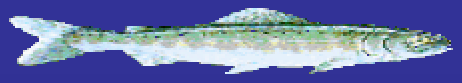
Salmonid Science Panel
EWA Workshop
October 15, 2003

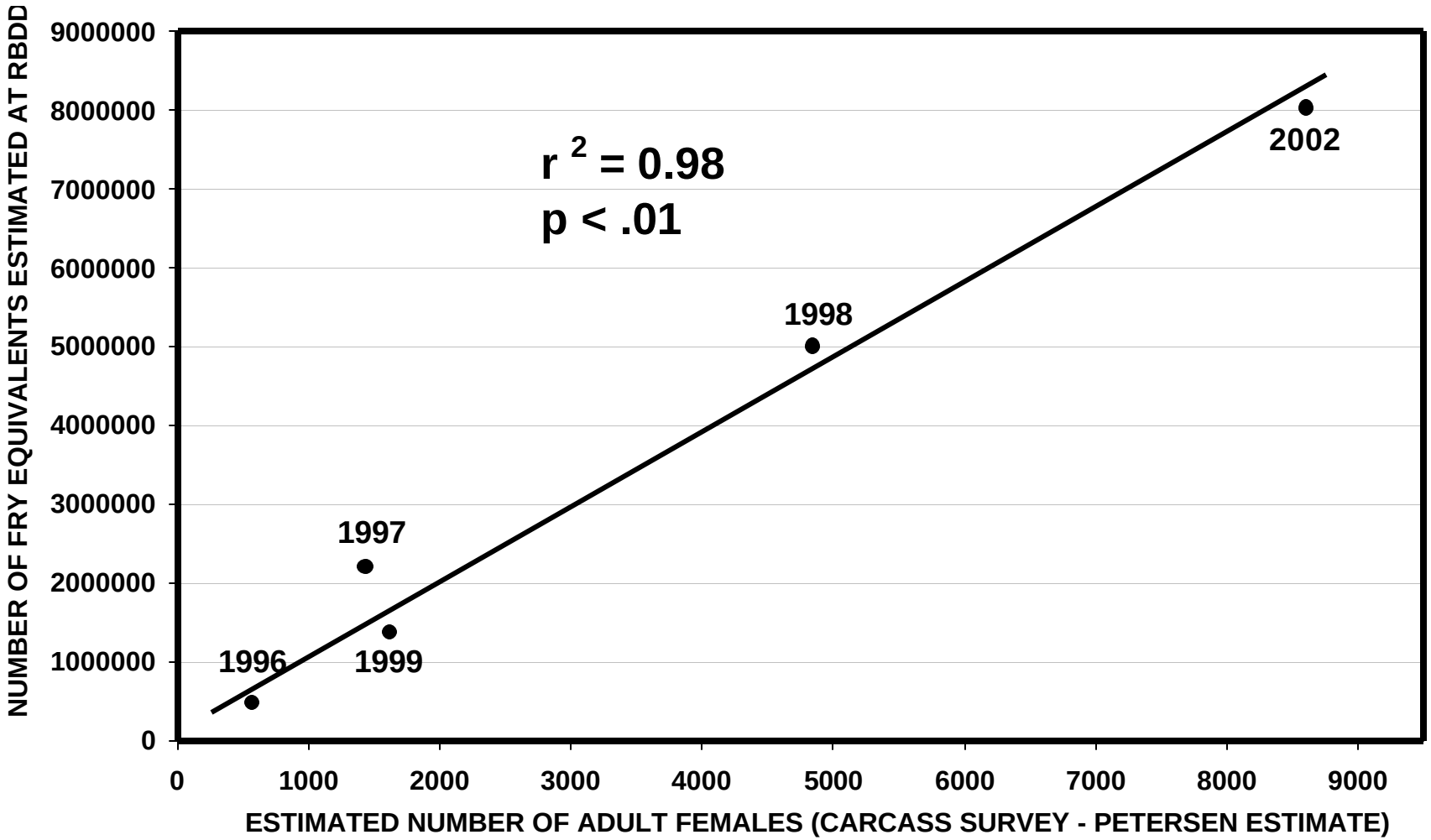
Alice Low – DFG
Sheila Greene – DWR
Pat Brandes – USFWS
Roger Guinee – USFWS
Bruce Oppenheim – NOAA Fisheries
Jim White - DFG

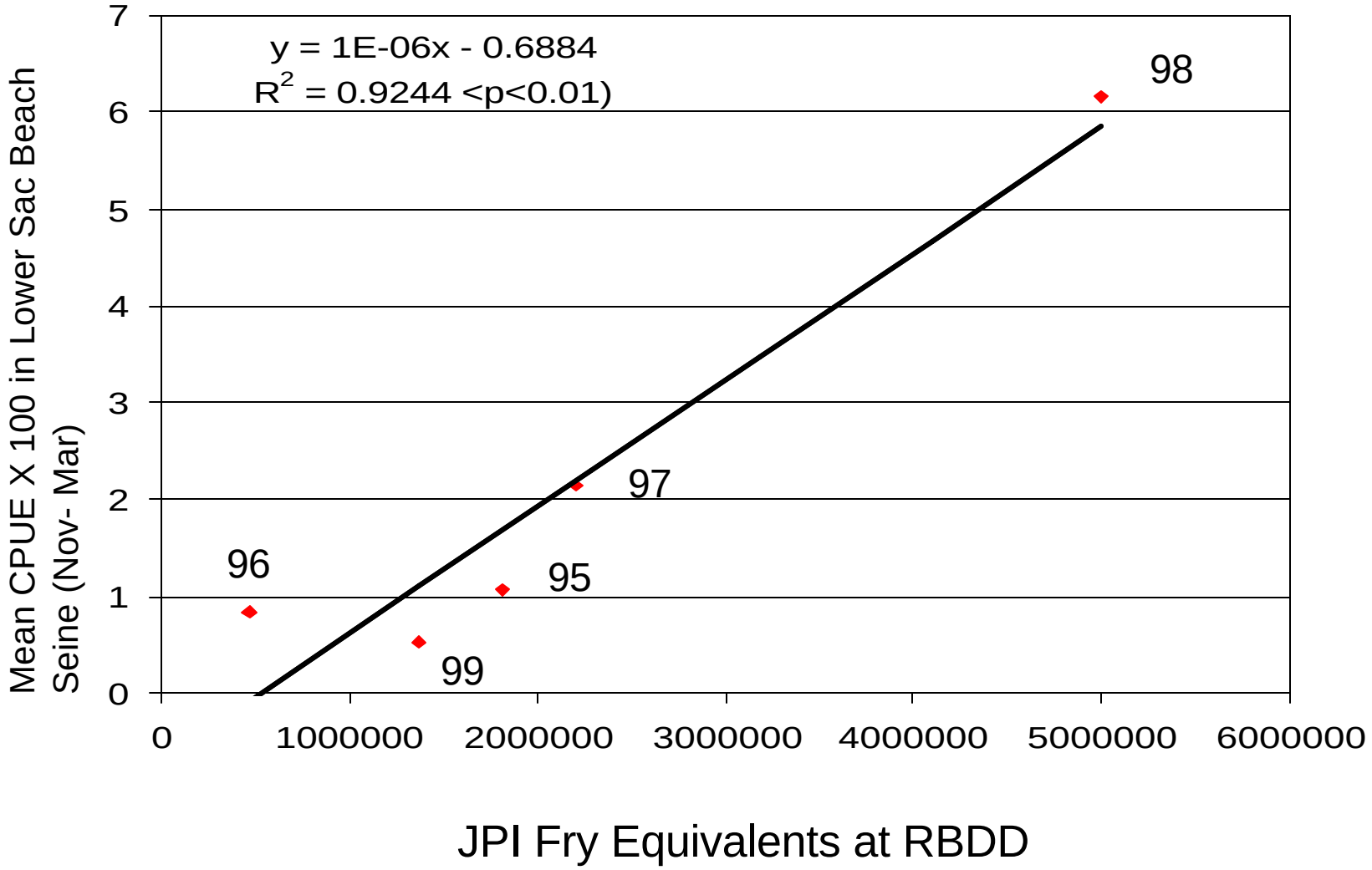


What Progress has been made in addressing the EWA technical panel's recommendations for:

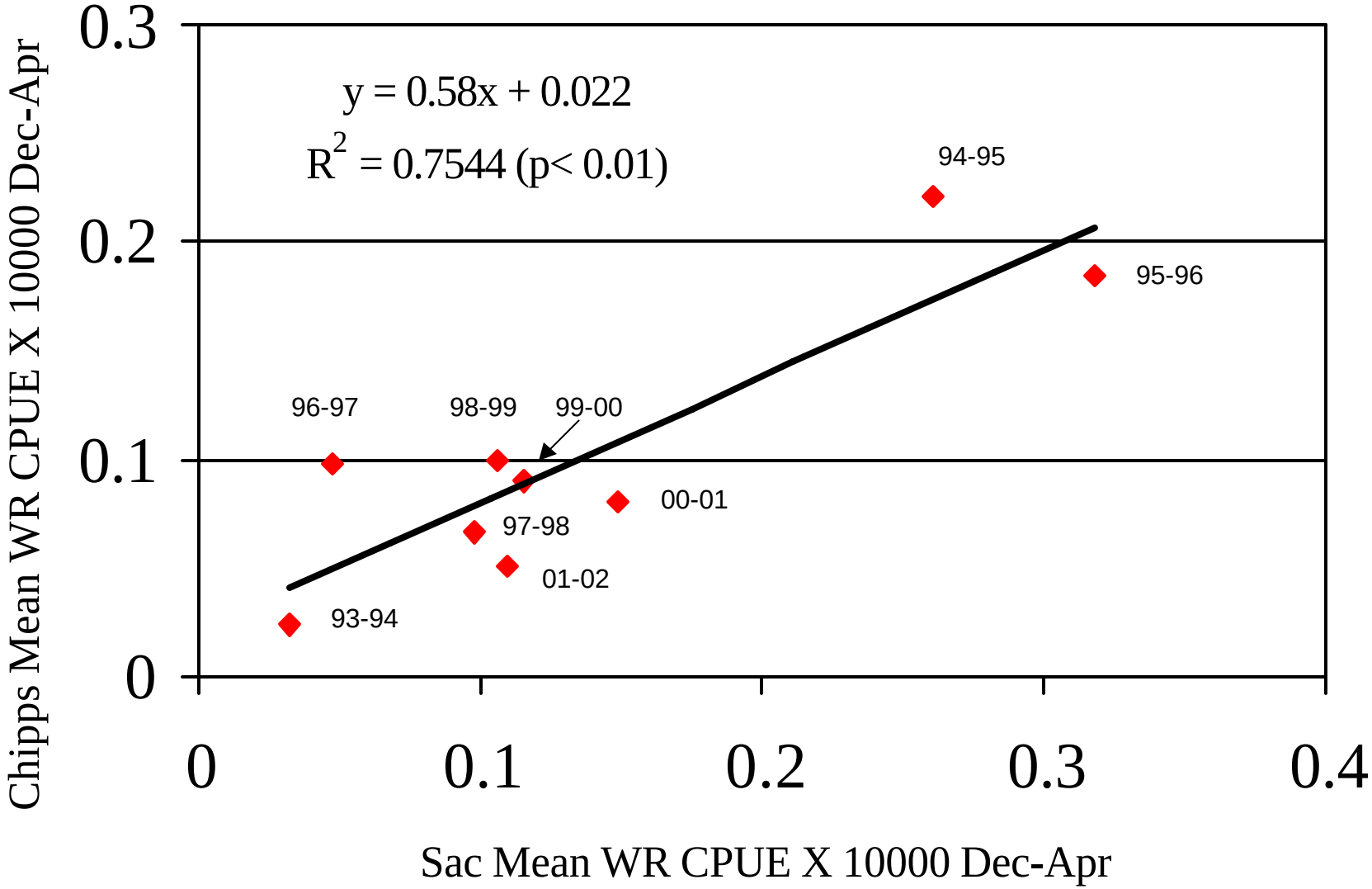
Developing a quantitative synthesis of the Chinook salmon life cycle ?

