EWA actions for Salmonids 2001-2004

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Types of actions

- SWP/CVP pumping curtailments
- Modify hydropower operations (Folsom Dam) for water temperature management (energy, $$, no water)
- Flow augmentation in some rivers, primarily during transfers

Purposes of EWA actions for salmonids

- Minimize “take” of salmonids at SWP/CVP diversions
- Reduce impact of SWP/CVP pumping on emigrating juvenile salmonids
- Augment stream flow
- Contribute to recovery of salmon and steelhead populations

Effects of pumping curtailments

- “Take” relative to re-consultation levels
- Fish saved from entrainment at SWP/CVP
- Survival of emigrating fish in the Delta

EWA actions at SWP/CVP (taf)

	WY 2001	WY 2002	WY 2003	WY 2004	Total
Salmon and/or steelhead prior to 4/15	86	0	62	0	148
Salmonids and delta smelt prior to 4/15	137	67 (38)	59	0	263
VAMP mid-Apr – mid-May	43	45	32	20	140
Post-VAMP delta smelt and salmon	24	137	195	104	460
Total	290	249	348	124	1,011

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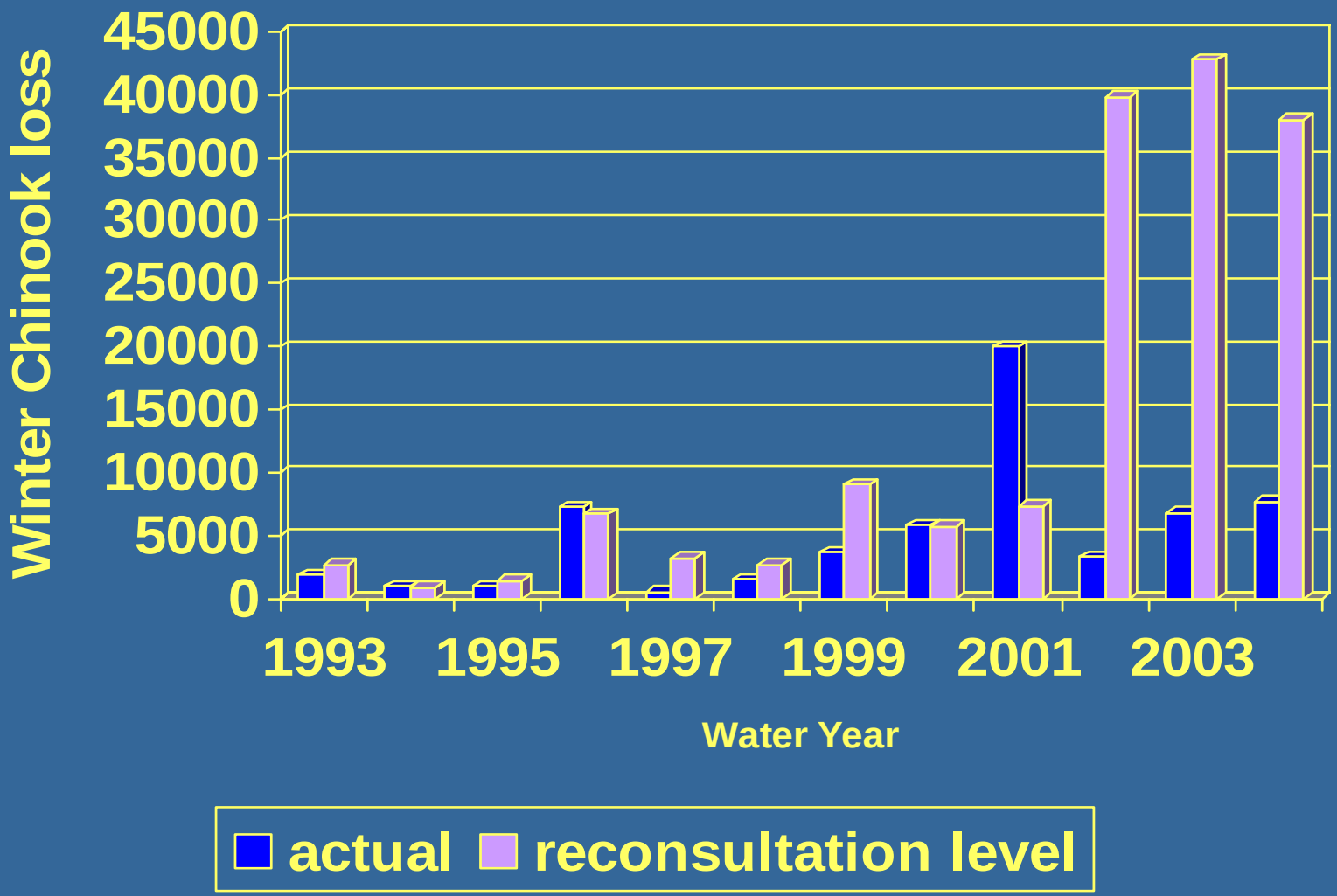
Winter Run Chinook loss at SWP/CVP

