Timing of hatchery and wild winter-run Chinook salmon caught in the Sacramento River and Chipps Island trawls for the implementation of management actions

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Kevin Reece, DWR
Jonathan Speegle and Denise Barnard, FWS
and Barb Byrne, NOAA - Fisheries

Talk Outline

1. Identify management actions dependent on timing and relative abundance
2. Explain how the River Length-at-Date (RLAD) model determines race of juvenile salmon, and how it is different than the Delta Length-at-Date model (Delta)
3. Show why the varying proportions of false positives relative to false negatives within the Winter Run (WR) RLAD result in poor abundance estimates at Sacramento and Chipps Island
4. Show the timing of wild WR (genetic) in trawls at Sacramento and Chipps Island relative to WR RLAD model
5. Show the timing of WR coded-wire-tag (CWT) hatchery fish at Sacramento and Chipps Island relative to the WR RLAD model

Objective

To evaluate the efficacy of the River Length-at-Date model and the catch of WR CWT for determining the timing of management actions.

Conclusion: It is better to use both River Length-at-Date and catch of WR CWT than either one alone, for the timing of management actions targeting winter run.

Use of RLAD for estimating relative abundance should be done with caution.

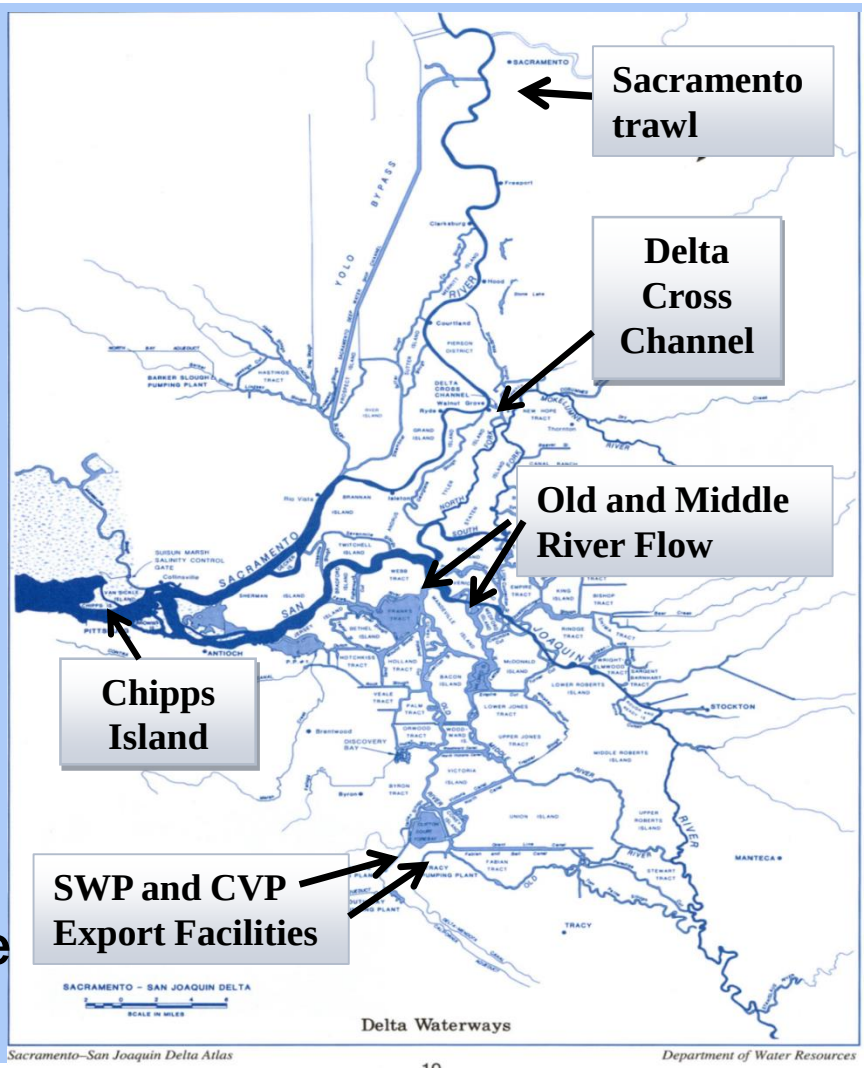
Management actions (RPAs) that use the timing and relative abundance of winter run and older juveniles as triggers

1. Action IV.1.1–IV.1.2: Delta Cross Channel (DCC) Gate Operations

2. Action IV.2.3: Old and Middle River (OMR) Flow Management

3. Action IV.3: Reduce Likelihood of Entrainment or Salvage at the Export Facilities

In addition, relative abundance at Sacramento and Chipps Island is used to help estimate what proportion of the wild WR population is in the Delta



Hatchery Winter Run

1. All hatchery WR are coded wire tagged (CWT)

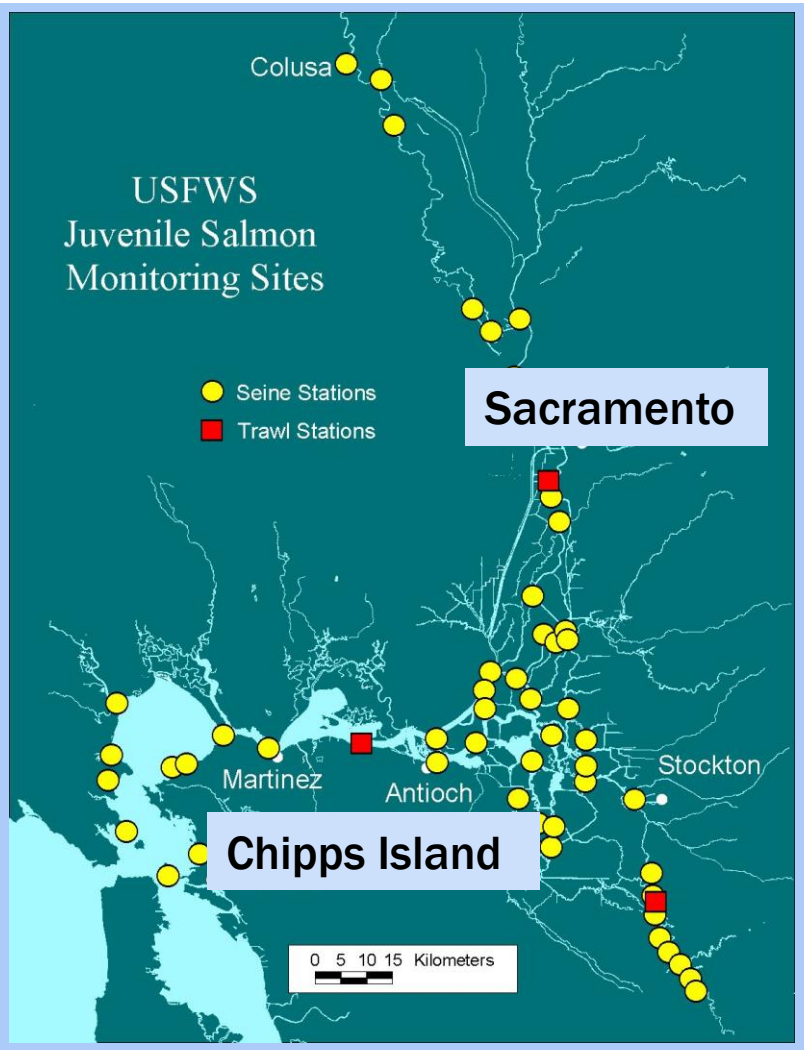
2. Hatchery WR are raised to smolt size and released in late January or early February

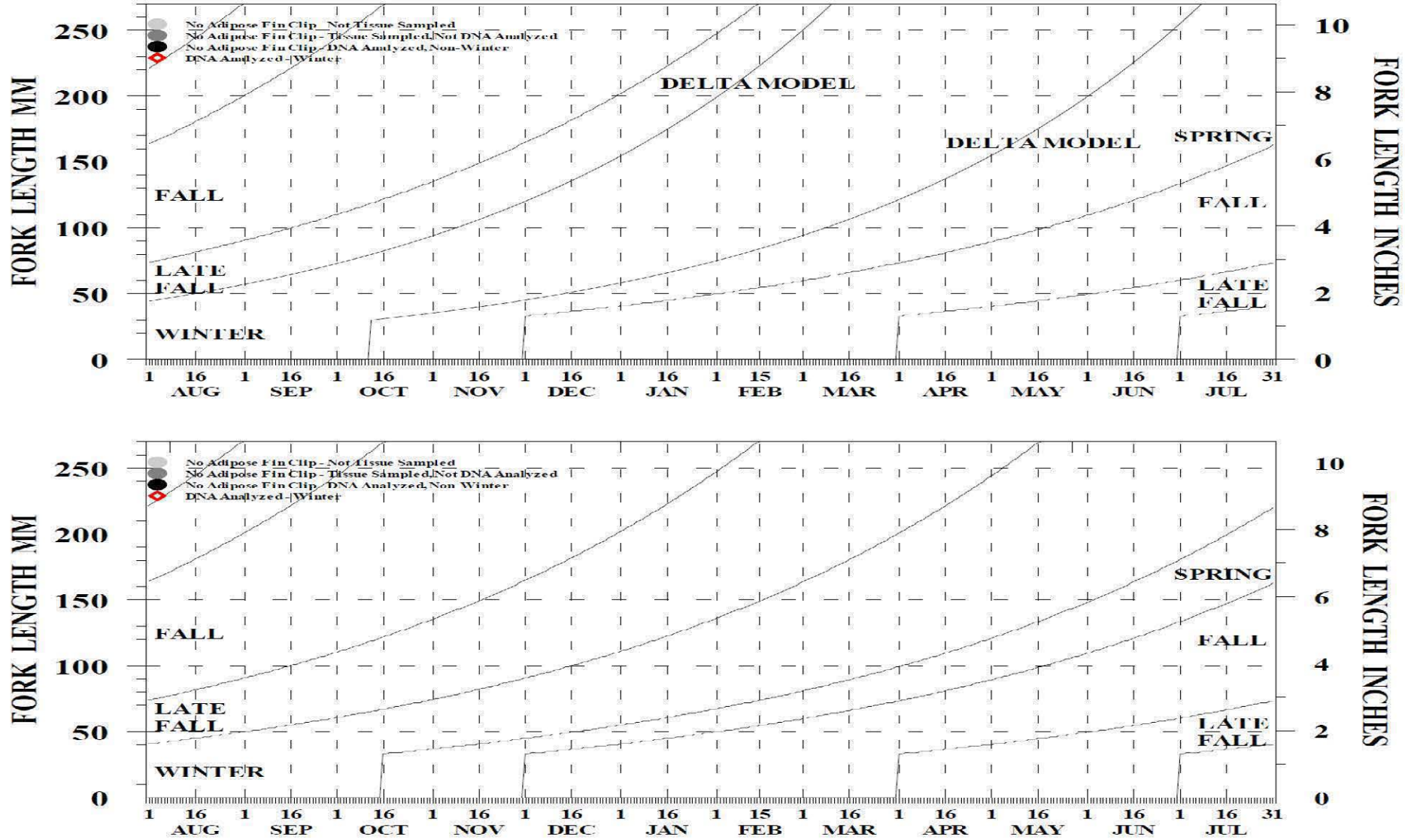
3. Hatchery WR are part of the ESA Ecological Significant Unit (ESU)

4. As such, the timing of their migration is also relevant for protective management actions (e.g. RPA's to avoid jeopardy)

