69 and 0.7-1.

Lower values=Lower Potential to Support Habitat

Higher values=Higher Potential to Support Habitat

We've observed reaches **>0.7** are those most likely to respond to restoration actions and support coho salmon populations.



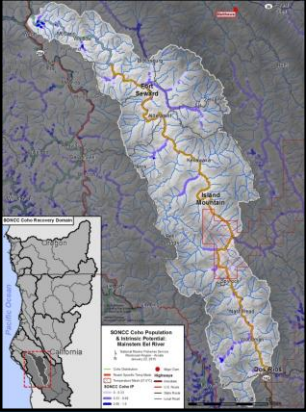
NOAA FISHERIES | U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 6

Slide 23

Refining IP

Recovery teams refined IP based on:

- Barriers (SONCC & CCC)
- Temperature (SONCC)
- Geology (SONCC)



The map displays the Skagitzi River watershed with various colored zones representing different IP levels. A legend in the bottom right corner identifies these zones: 'SONCC Core Prohibition & Extreme Potential Skagitzi River' (red), 'SONCC Core Prohibition Skagitzi River' (orange), 'SONCC Core Prohibition Skagitzi River' (yellow), 'SONCC Core Prohibition Skagitzi River' (green), 'SONCC Core Prohibition Skagitzi River' (light green), 'SONCC Core Prohibition Skagitzi River' (blue), and 'SONCC Core Prohibition Skagitzi River' (dark blue). It also shows 'SONCC Core Prohibition Skagitzi River' (grey) and 'SONCC Core Prohibition Skagitzi River' (white). A legend in the bottom left corner identifies 'SONCC Core Prohibition Skagitzi River' (red), 'SONCC Core Prohibition Skagitzi River' (orange), 'SONCC Core Prohibition Skagitzi River' (yellow), 'SONCC Core Prohibition Skagitzi River' (green), 'SONCC Core Prohibition Skagitzi River' (light green), 'SONCC Core Prohibition Skagitzi River' (blue), and 'SONCC Core Prohibition Skagitzi River' (dark blue). An inset map shows the location of the Skagitzi River watershed within the state of Washington.

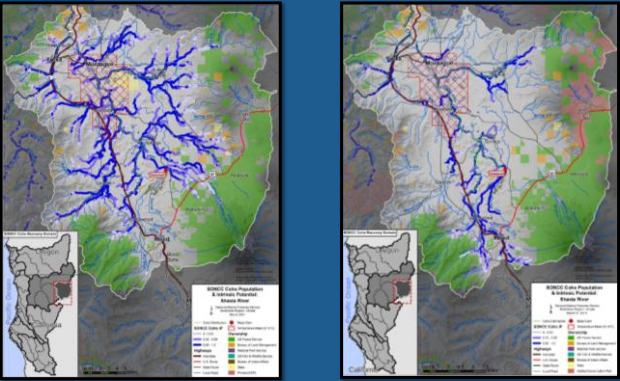
NOAA FISHERIES U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 7

Slide 24

Refining IP

Public Draft

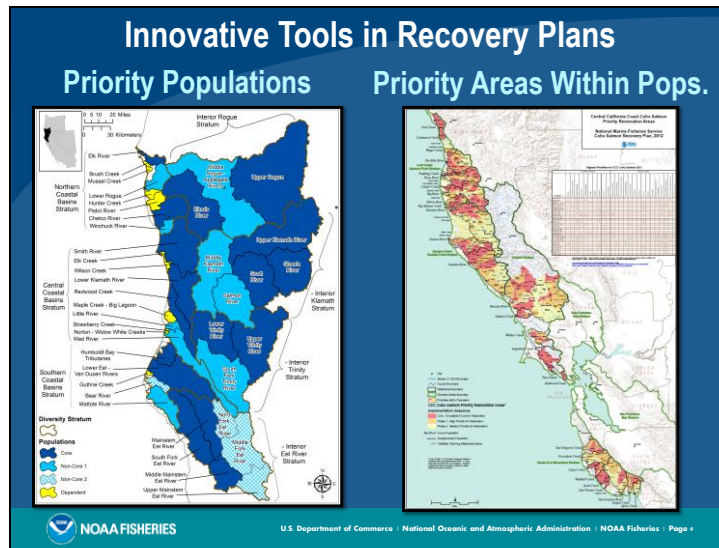
Final



The slide compares two maps of the Skagitzi River watershed, labeled 'Public Draft' and 'Final'. Both maps show the same watershed area with various colored zones representing different IP levels. The 'Public Draft' map shows a more extensive network of red and orange zones, while the 'Final' map shows a more refined network with fewer red and orange zones and more green and blue zones. A legend in the bottom right corner identifies these zones: 'SONCC Core Prohibition & Extreme Potential Skagitzi River' (red), 'SONCC Core Prohibition Skagitzi River' (orange), 'SONCC Core Prohibition Skagitzi River' (yellow), 'SONCC Core Prohibition Skagitzi River' (green), 'SONCC Core Prohibition Skagitzi River' (light green), 'SONCC Core Prohibition Skagitzi River' (blue), and 'SONCC Core Prohibition Skagitzi River' (dark blue). It also shows 'SONCC Core Prohibition Skagitzi River' (grey) and 'SONCC Core Prohibition Skagitzi River' (white). A legend in the bottom left corner identifies 'SONCC Core Prohibition Skagitzi River' (red), 'SONCC Core Prohibition Skagitzi River' (orange), 'SONCC Core Prohibition Skagitzi River' (yellow), 'SONCC Core Prohibition Skagitzi River' (green), 'SONCC Core Prohibition Skagitzi River' (light green), 'SONCC Core Prohibition Skagitzi River' (blue), and 'SONCC Core Prohibition Skagitzi River' (dark blue). An inset map shows the location of the Skagitzi River watershed within the state of Washington.

NOAA FISHERIES U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 8

Slide 25



Slide 26

Protecting nature. Preserving life.

Restoration | Policy | Science

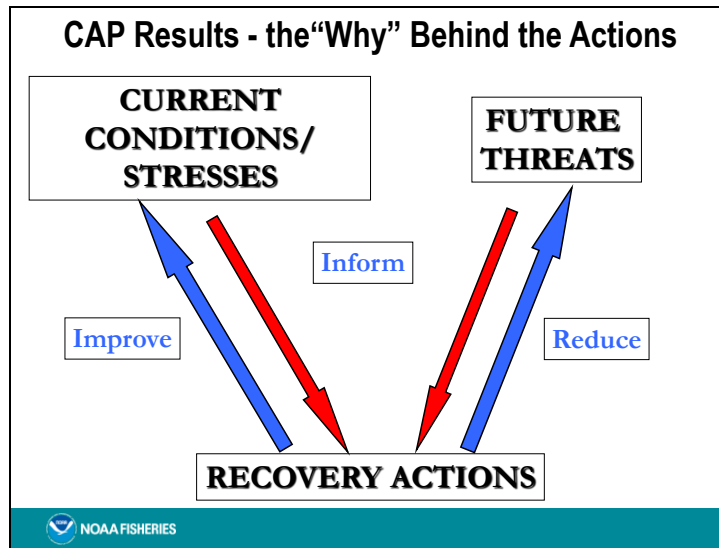
Open Standards for the Practice of Conservation & Conservation Action Planning (CAP)

Method and tool used to assess conditions and threats for salmonids and their life stages
Warehouses data, information, decisions, references and outputs results

Excel Program (now Miradi programming)

Stresses	Development of Program Goals																			
	Egg	Fry	Juvenile*	Smolt	Adult	Overall Stress Rating	Threats across Targets				Overall Threat Rating									
1. Lack of Food/past and Channel Alterations	Very High	Very High	High	High	Very High	Very High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
2. Altered Sediment Supply	Very High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
3. Altered Hydrologic Function*	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
4. Degraded Riparian Forest Conditions	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
5. Impaired Water Quality	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
6. Barriers	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
7. Impaired Disease/Parasite/Competition	Low	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
8. Impaired Estuary/Marsh Function	Low	Low	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
9. Adverse Fishery and Collection-Related Effects	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
10. Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Slide 27



Slide 28

Innovative Tools in Recovery Plans

Recovery Criteria

Recovery Criteria frame the conditions for downlisting and delisting and must separately address the following:

Biological Factors:

- Spawner abundance, population growth rate, population spatial structure and diversity

ESA Section 4(a)(1) Listing Factors:

- A. Present and threatened destruction of habitat or range
- B. Overutilization from commercial, recreational or scientific
- C. Disease or predation
- D. Inadequacy of regulatory mechanisms
- E. Other manmade or natural events

Number of Recovery Actions Implemented

CCC coho salmon, Mill Creek, Sonoma County, CA, Mariska Obiedzinski, UC SeaGrant

Attention Anglers!
If Mouth Has Black, Put It Back!
It's illegal to keep Coho Salmon with black mouths. Coho Salmon and Steelhead Trout.

Coho Salmon Recovery Program Partners

NOAA FISHERIES

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 17

Slide 29

Innovative Tools in Recovery Plans Recovery Criteria

□ When these criteria are met, coho salmon can be downlisted or removed from the ESA list.

□ Example:

- 7,900 spawners
- Pools rated good
- Barriers rated a medium stress
- Inadequate regulatory mechanisms rated a low threat
- Timber harvest rated medium threat

Recovery Criteria

- Low Extinction Risk
- Moderate Extinction Risk (with ≥ 4 spawners/IP-km)
- Juvenile Occupancy

NOAA FISHERIES | U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 11

Slide 30

NO ONE ESU Criterion Diversity Strata Viability = ESU Viability

Lost Coast Stratum
15,500 Spawners

Navarro-Gualala Stratum
15,600 Spawners

Coastal Stratum
15,300 Spawners

San Francisco Bay
Extirpated...N/A


Santa Cruz Mountains
10,900 Spawners


Central California Coast Coho Salmon Diversity Strata

NOAA FISHERIES | U.S. Department of Commerce

Innovative Tools in Recovery Plans Recovery Criteria

- ❑ Until now, the restoration community didn't know:
 - ❑ How many fish were needed in which places in order to have a recovered ESU.
 - ❑ How and where conditions would need to improve and threats would need to be reduced to support a recovered ESU.
- ❑ Now we can measure progress toward recovery.




U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 11

The Coho Recovery Plans

<http://www.westcoast.fisheries.noaa.gov/>




U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 11

Slide 33

The CCC Coho Recovery Plan Analysis of Current Conditions & Threats on Miradi Share <https://www.miradishare.org/>

The screenshot shows the NOAA Fisheries Recovery website. At the top, there is a navigation bar with 'Projects', 'Program Reports', and 'Manage Program'. Below this is a search bar and a 'Welcome to NOAA Fisheries Recovery' message. The main content area features several project cards, each with a green circular icon and a title such as 'Central California Coast Coho - Butte Creek', 'Central California Coast Coho - Arroyo Creek Population', 'Central California Coast Coho - Big Bear Population', and 'Central California Coast Coho - Clear Creek Population'. Each card includes a brief description and a 'View Project' link. At the bottom of the page, there is a footer with the NOAA Fisheries logo and the text 'U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 17'.

Slide 34

The CCC Coho Recovery Plan Analysis of Current Conditions & Threats on Miradi Share <https://www.miradishare.org/>

This slide displays a collage of screenshots from the Miradi Share website. The top screenshot shows the 'Project Details' page for the 'Central California Coast Coho Salmon - Butte River Population' project. It includes a table with columns for 'Task', 'Status', 'Priority', and 'Risk'. The tasks are listed with their respective due dates and assigned users. Below this, there are two more screenshots. The one on the left shows a 'Project Details' page for the 'Central California Coast Coho Salmon - Big Bear Population' project, featuring a similar task table. The one on the right shows a detailed data table with columns for 'Project Name', 'Status', 'Priority', and 'Risk', with rows of project activities color-coded by status (green for 'On Track', yellow for 'At Risk', and red for 'Off Track'). At the bottom of the collage, there is a footer with the NOAA Fisheries logo and the text 'U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 18'.

The Coho Recovery Plans IP Datasets

<http://www.westcoast.fisheries.noaa.gov/>

We used numeric IPkm data as a course filter to evaluate the potential restorability of stream reaches in a watershed and their intrinsic potential to provide higher or lower quality habitat

Population	PWNAME	Stream Km's in Low Rank 01-349	% of Km's in Low Rank	Stream Km's in Medium Rank 35-499	% of Km's in Medium Rank	Stream Km's in High Rank 50-0	% of Km's in High Rank	Grand Total	Category with highest percent
Garcia River	East of Forks Hill	0.2	5.6%	3.3	89.0%	0.2	6.4%	3.7	Medium
	Hathaway Creek	0.4	2.1%	2.4	12.0%	16.8	85.9%	19.6	High
	Jones Creek	0.2	2.7%	3.8	42.7%	4.5	54.0%	9.0	High
	Lamour Creek	0.0	0.0%	0.1	100.0%	0.0	0.0%	0.1	Medium
	Little Ferry	0.3	4.5%	4.8	79.2%	1.0	16.3%	6.1	Medium
	North Fork Garcia River	0.2	2.5%	1.9	23.8%	5.9	73.5%	8.0	High
	North of Gualala Mtn.	0.0	0.7%	2.7	85.6%	0.4	13.7%	3.2	Medium
	Redding Brook	0.3	3.2%	3.5	38.6%	7.2	58.3%	11.0	High
	Signal Creek	0.5	11.4%	1.9	45.9%	1.7	42.7%	4.1	Medium
	South Fork Garcia River	0.4	3.3%	4.9	49.7%	4.1	46.0%	9.3	Medium
Victoria Fork	0.6	8.4%	3.2	56.0%	2.1	37.5%	5.7	Medium	
Garcia River Total		2.8	3.7%	12.3	41.4%	42.7	55.0%	77.7	High

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 11

Innovative Tools in Recovery Plans – Recovery Actions in Excel

Watershed	Stream	Priority	Project/Action	Priority	Advisory	Responsible Party	Start Date	End Date	Comments			
Garcia River	East of Forks Hill	High	Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.
			Remove logs and debris from the stream and install a log structure to stabilize the stream bed.	2	2	CCC, Westcoast Fisheries, NOAA Fisheries	2008	2010	2008	2010	20	Completed. Stream is stable and log structure is in place.

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 12

Innovative New Tools & Collaborations TNC Salmon Snapshot – The Fish

By The Numbers

The Big Picture
Over 90% of the populations of salmon and steelhead in California's coastal streams are currently healthy. Estimated at 1.5 billion steelhead and 1.5 billion chinook.

Current Status of Coastal Salmon Populations
Completion of the federally threatened, endangered, and delisted salmon species

Species	Endangered	Threatened	Not Listed
Coho	77	10	11
Chinook	10	10	10
Steelhead	10	10	10
Total	97	30	31

2012/13 Salmon Numbers

Category	Fall	Spring
Watershed Coho	128	182
Watershed Chinook	76	76
Watershed Steelhead	20	118
Total	224	376

Navarro River

2012/13 Population

Species	Estimate of wild adult fish
COHO	140
CHINOOK	0
STEELHEAD	438

What We Need

Species	What We Need
COHO	5,700*
CHINOOK	3,600*
STEELHEAD	8,000*

Innovative New Tools & Collaborations TNC Salmon Snapshot – The Habitat

Stream Habitat Conditions

Summary
Characterizing and inventorying the physical conditions that define stream habitat for salmonids and trout is an important part of the habitat restoration process. The National Stream Information System (NSIS) compiled stream habitat data in support of recovery plans for coho salmon, chinook salmon, and steelhead in the North Central California Coast Recovery (NCCC) Domain from Humboldt County in northern California to Adobe Creek in Santa Cruz County. NSIS used the most recent available data from the California Department of Fish and Wildlife (CDFW) stream habitat summary data collected through habitat survey according to Trout et al. (2012). This data allowed for the development of standardized conditions and scoring metrics for the NCCC Domain. The CDFW data summary assessments are available on the Stream Data website (https://www.nature.org/usa/conservation/streams/).

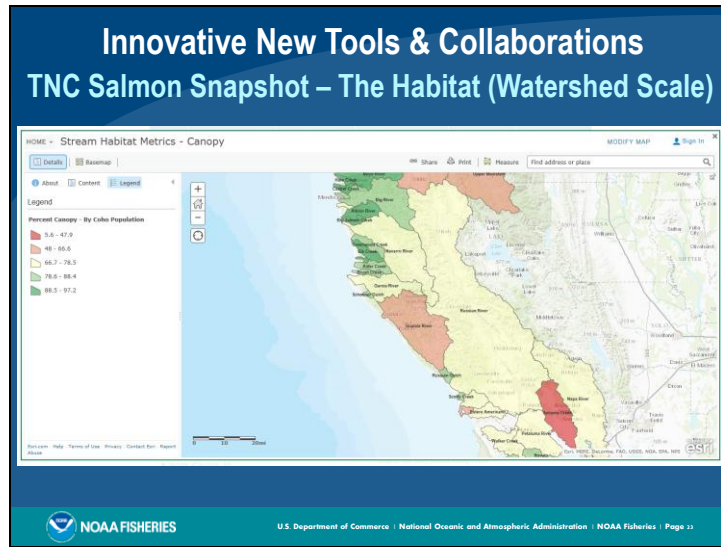
Survey Details

- Number of surveys: 64
- Stream miles surveyed: 113.63 of 197.92
- Site range: 1984 to 2013

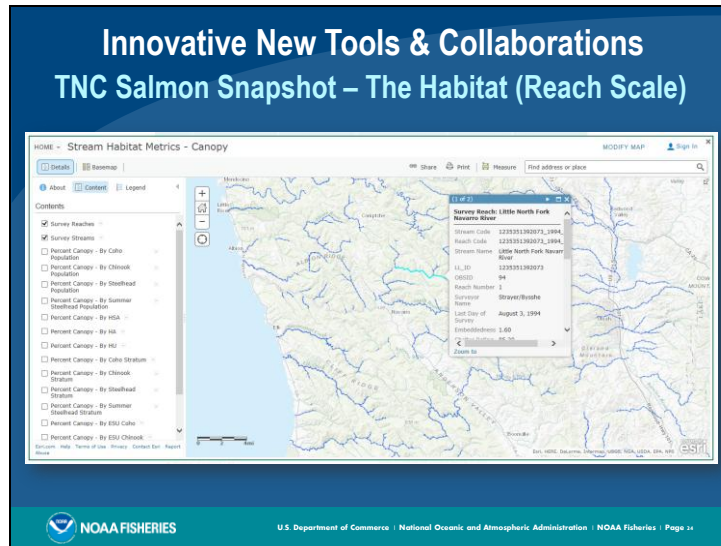
Stream Habitat Metrics
(Coho, Chinook, Steelhead)

Metric	Score	Target
Capacity	27.5%	30%
Embeddedness	2.7	3.0
Shelter Rating	46.7	50.0
Primary Pools	6.2%	10.0%
Pools	27%	30%
WPA	16.2%	20.0%
Flow Water	16.4%	20.0%
Dry	0%	5.0%
Large Woody Debris per 100M*	0.6	1.0

Slide 39



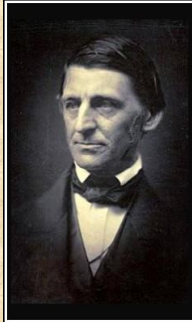
Slide 40



Slide 41

Approaches to Coho Recovery

Be An Agent of Change




Always do what you are afraid to do.
(Ralph Waldo Emerson)

izquotes.com

A slide with a light beige background. At the top, the text 'Approaches to Coho Recovery' is centered. Below it, 'Be An Agent of Change' is centered. A black-bordered box contains a portrait of Ralph Waldo Emerson on the left and a quote in white text on the right. The quote is 'Always do what you are afraid to do.' followed by '(Ralph Waldo Emerson)'. The website 'izquotes.com' is in the bottom right corner of the box.

Slide 42

Act Deliberately



It is not enough to be busy. So are the ants. The question is: What are we busy about?
(Henry David Thoreau)

izquotes.com

A slide with a light beige background. At the top, the text 'Act Deliberately' is centered. Below it, a black-bordered box contains a portrait of Henry David Thoreau on the left and a quote in white text on the right. The quote is 'It is not enough to be busy. So are the ants. The question is: What are we busy about?' followed by '(Henry David Thoreau)'. The website 'izquotes.com' is in the bottom right corner of the box.

One Person Can Make All The Difference

A close-up photograph showing a pair of hands holding a small, silver fish. The fish is held horizontally between the palms, with its head to the left and tail to the right. The hands are wet and glistening, suggesting the fish is being handled in water. The background is a plain, light-colored surface.

Taking The Path To Bring A Species Back

Title: Are California Coho Salmon Doomed? How to Improve Their Prognosis by Applying Lessons Learned from Studies on Canadian Coho Salmon.

Presenter: J.R. Irvine, Pacific Biological Station, Fisheries and Oceans Canada.

James.Irvine@dfo-mpo.gc.ca

Abstract: Coho Salmon in the Central California Coast Evolutionarily Significant Unit are listed as endangered. A recent draft Recovery Strategy listed hundreds of range-wide and watershed restoration recommendations to aid in their recovery. Yet, even though ~\$100 million has been spent since 2004 on these efforts, numbers of adult Coho Salmon returning to most monitored California systems continue to decline. Approximately 1500 kilometers to the north, Coho Salmon returning to the Interior Fraser River watershed in British Columbia, listed as endangered by the Committee on the Status of Endangered Wildlife in Canada in 2002, show recent evidence of recovery. We argue that applying important lessons learned from studying Canadian Coho Salmon can reduce the likelihood of extirpation of Central California Coho Salmon. Fishing, habitat perturbations, and climate change were identified as primary threats to the recovery of Interior Fraser Coho Salmon. Significant declines in spawning escapements and total returns during the 1990s were largely the result of declining smolt-adult survivals exacerbated by overfishing. An abrupt decrease in productivity (recruits per spawner) coincided approximately with the 1989-1990 shift in marine conditions in the North Pacific Ocean. Smolt survival remains low – recent variability in adult returns, including the minor increases seen for some populations, were the result of variable survivals in fresh water. The putative recovery of Interior Fraser Coho Salmon required: 1) long-term commitment to reduced fishery exploitation (~66% prior to 1998 to ~15% post 1998; 2) understanding the relative role of changes to survival in freshwater versus the ocean; 3) determining the geographic extent of reproductively isolated populations called Conservation Units; 4) investigating the pros and cons of enhancement; and 5) identifying abundance-based benchmarks that enable the determination of biological status. It is hard to be optimistic of the fate of California's Coho Salmon at the southern extent of their distribution during a period of climate warming. In order for Coho Salmon from the Central California Coast Evolutionarily Significant Unit to return to levels of sustained viability or to achieve harvestable populations, studies that investigate the relevant items listed above are required. In addition, a properly designed approach to evaluate the effectiveness of restoration efforts in California is crucial (e.g. <http://www.monitoringadvisor.org/>).

