Appendix C6: Economics Research and Regulatory Support: Protected Resources

Southwest Fisheries Science Center,
Fisheries Ecology Division - Santa Cruz

Economics Research and Regulatory Support: Protected Resources

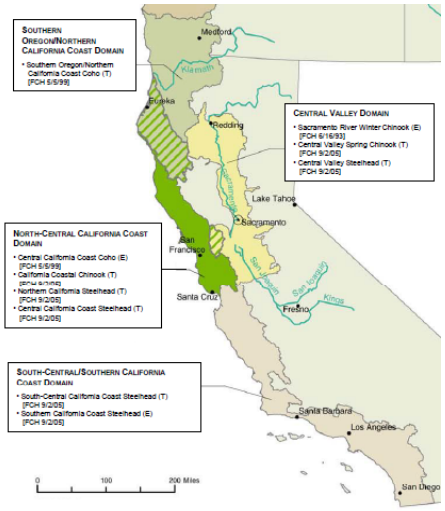
Southwest Fisheries Science Center
Fisheries Ecology Division
Santa Cruz

Cameron Speir
(along with Cindy Thomson and Aaron Mamula)

SWFSC - Santa Cruz (Fisheries Ecology Division)

Listed Salmonid Species – 9 ESUs

Species and ESU	*ESA Status*	Listed Updated
Sacramento R. Winter-run Chinook salmon	*Endangered*	1994 2014
Central Valley Spring-run Chinook salmon	*Threatened*	1999 2014
California Central Valley Steelhead	*Threatened*	2006 2014
Southern OR/Northern CA Coast Coho salmon	*Threatened*	2005 2014
Central California Coast Coho salmon	*Endangered*	2012 2014
California Coastal Chinook salmon	*Threatened*	1999 2014
California Coast Steelhead (3 ESUs)	*Threatened*	2006 2014



SWFSC – Santa Cruz PR Activities

Regulatory Support

- Klamath Dam removal
- Litigation Support: Biological Opinion, SF Bay Delta pumping operations
- Review of economic analysis: Bay Delta Conservation Plan, San Joaquin River restoration agreement

Research

- Effects of water supply changes on regional agriculture
- Groundwater management and instream flow
- Effect of energy development (hydraulic fracturing) on water quality, habitat, and regional economy

Economic Benefits/Costs and Economic Impacts of Removing Four Dams on the Klamath River

3-year DOI/NMFS collaboration

Copco 1 Dam

- **Management issue:** whether removal of four Klamath dams is in 'public interest'

Economic Benefits/Costs and Economic Impacts of Removing Four Dams on the Klamath River

3-year DOI/NMFS collaboration

Method: integrated models linking dam removal to

a) river hydrology
b) Chinook life cycle and population abundance
c) ocean troll, ocean sport, inriver sport and tribal fisheries – based on PFMC harvest control rule

Economic Benefits/Costs and Economic Impacts of Removing Four Dams on the Klamath River

Employment Impacts

Activity	Change	Duration
Dam removal	+1423	2020
Mitigation	+218	2018-25
KBRA Programs:		
Fisheries	+261	2012-26
Water Resources	+16	2012-26
Regulatory Assur	+10	2012-26
County	+?	2012-26
Tribal	+26	2012-26
Irrig agriculture	+29	2012-61
Refuge recreation	+5	2012-61
Dam O&MR	-49	2020-61
Reservoir rec	-4	2020-61
Whitewater rec	-14	2020-61

Activity	Change	Duration
Troll Chinook fishery:		
San Francisco	+218	2012-61
Fort Bragg	+69	2012-61
KMZ-CA	+19	2012-61
KMZ-OR	+11	2012-61
Central OR	+136	2012-61
Ocean rec Chinook fishery:		
KMZ-CA	+13	2012-61
KMZ-OR	+3	2012-61
Inriver rec fisheries:		
Chinook	+3	2012-61
Steelhead	+?	2012-61
Redband trout	+?	2012-61

Discounted Benefits and costs of Action Alternative 1 Relative to No Action (discounted at 4.125% over 2012-2061, base year=2012)

Benefit Category	Benefit Million $		Cost Category	Cost Million $
Dam O&MR (cost savings)	188.9		Dam removal/mitigation	166.8
Irrigated agriculture	29.9		KBRA	472.1
Refuge recreation	4.3		Foregone hydropower	1,320.1
Troll Chinook fishery	134.5		Foregone reservoir rec	35.4
Ocean rec Chinook fishery	50.5		Foregone whitewtr rec	6.0
Inriver Chinook fishery	1.8			
Non-use value	15,645.0			
Total quantified benefits	16,054.9		Total quantified costs	2,000.4
Non-quantifiable benefits: Tribal fisheries/culture rec steelhead fishery rec redband trout fishery Reservoir bird watching Conflict resolution (KBRA)			Non-quantifiable costs: CO2 emissions	