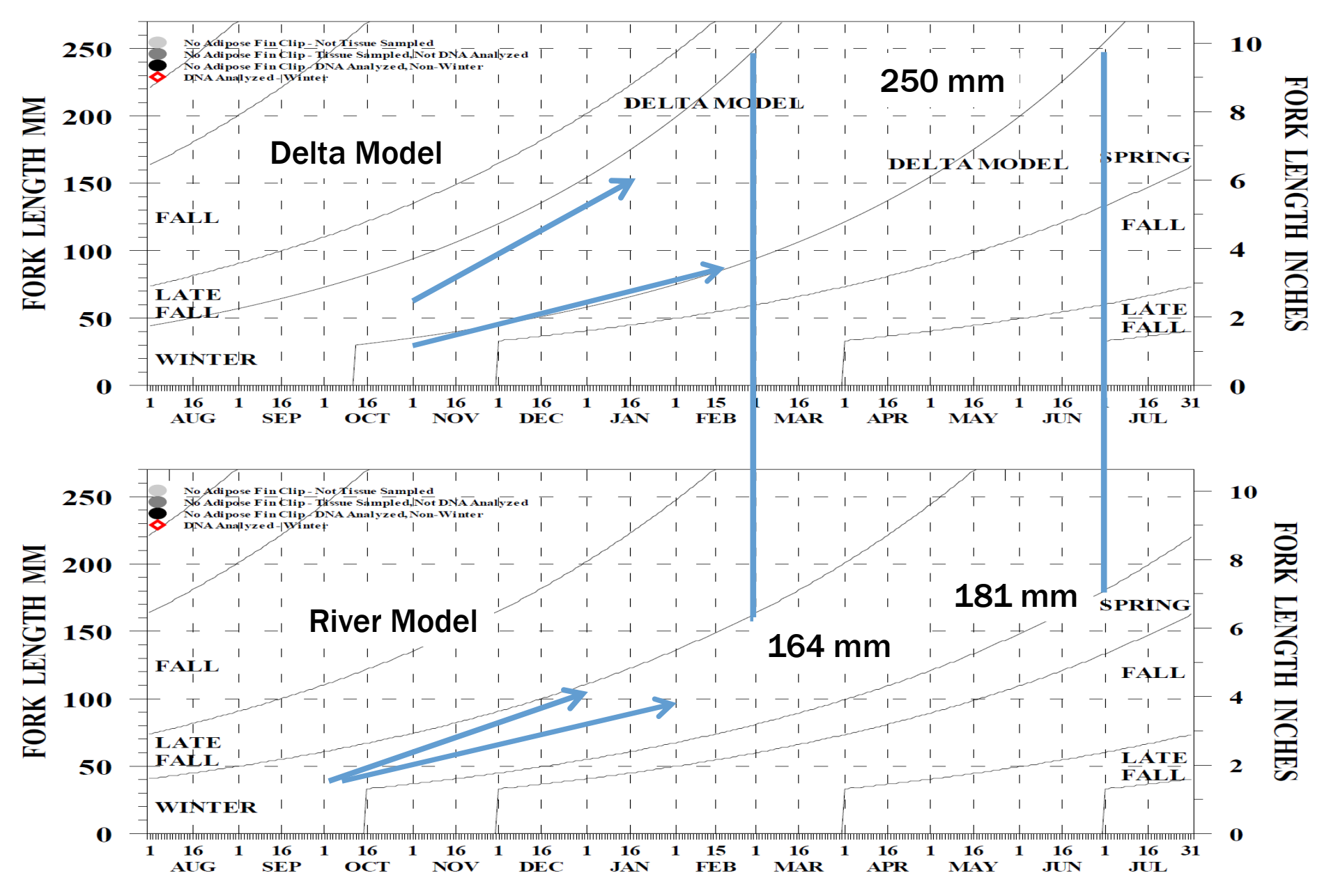
Sampling locations of juvenile salmon

- Sacramento Trawl
  - Kodiak trawl: Oct–March
  - Midwater trawl: April–Sept.
    - Usually samples 3 days per week
- Chipps Island Trawl
  - Midwater trawl: year round
    - Usually samples 3 days per week
- Beach seine sites
  - Year round
  - Usually once a week





Juvenile salmon are identified in the Delta using Length-at-Date Criteria; either the Delta model (top) or the River model (bottom). The River Length-at-Date (RLAD) model is used to determine juvenile salmon race at Sacramento, Chipps Island and in the beach seines



Growth is assumed to be greater for winter run in the Delta model when compared to the the River model. The Delta model is used at the SWP and CVP but I won't discuss it today.

Data sources

1. Genetic data
   A. Previous 2006 CALFED PSP Project
      Tissue samples collected at Sacramento (2008–2011) and at Chipps Island (2007–2011) and genotypes assigned for most runs (no FR SR); (Banks et al, 2014)

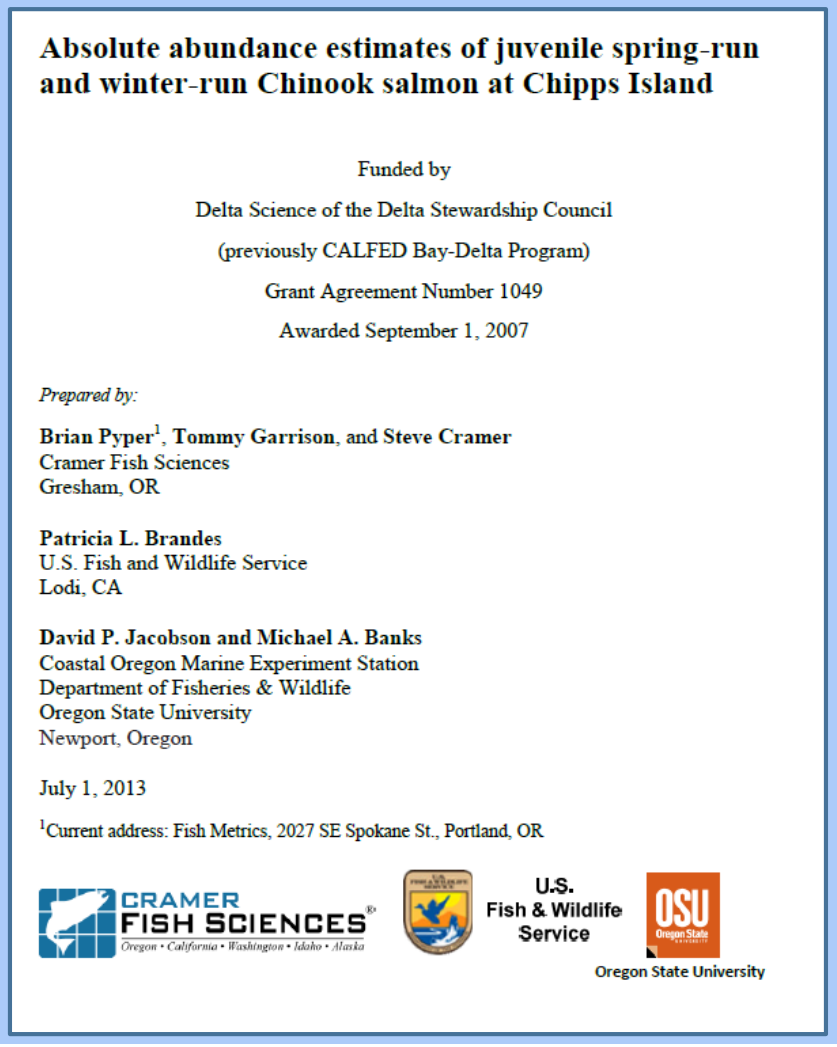
   B. Older data (1995–2002), from Sacramento, Chipps Island and beach seines. Samples processed by D. Hedgecock/M. Banks (Hedgecock 2002) to determine only if winter run

2. CWT WR data
   A. CWT WR recovered at Sacramento and Chipps Island from Delta Juvenile Fish Monitoring Program (USFWS-Lodi/IEP) between 1992–2014

Previous Project from 2006 CALFED PSP

Resulted in a report that estimated the abundance of all races of salmon at Chipps Island (2008–2011) using genetic sampling and estimates of trawl efficiency

http://deltacouncil.ca.gov/scienceprogram/projects/estimating-juvenile-chinook-salmon-spring-and-winter-run-abundance-chipps.



Absolute abundance estimates of juvenile spring-run and winter-run Chinook salmon at Chipps Island

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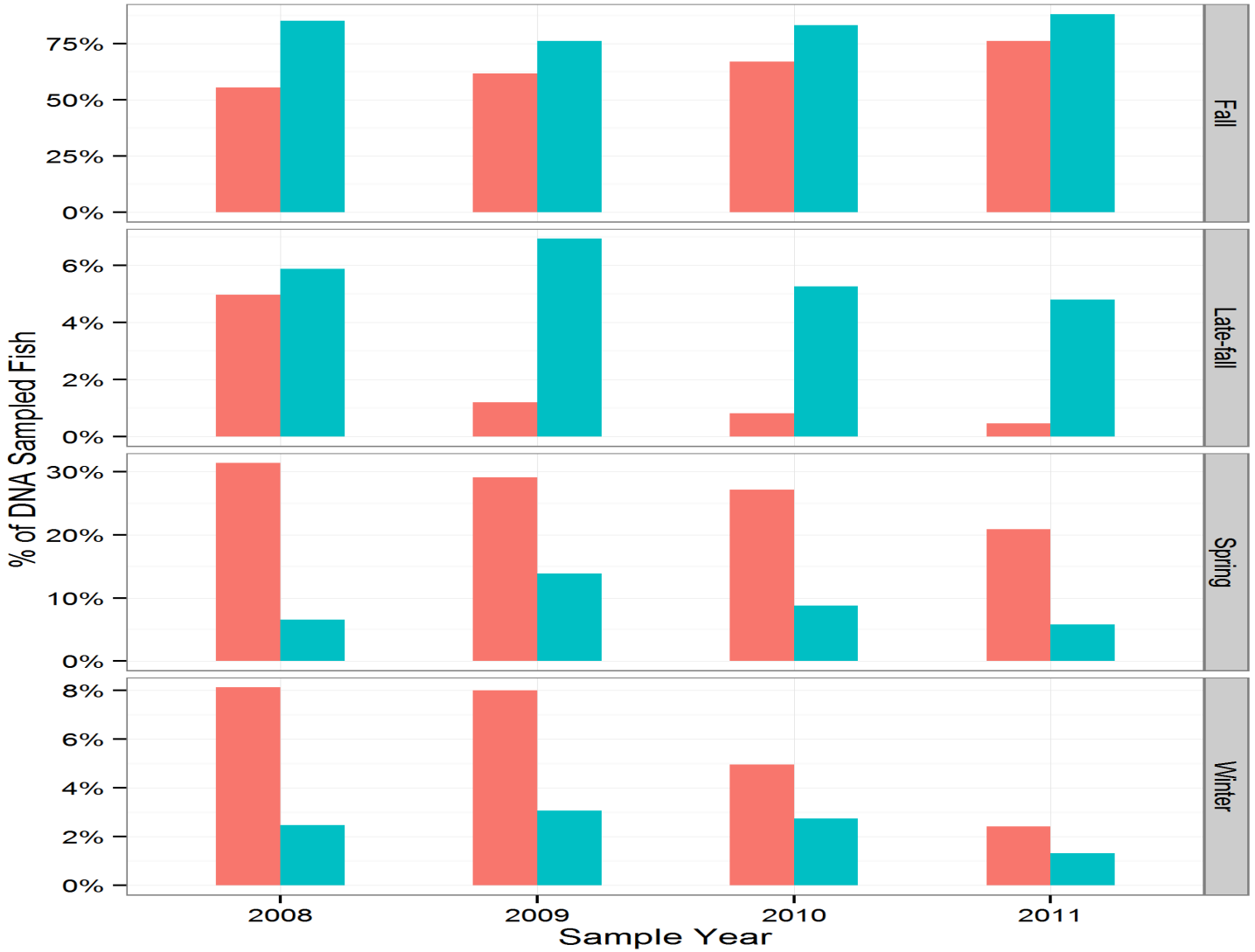


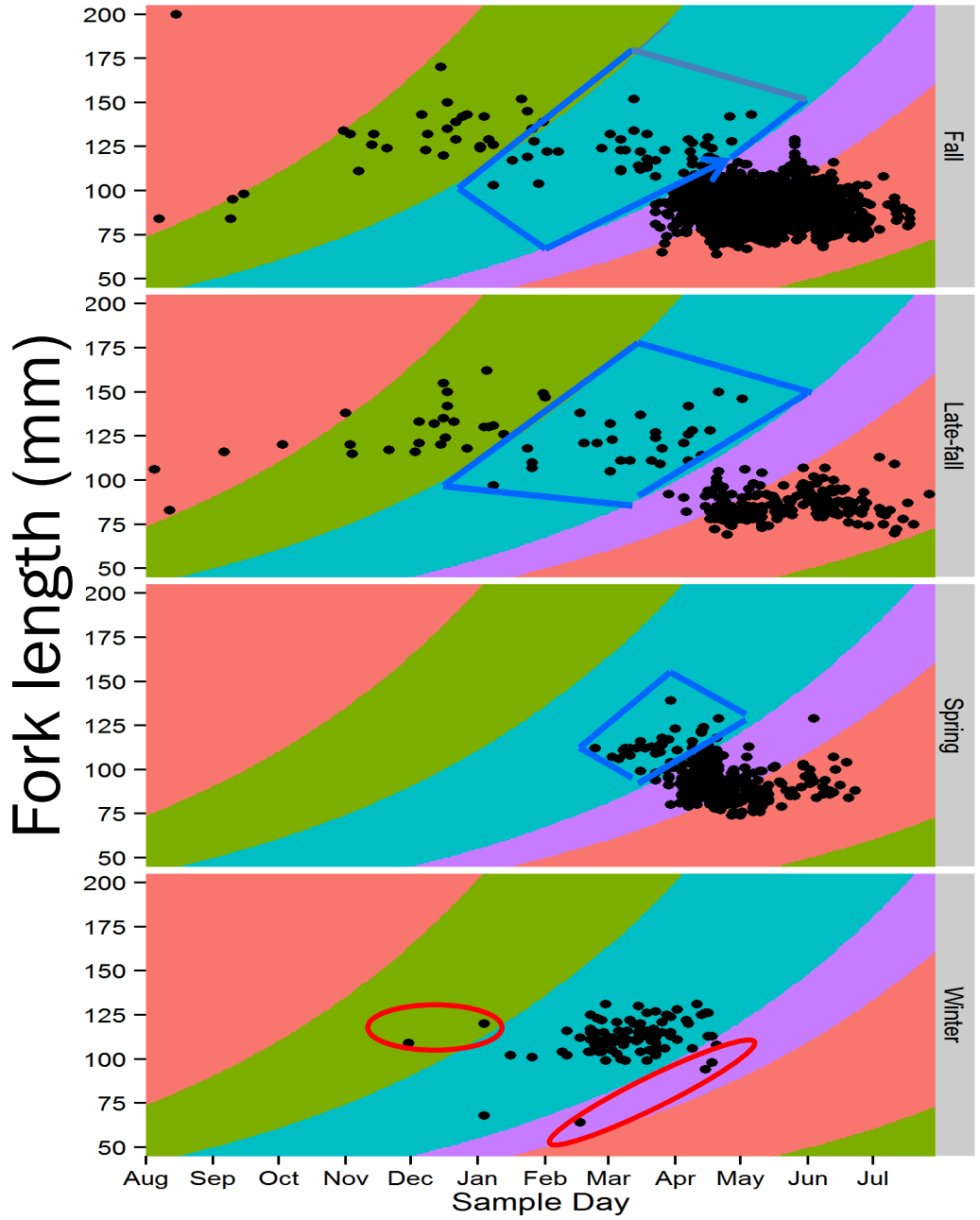
Percent of sample with winter run assignments based on RLAD and observed DNA for juvenile salmon caught between 2008–2011 at Chipps Island (Pyper et al, 2013)

