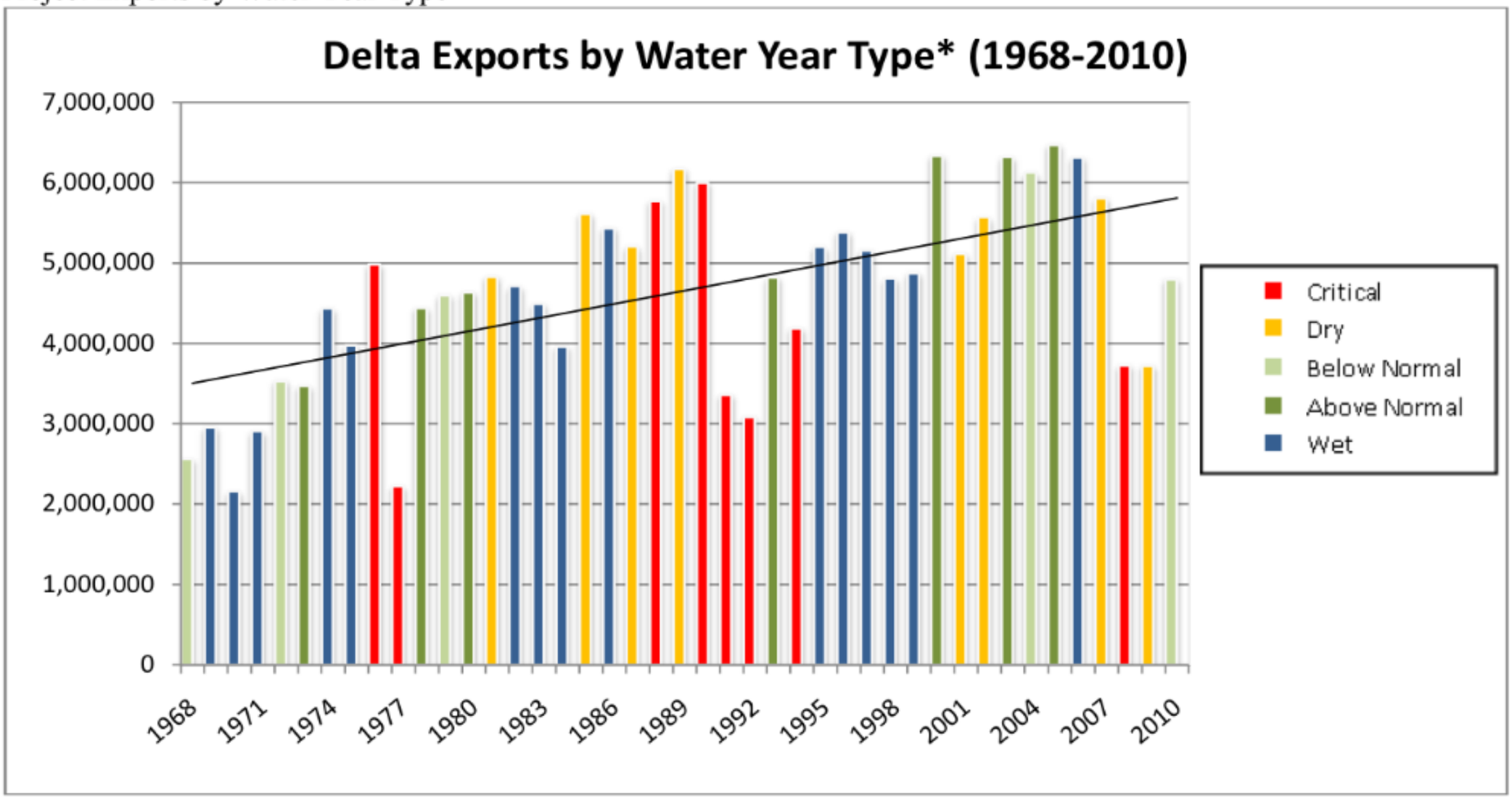
Fish and Standards

Presentation by Tom Cannon

Project Exports by Water Year Type

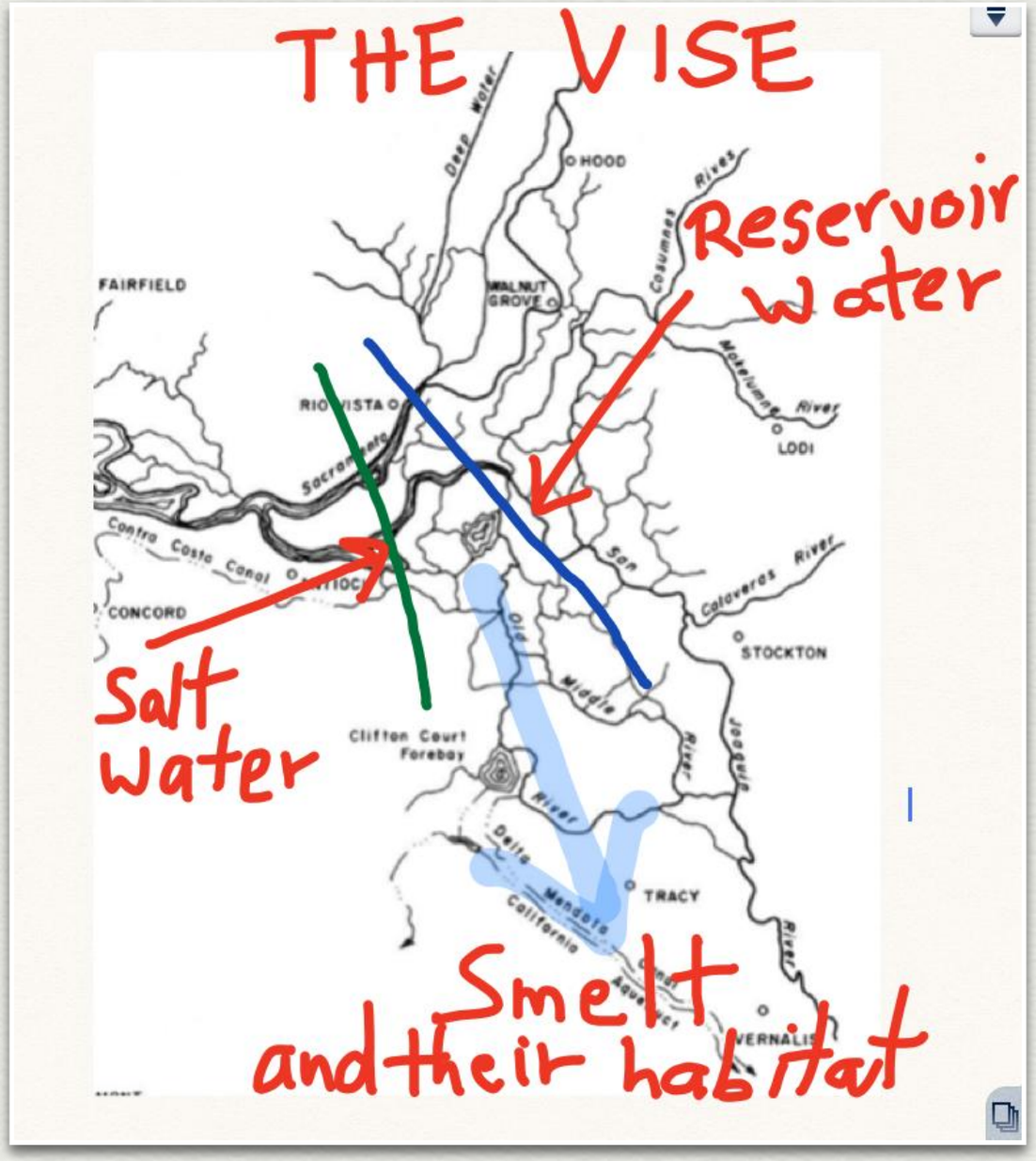


Source: Delta Stewardship Council. 2011. Letter to State and Federal Water Contractors Agency. September 29. Export figures adapted from DWR Dayflow Program and Water Year Classifications (Sacramento River Indices) are adapted from the California Data Exchange Center. *Total

The Problem – VISE

The VISE is caused by

- *Increasing Exports*
- *Increasing Inflow*
- *Declining Outflow*



RECOMMENDED STANDARDS

WINTER – DECEMBER - FEBRUARY Lower LSZ (2500-5000 EC) – Target: Western Suisun Bay Upper LSZ (500-2500 EC) – Target: Eastern Suisun Bay Freshwater Brackish Zone (200-500 EC) – Target: Western Delta				
YEAR TYPES	**Inflow**	**Outflow**	**Export Limits**	**DCC Closure**
Very Wet Winters 1995, 1997, 1998, 2006, 2011	**10,000[1]-32,000[2]**	**6,000-12,000**	**2,000[1]-8,000[2]**	Periodic Closure[3]
Wet and AN Years – major storms 1993, 1996, 1997, 1999, 2000, 2003, 2005, 2010	**10,000-32,000**	**6,000-12,000**	**2,000-8,000**	Periodic Closure
BN and Dry Years – substantial storms 2001, 2002, 2004, 2012	**10,000-24,000**	**6,000-10,000**	**2,000-8,000**	Periodic Closure
Dry Years – some storms 1994, 2007, 2008, 2009	**10,000-20,000**	**6,000-8,000**	**2,000-8,000**	Open
Very Dry Winters – no storms	**10,000**	**6,000**	**2,000**	Open

[1] Minimum starting
[2] After substantial storms
[3] Specific criteria

RECOMMENDED STANDARDS

SPRING – MARCH, APRIL, MAY Lower LSZ (2500-5000 EC) – Target: Western Suisun Bay Upper LSZ (500-2500 EC) – Target: Eastern Suisun Bay Freshwater Brackish Zone (200-500 EC) – Target: Western Delta				
YEAR TYPES	**Inflow**	**Outflow**	**Export Limits**	**DCC Closure**
Very Wet Years 1995, 1998, 2006, 2011	**32,000**	**20,000**	**4,000**	Periodic Closure
Wet and AN Years 1993, 1996, 1997, 1999, 2000, 2003, 2005, 2010	**24,000**	**16,000**	**3,000**	Periodic Closure
BN and Dry Years 2001, 2002, 2004, 2009, 2012	**18,000**	**12,000**	**2,000**	Periodic Closure
Very Dry Years post Wet 1994, 2007	**16,000**	**10,000**	**2,000**	Open
Very Dry Years post Dry 2008	**12,000**	**8,000**	**2,000**	Open

RECOMMENDED STANDARDS

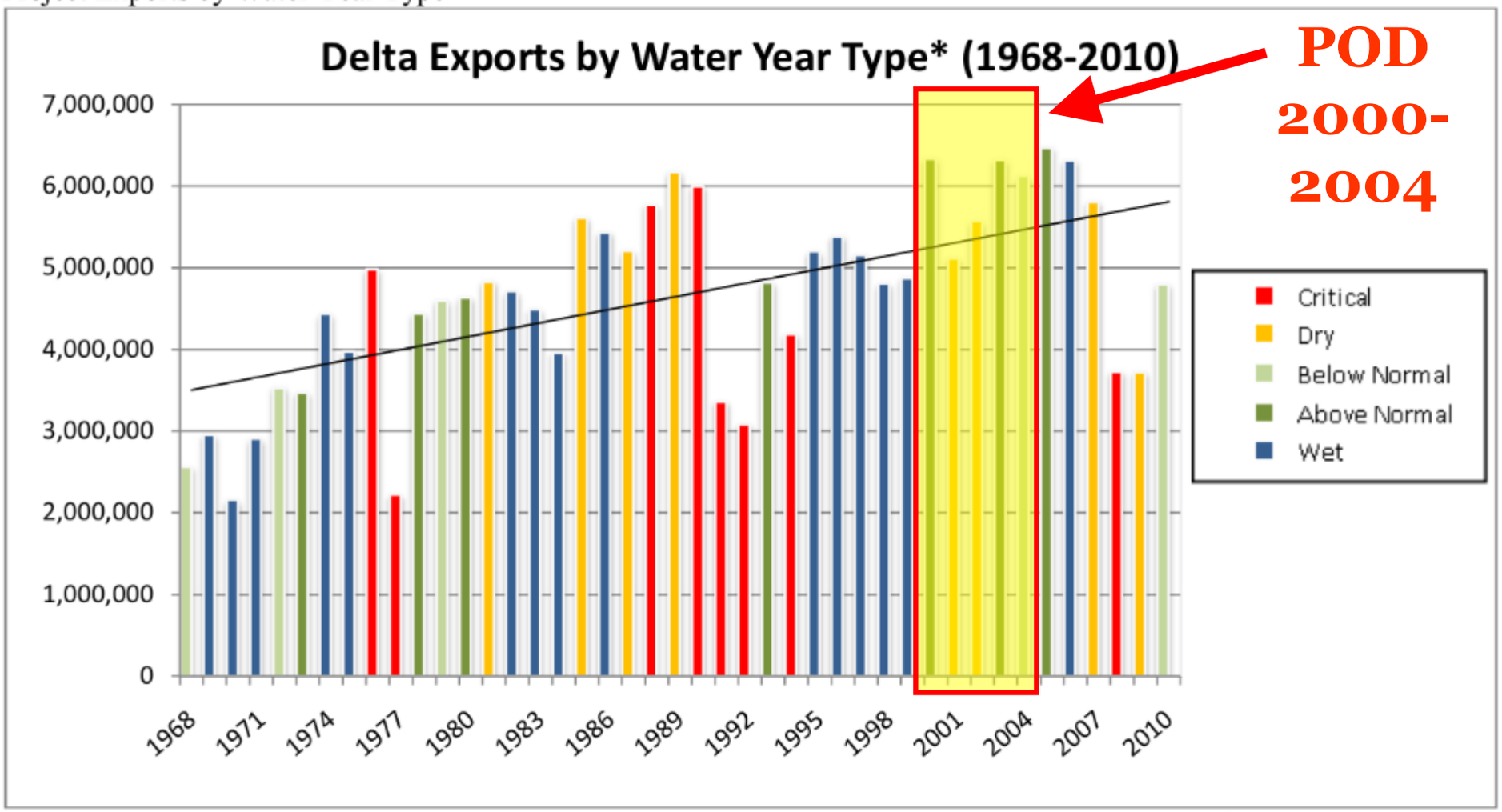
EARLY SUMMER – JUNE JULY Lower LSZ (2500-5000 EC) – Target: Western Suisun Bay Upper LSZ (500-2500 EC) – Target: Eastern Suisun Bay Freshwater Brackish Zone (200-500 EC) – Target: Western Delta				
YEAR TYPES	Inflow	Outflow	Export Limits	DCC Closure
Very Wet Years 1995, 1998, 2006, 2011	**24,000**	**16,000**	**6,000**	Open
Wet and AN Years 1993, 1996, 1997, 1999, 2000, 2003, 2005, 2010	**20,000**	**12,000**	**4,000**	Open
BN and Dry Years 2001, 2002, 2004, 2009, 2012	**16,000**	**10,000**	**2,000**	Open
Very Dry Years post Wet 1994, 2007	**12,000**	**8,000**	**2,000**	Open
Very Dry Years post Dry 2008	**10,000**	**6,000**	**2,000**	Open