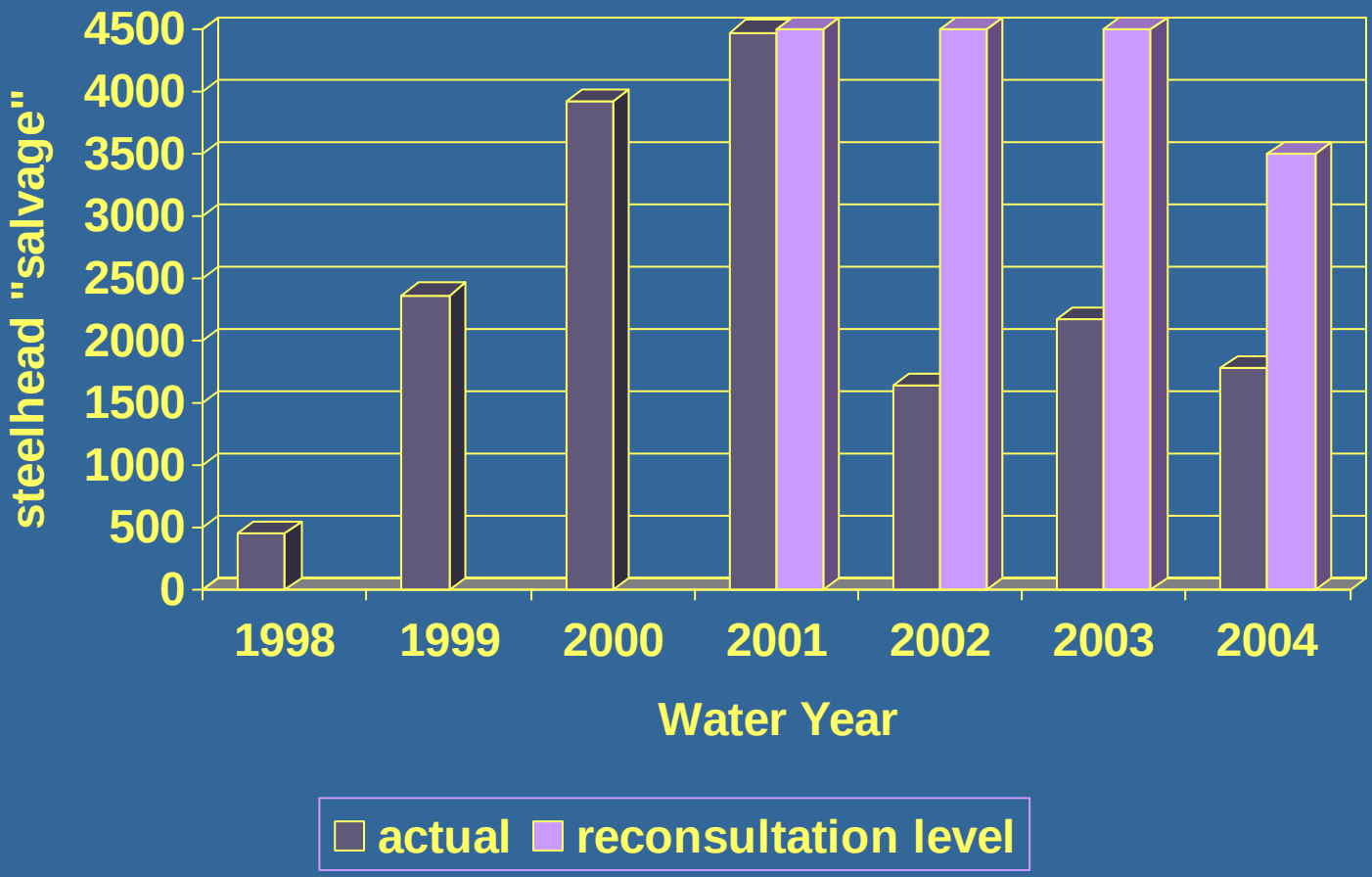


Spring run Chinook Surrogate Loss at SWP/CVP (re-consultation level = 1%)

Water Year	Nov. Release % Loss	Dec. Release % Loss	Jan. Release % Loss	Production Release % Loss
2001	0.11	0.27	0.36	0.39
2002	0.22	**0.90**	**0.73**	0.77
2003	0.28	**1.21**	**1.35**	3.29
2004	0.38	_	**1.36**	2.96

Steelhead salvaged at SWP/CVP

(unmarked, produced in-river)



Salmon saved from entrainment

- 200 TAF EWA in January – March 2001
- Without EWA actions, estimated WR size Chinook loss ~ 26,000
- Actual WR size Chinook loss ~ 20,000
- EWA actions saved about 6000 salmon from entrainment – 23% reduction in loss

2001 WR loss in perspective

20,000 juvenile WR size Chinook

- ~ 6% of the official JPE
- ~ 0.8% of revised JPE
- ~10% of estimated number of WR size Chinook migrating past Chipps Island
- 2001 EWA actions added ~3% to successful out-migrant population