Method

- Length-at-date
- Observed DNA

WR RLAD overestimated the abundance of genetic winter run at Chipps Island (2008–2011) and magnitude of overestimation varies between years

The WR RLAD for winter run is not suitable for estimating abundance at Chipps Island



Source: Pyper et al 2013

DNA

FALL

LATE-FALL

SPRING

WINTER

Run
Fall
Late Fall
Winter
Spring

River Length at Date Model

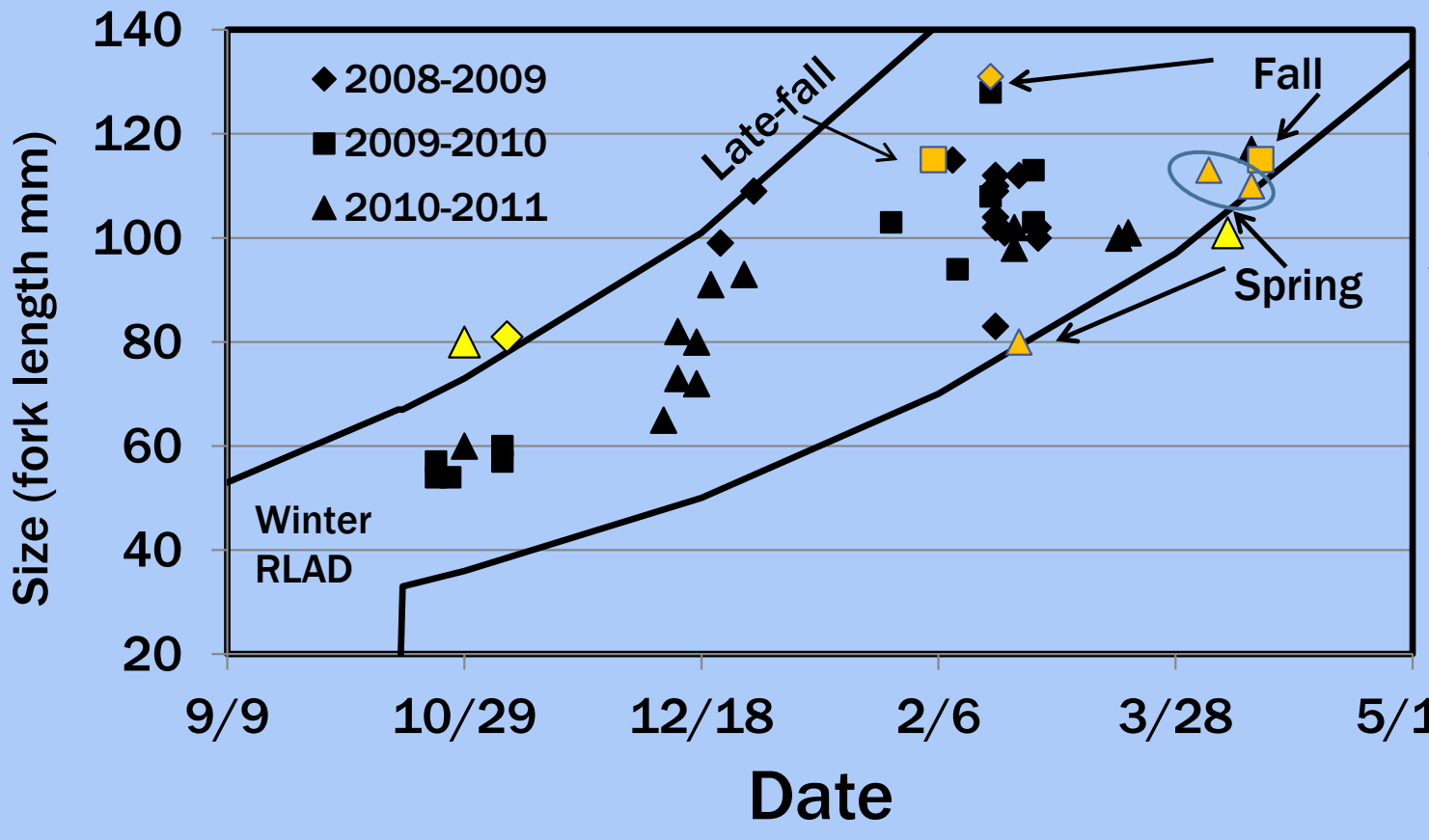
Chipps Island; (2007–2011)

WR RLAD overestimates WR abundance at Chipps Island because there are more false positives (in blue boxes) than false negatives (in red circles) and the magnitude of both varies by year.

False positives are non-winter run within WR RLAD;

False negatives are winter run outside of WR RLAD.

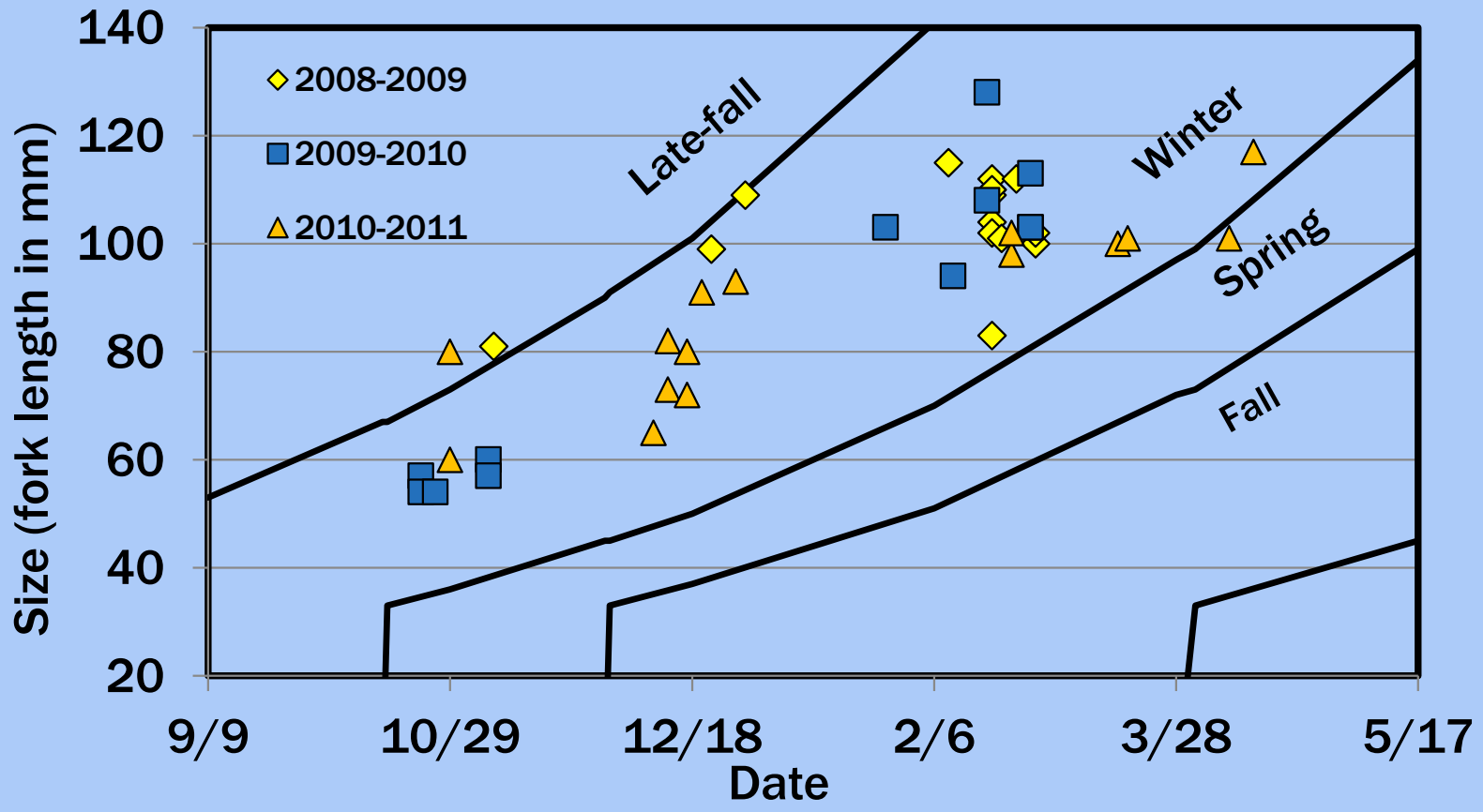
Genetic winter run and non-winter run in the WR RLAD in the Sacramento Trawl; 2008–2011



False positives (orange symbols) are usually greater than the false negatives (yellow symbols) but varies by year – which results in overestimation of abundance and variation in the magnitude of overestimation.

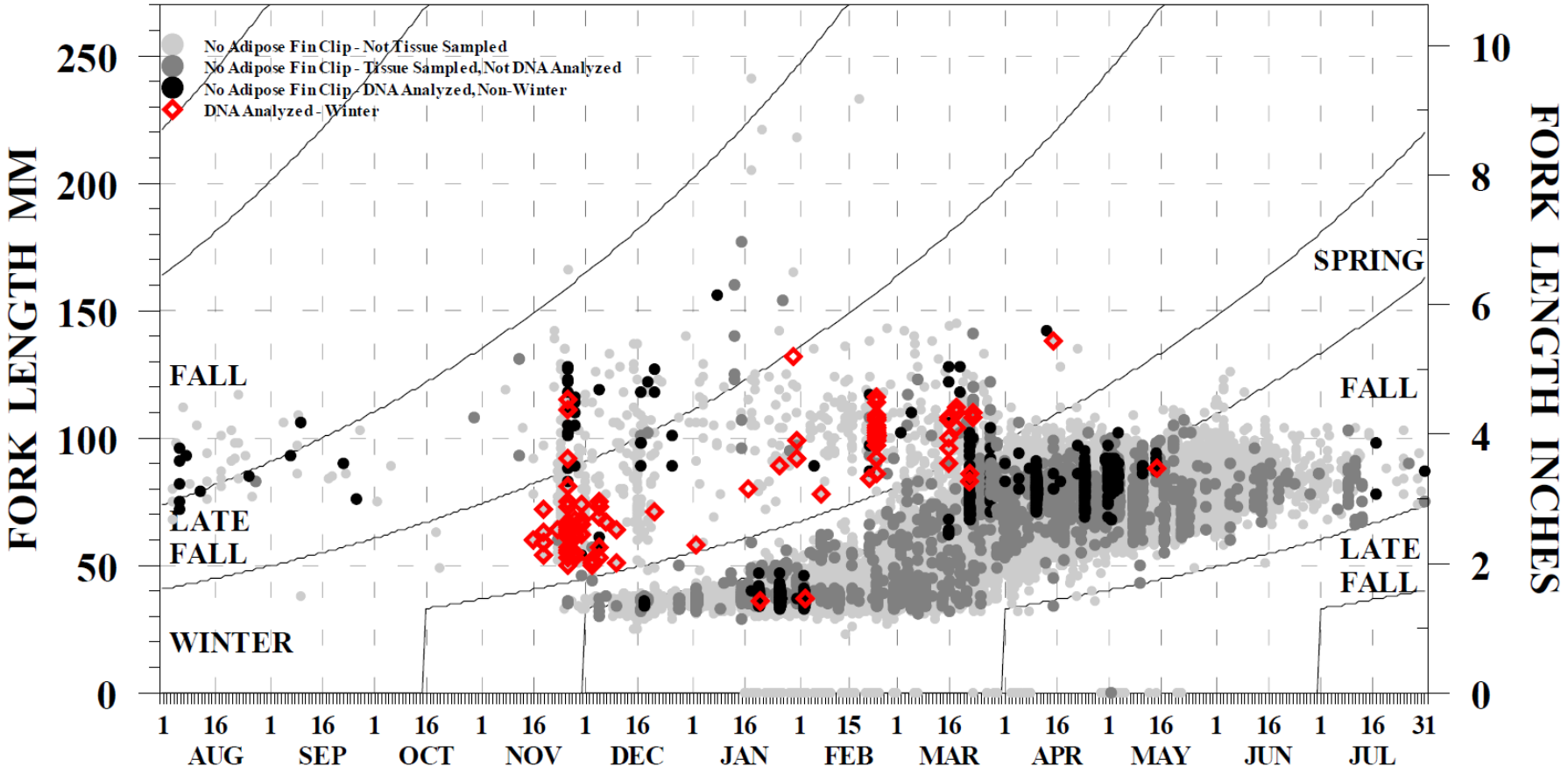
The WR RLAD for winter run is not suitable for estimating abundance at Sacramento

Most genetic winter run caught in the Sacramento Trawl between 2008–2011 were contained within the WR RLAD



