

guess who's coming to dinner

Evidence for Increasing Delta Smelt Utilization of the Yolo Bypass

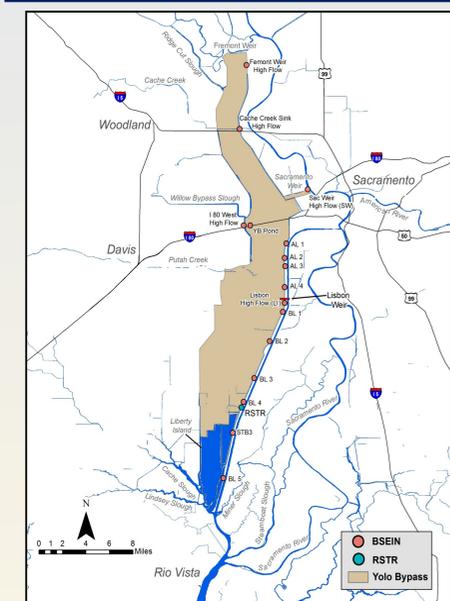
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Questions

1. When, where, and at what abundance are Delta Smelt detected in the Yolo Bypass?
2. Does annual abundance of Delta Smelt in the Yolo Bypass follow indices of Delta Smelt from other monitoring programs?
3. Is there a size difference between Delta Smelt found in the Yolo Bypass and those found elsewhere in the San Francisco Estuary?

Study Area



(Top) Fremont Weir not overtopping vs. overtopping
(Left) Overview map of the Yolo Bypass with sampling locations
(Bottom) Delta Smelt from the Yolo Bypass



- The Yolo Bypass is a flood conveyance system in the Sacramento Valley which redirects water from the Sacramento River through a system of weirs whenever the river water level exceeds 33.5 feet
- During overtopping event, flow enters the Bypass from the 2-mile long Fremont Weir, providing ample floodplain habitat for wildlife
- At times of the year when flooding is uncommon, the Bypass is used extensively for agriculture. However, the Toe Drain, a perennial tidal channel in the east side of the Bypass, remains heavily used by a number of fish species year-round

Methods

- We summarized Delta Smelt catch data from the Yolo Bypass Fish Monitoring Program (YBFMP):
 - For up to seven days a week from January to June, an 8-foot rotary screw trap located in the Yolo Bypass Toe Drain has been used to sample small adult and fishes since 1998.
 - Beach seine surveys were also conducted biweekly in the spring months from 1998 to 2009, and beginning in 2010, the sampling effort was increased to an all-year round sampling for a higher number of locations.
- Index and size data were compared with 20 mm Larval Survey, Summer Towner Survey, Fall Midwater Trawl Survey, and the Spring Kodiak Trawl Survey (SKT)
- We compared the fork length (FL) distribution of juvenile Delta Smelt in the Yolo Bypass with those collected by other IEP programs
 - No regression analysis used due to key differences in sampling methods that may severely bias the results (e.g. YBFMP does not measure fish smaller than 25 mm FL, larger disparity in sample size, etc.).
- ANOVA was used to compare Yolo Bypass adult smelt FL with that from Spring Kodiak Trawl by way of linear regression
 - Spring Kodiak Trawl fish were assigned to a dummy variable of 0, while YBFMP fish were assigned a dummy variable of 1



1. When, where, and at what abundance are Delta Smelt detected in the Yolo Bypass?

- From 1998 to 2014, a total of 707 Delta Smelt were captured by the YBFMP, with the majority of the catch (78%) coming after 2008
- Most were caught by Rotary Screw Trap and those captured by Beach Seine came mostly from downstream sites closest to the Cache Slough Complex