RECOMMENDED STANDARDS

LATE SUMMER AND FALL – AUGUST - NOVEMBER Lower LSZ (2500-5000 EC) – Target: Western Suisun Bay Upper LSZ (500-2500 EC) – Target: Eastern Suisun Bay Freshwater Brackish Zone (200-500 EC) – Target: Western Delta				
YEAR TYPES	**Inflow**	**Outflow**	**Export Limits**	**DCC Closure**
Very Wet Years 1995, 1998, 2006, 2011	**16,000**	**12,000**	**8,000**	Open
Wet and AN Years 1993, 1996, 1997, 1999, 2000, 2003, 2005, 2010	**16,000**	**12,000**	**8,000**	Open
BN and Dry Years 2001, 2002, 2004, 2009, 2012	**14,000**	**10,000**	**4,000**	Open
Very Dry Years post Wet 1994, 2007	**12,000**	**8,000**	**4,000**	Open
Very Dry Years post Dry 2008	**10,000**	**6,000**	**4,000**	Open

Five POD Years

Project Exports by Water Year Type

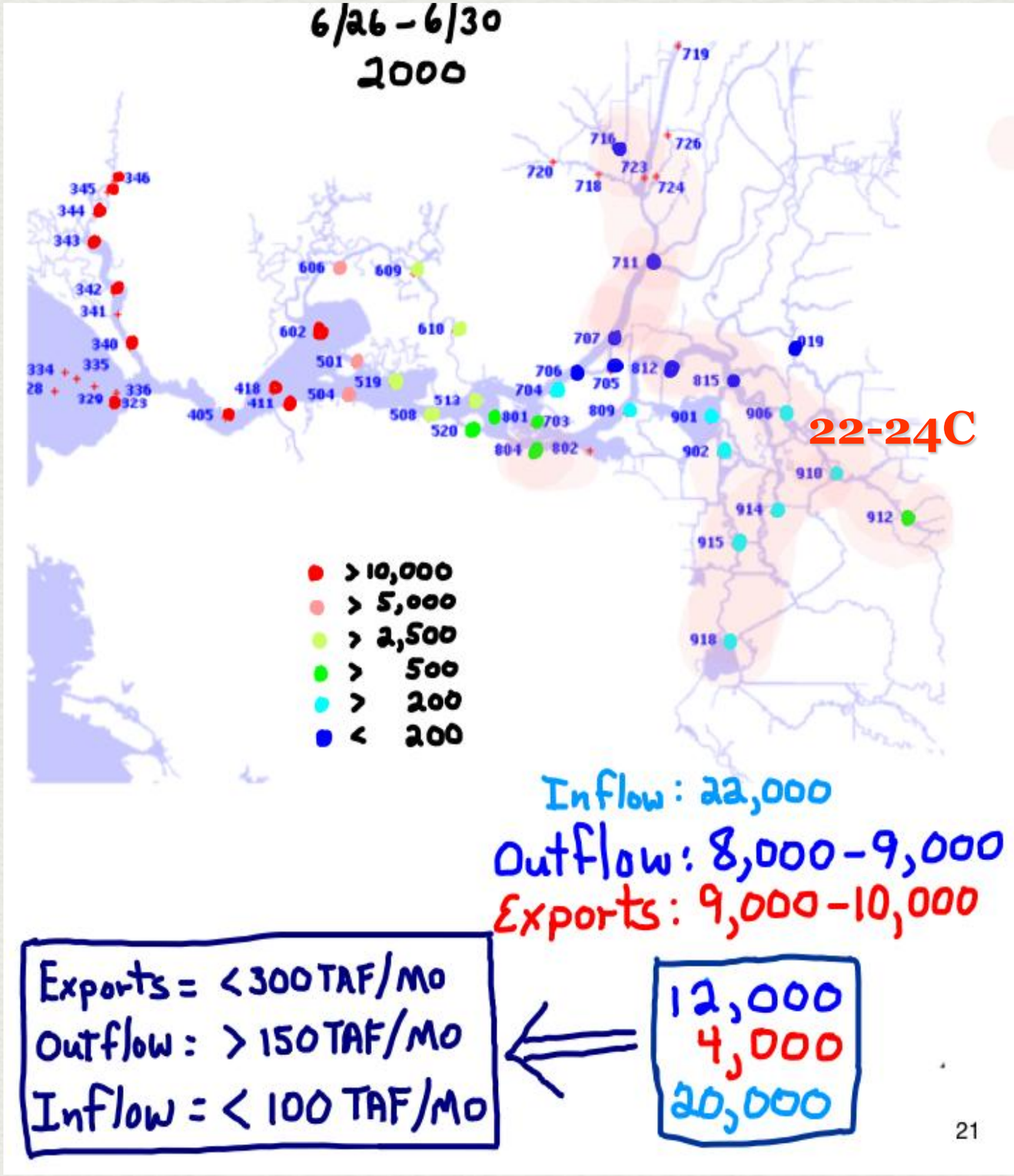


Source: Delta Stewardship Council. 2011. Letter to State and Federal Water Contractors Agency. September 29. Export figures adapted from DWR Dayflow Program and Water Year Classifications (Sacramento River Indices) are adapted from the California Data Exchange Center. *Total

June 2000

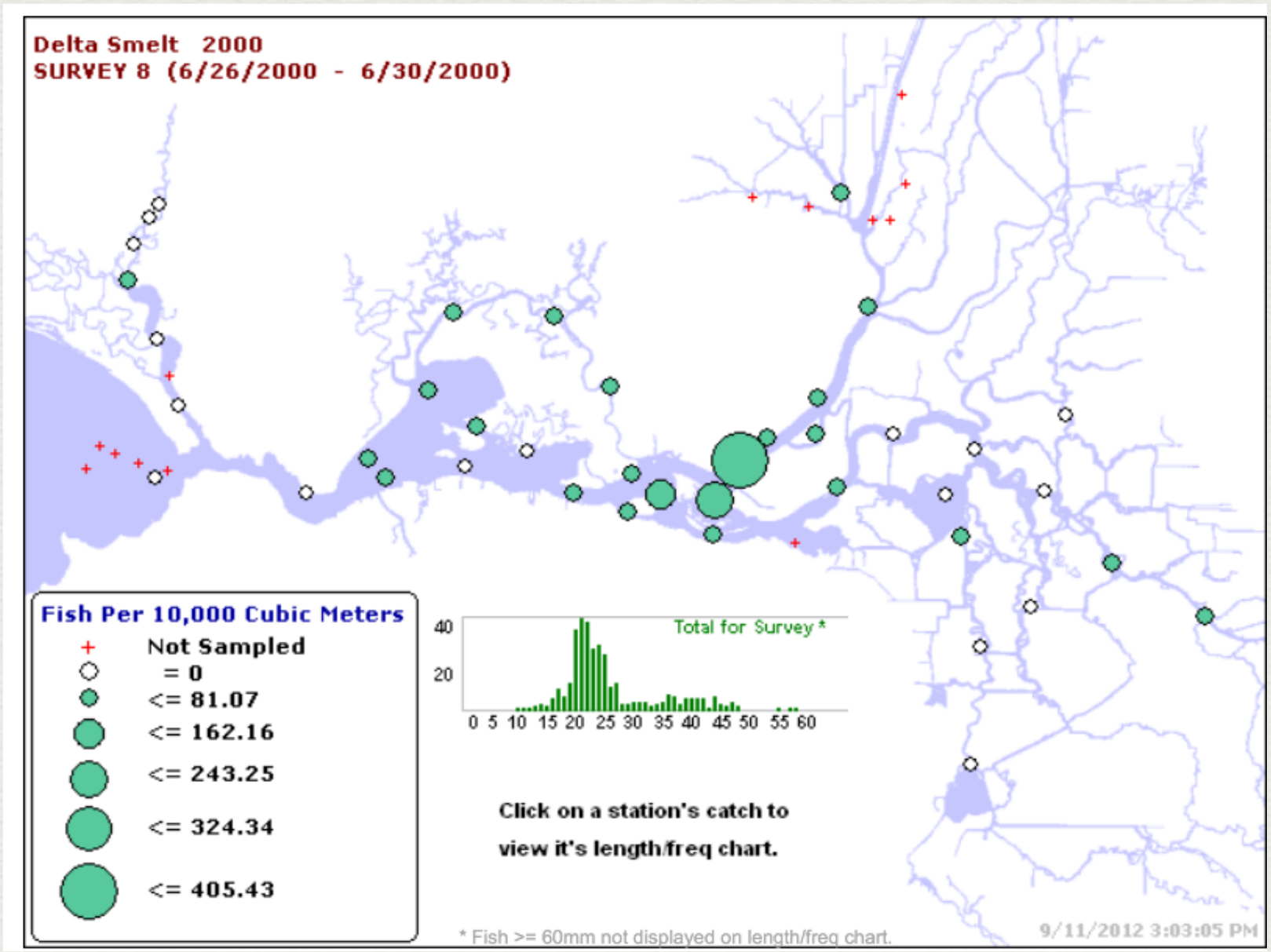
In June 2000 outflows were 8-10 kcfs, down from 20-30 kcfs in May, inflows were 20-22 kcfs, and exports were 8-10 kcfs, up from 2-4 kcfs in May. The LSZ zone was in the western Delta and moving eastward and down Old River to the Clifton Court Forebay. Much of the central, south, and east Delta was TOO WARM (>22°C) for delta smelt. Warm inflow water from the Sacramento and San Joaquin Rivers is part of the problem.

Under the recommended criteria June outflow for this ABOVE NORMAL YEAR would be 12 kcfs, inflow would be 20 kcfs, and exports limited to 4 kcfs. This regime would not only protect delta smelt, but decrease June exports 300 TAF, increase June outflow 150 TAF, and decrease June reservoir releases by 100 TAF.



Delta Smelt
Late June 2000

As you can see from this late June 2000 survey chart: delta smelt are concentrated in the low salinity zone of the north and west Delta. They are gone from the central, south, and east Delta where they were vulnerable to exports and degraded warm water habitat for most of June.

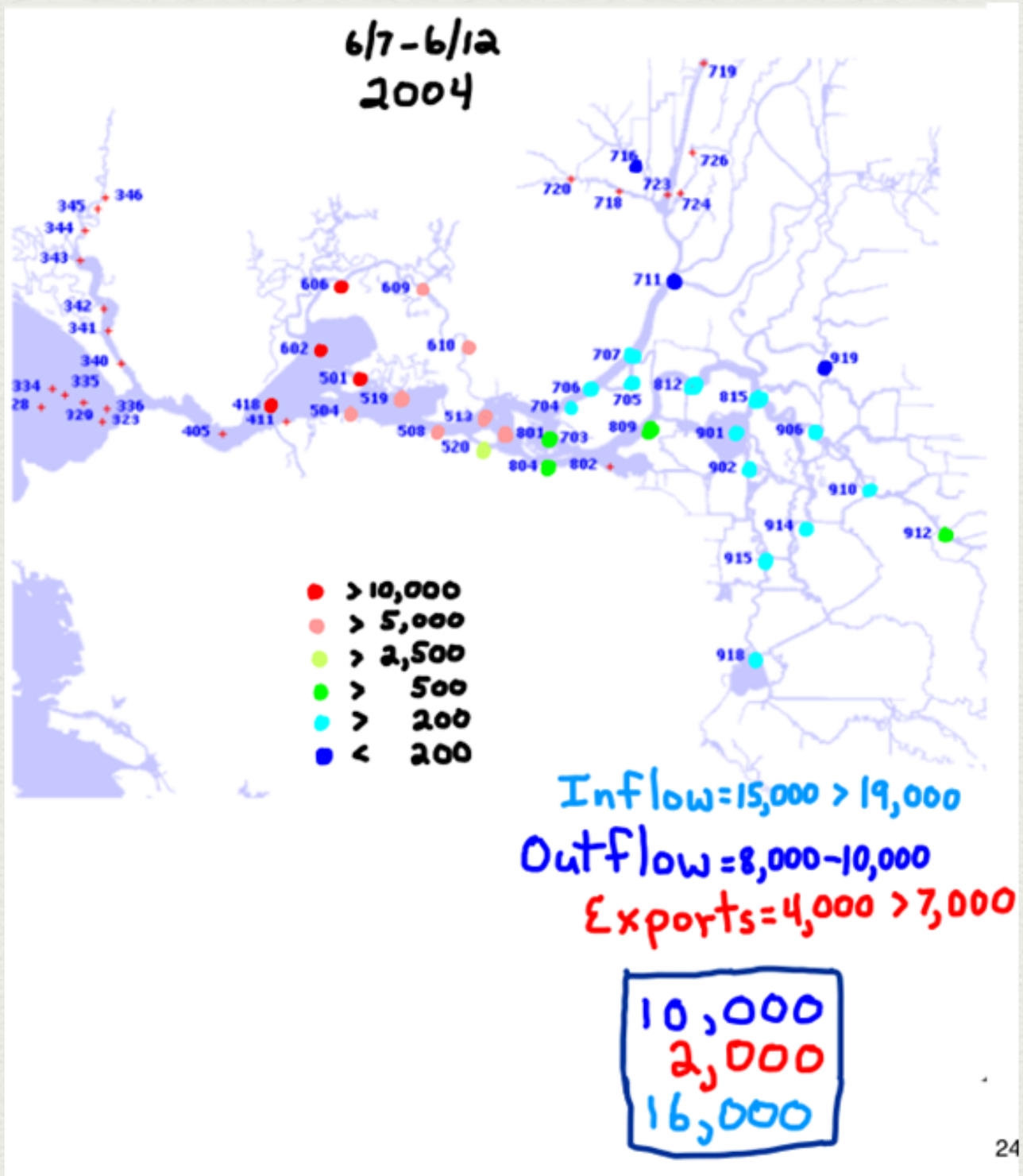


June 2004

In June 2004 outflows were 8-10 kcfs, inflows were 15-19 kcfs, and exports were rising from 4 to 7 kcfs. The LSZ zone was in the western Delta moving eastward into the lower San Joaquin channel and on to Old River and down to Clifton Court Forebay.

Under the recommended standards for a BELOW NORMAL YEAR, outflow would be 10 kcfs, inflow would be 16 kcfs, and exports limited to 2 kcfs. This would keep the LSZ in the western Delta and eastern Suisun Bay. Notice that outflows would be improved only slightly, with reduced exports and keeping the Cross Channel open doing most of the work of minimizing fish movement to the South Delta pumping plants.

The recommended management regime would not only protect delta smelt, but decrease exports for June 200 TAF, increase outflow 60 TAF, and decrease reservoir releases by 60 TAF.