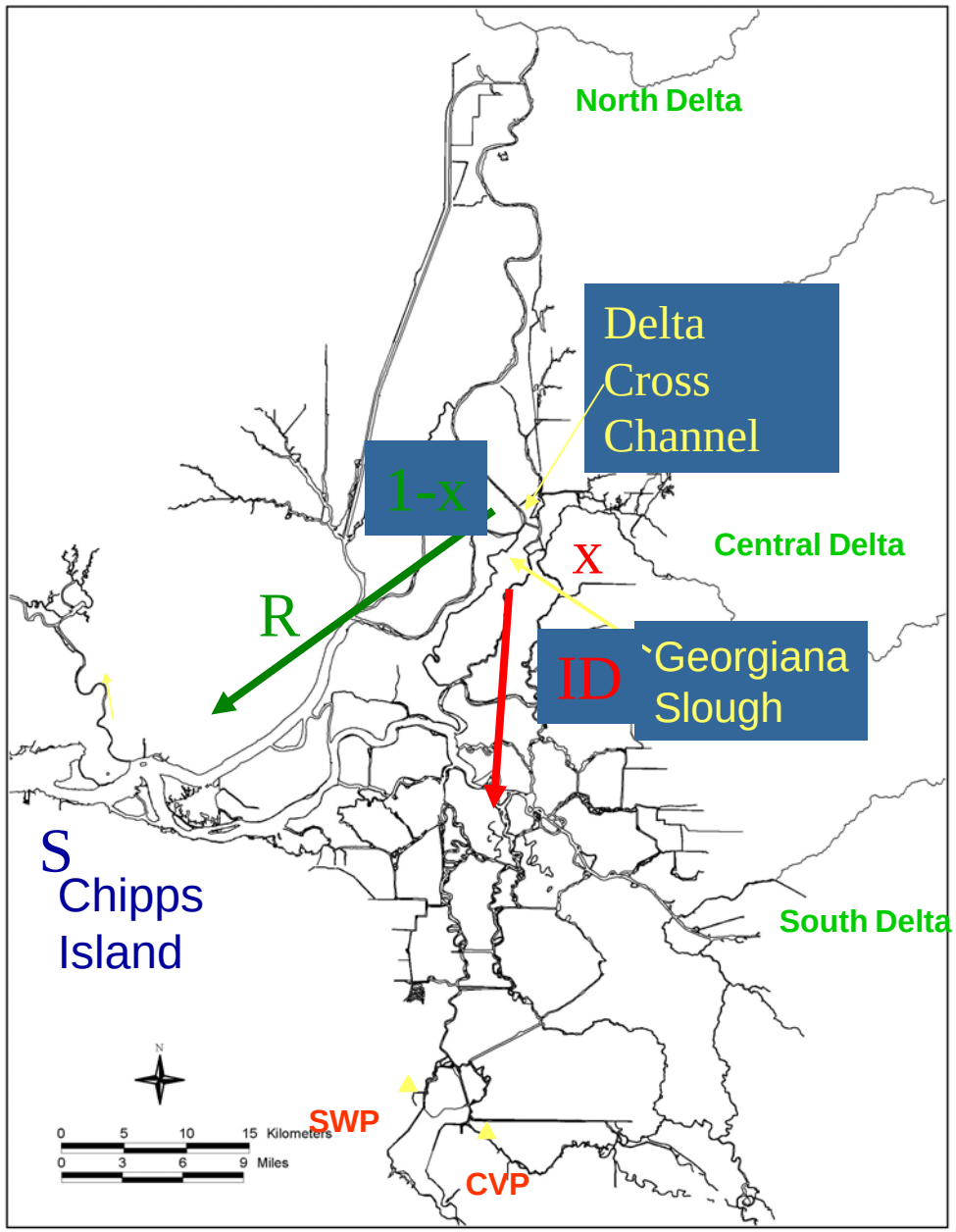
Implications of 2001

- Casts some doubt on JPE methodology
- SWP/CVP loss more than negligible impact for older juvenile Chinook in some years
- In-season assessments of impact besides JPE and take limit

Delta survival

- Examples
  - Delta Action 8 models
  - Prediction based on change in SWP/CVP loss
  - Cramer Model using Newman (2003)
- Effect depends on
  - magnitude and duration of reduction in pumping
  - Proportion of population migrating each day

MODELS 1 and 2



WR Delta survival between 2/1 and 3/31(model 1) and 11/15 and 4/15 (model 2)

(S) = ((1-x) * R) + (x * ID) * P

Where :