**Are California Coho Salmon Doomed?
How to Improve Their Prognosis by Applying
Lessons Learned from Studies on Canadian Coho
Salmon**

- **Jim Irvine¹, Chuck Parken², Scott Decker², Jake Schweigert³,
Mara S. Zimmerman⁴**
- **Innovative Trans-Boundary
Coho Salmon Recovery Workshop**
- **11 March 2015**
- **Santa Rosa California**

¹Presenter, Fisheries and Oceans Canada, Pacific Biological Station, 3190 Hammond Bay Road, Nanaimo, BC V9T 6N7 CANADA
² Fisheries & Oceans Canada, Fraser Stock Assessment, 986 McGill Place, Kamloops, BC V2C 6X6 CANADA
³ Retired, Fisheries and Oceans Canada, Pacific Biological Station, 3190 Hammond Bay Road, Nanaimo, BC V9T 6N7 CANADA
⁴ Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, Washington 98501, U.S.A

1

Background

- **- Coho salmon in southern BC experienced significant declines ~2 decades ago**
- **- One group, Interior Fraser coho listed as endangered by COSEWIC¹ in 2002 are currently being re-assessed by COSEWIC**
- **- Evidence for declines, why did they decline, what was done about it, has status improved, and are there lessons learned that are applicable in California?**

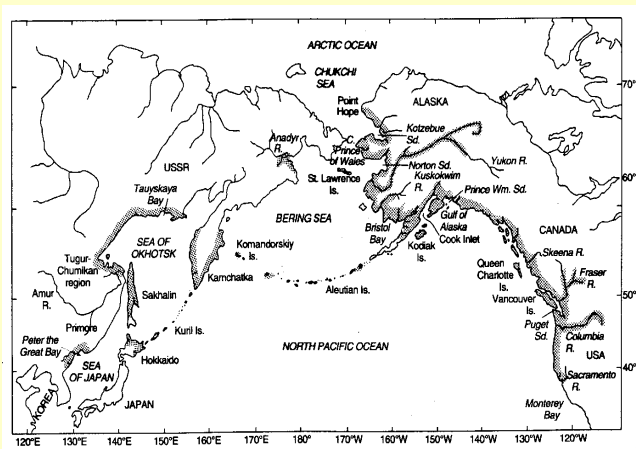
¹Committee on the Status of Endangered Wildlife in Canada

2

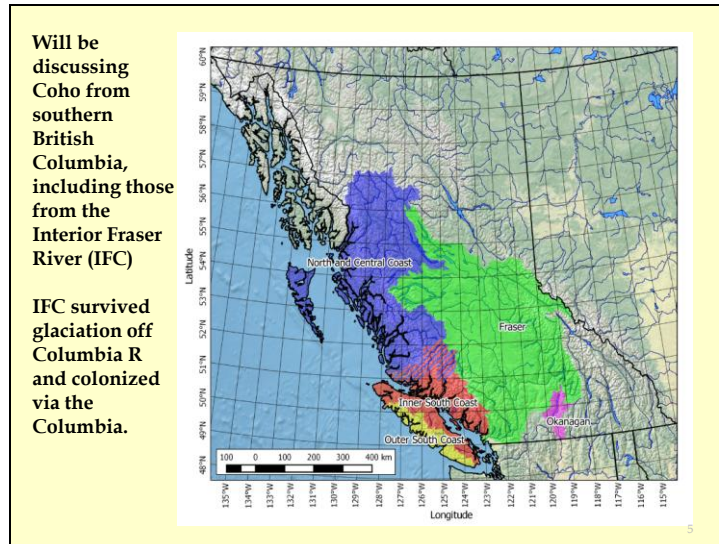
Objectives

- ▣ 1) Review relevant findings from “northern” studies of coho salmon
- ▣ 2) Provide recommendations relevant to studies of coho salmon in California

Approximate global distribution of naturally spawning Coho Salmon (from Sandercock 1991).



Slide 5




Slide 6

Interior Fraser Coho – the canary in the mine shaft?

- Have a unique Columbia River heritage and are an important component of the evolutionary legacy of the species
- Most genetically distinct and least diverse Coho population examined to date

Slide 7



Life history and biology

- ▣ Dominant 3-year life cycle with little overlap among generations (~ 95% of individuals spend 1 winter in freshwater and 18 months at sea)
- ▣ Interior Fraser Coho are smaller and less fecund than most other populations

Photo credit: Ernest Keeley

7

Slide 8



Habitat requirements:

(Differences from coastal populations)

- Spawning and juvenile rearing in specific habitats (e.g., groundwater habitat and lake-headed streams)
- Low fidelity to natal spawning streams
- Non-natal juvenile rearing

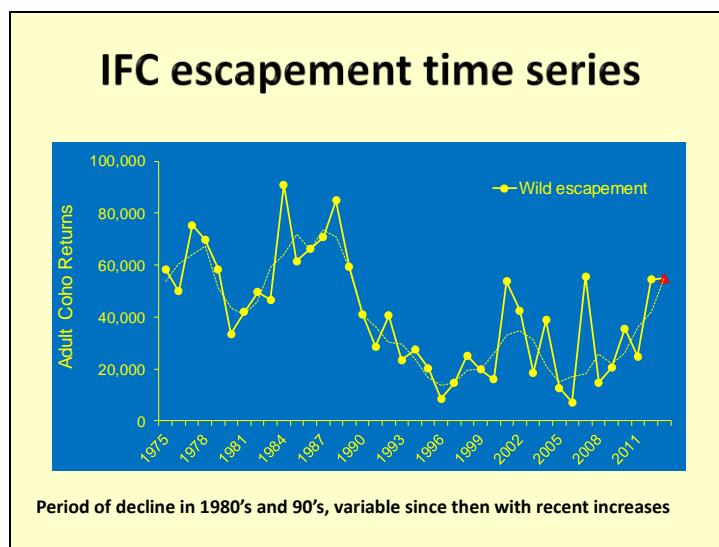
8

Slide 9

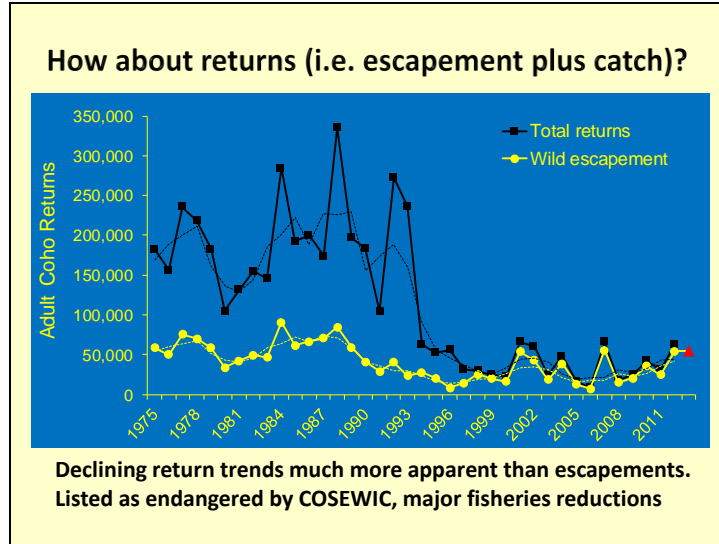
**Let's look at some abundance
and survival data**

9

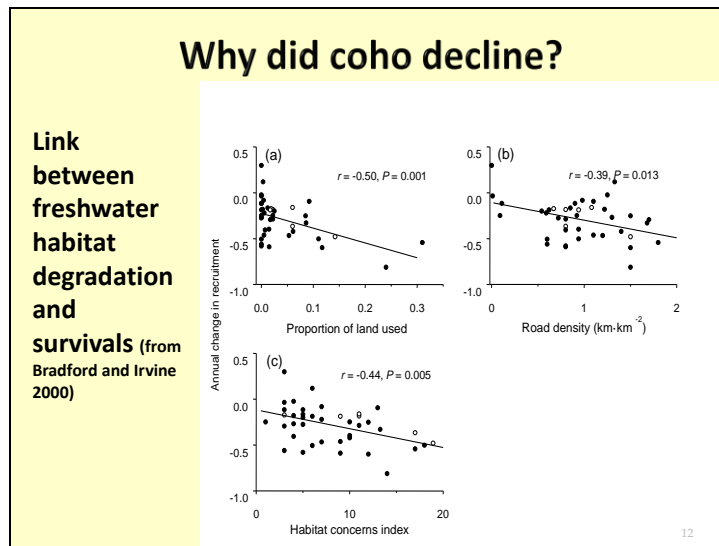
Slide 10



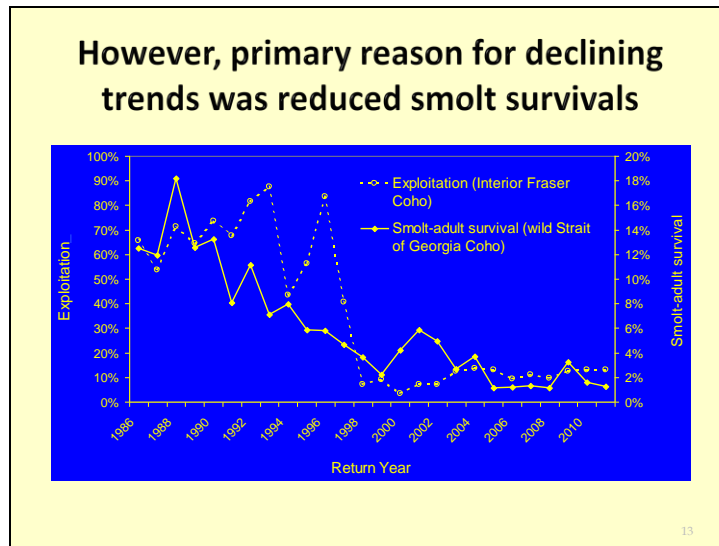
Slide 11



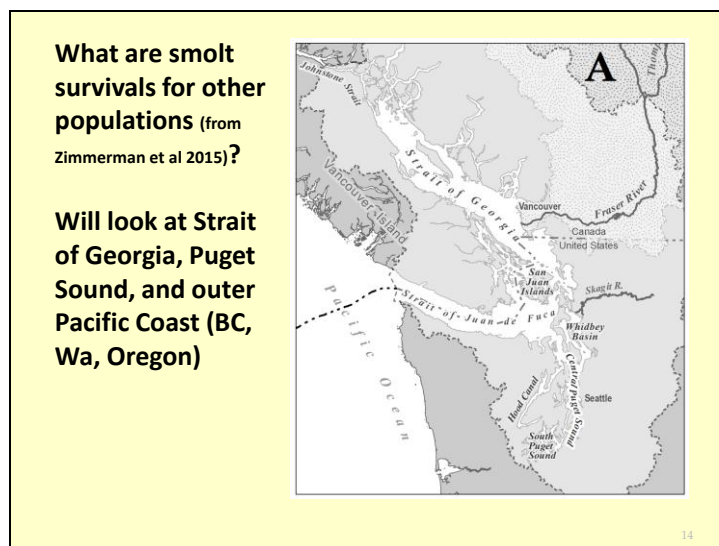
Slide 12

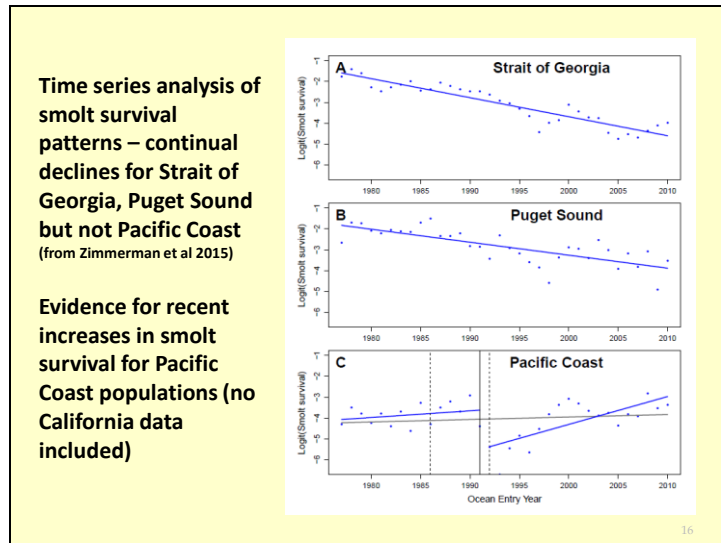
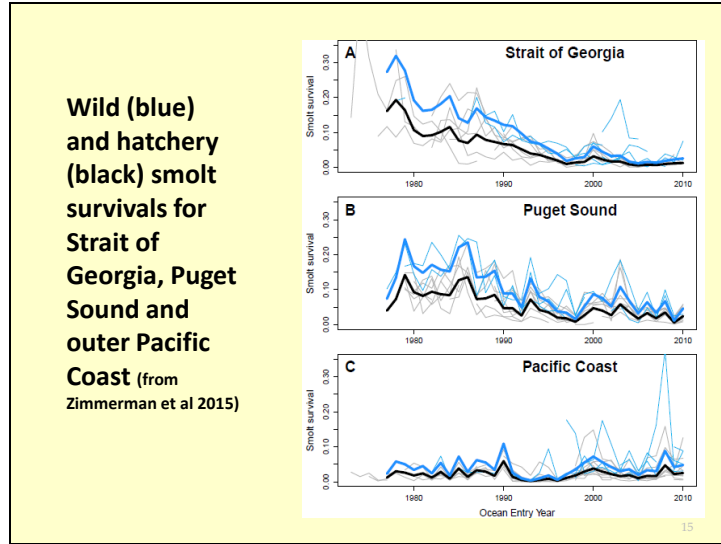


Slide 13



Slide 14







Summary

- Southern BC coho declines in 1990's resulted in 1 population being listed by COSEWIC as endangered
- Declines resulted from decreased smolt survivals exacerbated by changes in freshwater habitat. Significant reductions in fisheries followed a lag in abundance declines (i.e. overexploitation).
- Low exploitations maintained since; improved assessments documented subsequent increases in coho abundances
- Outer coast populations appear to have distinct patterns of smolt survival (similar in California?)

17

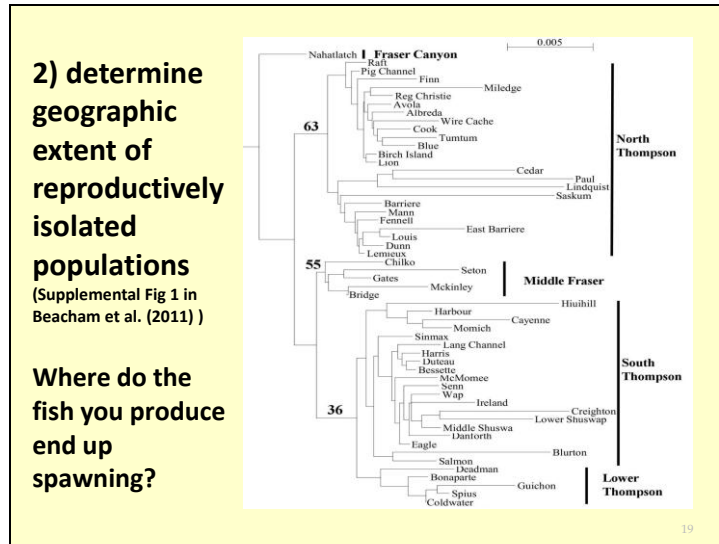
Lessons for California From the North

- 1) understand the relative role of changes to survival in freshwater versus the ocean

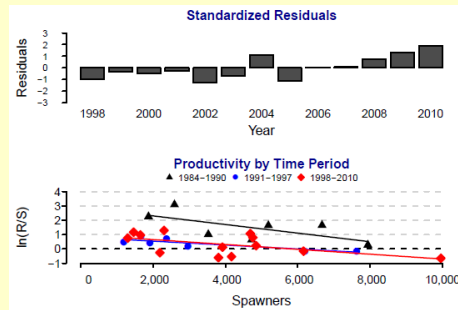


Need time series of spawners and smolts
Where are the bottlenecks? Perhaps recent smolt survivals have been increasing?

18



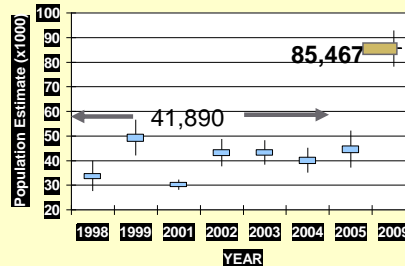
4) identify abundance-based benchmarks that enable the determination of biological status for reproductively isolated units



There are various options for measuring population status.

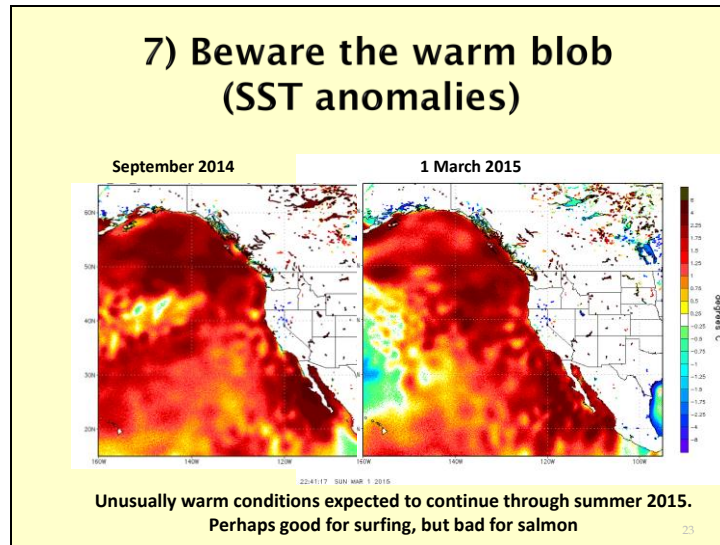
5) implement a properly designed approach to evaluate the effectiveness of restoration efforts (BACI before after control impact design)

Englishman River coho smolt counts before (1998-2005) and after (2009) side channel improvements (courtesy Mel Sheng)



Must assess the effectiveness of habitat restoration!

Slide 23



Updated from presentation by L. Weitcamp.

http://polar.ncep.noaa.gov/sst/ophi/color_newdisp_anomaly_160W_95W_15N_65N_ophi0.png

Slide 24



References

- Beacham, T.D., M. Wetklo, L. Deng and C. MacConnachie. 2011 Coho Salmon population structure in North America determined from microsatellites. *Transactions of the American Fisheries Society* 140: 253-270.
- Bradford, M.J., and J.R. Irvine. 2000. Land use, fishing, climate change and the decline of Thompson River, British Columbia, Coho Salmon. *Canadian Journal of Fisheries and Aquatic Sciences* 57: 13-16.
- Decker, A. S. and J. R. Irvine (2013). "Pre-COSEWIC Assessment of Interior Fraser Coho Salmon (*Oncorhynchus kisutch*)."
DFO Can. Sci. Advis. Sec. Res. Doc. **2013/121**: x + 57 p.
- Irvine, J.R. 2002. COSEWIC status report on the Coho Salmon *Oncorhynchus kisutch* (Interior Fraser population) in Canada. In COSEWIC Assessment and Status Report on the Coho Salmon *Oncorhynchus kisutch* (Interior Fraser population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. pp. 1-34.
- Sandercock, F.K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). Pp. 397-445 in C. Groot and L. Margolis, (eds.) *Pacific Salmon Life Histories*. UBC Press, Vancouver, Canada.
- Zimmerman, M., J.R. Irvine, M. O'Neill, J.H. Anderson, C.M. Greene, J. Weinheimer, M. Trudel, and K. Rawson: Accepted. Spatial and Temporal Patterns in Smolt Survival of Wild and Hatchery Coho Salmon (*Oncorhynchus kisutch*) in the Salish Sea. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science*

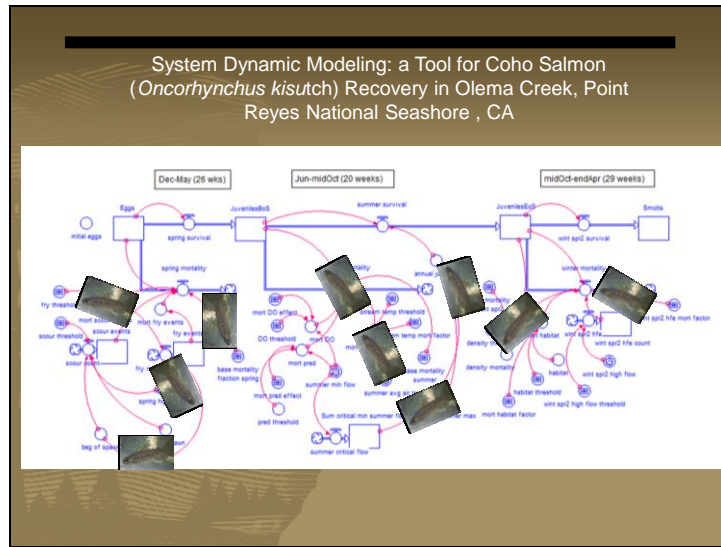
Title: Use of System Dynamic Modeling as a tool for Coho Recovery in Olema Creek, Point Reyes National Seashore, Marin County, California.

Presenter: Michael Reichmuth, National Park Service. michael_reichmuth@nps.gov

Abstract:

Olema Creek is a primary tributary to Lagunitas Creek, which is considered a coho salmon (*Oncorhynchus kisutch*) stronghold within the Central California Coast ESU. With over eight years of existing data, the U.S. Geological Service collaborated with the National Park Service to develop a system dynamic model to investigate potential factors limiting survival and production, identify data gaps, and improve monitoring and restoration prescriptions. A key component of the model was the use of both coho monitoring data and physical parameter data such as water quality and stream flow. In addition to existing data, surrogate data from outside sources, commonly reported in peer-reviewed literature, and professional judgment were utilized when existing data was not available. This model was completed in 2014 giving park managers a new assessment method for evaluating the freshwater survival of coho salmon in Olema Creek. For example, summer juvenile coho estimates plotted against spring coho smolt estimates suggest a smolt production threshold. Using the Olema Creek model it was determined that a data gap exists for winter habitat on Olema Creek which may be a significant driver on overwintering coho survival. Models such as this one developed for Olema Creek are becoming a valuable management tool in the face of climate change and limited funds for salmonid restoration and monitoring.

