Scope of Potential Frost Protection Impacts on Salmonids

With an Emphasis on the Russian River

David Hines, Fishery Biologist / Water Rights Specialist
Brian Cluer, Ph.D., Hydrologist / Geomorphologist
Robert Hoffman, Assistant Regional Administrator
National Marine Fisheries Service

NMFS-SWR
Habitat Conservation Division

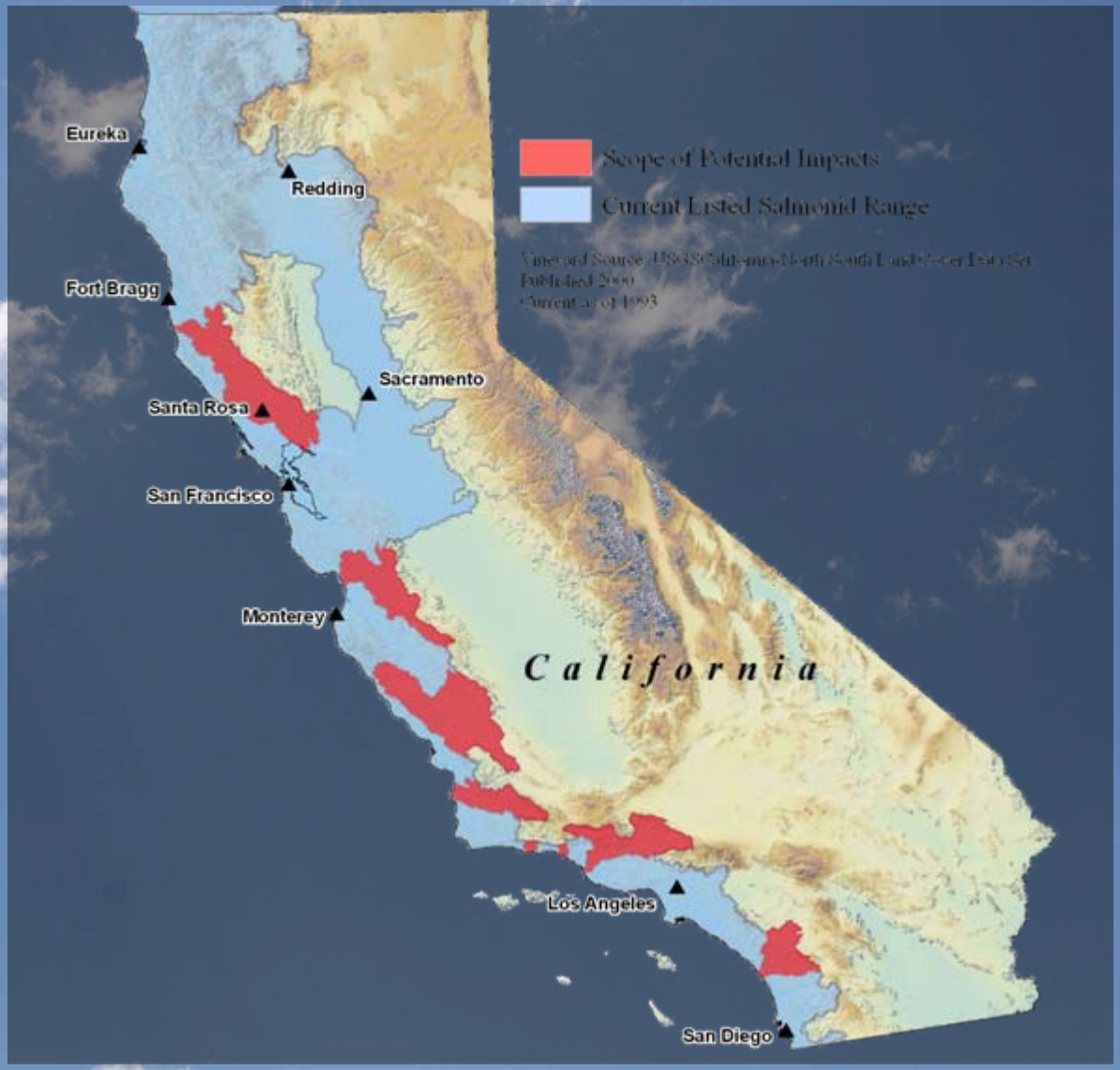
Presentation Overview

- Species Risk analysis
  - Exposure to threat
  - Biological Response
  - Changes to Extinction Risk
- Hydrologic Analysis
  - Event Frequency
- NMFS Recommendations
  - Chronology
  - Recommendation

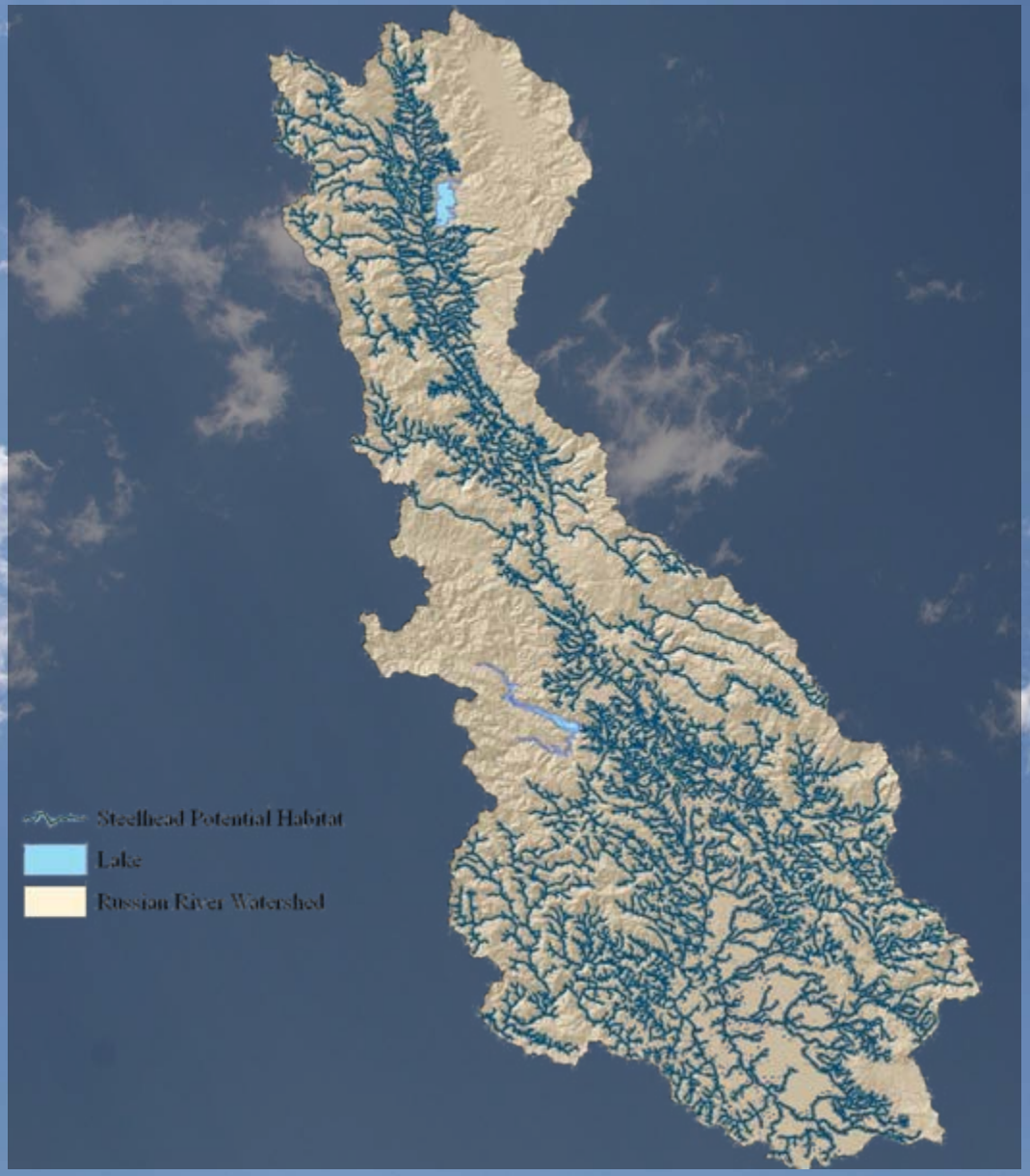
Range of Salmonids in California

Range of all salmonid species listed as threatened or endangered under the Federal Endangered Species Act in California

