University of California Davis 2011 Delta Smelt predation project update

2011 Smelt Predation project update:

Task 1: Field Survey

Field sampling was successfully completed in June of 2011. In collaboration with field crews from CA Dept. of Water Resources (DWR), UC Davis, US Fish and Wildlife Service (USFWS), and Cramer Fish Sciences (CFS), a total of 845 putative predators were collected by beach seine, e-fishing, and mid-water trawl. All predator samples, excluding those collected with USFWS during the Spring Kodiak Trawl, were dissected and the stomachs preserved on-site. Due to unforeseen permitting limitations all zooplankton sampling was terminated after the first week of sampling. As a result, only a few vertical zooplankton tows were conducted and no nutrient samples were taken. The detailed field data will be provided with the final report.

Task 2: Laboratory Analysis

Stomachs were dissected from euthanized predators immediately following collection at the on-site mobile lab and placed directly in lysis buffer to begin the DNA extraction process. All data sheets were collected and tabulated by DWR staff. Stomach samples were delivered to the Genomic Variation Laboratory (GVL) at UC-Davis for DNA extraction and PCR analysis. Stomach samples were tested for the presence of delta smelt DNA by qPCR assays using a delta smelt specific TaqMan probe designed and validated during the 2010 predation study. Prospective positives were retested multiple times. Multiple positive and negative controls were used throughout the extraction and qPCR steps to ensure proper quality control. The initial results showed that ~10% of all predators sampled had delta smelt DNA in their stomachs. The detailed results of the testing will be included in the final report.

Task 3: Data Analysis

Comprehensive data analysis was completed by DWR in February of 2012. Overall, predation rates varied considerable between species, locations, habitat types and environmental factors. Sample sizes for rare species and specific locations were sometimes too low to be statistically significant.

Predation experiment objectives as stated in the June 2011 proposal:

1)How do predation rates compare among different predators?

	# sampled	# positive for Delta smelt	percent positive of sampled	Percent of total positives
Exopaleomon shrimp	4	1	25.0	1.25
Tule perch	6	1	16.7	1.25
Chinook salmon	16	2	12.5	2.5
Mississippi silverside	559	66	11.8	82.5
Bluegill sunfish	10	1	10.0	1.25
Largemouth bass	30	3	10.0	3.75
Sacramento Pikeminnow	44	3	6.8	3.75
Threadfin shad	33	1	3.0	1.25
Shimofuri goby	20	2	10.0	2.5
American Shad	2	0	0.0	0
Black crappie	14	0	0.0	0
Delta smelt	1	0	0.0	0
Golden shiner	10	0	0.0	0
Prickley sculpin	2	0	0.0	0
Redear sunfish	14	0	0.0	0
Sacramento sucker	1	0	0.0	0
Striped bass	73	0	0.0	0
Threespine stickleback	1	0	0.0	0
Yellowfin goby	5	0	0.0	0
Total	845	80	9.5	100

3) Do predation rates differ between inshore, channel edge, and open water?

There was no difference in the incidence of fish positive for delta smelt DNA between MSS collected by beach seine (inshore) and electro-fishing (inshore/channel edge). As observed in previous sampling, SKT (open water) fish were much more likely to be positive for delta smelt DNA compared with fish collected by the other gears, though the low spatial resolution of SKT sampling limits the conclusions that can be drawn from this result.

4) Do predation rates differ between the "restored" habitat of Liberty Island and the altered habitat of the DWSC?

The frequency of detected predation was significantly different between Liberty Island and the DWSC ($P = 0.002$) when all sampling methods were included in the analysis. However, this result disappears when fish collected via the Spring Kodiak Trawl (SKT) are removed from analysis ($P = 0.3$). Given our previous findings of SKT fish being more likely than other gears to be positive for delta smelt

DNA, and that there was no SKT sampling conducted in Liberty Island, we feel that there is no difference in detected predation between these two regions.

5) Do predation rates correlate with specific habitat variables such as turbidity, flow, temperature, etc?

A significant correlation was shown between turbidity and predation (B. Schreier, unpublished data). Areas of lower visibility (higher turbidity) were linked to reduced predation on delta smelt. Other environmental factors (water temperature, salinity, and pH) did not show correlations with predation.

Task 4: Assay Development

-Delta smelt assay

In Baerwald et al. (2011) the delta smelt assay was described as having a limit of detection equivalent to a cycle threshold (Ct) value of 35. It was originally thought that the limit of detection should be set at this conservative level to avoid reporting what may be false positives. As part of the 2011 predation study we set out to maximize the sensitivity of the delta smelt qPCR assay allowing us to detect the presence of even more minute amounts of DNA in the stomachs of predators. This additional task has been accomplished by using cloning techniques in combination with DNA sequencing technology to verify that samples testing positive for the presence of delta smelt DNA beyond the previous limit of detection are in fact positive. These verifications of all positives will effectively increase the limit of detection to the point where any "positive" will be reported as such with confidence. More experiments are currently under way to further our knowledge of detection limits. A detailed description of all experiments and data resulting from the experiments will be included in a manuscript to be submitted for peer review.

-Largemouth and striped bass assays

Assays for striped bass and largemouth bass are currently in development at the GVL. The assays have been designed and amplify target species DNA. Demonstrating that the assays do not produce false positives (i.e., amplify other delta species DNA) will be completed by late summer. The assays will be incorporated into future predation and food web studies by the GVL.

Task 5 Feeding trial experiment

-Objective 2 as stated in the original proposal prepared by CFS in June 2011.

How does delta smelt DNA degrade in a predator's stomach?

A controlled feeding experiment was conducted in May 2012. The feeding trial was originally proposed to assess the length of time delta smelt DNA is detectable in the stomach of striped bass. The predator used to conduct the experiment in 2012 was changed to Mississippi silverside for two reasons. One, bass represented a relatively small proportion of our field sampling predators in 2011 and two, in light of the original feeding trial in which silversides were fed delta smelt, more questions were formulated and a more extensive set of experiments with the same species were deemed necessary.

Objectives for the live feeding experiment have evolved since it was first proposed. The questions we have addressed are more directly relevant to the predation experiment in its current state. A more accurate and comprehensive experiment for the persistence of delta smelt DNA in the gut of silversides was conducted. Field preservation methods for both large fish (striped bass) and small fish (silversides) were simulated. Lastly, the possibility of detecting multiple prey species in the gut of a predator (silverside) was conducted. This last experiment, if successful, will prove useful in applying the genetic prey detection assays to bioenergetics models.

Live feeding experiments were conducted at the Center for Aquatic Biology and Aquaculture on the UC Davis campus. On-site experiments were completed in early June 2012. The live feedings have been completed and the fish stomachs have been removed, placed in ATL buffer and homogenized. Sample processing has begun at the GVL and is on track to be completed by late summer.

Task 6: Manuscript

UC Davis, in collaboration with Cramer Fish Sciences and DWR staff, has begun to write a draft manuscript and will submit a final version to a peer-reviewed scientific journal.

Task 7: Science meeting

Results of the 2011 predation study were presented at the IEP workshop in April 2012. Feeding trial results will be presented at the Delta Science conference in October of 2012.