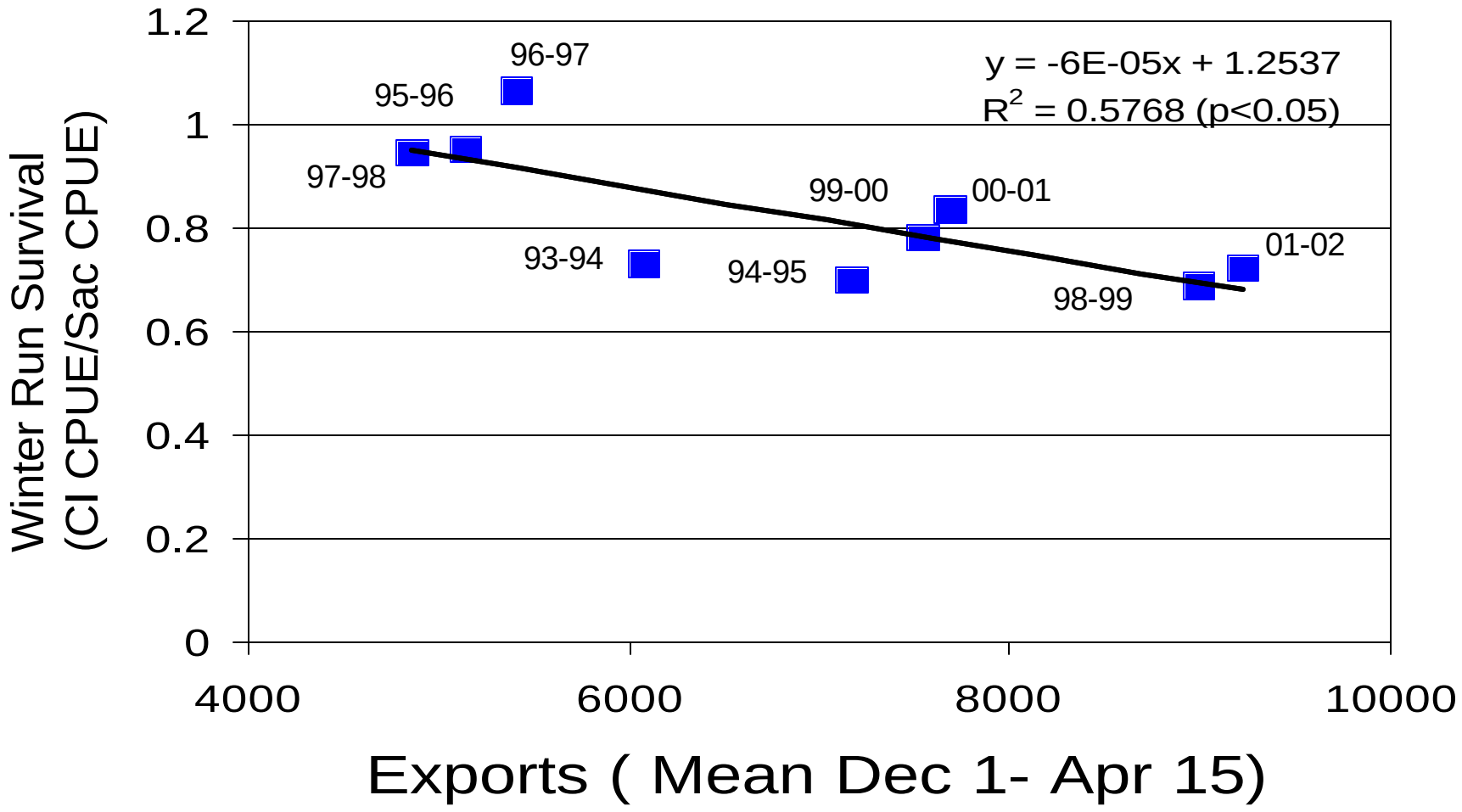
RELATIONSHIP BETWEEN NUMBER OF WINTER-RUN SPAWNERS AND FRY EQUIVALENTS AT RBDD





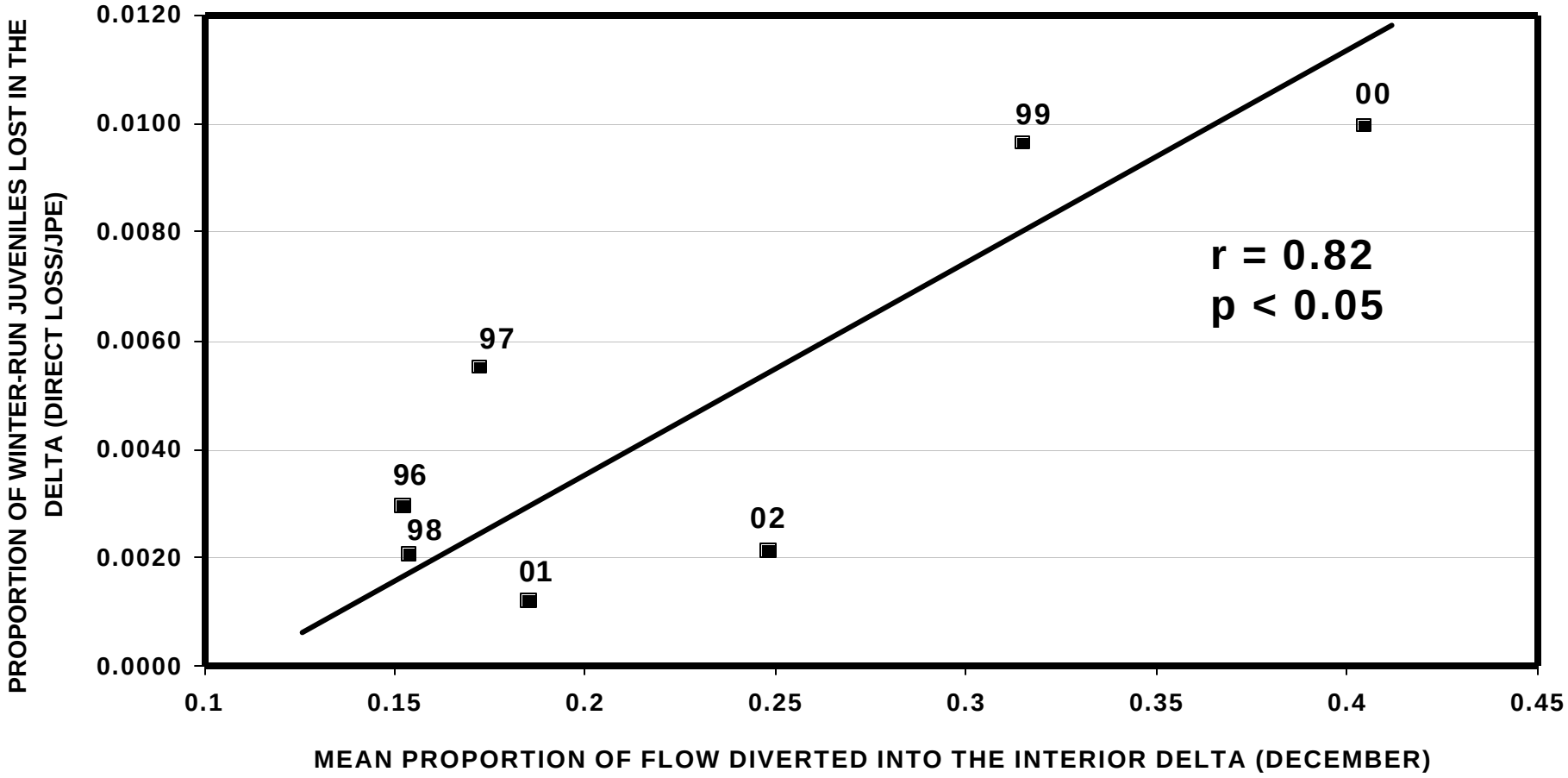
CPUE of Winter run sized Chinook at in lower Sacramento Beach Seine (Nov- Mar) versus Juvenile Production Index Fry Equivalents at RBDD, 1995 -1996 (95) through 1999-2000 (99).


y = 0.58x + 0.022
R2 = 0.7544 (p< 0.01)
94-95
95-96
96-97
98-99
99-00
00-01
97-98
01-02
93-94
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
Chipps Mean WR CPUE X 10000 Dec-Apr
Sac Mean WR CPUE X 10000 Dec-Apr



Survival of winter run between Sacramento and Chipps Island versus Mean CVP+SWP exports December through April 15, 1993-1994 through 2001-2002