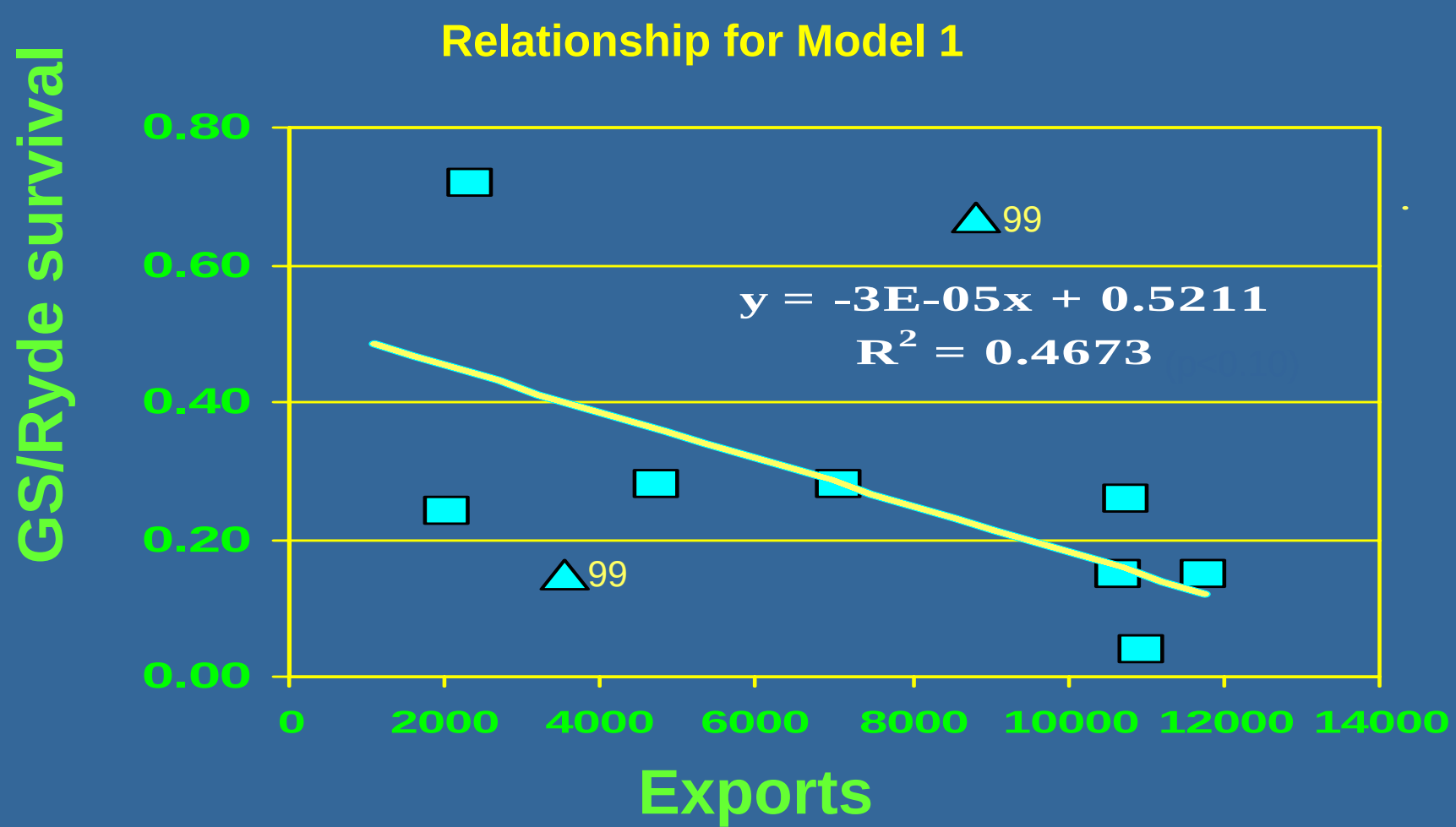
x = % water diverted

R = Ryde survival = (0.8)

ID= ((GS/Ryde survival ratio *(Ryde survival)))

P is the % of the population passing Sacramento +2day lag and GS/Ryde survival = 0.52 - 0.00003*exports (model 1) (newest relationship: 0.47-0.00003*exports) (model 2)

Estimate survival on daily basis with and without EWA export curtailments to estimate benefits



1999 data point is not included in regression.

Ratio of survival for late fall yearlings released into Georgiana Slough relative to those released at Ryde versus mean daily combined CVP+SWP exports 17 days after release. Data from 1993-1998