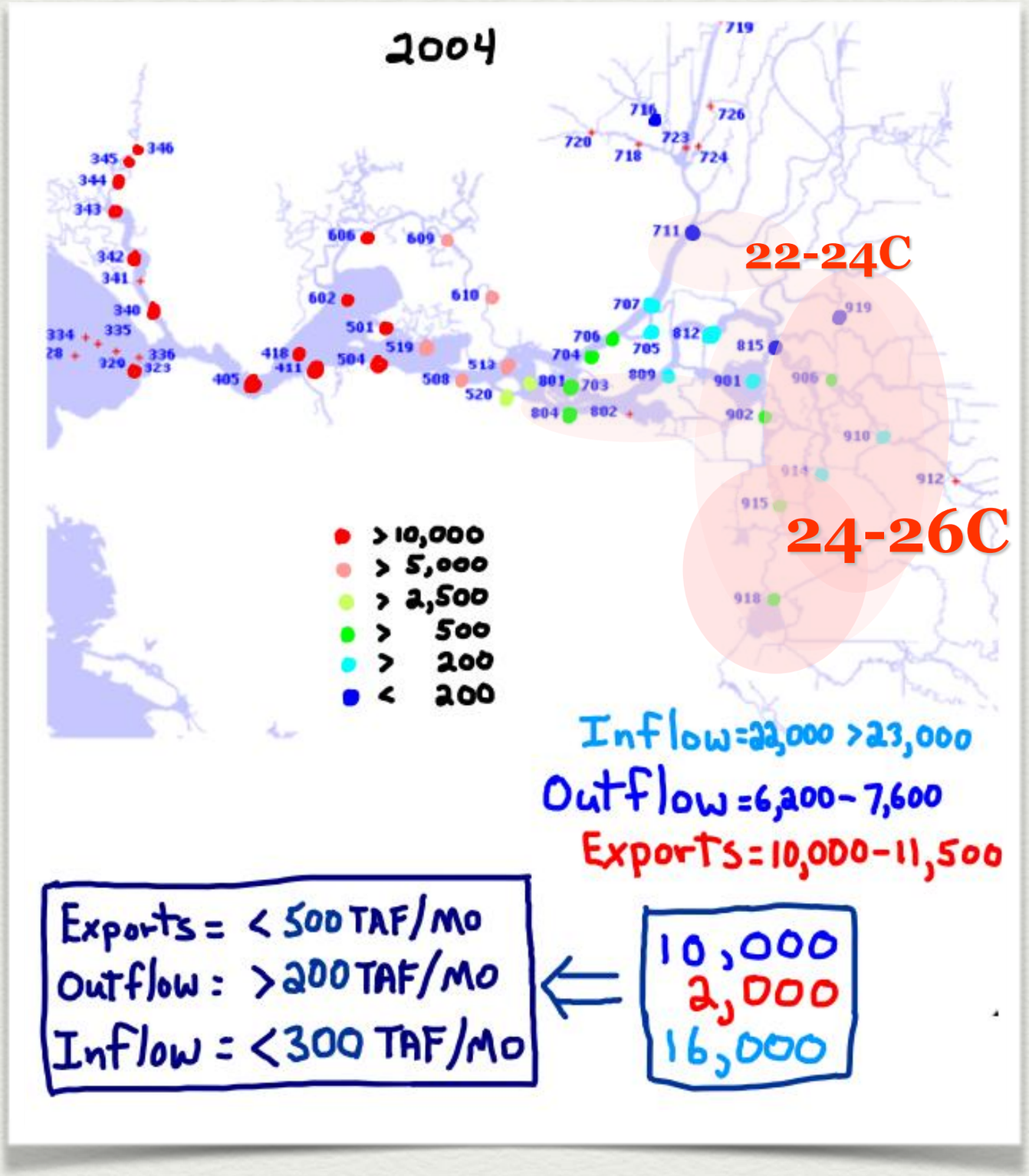


July 2004

In July 2004 outflows were 6-7 kcfs, inflows were 22-23 kcfs, and exports were 10-11 kcfs. The LSZ zone was in the western Delta and Old River down to CCF. Water temperatures in the east and south Delta were lethal to smelt (24-26C). Only the lower Sacramento River channel and Suisun Bay remained below 22C.

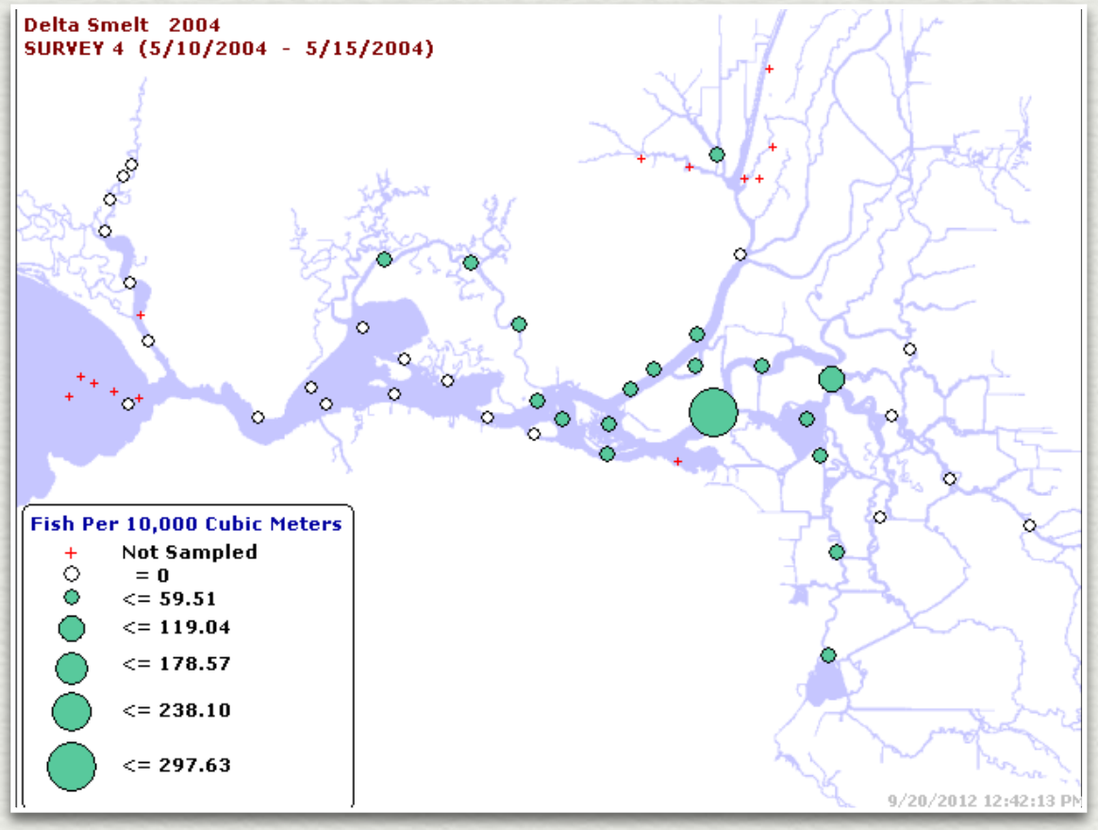
Under the recommended standards for a BELOW NORMAL YEAR, outflow would be 10 kcfs, inflow would be 16 kcfs, and exports limited to 2 kcfs. This would keep the LSZ in the western Delta and eastern Suisun Bay.

The recommended management regime would protect delta smelt, and decrease exports for July 500 TAF, increase outflow 200 TAF, and decrease reservoir releases by 300 TAF.

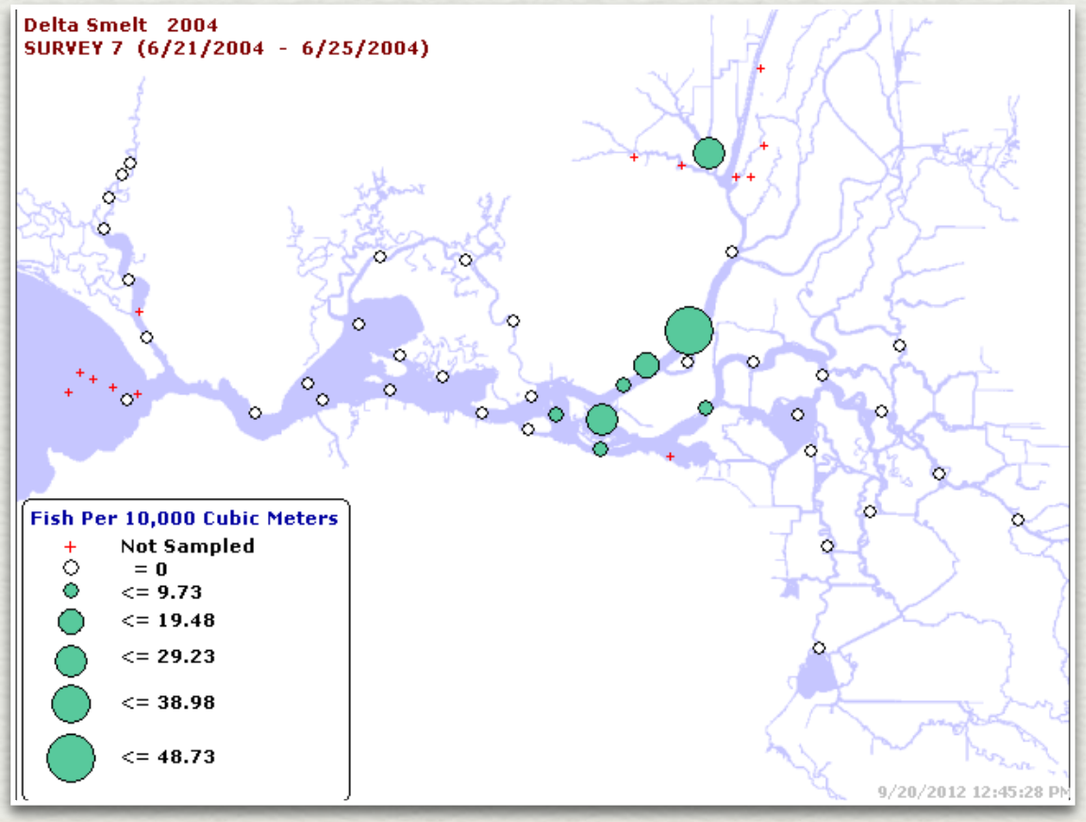


Delta Smelt May-June 2004

Delta smelt in May 2004 were distributed Delta wide in mid-May. Concentrations were apparent in the lower San Joaquin channel of the Central Delta.

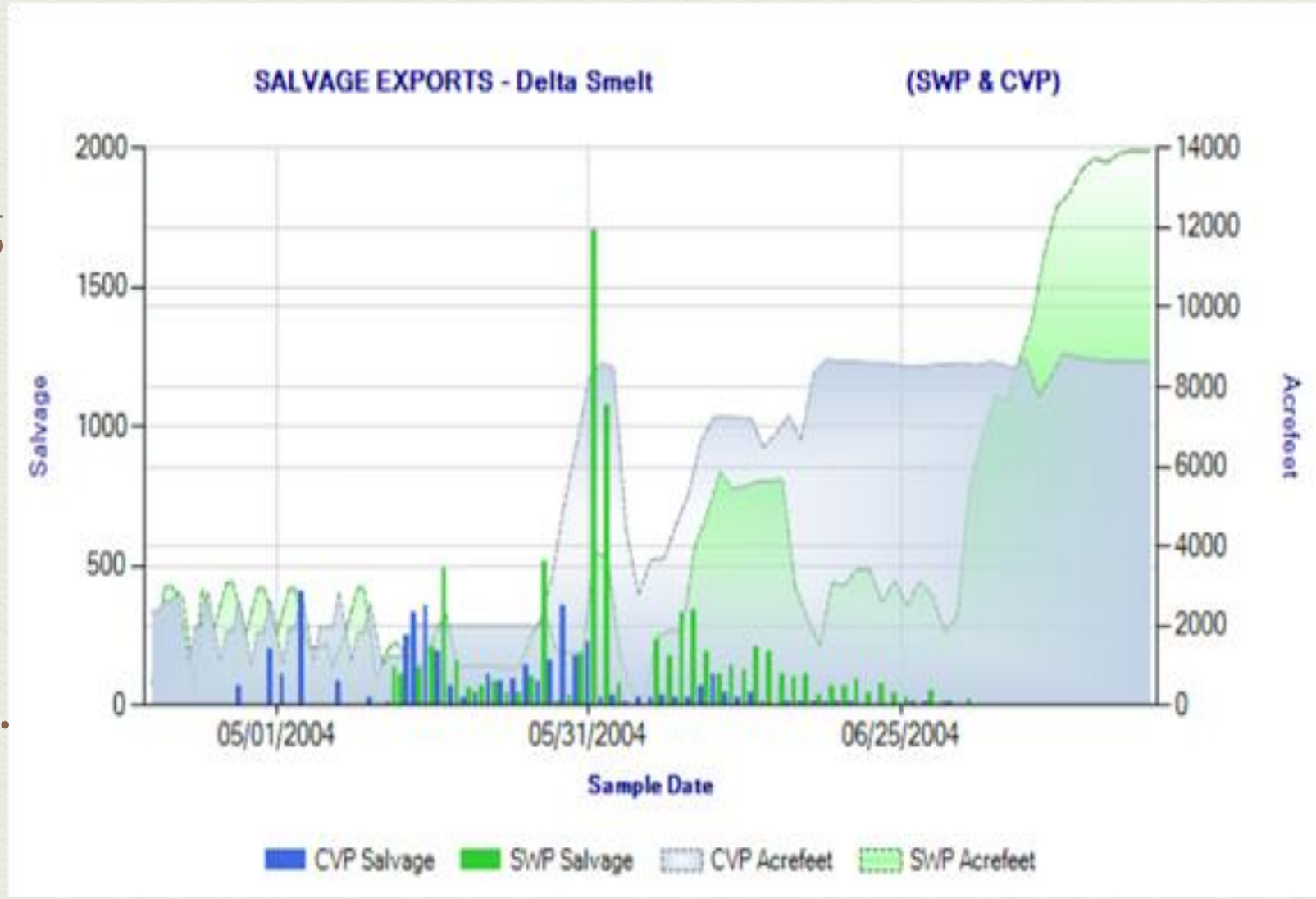


The delta smelt survey in June depicts much lower density (1/6th) with few smelt in the central, east, or south Delta. They have succumbed to exports or poor habitat conditions over the five weeks between the surveys.