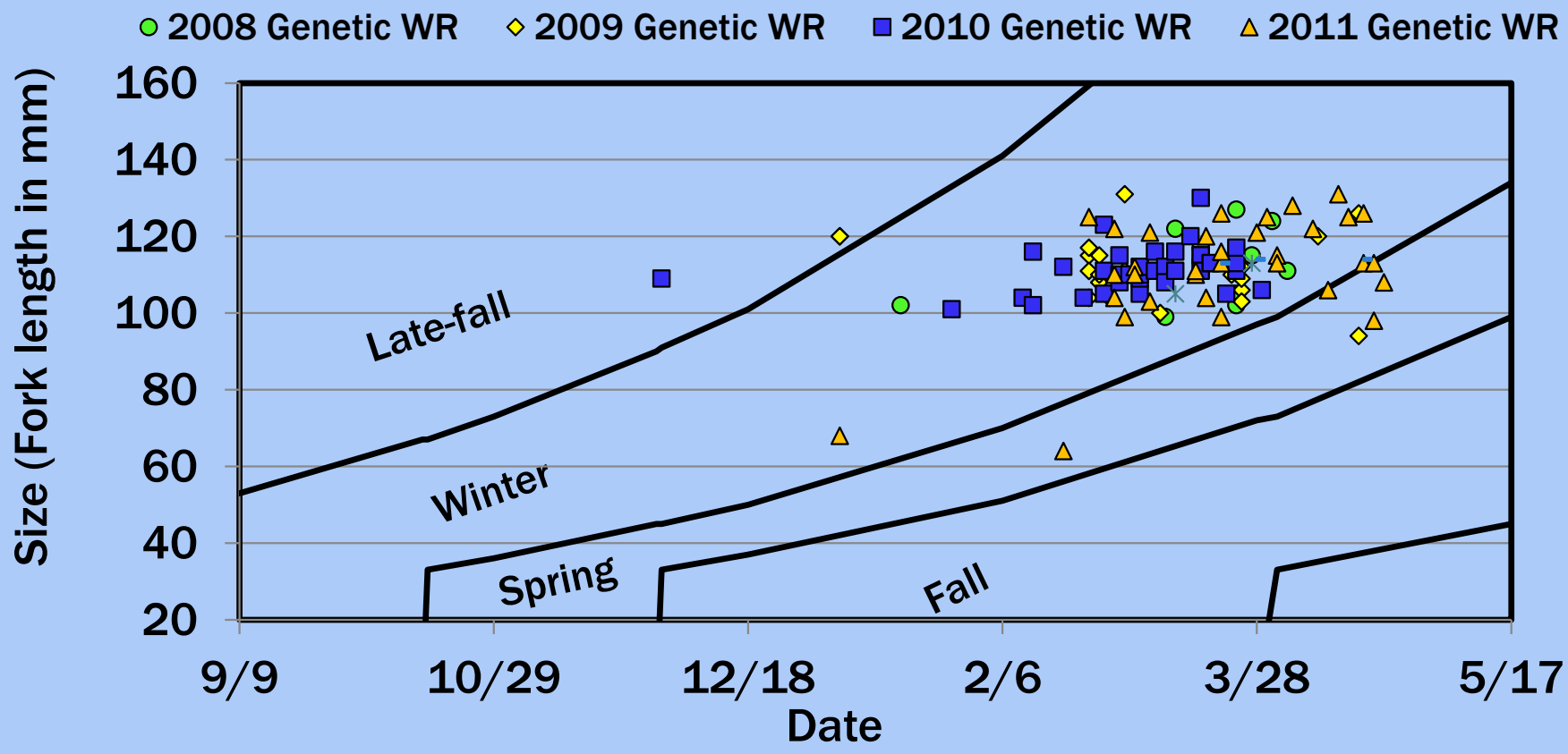
The WR RLAD is generally suitable for estimating the timing of winter run at Sacramento

Most genetic winter run (red open diamonds) caught in the Sacramento Trawl between 1995 -2002 were also contained within the WR RLAD



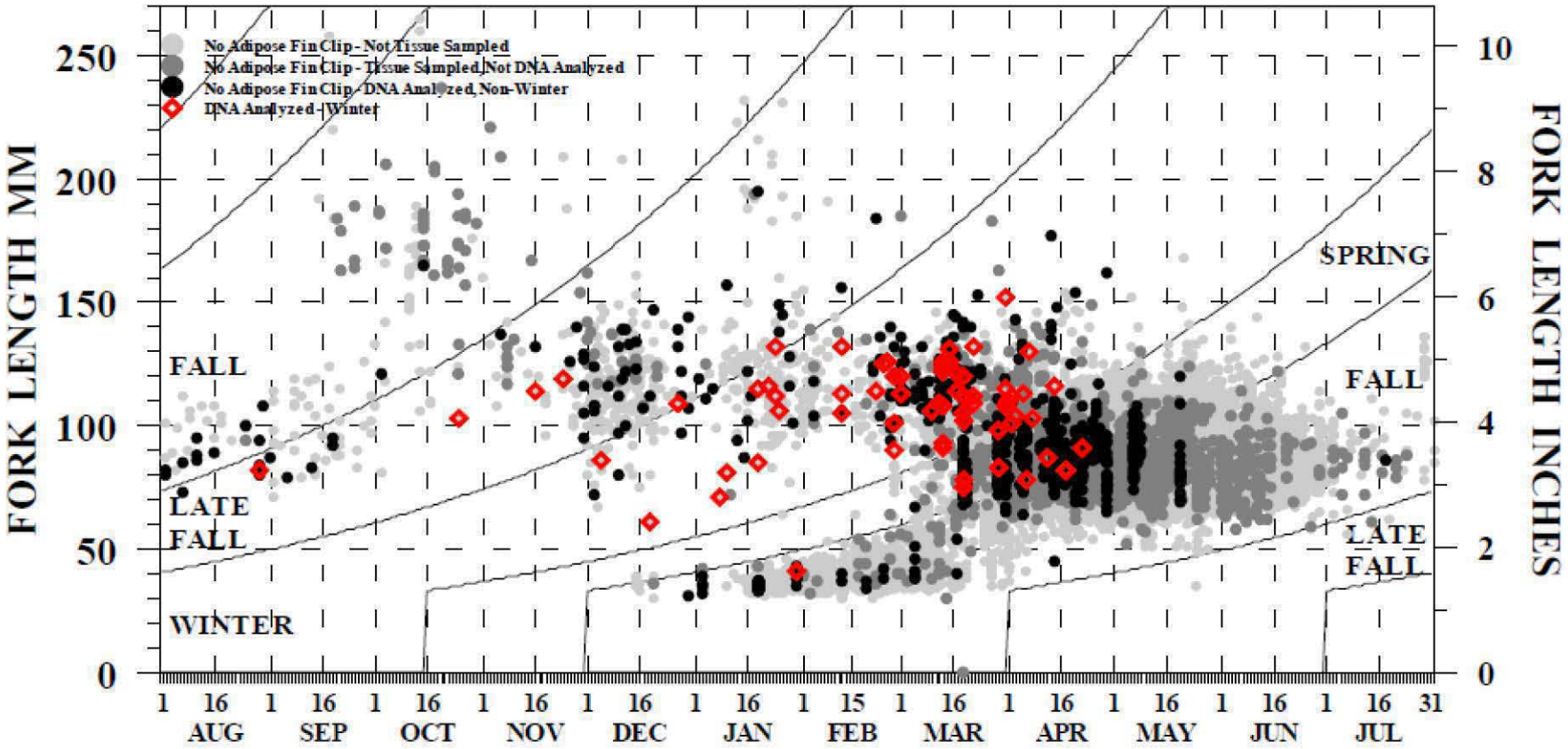
The WR RLAD is generally suitable for estimating the timing of winter run at Sacramento

Most genetic winter run observed at Chipps Island were in the WR RLAD (2008–2011)



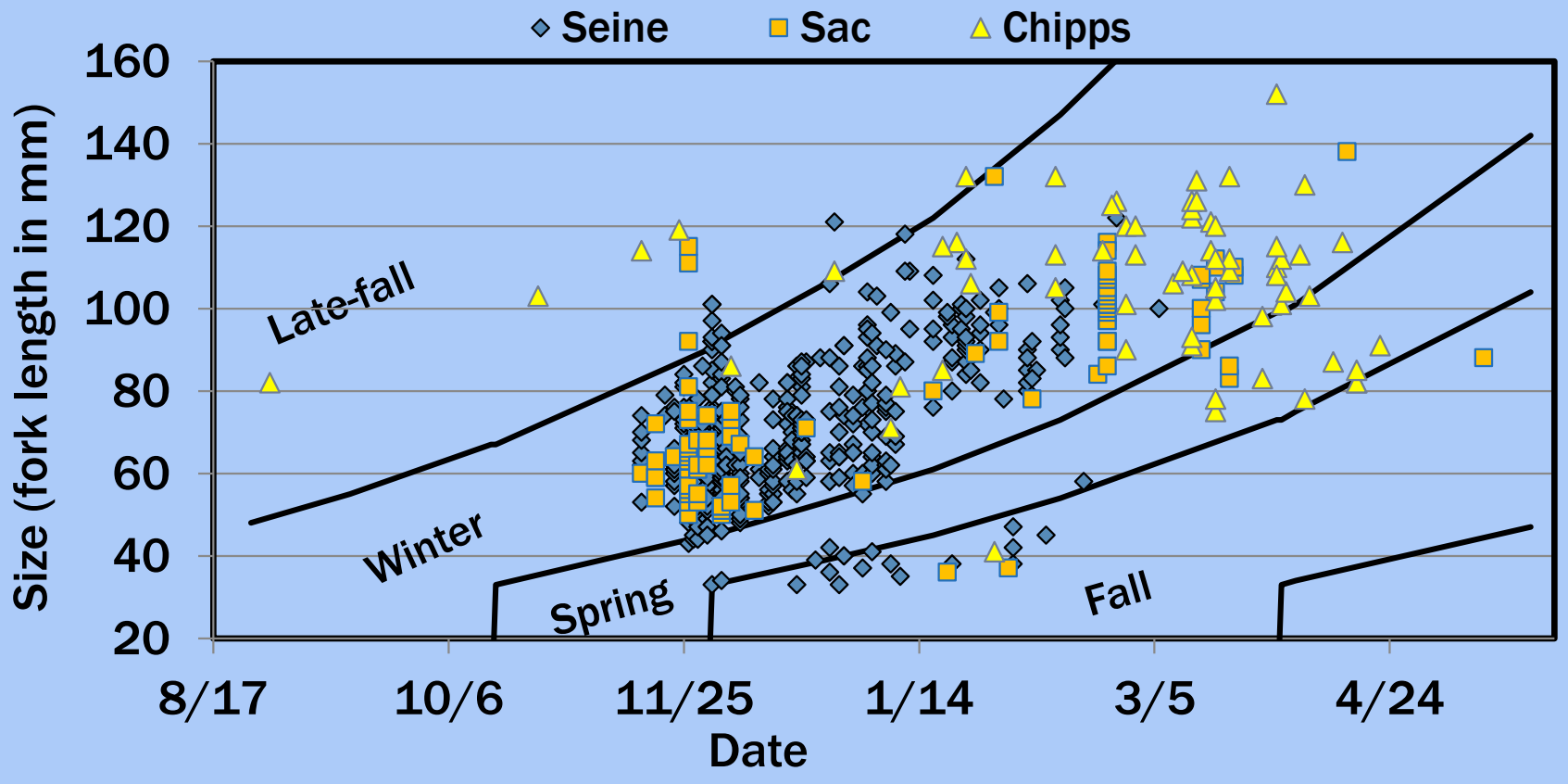
The WR RLAD is generally suitable for estimating the timing of winter run at Chipps Island

Most of the genetic WR (red open diamonds) in 1995–2002 were in the WR RLAD at Chipps Island



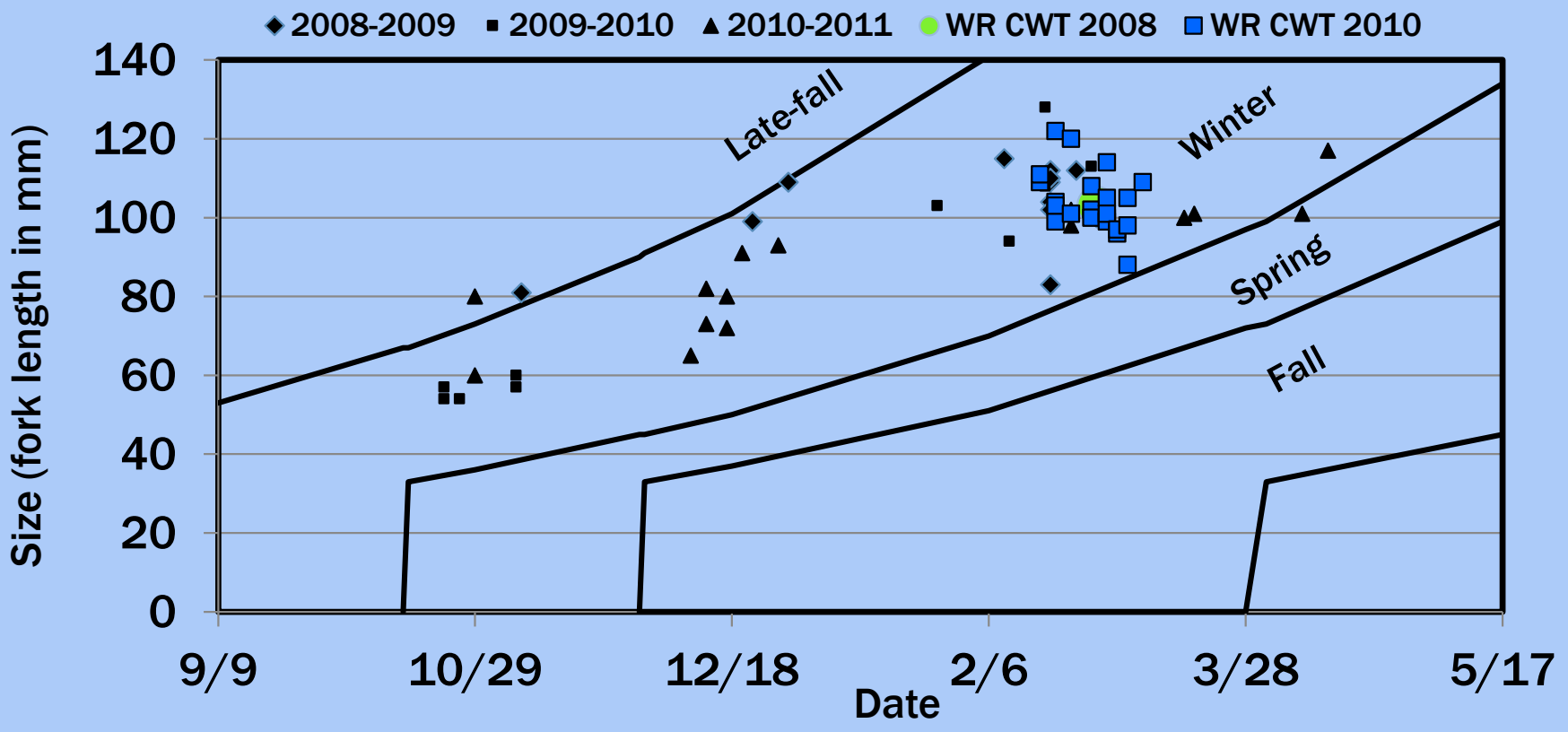
The WR RLAD is generally suitable for estimating the timing of winter run at Chipps Island