RELATIONSHIP BETWEEN PROPORTION OF FLOW DIVERTED INTO DELTA AND PROPORTION OF JUVENILE WR LOST



1998 BROODYEAR COHORT RECONSTRUCTION
WINTER-RUN CHINOOK

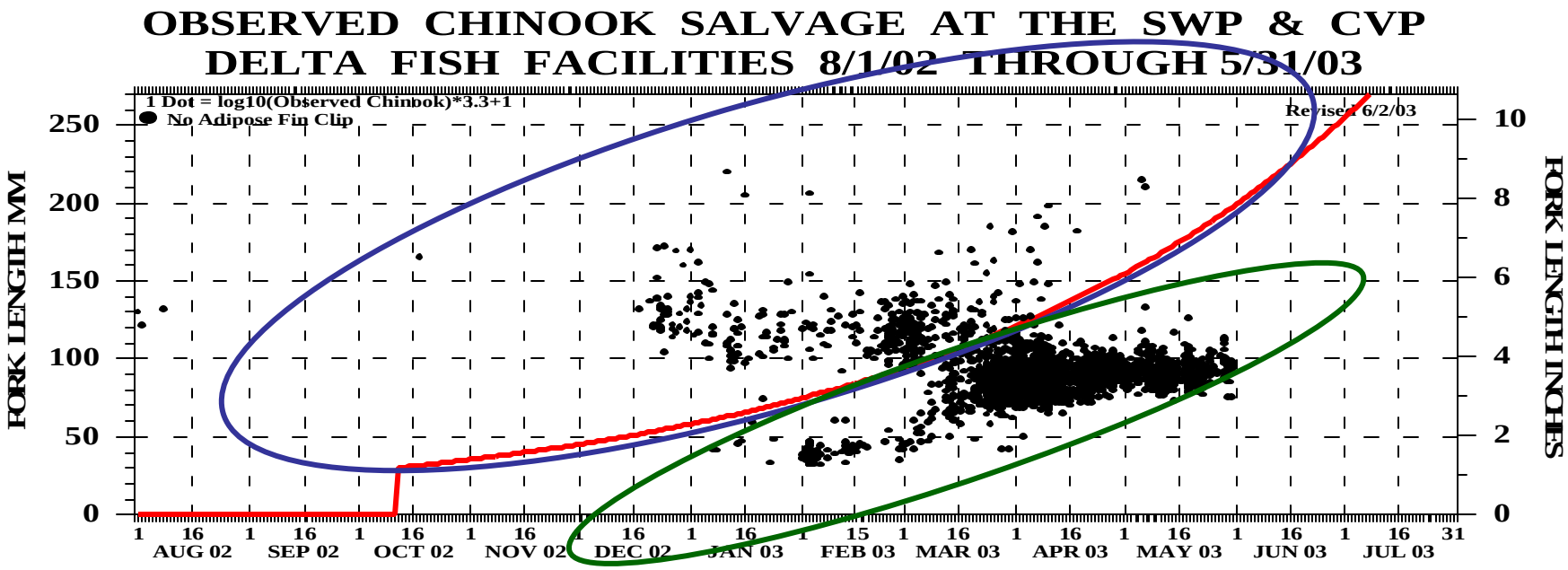
	AGE 4		AGE 3		AGE 2	
MONTH	IMPACTS	ALIVE	IMPACTS	ALIVE	IMPACTS	ALIVE
MAR	0	13	0	629		
APR	0	13	5	617		
MAY	5	13	0	601		
JUN	0	8	56	590		
JUL	0	8	57	524		
AUG	0	8	14	458		
SEP	3	7	5	436		
OCT	0	5	9	423		
NOV	0	5	0	406		
DEC	0	4	0	399		
JAN	0	4	0	392		
FEB	0	4	0	384	0	674
TOTAL	8		146		0	
ESCAPE	4		371		8	

CUWA INTEGRATED MODELING FRAMEWORK FOR WINTER-RUN CHINOOK

- S.P. Cramer/R2 Resource Consultants developing IMF, in collaboration with agency and stakeholder scientists
- Step 1 of 4-step process completed:
  - Development of conceptual framework
  - Review of 14 existing models
  - Development of prototype quantitative model

Developing EWA decision process criteria for salmon actions?

Understanding juvenile salmon movement patterns and habitat use in the Sacramento river and Delta?

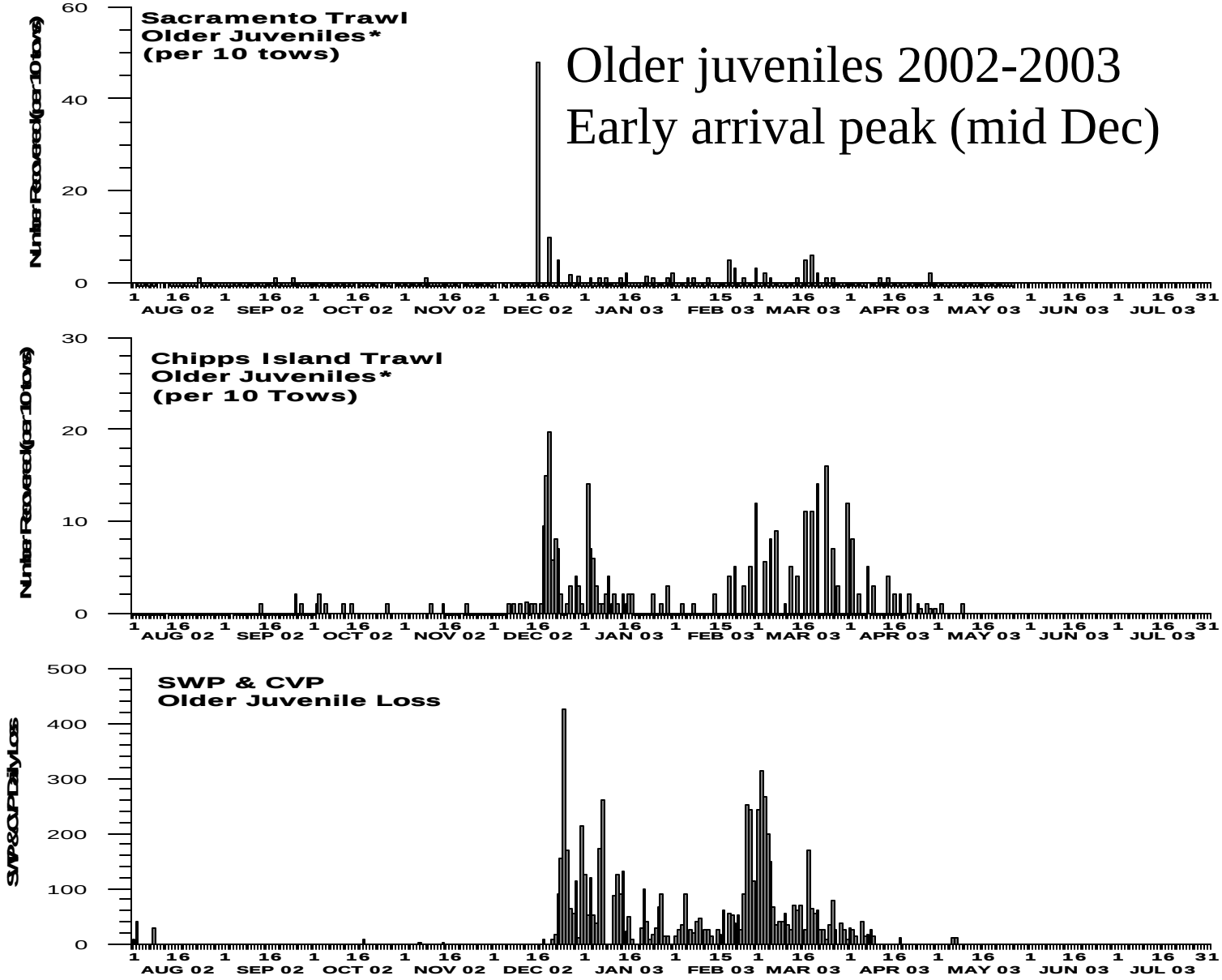


Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul

Older Juveniles above minimum winter run size

Fry/smolts below minimum winter run size

NUMBER OF JUVENILE CHINOOK RECOVERED IN THE SACRAMENTO RIVER AND DELTA



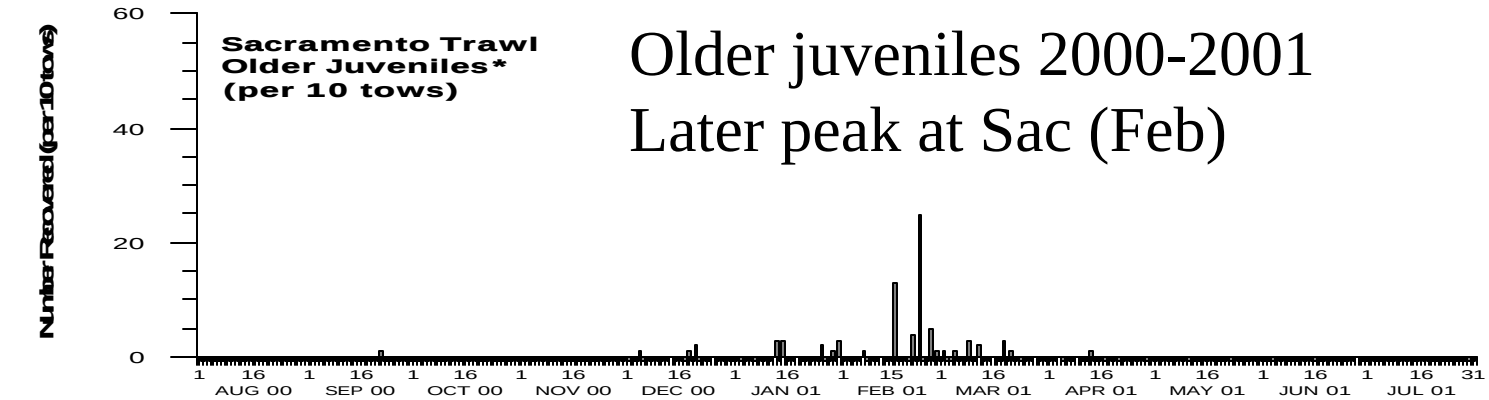
Older juveniles 2002-2003
Early arrival peak (mid Dec)

Plus co
DWR-D

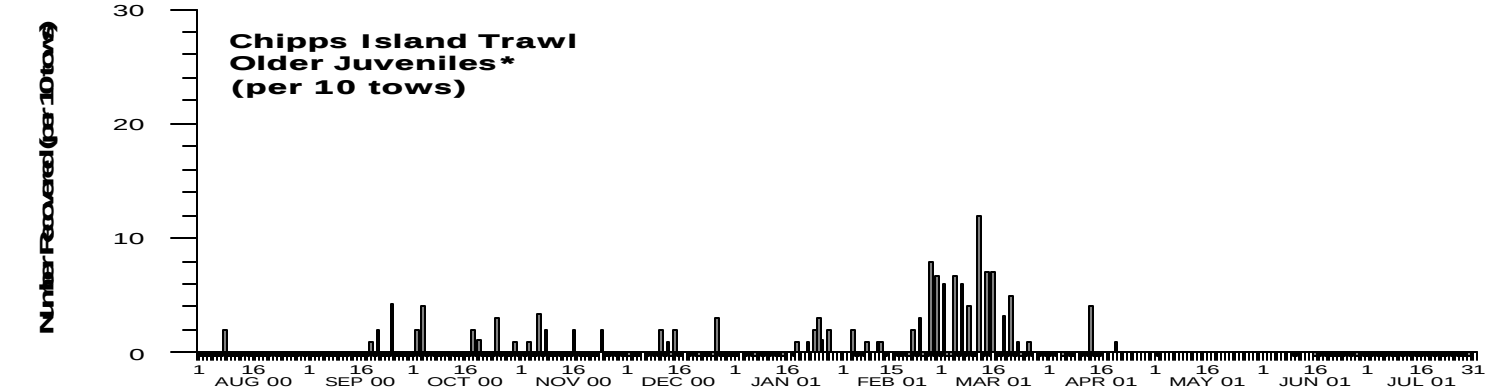
A S O N D J F M A M J J

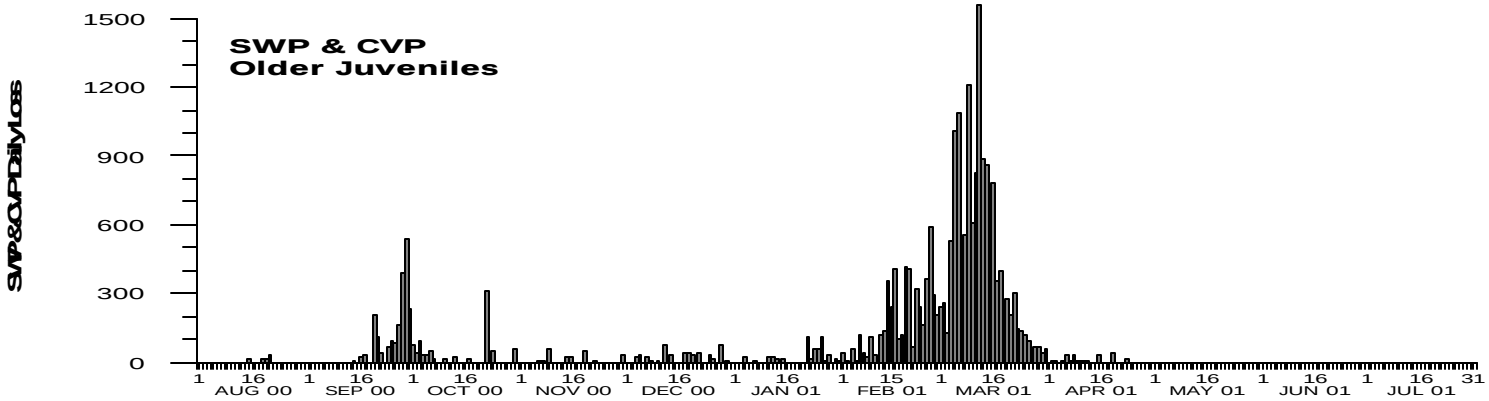
REVISION

NUMBER OF JUVENILE CHINOOK RECOVERED IN THE SACRAMENTO RIVER AND DELTA



Older juveniles 2000-2001
Later peak at Sac (Feb)