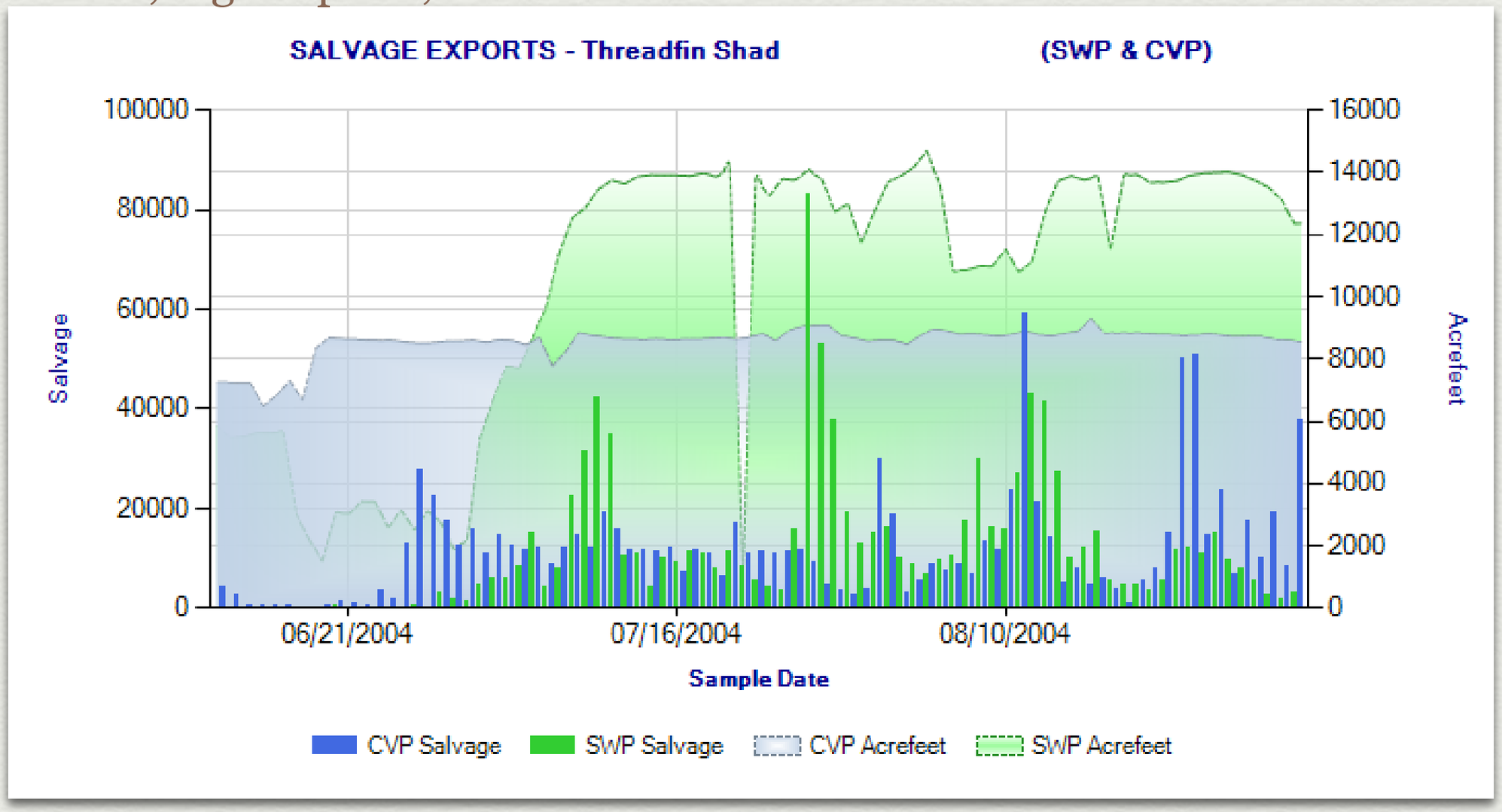
Delta Smelt Salvage 2004

Salvage at the export facilities for May through July in 2004 shows the vulnerability of the smelt to the exports with falling outflow and increasing exports. The large peak at the beginning of June represents the loss of over 200,000 smelt based on a measured efficiency of less than 1 %. Few smelt are salvaged after late June because they simply cannot survive the warm water to reach CCF.



Threadfin Shad Salvage 2004

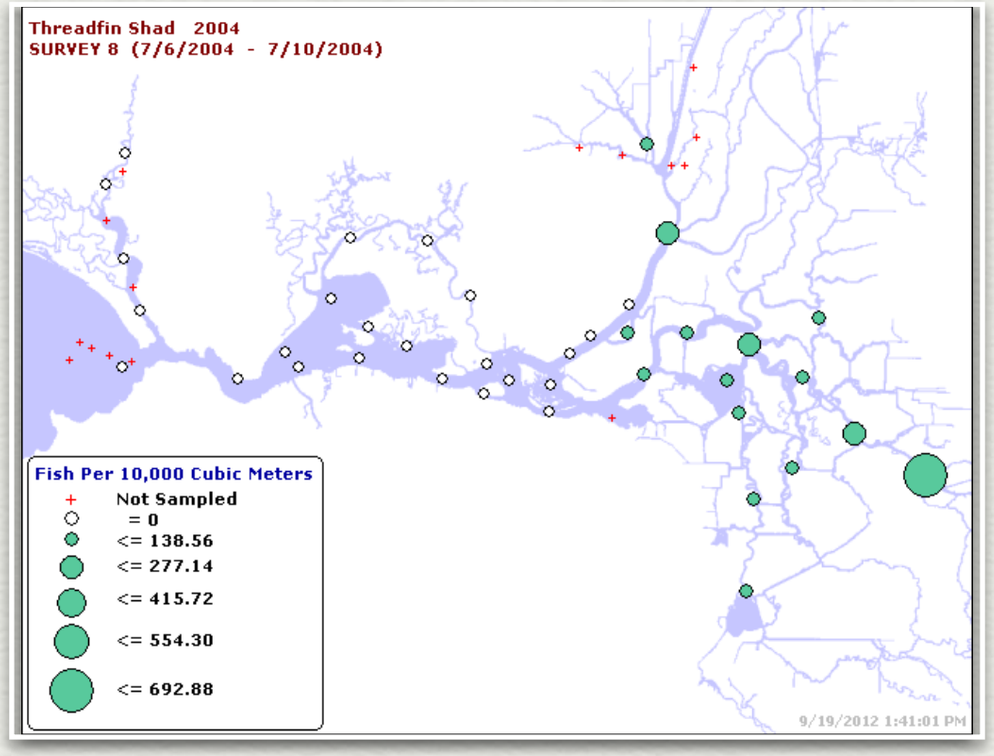
Threadfin shad another POD species is able to tolerate the summer Delta conditions, however, they too are highly vulnerable to summer exports. There were several large salvage peaks in 2004. I believe these are directly related to very negative lower San Joaquin flow, high exports, and low outflows.



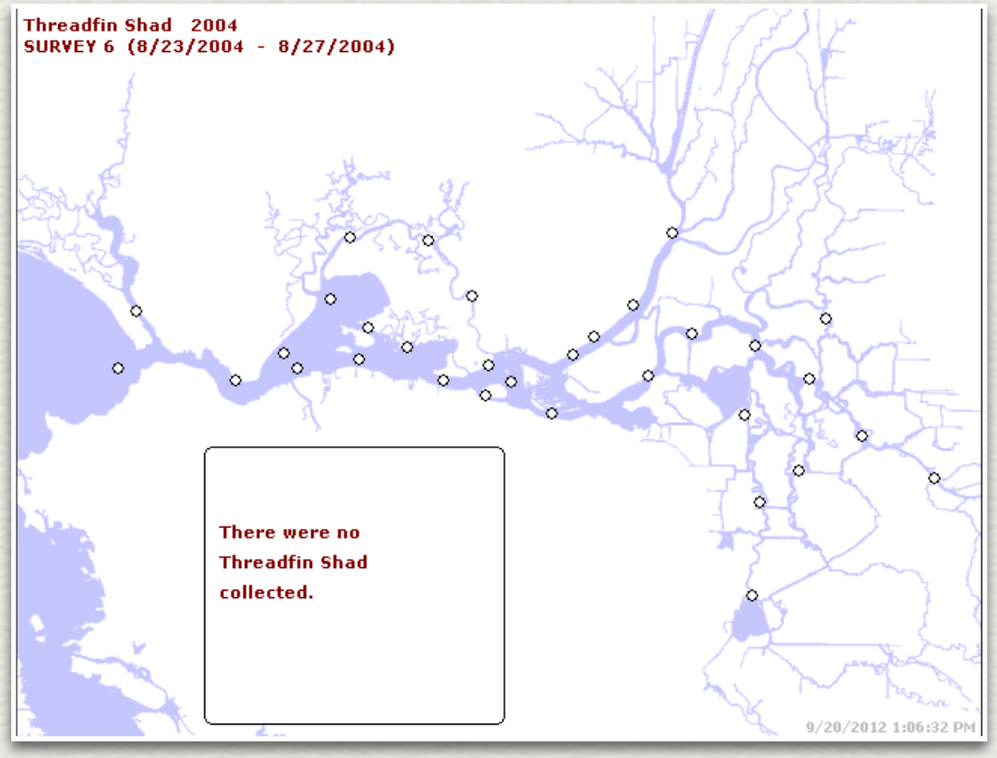
- QWEST reached - 8,000 cfs on July 12
- Exports reached 11,700 cfs in late July
- Outflow dropped from 7,000 to 4,000 cfs in first three weeks of August

Threadfin Shad July & August 2004

In July 2004 threadfin were captured throughout the freshwater Delta in the Summer Townet Survey with concentrations in the lower San Joaquin River.

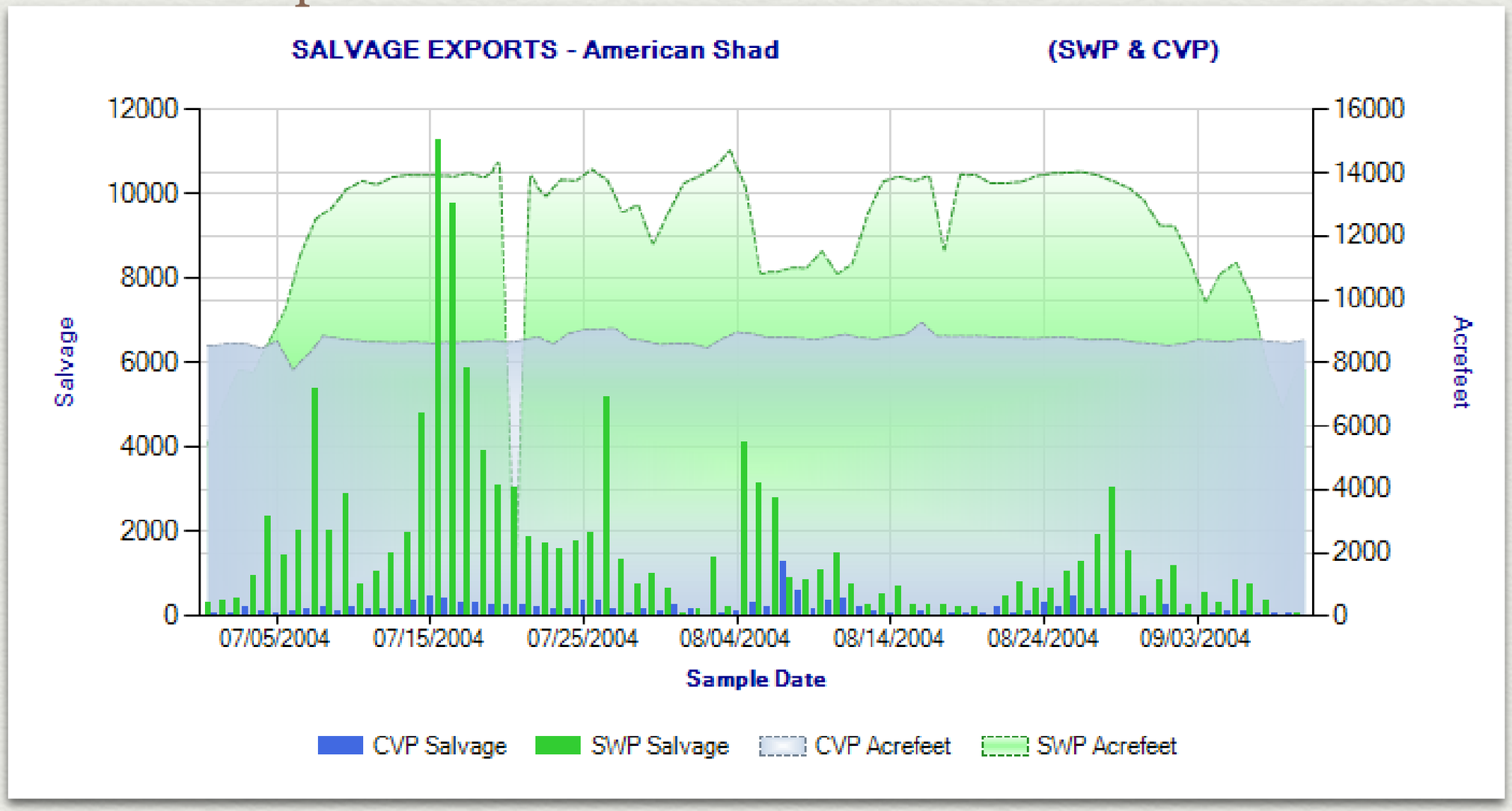


By August 2004 there were no threadfin shad captured in the Townet Survey. Many were lost in the maximum July-August exports of 2004, which is characteristic of nearly all years under the D-1641 standards.



American Shad Salvage Summer 2004

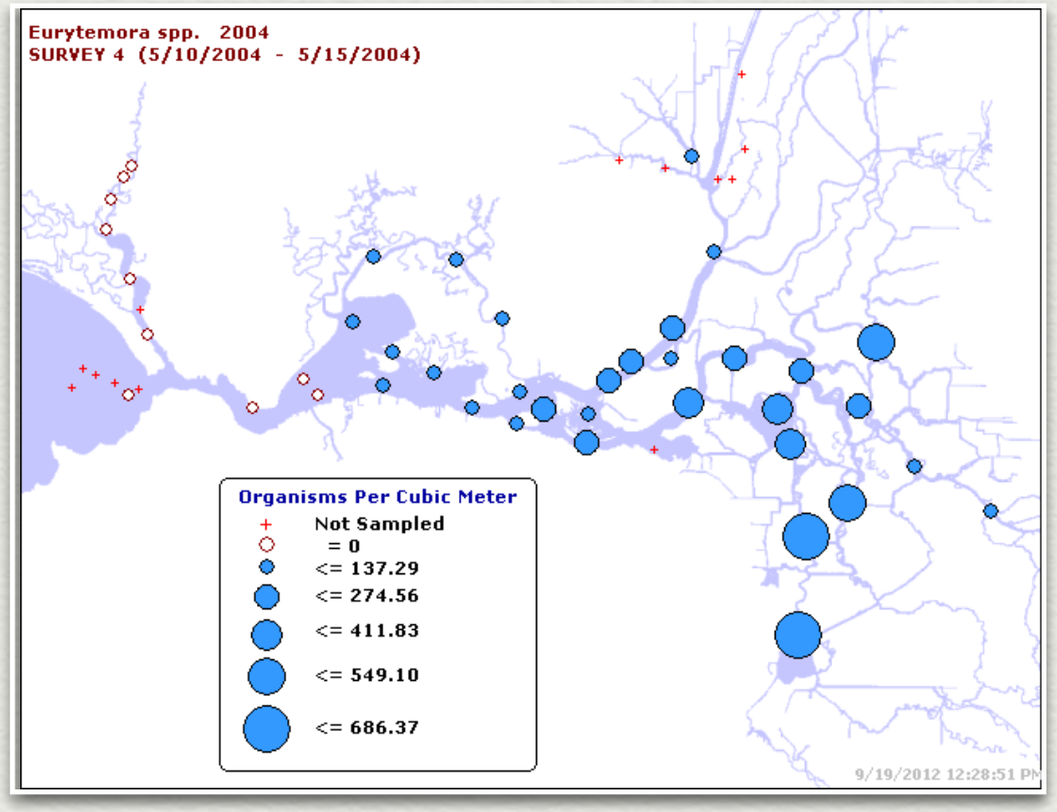
American shad are another POD species affected by high summer exports and low outflows.