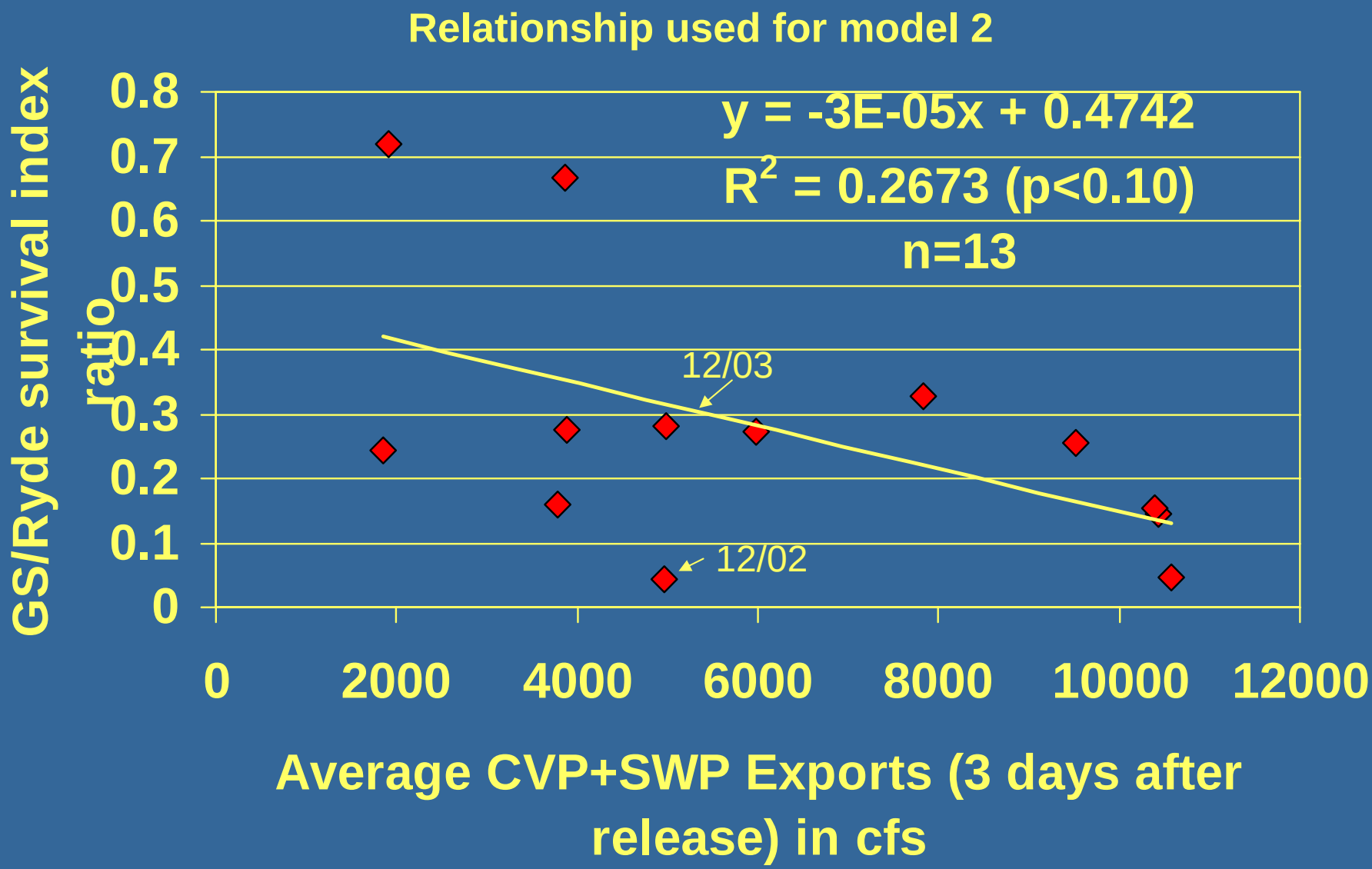


Figure 8: GS/Ryde survival ratio versus exports, 1993-2003

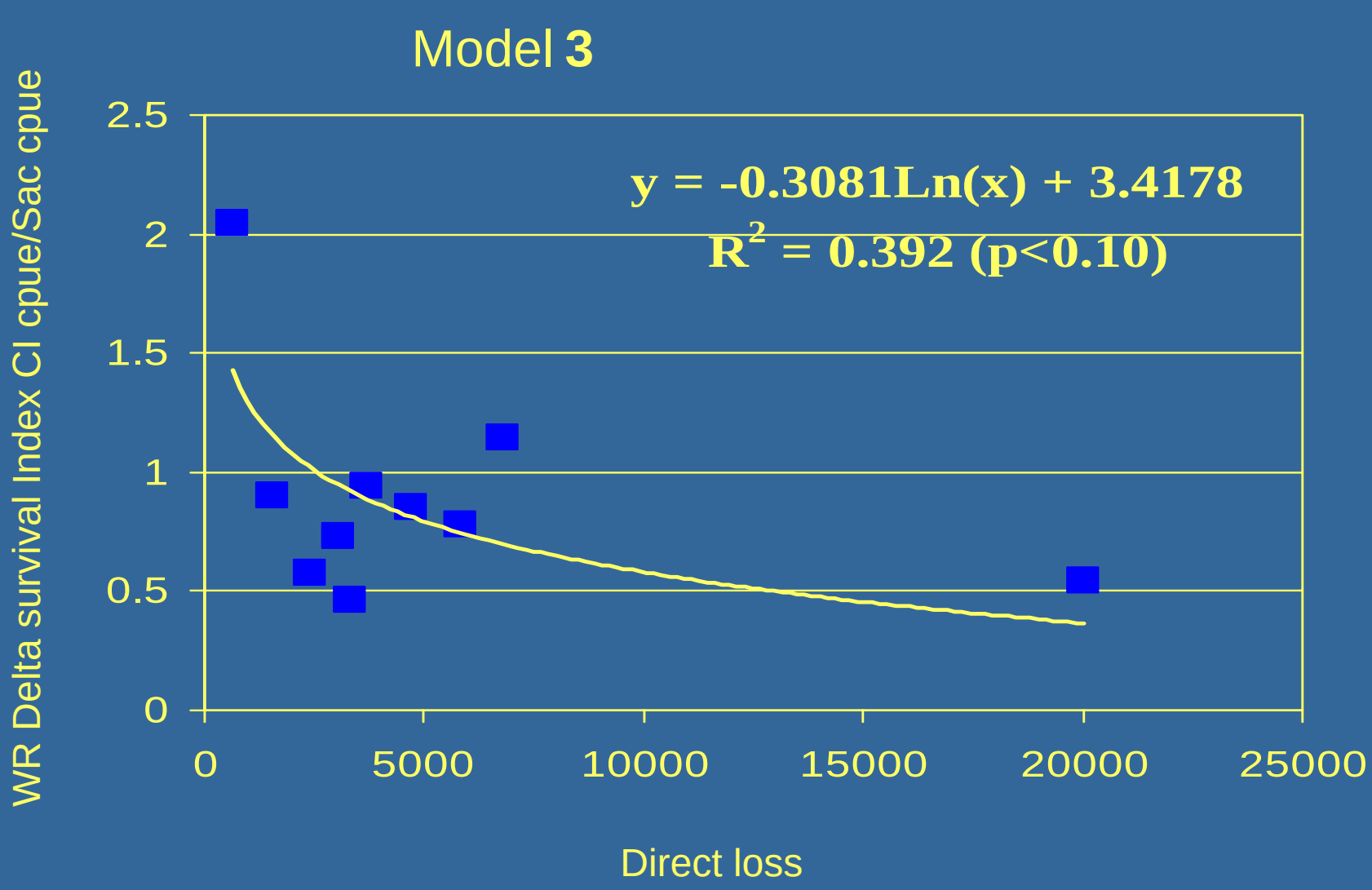


Figure 4: Survival of winter run between Sacramento and Chipps Island (based on FF curves) versus direct loss (Delta curves) at the CVP+SWP, 1993-1994 through 2001-2002.

Model 4

Winter run Chinook Salmon Integrated Modeling Framework Model
Version 1.2 (Cramer et al., 2004)
Delta portion of model from Newman (2003)

$$\text{Survival} = 0.65 + 0.86 * \log_e(\text{Flow}) - 0.81 * \text{River Temp.} - 0.32 * \text{Exports} + 0.378 * \text{Turbidity} + 0.35 * \text{Salinity} - 0.75 * \text{Gate Position}$$

Where:

Flow = Mean flow in cfs at Freeport
River Temp = Mean temperature in degrees F at Freeport (used 58°F)
Export flow = Combined export flow at CVP and SWP
Turbidity = in fromazine turbidity units near Courtland (used default value of 8)
Salinity = measured by conductivity, µmho/cm at Collinsville (estimated on relationship with flow: $y = 102{,}003 * e^{(-0.0002*x)}$
Gate Position - 1 = open, 0 = closed or fraction thereof