Most genetic winter run between 1995 and 2002 in seines also in WR RLAD (and similar to what observed at Sacramento trawl and Chipps Island)



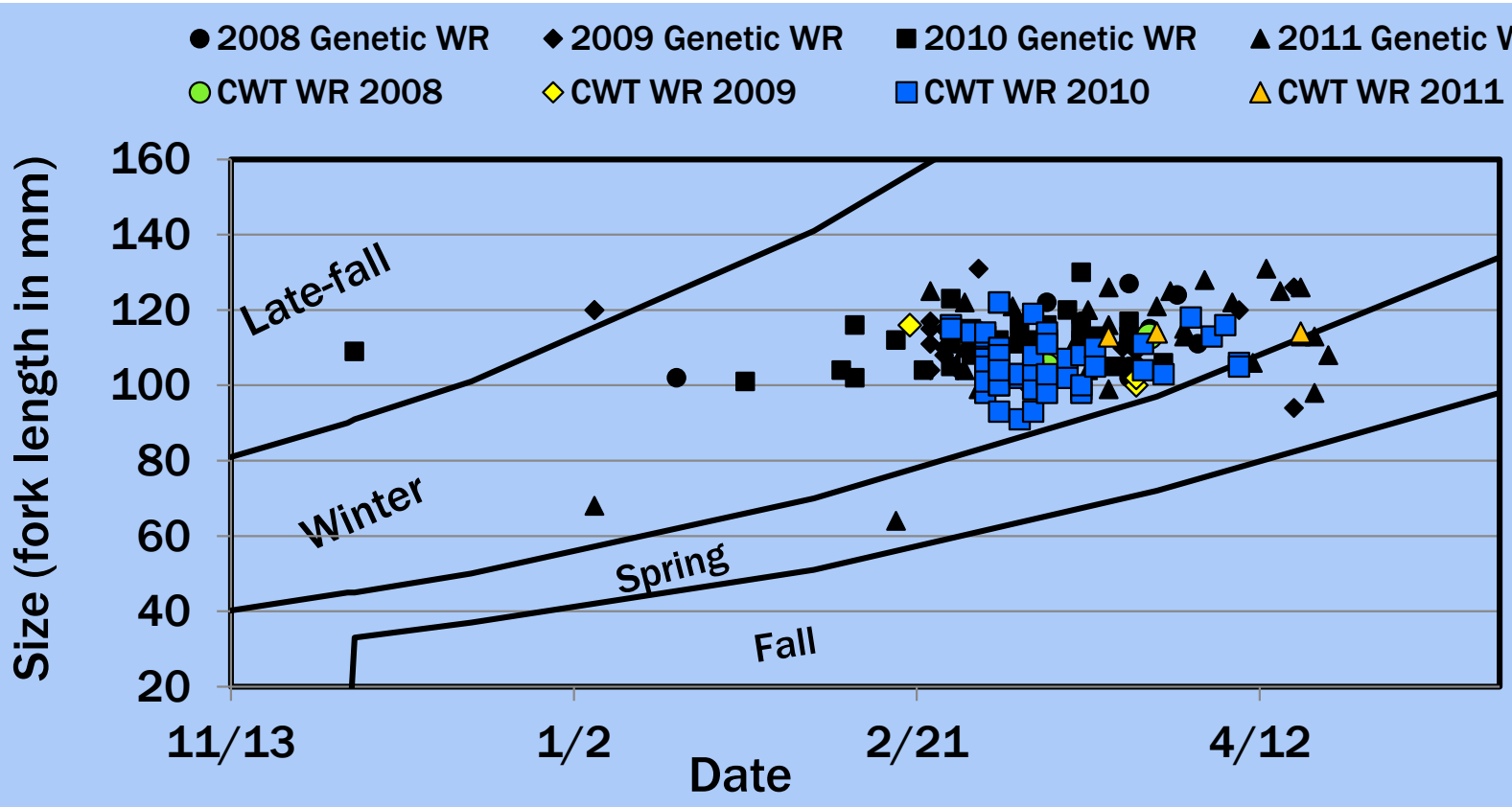
The WR RLAD is generally suitable for estimating the timing of winter run in the Delta

Genetic and CWT WR caught in the Sacramento trawl
Most CWT WR found to be within the WR RLAD
(although not many caught; 1 in 2008, the rest caught in 2010)



But the hatchery CWT fish, released late in the season, do not adequately represent wild winter run that **enter** the Delta (at Sacramento) earlier in the season

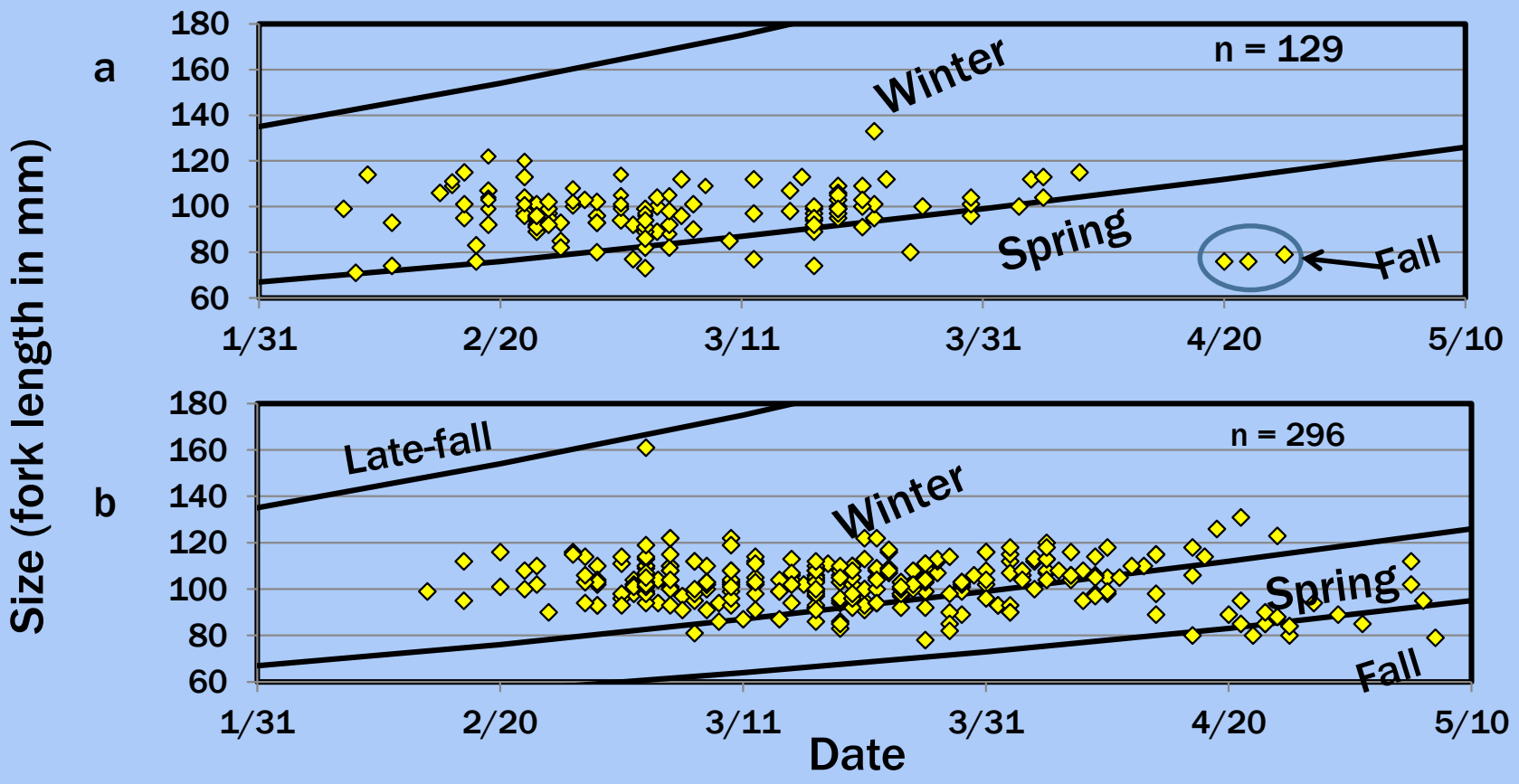
Genetic and CWT winter run (2008-2011) at Chipps Island and WR RLAD
Most CWT WR found to be within the WR RLAD



Most (54) CWT fish caught in 2010, 2 caught in 2008; 3 caught in 2009; 3 in 2011

The WR CWT fish do seem to coincide with most of the wild winter run moving past Chipps Island in these years

CWT WR at Sacramento (a) and Chipps Island (b) between 1992 - 2014



Most CWT WR incorporated into the WR RLAD, but some variability , more so at Chipps Island

Summary

For management actions that target protection of winter run;

the WR RLAD can be used to generally identify the timing of winter run, both at Sacramento and Chipps Island,

but it should be used with caution to estimate abundance as it overestimates abundance due to the greater number of false positives relative to false negatives and the variation between these among years.

Hatchery winter run (CWT) can also be used to determine the timing of migration for implementation of protective management actions but should not be used to estimate the timing of Delta entry by wild winter run at Sacramento.

Questions?

Sacramento Trawl

Chips Island Trawl

Beach Seine

References:

Banks, M.A., D. P. Jacobson, I.Meusnier, C.A. Greig, V.K. Rashbrook , W.R. Ardren, C.T. Smith, J.Bernier-Latmani, J. Van Sickle and K.G. O'Malley*. 2014. Testing advances in molecular discrimination among Chinook salmon life histories: evidence from a blind test . Animal Genetics. DOI: 10.1111/age.12135. http://onlinelibrary.wiley.com/doi/10.1111/age.12135

Hedgecock, D., 2002. Microsatellite DNA for the management and protection of California's Central Valley chinook salmon (Oncorhynchus tshawytscha). Final Report for the Amendment to Agreement No. B-59638. University of California, Davis, Bodega Marine Laboratory

Pyper, Brian, T. Garrison, S. Cramer, P.L. Brandes, D.P Jacobson and M.A. Banks 2013. Absolute abundance estimates of juvenile spring-run and winter-run Chinook salmon at Chipps Island. Submitted to Delta Science, Delta Stewardship Council, White paper deliverable for Grant Agreement Number 1049. July 1, 2013. 89p.

Key Points

1. The River Length-at-Date (RLAD) model is not suitable for estimating winter-run abundance at Sacramento or Chipps Island

2. The RLAD is generally suitable for estimating the timing of winter run at Sacramento and Chipps Island

3. The WR CWT fish generally fall within the winter run RLAD – both at Sacramento and Chipps Island (although some variability and more at Chipps Island)

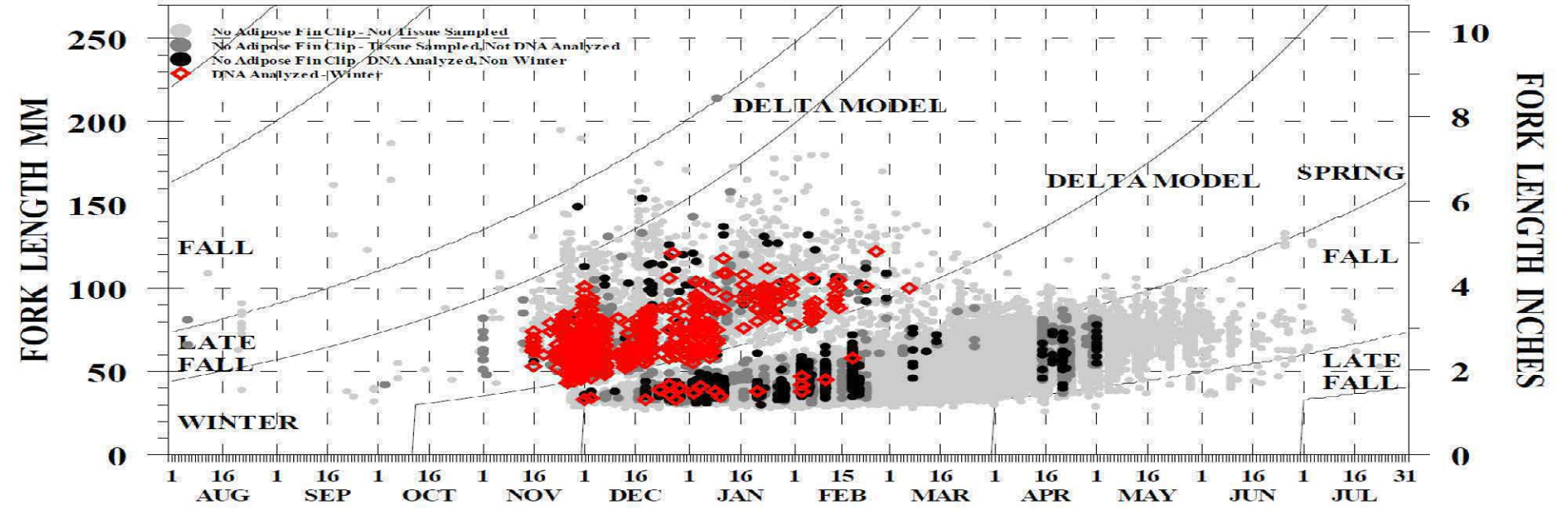
4. The WR CWT fish do not adequately represent wild winter run that **enter** the Delta (at Sacramento) earlier in the season.