Slide 1



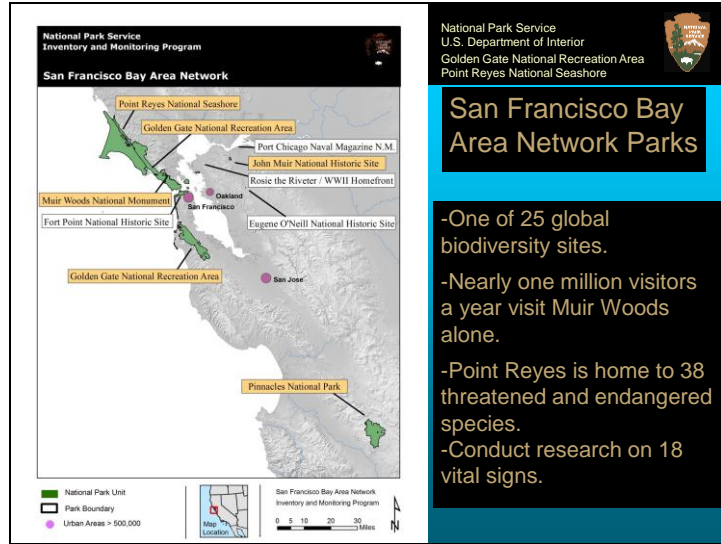
Slide 2

National Park Service
U.S. Department of Interior
Golden Gate National Recreation Area
Point Reyes National Seashore

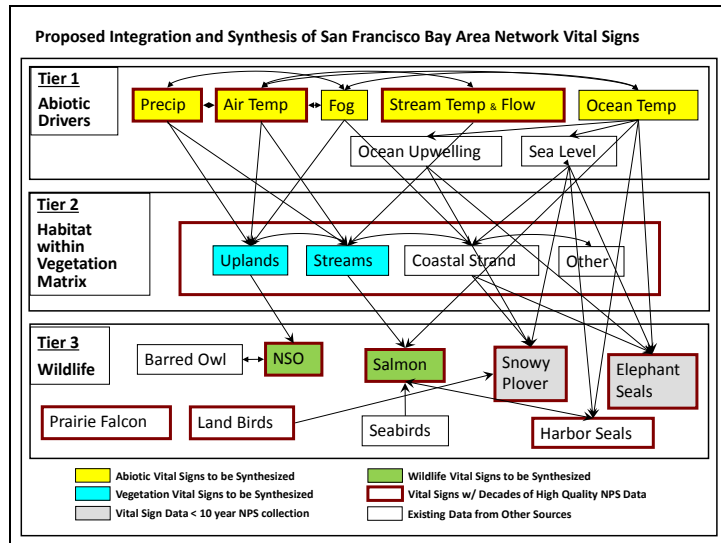
System Dynamic Modeling: a Tool for Coho Salmon
(*Oncorhynchus kisutch*) Recovery in Olema Creek,
Point Reyes National Seashore, CA

Contributors
Michael Reichmuth and Darren Fong
National Park Service
&
Andrea Woodward, Alicia Torregrosa, and Mary Ann Madej
U.S. Geological Service

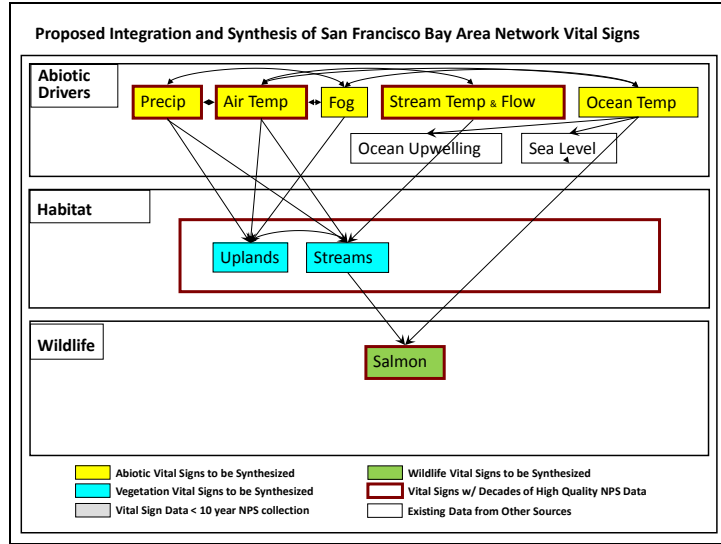
Slide 3



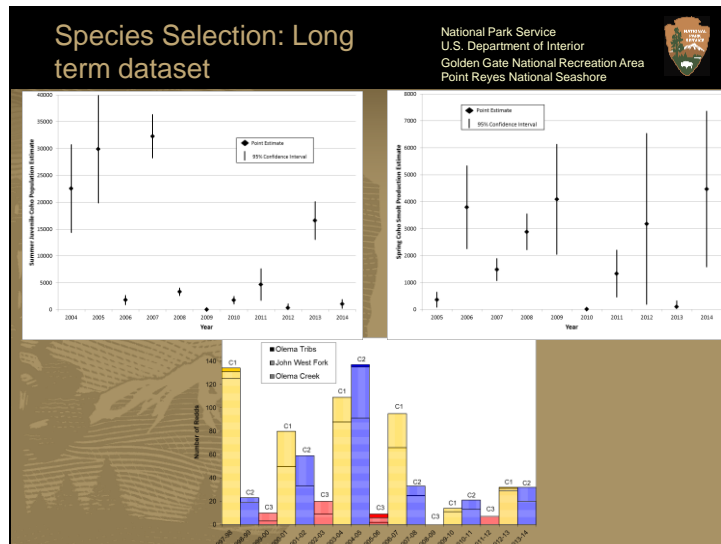
Slide 4



Slide 5



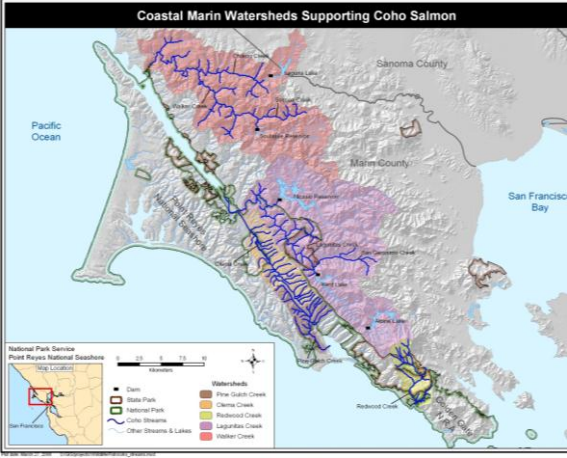
Slide 6



Slide 7

Program Watersheds

National Park Service
U.S. Department of Interior
Golden Gate National Recreation Area
Point Reyes National Seashore



The map shows the coastal watersheds of Marin and Sanoma counties, California, with various creeks highlighted in different colors. A legend in the bottom left identifies symbols for dams, state parks, national parks, coho streams, other streams and lakes, and specific watersheds: Olema Creek (orange), Redwood Creek (yellow), Lagunitas Creek (green), and Walker Creek (red). The map also shows the Pacific Ocean to the west and San Francisco Bay to the east.

Coastal Marin Watersheds Supporting Coho Salmon

Lagunitas Creek Watershed Characteristics

- Independent Population
- Over 60 miles of potential habitat
- Olema Creek is largest tributary in NPS lands
- Currently no hatchery inputs

Slide 8

Project Goals

National Park Service
U.S. Department of Interior
Golden Gate National Recreation Area
Point Reyes National Seashore

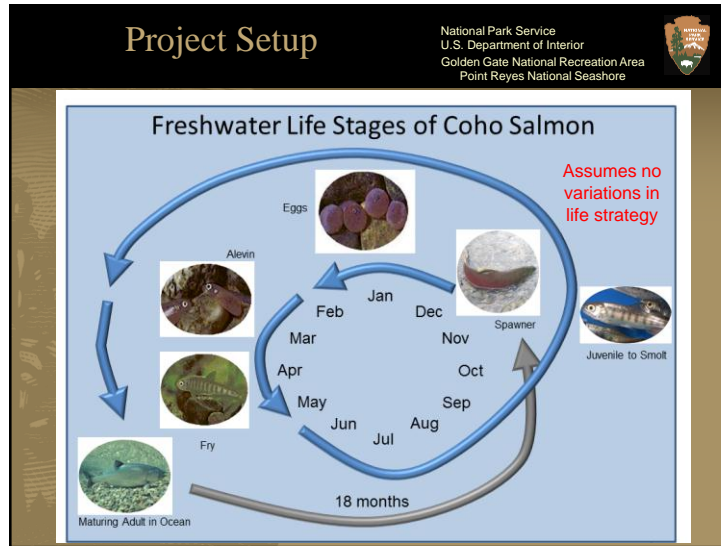
Develop a methodology to integrate inventory and monitoring data to better understand ecosystem dynamics and trends using salmon in Olema Creek



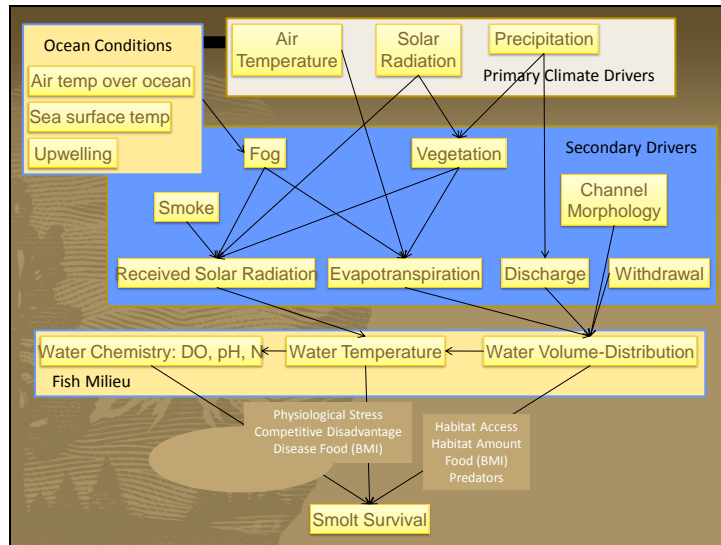
The slide features two photographs. The top one is an underwater shot of a salmon swimming over a rocky riverbed. The bottom one shows three people in field gear working with equipment outdoors, likely conducting research or monitoring.

- Summarize and synthesize NPS monitoring data with data and information from other sources to describe factors and processes affecting freshwater survival of coho salmon in Olema Creek.
- Provide a model that can be easily manipulated to experiment with alternative values of model parameters and novel scenarios of environmental drivers.

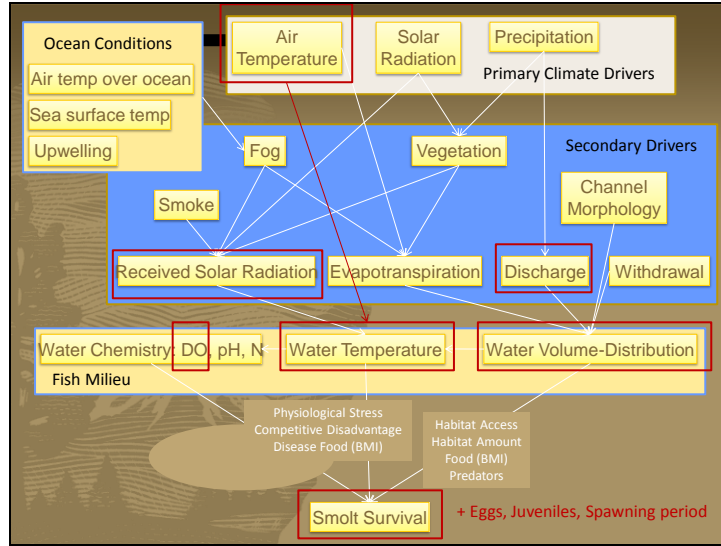
Slide 9



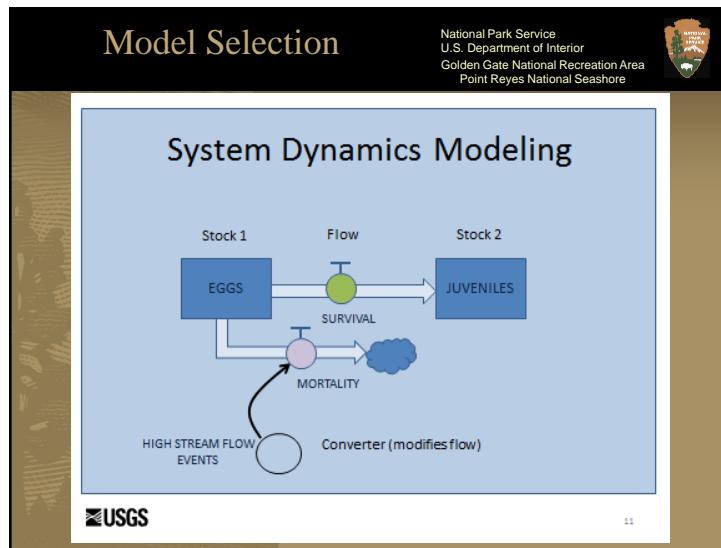
Slide 10

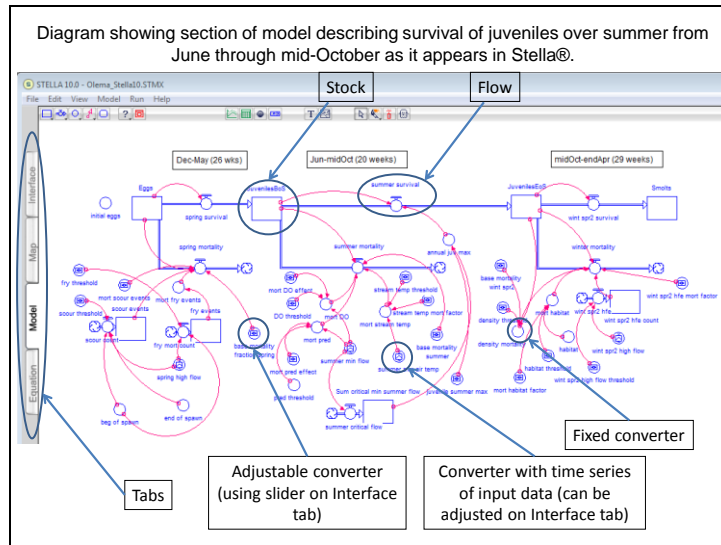
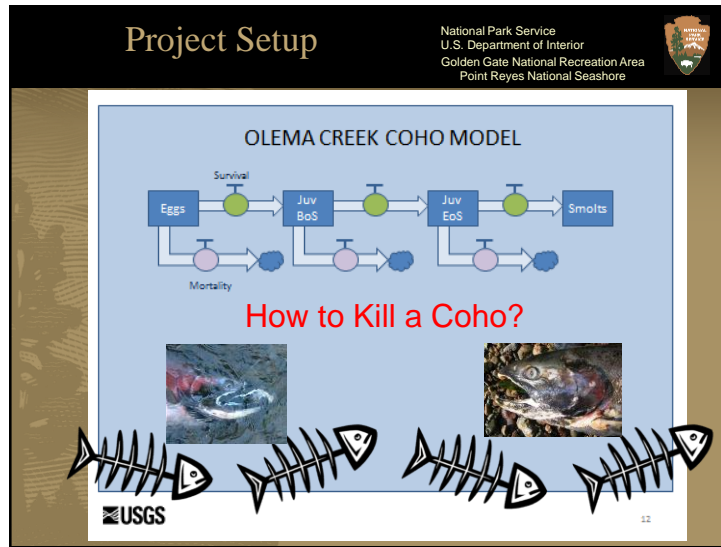


Slide 11

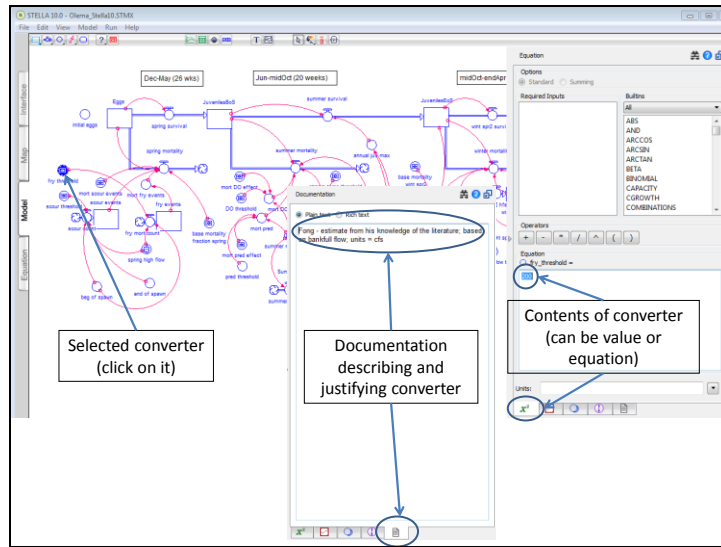


Slide 12

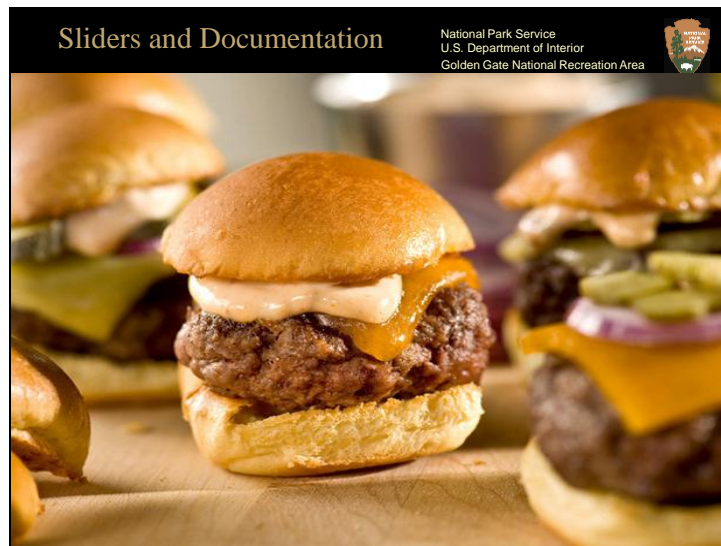




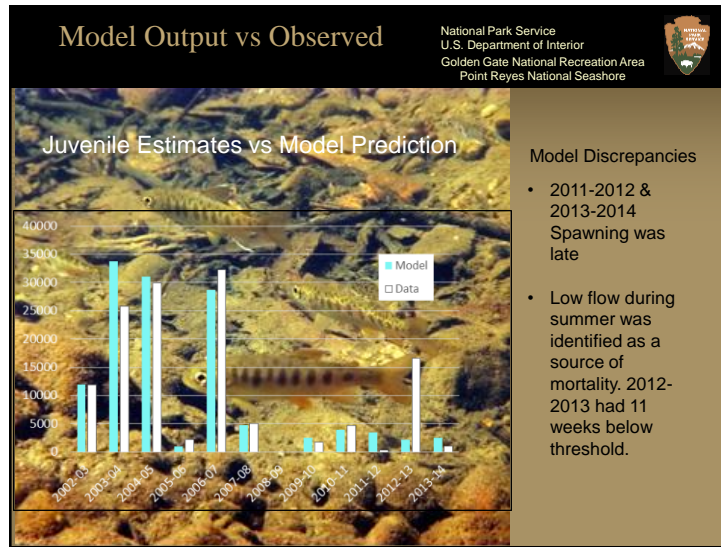
Slide 15



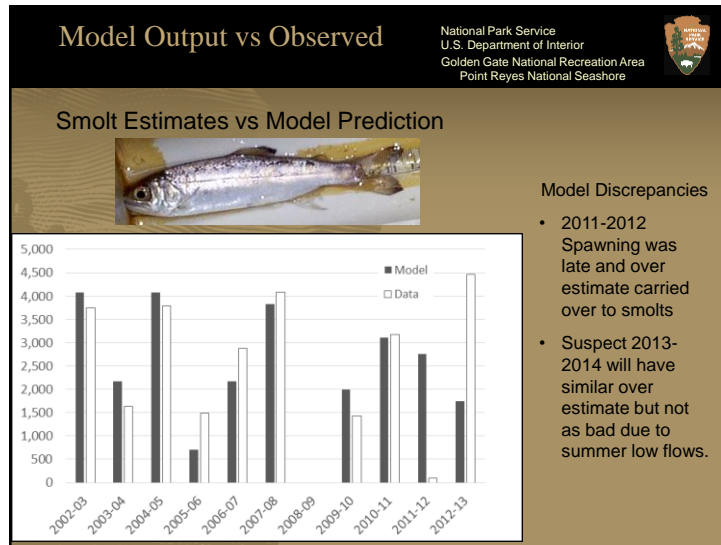
Slide 16



Slide 17



Slide 18



Slide 19

Next Steps

National Park Service
U.S. Department of Interior
Golden Gate National Recreation Area
Point Reyes National Seashore



- Continue to run model against observed to improve the model.
- Perform surveys on winter habitat to determine mortality due to lack of winter habitat.
- Perform sensitivity analysis to see what are the largest drivers of mortality in the model.
 - After analysis is performed make changes based on habitat improvements.
- Run climate change scenarios to determine areas to focus on for habitat improvement


Slide 20

For More Info

National Park Service
U.S. Department of Interior
Golden Gate National Recreation Area
Point Reyes National Seashore

Prepared in cooperation with the National Park Service

Users' Guide to System Dynamics Model Describing Coho Salmon Survival in Olema Creek, Point Reyes National Seashore, Marin County, California



Open-File Report 2014-1131

U.S. Department of the Interior
U.S. Geological Survey

Creating Rearing Habitat for ESA Listed Coho Salmon With Multiple Life History Strategies.

Presenter: Michael Wallace, California Department of Fish & Wildlife, Arcata.

mike.wallace@wildlife.ca.gov

Abstract:

There has been a growing appreciation of the importance of the stream-estuary ecotone (SEE) to juvenile coho salmon (*Oncorhynchus kisutch*) which has resulted in numerous habitat restoration projects being planned and completed in this habitat throughout northern and central CA. This talk will present examples of various SEE restoration projects to improve habitat and restore access to Humboldt Bay tributaries. These projects occur throughout the entire continuum of the SEE from brackish water through tidal freshwater to low gradient stream habitat in the lower portion of broad valley floors. The California Department of Fish & Wildlife (DFW) is sampling many of these projects to assess their performance and working with the restoration community to help design and improve future restoration projects. Initial results show that juvenile salmonids, especially coho salmon, moved into the newly restored sites as soon as they were accessible and water quality conditions allowed. The completed restoration projects in the lower portion of the SEE provided mostly over winter rearing habitat from December to June and individual juvenile coho reared at these sites for up to six months. DFW also found that juvenile coho captured in the SEE are larger than their cohorts rearing upstream in stream habitat and that restoring SEE habitat can benefit coho from the entire basin. This talk will show results of various SEE restoration techniques such as tide gate removal/modification, levee removal, and constructing or reconnecting off channel habitat. Providing access to and improving connections between small tributaries entering the SEE and creating off channel habitat appear to benefit juvenile salmonids.

Slide 1

**How Can You Be In Two Places At Once If You're Not
(Supposed To Be) Anywhere at All?:**
Creating Rearing Habitat For ESA Listed Coho Salmon
With Multiple Life History Strategies



Michael Wattace
California Department of Fish and
Wildlife



Slide 2



Traditional Coho Habitat



Newly Appreciated Coho Habitat

Slide 3

Pertinent Literature

Miller, B.A. and S. Sadro. 2003. Residence time and seasonal movements of juvenile coho salmon in the ecotone and lower estuary of Winchester Creek, South Slough, Oregon. *Transactions of the American Fisheries Society* 132(3): 546-559.

Koski, K.V. 2009. The fate of coho salmon nomads: the story of an estuarine-rearing strategy promoting resilience. *Ecology and Society* 14 (1): 4.

