■ Interagency Ecological Program for the San Francisco Estuary ■

IEP NEWSLETTER

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Of Interest to Managers

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The continued decline of delta smelt has led to increased interest in using "artificial" methods to maintain populations of smelt for research. The current newsletter describes efforts to develop a refuge population. The article by Bradd Baskerville-Bridges and Joan Lindberg describes how the UCD Fish Conservation and Culture Laboratory was able to use two-year old "wild" delta smelt (collected in the previous year) to develop a small refuge population. The team is working with UC Davis geneticists to maximize genetic diversity of these fish. In addition, Theresa Rettinghouse reports on progress to freeze delta smelt semen for future research and production. Her companion article shows that there is a high demand among researchers and other groups for hatchery-raised delta smelt.

This issue of the IEP Newsletter includes a quarterly highlight from USFWS about their Delta Juvenile Fish Monitoring Program. The article summarizes late winter-early spring 2008 catch from several surveys: Kodiak trawls, midwater trawls, and beach seine.

Kevin Reece and Ted Sommer provide an update on the Yolo Bypass Study, which has sampled floodplain fish populations for the past decade. This region continues to be of major management interest because of its role as native fish nursery and spawning habitat, and as a migration corridor. The last year was the driest year on the floodplain since the study was initiated; there was no inflow from Sacramento River and minimal inflow for west side tributaries. As expected, the extreme low flow conditions resulted in correspondingly low numbers of young native fishes. However, higher than average numbers of adult native fish were observed, reinforcing earlier findings that the region is a key migration corridor in all years.

The Summer 2008 issue of the IEP Newsletter contains another substantial list of recent scientific papers about the San Francisco Estuary and its tributaries. The list includes 37 articles published in regional, national, and international scientific journals. More than on third of these articles included IEP staff as authors, were funded in part by IEP, or relied heavily on IEP data or samples. This latest publications reflects IEP's continuing commitment to publication of high-quality research about the San Francisco Estuary and its biota.

IEP QUARTERLY HIGHLIGHTS

Initiation of a Delta Smelt Refugial Population

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The Fish Conservation and Culture Lab (FCCL; a UC Davis facility located near Byron CA) is working collaboratively with the Genomic Variation Lab on the UC Davis (GVL, UCD) Campus and with US Fish and Wildlife Service (FWS) to initiate a delta smelt refugial population. The refugial population was initiated during the spring of 2008 with 2-year old natural origin (NOR) fish (birth year 2006; BY2006). These NOR fish were collected in the lower Sacramento River, in the fall of 2006 and served as broodfish during the 2007 season. Wild delta smelt were not collected this past fall (2007), due to take restrictions, resulting from the sustained decline in the population abundance index. Therefore, a subset of the NOR group was held for an additional year to serve as broodfish in 2008. The 2008 spawning season started with just over 560 adult delta smelt (NOR, BY2006).

This season over 250 single pair crosses have been completed (ova of a single female fertilized with milt of a single male via manual expression of gametes). Though a few fish began spawning earlier in the season (December), the majority of eggs were collected in February through April (Figure 1). In captivity, under a controlled temperature regime, delta smelt can spawn up to four times over the season (unpublished data); second spawns were first observed on March 31. Only larvae from the first clutch of eggs were used for development of the refugial population. These were collected between December 12, 2007 and May 5, 2008, creating unique female-male pairings. Additional crosses to other mates were not performed to minimize the risk of half-sibling crosses within the refugial population. The average fecundity of the 2-year olds was 4,578 eggs per female (Figure 2). One-thousand eggs were taken from each of 6 single paired crosses. These eggs were combined into a single incubator and then transferred into subsequent larval rearing tanks (130-L) at hatch; this group of several single pair crosses is termed a "multi-family group". Fin clips from each parent were taken at the time of spawn for later DNA analysis at UC Davis (GVL, K. Fisch). DNA tracking of individual progeny (F1 generation) to parental cross allows confirmation of parentage, and is essential to developing a spawning pedigree for the upcoming season in 2009. Implementing the spawning pedigree will help maximize genetic diversity while minimizing genetic inbreeding and genetic drift.