Survival = Logistic transform of proportion surviving to Chipps Island

Change in WR (size) Salmon Survival Metric with EWA actions

	Model	1	2	3	4
2000-2001 6 WR actions (233 TAF) -22 TAF State Gain Dec-Apr	Base	0.69	0.66	0.28	0.82
	EWA	0.70	0.69	0.36	0.84
	Difference	0.01	0.03	0.08	0.02
2001-2002 No targeted WR actions 1 targeted to SR in Jan (66 TAF), 38 TAF used in March -76 TAF Relaxation of E/I in Feb	Base	0.71	0.676	0.90	0.872
	EWA	0.69	0.675	0.92	0.873
	Difference	-0.02	-0.001	0.02	0.001
2002-2003 3 SR actions Dec-Jan (121 TAF) -60 TAF E/I relaxation, debt repayment and State Gain in March	Base	0.68	0.68	0.69	0.908
	EWA	0.68	0.68	0.70	0.911
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2003-2004 No actions
Dec 1 – Apr 14

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Results from survival models

- 2001 actions: 0.01 to 0.08 change in measures of Sacramento salmon survival
- 2002 – 2004: few or no winter season EWA actions, none specifically targeting winter Chinook – smaller changes
- Pumping to obtain EWA assets has negative effect on survival (E:I flexing, etc.)