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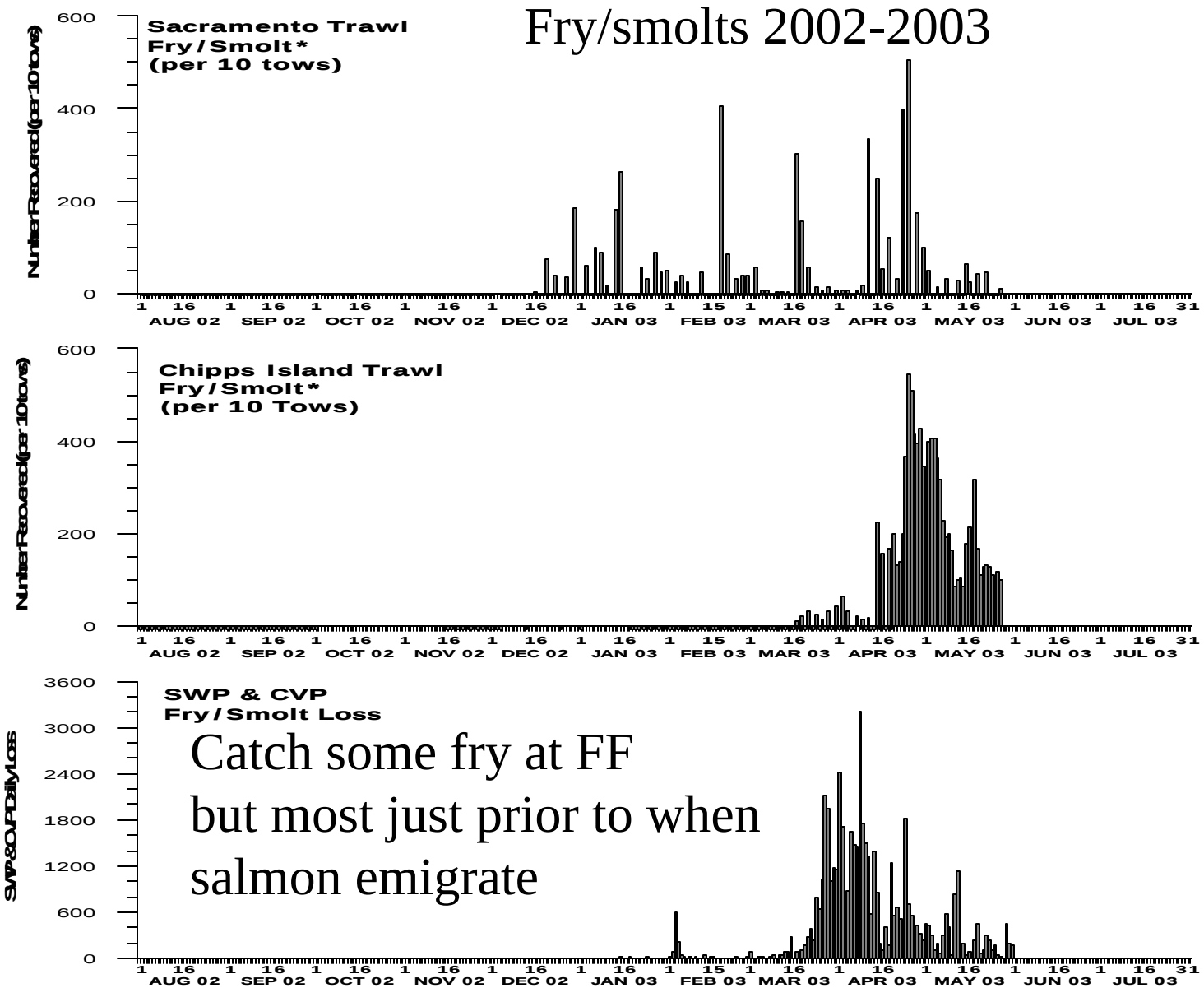
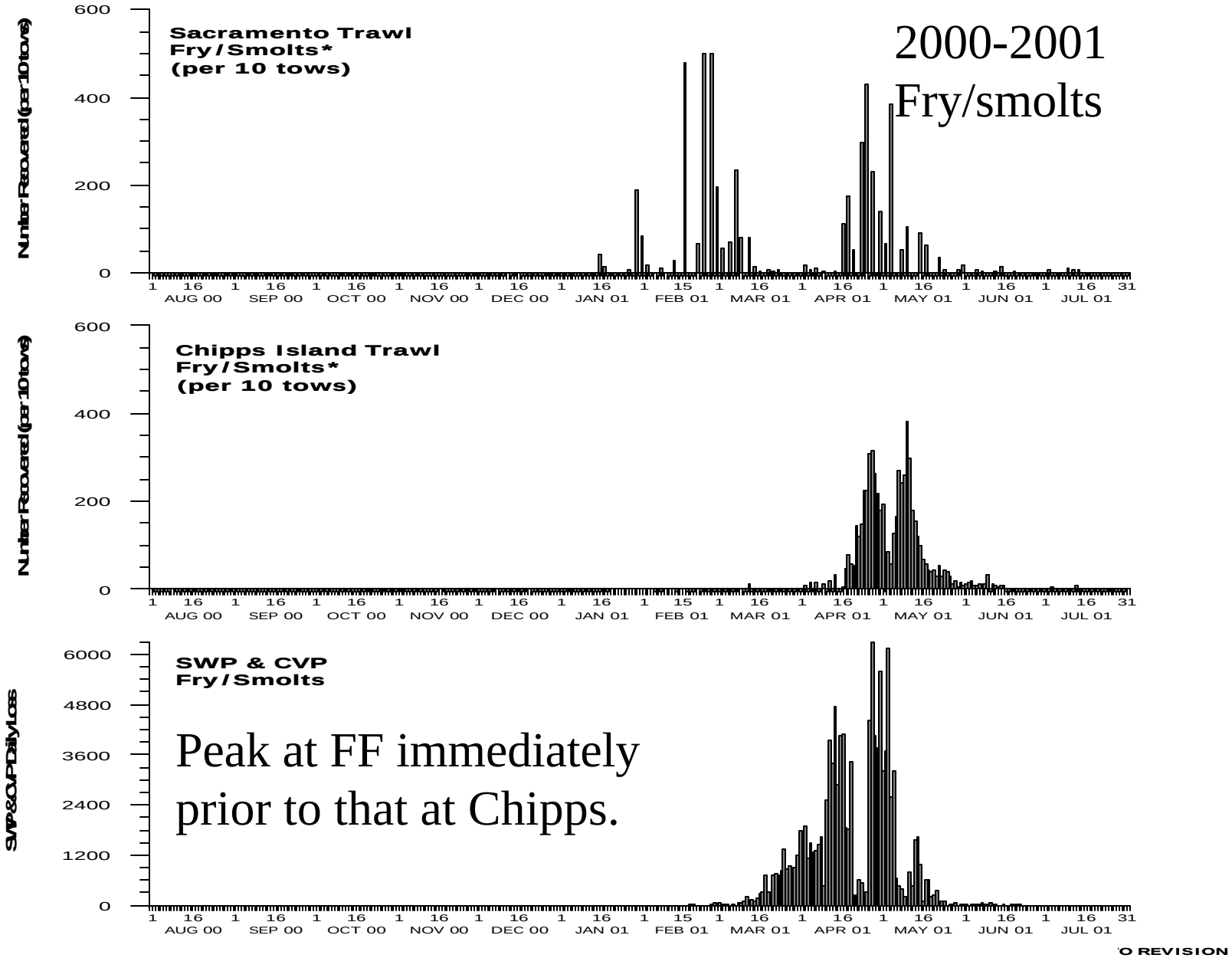
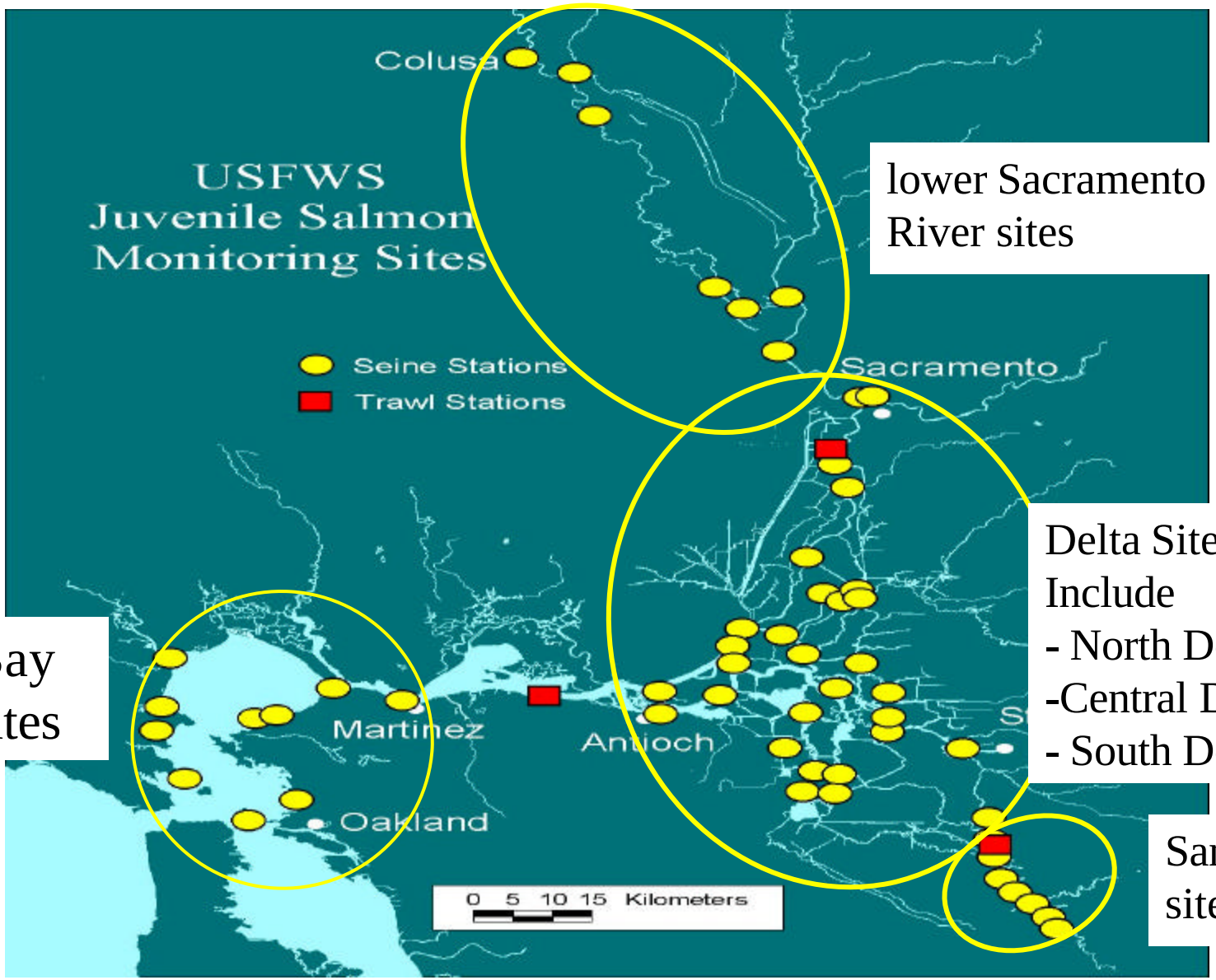
NUMBER OF FRY/SMOLT CHINOOK RECOVERED IN THE SACRAMENTO RIVER AND DELTA