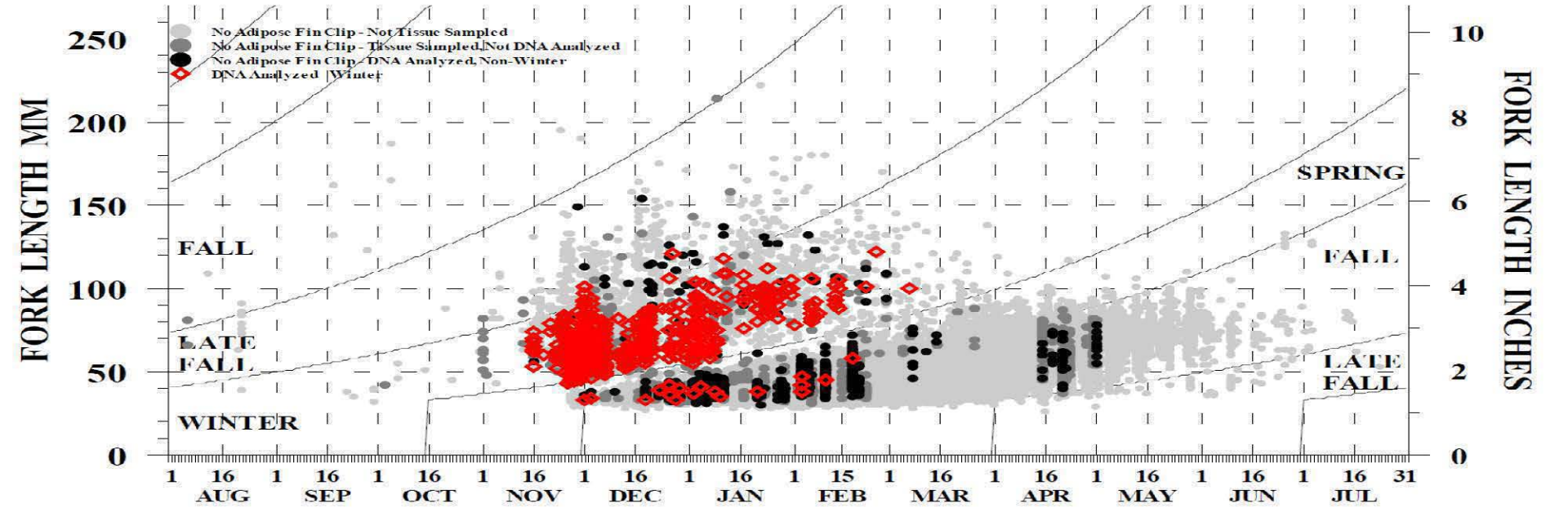
Key Points

5. WR CWT fish seem to coincide with most of the wild winter run moving past Chipps Island.

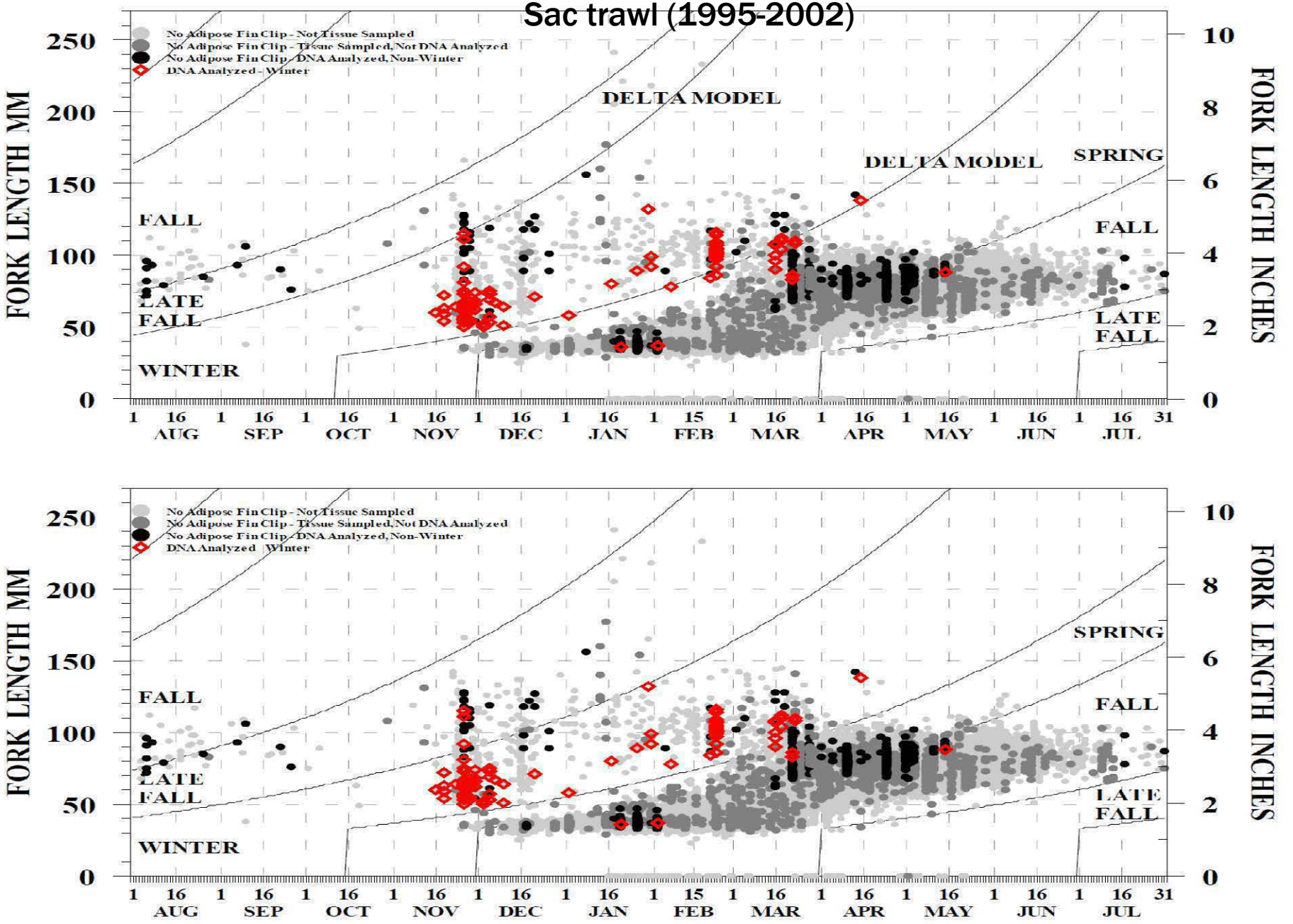
6. Management Actions derived for the protection of winter run should use both the RLAD and the recovery of WR CWT fish to determine the timing of such actions.

Seine 1995-2002



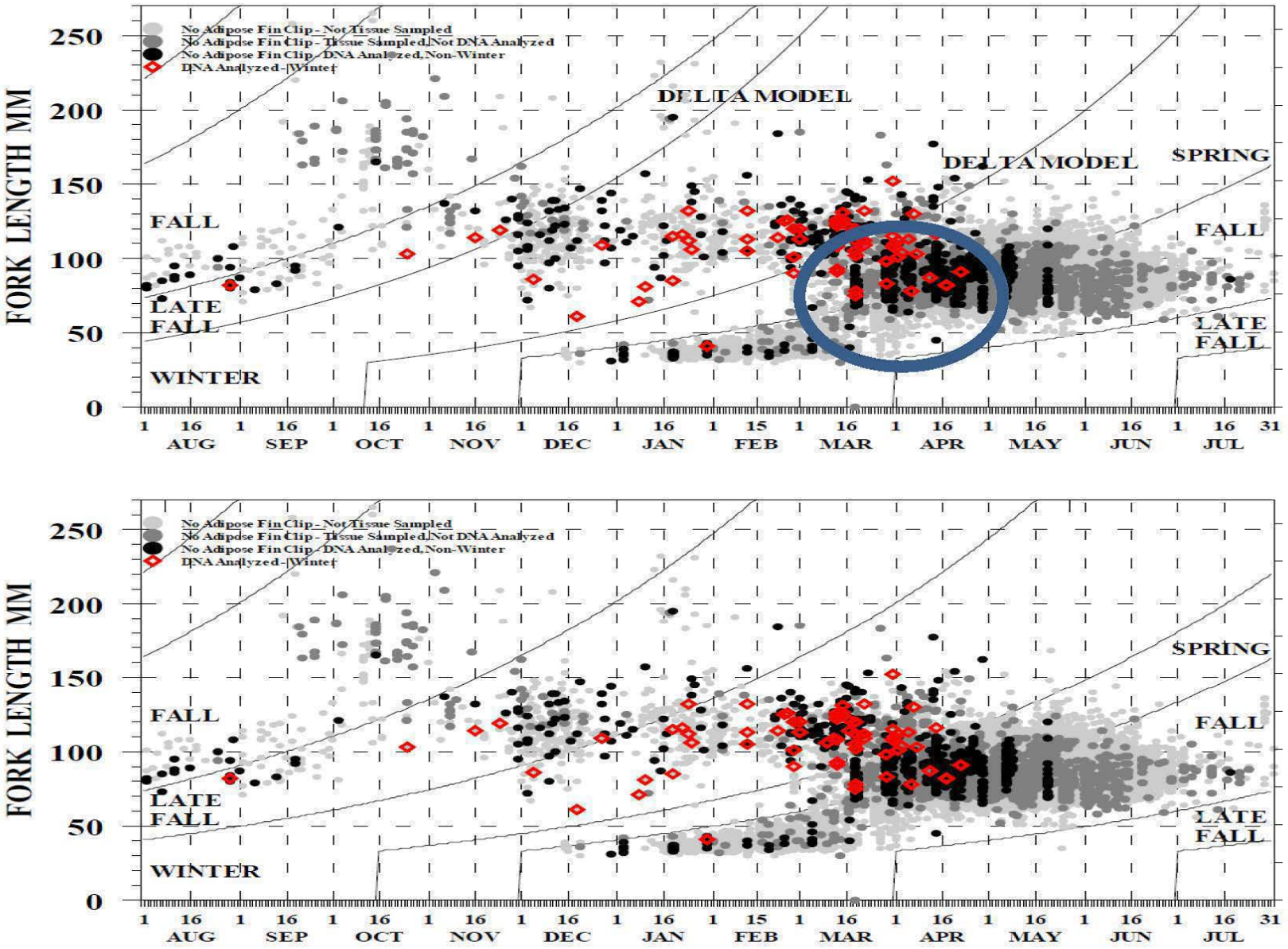


Sac trawl (1995-2002)



No Adipose Fin Clip - Not Tissue Sampled
No Adipose Fin Clip - Tissue Sampled, Not DNA Analyzed
No Adipose Fin Clip - DNA Analyzed, Non-Winter
DNA Analyzed - Winter
SPRING
FALL
LATE FALL
WINTER
FALL
LATE FALL
FORK LENGTH MM
FORK LENGTH INCHES
0
50
100
150
200
250
0
2
4
6
8
10
1 16 1 16 1 16 1 16 1 16 1 16 1 16 1 15 1 16 1 16 1 16 1 16 1 16 31
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL

Genetic winter run at Chipps Island (1995 – 2002) with Delta and River LAD models