Potential Areas of Concern

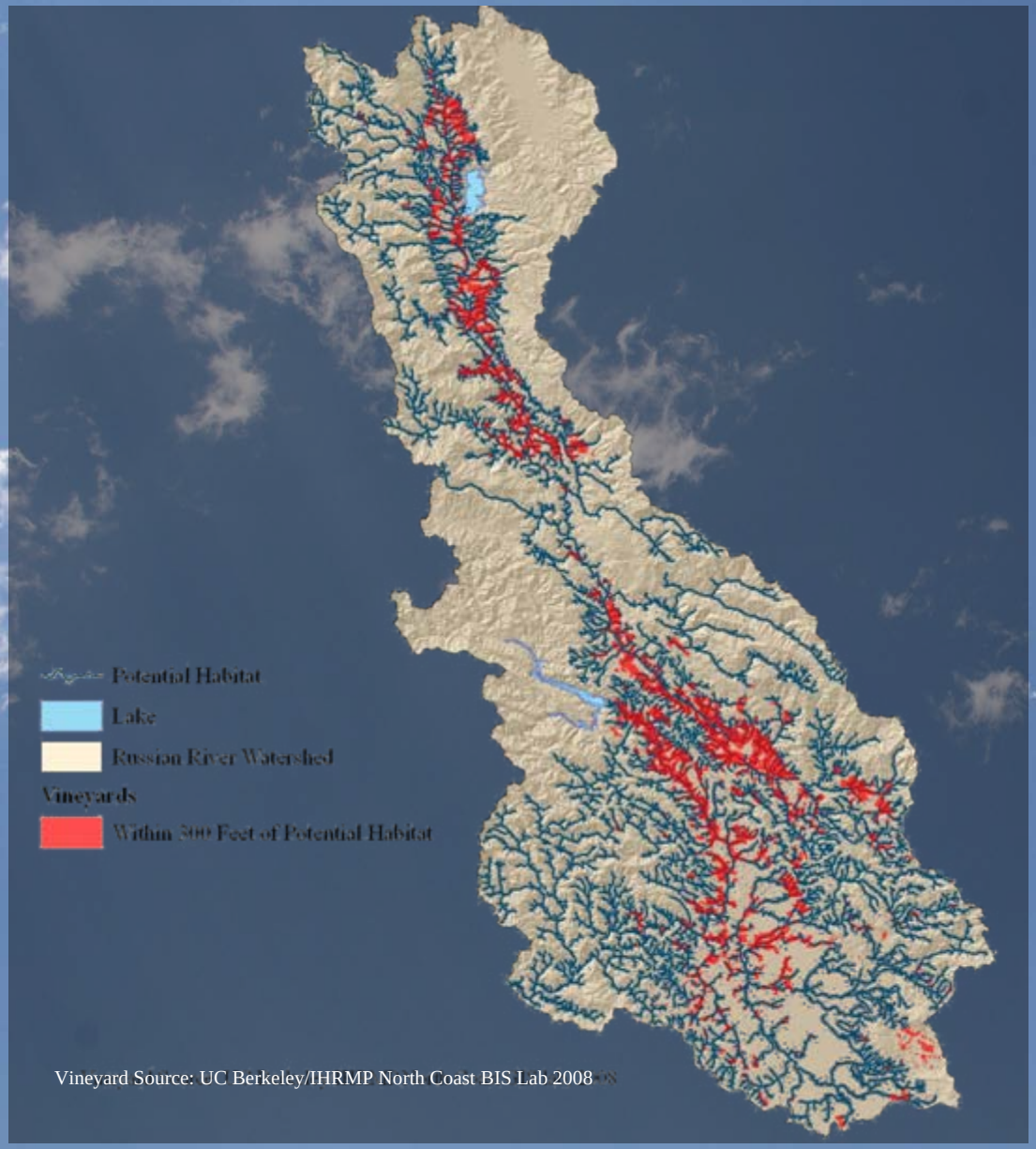


Occupied watersheds with considerable acreage of vineyard development indicating the scope of potential frost protection issues in California



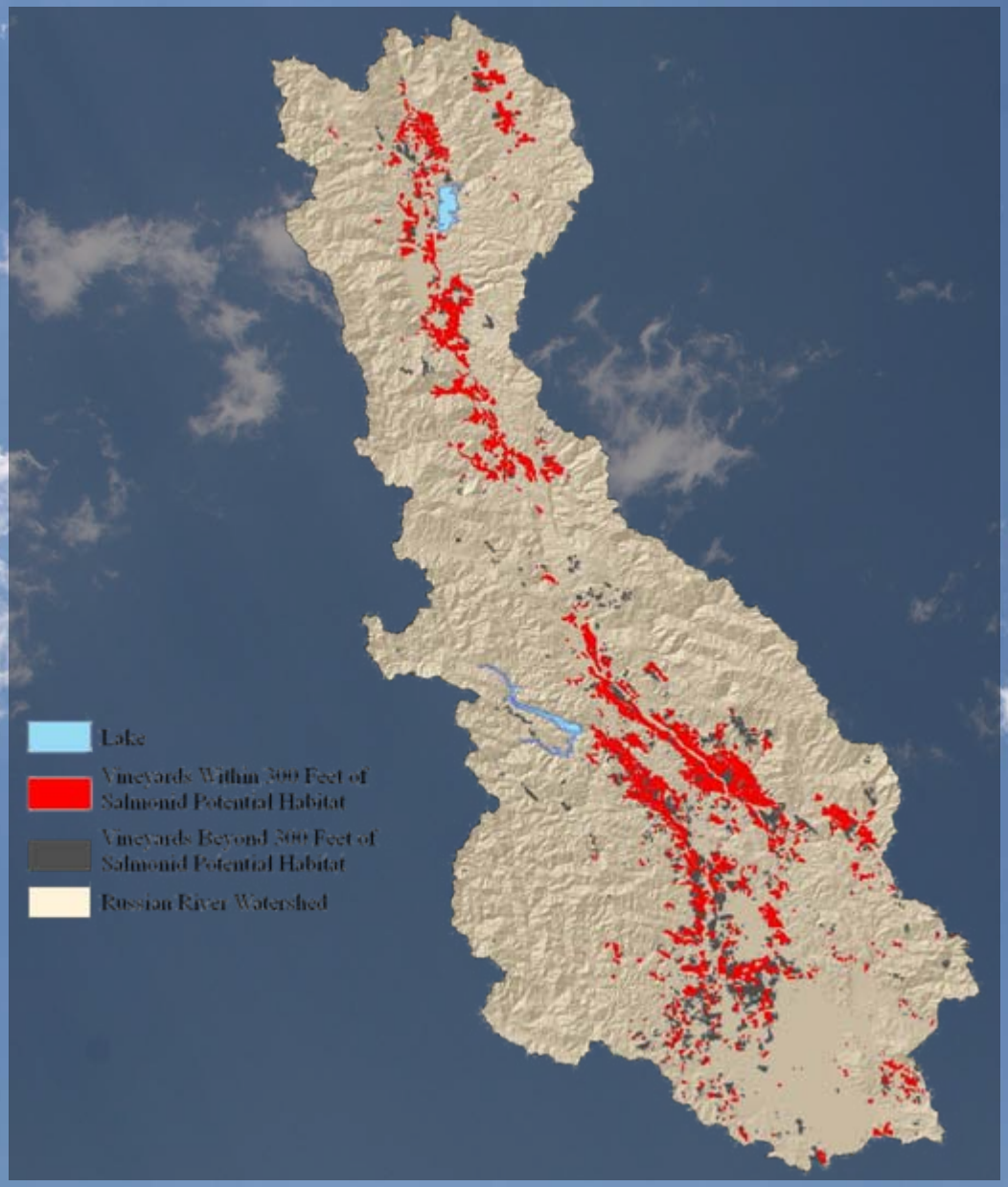
Salmonid Habitat in the Russian River

There are 1,778 miles of potential salmonid habitat in the Russian River. All of this habitat is needed for recovery of the three species as described in the forthcoming NMFS recovery plans.