Water Use and Impacts to Agriculture: San Francisco Bay Delta

Delta is the "hub" of the water supply system in California

Chinook, steelhead ESUs and Delta smelt affect the quantity and timing of water exports

There are real and perceived economic impacts

Water Use and Impacts to Agriculture: San Francisco Bay Delta

Inspiration: 2009 drought and Biological Opinions

Jobs vs. Fish

Author	Date	Agriculture	Non-agriculture
Howitt et al.	Jan 2009	*60,000 – 80,000*	
Howitt et al.	May 2009	*35,000*	
Michael	Aug 2009	5,000 – 6,500	5,000 – 6,500
Howitt et al.	Sep 2009	12,000	9,000
Michael	Dec 2009	4,400 – 6,300	2,500 – 3,500
Michael, Howitt	Dec 2010	3,500 – 4,725	2,000 – 3,000
Sunding et al.	May 2011	5,000	--
Howitt et al.	Jul 2011	9,800	--
Foreman	May 2013	6,900 – 9,000	--
Speir & Stradley	Jan 2014	5,500	0
Speir, Mamula & Ladd	Apr 2014	5,300	--

Water Use and Impacts to Agriculture: San Francisco Bay Delta

Estimating Economic Impacts of Irrigation Water Supply Policy Using Synthetic Control Regions: A Comparative Case Study

Cameron Speir and Eric Stradley

- Estimate job losses by comparing employment in affected counties to other counties
- Natural Experiment
  - Synthetic control group: Abadie et al. 2010
  - Concept similar to difference-in-differences

Effects of Water Supply on Labor Demand and Agricultural Production in California's San Joaquin Valley

Cameron Speir, Aaron Mamula, Daniel Ladd

Estimate structural model: labor demand and crop production as a function of water supply

- Production system: 1 variable input (labor), 1 quasi-fixed input (water), 7 crop categories
- Theoretically consistent (properties)
- Cross equation constraints: symmetry and allows calculation of crop substitution effects

Potential Economic Benefits of Fish Passage Above Dams for Central Valley Recreational Fisheries

What is probability that salmon anglers will fish in newly accessible areas?

Management issue: whether fish passage (ladders, dam removal) likely to yield recreational benefits

Method: Central Valley angler survey to collect data for recreational demand and location choice models

- effort and trip expenditures by waterbody type (rivers/creeks, lakes/reservoirs, Delta waterways), target species, and mode (bank, private boat, hired guide)
- non-trip expenditures
- angler demographics
- factors other than salmon CPUE that affect fishing location decisions (site accessibility, boat ramp, etc.)

Groundwater Management and Instream Flow

Spatial-Dynamic Problem

Optimization model: maximize farm profits subject to instream flow requirements

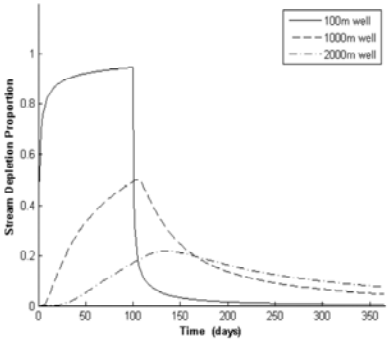
- Allocate ***daily*** water pumping to wells located at different distances from the stream
- Hydrologic model: stream-aquifer system where stream depletion effects vary across space and time (Glover-Balmer)

Groundwater Management and Instream Flow

Spatial-Dynamic Problem

1) Tradeoff between magnitude and duration of stream depletion effect. Optimal allocation of water across wells is differentiated over space and time.

2) In some cases in drought years, wells located closer to the stream should be allocated more water. Duration of the stream depletion effect is more important than the magnitude.