Slide 4

The Stream-Estuary Ecotone is Important Rearing Habitat for Coho Salmon

Impaired Estuary Function is a Stressor and a Threat to Coho Salmon

NOAA Draft Recovery Plan for SONCC Coho Salmon

Slide 5



Slide 6



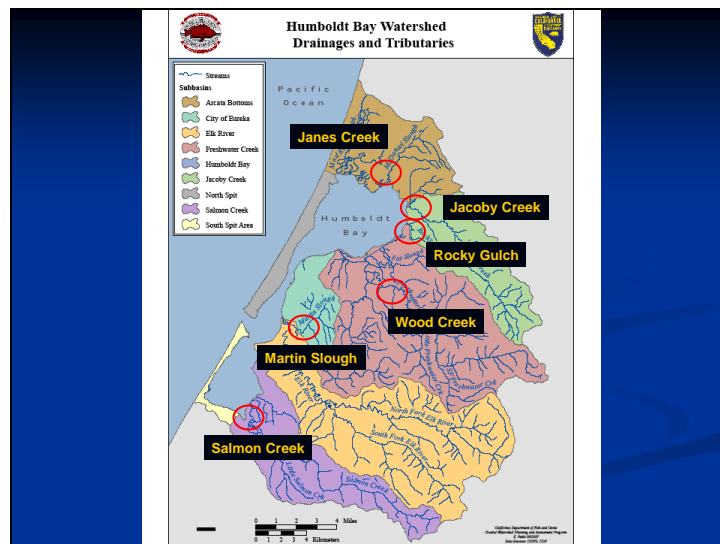
Common Restoration Techniques

Provide Access and Decrease Isolation

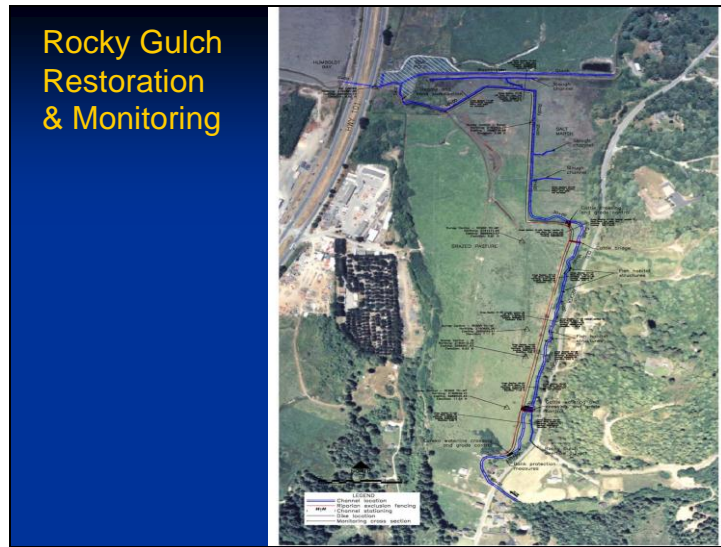
- Tide gate replacement or removal
- Remove or improve culvert passage
- Remove or set back levees
- Reconnect stream channel to adjacent floodplain

Improve Habitat

- Re-establish muted tidal cycle
- Increase tidal prism
- Create off channel habitat such as ponds, side channels, and alcoves
- Add large wood
- Create additional edge habitat
- Remove reed canary grass and other invasive spp



Slide 9



Slide 10



Slide 11



Slide 12

Coho Salmon Catches 2007-2009

<u>Dates</u>	<u>Rocky Gulch</u>	<u>Wood Creek</u>	<u>Martin Slough</u>	<u>Total</u>
Jan-Mar 07	48	86	4	138
Apr-Jun 07	29	29	71	129
Jul-Sep 07	0	17	17	34
Oct-Dec 07	1	17	22	40
Jan-Mar 08	20	125	123	268
Apr-Jun 08	16	50	76	142
Jul-Sep 08	0	1	7	8
Oct-Dec 08	0	5	17	22
Jan-Mar 09	28	46	435	509
Apr-Jun 09	3	22	247	272

Three life history types for coho salmon

Slide 13



Slide 14



Slide 15



Slide 16



Slide 17



Slide 18



Slide 19



Slide 20

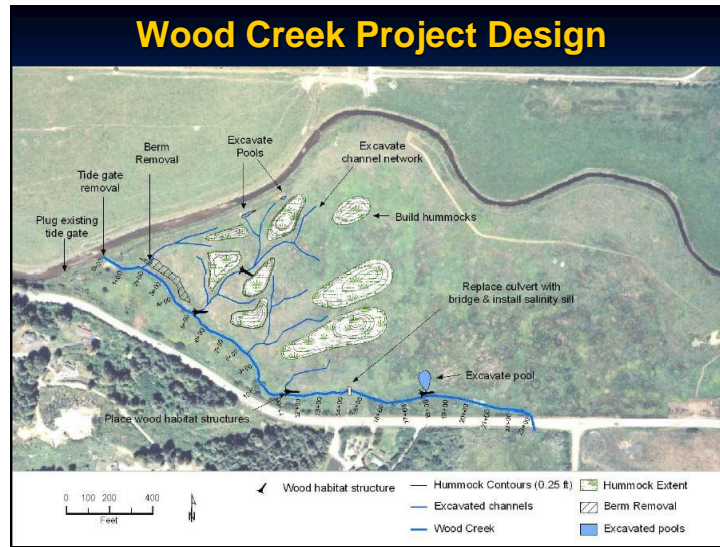
The Number of Juvenile Coho Salmon Steelhead Trout and Tidewater Goby Captured in Cattail Creek and Off Channel Ponds of Salmon Creek 2011-2014

Date	Pond 0			Pond 1			Pond 2			Ponds 3&4 ^a			Cattail Cr		
	CO	SH	TG	CO	SH	TG	CO	SH	TG	CO	SH	TG	CO	SH	TG
Fall 11	-	-	-	0	1	3	0	0	20	0	0	3	-	-	-
Win 12	-	-	-	59	10	22	6	3	143	1	0	0	-	-	-
Spr 12	-	-	-	31	1	1	9	1	46	0	0	0	-	-	-
Sum 12	-	-	-	0	0	462	0	0	168	0	0	0	-	-	-
Fall 12	0	0	37	0	0	2163	0	0	0	0	0	1	-	-	-
Win 13	1	0	7	1	0	8	0	0	77	0	0	0	-	-	-
Spr 13	6	0	73	2	0	96	2	0	171	0	0	0	0	0	108
Sum 13	0	0	130	0	0	190	0	0	180	0	0	0	0	0	148
Fall 13	0	0	56	0	1	36	0	0	139	0	0	0	0	0	36
Win 14	0	3	26	7	20	10	0	0	7	0	0	0	0	0	42
Spr 14	0	0	33	3	3	60	0	0	9	0	0	0	0	0	65
Sum 14	0	0	109	0	0	17	0	0	285	0	0	0	0	0	390
Fall 14	0	0	24	0	0	130	0	0	371	0	0	0	0	0	311
Total	7	3	495	103	36	3198	17	4	1616	1	0	4	0	0	1100

Pre-Project Coho Catch 2005-2010 = 9
 Post-Project Coho Catch 2011-2014= 128

^a Sampled only with minnow traps

Slide 21



Slide 22



Slide 23

Number of juvenile salmonids captured by season during opportunistic seining in Wood Creek Pond, January 2011 to December 2014. Winter is January-March, Spring is April-June, Summer is July-September, and Fall is October-December.

Date	Coho Yearling	Coho YOY	Steelhead/ RT	Cutthroat Trout.
Winter 2011	11	1	0	1
Spring 2011	1	46	0	1
Summer 2011	0	0	0	0
Fall 2011	0	1	0	0
Winter 2012	211	0	1	0
Spring 2012	26	73	0	1
Summer 2012	0	2	0	0
Fall 2012	0	15	0	0
Winter 2013	61	0	0	0
Spring 2013	3	0	0	0
Summer 2013	0	0	0	0
Fall 2013	0	10	0	0
Winter 2014*	1	0	0	0
Spring 2014*	4	0	0	0
Summer 2014*	0	0	0	0
Fall 2014*	0	2	0	0

*reduced effort due to heavy algae growth; used small 10X4 ft. seine designed to capture tidewater goby.

Slide 24

Origin of PIT tagged juvenile coho salmon tagged in Freshwater Creek basin detected at Wood Creek pond antennas during January to September 2010, October 2010 to October 2011, October 2011 to July 2012, October 2012 to June 2013, and September 2013 to June 2014

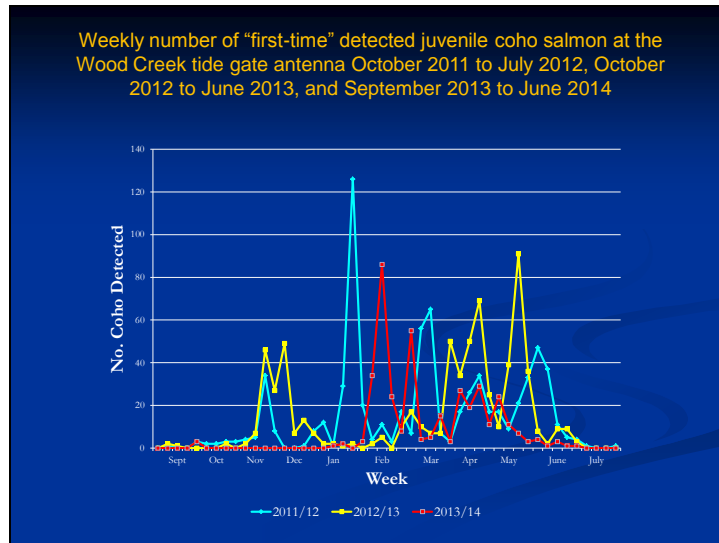
Fish Origin	2010	10/11	11/12	12/13	13/14
Stream Estuary Ecotone	7	1	-	1	0
Lower Mainstem Freshwater Creek	11	6	26	2	0
Middle Mainstem Freshwater Creek	-	11	16	1	1
Upper Mainstem Freshwater Creek	7	6	12	4	0
Little Freshwater Creek	12	-	-	-	0
Cloney Gulch	9	4	6	4	0
South Fork Freshwater Creek	-	0	10	2	0
Freshwater Creek (total)	46	28	70	14	1
Wood Creek Pond	74	8	199	42	5
Wood Creek	27	19	20	11	11
Ryan Slough/Creek	0	0	7	2	0
Freshwater Creek Slough	5	0	8	6	0
HFAC Weir	1	0	2	0	4
Estuary Ecotone (total)	107	27	236	61	20
Grand Total	153	55	306	75	21

Slide 25

Origin of PIT tagged juvenile coho salmon tagged in Freshwater Creek basin detected at Wood Creek tide gate antennas during January to September 2010, October 2010 to October 2011, October 2011 to July 2012, October 2012 to June 2013, and September 2013 to June 2014

Fish Origin	2010	10/11	11/12	12/13	13/14
Stream Estuary Ecotone	9	30	-	11	16
Lower Mainstem Freshwater Creek	11	49	75	29	32
Middle Mainstem Freshwater Creek	-	79	51	31	43
Upper Mainstem Freshwater Creek	10	59	34	25	35
Little Freshwater Creek	13	-	-	-	-
Cloney Gulch	8	45	23	32	30
South Fork Freshwater Creek	-	13	31	23	16
Freshwater Creek (total)	51	275	214	151	172
Wood Creek Pond	33	3	138	16	5
Wood Creek	48	35	69	89	44
Ryan Slough/Creek	26	5	71	38	11
Freshwater Creek Slough	11	10	67	86	47
HFAC Weir	165	123	156	221	105
Estuary Ecotone (total)	283	176	502	450	212
Unknown	-	-	-	-	64
Grand Total	334	451	716	601	448

Slide 26



Slide 27



Slide 28



Slide 29



Slide 30

Number of juvenile salmonids and TWG captured in Martin Slough 2007 to 2014

Date	Coho Yearling	Coho YOY	Steelhead/ RT	Cutthroat Trout.	TWG
Winter 2007	4	0	0	0	0
Spring 2007	71	0	0	3	0
Winter 2008	68	0	0	0	0
Spring 2008	70	0	0	5	0
Winter 2009	435	0	0	0	0
Spring 2009	246	1	1	11	0
Winter 2010	198	0	0	1	0
Spring 2010	83	0	0	3	0
Spring 2011	66	33	0	24	2
Summer 2011	0	97	0	19	158
Fall 2011	0	121	0	20	411
Winter 2012	553	0	0	6	25
Spring 2012	74	1	0	1	5
Winter 2013	80	0	1	0	46
Spring 2013	159	2	0	6	119
Summer 2013	0	0	0	1	0
Fall 2013	0	4	0	0	0
Spring 2014	10	0	0	7	189
Summer 2014	0	15	0	7	16
Fall 2014	2	1	0	0	132

Slide 31



Slide 32



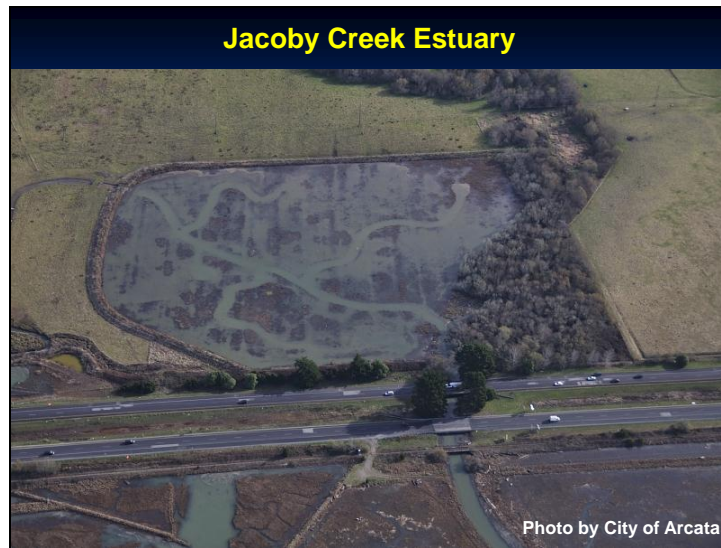
Slide 33



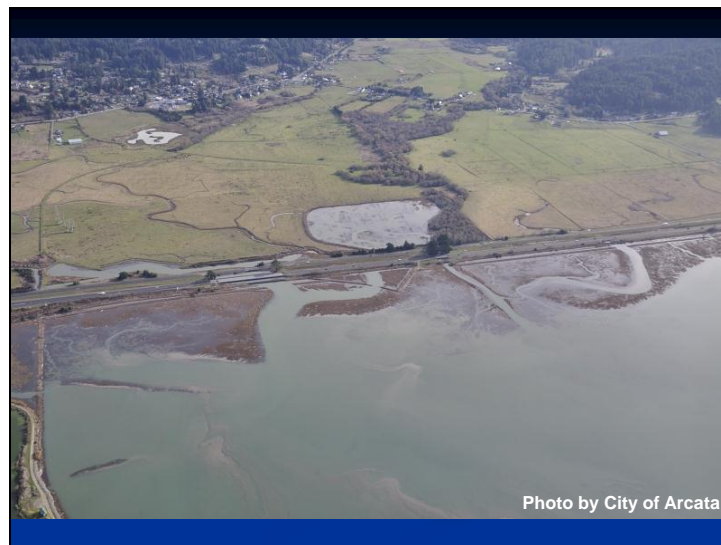
Slide 34



Slide 35



Slide 36



Slide 37



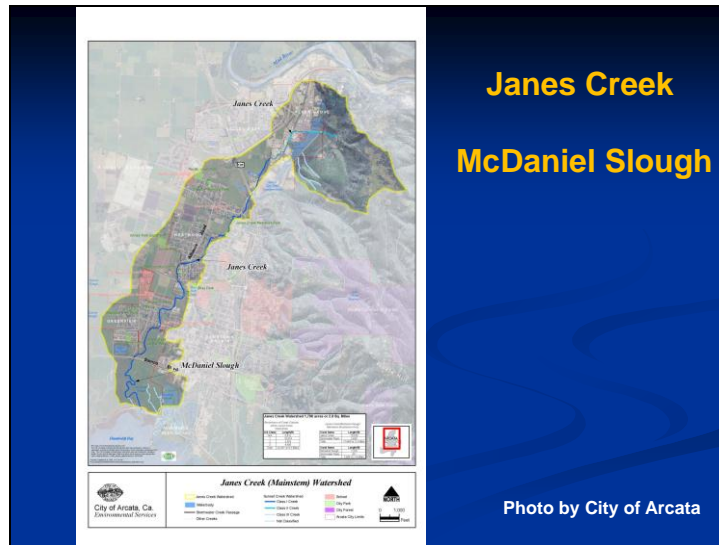
Slide 38

Number of juvenile salmonids captured in constructed Jacoby Creek Marsh and mainstem Jacoby Creek, 2012 to 2014. Winter is January-March, Spring is April-June, and Summer is July-September.

Date	Jacoby Creek Marsh			Jacoby Creek		
	Coho Yearling	Coho YOY	Steelhead/ RT	Coho Yearling	Coho YOY	Steelhead/ RT
Spring 2012	6	148	0	-	-	-
Summer 2012	0	0	0	-	-	-
Winter 2013	0	0	0	0	0	0
Spring 2013	0	0	0	1	0	2
Winter 2014	5	0	0	0	0	0
Spring 2014	0	1	0	15	0	0

Data from City of Arcata

Slide 39



Slide 40



Slide 41



Slide 42



Slide 43

Number of juvenile salmonids captured in Janes Creek and McDaniel Slough 2010 to 2011 and 2013 to 2014. Winter is January-March, Spring is April-June, Summer is July-September, and Fall is October-December.

Date	Coho Salmon	Cutthroat Trout	TWG
Fall 2010	0	12	1
Winter 2011	0	3	0
Spring 2011	0	2	4
Summer 2011	0	6	~200
Fall 2011	0	4	1
Winter 2013	0	14	0
Spring 2013	0	22	0
Summer 2013	0	33	0
Fall 2013 (breach 9/13)	0	3	0
Winter 2014	10	26	0
Spring 2014	4	24	0
Summer 2014	2	21	0
Fall 2014	0	8	0

Data from City of Arcata

Slide 44



Slide 45



Investigation of the relationship between physical habitat and salmonid abundance in two coastal Northern California streams.

Presenter: Sean Gallagher. California Department of Fish & Wildlife.

sean.gallagher@wildlife.ca.gov

Abstract:

To design and implement effective freshwater habitat restorations that improve conditions for coho salmon and other anadromous salmonids requires clear understanding of the relationships between fish abundance and stream habitat variables. In this study we investigated the relationships between summer Coho salmon and steelhead parr abundance and physical stream habitat variables in Caspar and Pudding Creeks in Mendocino County, California. The relationship between summer habitat and juvenile abundance were investigated using a stratified random experimental design. Our null hypothesis was that one or more of the habitat unit types and variables examined would be associated with salmonid abundance. We also examined habitat differences between the streams and tested our hypotheses regarding habitat variables and salmonid abundance, using two-way ANOVA, factor analysis, and negative binomial regression modeling. The abundance of juvenile Coho salmon and steelhead was positively associated with slow water, volume, and dry large wood abundance, and negatively associated with fast water habitat variables. Larger steelhead were also associated with cover habitat formed by wet and dry wood. We discuss our findings relative to the use of large wood in anadromous salmonid habitat recovery programs in California coastal watersheds.

Slide 1

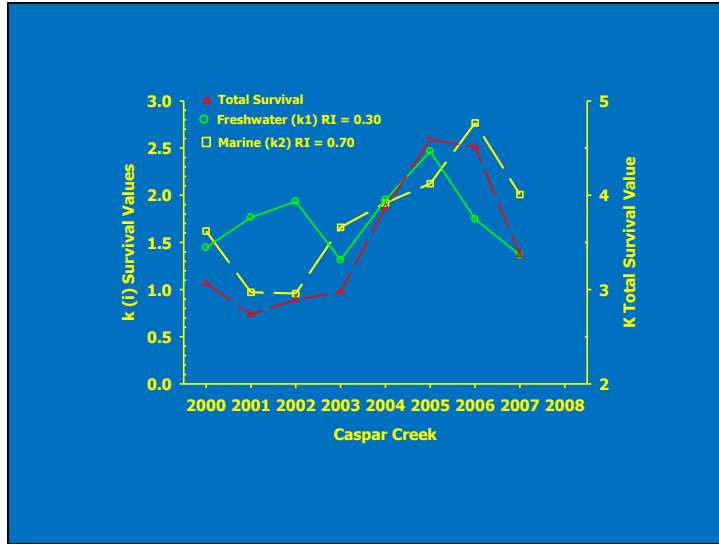
Investigation of the Relationship Between Physical Habitat and Salmonid Abundance in Two Coastal Northern California Streams

Sean P. Gallagher, Joe Ferreira, Emily Lang, Wendy Holloway,
and David W. Wright

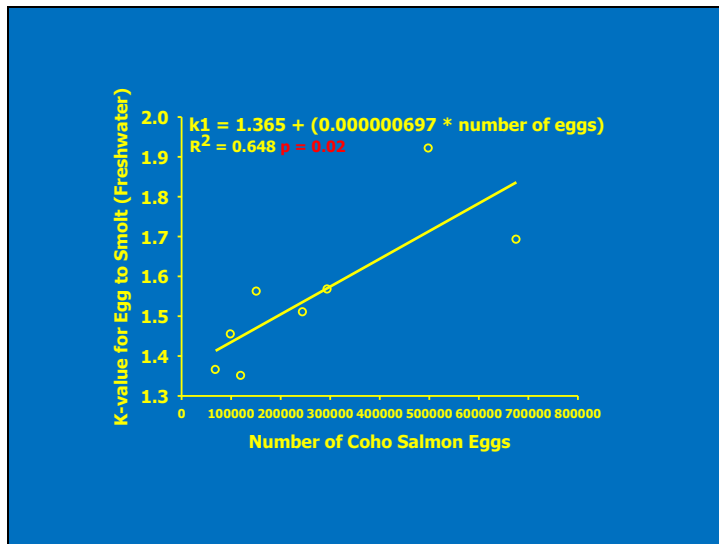
Slide 2

The slide features a central map of the Noyo River watershed in Mendocino County, California. The map shows the main river and its tributaries, including Pudding Creek and Crispin Creek. It also indicates the location of the South Fork Noyo River Dam. Surrounding the map are several photographs: a person handling a salmon, a stream bed with rocks, a stream with a dam, a stream with a green net, and two people wading in a stream.

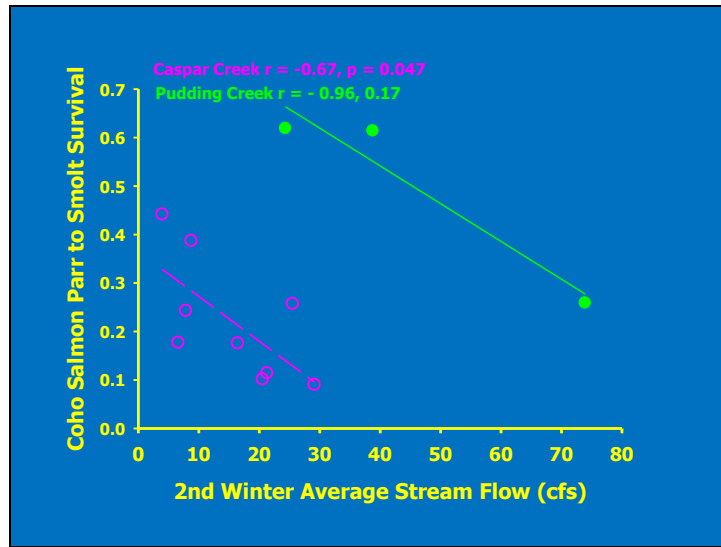
Slide 3



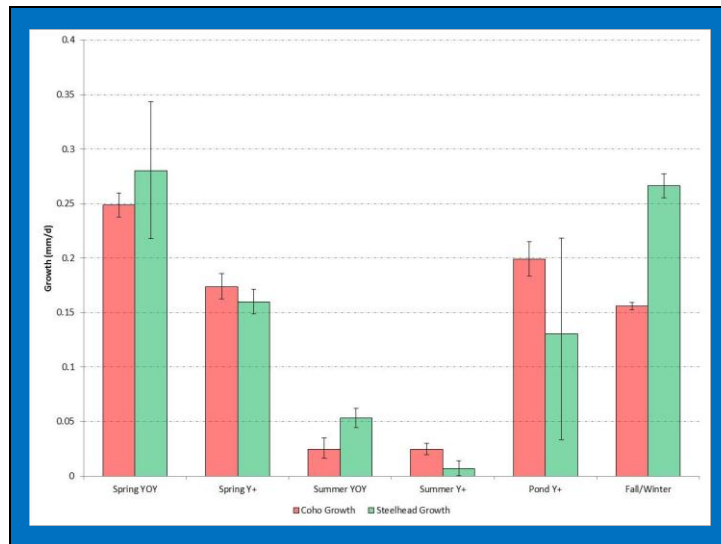
Slide 4

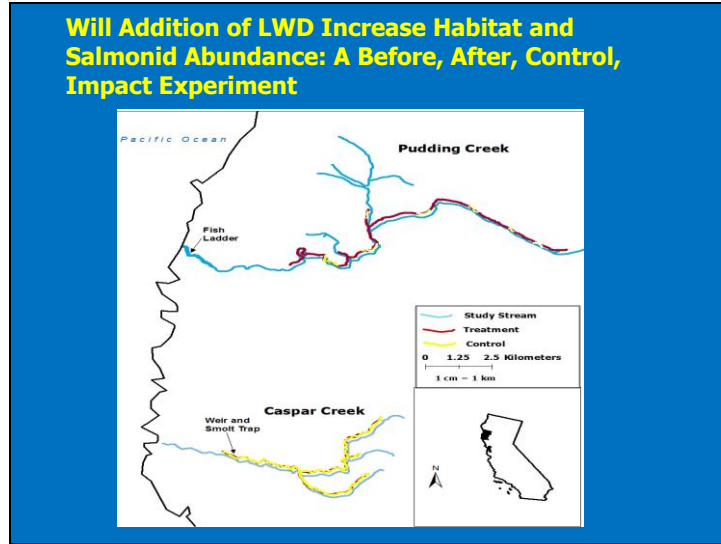


Slide 5



Slide 6





Analytical layout of population and habitat metrics for the BACI Experiment.