Overlap between Vineyards and habitat

There are 60,640 acres of vineyard in the Russian River (Heaton 2008). **70%** are within 300 feet of salmonid habitat and **25%** of salmonid habitat is within 300 feet of a vineyard.



Risks from Vineyards

Proximity of vineyards to habitat suggests easy access to surface diversions and potential impacts from instantaneous reductions in flow during the frost protection season. Adjacency does not necessitate an impact, but one one study estimated 30% of tributaries are affected.

Unknowns:

- Percentage of vineyards that irrigate for frost protection.
- Proportion of vineyards that rely on surface water diversions for their frost protection needs.

Biological Response

- Life-stage
  - Egg
  - Fry
  - Juvenile
  - Smolt
  - Adult
- Response
  - Timing
  - Behavior
  - Physiological tolerance

Background photo courtesy of Simpson Timber Co. 2001

Fry

- Typically emerge from redds in April or May
- Have poor swimming ability
- Occupy the shallow margins of streams
- Take refuge in cobble substrates
- Highly susceptible to stranding

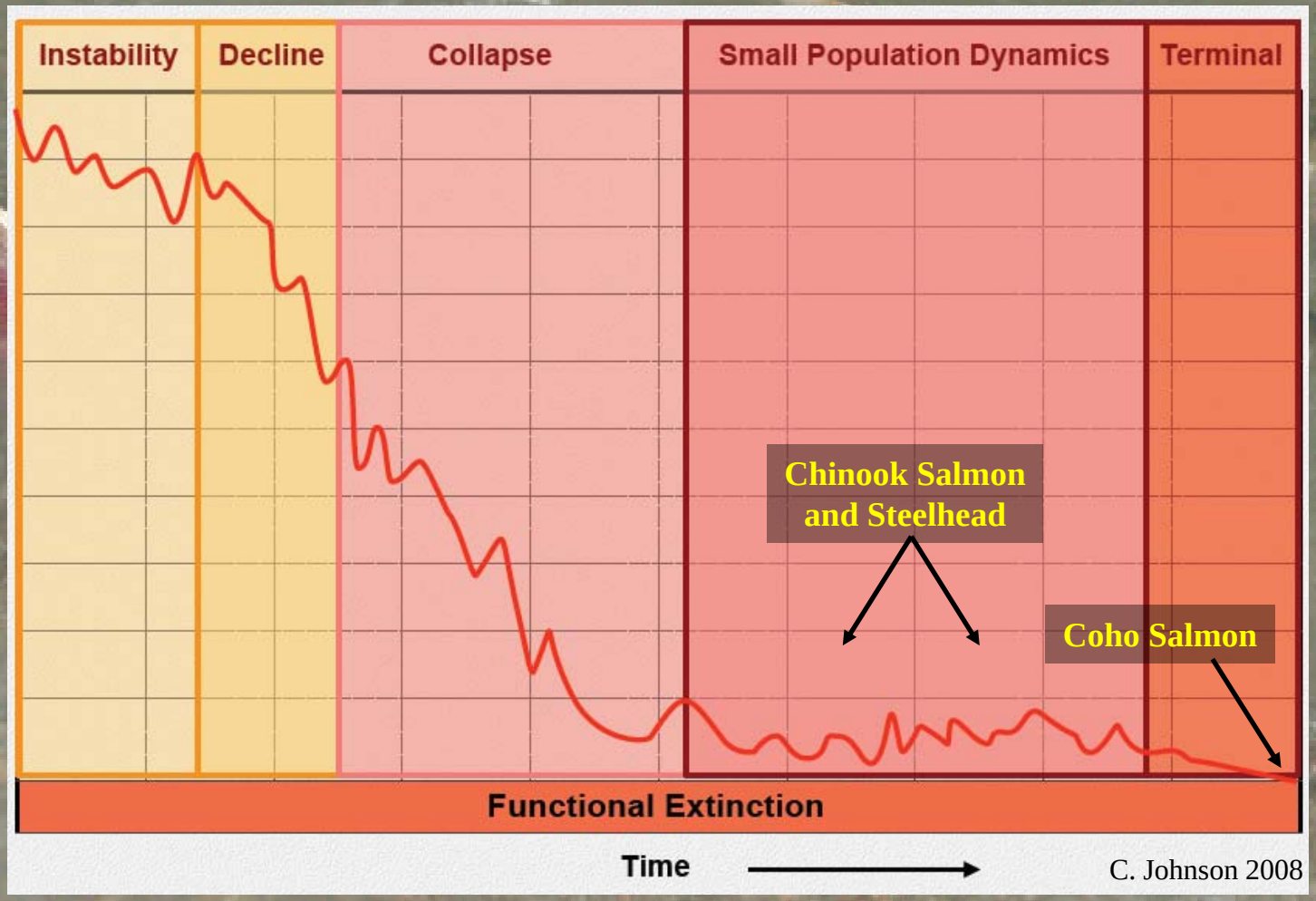
Smolts

- Typically migrate from March through May
- Represent the net productivity of a watershed
- Strong swimmers
- Less susceptible to stranding than fry
- We ***have*** observed smolt mortality with frost event drawdowns

Population Viability and Extinction

- Viable Population
  - A population that has a low probability of going extinct over the next 100 years
- 4 viability attributes
  - Abundance
  - Population growth rate
  - Spatial Structure (i.e. distribution)
  - Diversity (genetic and ecological)

General Pattern of Population Decline and Extinction



Threats to Survival and Recovery

- Habitat conditions
  - 22 of 35 habitat attributes are limiting production
  - Including instantaneous flow reductions in spring
- Sources of Stress (top 4)
  - Agriculture practices
  - Droughts
  - Roads
  - Water diversion and impoundment