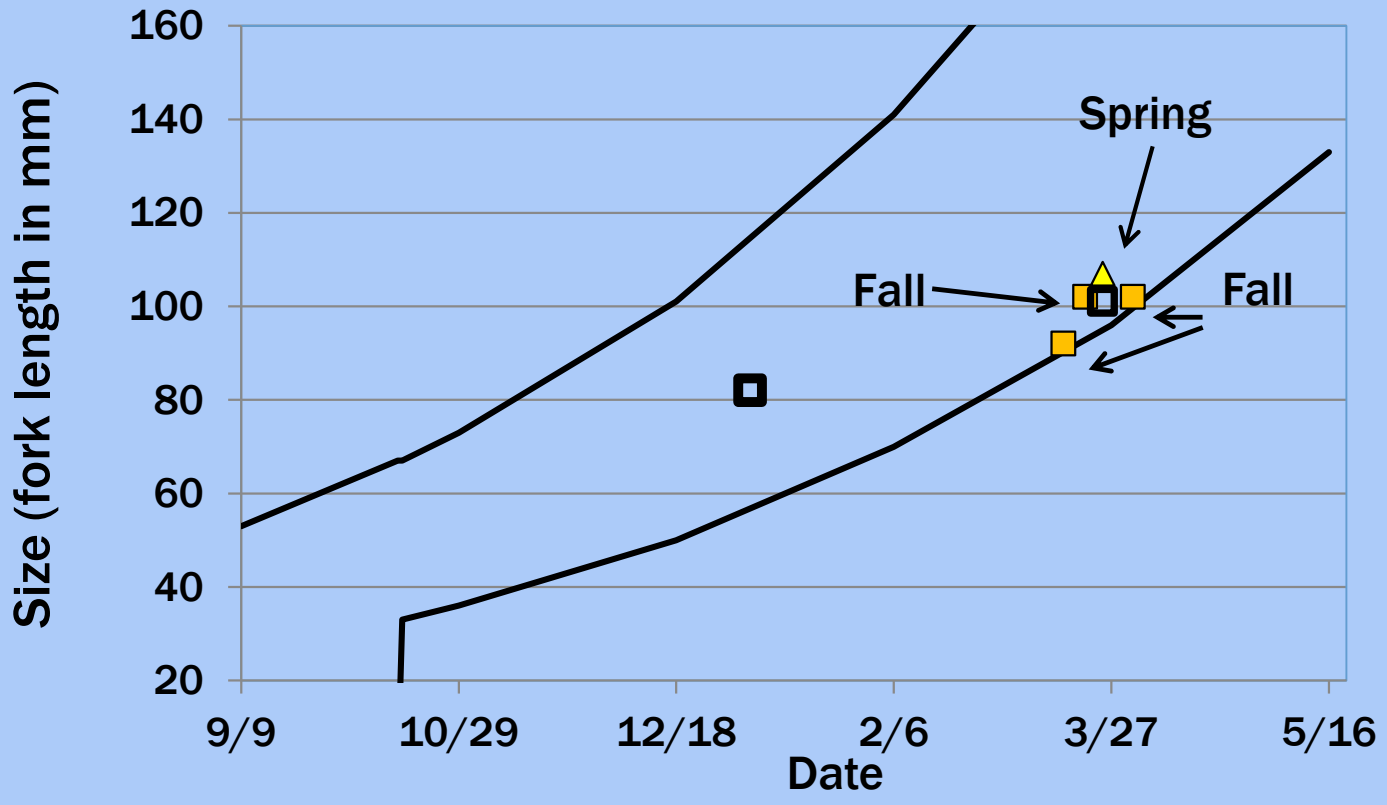


Delta model

River model

River model incorporates more of the winter run than the Delta model at Chipps Island

No genetic winter run caught at Sacramento in 2016

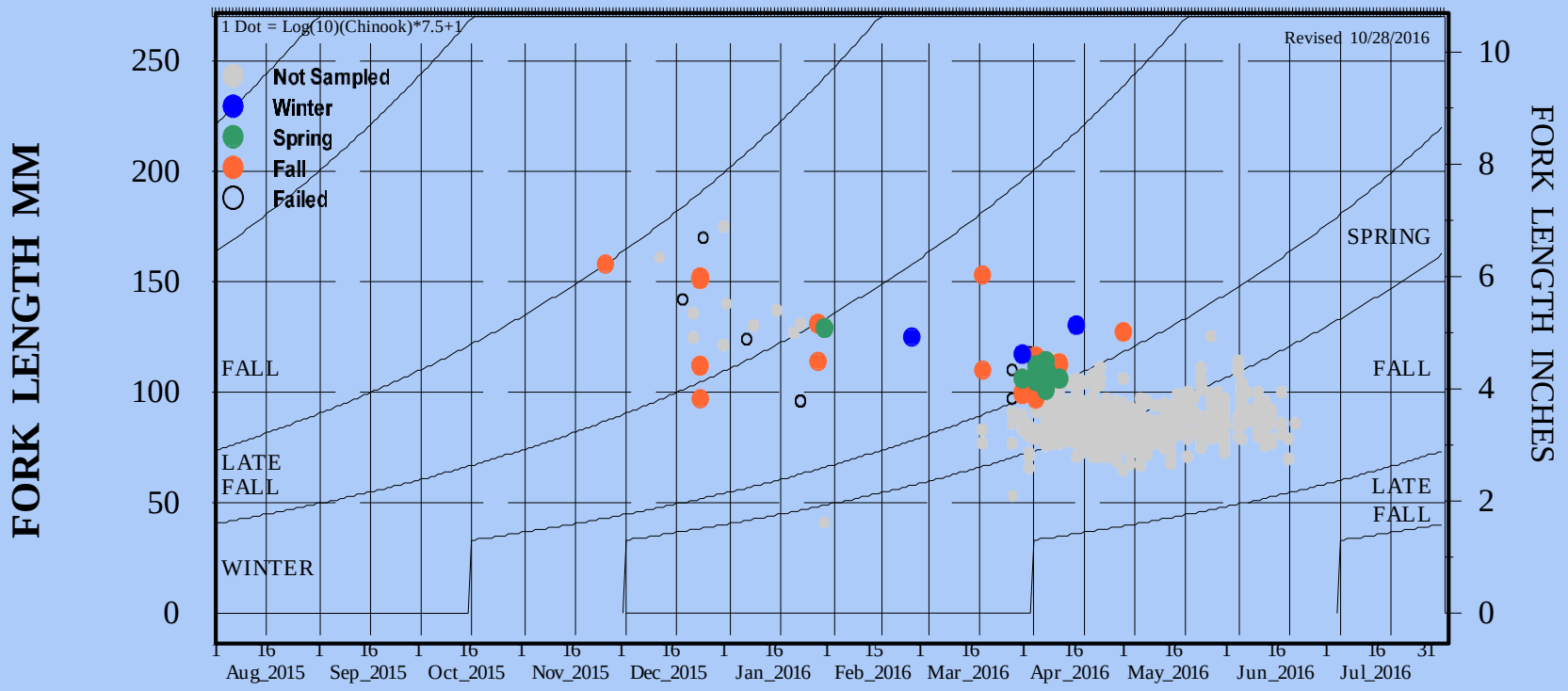


4 false positives (1 spring run [yellow triangle] and 3 fall run [orange boxes]) , and two that failed to amplify (open boxes) within Winter run RLAD

KP#2: The RLAD is generally suitable for estimating the timing of winter run in the Delta

BUT… not at Sacramento in 2016.

Genetic and RLAD Identification at Chipps Island in 2016)

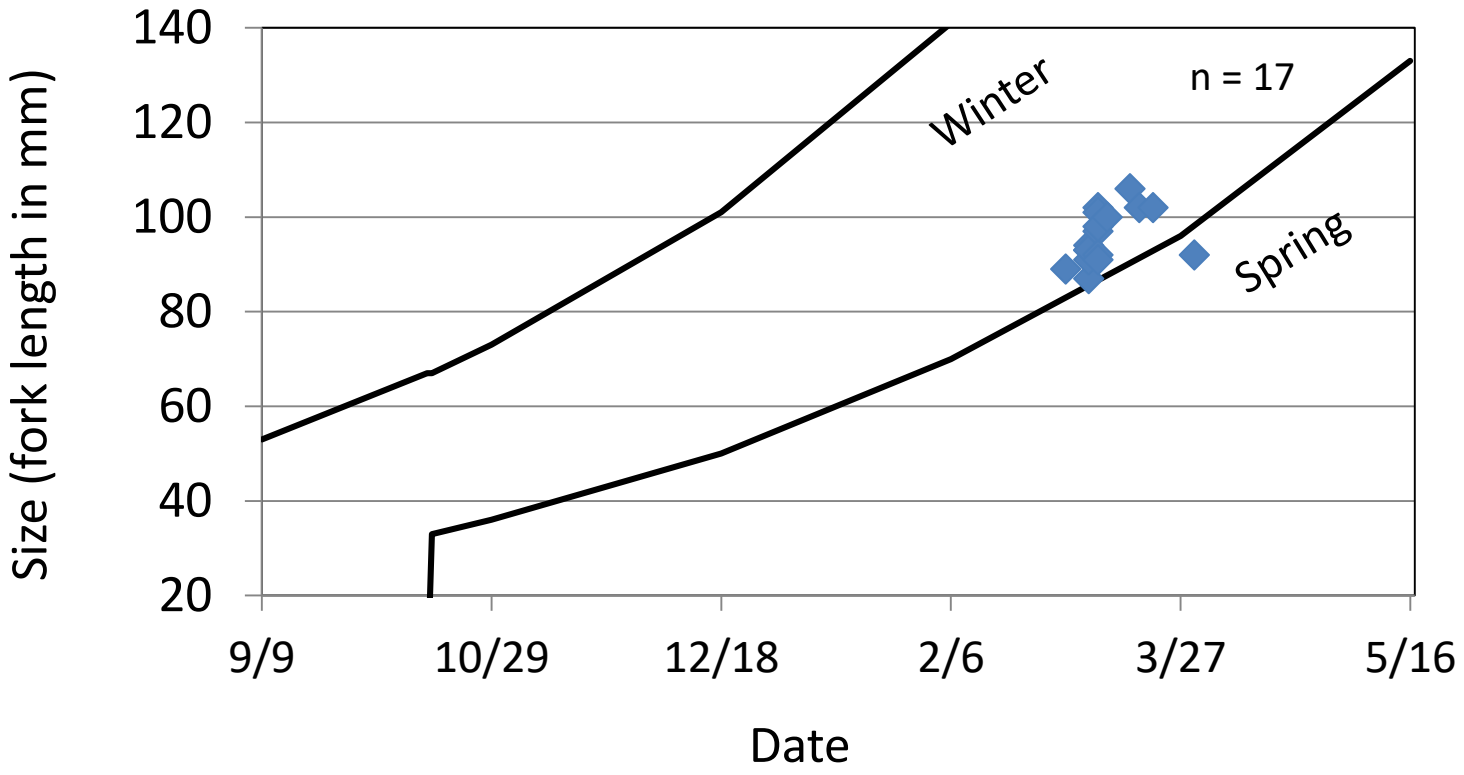


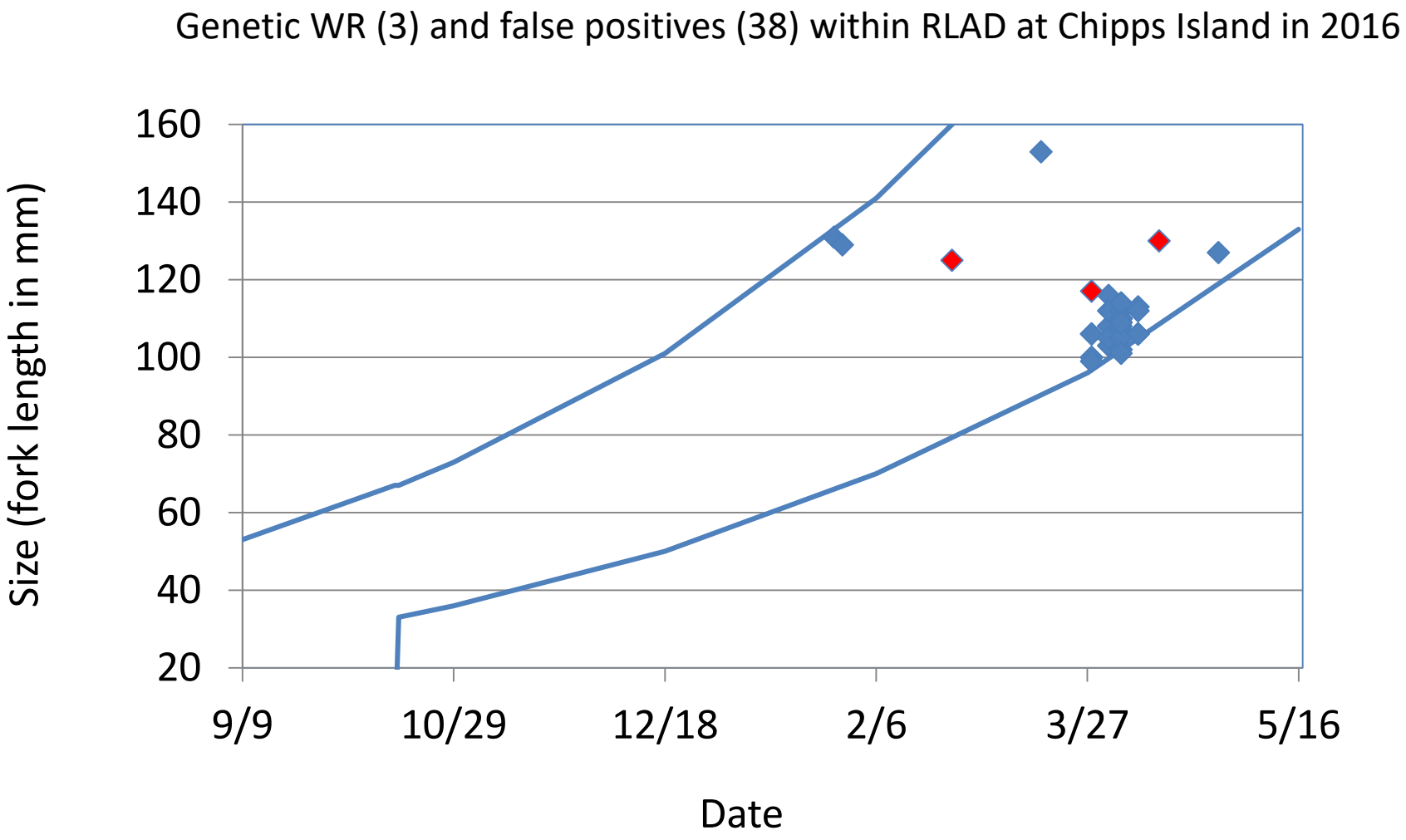
Assumed in 2016 that the RLAD was generally suitable for estimating the timing of winter run in the Delta: no sampling of spring or fall run LAD.