Parameter		Data collection period		
		Pretreatment Years	Transition	Post Treatment
Physical Habitat				
Summer and winter	Habitat number, size, volume, heterogeneity, and geometry	2013-2015	2015	2016-2019
	Channel Morphology/ geometry, substrate composition, sinuosity	2013-2015	2015	2016-2019
	Wood density, volume, and rate of input	2013-2015	2015	2016-2019
Winter only	Seasonal stream flow, water temperature, and others (Bouwens et al. 2011)	2013-2015	2015	2016-2019
	Percent slow water habitat, Percent off channel habitat, floodplain channel length	2012-2014	2015	2016-2019
Biological				
Summer	Steelhead 0+ abundance	2006-2010, 2012, 2013, 2014	2015	2016-2019
	Coho abundance	2006-2010, 2012, 2013, 2014	2015	2016-2019
	Coho and Steelhead Growth*	2011-2014	2015	2016-2019
Winter	coho and steelhead Survival	2011-2014	2015	2016-2019
	Coho and Steelhead Growth*	2011-2014	2015	2016-2019
Annual	coho and steelhead Survival	2011-2014	2015	2016-2019
	Coho salmon and Steelhead smolt abundance	2006-2010, 2012, 2013, 2014	2015	2016-2019
	Coho salmon and Steelhead adult abundance	2006-2010, 2012, 2013, 2014	2015	2016-2019
	Over-summer survival	2006-2010, 2012, 2013, 2014	2015	2016-2019
	Winter survival	2006-2010, 2012, 2013, 2014	2015	2016-2019
	Habitat specific survival and growth	2011-2014	2015	2016-2019
	Proportion of two-year old coho residents	2006-2010, 2012, 2013, 2014	2015	2016-2019

* This will also be relevant to specific habitat units types and size history (Bart et al. 2003).

Slide 9

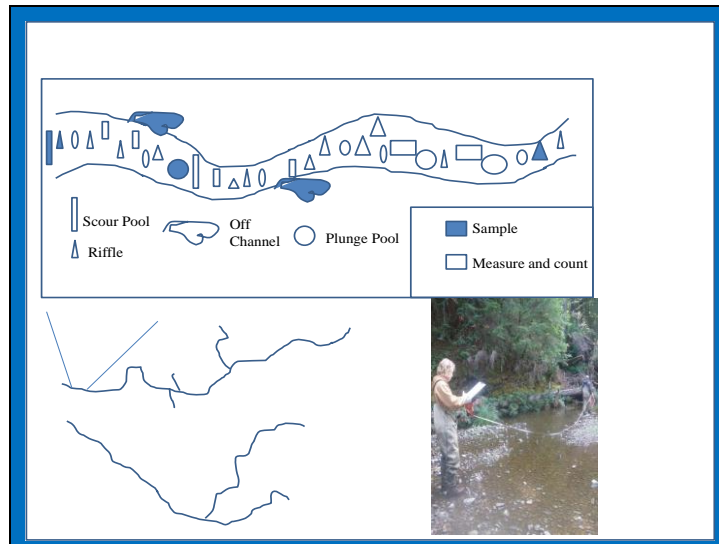
Detailed habitat variables collected in each selected unit in Caspar and Pudding creeks during summer 2013.

Habitat Unit Type	Percent Fish Cover	Substrate Composition	Measured Unit Variables	Calculated Unit Variables
Cascade*	Aquatic Vegetation	Bedrock	Average Depth	Residual Pool Depth ¹
Dam Pool*	Artificial Structures*	Boulders	Bankfull Width	Residual Pool Volume ²
Dry Units*	Dead Woody Debris	Cobbles	Length	Unit Surface Area
Falls*	Live Overhanging Vegetation	Course Gravel	Maximum Depth ¹	Unit Volume
Non-Turbulent	No Cover	Fine Gravel	Pool Tail Crest Depth ¹	Dry LWD Abundance
Off Channel	Undercut Banks	Fines	Width	Wet LWD Abundance
Plunge Pool		Sand		Dry LWD Density
Rapid*		Pool Tail Fines < 2mm ¹		Wet LWD Density
Riffle		Pool Tail Fines 2-6mm ¹		
Scour Pool				

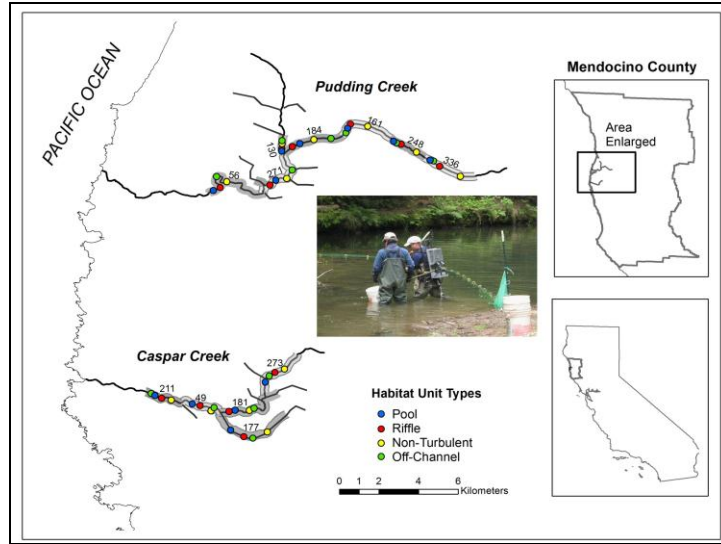
*Few or none encountered
¹ Pools only

Columbia Habitat Monitoring Program: Bouwes, N., J. Moberg, N. Weber, B. Bouwes, C. Beasley, S. Bennett, A. Hill, C. Jordan, R. Miller, P. Nelle, M. Polino, S. Rentmeester, B. Semmens, C. Volk, M. B. Ward, G. Wathen, and J. White. 2011. Scientific protocol for salmonid habitat surveys within the Columbia Habitat Monitoring Program. Prepared by the Integrated Status and Effectiveness Monitoring Program and published by Terraqua, Inc., Wauconda, WA

Slide 10



Slide 11



Slide 12

Salmonid Unit Abundance:
Coho Parr, Steelhead YoY, Y+, Y++

Habitat Unit Type	Percent Fish Cover	Substrate Composition	Measured Unit Variables	Calculated Unit Variables
Cascade*	Aquatic Vegetation	Bedrock	Average Depth	Residual Pool Depth ¹
Dam Pool*	Artificial Structures*	Boulders	Bankfull Width	Residual Pool Volume ¹
Dry Units*	Dead Woody Debris	Cobbles	Length	Unit Surface Area
Falls*	Live Overhanging Vegetation	Course Gravel	Maximum Depth ¹	Unit Volume
Non-Turbulent	No Cover	Fine Gravel	Pool Tail Crest Depth ¹	Dry LWD Abundance
Off Channel	Undercut Banks	Fines	Width	Wet LWD Abundance
Plunge Pool		Sand		Dry LWD Density
Rapid*		Pool Tail Fines < 2mm ¹		Wet LWD Density
Riffle		Pool Tail Fines 2-6mm ¹		
Scour Pool				

* Few or none encountered
¹ Pools only

Slide 13

“The relationship between any one habitat parameter and salmon and steelhead survival is difficult.... ”

“It is easy to draw conclusions that the more pristine reference streams were better for salmon and steelhead, but more difficult to prove what specific mechanisms are at work.”

Crawford, B. A. and S. Rumsey. 2011. Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead Listed Under the Endangered Species Act: Guidance to salmon recovery partners concerning prioritizing monitoring efforts to assess the viability of salmon and steelhead populations protected under the Federal Endangered Species Act. National Marine Fisheries Service, NW Region. 160 pp.

Slide 14



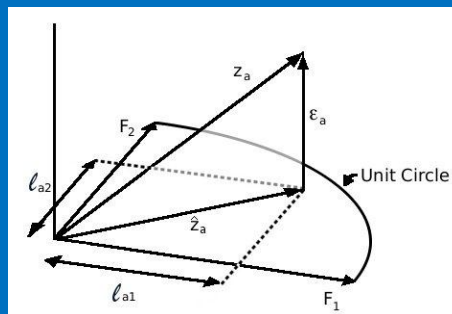
Slide 15

Reduced data set of variables used in factor analysis to evaluate relationships between salmonid abundance and physical stream habitat.

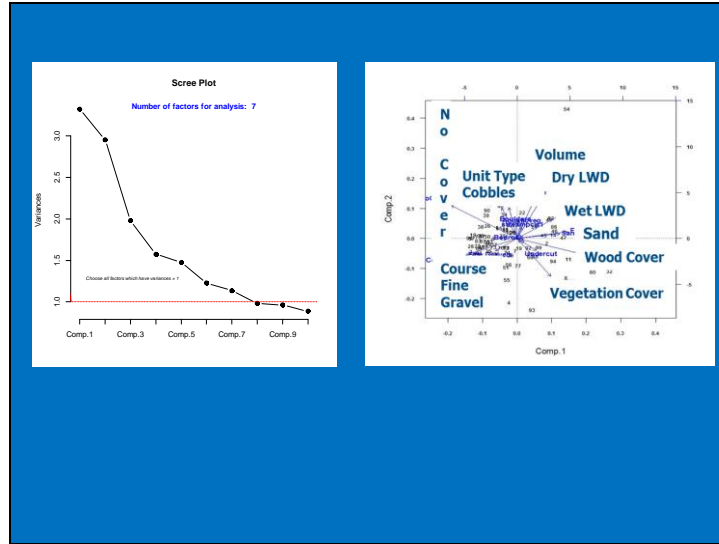
Unit Abundance*	Stream	Unit Type	Percent Bedrock	Boulders	Cobbles
Coarse Gravels	Fine Gravels	Sand	Fines	Woody Debris Cover	Live Overhead Cover
Undercut Banks	No Cover	Aquatic Vegetation Cover	Unit Volume	Dry LWD Abundance	Wet LWD Abundance

* Dependent variable: coho salmon, steelhead YoY, Steelhead Y+, or Steelhead Y++.

Slide 16



Slide 17



Slide 18

Factor Analysis:
Factor names, factor loadings (variables), and loading coefficients.
Bold indicates significant coefficients.

Variable	Factor Names						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Bedrock				0.59			
Boulders				0.89			
Cobble							
Coarse Gravels					-0.38	-0.74	
Fine Gravels						-0.46	
Sand					0.96		
Fines						0.64	
Large Wood Wet		0.75					
Large Wood Dry	0.31	0.47		0.34			
Overhead Vegetation Cover			0.76				
Overhead Wood Cover		0.72					
Aquatic Vegetation Cover							
Undercut Banks							0.98
No Cover		-0.43	-0.86				
Unit Type							
Unit Volume	0.79				0.32		
Stream				0.33			

Slide 19

Negative Binomial Regression Modeling

Habitat factors associated with salmonid abundance

Salmonid Abundance	Factor Names						
	Volume and Dry Large Wood	Wood	Overhead Vegetation	Turbulent Water Stream And Dry Large Wood	Slow Water Volume	Fast Water	Undercut Banks
Coho Salmon	Positive	NS	NS	NS	Positive	Negative	NS
Steelhead YoY	Positive	NS	Negative	Negative	NS	Negative	NS
Steelhead Y+	Positive	Positive	Negative	Negative	Positive	Negative	Positive
Steelhead Y++	Positive	Positive	NS	NS	NS	NS	NS

Slide 20

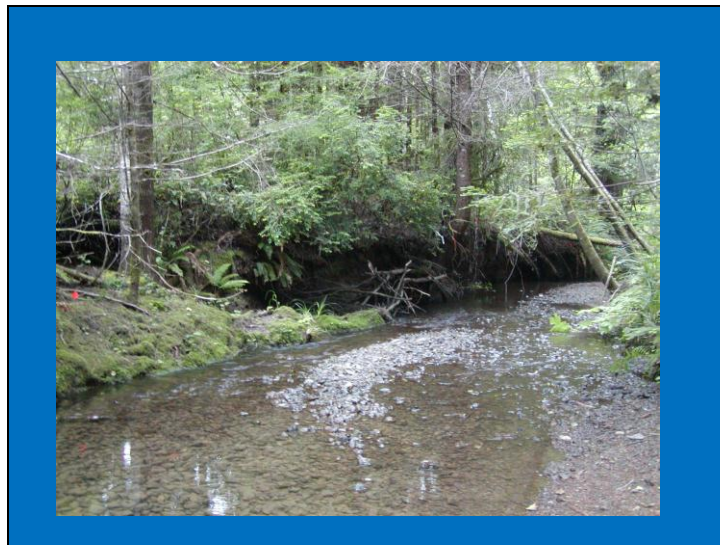
Coho Salmon Abundance and Habitat Variables

Variable	Factor Names						
	Volume and Dry Large Wood	Wood	Overhead Vegetation	Turbulent Water Stream And Dry Large Wood	Slow Water Volume	Fast Water	Undercut Banks
Bedrock							
Boulders				0.59			
Cobbles				0.89			
Coarse Gravels					-0.38	-0.74	
Fine Gravels						-0.46	
Sand					0.96		
Sines						0.64	
Large Wood Wet		0.75					
Large Wood Dry	0.31	0.47		0.34			
Overhead Vegetation Cover			0.76				
Overhead Wood Cover		0.72					
Aquatic Vegetation Cover							
Undercut Banks							0.98
No Cover		-0.43	-0.86				
Unit Type							
Unit Volume	0.79				0.32		
Stream				0.33			

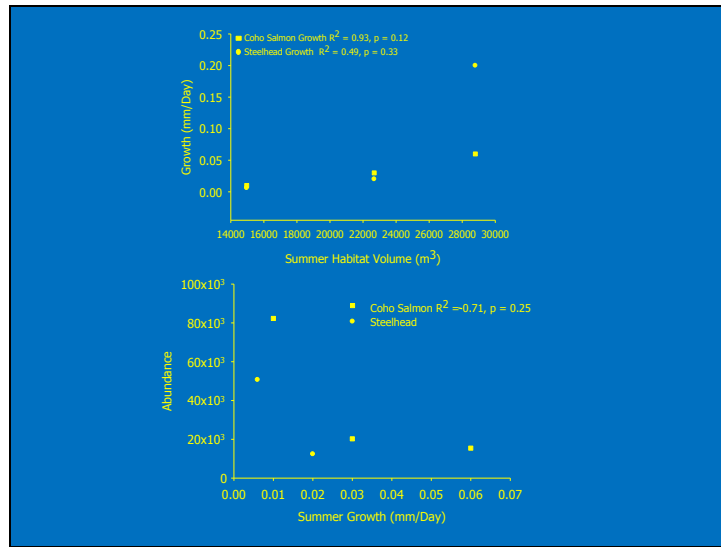
Slide 21



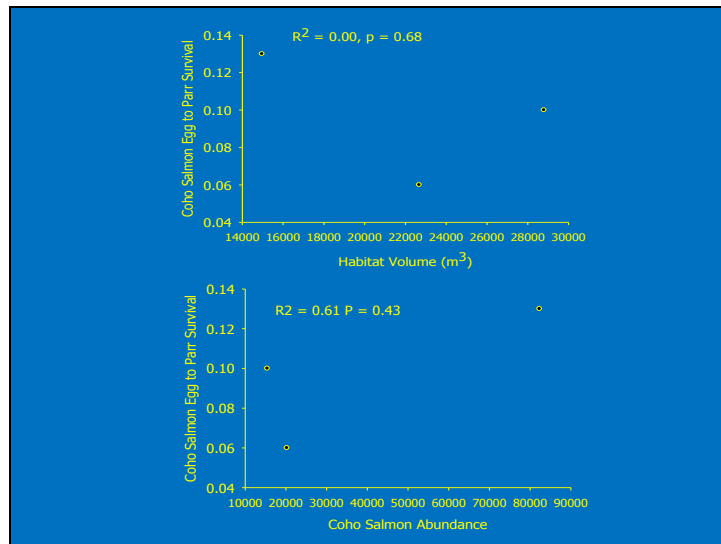
Slide 22



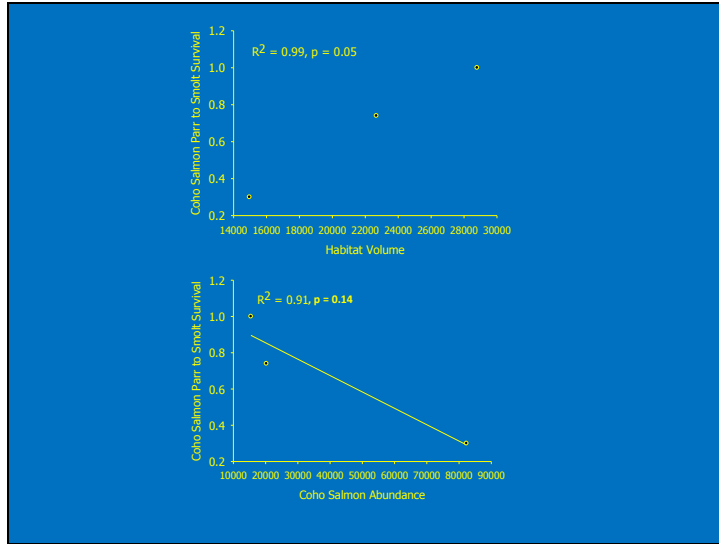
Slide 23



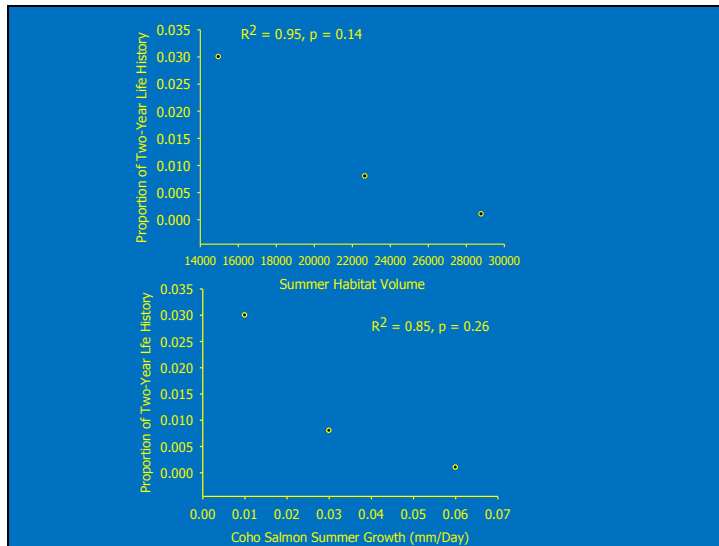
Slide 24



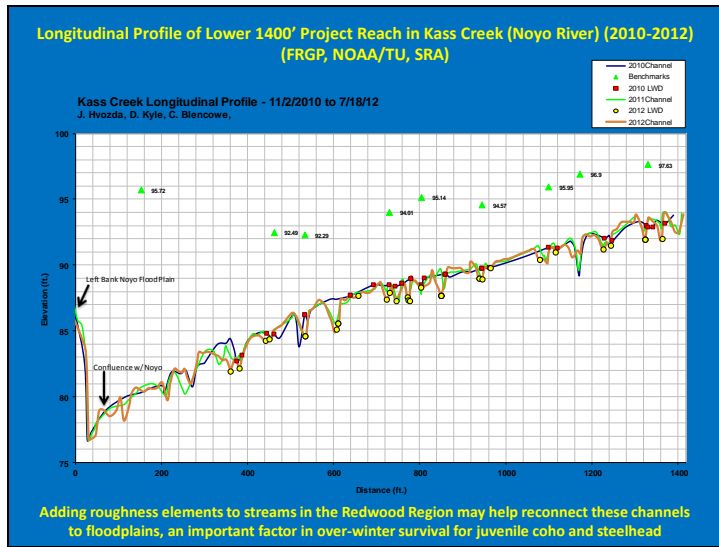
Slide 25



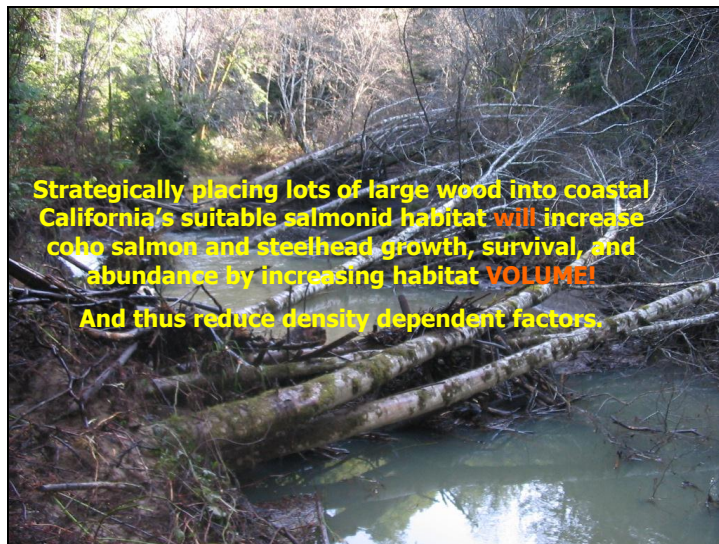
Slide 26



Slide 27



Slide 28



The Effectiveness of Artificial Upstream Migration Flows for Coho Salmon.

Presenter: Eric Ettlinger. Marin Municipal Water District. eettlinger@marinwater.org


Abstract:

The Marin Municipal Water District releases extra water into Lagunitas Creek to provide fall and winter “upstream migration flows” when rain does not provide adequate runoff to facilitate adult salmon migration. Assessing the effectiveness of these cold water releases is particularly important during critically dry years when water supplies are stretched. We analyzed 18 years of stream flow and spawner data, including time-lapse video monitoring, to assess the effectiveness of these water releases. With very few exceptions these releases failed to trigger upstream migration or increase spawning. Even very small runoff events elicited stronger migration responses, indicating that water depth is not the most important factor for encouraging salmon to migrate in Lagunitas Creek. Opportunities to improve stream flow management and obstacles to change will be discussed.

Slide 1



The Effectiveness of Artificial Upstream Migration Flows for Coho Salmon

Eric Ettlinger, Aquatic Ecologist
Marin Municipal Water District



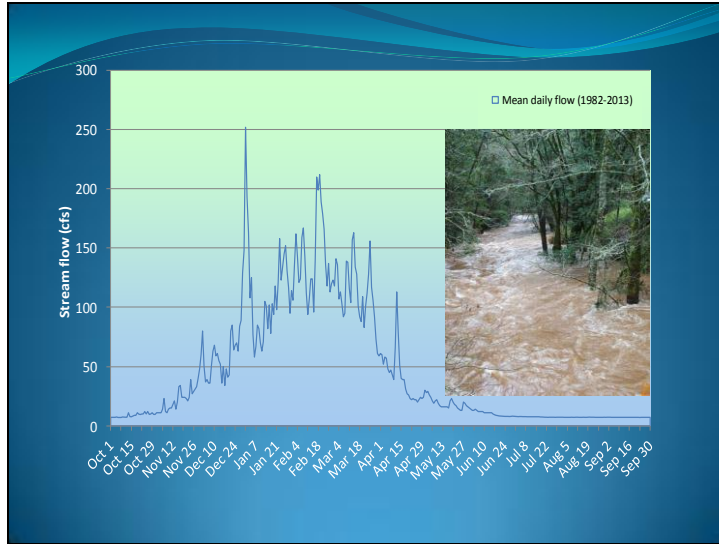
Slide 2

Lagunitas Creek Watershed

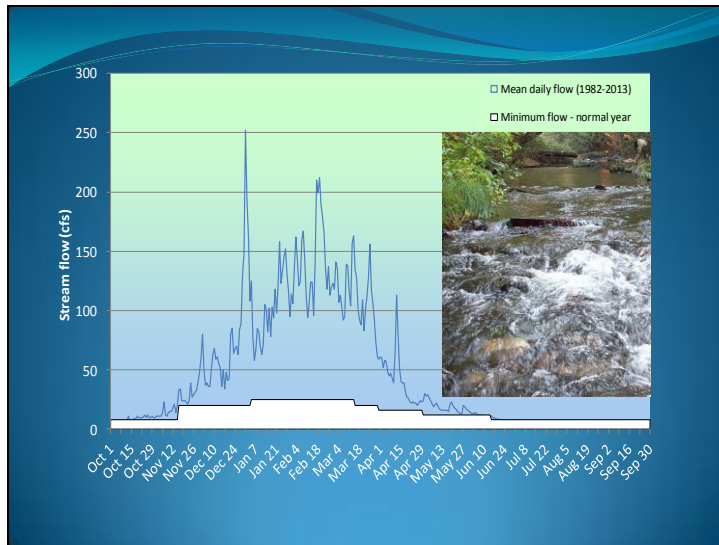


- 109 mi²
- Half is accessible to anadromous salmonids
- 52% public land
- Provides 190,000 MMWD customers with 75% of their water.