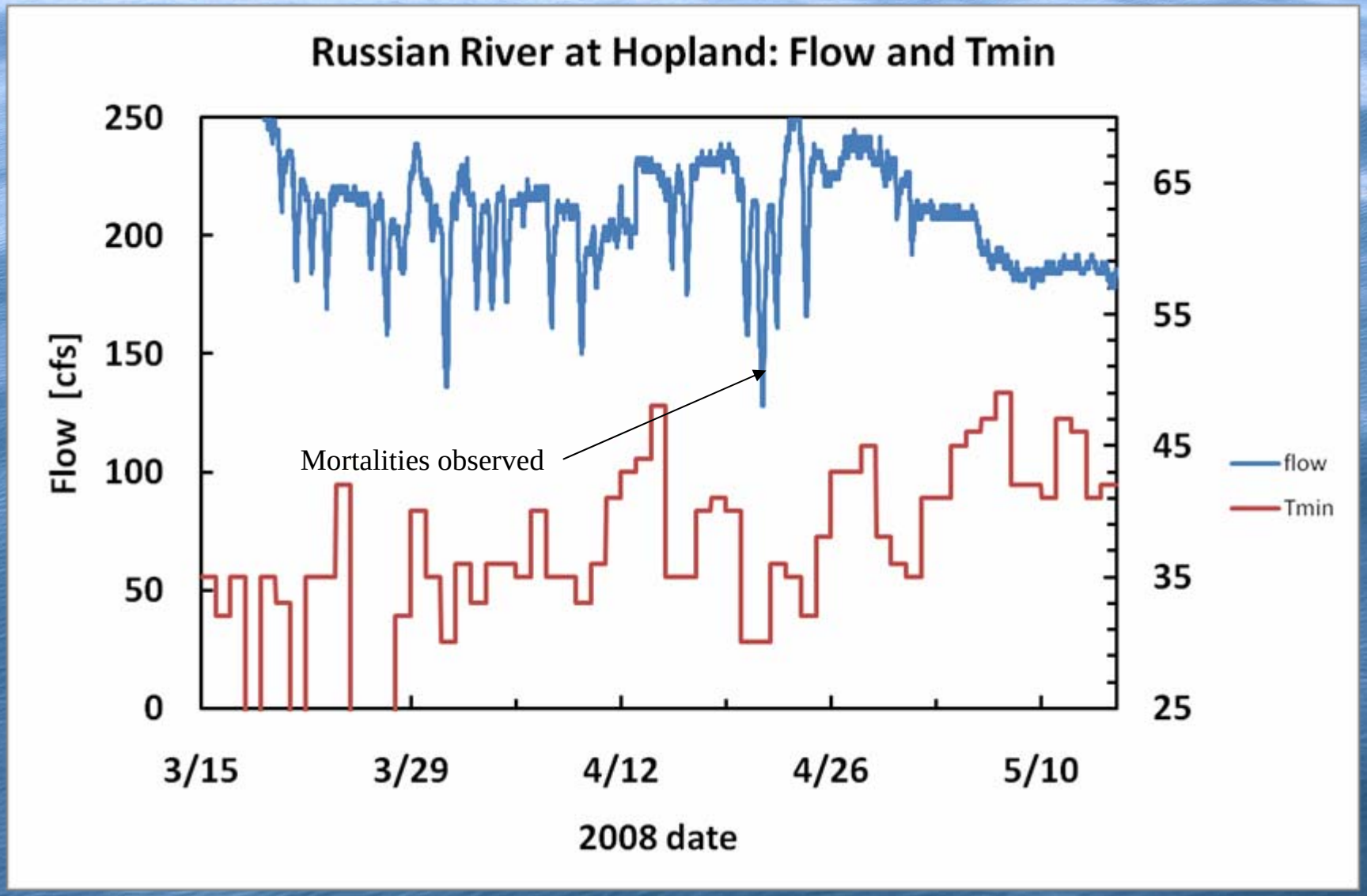
Source: Draft Federal Recovery Plan for CCC coho salmon

Conclusion

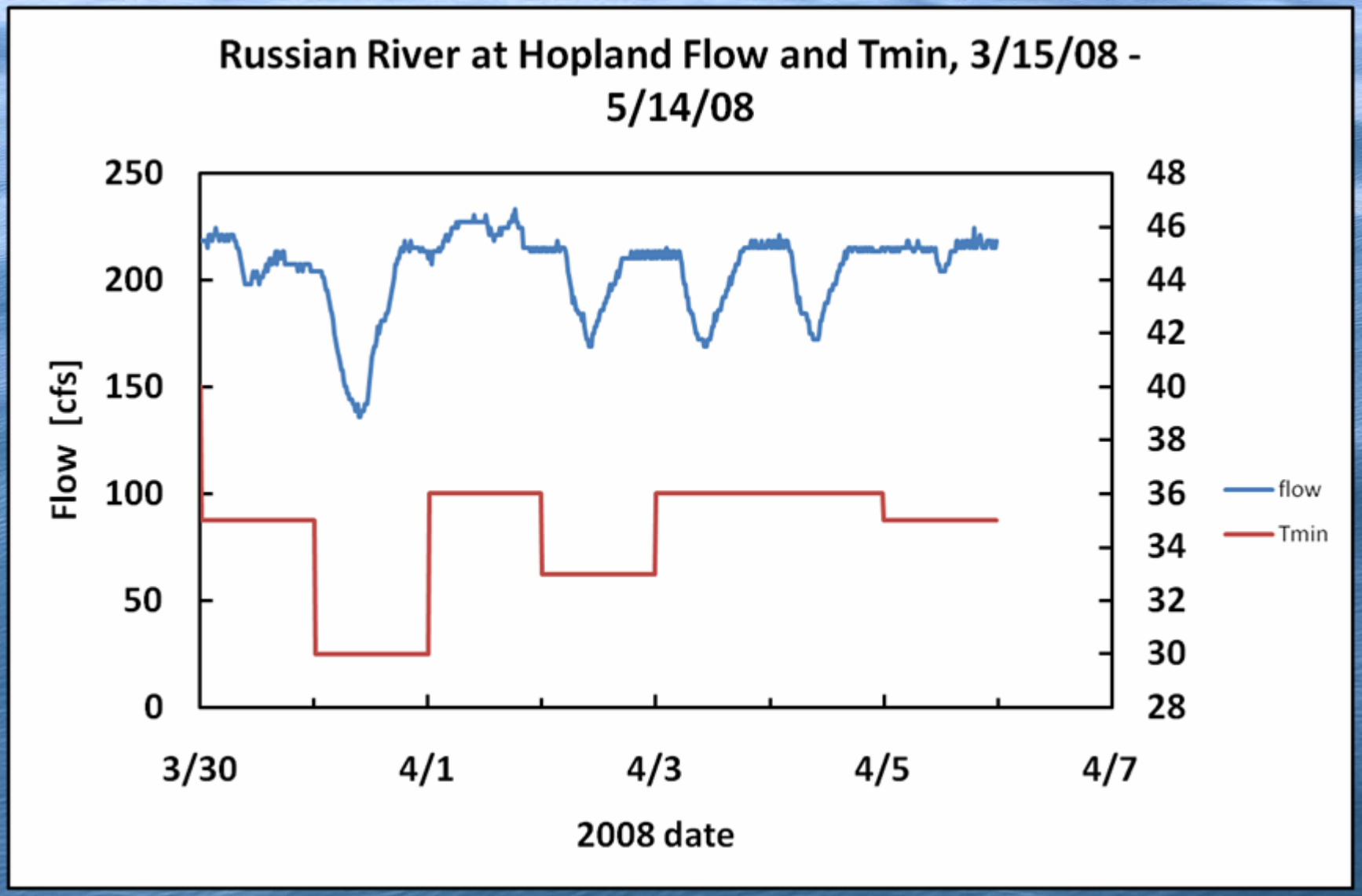
- Population viability is low for all three salmonids in the Russian River
  - Coho salmon are at very high risk of extinction
- Exposure to the threat of Frost protection irrigation is high
- This threat (and others) likely limits the survival and recovery of these species