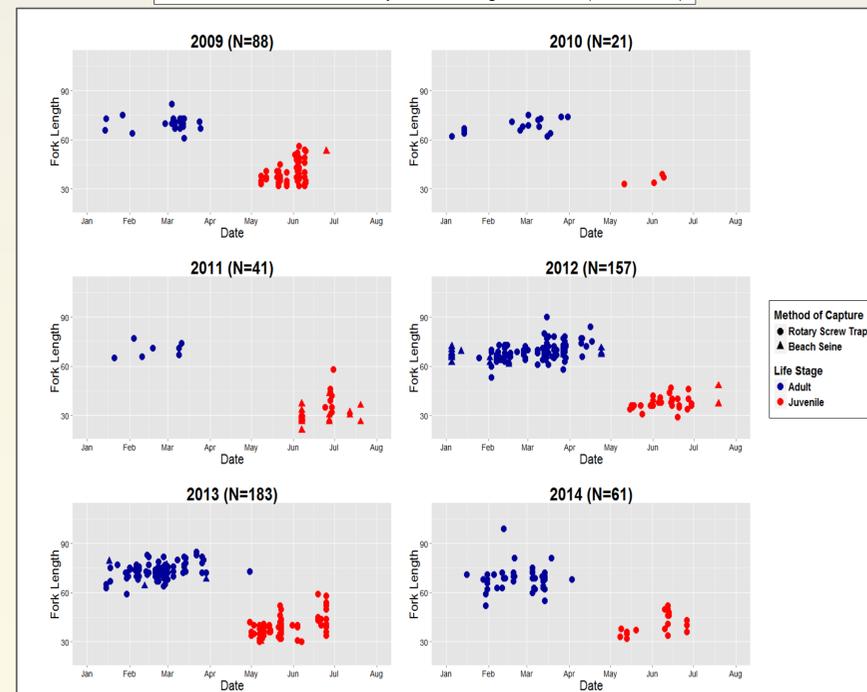
Total Delta Smelt Catch by Year																
1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
4	13	25	10	17	29	7	4	17	4	26	88	21	41	157	183	61

Total Delta Smelt Catch from Yolo Bypass by Sampling Method											
Rotary Screw Trap						Beach Seine					
631 (89.2%)						76 (10.7%)					

Total Delta Smelt Catch by Beach Seine Location											
AL1	AL2	AL4	BL1	BL2	BL3	BL4	BL5	LI	STB3	SW	
1	1	2	3	1	4	7 (9%)	52 (68%)	1	1	3	

- In high catch years (2009-2014), we observed two cohorts of Delta Smelt annually (adults from previous year and young-of-year juveniles)
- Only 4 Delta Smelt have been sampled by the YBFMP in the fall: one in November of 2010, two in October of 2011, and one in November of 2011 (not shown below)

Delta Smelt size for the six years with highest catch (2009-2014)



Discussion

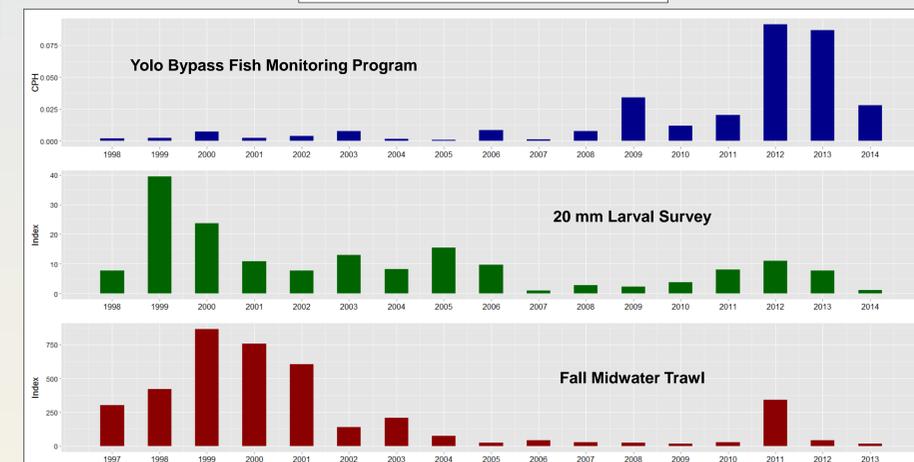
1. In recent years, two cohorts of Delta Smelt have been observed regularly from January to June
2. Delta Smelt utilization of the Yolo Bypass appears to have increased
 - This is in line with previous otolith microchemistry analysis suggesting that Delta Smelt may be shifting towards freshwater residency in recent years (James Hobbs, unpublished data)
3. Delta Smelt found in the Yolo Bypass appear to be generally larger in recent years than those elsewhere
 - It is unclear if these differences are biological (e.g. earlier spawning or faster growth rates) or are related to differences in gear efficiency in the Yolo Bypass versus the rest of the Delta. However, we have collected otoliths from ~200 Yolo Bypass Delta Smelt between 2012 and 2014, allowing for future work that may address this question directly