San Joaquin R. basin Chinook

- EWA covers part of the VAMP export reduction beginning in 2001
- EWA covers all pumping curtailments in the Post-VAMP period

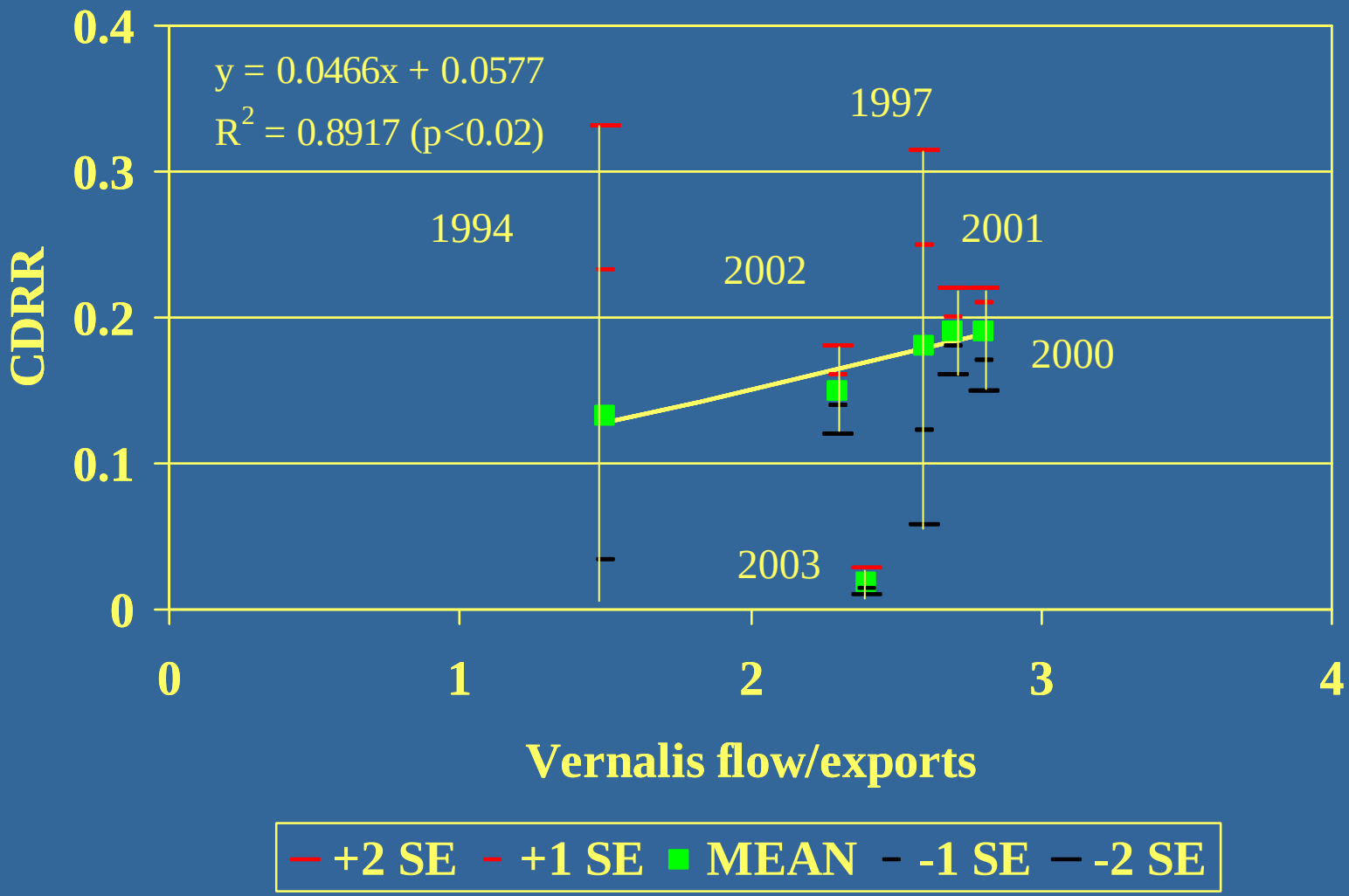
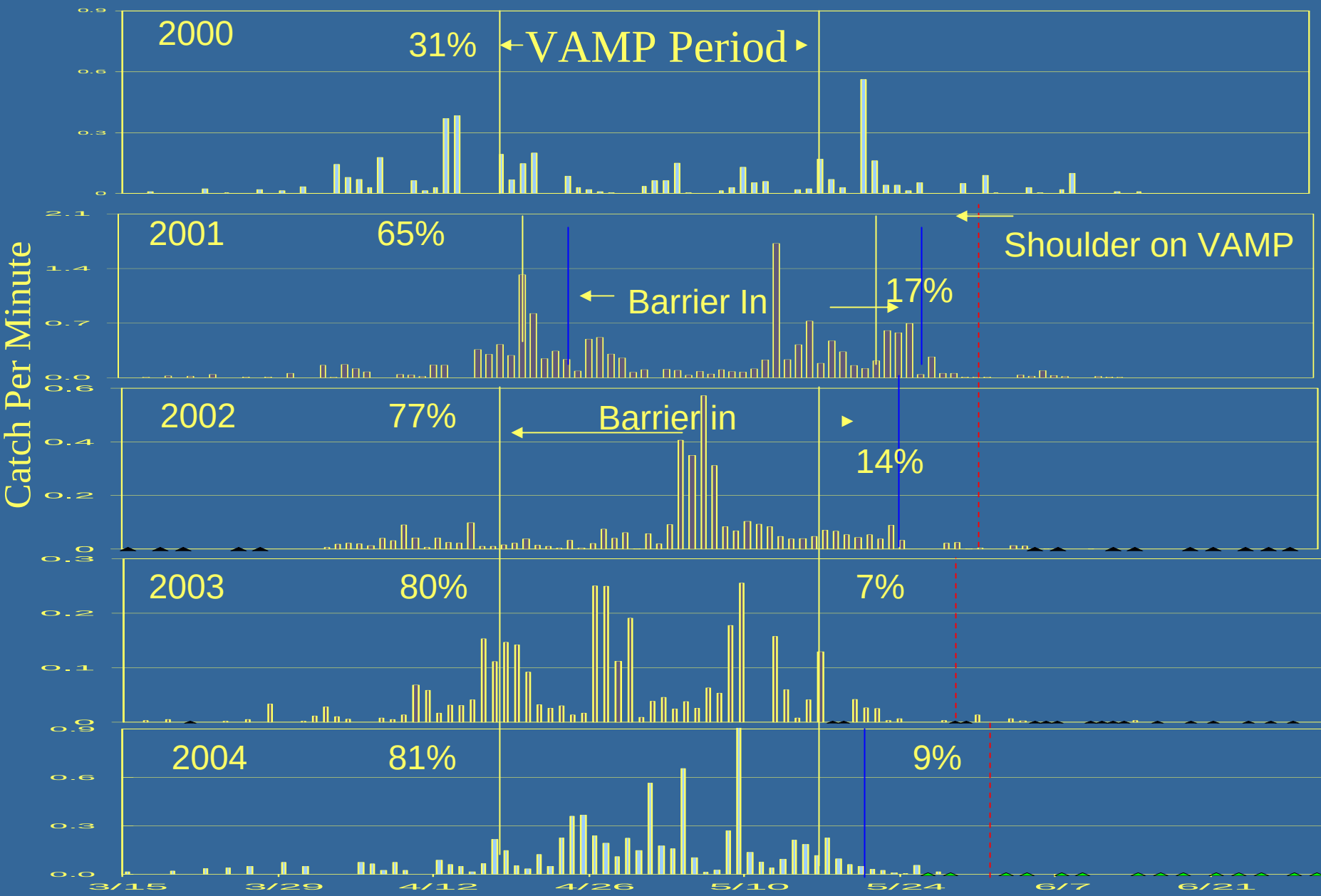