Hydrologic Analysis

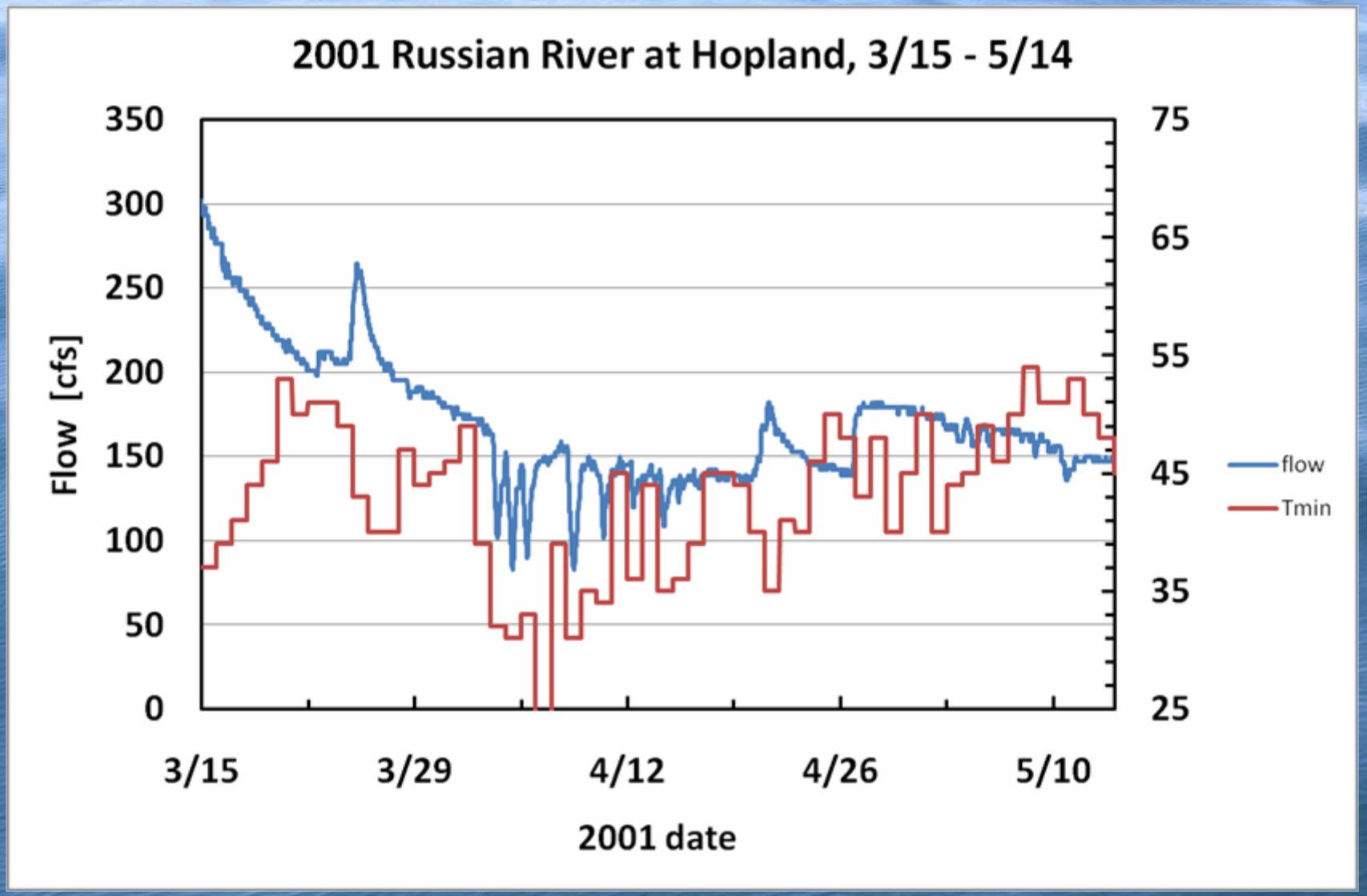
- Evaluation of the scope, frequency, and magnitude of streamflow drawdown events associated with irrigation for frost protection
  - Analysis by Berkeley Water Center of Hopland gage data
  - Comparison with tributary observations
- Interpretation of results
  - Frequency and magnitude of drawdown events
  - Historical emergence of drawdown pattern



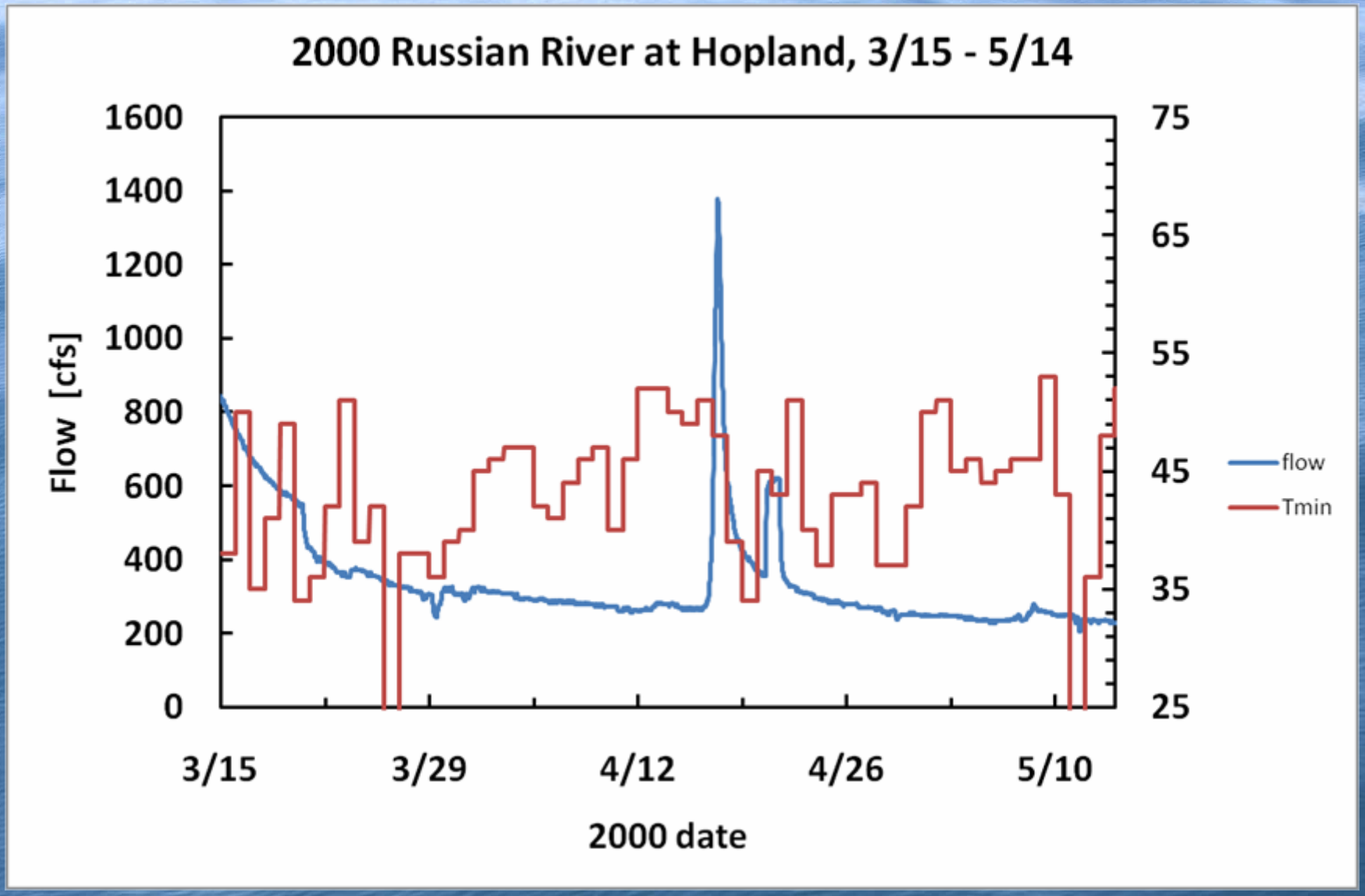
Full flow record for the 2008 Spring where multiple pumping events were initiated.
Berkeley Water Center