No WR in late-fall category; Several false positives (3 WR were identified out of 41 in winter run RLAD). Supports KP #2: The RLAD is generally suitable for estimating the timing of winter run in the Delta

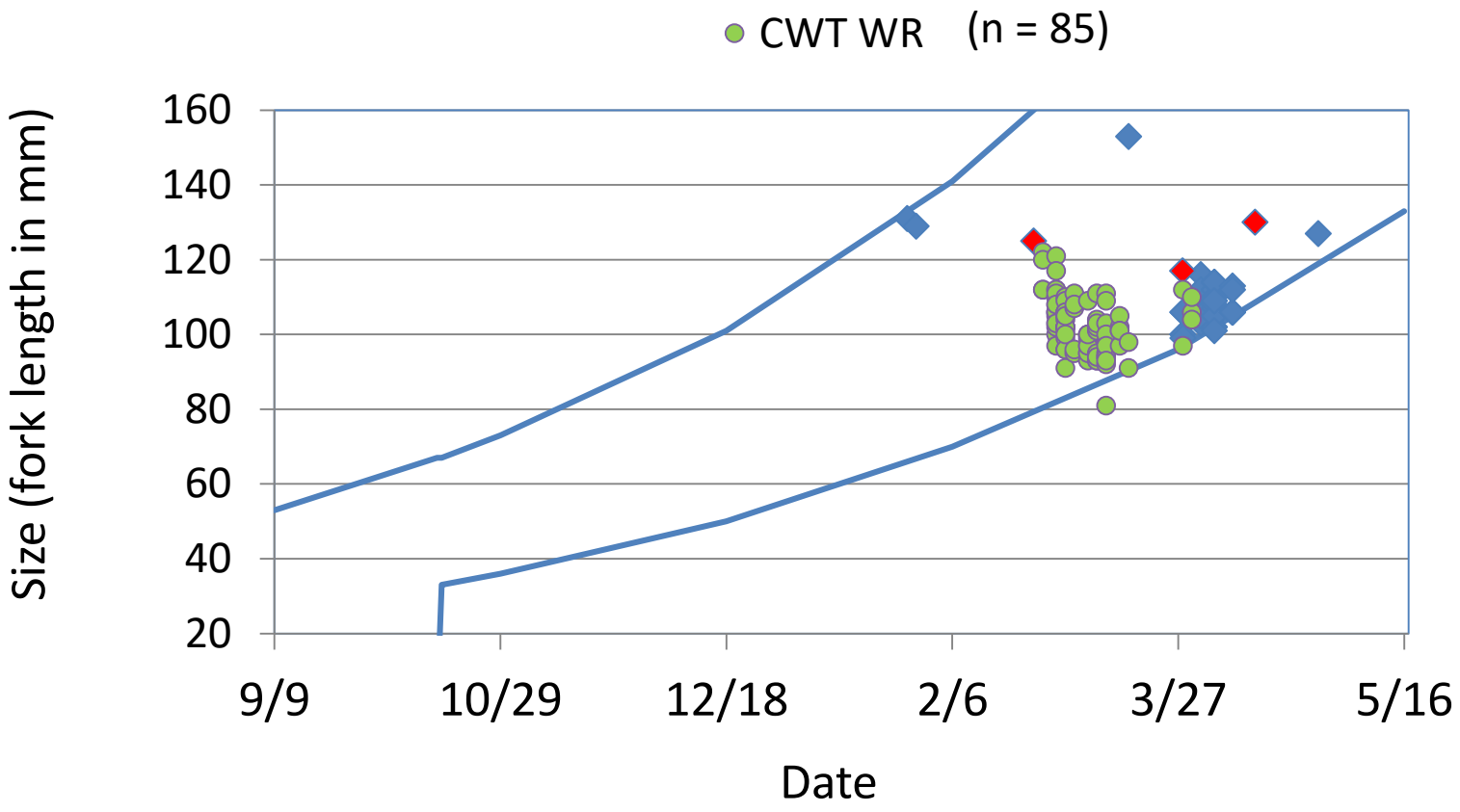
Graph Credit: Sheila Greene, WWD

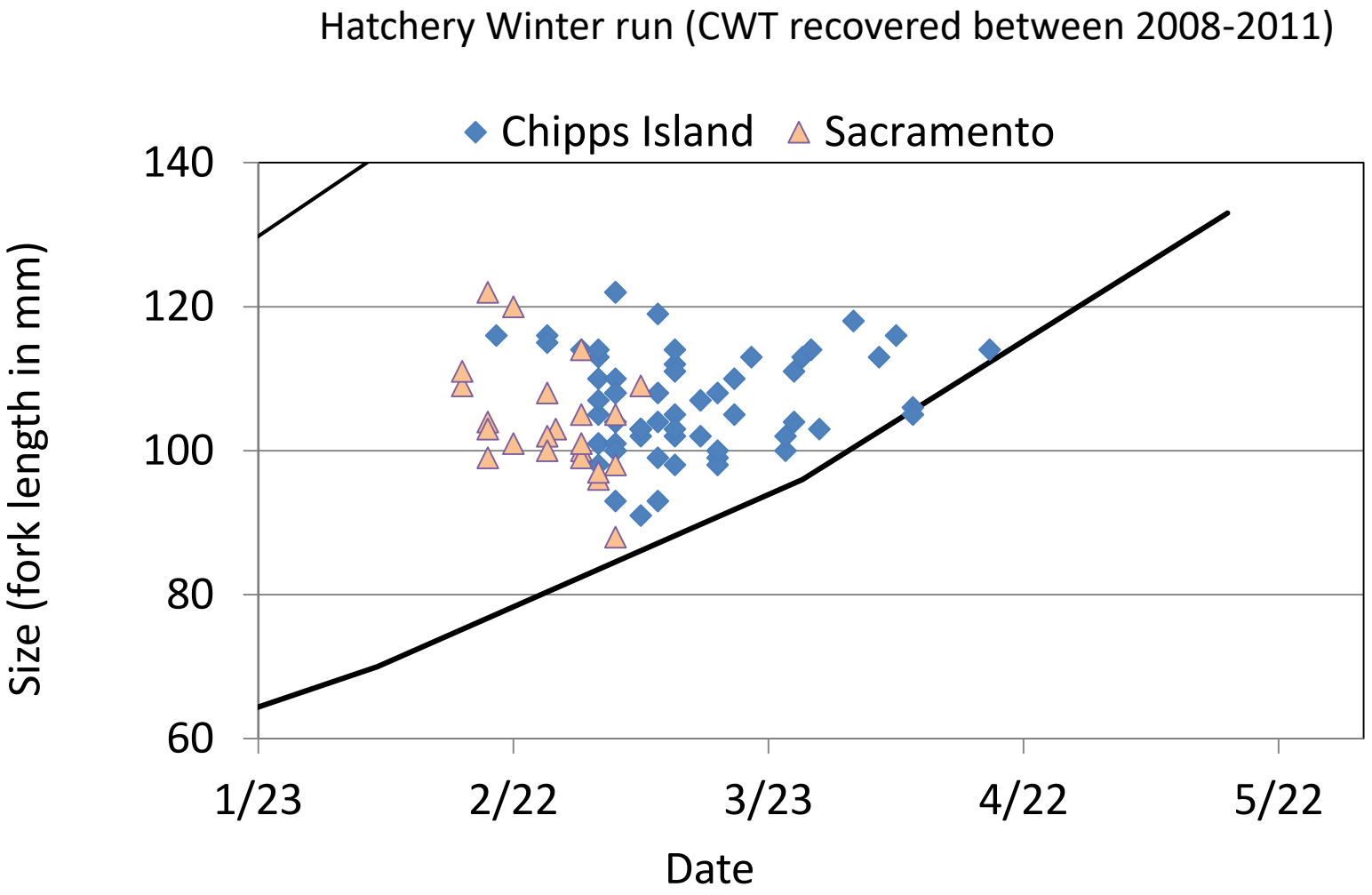
CWT WR sampled at Sacramento in 2016. Most were within WR RLAD criteria.
No genetic WR were captured at Sacramento in 2016.



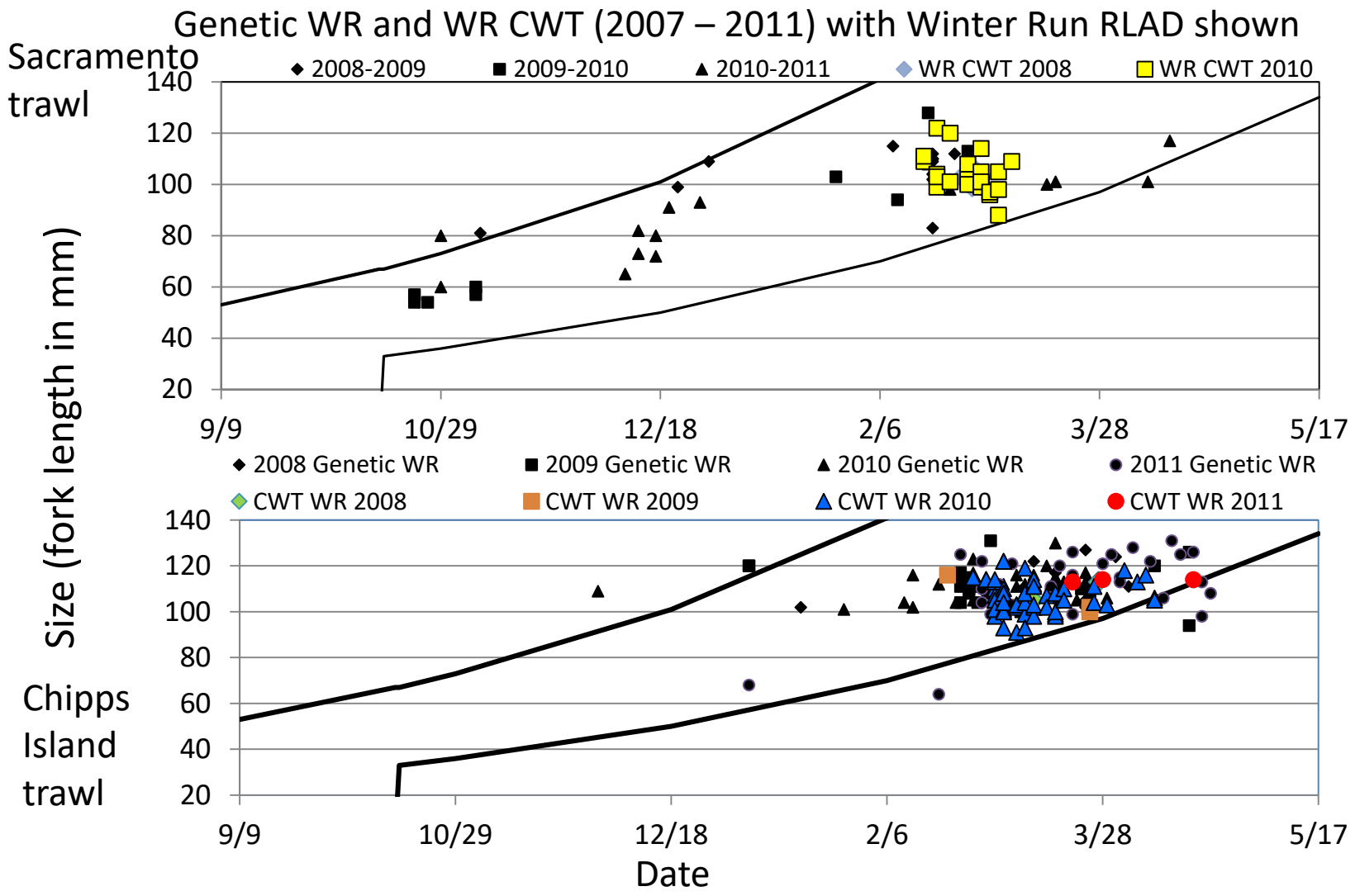

Genetic WR (3) and false positives (38) within RLAD at Chipps Island in 2016
Size (fork length in mm)
160
140
120
100
80
60
40
20
9/9
10/29
12/18
2/6
3/27
5/16
Date

Genetic (red triangles) and CWT WR (green dots) and false positives (blue triangles) in the WR RLAD in 2016 at Chipps Island





KP #6: The hatchery CWT are in the Delta for a shorter period (mid-February to mid-April) than the wild WR.



KP #3: The hatchery WR CWT fish generally fall within the winter run RLAD at Sacramento and Chipps Island

KP #4: But the hatchery CWT fish are released late in the season do not adequately represent wild winter run that **enter** the Delta (at Sacramento) earlier in the season.

KP #5: Whereas the hatchery CWT fish do seem to coincide with most of the wild winter run moving past Chipps Island

KP #6: The hatchery CWT are in the Delta for a shorter period (mid-February to mid-April) than the wild WR.