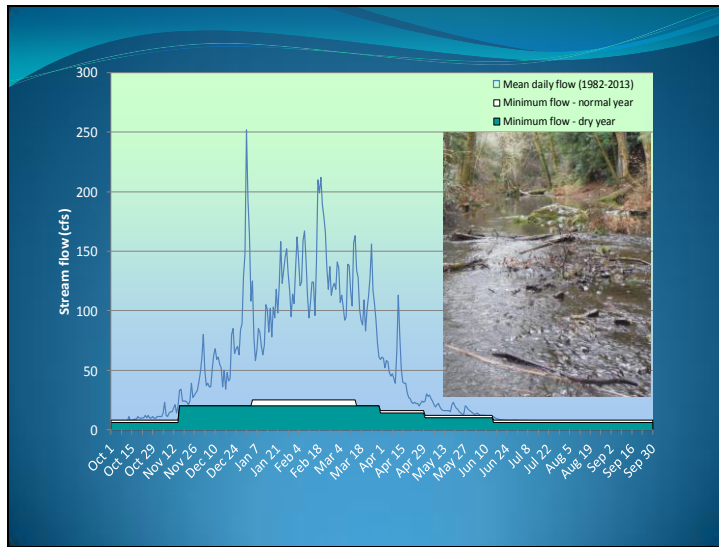
Slide 3



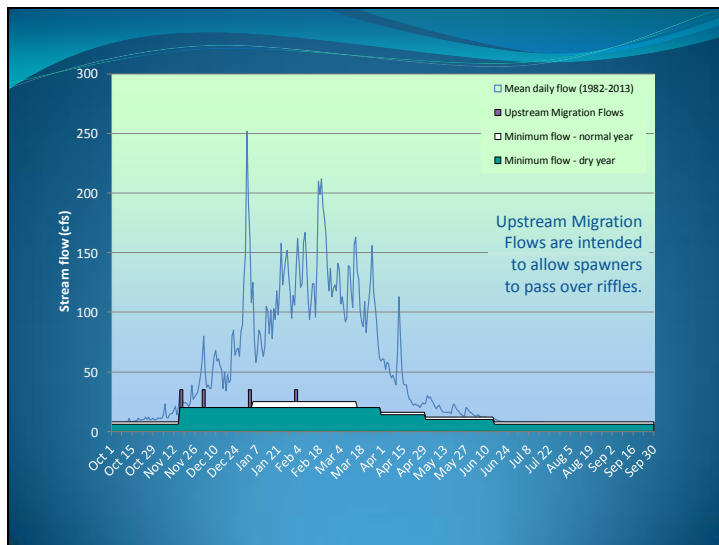
Slide 4



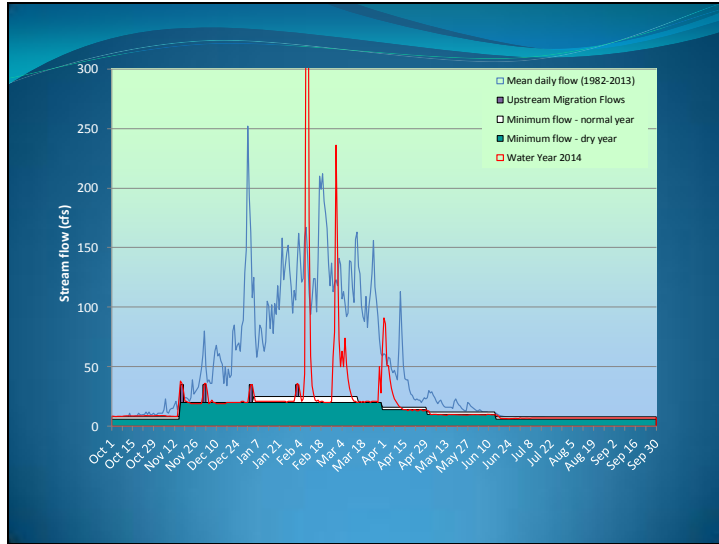
Slide 5



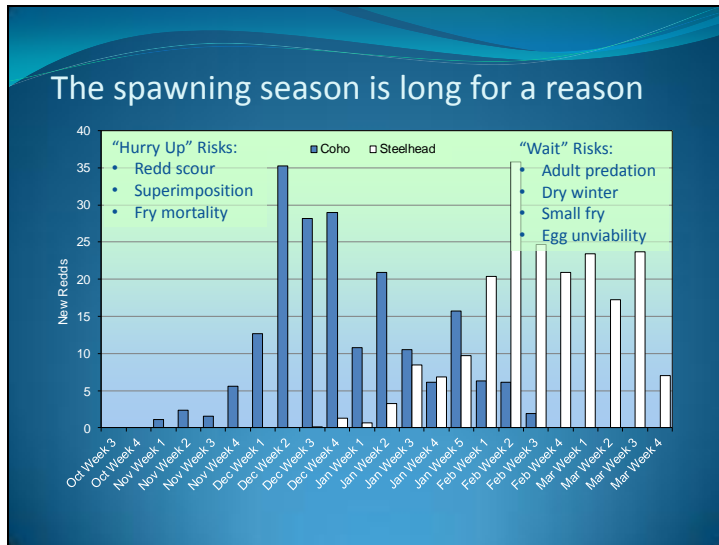
Slide 6



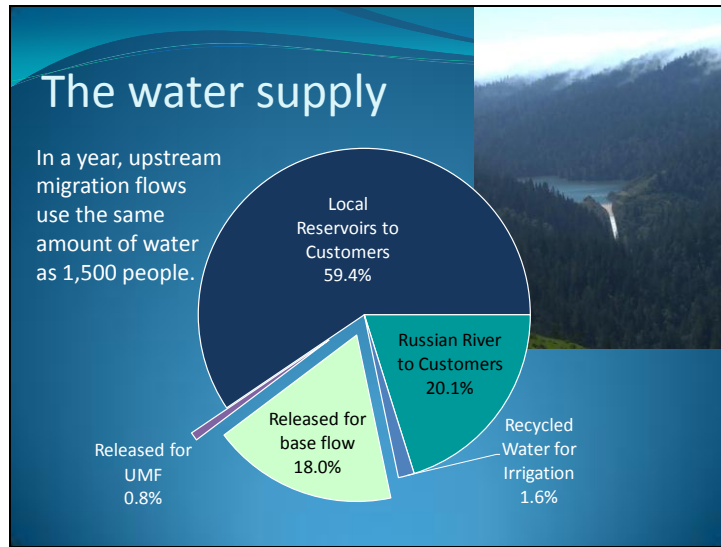
Slide 7



Slide 8



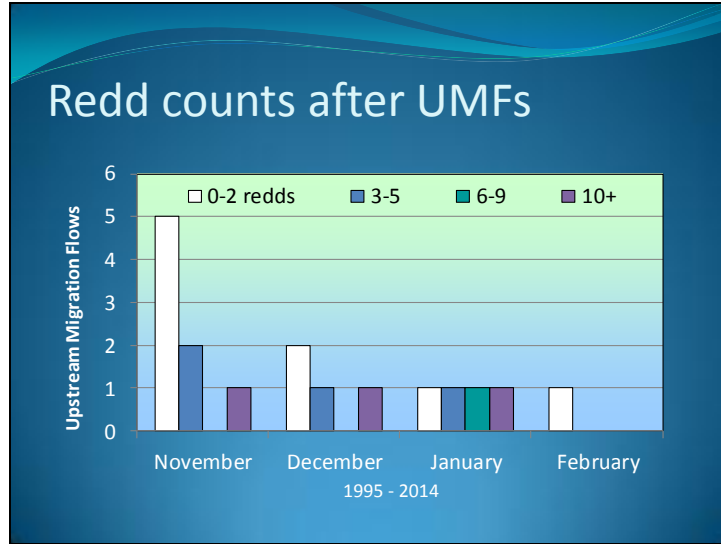
Slide 9



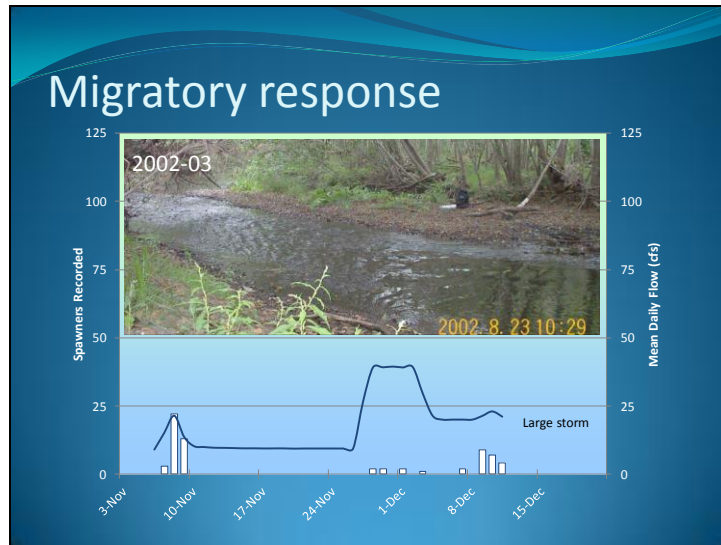
Slide 10



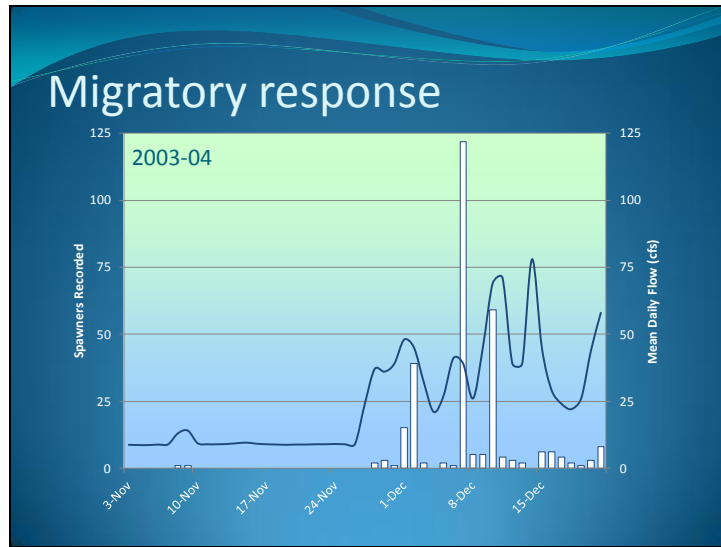
Slide 11



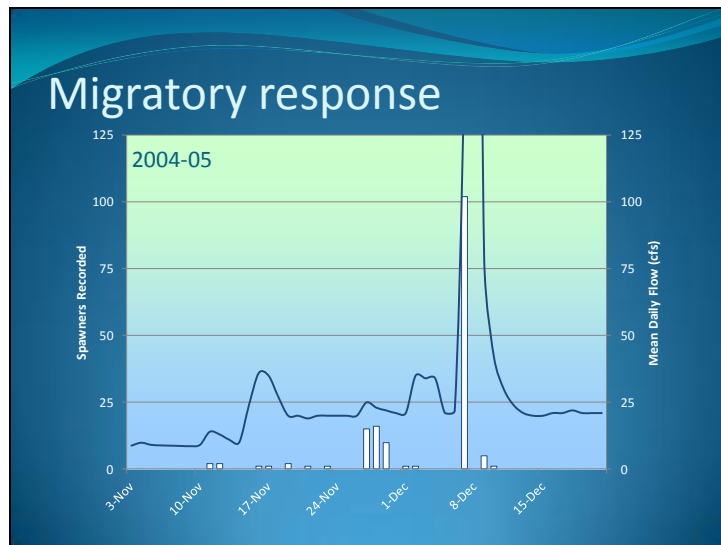
Slide 12



Slide 13




Slide 14



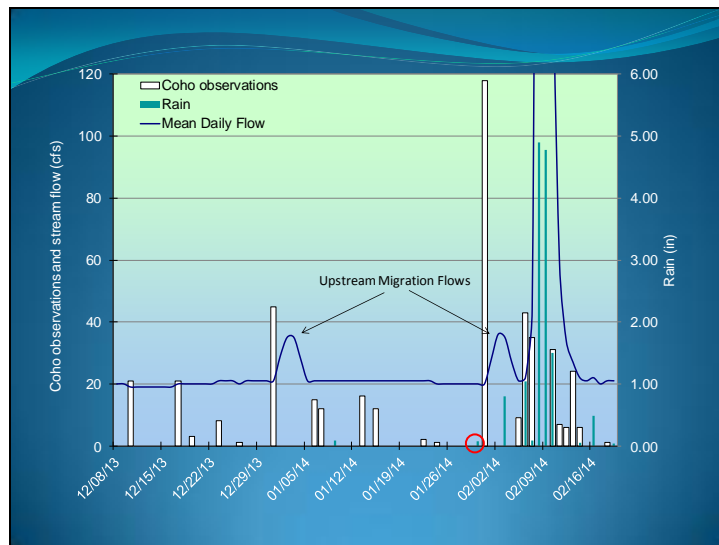
Slide 15

Coho reviews of MMWD water

- “Okay, but there’s not enough of it.”
- “It just doesn’t smell right.”
- “I like my water a little cloudier.”

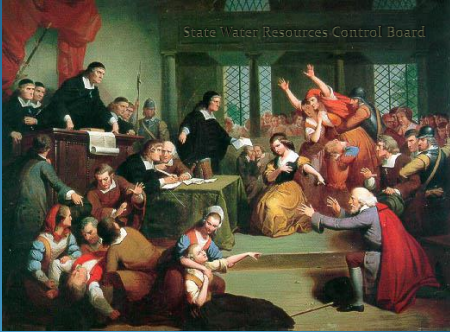


Slide 16



Is it time to end UMFs?


- The process leading to Order WR95-17 lasted 13 years.
- New hearings would likely result in a reexamination of all aspects of the Order.



"The Water Board Spectacle"

Conclusions

- Spawners can pass over riffles without Upstream Migration Flows.
- UMFs are rarely associated with increased spawning.
- UMFs are less effective at encouraging spawner migration than runoff turbidity or even drizzle.
- UMFs don't appear to have any benefit, but also don't appear to do any harm.
- Unless revisiting the Water Board Order becomes a higher priority, UMFs will continue.



Coho Salmon in a Spring Creek: Life history tactics of coho salmon in the Shasta River and a method for quantifying survival to evaluate and prioritize restoration efforts.

Presenter: Chris Adams, California Department of Fish & Wildlife. Chris.adams@wildlife.ca.gov

Abstract:

The Shasta River was historically among the top producers of coho salmon in the Klamath system. Its unique spring-dominated hydrology promotes rapid growth rates and provides consistent inter and intra-annual flow. However, surface water diversions degrade the river and its salmonid habitat. A network of approximately twenty PIT tag detection stations have been in operation at key locations throughout the watershed for several years, providing detailed information on habitat use by tagged juvenile coho salmon. During periods of juvenile coho redistribution in early summer, we have documented extensive upstream movements to headwater springs, as well as extensive downstream movements to thermal refugia areas in the mid-Klamath. Some age-0 coho salmon grow to over 100 mm by June when they appear to undergo smoltification and leave the Shasta River. A multi-state mark-recapture modeling framework has been established to estimate seasonal survival and movement parameters in different areas. These analyses have indicated that survival is lowest in summer and as high as 100% in winter. This data has been used to prioritize and evaluate restoration efforts including conservation of cold springs, tailwater reduction, riparian fencing, and coordination among diverters to reduce impacts on coho salmon habitat.

*Juvenile coho salmon (*Oncorhynchus kisutch*) exhibit compensatory mechanisms in a large volcanic spring-fed river.*

Presenter: Robert Lusardi, UC Davis Center for Watershed Sciences. ralusardi@ucdavis.edu

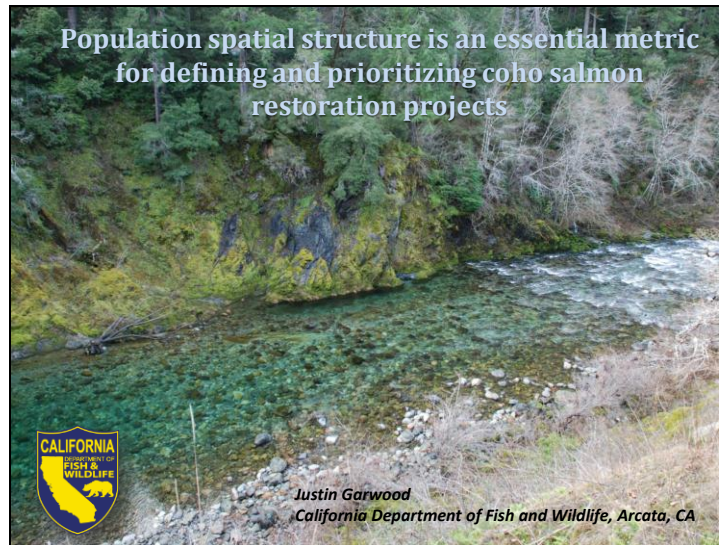
Abstract: Southern Oregon/Northern California Coast (SONCC) coho salmon are currently listed as threatened under both the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA). Populations are depressed throughout the SONCC ESU and in many watersheds all three brood-year lineages may have too few individuals to be self-sustaining. Consequently, there is an urgent need to identify and understand the habitats and ecological processes that can assist recovery planning and enhance viability. Recent thermal restoration on the Shasta River, a spring-fed tributary to the Lower Klamath River, has extended downstream rearing habitat for juvenile coho salmon. The longitudinal influence of cold water spring sources, rich in naturally-occurring nutrients, and their effects on the growth and prey availability of coho salmon were studied. Specifically, we quantified the growth and production of juvenile coho in five stream segments that differed in their spatial proximity to cold water spring sources on the Shasta River. We found strong differences in mean weekly maximum temperatures (MWMT), invertebrate prey availability, and the growth and condition factor of juvenile coho salmon. Coho salmon reared in close proximity to springs experienced MWMTs ranging from 14.8°C to 16°C, exhibited an apparent growth rate of 0.13 mm/day, and a 26% increase in mass over the nine week study period. Conversely, individuals reared six kilometers downstream from cold water spring sources experienced MWMTs ranging from 17.6°C to 21°C, exhibited a growth rate of 0.27 mm/day, and a 161% increase in mass during the same period. Downstream individuals subjected to warmer water temperatures exhibited an 18% increase in fork length and two-fold increase in mass when compared with upstream individuals in closer proximity to spring sources. Our results indicate that juvenile coho salmon may have the ability to metabolically compensate for elevated water temperatures when food resources are near saturation. Moreover, our results suggest that volcanic spring-fed rivers may be areas of extraordinary intrinsic potential for the recovery of federally threatened coho salmon and should continue to be the focus of thermal restoration efforts.

Population spatial structure is an essential metric for defining and prioritizing coho salmon restoration projects.

Presenter: Justin Garwood, California Department of Fish & Wildlife. Justin.Garwood@wildlife.ca.gov

Abstract: The spatial arrangement of resources across a landscape can have profound effects on species distribution. Resources are not randomly distributed, but reflect geological and geomorphic processes dictating physical and biological characteristics of fish habitat. For coho salmon, juvenile life stages are the most widely distributed across the riverscape, with patchy habitats being spatially and temporally dynamic. The spatial structure of a population refers both to the spatial distribution of individuals in the population and to the processes that generate that distribution. Winter and summer seasons represent distinctive time periods during which there is a high likelihood of contrasting stream habitat availability for juvenile coho salmon. Understanding seasonal habitat patch size, utilization, connectivity and colonization, and also the extinction processes affecting a population, will help managers define source patches, while also identifying isolated patches that are much more vulnerable to extinction. This information is critical to defining restoration goals that are based on current population distributions. Restoration of areas currently being used by coho salmon, or areas in close proximity to population centers, will likely have a rapid positive effect on productivity. I developed an affordable snorkel survey protocol to sample juvenile coho salmon throughout a population space during the summer, using a randomly selected set of reaches with pools defined as the primary sampling unit. I applied multi-scaled occupancy models (i.e. Nichols et al. 2008) to estimate the probability of coho salmon occupancy simultaneously at two spatial scales, while accounting for detection probabilities. The larger scale corresponds to the probability of occupancy at the sample reach (ψ), whereas the smaller scale corresponds to the probability of occupancy at the sample pool (θ), given the species was present in the sample reach. Detection probability (p) is modeled at the smaller pool scale based on individual snorkel passes in each sampling unit. The advantage to modeling occupancy at two spatial scales in both landscape and local spatial distributions of a given species can be calculated while accounting for individual survey detection probabilities in a single framework. By tracking occupancy at both scales, the overall proportion of area occupied (PAO) can be determined for the population. Results from each year can be directly compared to assess the relative change in annual spatial structure. I will report on the first three years of spatial structure monitoring across four coho salmon populations in northern California and provide examples of prioritized restoration opportunities. I will also report on the recent development and application of annual PAO metrics in coastal plain and estuarine habitats employed during the winter.

Slide 1



Slide 2

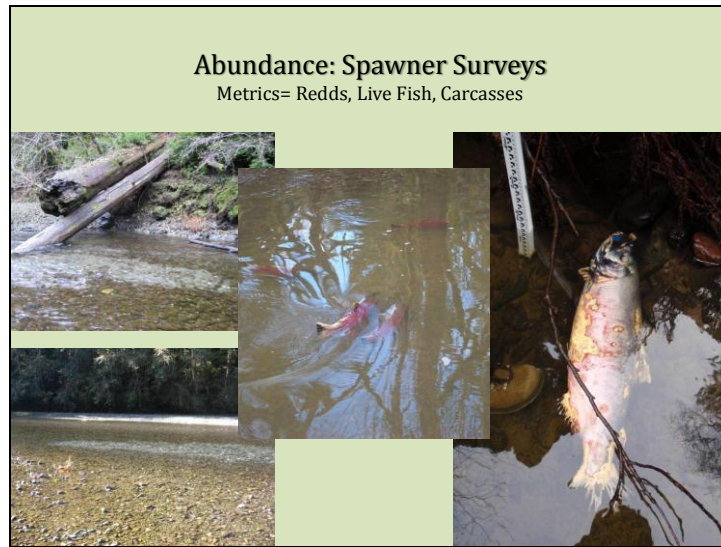
California Coastal Salmonid Monitoring Program

Viable Salmonid Conceptual Framework:

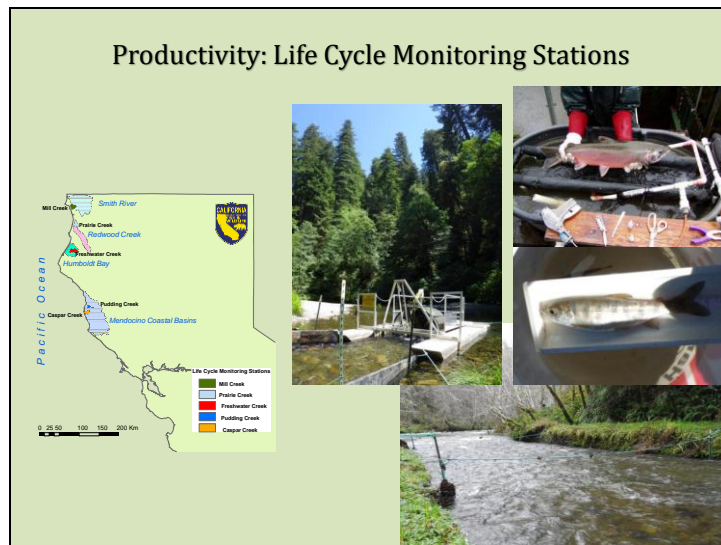
- Abundance
- Productivity
- Spatial Structure
- Diversity

****Trend monitoring for these VSP parameters is the measure by which extinction risk and recovery status of listed salmonids are determined****

Slide 3



Slide 4



Why Spatial Structure?