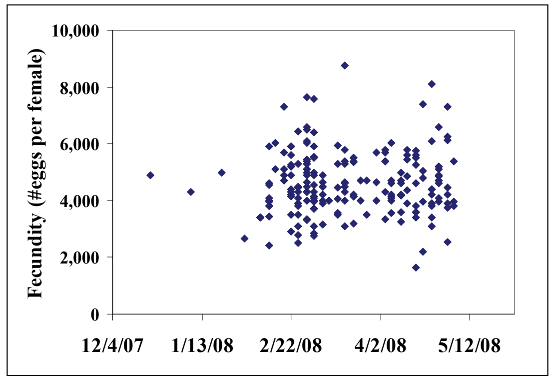

Figure 1 Egg collection during 2008

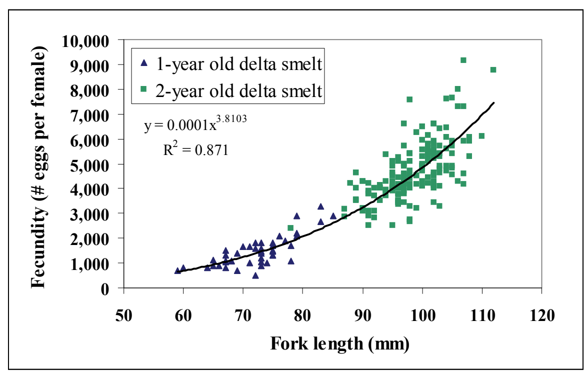

Figure 2 Relationship between fecundity and fork length of delta smelt. Both 1- year old (hatchery origin) and 2-year old (natural origin) fish were measured.

Preservation of Delta Smelt Gametes: Semen Studies 2008

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This year, due to the delta smelt's continuing decline, the Fish Conservation and Culture Lab (FCCL) has been developing a refugial population in collaboration with State and federal agencies. Delta smelt semen studies were initiated in January 2008 to determine if semen could be collected and stored to help maintain the genetic diversity of the refugial population. The FCCL investigated two techniques for the preservation of semen: (1) short-term storage with refrigeration and (2) long-term storage via cryopreservation with liquid nitrogen.

Several samples of semen were collected from 1-year old hatchery origin HOR smelt for short-term evaluation. The milt was kept on ice during motility observations and then refrigerated. Progressive motility for up to 12 seconds can be initiated by the addition of fresh water to the raw semen sample. Fertilization was accomplished with 7-day old semen with comparable results of 89% for stored semen and 94% for fresh semen. Short-term storage of semen will allow time for verification of DNA parentage prior to spawning, essential for implementing the new spawning pedigree in 2009.

Cryopreservation studies for long term storage of delta smelt semen were begun in collaboration with the UC Davis – Veterinary Gamete Biology Lab (Dr. S. Meyers and Dr. D. Ostrach). Fresh semen was collected from HOR and motility was first observed with raw semen activated with FCCL lab water (5-8 mOsm) used for strip spawning. Hanks Balanced Salt Solution (HBSS) and Dulbecco's Phosphate Buffered Saline (DPBS) solutions were chosen and evaluated as potential extenders. Activation trials of semen using a range of solutions with HBSS or DPBS from 0-600 confirmed that 600 mOsm does not activate the sperm; therefore, allowing for manual manipulation and fertilization success after cryopreservation. HBSS semen samples appeared to maintain activation longer than DPBS; so, several samples were frozen using HBSS and either 8% methanol (METH) or 5%,10% or 15% Dimethyl Sulfoxide (DMSO). DMSO had a larger percentage of live cells when compared to the METH post-thaw specimen. The flow cytometer showed a post-thaw assessment of approximately 40-50% live cells in the DMSO samples, but the motility was not tested to ascertain the semen's overall health. Additional studies will be planned to determine the most efficient cryoprotectant solution and to test the post-thaw samples for motility and fertility to determine if this is a viable option to store smelt semen long-term in the future.

The ability to store delta smelt semen may be a useful tool for gathering samples from wild fish due to the collection restrictions. Semen can also be transported on ice to fertilize natural origin (NOR) fish in the field to supplement the genetic diversity of the refuge currently on-site at the FCCL.