NUMBER OF FRY/SMOLT CHINOOK RECOVERED IN THE SACRAMENTO RIVER AND DELTA



Beach Seine sites in the lower Sacramento River and Delta

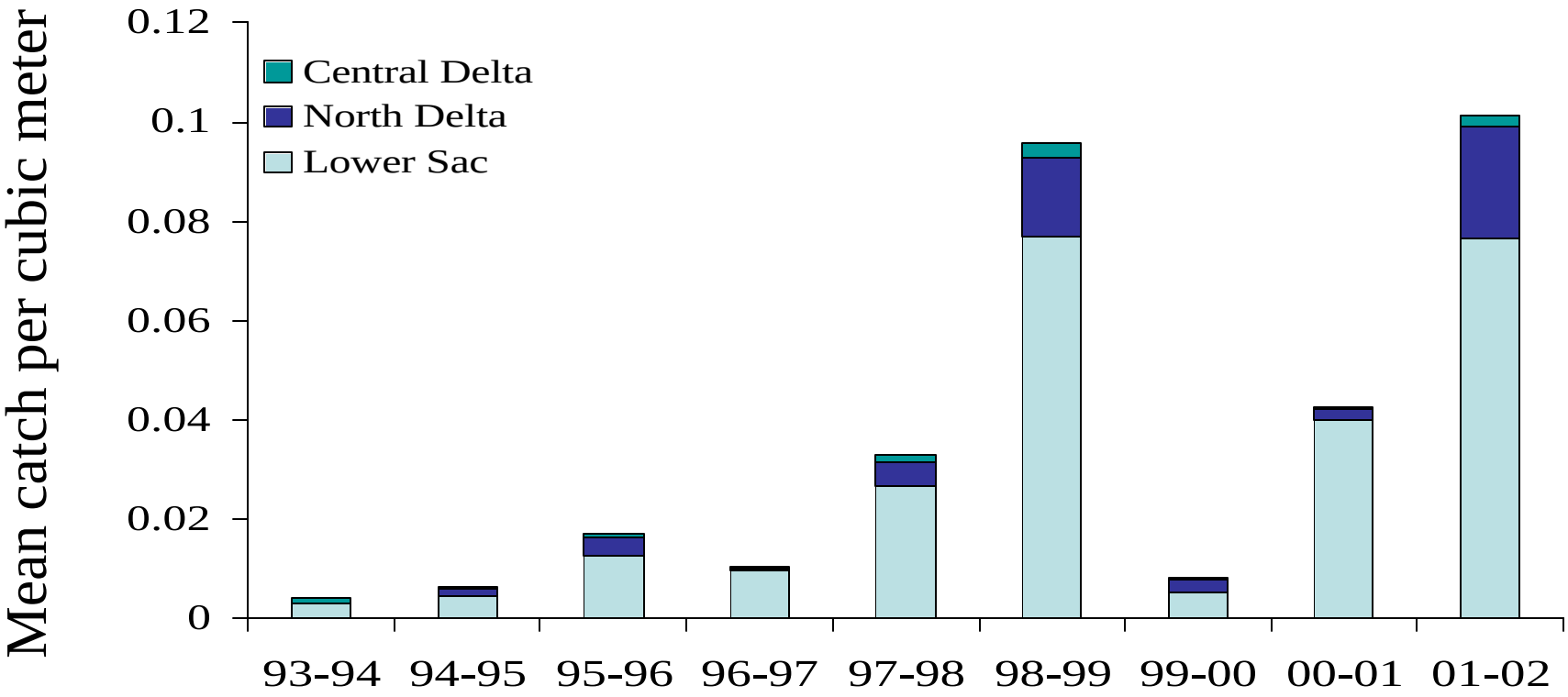


lower Sacramento River sites

Delta Sites Include
- North Delta
-Central Delta
- South Delta

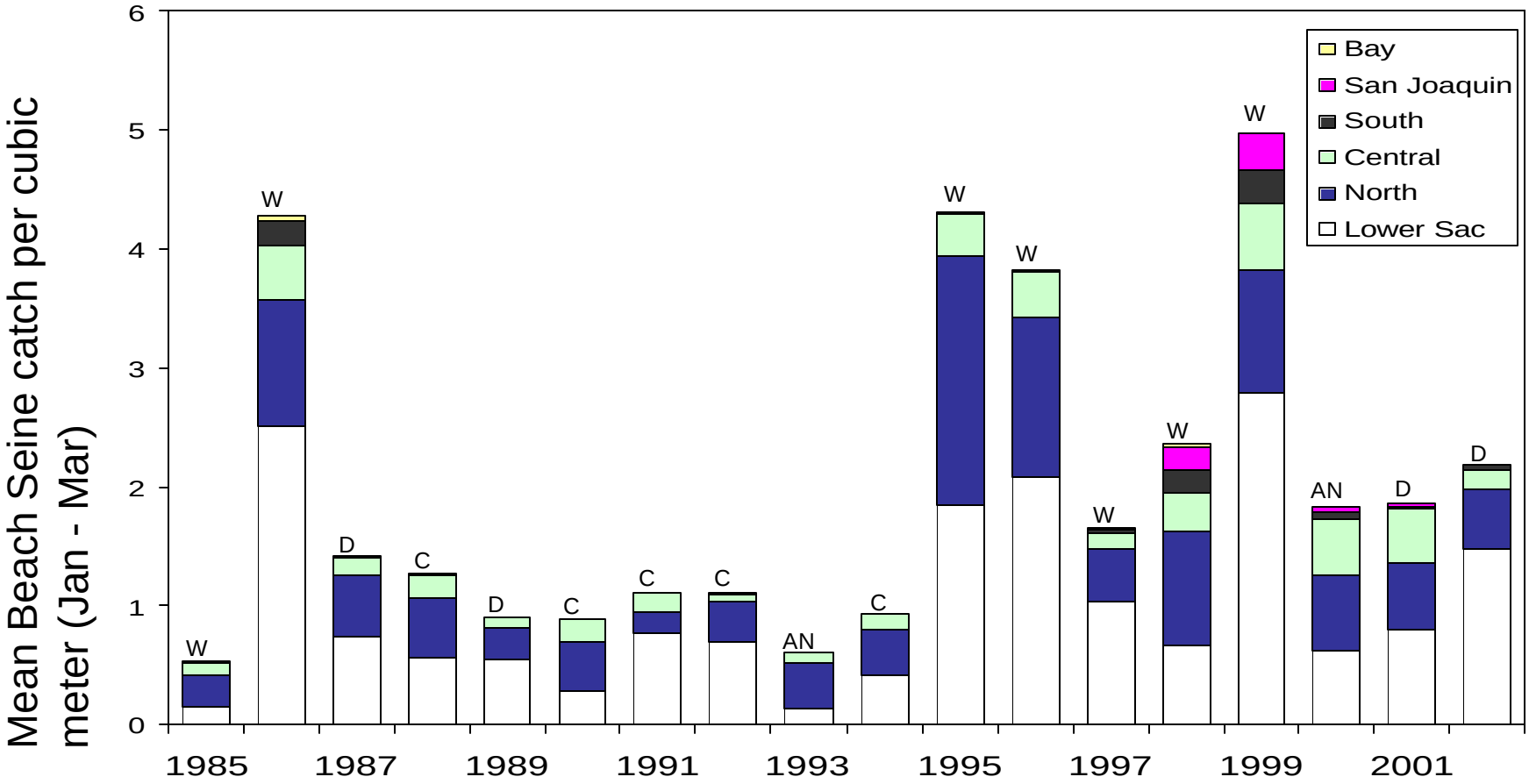
Bay sites

San Joaquin sites



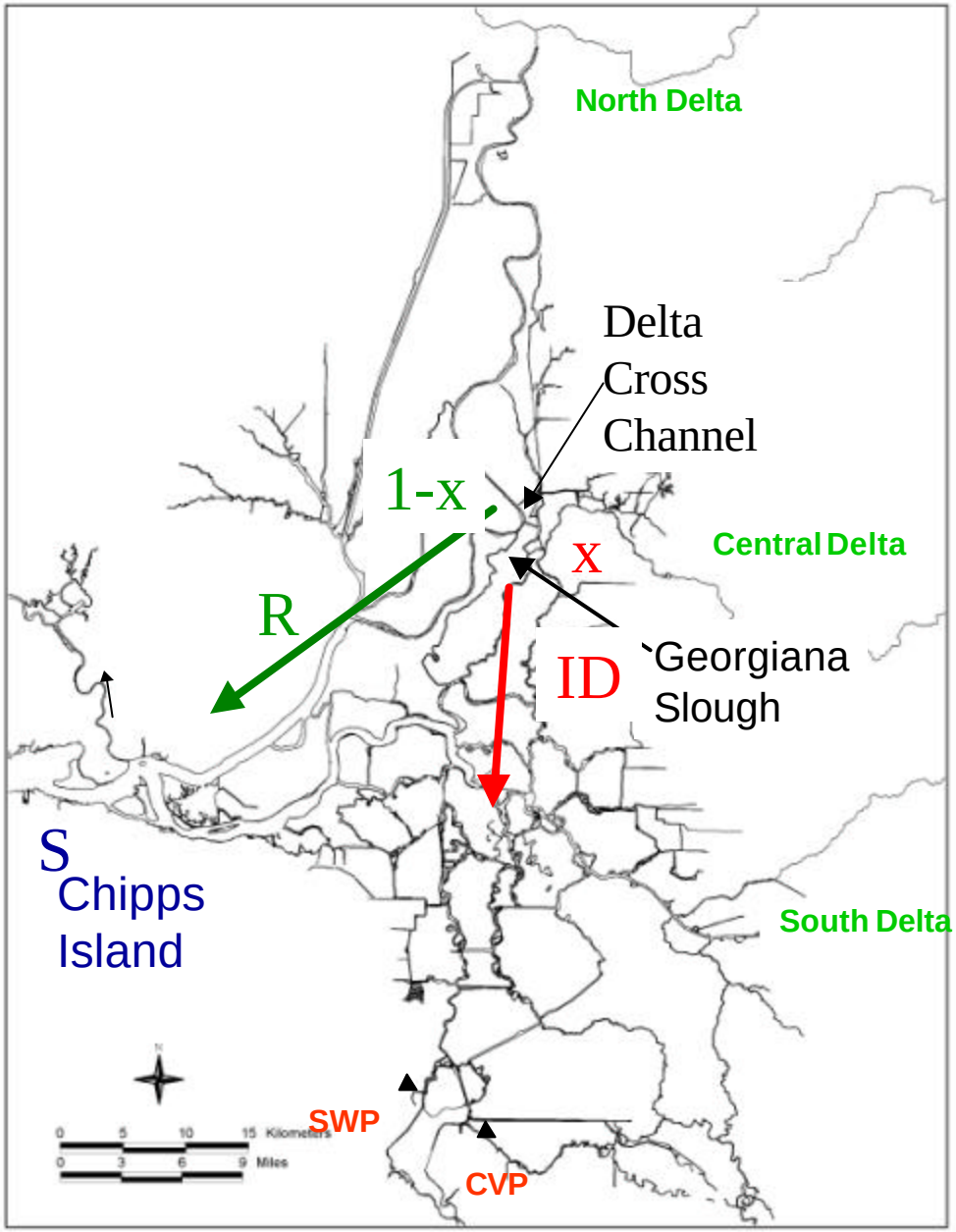
Mean catch per cubic meter of winter run sized salmon (November – February).