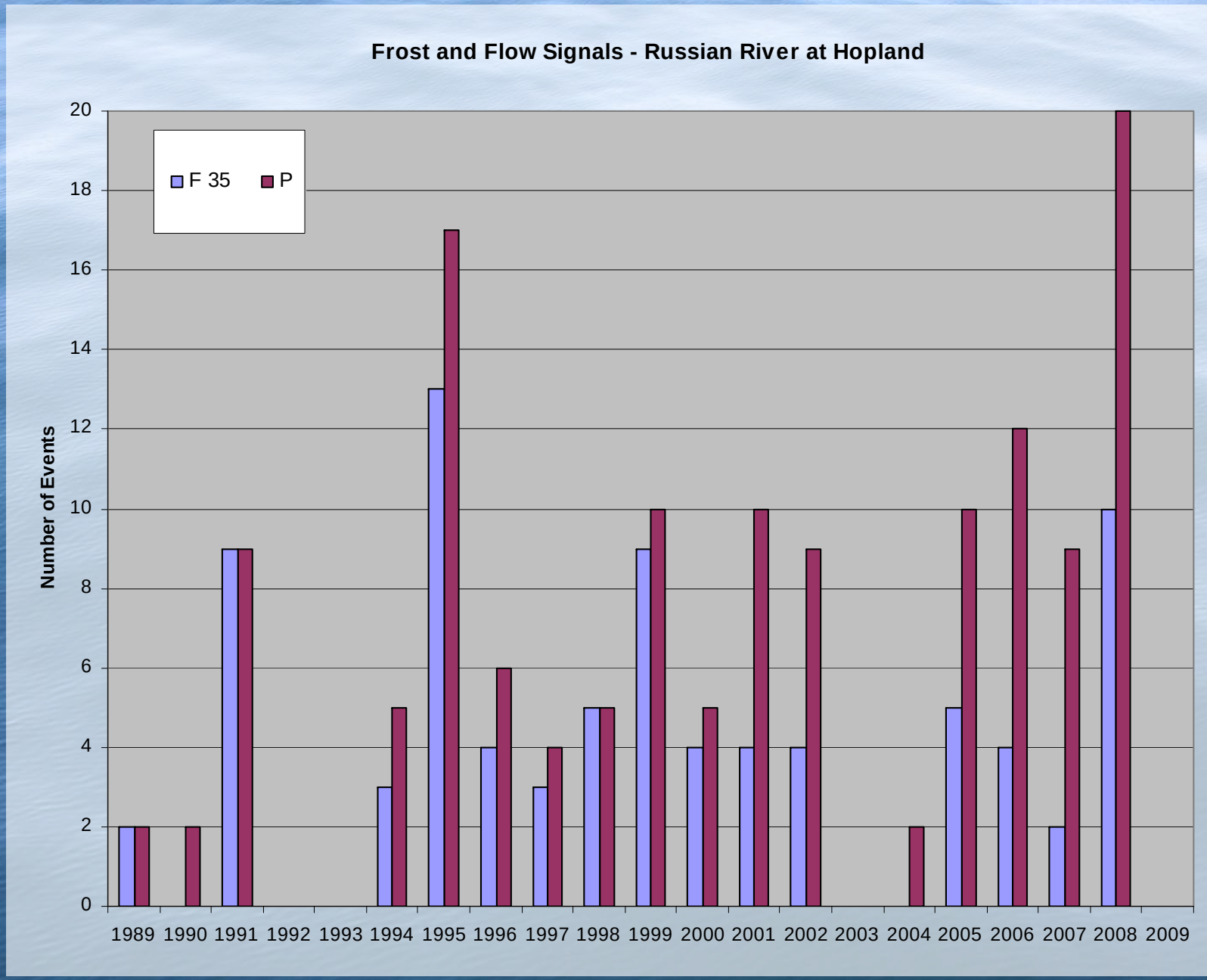
Detailed look at a week with multiple pumping periods, some of which correspond to low temperatures.

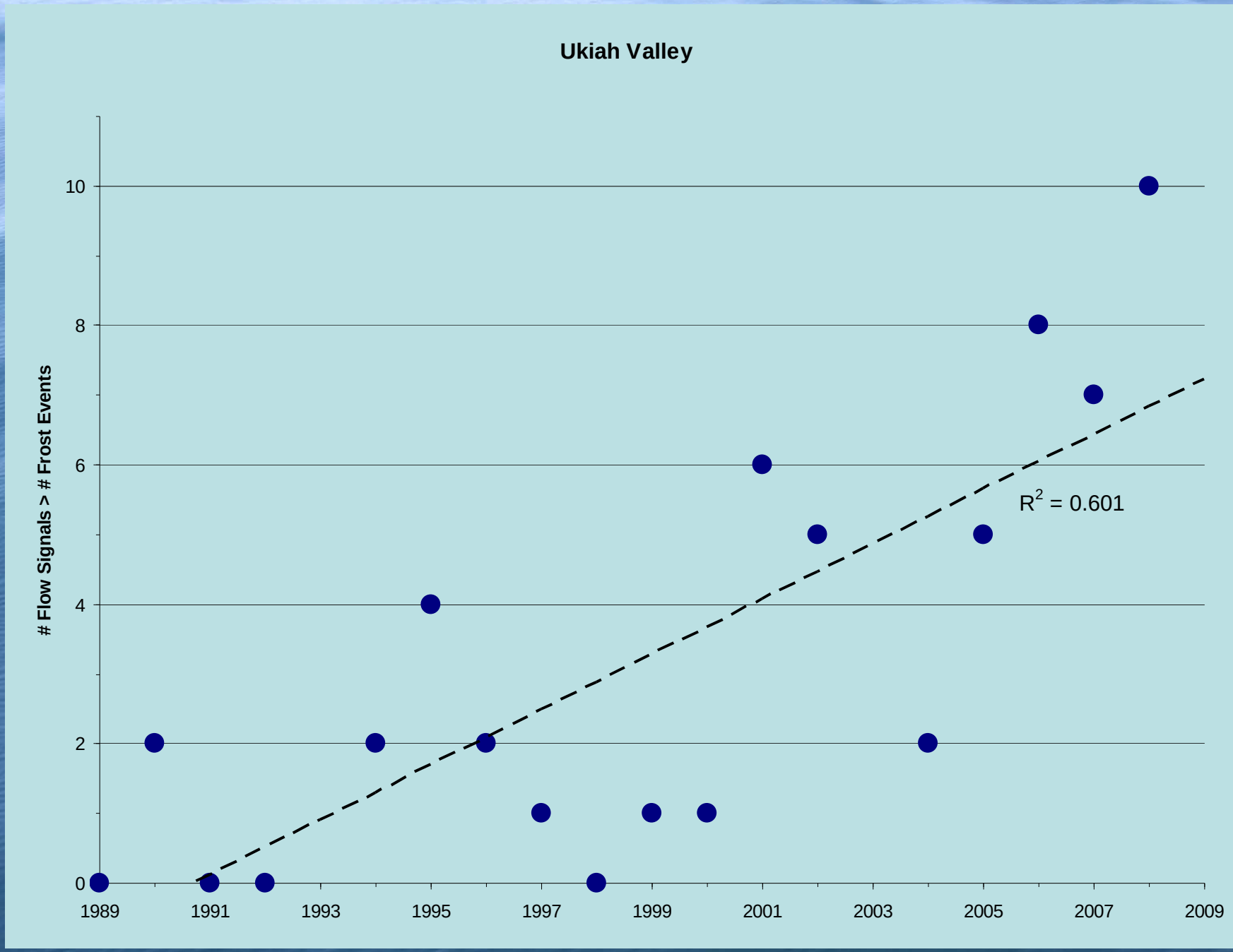


2001 had a dry spring and many days in the early April period with rapid water draw downs.

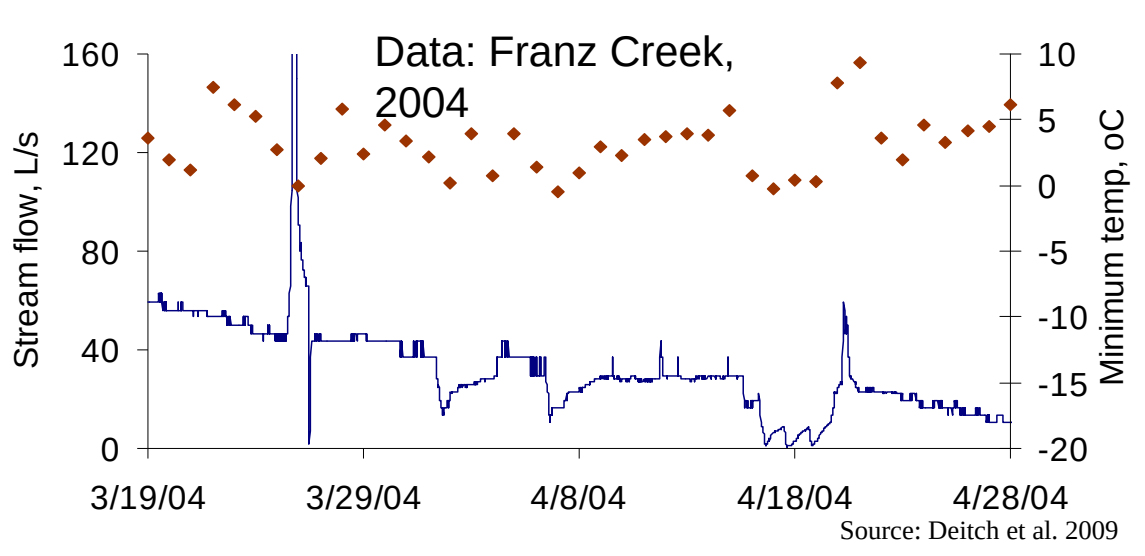


Very wet Spring with little frost to worry about.