- Resources are not randomly distributed
- Salmonids have complex life history needs
- Population and life history diversity reduce variability in abundance and ecosystem function

Inference from Spatial Structure

- Patch use
- Patch size
- Patch connectivity
- Patch colonization and extinction processes

The diagram shows a central pink circle labeled 'Source'. It has several arrows pointing outwards to other circles: a solid arrow to a grey circle labeled 'Sink' at the top, a solid arrow to a pink circle labeled 'Source' at the top-right, and a solid arrow to a grey circle labeled 'Sink' at the bottom-right. Additionally, there are dashed arrows pointing from the central 'Source' to a pink circle labeled 'Source' on the left and a grey circle labeled 'Sink' at the bottom-left.

Slide 7

What do we know about 'historic' Spatial Structure?

SONCC Basin	Net Total Coho Streams
Del Norte Coastal	17
Smith River	36
Klamath River	184
Humboldt Coastal	21
Redwood Creek	30
Mad River	22
Humboldt Bay Tributaries	40
Eel River	148
Mattole River	44
Total:	542

Garwood, J. 2012a. Historic and Recent Occurrence of Coho Salmon (*Oncorhynchus kisutch*) in California Streams within the Southern Oregon/ Northern California Evolutionarily Significant Unit. California Department of Fish and Game, Fisheries Branch Report 12-3; 77p.

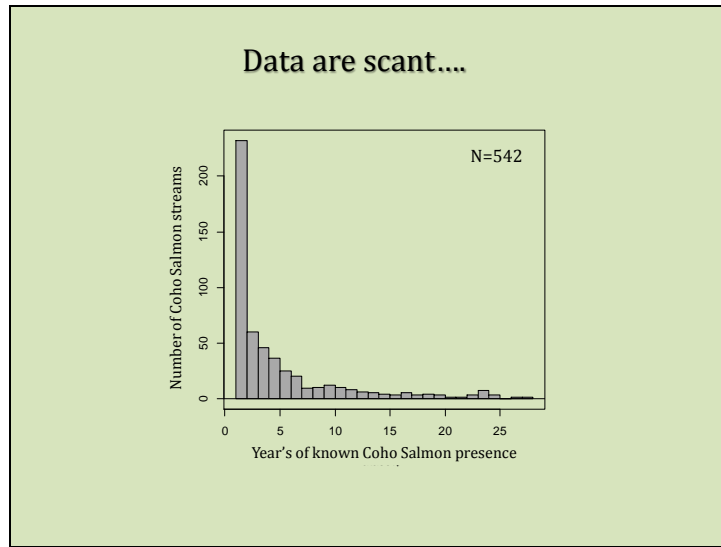
Garwood, J. 2012b. Supporting evidence in defining historic and recent occurrence of Coho Salmon (*Oncorhynchus kisutch*) in California streams within the Southern Oregon/ Northern California Evolutionarily Significant Unit. California Department of Fish and Game, Arcata, CA: 317 p.

Slide 8

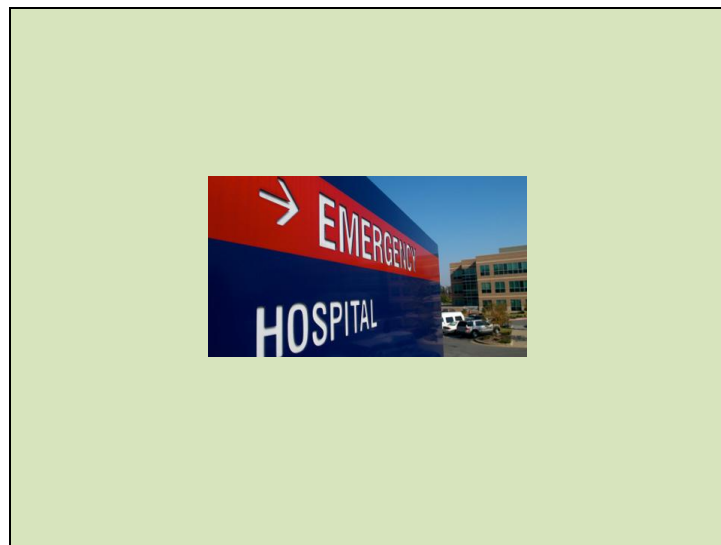
Lack of historic data...

The graph shows two cumulative lines: a grey line for 'Cumulative streams with fisheries data' and a black line for 'Cumulative documented coho salmon streams'. Both lines show an upward trend over time, with the grey line reaching approximately 1200 streams by 2000 and the black line reaching approximately 500 streams. A vertical line is drawn at approximately 1970, with a red arrow pointing to it from the text 'California Forest Practice Rules' and a green arrow pointing to it from the text 'NEPA, CESA, and CEQA laws in place'.

Slide 9



Slide 10



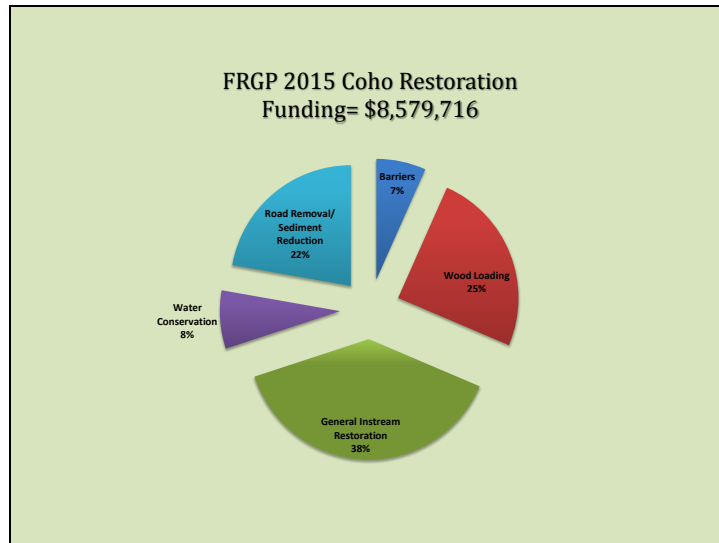
Slide 11

Population Recovery Actions

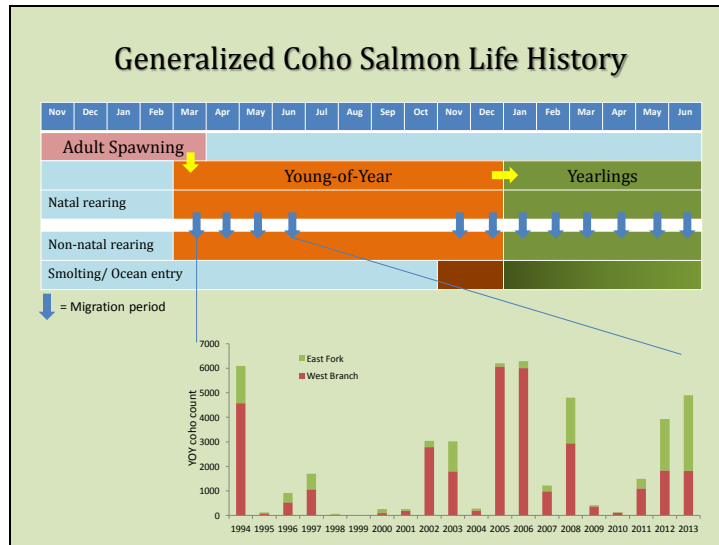
Mattole River Population						
Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
<i>Step Description</i>						
SONCC-MatR.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3b
<i>SONCC-MatR.8.1.17.1 Assess and prioritize road-stream connections, and identify appropriate treatments</i> <i>SONCC-MatR.8.1.17.2 Decommission roads, guided by assessment</i> <i>SONCC-MatR.8.1.17.3 Upgrade roads, guided by assessment</i> <i>SONCC-MatR.8.1.17.4 Maintain roads, guided by assessment</i>						
SONCC-MatR.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
<i>SONCC-MatR.8.1.16.1 Assess and prioritize road-stream connections, and identify appropriate treatments</i> <i>SONCC-MatR.8.1.16.2 Decommission roads, guided by assessment</i> <i>SONCC-MatR.8.1.16.3 Upgrade roads, guided by assessment</i> <i>SONCC-MatR.8.1.16.4 Maintain roads, guided by assessment</i>						
SONCC-MatR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
<i>Review General Plan or City Ordinance to ensure coho salmon habitat needs are accounted for. Revise if necessary</i>						
SONCC-MatR.3.1.4b	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MatR.2.2.4c.1				Provide fee and permit incentives for protection of coho salmon and their habitat		
SONCC-MatR.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
<i>Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and Carlin to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 496.205 prior to approval by the Director (similar to a Spotted Owl Resource Plan)</i>						
SONCC-MatR.7.1.15.1	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
<i>Develop an appropriate timber harvest management plan for benefits to coho salmon habitat</i> <i>This, or riparian conifers, guided by the plan</i> <i>Plant conifers, guided by the plan</i>						
SONCC-MatR.7.1.40	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Re-establish natural fire regime	Population wide	3d
<i>Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime</i> <i>Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan</i>						

Final SONCC Coho Recovery Plan 29-23 2014

Slide 12



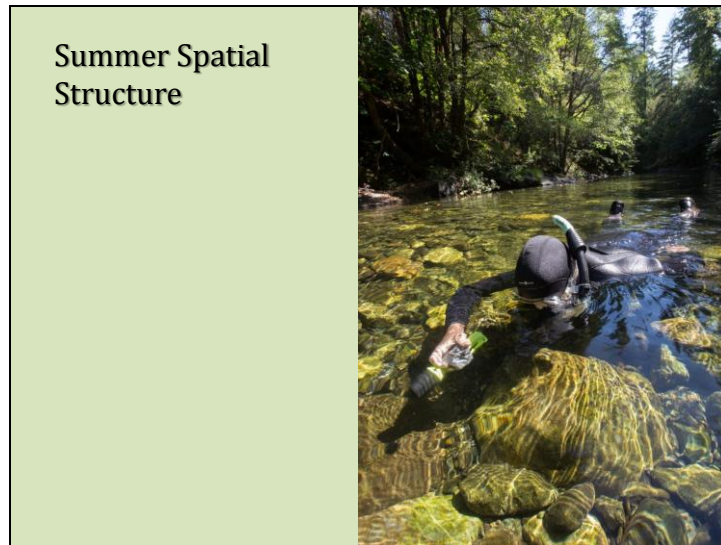
Slide 13



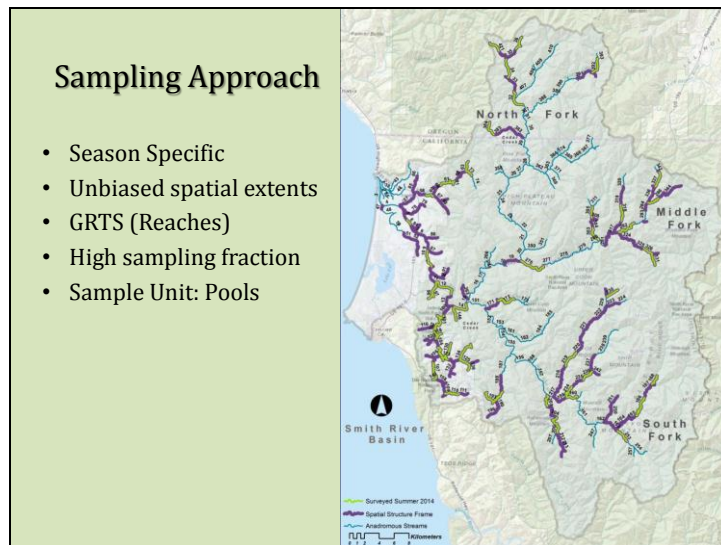
Slide 14

- ### Why use Juveniles?
- Most widely distributed stage
 - Reliable detection
 - Accessibility of habitat
 - Cost
 - Much of the restoration effort focused on juvenile stage

Slide 15



Slide 16




Slide 17

Sample Units Defined

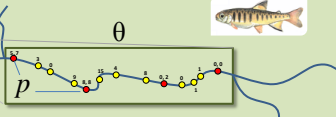
Pool Parameter	Small Stream (<3 meters wide)	Large Stream (>3 meters wide)	River	Side Channel/ Off Channel
Average Pool Width (Meters)	> One half channel	> One half channel	NA	> half side channel
Pool Surface Area (Square Meters)	$\geq 3 \text{ m}^2$	$\geq 6 \text{ m}^2$	$\geq 6 \text{ m}^2$	$\geq 3 \text{ m}^2$
Pool Depth (Centimeters)	≥ 25 , or $\geq 30 \text{ cm}$	≥ 30 , ≥ 40 , or $\geq 50 \text{ cm}$	$\geq 50 \text{ cm}$	$\geq 30 \text{ cm}$
Water Temperature (Celsius)	$\leq 21^\circ \text{ C}$	$\leq 21^\circ \text{ C}$	$\leq 21^\circ \text{ C}$	$\leq 21^\circ \text{ C}$
Visibility (Meters)	Secchi > 1.25 m	Secchi > 1.25 m	Secchi > 1.25 m	Secchi > 1.25 m
Sample Rate	Every other unit	Every other unit	Every unit	Every unit
Re-sample Rate	Every 4 th unit	Every 4 th unit	Every unit	Every unit

Slide 18


Level of Inference: Multi-scaled occupancy models



Ψ



θ



p

p = Pool-level coho salmon detection rate
 θ = Reach-level pool occupancy rate
 Ψ = Survey-level occupancy rate
 (Ψ, θ, p) = Population occupancy rate

Nichols, J., L. Bailey, A. O'Connell, Jr., N. Talancey, E. Campbell Grant, A. Gilbert, E. Annand, T. Husband, and J. Hines. 2008. **Multi-scale occupancy estimation and modeling using multiple detection methods.** Journal of applied ecology 45: 1321-1329.

Slide 19

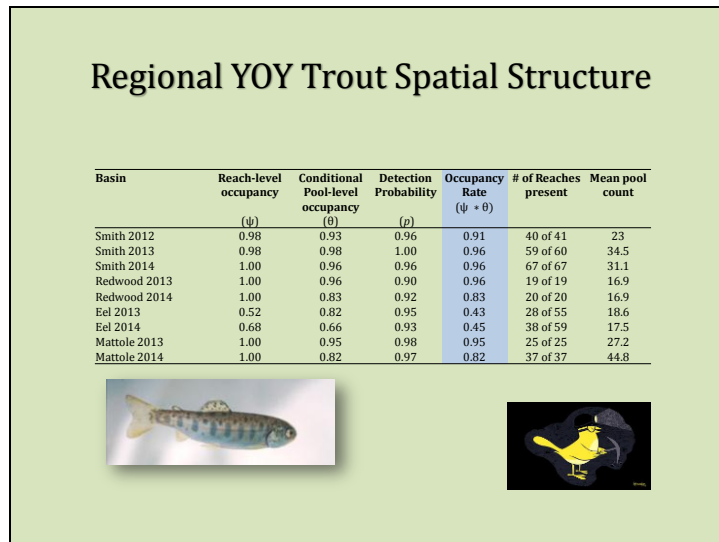
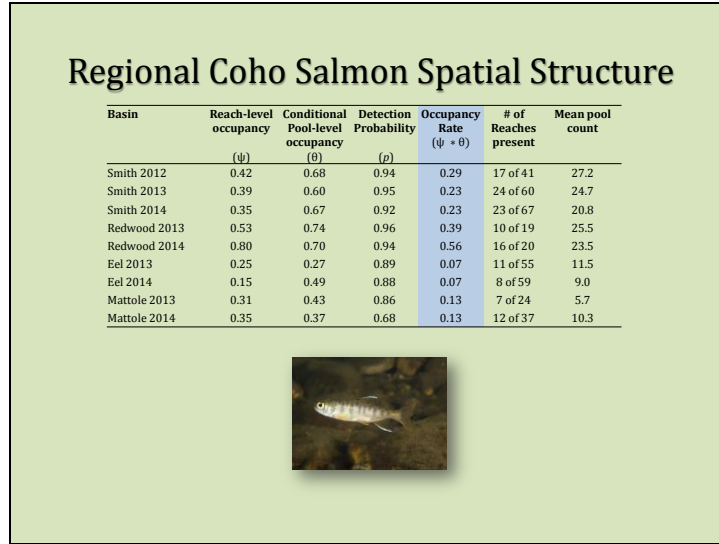


Slide 20

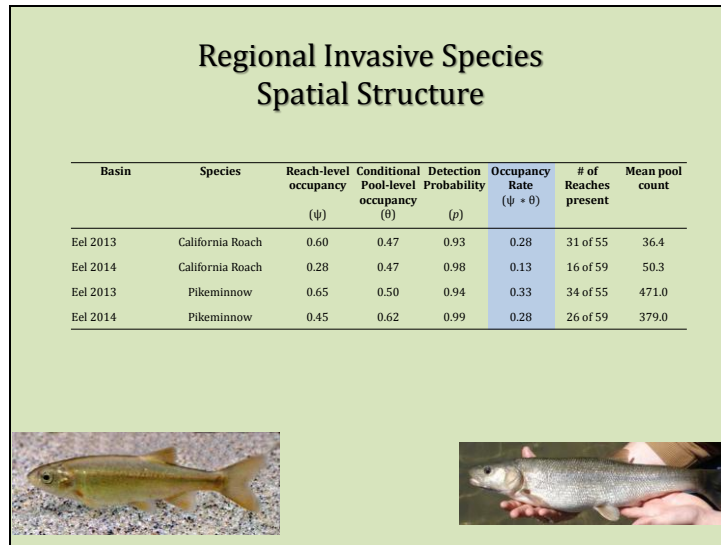
Summer Spatial Structure Effort

Basin	Years	Frame Size	Sampled km	Pools Sampled
Smith River	2012-2014	298 km	320 km	4093
Redwood Creek	2013-2014	149 km	91 km	1146
Eel/ van Duzen	2013-2014	397 km	240 km	1337
Mattole River	2013-2014	262 km	112 km	1279
Totals:		1106 km	763 km	7855

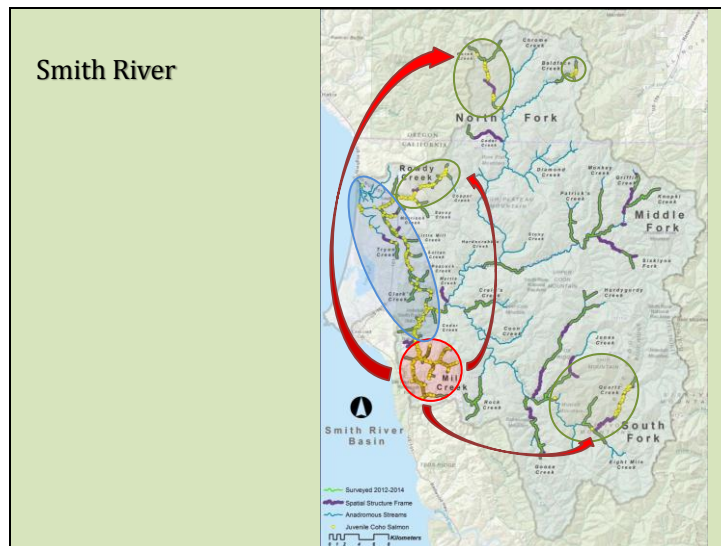
Cost per annual population survey (~30k-50k)