Figure 10: Combined Differential Recovery Rate (CDRR) and (+/- 1 and 2 Standard Errors) from Durham Ferry and Mossdale to Jersey Point with the HORB in place, versus inflow at Vernalis / exports, 1994, 1997 and 2000-2003. Regression line without 2003 data.

VAMP effects on salmon survival

	Without VAMP				With VAMP			
Year	Flow	Exports	Ratio	Survival	Flow	Exports	Ratio	Survival
2000	4815	4815	1.0	**0.10**	5869	2155	2.72	**0.18**
2001	2920	2920	1.0	**0.10**	4220	1420	2.97	**0.20**
2002	2757	2757	1.0	**0.10**	3300	1430	2.31	**0.17**
2003	2290	2290	1.0	**0.10**	3235	1446	2.24	**0.16**
	Mean			**0.10**				**0.18**



Catch per minute of all unmarked juvenile Chinook in the Mossdale Kodiak trawl between March 15 and June 30.

Post-VAMP EWA action

- SJR flow drops and HORB removed
- Extended pumping curtailment to protect juvenile delta smelt
- Aid salmon emigrating from San Joaquin River tributaries
- Timing of salmon emigration and benefits of post-VAMP action vary (9-17%)

Upstream actions

- River level outlet releases at Folsom Dam
- Replace foregone power generation
- Use cold water to cool lower American River
- High pre-spawn mortality in fall 2001, 2002
- Reduced temperature to 60 degrees F about 12 days earlier in fall 2002.
- No quantitative estimate of effect of action on adult mortality or fish production

Upstream flow augmentation

- Mostly during transfer of EWA water to the Delta for export
  - Primarily during the summer
  - + and - effects
  - Rarely during the fall (Merced River in 2001)
- Little EWA used exclusively to augment flow
  - Lower American River – 2002, maybe in 2004

Conclusions

- Small entrainment effect on Sacramento basin salmonids in most years
- Take management is a mixed story
- Loss significant in some situations, e.g. ~10% of emigrating population in 2001
- Winter EWA actions for Sacramento basin salmon appropriate under some circumstances

Conclusions

- If survival benefit is at low end of range, may use EWA solely for Sacramento basin salmon only in certain situations
- WR JPE not the only meaningful reference
- Ideally EWA actions can provide concurrent protection for several species

Conclusions

- VAMP experiment needs to continue
- Sort out relative importance of factors
- Very poor survival in recent years raises new questions

Conclusions

- Difficult to determine source of variability in results of salmon survival studies
- Delta is not an ideal laboratory
- How confident are we in the state of our knowledge of salmon in the Delta?

Conclusions

- Little EWA water used upstream – no quantitative assessment
- Is $$ for replacement power really EWA?
- Unresolved issues on implementation and evaluation of EWA
- Be careful not to do more harm than good

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END