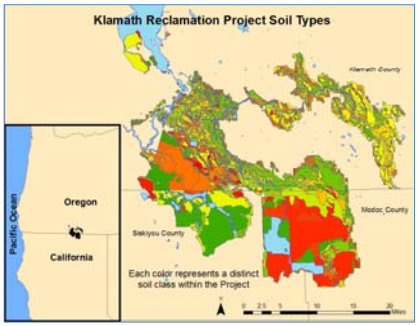
Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Objectives: evaluate the efficacy/economic efficiency of water buybacks as a strategy for freshwater salmonid habitat provision

Study Area: Klamath Irrigation Project in Northern California/Southern Oregon where land idling programs have been used since 2002 to reduce agricultural water diversion from the Klamath River

Methods:

- GIS modeling used to generate spatially explicit data on soil productivity
- Linear profit maximization model is constructed using agronomic production functions with decreasing marginal physical products
- Project level derived demand for surface water is generated using positive math programming to solve the profit maximization problem with relevant acreage and crop rotation constraints



Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Results:

- Results show that value of accepted land idling bids exceeded value of the water by 10%, 40% and 75% in low, medium and high baseline diversion scenarios, respectively.

Implications: A key finding of our study is that a portion of the wedge between observed payment and derived value can be attributed to the program's insistence on paying for land rather than water…a situation necessitated by the fact that water use is not monitored/measured/metered in the KIP.

Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Dissertation project – Duran Fiack, UCSC, Environmental Studies

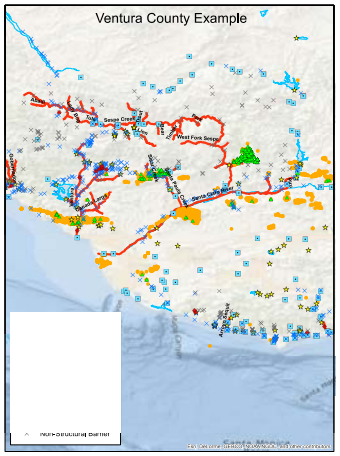
1. What are the impacts and risks to critical habitat, the agricultural sector, and regional economies from hydraulic fracturing in California?
2. Do impacts differ across space?
   - Inter-regional (macro): three regions with distinct water and ecological characteristics, different local institutions
   - Small scale (micro): siting issues, habitat connectivity, aquifer properties, population diversity, local geology
3. What polices and institutions will be (or should be) used to help mitigate these impacts?

Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Oil production occurs in watersheds with protected steelhead – Southern California Coast ESU

- Water quality
- Water quantity – instream flow
- Cumulative impacts analysis

Water reallocation in the southern San Joaquin Valley may affect the demand for Delta water



California Current Integrated Ecosystem Assessment (CCIEA) Pacific Salmon Component

Joint NWFSC/SWFSC Effort

- **Management context:** CCIEA is part of NOAA Integrated Ecosystem Assessment Program, goal being to facilitate more comprehensive and holistic management
- **CCIEA Pacific Salmon component:** ESA listings of 9 Chinook, 2 chum, 4 coho, 2 sockeye, 11 steelhead stocks
- **2014 CCIEA Pacific Salmon report:** status and trends of salmon abundance, environmental pressures (ocean/freshwater conditions, climate change), and human dimensions
  - ✓ Human dimensions: historical context – including legacy effects of fishing, farming, logging, mining, etc. on salmonids and their habitat – and recent trends in these industries
- **Next step:** management scenario analysis

Costs of Implementing Sacramento River Winter-Run Chinook Recovery Plan

- **Management issue:** address ESA requirement that Recovery Plan include "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal " (ESA Section 4(f)].
- **Approach taken by SWR:** estimate agency costs only (no NMFS-wide guidance)
- **Challenges:**
  - ✓ diversity of recovery actions and number of agencies involved (State and Regional Water Quality Control Boards, CA Fish & Game, Fish & Wildlife Service, Environmental Protection Agency, Bureau of Reclamation, Army Corps of Engineers, etc.)
  - ✓ high uncertainty in some cost estimates due to vagueness of some recovery actions (economist brought in at end)
  - ✓ isolating costs of Recovery Plan from salmon conservation costs associated with other laws/regulations/programs

Effects of Changes in Environmental Conditions and Hatchery Practices on Klamath River Chinook Population and Chinook Fisheries in California

SWFSC Santa Cruz, Humboldt State, UC Davis

Management issues:

- trade-off hatchery reform versus fisheries (which depend heavily on hatchery fish)
- distinguishing variability in abundance due to ocean conditions versus management actions that affect hatchery practices and river flows

Method: enviro-bio-economic simulation model for Klamath Chinook

- 100-year simulations of ocean conditions (upwelling, curl, sea surface temperature, sea level height) and river flow in monthly time steps
- Age-structured stock recruitment model linked to environmental simulations
- Stock abundance linked to commercial and tribal harvest and ocean and inriver recreational effort via PFMC harvest control rule
- Scenario analysis – how changes in hatchery practices and river flows affect stock structure/abundance and fisheries