- QWEST reached -8,000 cfs on July 12
- Exports reached 11,000 cfs in mid July
- Outflow dropped from 7,000 to 4,000 cfs in first three weeks of August

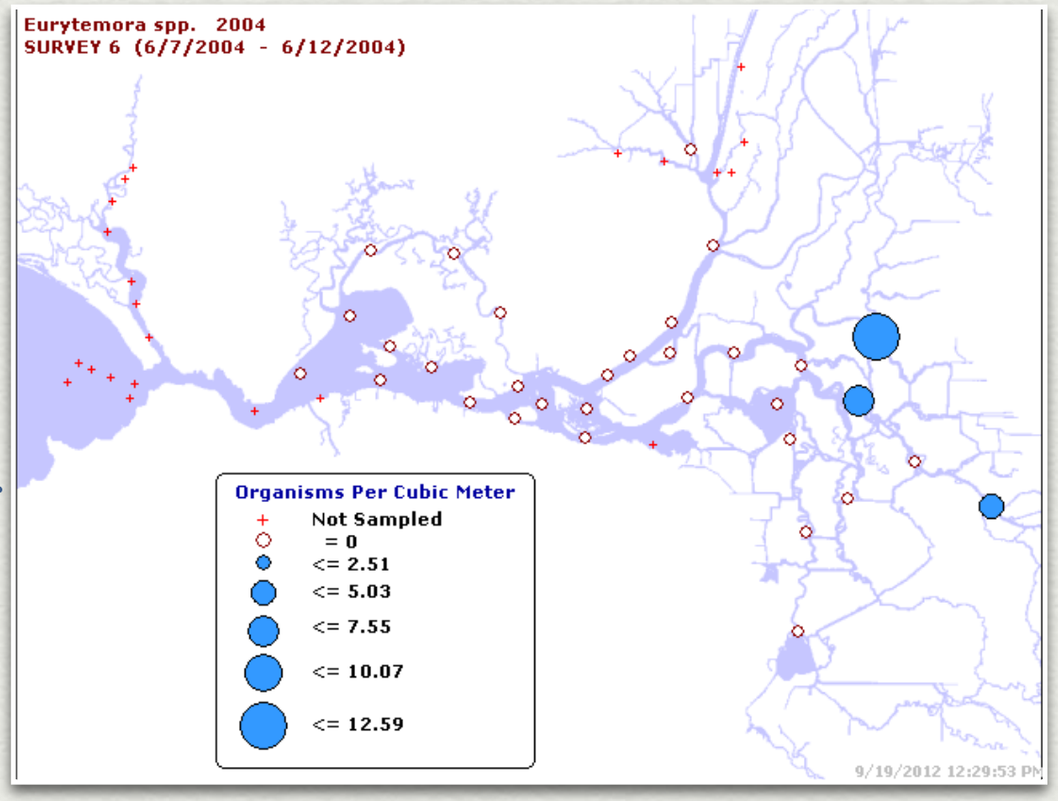
Eurytemora spp.

Eurytemora, an often mentioned zooplankton food of the young of many Delta fish including delta smelt, are shown here distributed throughout the Delta in the May 2004 survey.



May 2004

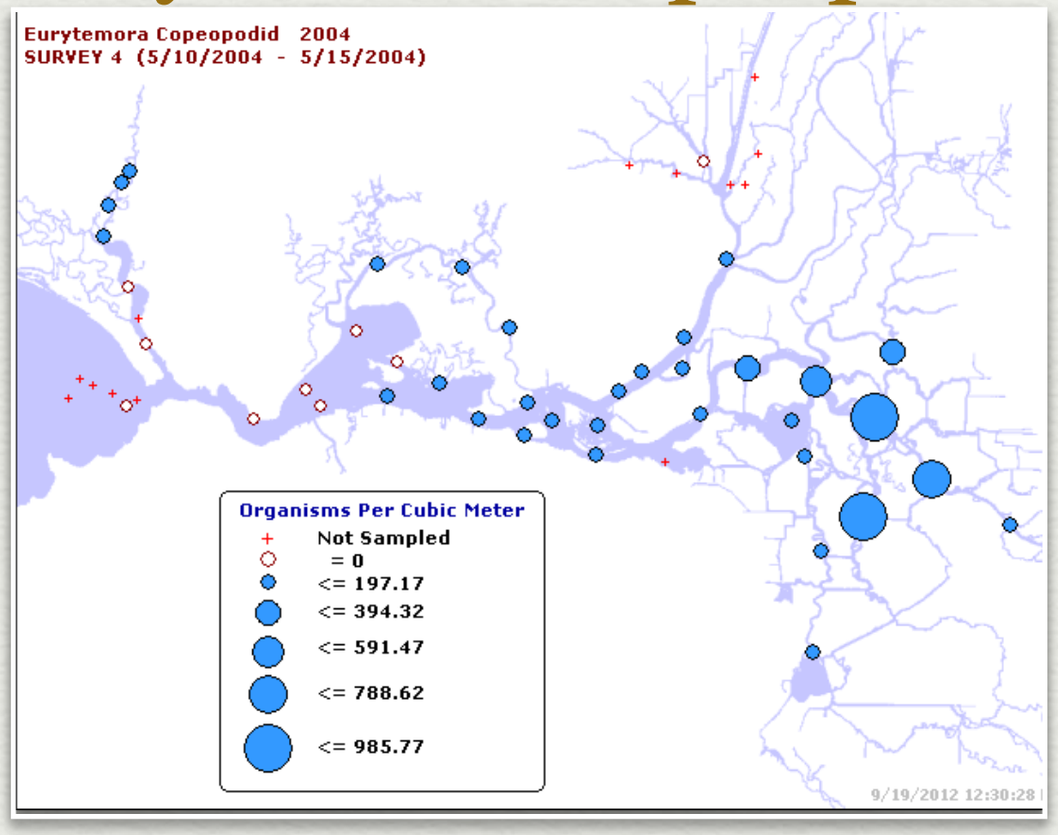
Eurytemora shown here for the June 2004 survey (at 1/50th the density of May) are greatly reduced in abundance from May. The VISE not only causes the loss of fish, but also their low salinity zone habitat and the zooplankton food supply of Delta fishes.



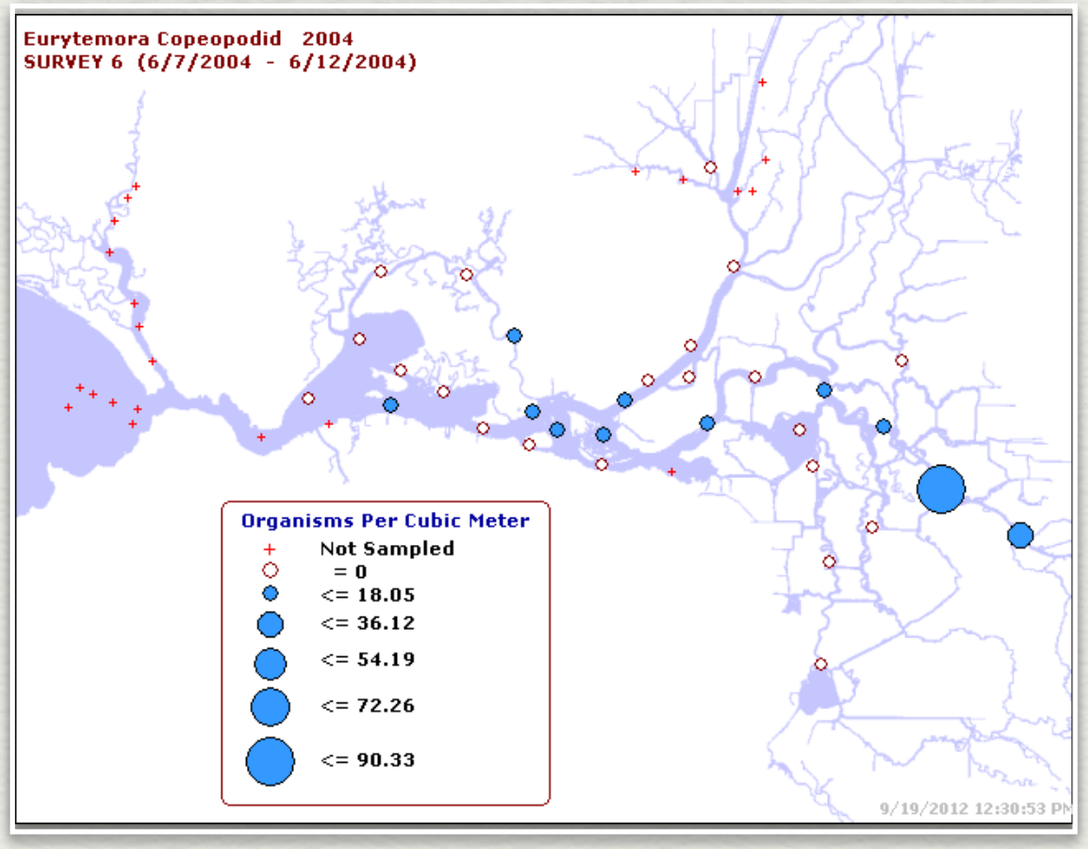
June 2004

Eurytemora Copeopodid

The same pattern occurs for Eurytemora young in May and June.



May 2004

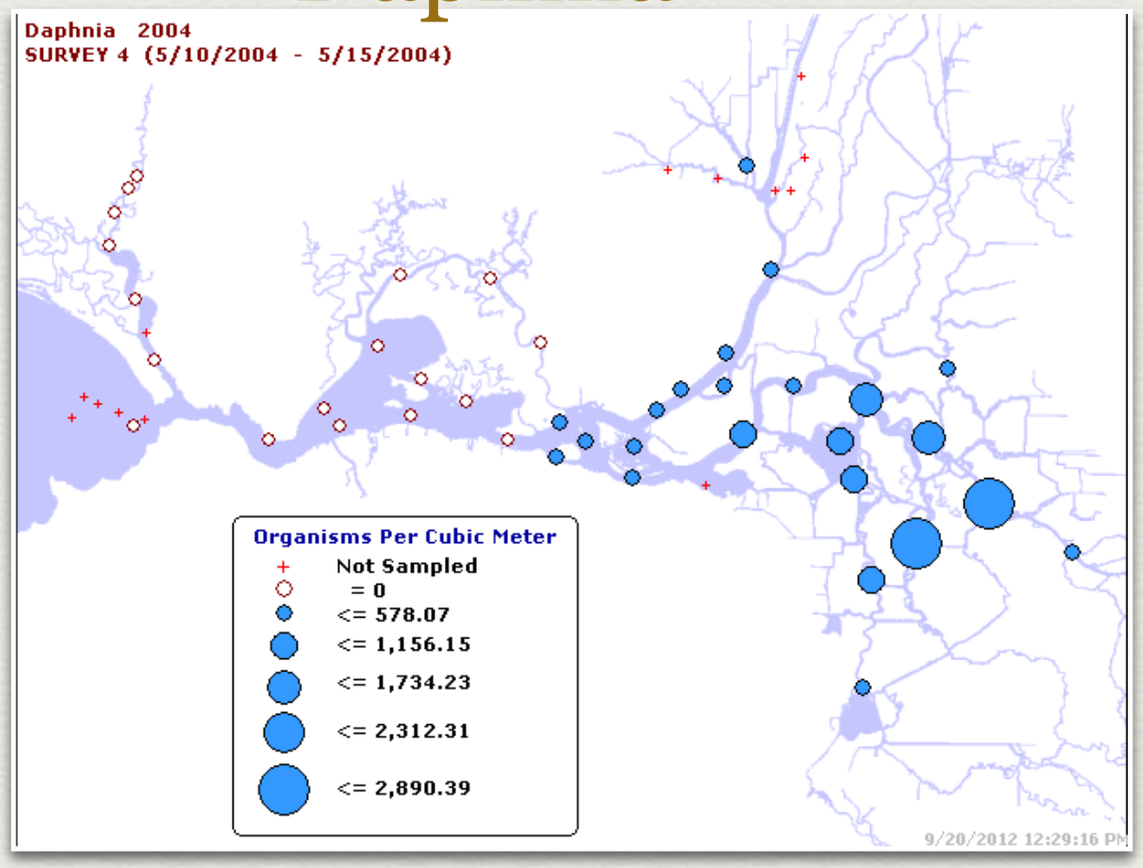


June 2004

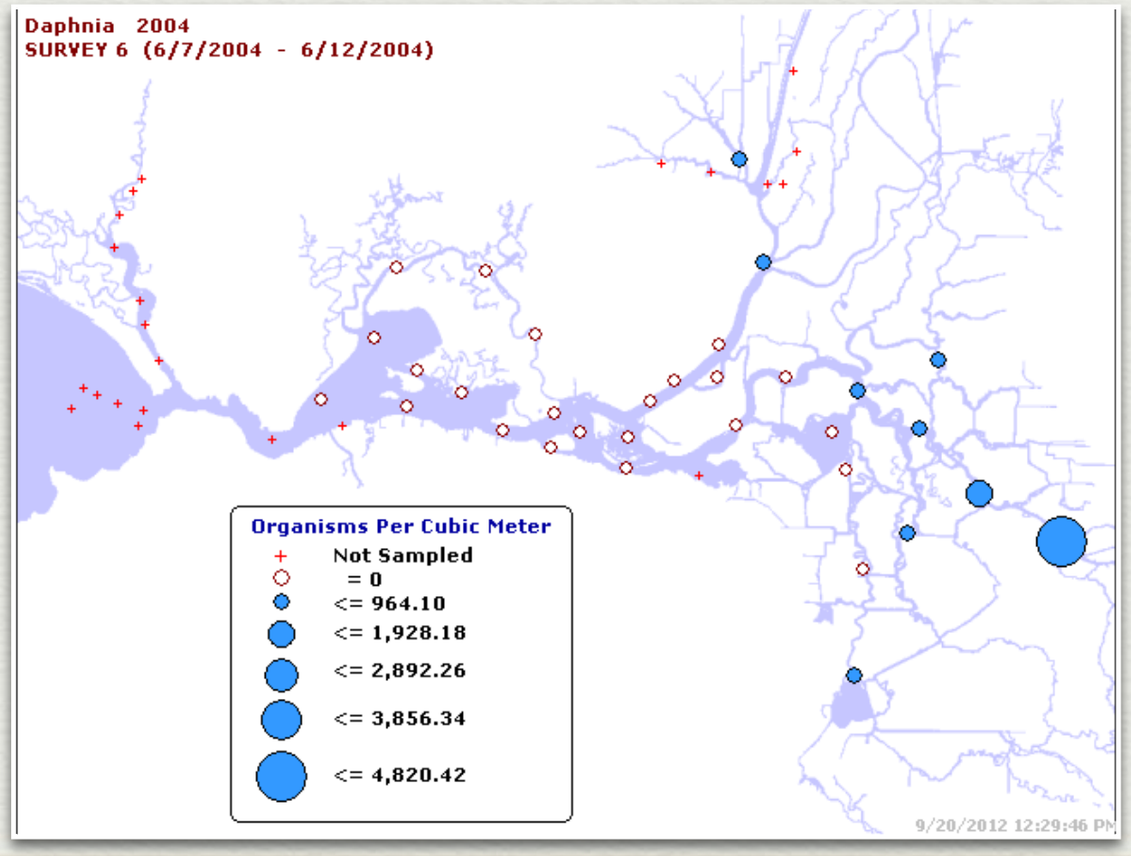
1/10 density

Daphnia

A similar pattern occurred for Daphnia, another important fish food zooplankton.