Where do most of the winter run rear?



Where are fall/spring sized run fry in the Delta ? Where are they rearing?

Refining the relationship between indirect and total water project mortality of juvenile salmon in the Delta?



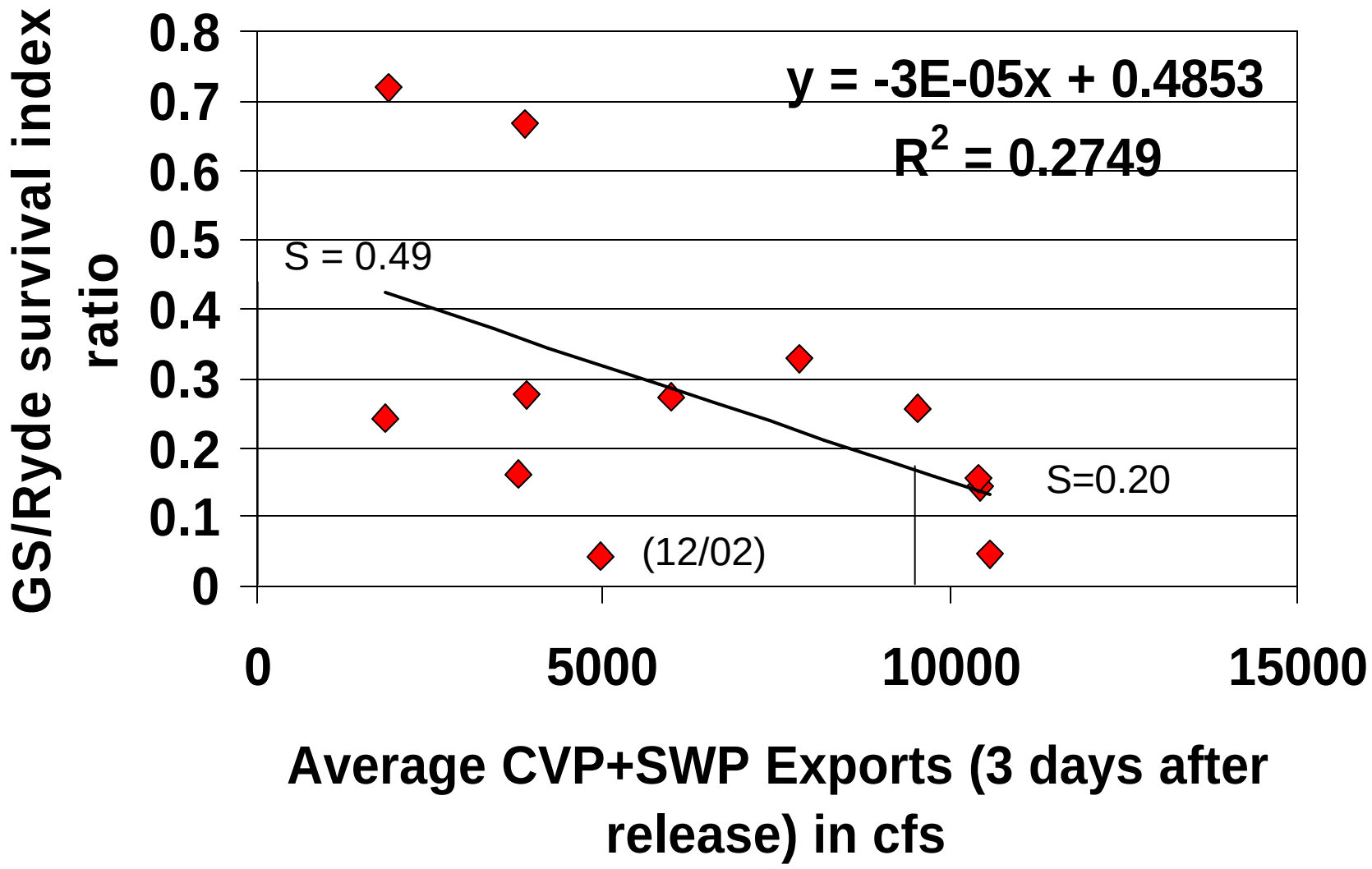
WR Delta survival (S) =
((1-x) * R) + (x * ID)

Where :

x = % water diverted in Dec
R = Ryde survival = (0.8)
ID= ((GS/Ryde survival ratio *(Ryde survival)))

and GS/Ryde survival = 0.49 - 0.00003*exports

Compare survival with and without exports to estimate increase in Delta survival and index total export related mortality


GS/Ryde survival index ratio
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
y = -3E-05x + 0.4853
R2 = 0.2749
S = 0.49
S=0.20
(12/02)
0
5000
10000
15000
Average CVP+SWP Exports (3 days after release) in cfs

How does survival through the Delta change due to exports ?

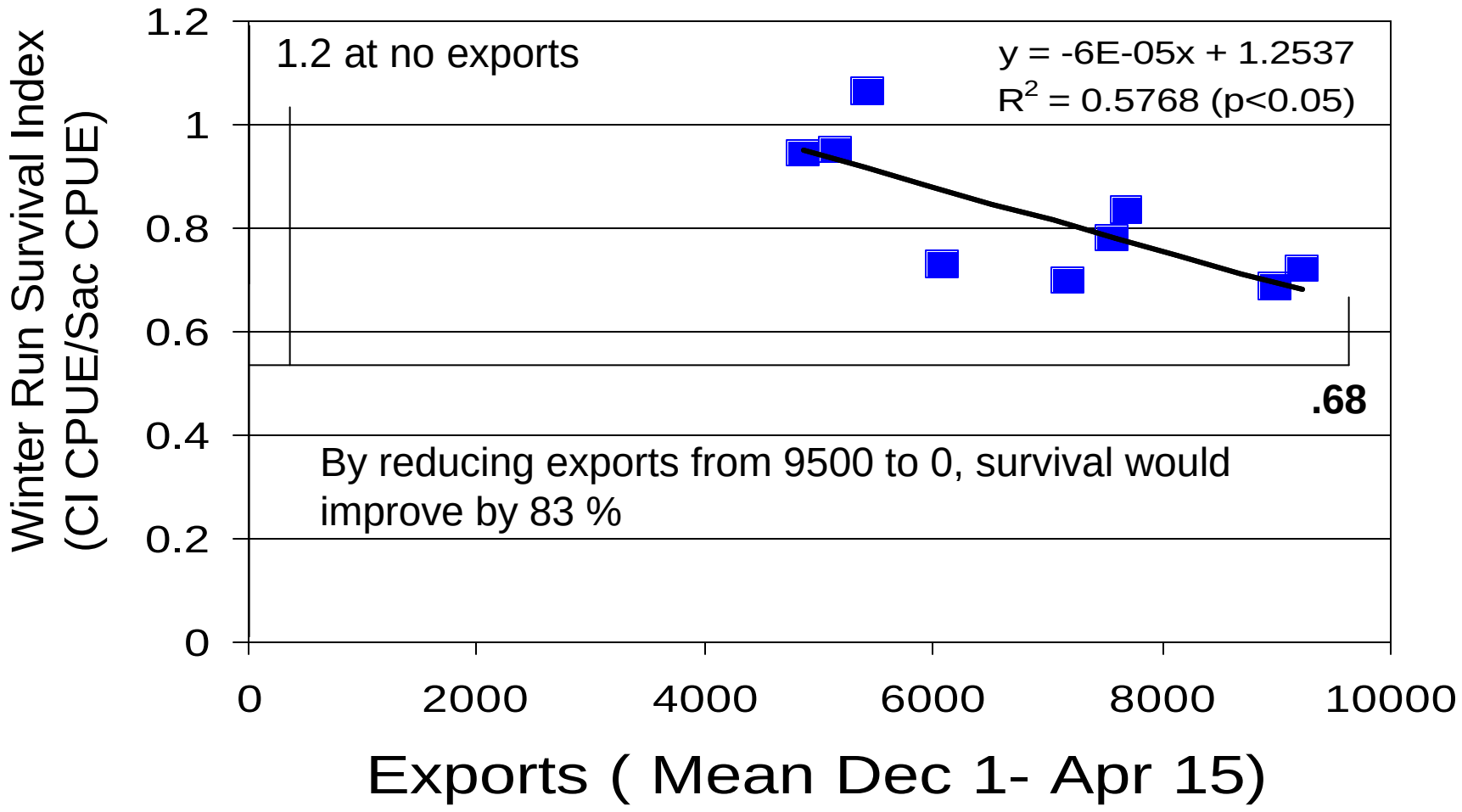
Example

Year	Exports	GS/Ryde ratio	Ryde survival	% in mainstem	Interior Delta survival	% in interior Delta (DEC)	Total Delta survival	Relative increase % in Delta survival
2002/ 2003	9516	0.20	0.80	75	0.16	25	0.64	
	0	0.49	0.80	75	0.39	25	0.70	9