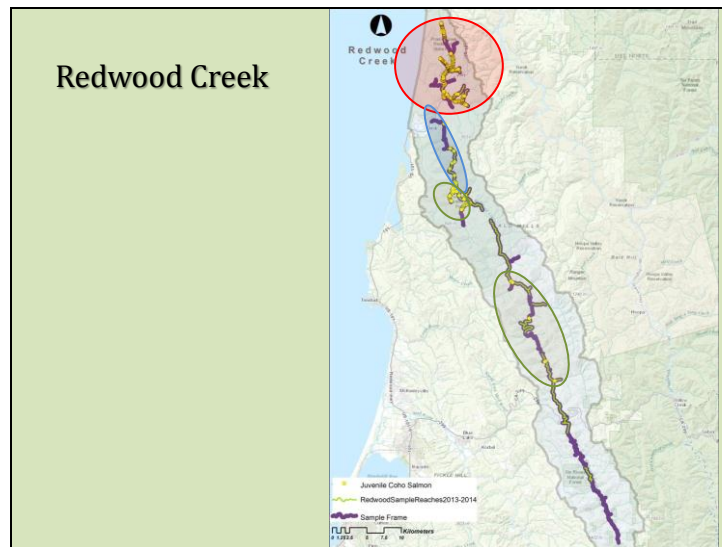
Slide 23



Slide 24



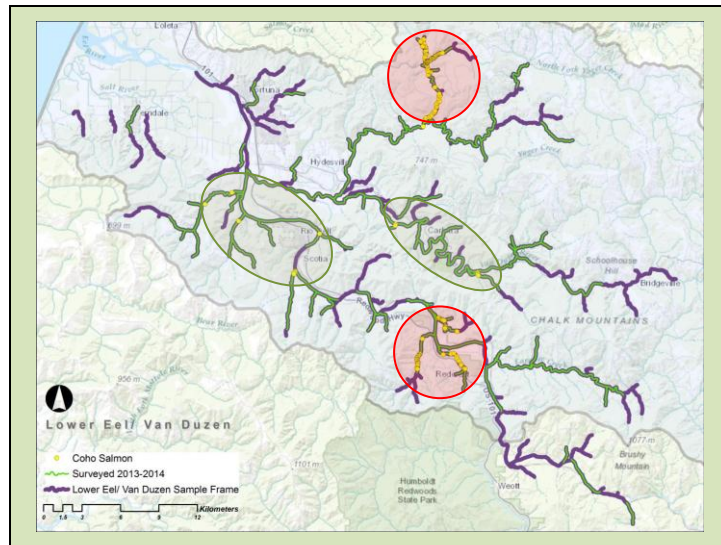
Slide 25



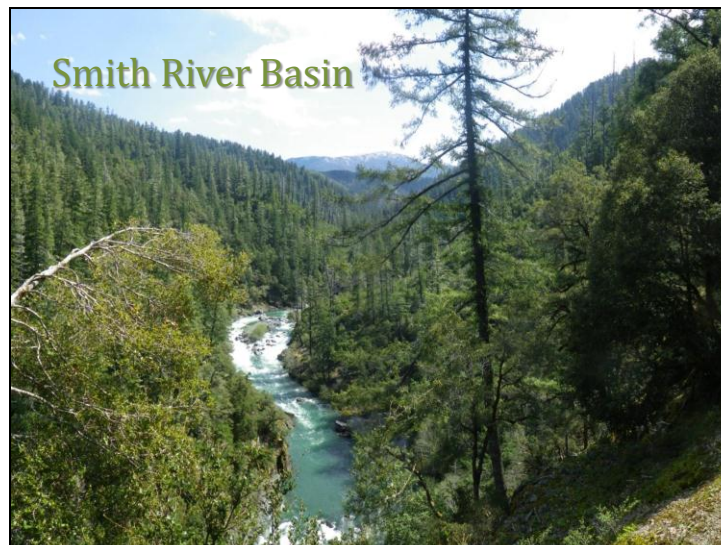
Slide 26



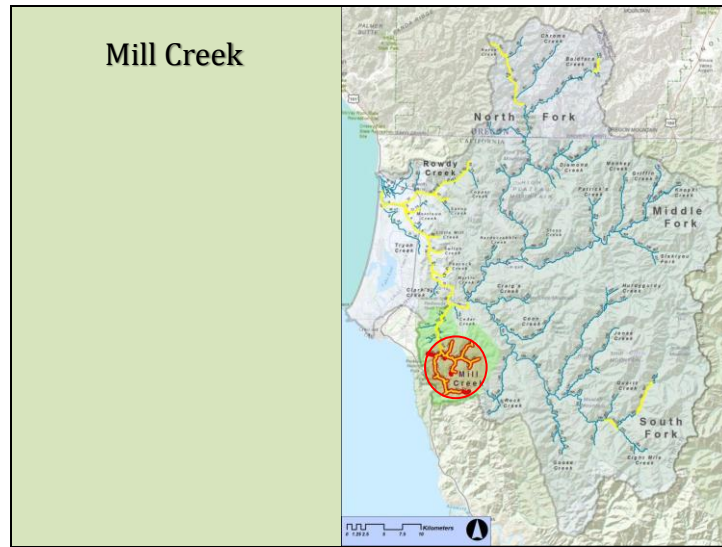
Slide 27



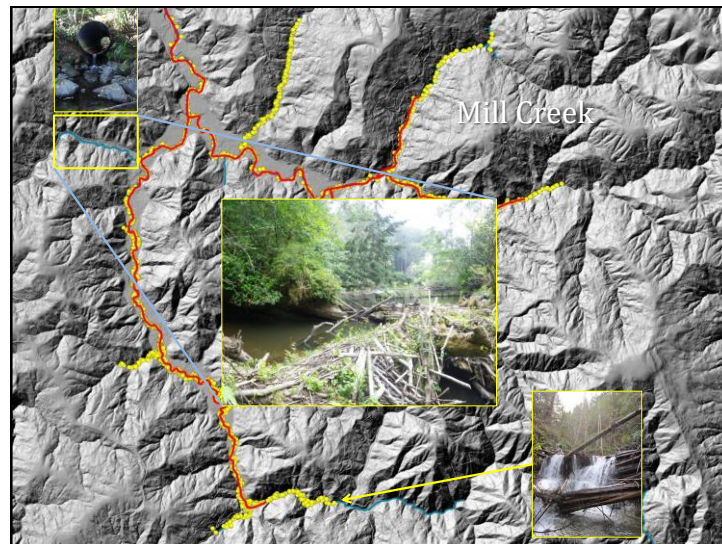
Slide 28



Slide 29



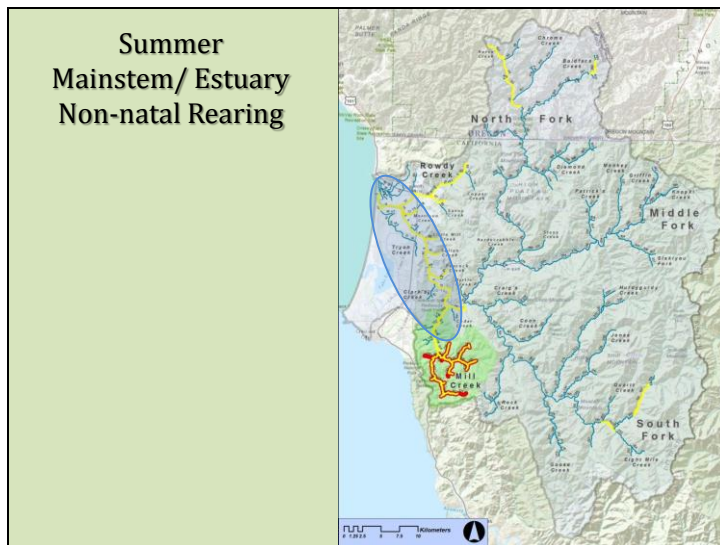
Slide 30



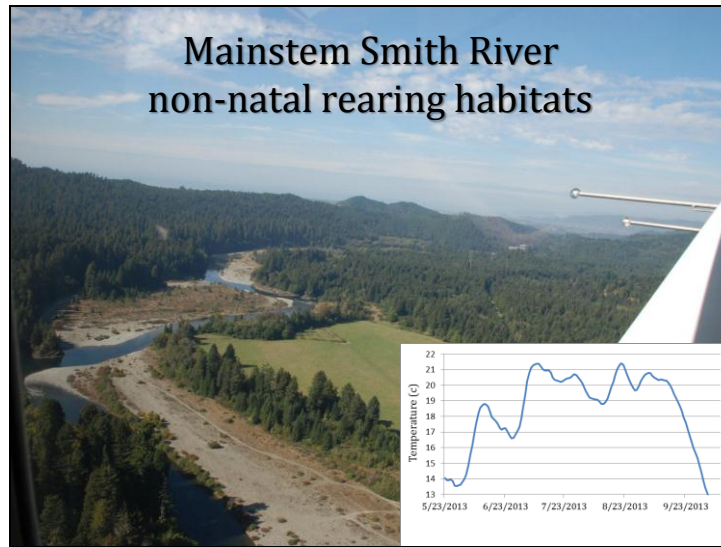
Slide 33



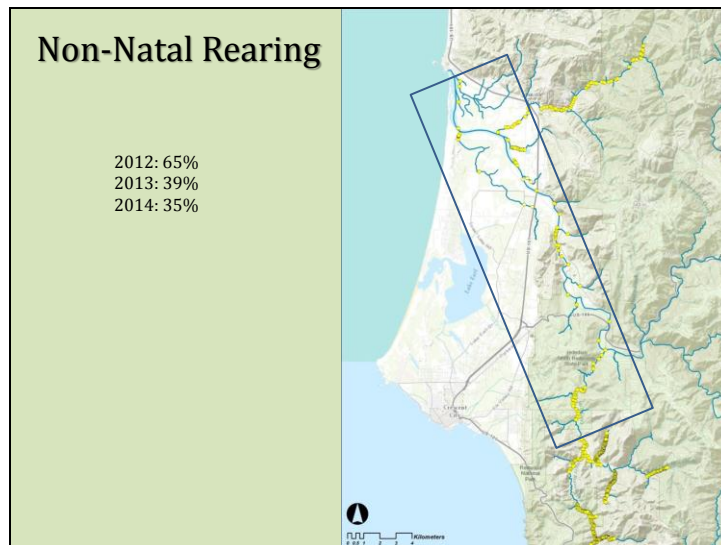
Slide 34



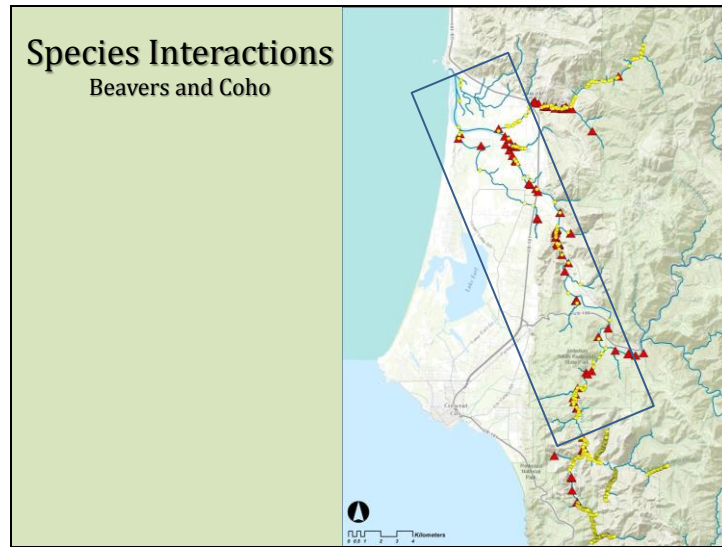
Slide 35



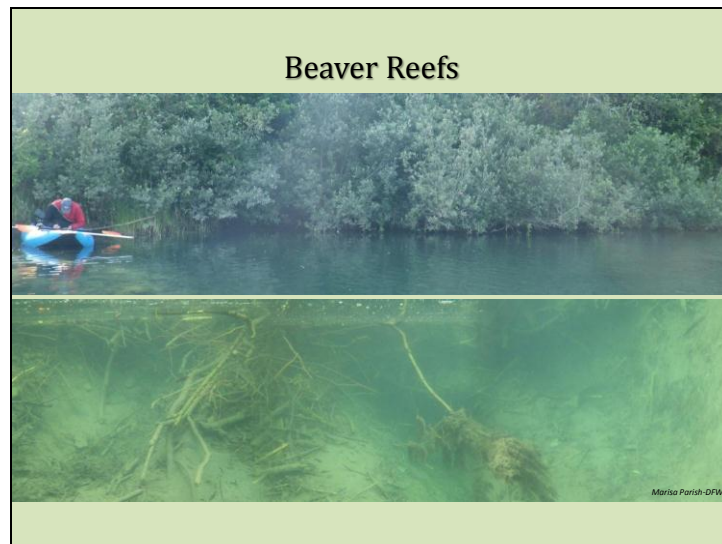
Slide 36



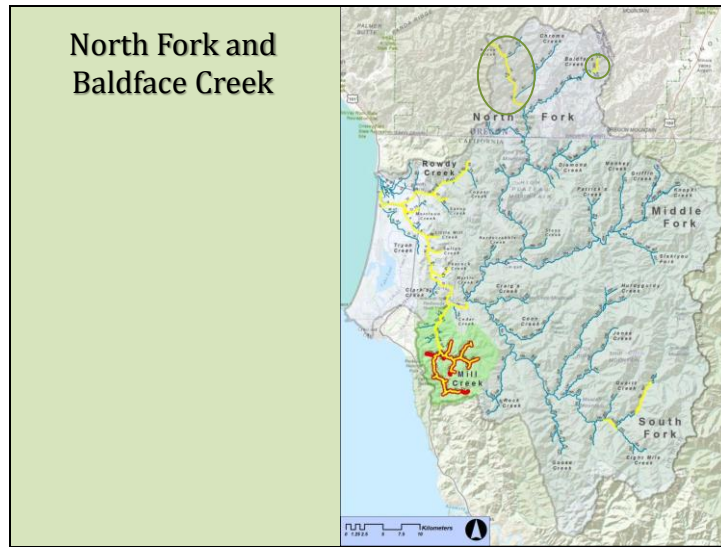
Slide 37



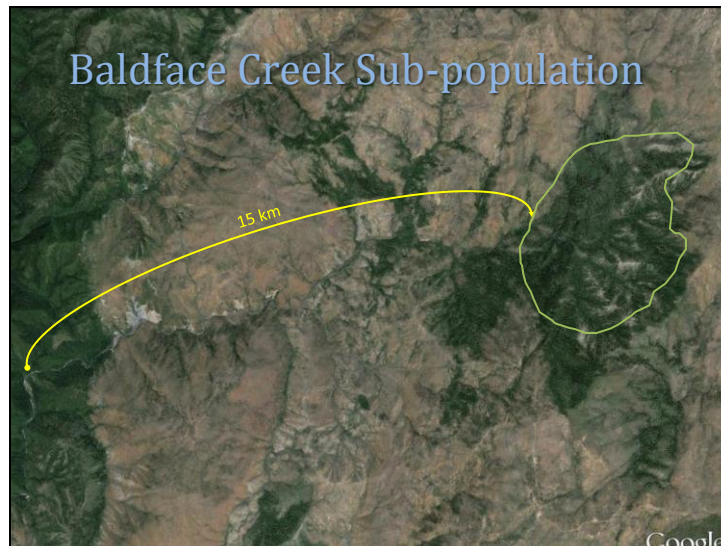
Slide 38



Slide 39



Slide 40



Slide 41



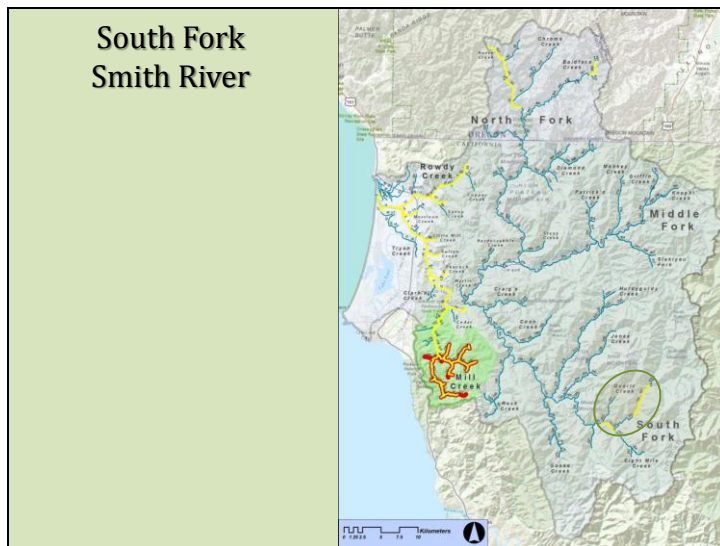
Slide 42



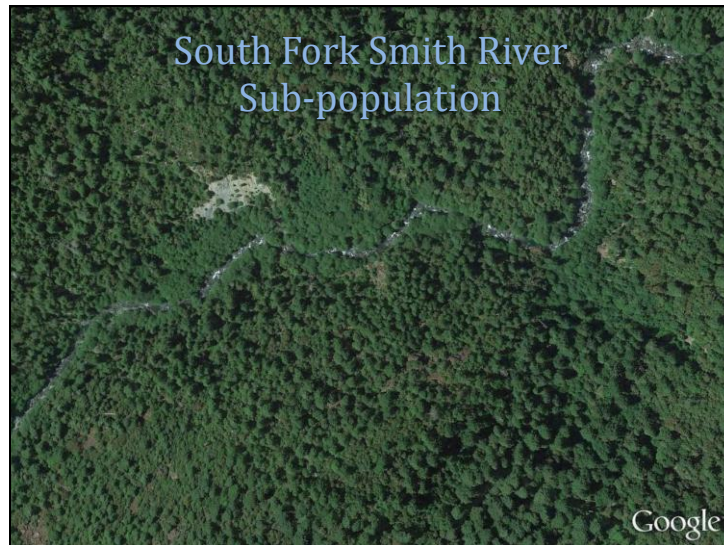
Slide 43



Slide 44



Slide 45



Slide 46

Conclusions

- Snorkel surveys provide rapid, affordable, and high quality distribution data.
- Coho salmon populations are collections of discrete patches.
- Life-history expressions appear to be basin-specific.
- Restoration can be specifically tailored to have immediate results for specific life-histories.
- Monitoring data needs to be more available to restoration groups.
- Monitoring folks need to have beverages with restoration folks.

Thanks!



2012 Smith Crew



2013 Smith Crew



2014 Smith Crew

Support: Smith River Alliance, CDFW Fisheries Restoration Grants Program
Regional Collaboration: Mattole Salmon Group, CDFW Fortuna, Humboldt Redwood Company, CDFW Arcata

What You Do Matters: The Latticework of Federal Listing Factors.

Presenter: Charlotte Ambrose, NOAA Fisheries. charlotte.a.ambrose@noaa.gov

Abstract:

Section 4(a)(1) of the Federal Endangered Species Act requires Federal agencies to determine whether a species is endangered or threatened based on the threats associated with one or more of the following five factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting its continued existence. Section 4(b) also requires the determination be made on the basis of the best scientific and commercial data available after taking into account those efforts, if any, being made by any State or foreign nation, to protect such species.


In 2015, NOAA Fisheries will be conducting a 5-year status review for all listed salmon and steelhead in the Pacific Northwest. This review will assess the accuracy of the listing classifications and determine if conditions have changed to warrant a delisting or status reclassification. To ensure that the 5-year reviews are complete and based on the best available information, we are soliciting new information from the public, concerned governmental agencies, Tribes, the scientific community, industry, environmental entities, and any other interested parties concerning the status of salmon and steelhead and conservation efforts conducted to improve the threats associated with the five listing factors.

Specifically, we will be requesting new information that has become available since the respective species' previous status review on: (1) population abundance; (2) population productivity; (3) changes in species distribution or population spatial structure; (4) genetics or other diversity measures; (5) changes in habitat conditions; (6) conservation measures that have been implemented that benefit the species, including monitoring data demonstrating the effectiveness of such measures in addressing identified limiting factors or threats; (7) data concerning the status and trends of identified limiting factors or threats; (8) for Pacific salmon and steelhead, information on changes to hatchery programs that may affect their ESU or DPS membership; and (9) other new information, data, or corrections including, but not limited to, taxonomic or nomenclatural changes, identification of erroneous information in the previous listing determination, and improved analytical methods.

This presentation will provide an overview of the 5-year status review process, how NOAA Fisheries reviews threats associated with the five listing factors, and how the innovative approaches of what you do (or not do) is evaluated against the Federal listing status of Pacific Northwest salmon and steelhead.

Slide 1

Science, Service, Stewardship




**What You Do Matters:
The Lattice Work of Federal ESA Listing Factors
and 5-year Reviews for
West Coast Salmon and Steelhead**

Charlotte Ambrose – NOAA West Coast Region
Salmonid Restoration Federation
Santa Rosa, California
March 2015

NOAA
FISHERIES
SERVICE

Slide 2


NOAA
FISHERIES
SERVICE



Outline

- What are 5-year reviews and ESA Listing Factors
- NOAA 5-year reviews currently underway (2015)
- How we assess restoration/protective efforts
 - **What You Do MATTERS**
- Opportunities for input
- Timelines

NOAA FISHERIES SERVICE




What Are 5-Year Reviews?

Section 4 of the ESA requires Secretary to:

At least once every five years, review the list of Threatened and Endangered species and determine based on that review whether the species should:

- Retain its current listing status;
- Be removed from the list;
- Be changed from an endangered to a threatened species; or
- Be changed from a threatened to an endangered species.


NOAA FISHERIES SERVICE




What Are 5-Year Reviews?

The species status reviews are based on:


- Biological status and trends
- Factors that led to species decline (aka Listing Factors)
- Conservation and protective efforts that reduce threats and reverse species decline



CCC Coho Salmon Adult, Albion River; Marilyn Stubbs



Kelley House Museum, Mendocino County, CA.



David Wright, Mendocino County, CA.

NOAA FISHERIES SERVICE



What Are 5-Year Reviews?

Basis for status review and reclassification conclusions:

- Biological status and trends
 - Density-based spawner abundance, population growth rate, population spatial structure and diversity




CCC Coho Salmon Adult, Albion River
Marilyn Stubbs




Kelley House Museum, Mendocino County, CA.




David Wright, Mendocino County, CA.




Listing Factor A
• Estuarine, freshwater or marine conditions
• Source of degraded conditions (e.g., land uses or natural events)




Listing Factor B
• Scientific collection
• Freshwater and marine harvest



Listing Factor C
• Avian, freshwater, and marine predation
• Infectious disease



Listing Factor D
• Federal, State and local government regulations protecting the species
• Law enforcement



Factor E
• Hatchery programs
• Drought, Floods, Fires, Climate and Ocean Conditions

ESA Section 4(a)(1) Listing Factors

- A. Present and threatened destruction of habitat or range**
- B. Overutilization from commercial, recreational or scientific**
- C. Disease or predation**
- D. Inadequacy of regulatory mechanisms**
- E. Other manmade or natural events**

NOAA FISHERIES | U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 4

Slide 7

Listing Factor A
• Estuarine, freshwater or marine conditions
• Source of degraded conditions (e.g., land uses or natural events)

Listing Factor B
• Scientific collection
• Freshwater and marine harvest

Listing Factor C
• Avian, freshwater, and marine predation
• Infectious disease

Listing Factor D
• Federal, State and local government regulations protecting the species
• Law enforcement

Factor E
• Hatchery programs
• Drought, Floods, Fires, Climate and Ocean Conditions

NOAA is required to evaluate the status of each Factor and associated threats during status reviews, recovery plan development, and when making a determination to reclassify or delisting a species.

We are also required to develop criteria for each Factor that would trigger a possible reclassification of a species.

NOAA FISHERIES | U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 7

Slide 8

ESA Listing Factors and Threats

Listing Factor A
• Estuarine, freshwater or marine conditions
• Source of degraded conditions (e.g., land uses or natural events)

Listing Factor B
• Scientific collection
• Freshwater and marine harvest

Listing Factor C
• Avian, freshwater, and marine predation
• Infectious disease

Listing Factor D
• Federal, State and local government regulations protecting the species
• Law enforcement

Factor E
• Hatchery programs
• Drought, Floods, Fires, Climate and Ocean Conditions

Restoring Habitats

Reducing Collection or Harvest Effects

Abating Disease & Predation


Enforcing & Improving Regulations

Planning for Natural Events & Reducing Hatchery Effects

NOAA FISHERIES | U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 8

Slide 9

NOAA
FISHERIES
SERVICE



The Lattice Work of Listing Factors: What You Do Matters

PECE Criteria when evaluating conservation efforts:

- Certainty effort will be implemented
- Certainty effort will be effective

Conservation Efforts assessed:


- Agreements, plans, documents, monitoring protocols, etc., developed by agencies, tribal governments, businesses, organizations, and individuals.

Slide 10



NOAA FISHERIES SERVICE

February 6, 2015 FRN Requesting New Information
Comments Due: May 7, 2015



New Information since the 2011 Status Review:

- 1) Population abundance;
- 2) Population productivity;
- 3) Changes in species distribution or population spatial structure
- 4) Genetics or other indicators of diversity;
- 5) Changes in habitat conditions and associated limiting factors and threats;
- 6) Conservation measures that have been implemented that benefit the species, including monitoring data demonstrating the effectiveness of such measures in addressing limiting factors and threats;
- 7) Data concerning the status and trends of identified limiting factors or threats;
- 8) Information that may affect determinations regarding the composition of an ESU or DPS;
- 9) Information on changes to hatchery programs;
- 10) Information on targeted harvest and bycatch; and
- 11) Other new information or data.

NOAA FISHERIES SERVICE

Opportunities with 5-Year Reviews

- Report on **progress toward recovery**
- Highlight key accomplishments and **successes**
- Underscore **key challenges** and gaps
- Provide recommendations for priority actions, research/monitoring, regulatory measures, etc.
- **Recommend needed updates to recovery plans**, more in-depth analyses, etc.
- Alignment of assessments and metrics (e.g., Status and Effectiveness of the **Coast Monitoring Plan**)

NOAA FISHERIES SERVICE



Draft Timeline for 2015 Reviews

- Feb. 2015 – Federal Register notice announcing 5-year reviews
- **May 2015** – Comment period closes
- Jun. 2015 – Science Centers submit draft viability report(s) to Region
- Jul. 2015 – “Domain teams” convene and evaluate status/trends in listing factors
- Nov. 2015 – Internal draft 5-year review reports complete
- Jan. 2016 – Transmit recommended findings to HQ
- Mar. 2016 – 5-year review findings published in Federal Register

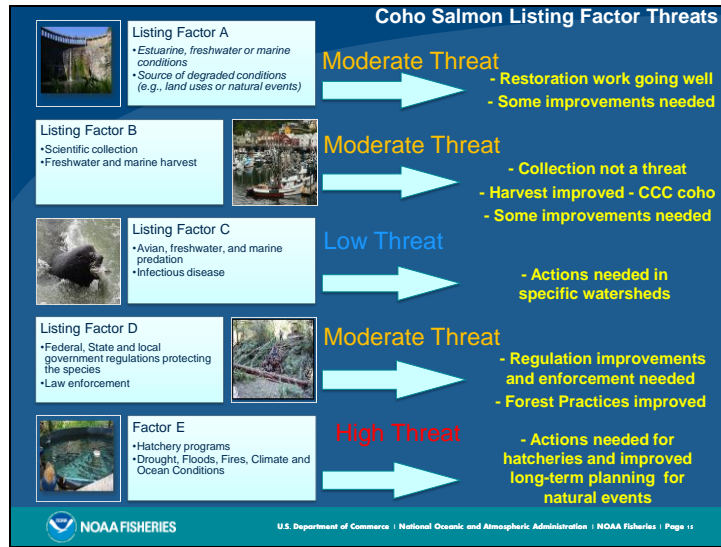
Compelling Data Needs for Status and Trends, and the Five Listing Factors for 5-Year Reviews and Reclassification Decisions



NOAA FISHERIES

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 11


Slide 15



Slide 16



Endangered Species Act Listing Factors Are Not Scary
They empower us to track all the work you're doing to save salmon



NOAA
FISHERIES
SERVICE

Innovative Approaches to Coho Salmon Recovery

*"The dogmas of the quiet past
are inadequate to the stormy present.
The occasion is piled high with difficulty,
and we must rise with the occasion.
As our case is new, so we must think anew, and act anew."*

(Abraham Lincoln, 1809-65, Second Annual Message to Congress, December 1, 1862)