Delta Smelt Supplied for Research through July 2008

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Due to the low abundance index and collection restrictions, 2-year old natural origin (NOR) delta smelt were spawned at the Fish Conservation and Culture Lab (FCCL) this year to supply research needs. Although the spawning season began early in December 2007, egg production occurred primarily from February to May 2008, and the broodstock tanks were maintained at 14-16°C to extend spawning conditions into July. The FCCL has supplied all life stages of delta smelt for research in 2008. A total of 42,251 specimens, as well as technical support,were provided for 8 projects through July 2008 (Table 1).

Table 1 Total number of each life stage of delta smelt provided to date, January - June 2008

Project	Agency - Lead	Eggs	Larvae <20mm	Juveniles 20-50mm	Adults >50mm cultured 2007	Adults >50mm cultured 2008	Project totals
Fore bay Release Study	USFWS- Castillo			4574			4574
Toxicity testing	UCD - Werner		7202				7202
Histology/Temperature studies	UCD - Teh	15300			12		15312
County Earth Day	AAI - Lang				11		11
Feeding Behavior	SFSU- Sullivan		931				931
Refugia - backup population	LSNFH - Rueth				200		200
Fish Screen efficiency	USBR - TFCF		1870	491	1513		3874
Genetic studies	UCD - Fisch	500	9367	280			10147
Subtotals		15800	19370	5345	1736	0	
Present total							42251

Acronyms:
UCD: University of California, Davis;SFSU:San Francisco State University;USFWS: US Fish and Wildlife Service;
LSNFH: Livingston Stone National Fish Hatchery;USBR: US Bureau of Reclamation; TFCF: Tracy fish collection facility
AAI: Aquaris Aquarium Institute

Delta Juvenile Fish Monitoring Program

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The Delta Juvenile Fish Monitoring Program (DJFMP) of the U.S. Fish and Wildlife Service (USFWS), Stockton Office, has monitored the relative abundance and distribution of juvenile Chinook salmon *Oncorhynchus tshawytscha* in the lower Sacramento and San Joaquin rivers and in the delta for the Interagency Ecological Program since the 1970s (Brandes and McLain, 2001). The program expanded in the early 1990s to monitor other juvenile fish species. This report summarizes results from trawling and the beach seine survey from February 24, 2008 to May 31, 2008.

Trawling

For the reporting period, there were 10, 20-minute Kodiak trawls conducted 3 days a week at Mossdale (San Joaquin River, River Mile [RM] 54). Kodiak trawls were also conducted at Sherwood Harbor (Sacramento River RM 55) for the month of March before the sampling method was changed to midwater trawls. Midwater trawls were conducted 3 days a week at Benicia (Suisun Bay RM 1) instead of Chipps Island (Suisun Bay RM 18) during the last week in February through March 8, 2008 to reduce the take of delta smelt *Hypomesus transpacificus*, but then returned to Chipps Island through May 2008 on a 2-day per week schedule. We decreased our sample days at Chipps Island to minimize catch of delta smelt. Midwater trawls were conducted at Sherwood Harbor (Sacramento River RM 55) 3 days a week from March 9 through May 4, 2008 and 2 days a week from March 5 through May 31, 2008.

Mossdale captured the greatest number of unmarked Chinook salmon (n = 1668 fish) of the 4 trawling locations during the reporting period. Unmarked Chinook salmon size classes captured at Mossdale were: 1183 fall-run, 5 winter run, and 480 spring-run. Kodiak trawling at Sherwood Harbor from March 1 through March 31, 2008 resulted in catch of 8 unmarked Chinook salmon in the following size classes: 5 fall-run, 2 spring-run and 1 winter-run. Midwater trawling at Sherwood Harbor from April 1 through May 31, 2008 reported 516 unmarked Chinook salmon in the following size classes; 471 fall-run and 45 spring-run. Chipps Island reported 544 unmarked Chinook salmon: 353 fall-run, 28 winter-run and 163 spring-run. Benica reported 1 winter-run sized unmarked Chinook salmon. A total of 379 adipose fin-clipped Chinook salmon was recovered during the sampling period:

202 were recovered at Chipps Island and 177 were recovered at Sherwood Harbor via midwater trawling.