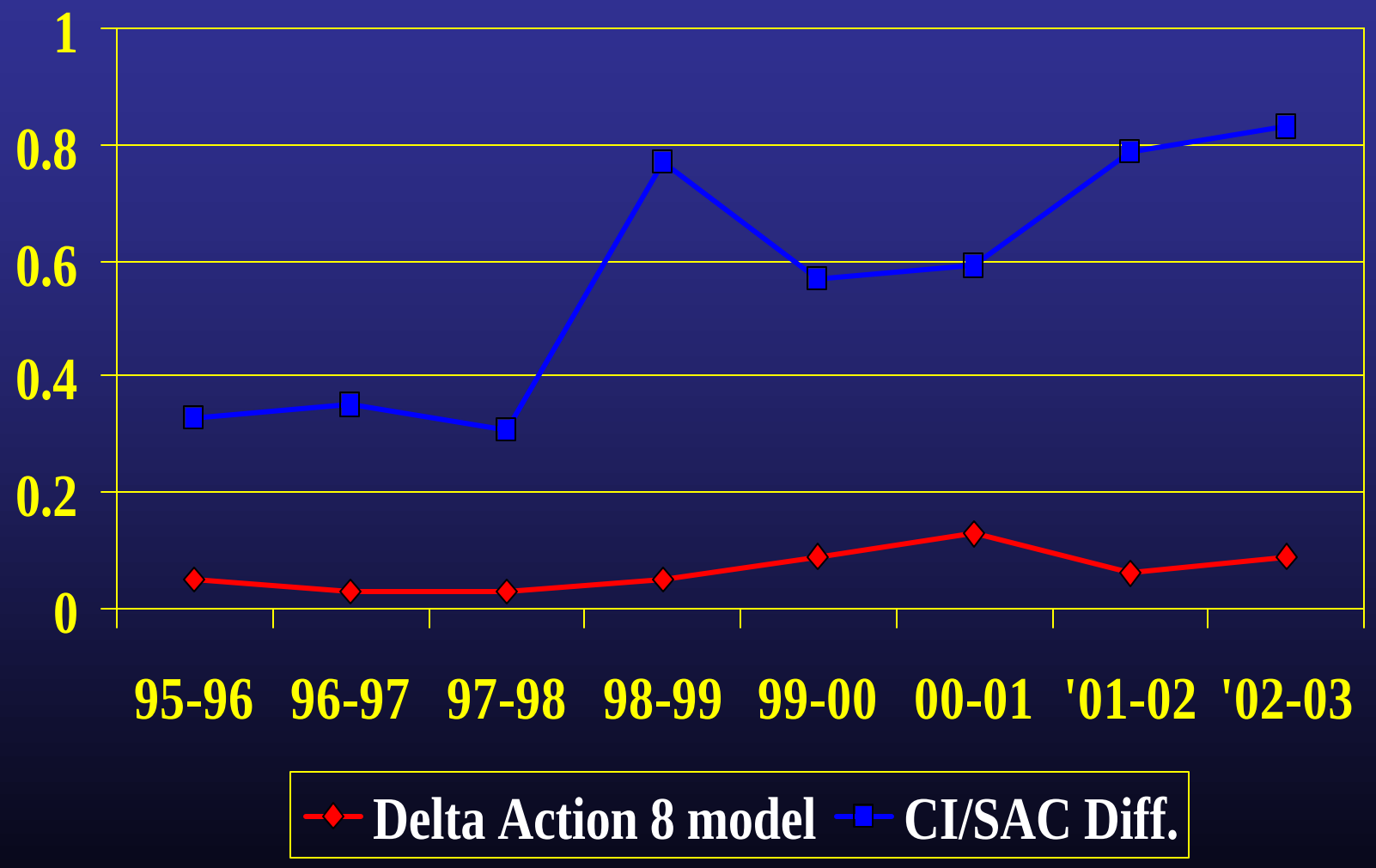
Exports - Mean daily between Dec 1 and Apr 15.

% interior Delta based on proportion of flow entering interior Delta in Dec

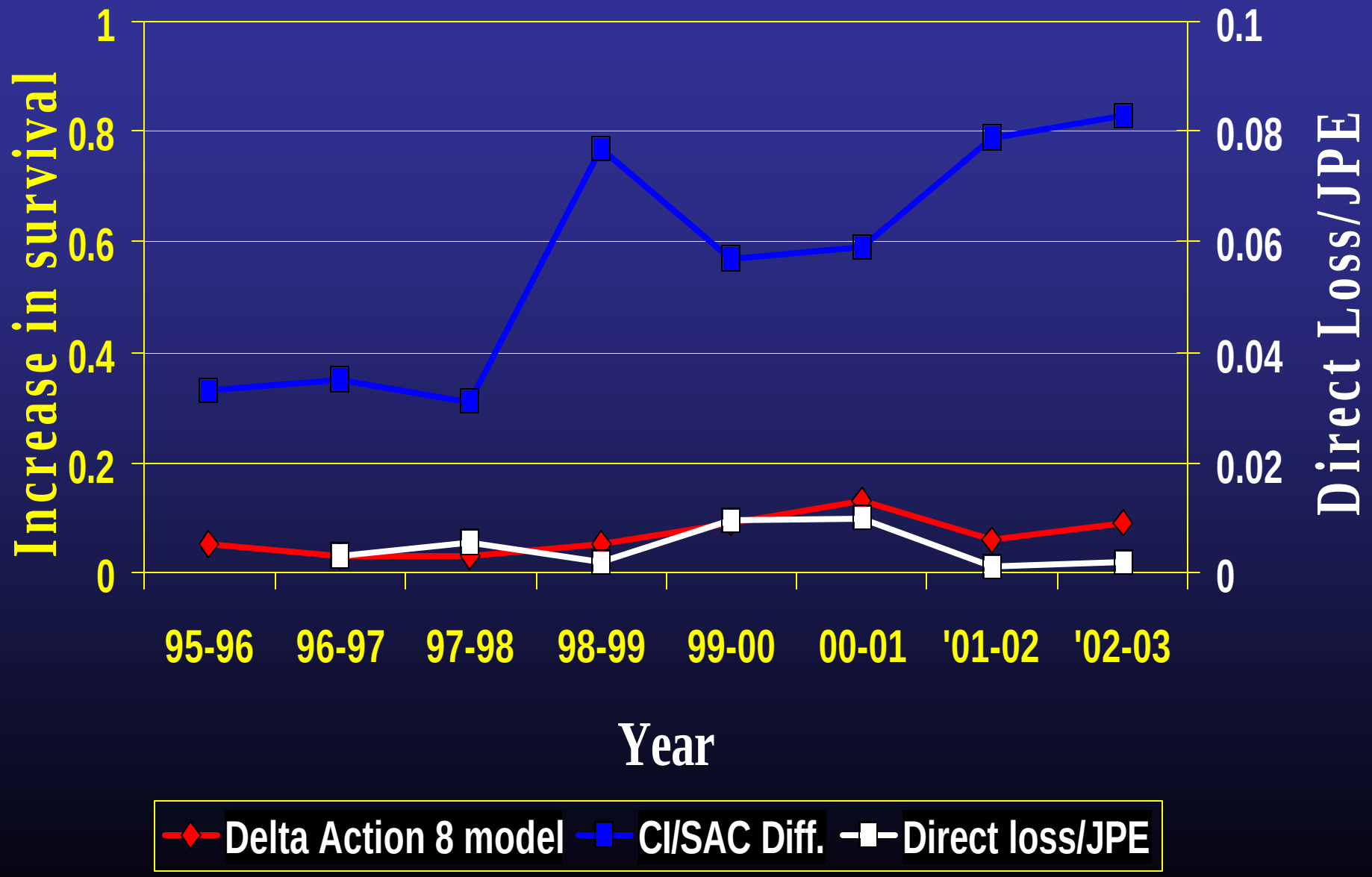
Relative Increase in survival = (0.70- 0.64) / 0.64 = 9 %


1.2 at no exports
y = -6E-05x + 1.2537
R2 = 0.5768 (p<0.05)
.68
By reducing exports from 9500 to 0, survival would improve by 83 %
Winter Run Survival Index (CI CPUE/Sac CPUE)
1.2
1
0.8
0.6
0.4
0.2
0
0
2000
4000
6000
8000
10000
Exports (Mean Dec 1- Apr 15)

Increase in Winter Run survival with no exports



Increase in Winter run survival with no exports using two different models and the direct loss/JPE



Identifying feasible approaches to using EWA assets to manipulate stream temperatures and flows to benefit salmon spawning and rearing?

Upstream uses of EWA to benefit salmon and steelhead

Objective: Identify feasible approaches to increase flows and/or manipulate water temperatures to provide suitable conditions for:

- **Upstream migration of adults**
- **Spawning**
- **Egg incubation and emergence**
- **Juvenile rearing and outmigration**

Background: Current temperature control efforts

- **Sacramento River:**
  Shasta Dam temperature control device (TCD) manages water temperatures for winter-run chinook salmon

- **American River:**
  Folsom Dam TCD for juvenile steelhead and spawning salmon

- **Feather River:**
  Oroville Dam TCD for juvenile steelhead and adult salmon

- **Clear Creek:**
  Whiskeytown Dam flows are supplemented with (b)(2)

EWA upstream actions to date

- **Merced River:** EWA transfer in 2001 increased flows for spawning salmon

- **Yuba River:** EWA transfers in 2001, 2002, and 2003 provided increased flows for over-summering steelhead

- **American River:** EWA transfers in 2001 and 2002 provided increased flows for over-summering steelhead and spawning salmon

EWA assets were also used on the American River in 2001 and 2002 to conduct lower river outlet releases to provide cold water to spawning chinook salmon