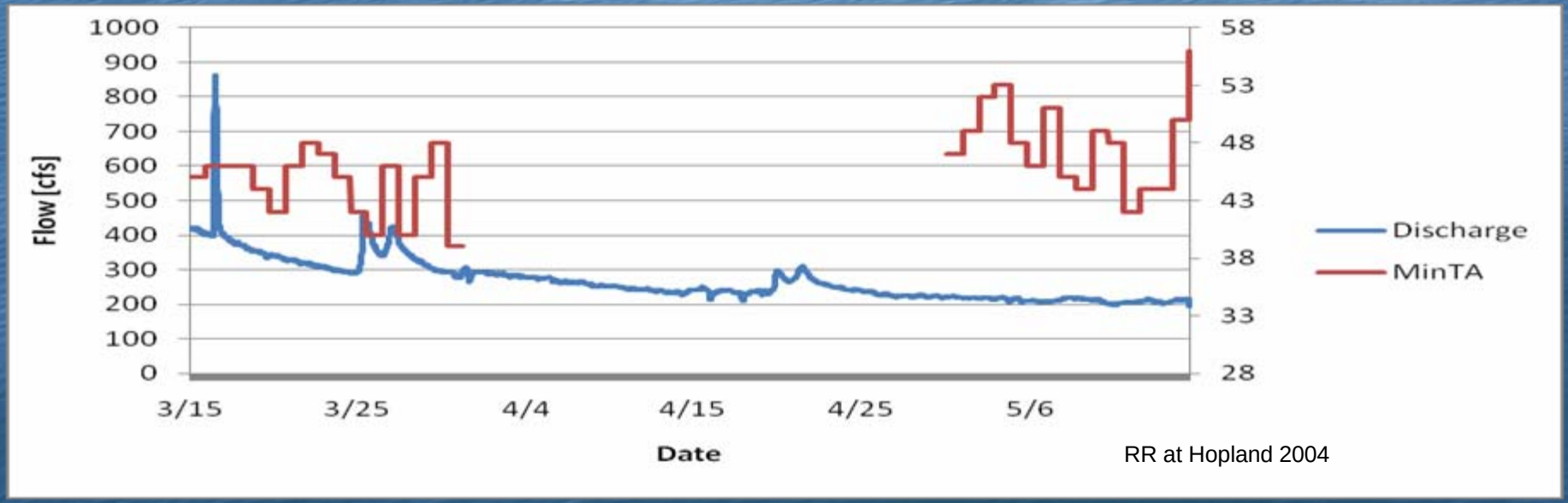

Frost and Flow Signals - Russian River at Hopland
F 35
P
Number of Events
0
2
4
6
8
10
12
14
16
18
20
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009


Ukiah Valley
Flow Signals > # Frost Events
10
8
6
4
2
0
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
R2 = 0.601

Signal in Tributaries



Source: Deitch et al. 2009



RR at Hopland 2004

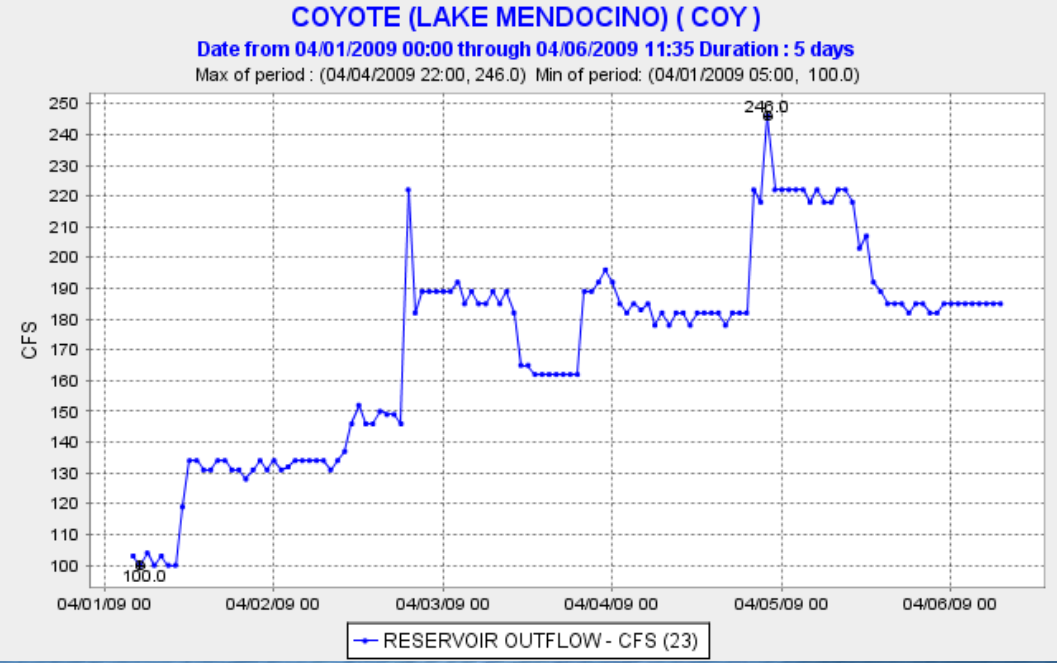
Hydrologic Conclusions

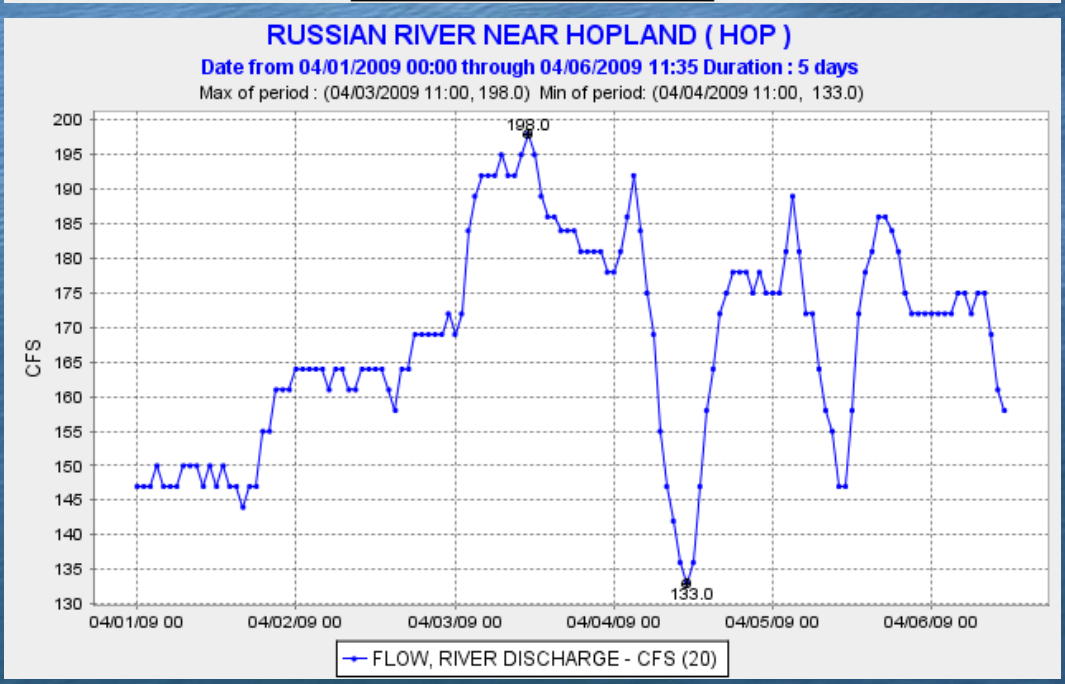
- Frost pumping drawdown events typically occur multiple times a year.
- They happen on average 3 out of 4 years.
- They are more extreme in dry years.
  - When fish are at greatest risk.
- Events correlate with frost risk
  - Not necessarily with actual frosts
  - Over-response appears to be increasing
- Tributary events are likely more frequent and more severe

2009 Mitigation

- Flow release increases from Coyote Dam, apparently anticipating drawdown events downstream.