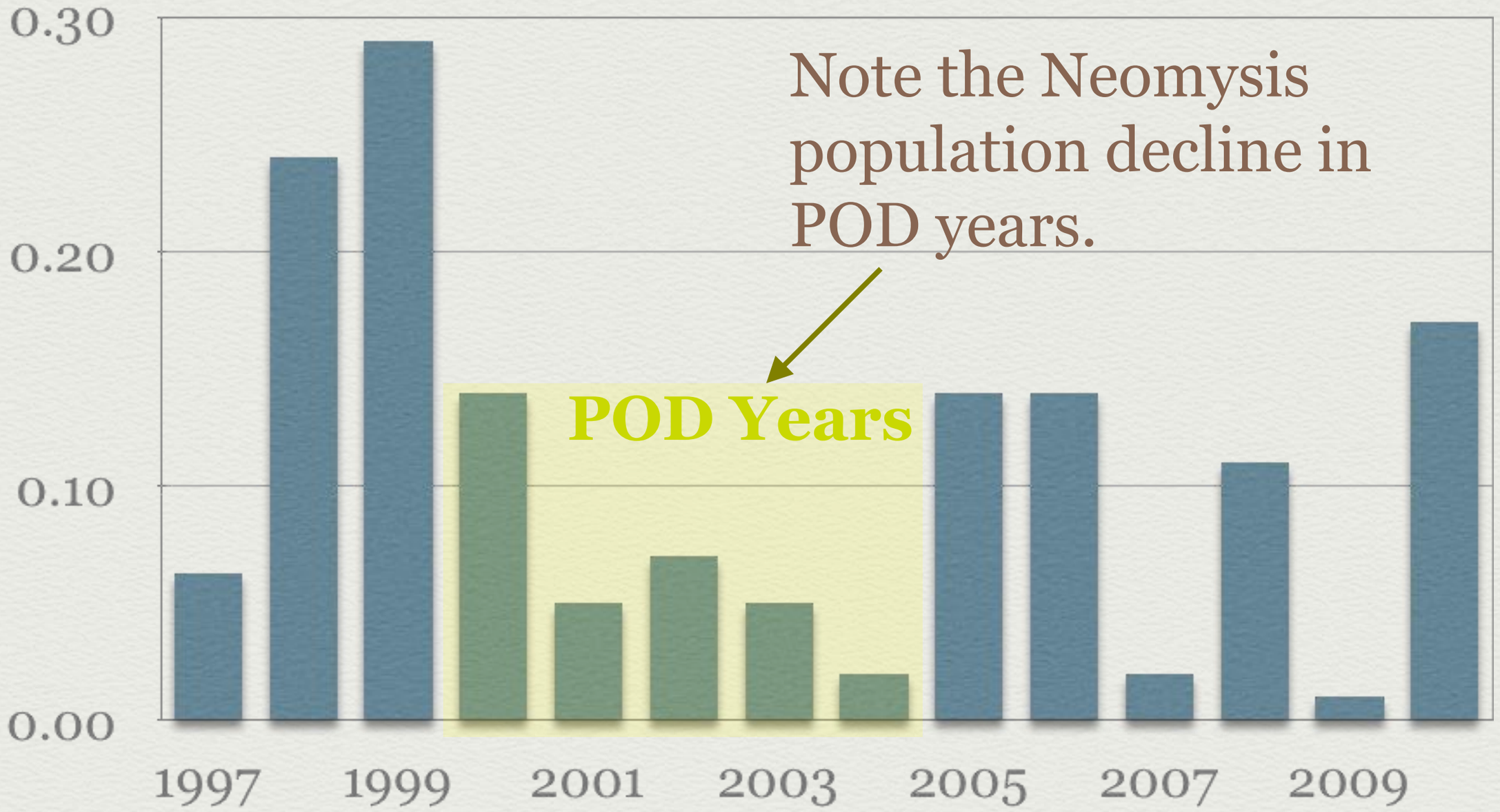


May 2004



June 2004

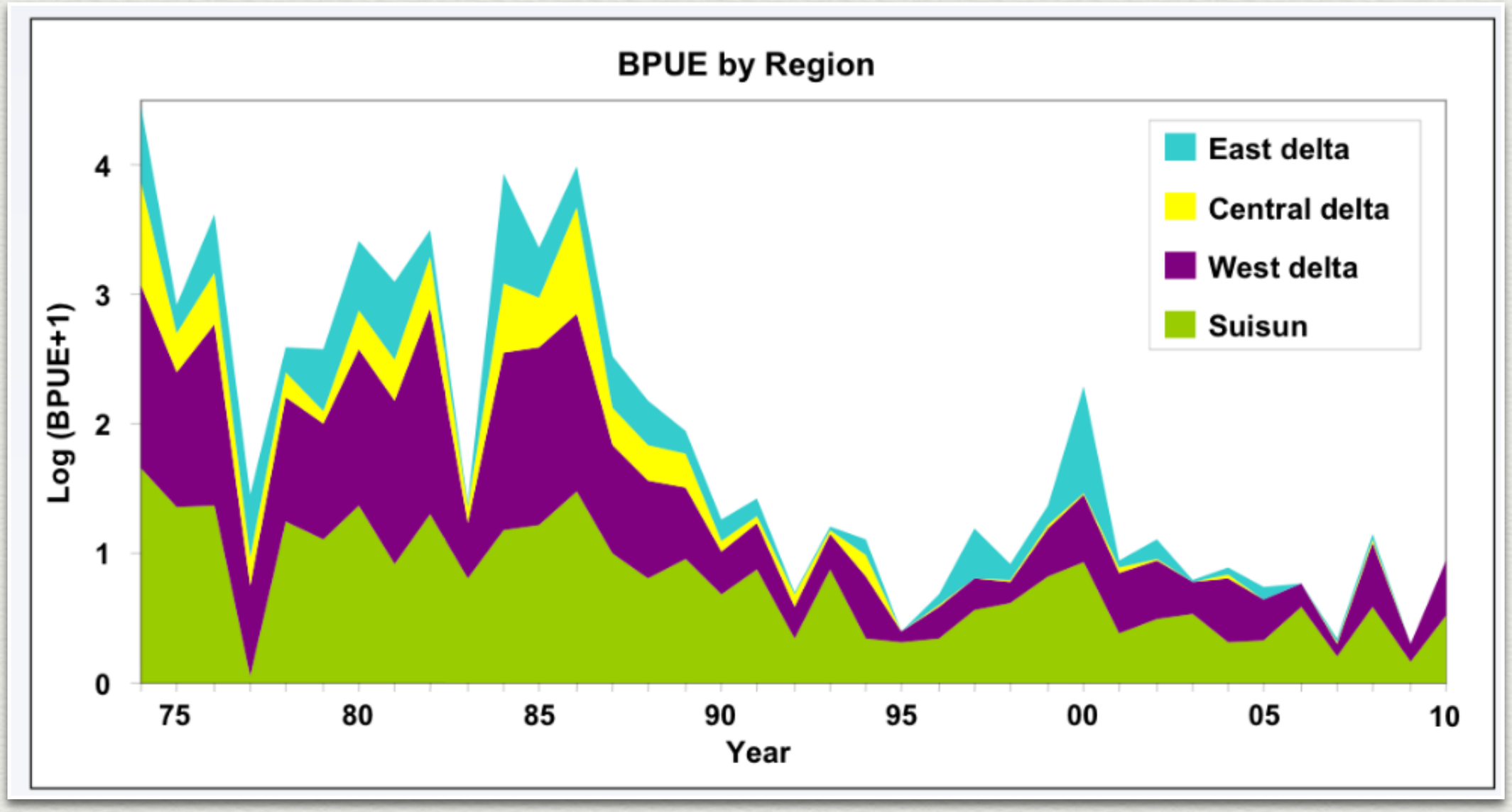
Neomysis Summer 1997-2010
Zooplankton Survey



Data Source: Spring 2011 IEP Newsletter

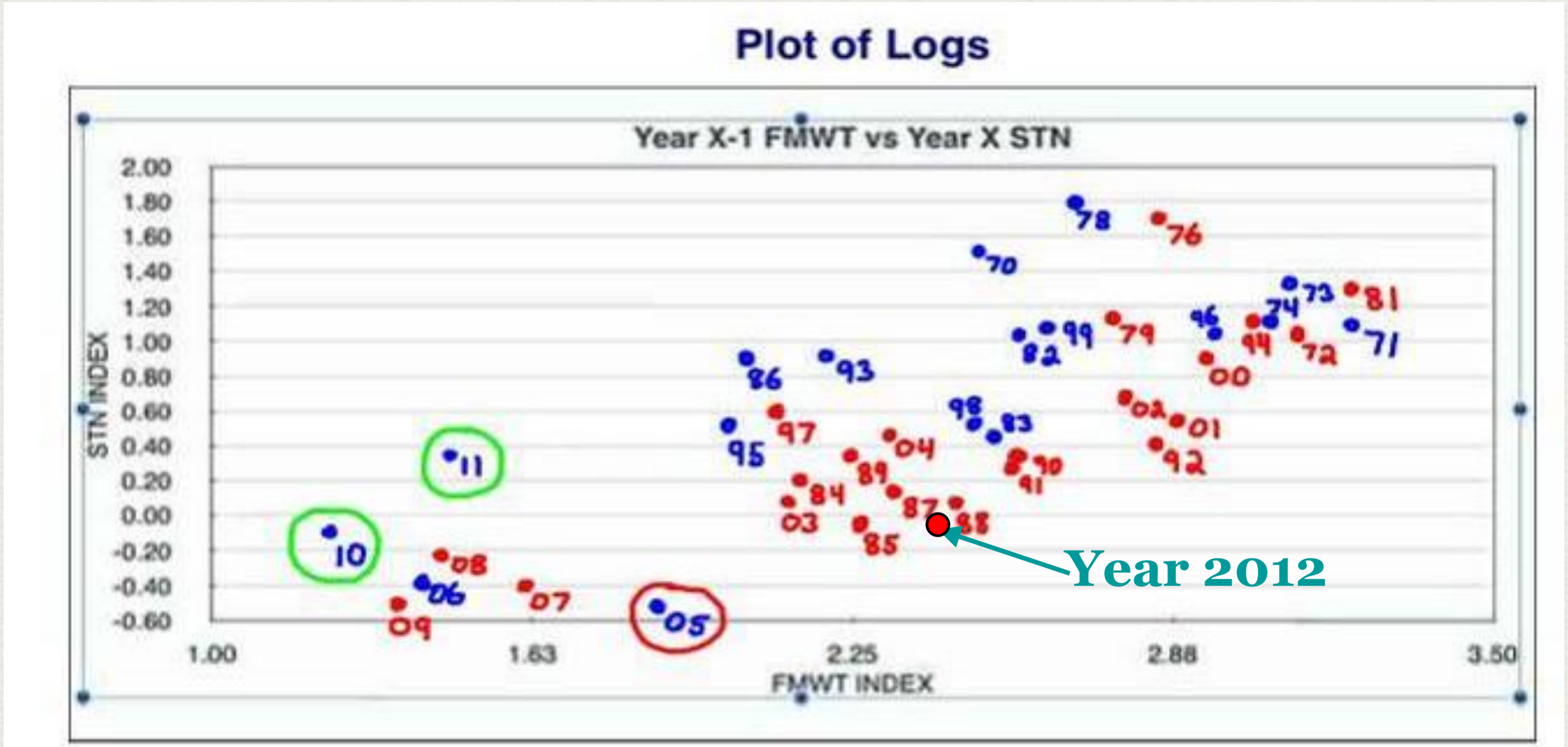
Neomysis by Region 1974-2010

Note the disproportionate loss of Neomysis in Central and East Delta after D-1641. This is directly attributable to high summer exports since 1995.



Source: Figure from CDFG 2011

DELTA SMELT STOCK RECRUITMENT MODEL

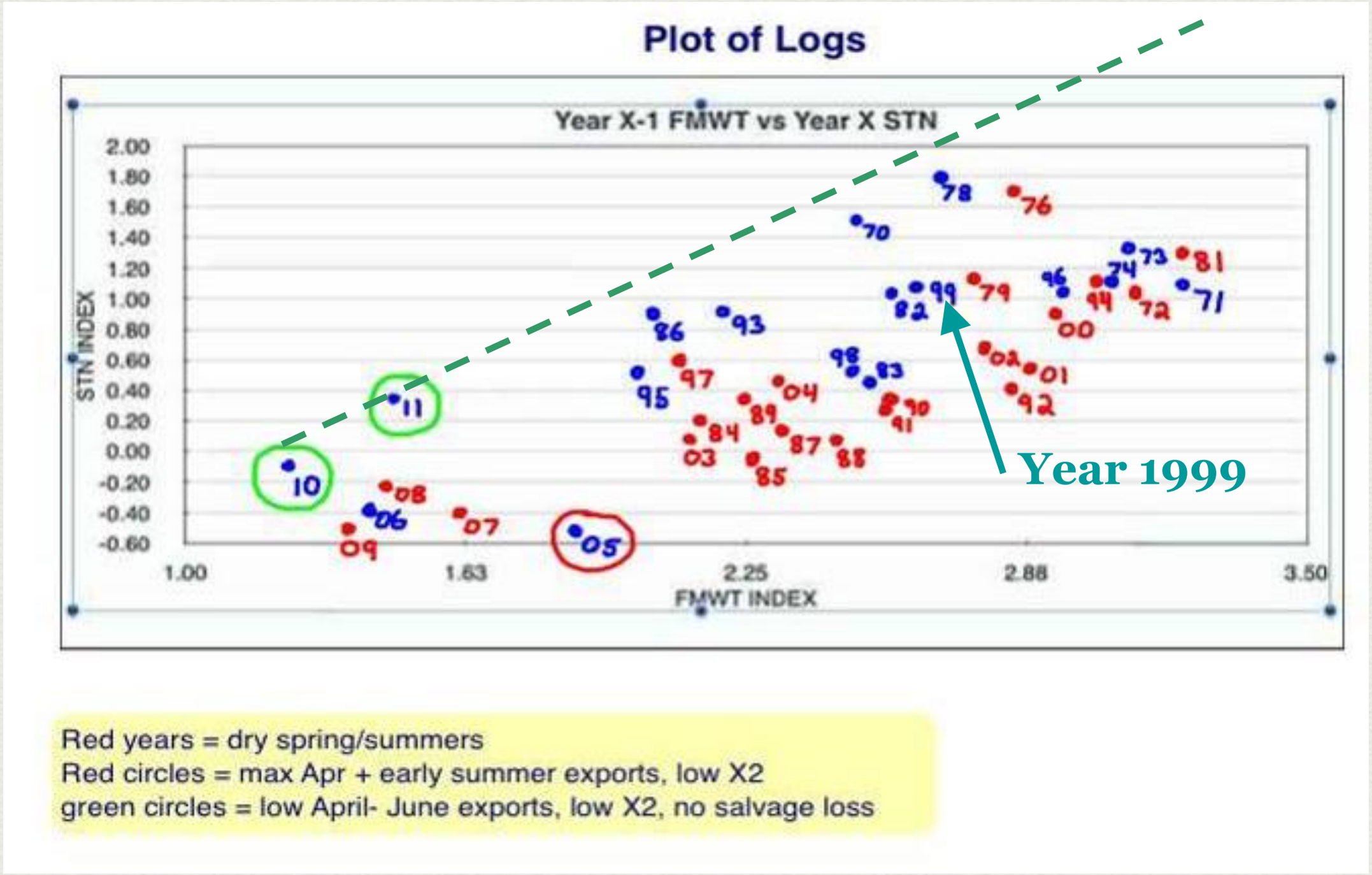


Red years = dry spring/summers
Red circles = max Apr + early summer exports, low X2
green circles = low April- June exports, low X2, no salvage loss

DELTA SMELT STOCK RECRUITMENT MODEL

Even a wet year like 1999 provided for less delta smelt than its potential as evident in the next slide.