Results

2. Does annual catch-per-unit-effort of Delta Smelt in the Yolo Bypass follow the annual abundance indices of Delta Smelt from other IEP monitoring programs?

- When the rotary screw trap data is standardized for effort (catch per hour; CPH), we observed a pattern of increased catch over time
- This is in contrast to the 20mm Larval Survey and the Fall Midwater Trawl Survey, which had an overall declining trend (Spring Kodiak Trawl not shown as it did not begin until 2002)

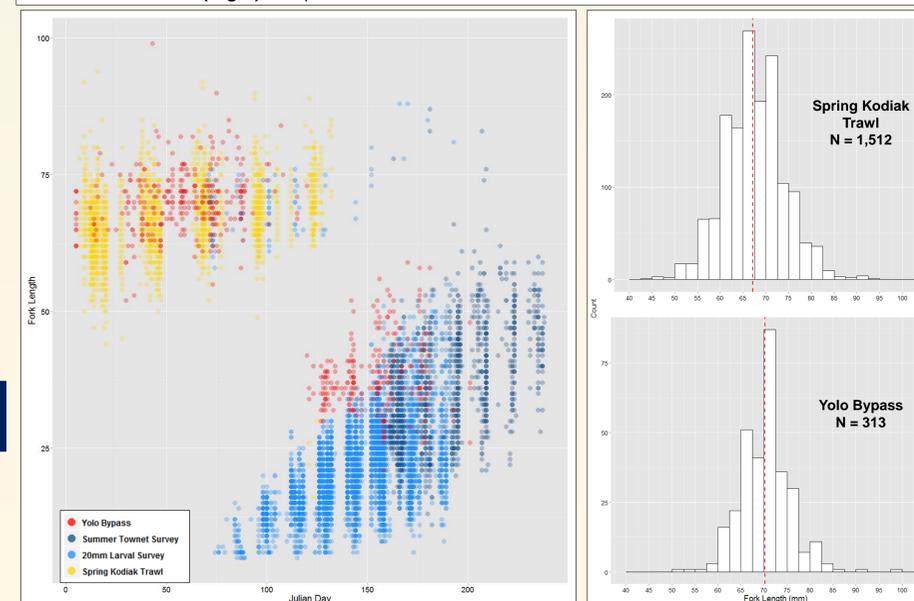
Annual indices of Delta Smelt abundance



3. Is there a size difference between Delta Smelt found in the Yolo Bypass and those found elsewhere in the San Francisco Estuary?

- Juvenile Delta Smelt in Yolo Bypass collected between 2009 and 2014 appear to be generally larger than those collected elsewhere in the San Francisco Estuary
- Adult Delta Smelt in the Yolo Bypass also seems to be slightly larger than those captured elsewhere by the Spring Kodiak Trawl
 - Significant ANOVA at $p < 0.001$ with estimated coefficient of 3.022

(Left) Comparison of Delta Smelt FL in the Yolo Bypass (red) and elsewhere in the San Francisco Estuary from 2009 to 2014 (Right) Comparison of adult Delta Smelt FL for SKT and YBFMP from 2009 to 2014



Acknowledgements

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