- Significant drawdowns occurred, despite attempts to mitigate with increased flows.





Summary

- Rapid drawdowns are a threat to species survival and recovery.
- Frost pumping impacts are documented and widespread.

- Fisheries are near extinction.
- 12 years after the SWRCB Staff Report, coho salmon are in danger of extinction in the Russian River.

- Failure of the SWRCB to take appropriate action this year on frost irrigation will likely result in additional fish kills and violations of ESA.

NMFS' Mandates

- NOAA Fisheries Habitat Program Mandates to protect and restore habitat:
- Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Coastal Wetlands Planning, Protection, and Restoration Act
- Fish and Wildlife Coordination Act
- Federal Power Act,
- Energy Policy Act, and other acts and policies.

NMFS Roles and Recommendations

- NMFS is the agency responsible for implementing the Federal Endangered Species Act as it applies to salmon and steelhead.

- We achieve this via technical assistance, permitting, and enforcement.
  - Building partnerships with stakeholders is our preferred means of protection and recovery

Chronology of Frost Policy

- 1972 SWRCB determines frost protection irrigation is an unreasonable use of water in the Napa River
- 1977 Watermaster system for the Napa River is codified
- 1997 SWRCB Staff Report identifies frost protection impacts to salmonids in the Russian River
  - Concludes it to be a waste and unreasonable use of water
  - Found wind machines to be a reasonable alternative

Chronology Continued

- 2008 drought and frost events lead to fish kills
  - NMFS Office of Law Enforcement (OLE) opens investigations
  - OLE forms the Frost Protection Task Force in July, 2008
  - NMFS identifies instantaneous flow reductions in spring as a limiting factor for coho salmon in the Federal Recovery Plan
- 2009
  - NMFS requests emergency regulations from SWRCB
  - Additional fish kills occur with frost protection events

NMFS Recommendation

- We recommend the SWRCB exercise their authorities to regulate water use to protect salmonids, throughout their range, from any harmful water use.
- For this year, we recommend no diversion from surface and hydrologically connected sources for frost protection.
- Implement long term solution.

Long Term Alternatives?

- Wind Machines (Staff report 1997)
- Coordinated water use.
- Vine and Field Management Practices
  - Pruning Timing
  - Soil Moisture and Tilling
  - Cover Crop
  - Frost Resistant Varieties
  - Frost Prone Areas
- Sprinkler automation, reduce false alarms

State Water Resources Control Board

Division of Water Rights

STAFF REPORT

RUSSIAN RIVER WATERSHED

Proposed Actions to be taken by
the Division of Water Rights
on Pending Water Right Applications
within the Russian River Watershed

August 15, 1997

Compliance New permits would contain specific measures to demonstrate compliance with the terms described above. Those measures would be developed on a case-by-case basis

5.3 Spring Frost Protection There are 11 applications within tributary watersheds requesting water rights for direct diversion for frost protection from March through May. Diversions of water for frost protection present a difficult problem. The period from March through May is a critical season for frost protection; however, maintaining adequate flow in the stream is also important for several critical life-stages of coho and steelhead. If all diverters simultaneously divert water for frost protection, flows could be lowered dramatically and impact fish. In order to evaluate the reasonableness of direct diversion for frost protection, Division staff have evaluated alternative methods that could be used to provide frost protection.

The SWRCB was faced with a similar situation on the Napa River. In that particular case, the SWRCB determined in 1972 that direct diversion for frost protection, when the river contained insufficent flow to supply all needs, represented an unreasonable method of diversion and use of water. The SWRCB restricted diversions from the Napa River for frost protection purposes, and required diverters to participate in a trial distribution program controlled by a watermaster. Sections 659 and 660 were added to the Regulations to define SWRCB policy for diversion of water from the Napa River for frost protection. In March 1974, legal action was brought in the Superior Court of Napa County by the SWRCB against diverters who were in violation of SWRCB policy. The lawsuit was ultimately settled by a stipulated judgement which required the diverters to participate in the trial distribution program.

A publication prepared by the Cooperative Extension at the University of California at Davis (Leaflet #2743) discusses frost protection measures for vineyards in Napa, Sonoma and Mendocino counties. The report presents comparative cost data for the two principal methods used for frost protection -- wind machines and sprinklers. The report states that the total annual costs of the two methods are:

	Cost per acre
. Wind machines and heaters	$220 to 230
. Sprinklers	$190 to 200

These data indicate that using wind machines, rather than directly diverting water from streams, is more expensive but is a reasonable, cost-effective, alternative method for providing frost protection. As described in the SWRCB memo on reasonableness "The overriding public interest may require an individual to incur reasonable additional expense in order to maximize beneficial uses of water."

The Cooperative Extension report also discusses the requirements for construction of small reservoirs to provide for winter time storage of water that could then be used to supply water for frost protection in the spring. The report states that a reservoir with a capacity of 22 af would provide sufficient capacity to provide frost protection for a 40 acre vineyard for a total of 60 hours of frost conditions. The total area required for the reservoir would depend on the topography of the

site and the depth of the reservoir. The report indicates that a 22 af reservoir would require about three acres of land.

The report also discusses the cost and practicality of using wells to provide water for frost protection.

As indicated above, there are reasonable, cost-effective alternative methods of providing frost protection, other than further direct diversions from the streams. As discussed in Attachment B, there are limited data available to define the flow regime in the spring to protect the fishery resources, however, providing adequate flow during this period is important for several life-stage of coho and steelhead. Consequently, staff concludes that new diversions for frost protection represent an unreasonable method of diversion and use of water. Accordingly, staff recommend that new diversions not be allowed after March 31, unless the applicant submits specific studies which demonstrate that further diversions in the spring will have no significant effect on coho and steelhead.

If applicants wish to construct off-stream storage reservoirs for storage of water for frost protection, rather than requesting a water right for direct diversion of water, it may be necessary for parties to submit a new application. Those new applications would have lower priorities than the pending applications. Where allowed, the Division will modify the applications for direct diversion and issue permits for off-stream storage reservoirs.

5.4 Projects on Main Stem Water is available for appropriation under D-1030 reservations for Mendocino and Sonoma Counties. Staff recommends the conditional approval of these pending applications, provided that existing protests can be resolved. Approval of the pending applications will have immeasurable impact on the flow in the main stem of the Russian River.

5.5 Municipal There is one pending application that requests a water right for existing diversion from the underflow of Austin Creek to supply 53.59 afa of water for municipal purposes in the town of Cazadero, which has about 280 permanent residents and 350 vacation residents. There is one other pending application that requests a water right for existing diversion from the underflow of Austin Creek to supply 10 afa for domestic purposes at 25 homes. There may be overriding public interest considerations that would preclude the SWRCB from canceling these applications. In both cases, the SWRCB is the "lead" agency and must prepare an environmental document. Staff will conduct an evaluation to determine whether there are feasible alternatives to the existing diversions and/or whether measures can be developed that would mitigate the potential impacts to fishery resources resulting from these diversions.

5.6 Domestic Several applications request the right to store 10 af or less of water for domestic purposes. Section 1228 et seq. of the Water Code provides for the issuance of Small Domestic Registration certificate for domestic use not exceeding direct diversion of 4,500 gpd or diversion by storage of 10 afa. For pending applications that meet these criteria, staff proposes to issue Small Domestic Registration certificates.