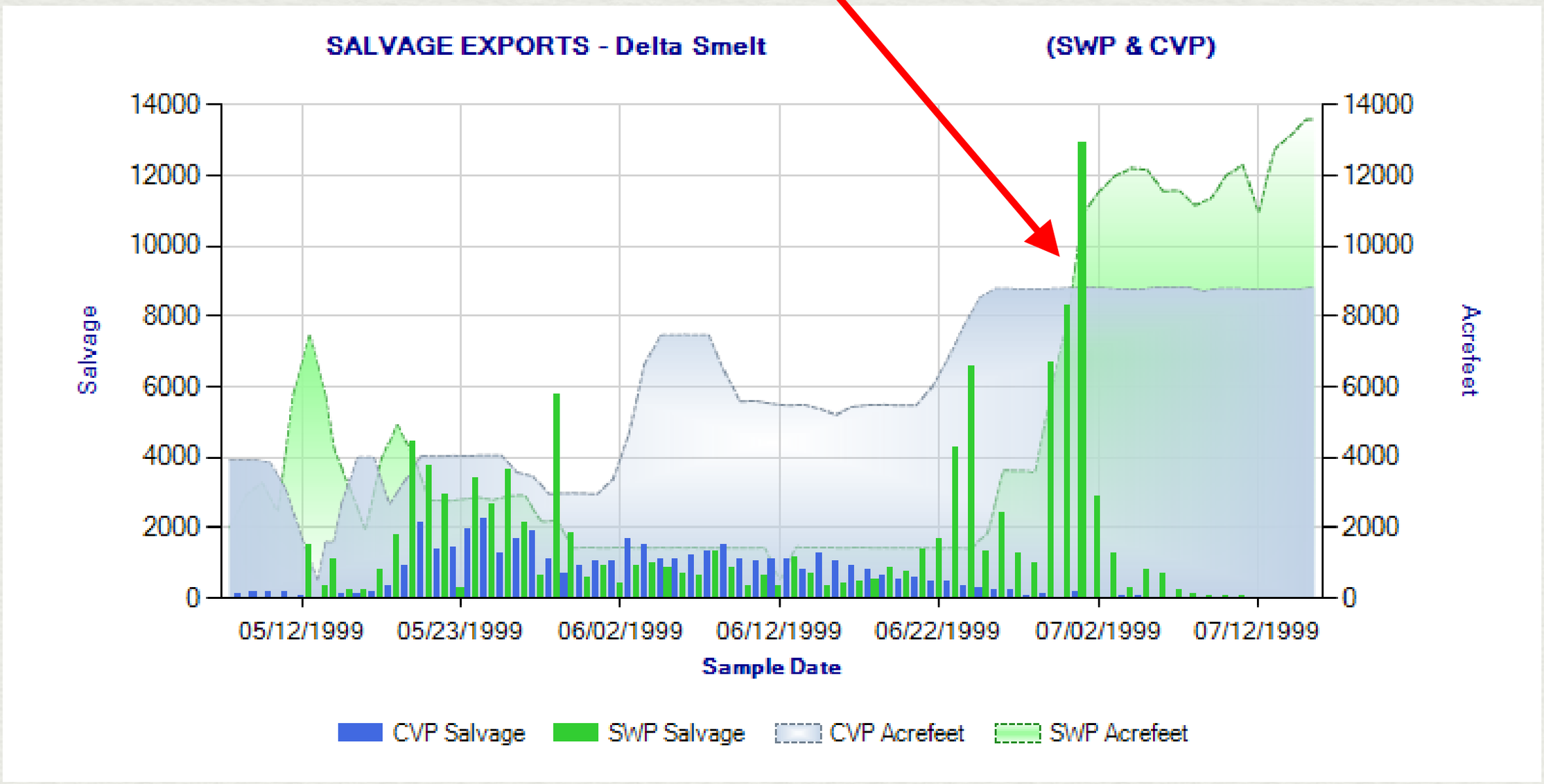
Potential



DELTA SMELT SALVAGE 1999

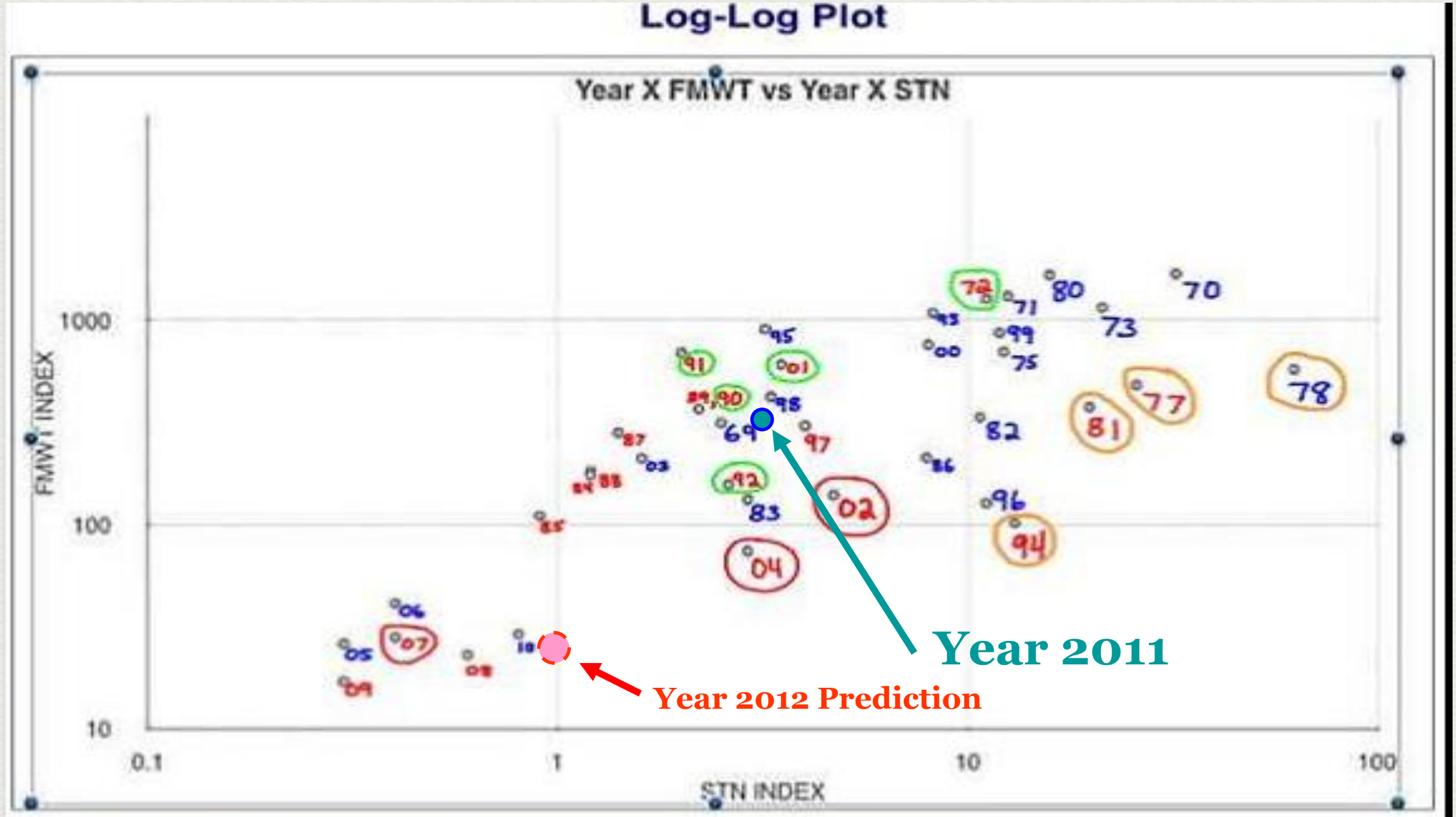
ACTUAL EXPORTS 11 kcfs, INFLOW 25 kcfs, OUTFLOW 8 kcfs

RECOMMENDED EXPORTS 4 kcfs, INFLOW <20 kcfs, OUTFLOW 12 kcfs



The late June–early July salvage peak (over a million lost per day assuming 1 % efficiency) would not have reached this level with the recommended higher outflows and lower exports. Earlier salvage would have been less under recommended higher outflow.

DELTA SMELT STOCK RECRUITMENT MODEL



Red years = dry spring/summers
Red circles = also with max summer exports
Green circles = low summer exports
Orange circles = high spring salvage/entrainment (no VAMP)

STRIPED BASS STOCK RECRUITMENT MODEL

Striped bass, another POD species, has a similar stock recruitment relationship. The higher the adult population the more young are produced. Production is reduced in drier years as a consequence of entrainment and salvage losses, as well as reduced estuary productivity.

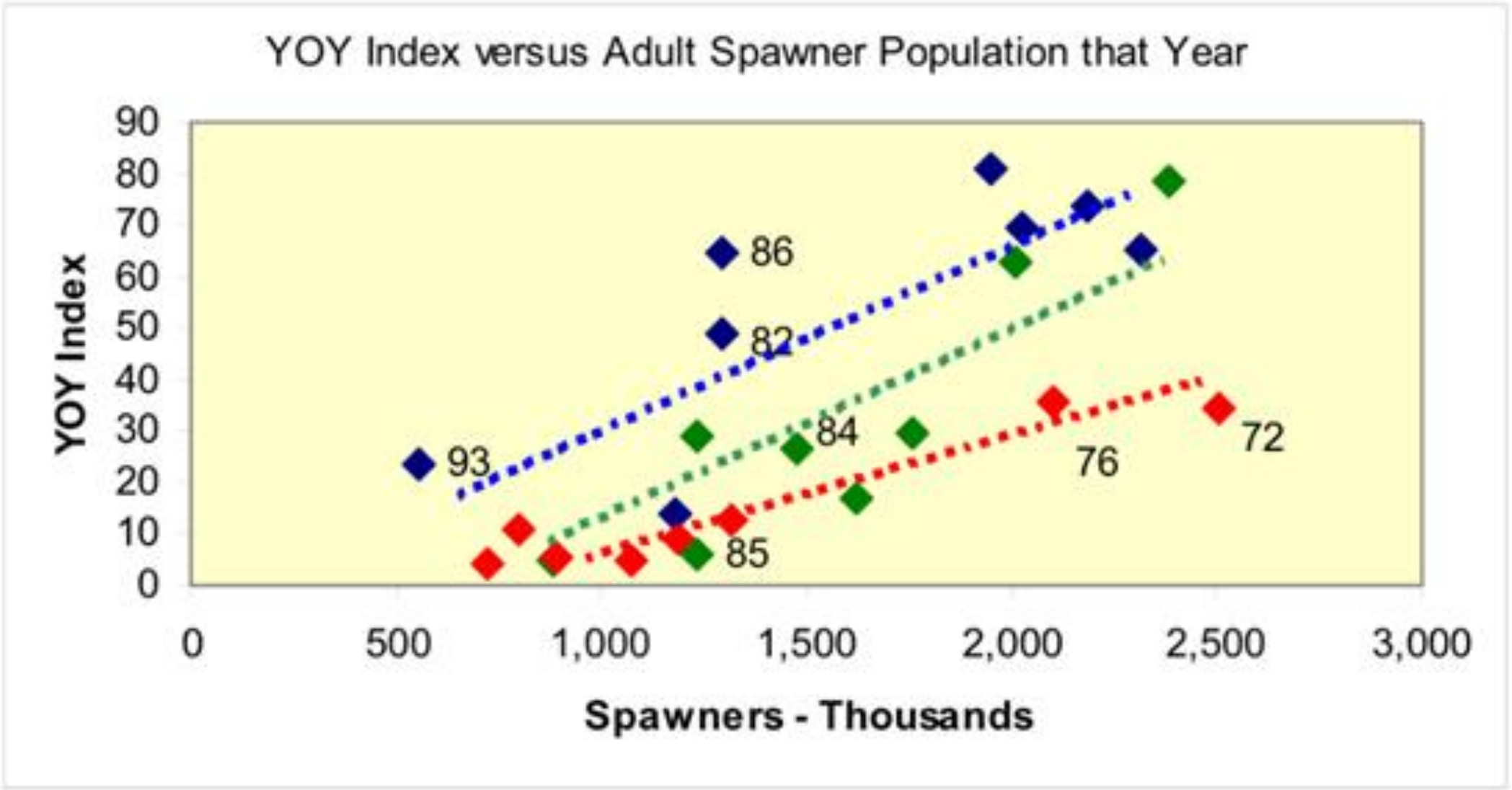
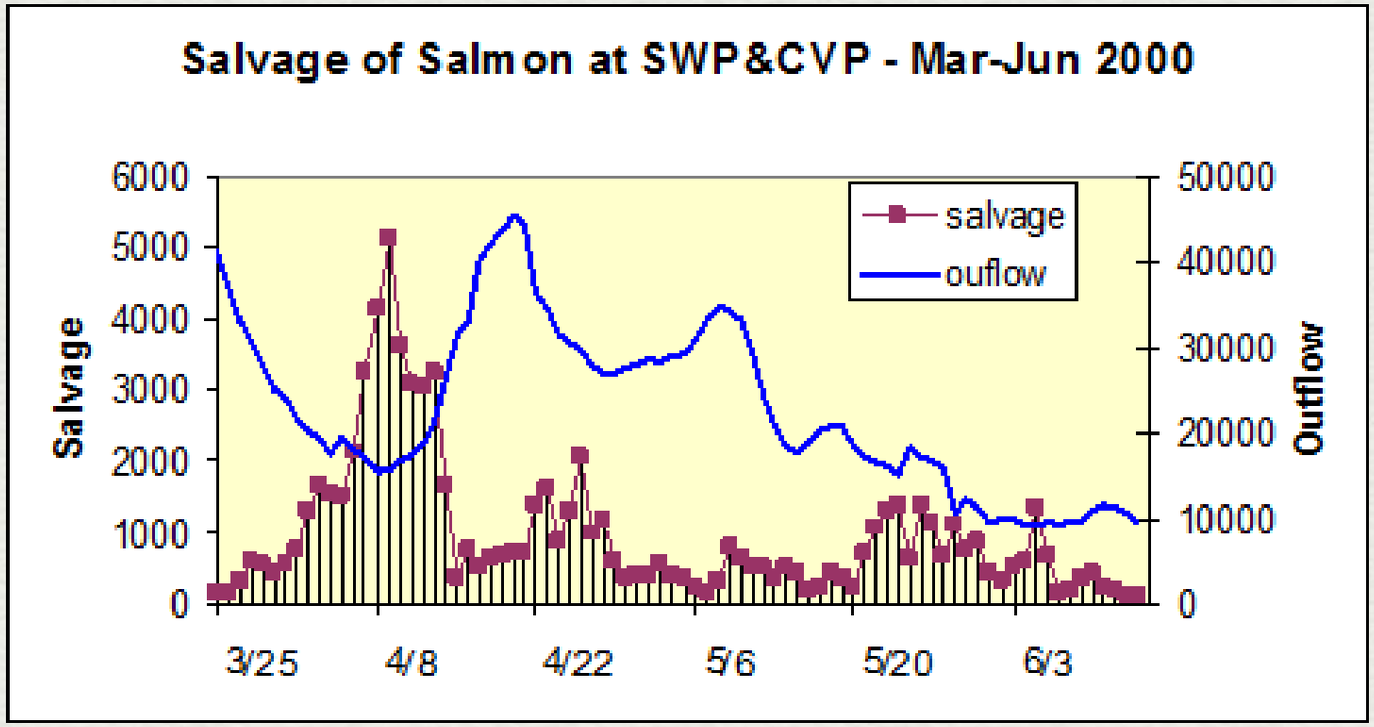
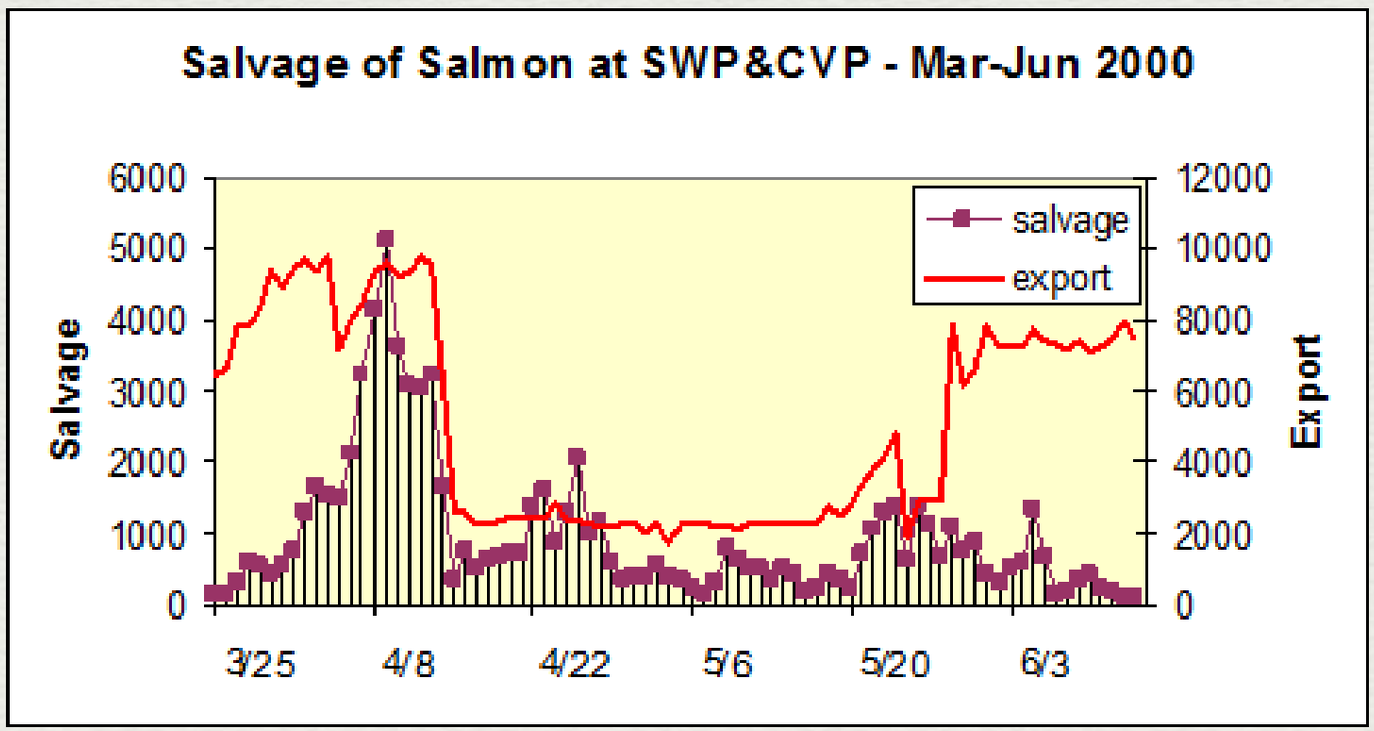