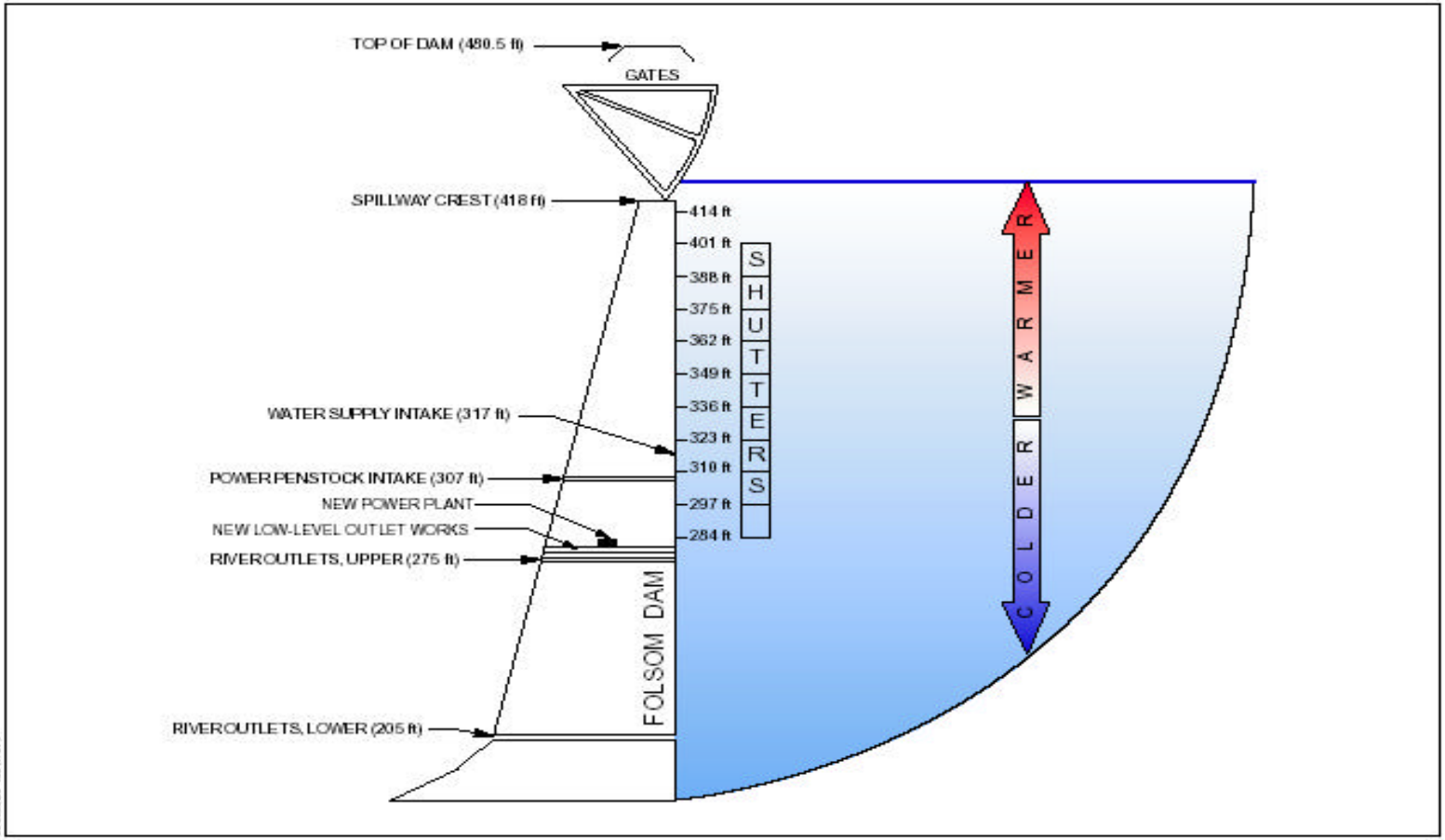
Future actions…

- **Continued use on the Yuba, American, and Merced Rivers**
- **Other tributaries will be considered as the opportunities arise**

Upstream Use of EWA assets for American River Outlet Releases

In 2001 and 2002 EWA assets were used for lower outlet releases at Folsom Dam to provide cooler water to the Lower American River for spawning chinook salmon (Fish Actions #2-02 and #2-03)

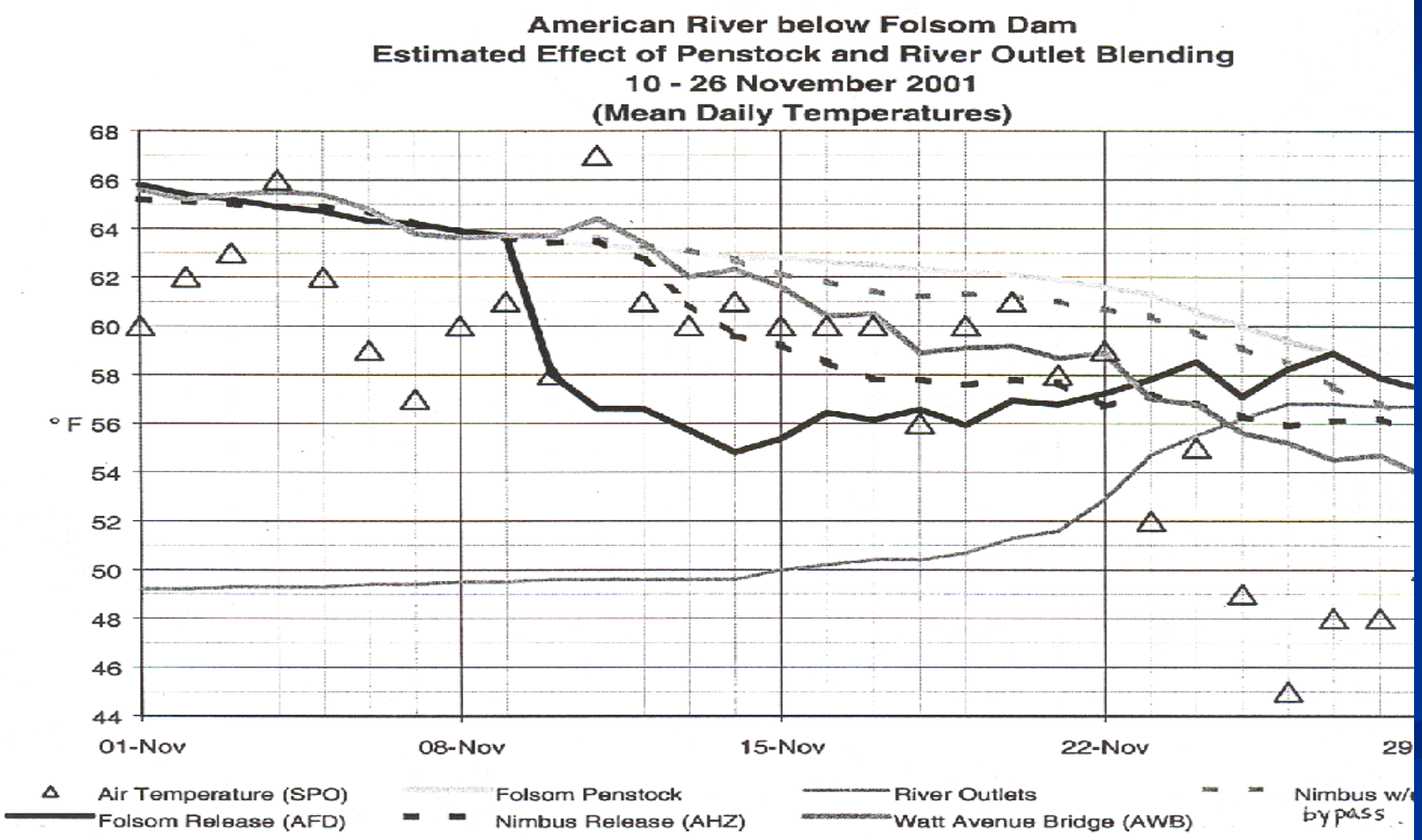
Folsom Dam diagram



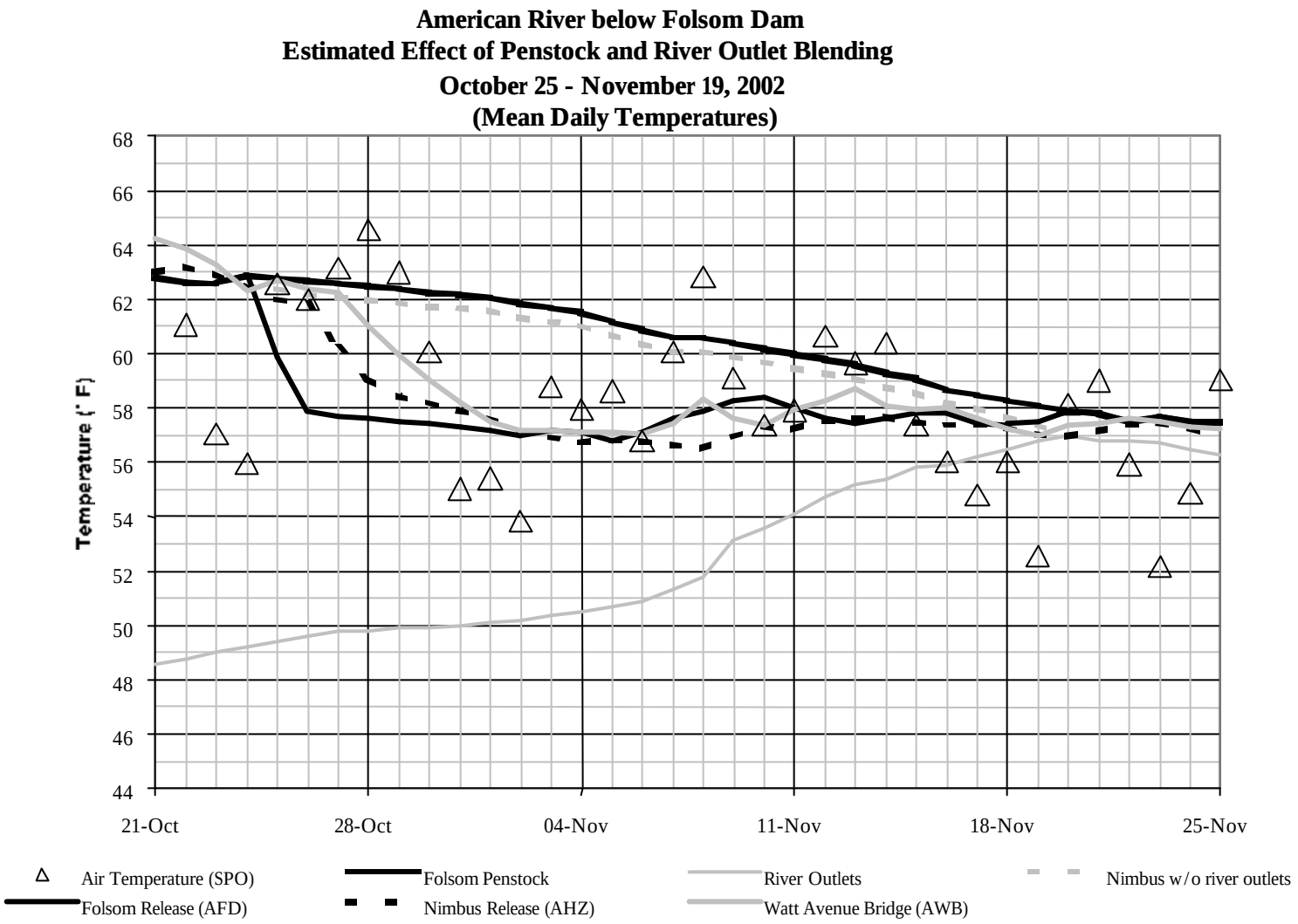
Jones & Stokes

Figure 4-4
Low Elevation Cold-Water Pool with Generation

2001 Outlet Release



2002 Outlet Release



Summary of outlet releases in 2001 and 2002 using EWA assets

	2001	2002
Start date:	Nov 10	Oct 25
Folsom storage:	270 TAF	464 TAF
Est. cold water (<60ºF)	21 TAF	50 TAF
Avg temp at Watt Br at start	63.7º F	62.7º F
Total release	1,000 cfs	1,500 cfs
# days to reach 60º F at Watt Br	7 days	4 days
Outlet release vs natural cooling	9 days earlier	12 days earlier
Pre-spawn mortality estimate	67%	30%
Fall-run escapement (preliminary)	130,785	118,114

Options for increasing long-term success of salmonids

- **Improve upstream habitat using flows and temperature.**

2. Expand capacity and timing of water transfers to obtain dual benefits (upstream and at the pumps).

3. Build access to and restore historical spawning and rearing habitat above dams.

4. Evaluate importance of river and Delta habitat to salmonid production (other than migratory routes). Modify water and habitat management accordingly.

5. Evaluate Delta water quality effects on salmon production and mitigate adverse impacts.

6. Evaluate and adjust the role of hatcheries to achieve a balance of natural and “assisted” production.

7. Manage inland and ocean harvest responsibly.

Over-arching Principle

- **Diversify the use of protective actions :**
  - **To overcome uncertainty from benefits of individual actions**
  - **To benefit different life history strategies of the population**
  - **To maximize opportunities of different programs**
  - **To obtain synergistic benefits on the population.**