Figure 54. Version of Figure 31 showing spawner to first-summer recruit relationship for different water year types (blue = wet year; green = moderate year; and red = dry year).

Delta Salmon Salvage

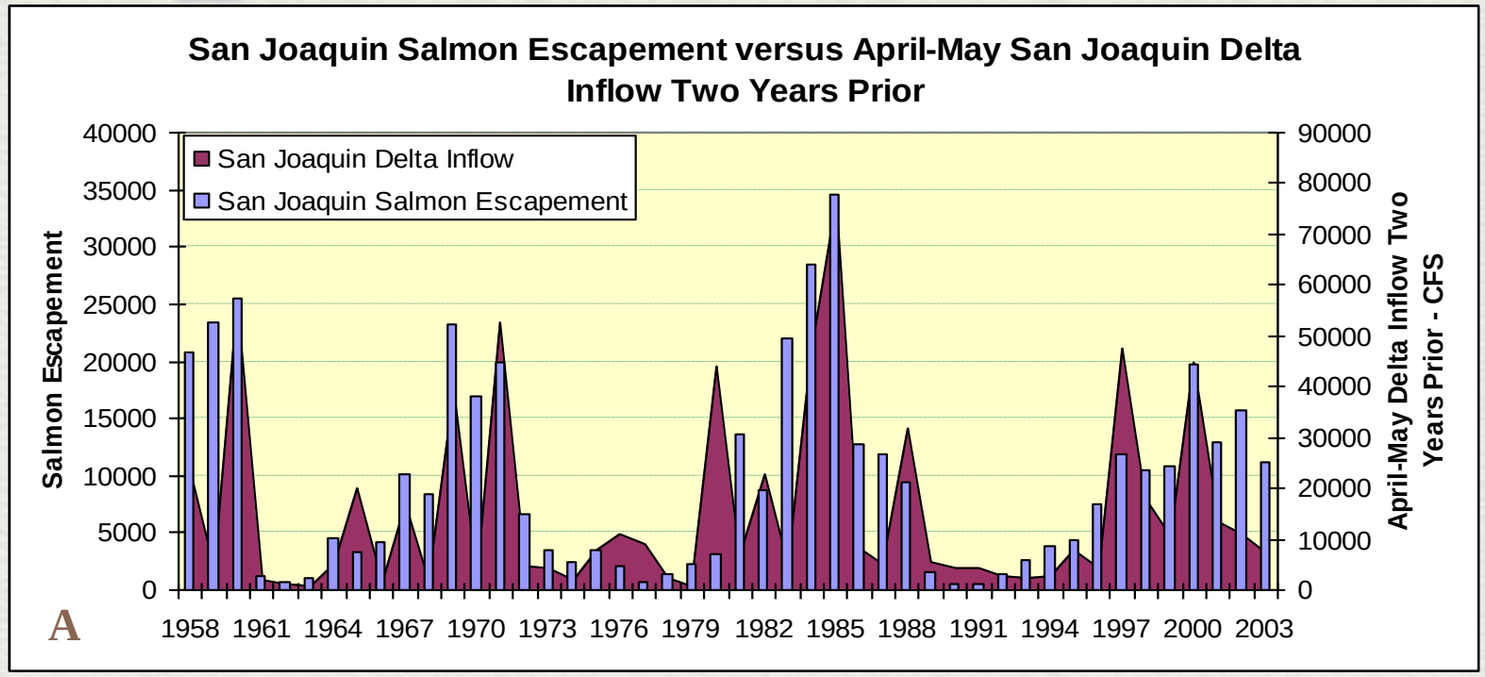
Salmon rearing in the Delta are most vulnerable to exports in the spring. High exports and declining outflow lead to high salvage rates at south Delta fish facilities. Recommended outflow and export criteria will reduce losses of young salmon.





San Joaquin Salmon

San Joaquin salmon run size is strongly related to San Joaquin inflow to the Delta in spring one and two years prior to their return to rivers. Reduced exports are necessary in spring to allow San Joaquin salmon emigrants to reach to the Bay.



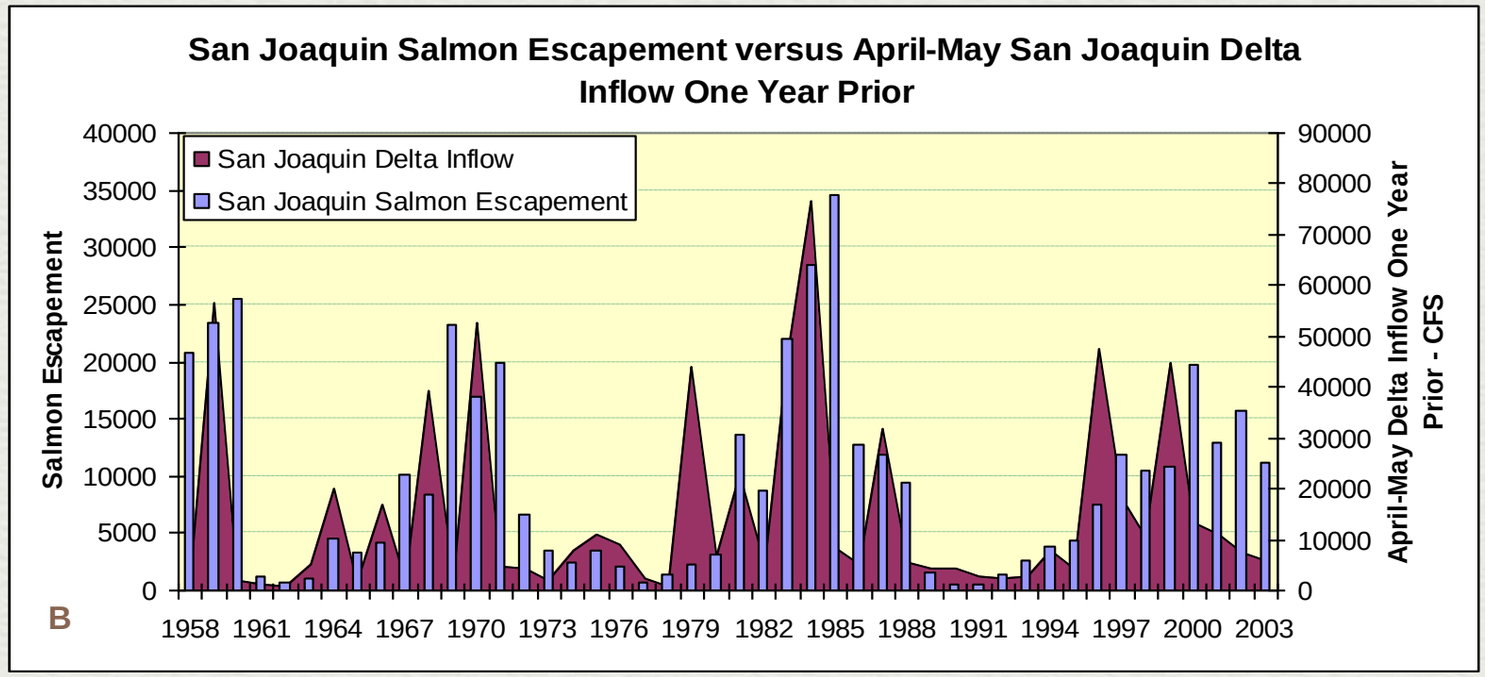


Figure 4. San Joaquin salmon escapement from 1958 to 2003 versus average San Joaquin River Delta inflow in April-May: **A** - two years prior; and **B** - one year prior.

San Joaquin Salmon

A secondary negative relationship also exists with the magnitude of spring exports.

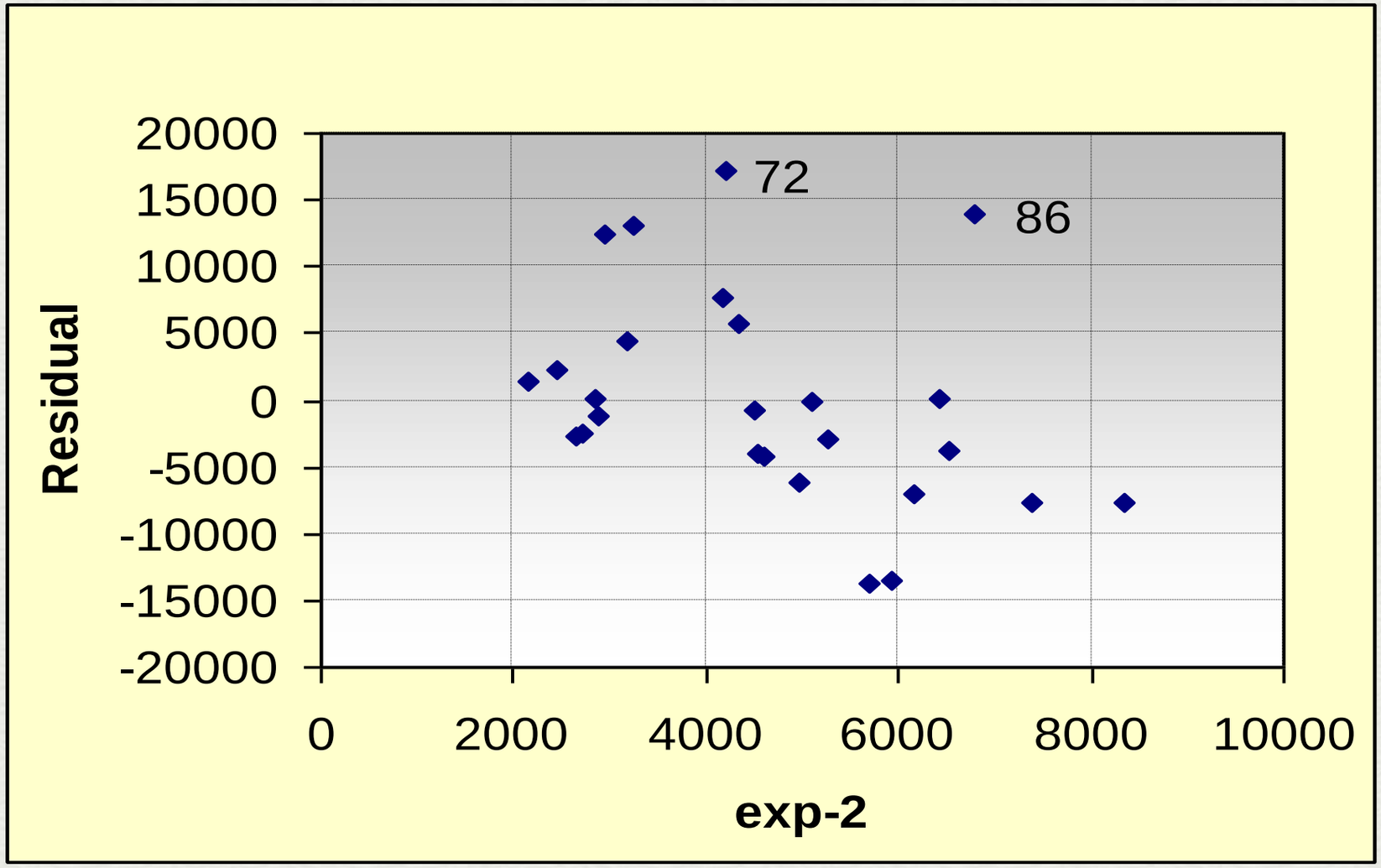


Figure 5. Residuals of regression of escapement, flow, and escapement two years earlier versus export level in April-May two years earlier for only low flow years. The relationship is marginally significant with 1972 and 1986, and highly significant without these years. Both years followed several years of high escapement, which may have contributed to the higher than predicted escapement in 1972 and 1986. The unusually high flows in the fall of 1986 may have also contributed to the large spawning run in the San Joaquin River that year.

Overall Conclusions

1. Outflow criteria are too low in non-wet years and summer of wet years to protect Delta fishes, their food supply, and their low salinity zone habitat.

2. Export criteria expressed as Export to Inflow ratios do not protect Delta fishes, their food supply, and their low salinity zone habitat from being exported from the Delta.

3. Direct effects of low outflow and high exports also translate downstream into the Bay in the form of lower Bay inflow, less nutrients, fewer organisms, and reduced low salinity zone productivity.

4. Specific export and outflow criteria are needed to protect beneficial uses in the Bay and Delta.