Weekly and mean of weekly catch per unit effort as fish/10,000 m^3, were calculated for each sampling location for all fish species and salmon races. For the reporting period, we captured 4,890 fishes (excluding marked salmon): 20 fishes representing 10 species at Sherwood Harbor via Kodiak trawling; 518 of 4 species at Sherwood Harbor via midwater trawling; 1,569 fishes representing 25 species at Chipps Island; 193 fishes of 8 species at Benicia, and 2,590 representing 23 species at Mossdale. Kodiak trawling at Sherwood Harbor was only conducted for a short period of time during this reported period before the sampling method was replaced with midwater trawling. The most abundant species caught via Kodiak trawling and midwater trawling was fall-run sized Chinook salmon (Table 1 and Table 2). The most abundant species caught at Mossdale was fall-run sized Chinook salmon followed by threadfin shad *Dorosoma petenense* (Table 3). The most abundant species caught at Chipps Island was American shad *Alosa sapidissima,* followed by fall-run Chinook salmon (Table 4). The most abundant species of fish caught at Benicia was American shad (Table 5).

Beach Seining

For the reporting period, we collected a total of 440 beach seine samples at 52 sites. We collected 64 samples on the lower Sacramento River (7 sites), 67 samples on the San Joaquin River (8 sites), 266 samples in the delta (28 sites), and 43 samples in San Pablo and San Francisco Bays, collectively (9 sites) (Brandes and McLain, 2001). The lower Sacramento River, Delta, and San Joaquin River sites were typically sampled once per week, and Bay sites were sampled every other week.

We captured 480 fall-run sized, 1 winter-run sized, and 27 spring-run sized, unmarked Chinook salmon in the Delta. We captured 192 fall-run sized, 1 winter-run sized, and 9 spring-run sized unmarked Chinook salmon in the lower Sacramento River. No Chinook salmon were captured in the San Joaquin River. No Chinook salmon were captured in the Bay seines. In addition, 45 marked salmon were recovered in the beach seines during the reporting period.

Table 1 Weekly catch per unit effort (fish/10,000 m^3) of the 5 most abundant fish species caught via Kodiak trawl between March 1-30, 2008 at Sherwood Harbor

Week starting	Fall-run sized Chinook salmon	Threadfin shad	Golden shiner	Sacramento pikeminnow	Spring-run sized Chinook salmon
3/2/2008	1.28	1.34	0	1.17	0
3/9/2008	1.27	1.61	1.20	0	0
3/16/2008	0	0	0	0	1.20
3/23/2008	0	0	1.58	0	0
3/30/2008	0	0	0	0	1.09
sum of catch	5	4	2	2	2
% of catch	25.00	20.00	10.00	10.00	10.00
Ave CPUE (SE)	1.28 (1.58)	1.12 (1.54)	0.56 (0.67)	0.47 (0.92)	0.46 (0.55)

Table 2 Weekly catch per unit effort (fish/10,000 m^3) of the 5 most abundant fish species caught via midwater trawl between March 30 and May 25, 2008 at Sherwood Harbor

Week starting	Fall-run sized Chinook salmon	Adipose-Clipped Chinook salmon	Spring-run sized Chinook salmon	Delta smelt	Wagasaki
3/30/2008	0	3.04	1.98	0	0
4/6/2008	2.94	3.67	2.99	3.42	0
4/13/2008	2.72	5.30	4.45	0	0
4/20/2008	3.34	2.35	4.06	0	2.02
4/27/2008	10.58	5.67	3.18	0	0
5/4/2008	23.61	10.70	0	0	0
5/11/2008	5.74	3.19	0	0	0
5/18/2008	2.07	1.87	0	0	0
5/25/2008	3.66	2.01	0	0	0
sum of catch	471	177	45	1	1
% of catch	67.77	25.47	6.47	0.14	0.14
Ave CPUE (SE)	6.07 (4.70)	4.20 (1.82)	1.86 (1.23)	0.38 (0.74)	0.22 (0.44)

Table 3 Weekly catch per unit effort (fish/10,000 m^3) of the 5 most abundant fish species between March 1 and May 25, 2008 at Mossdale

Week starting	Fall-run sized Chinook salmon	Threadfin shad	Spring-run sized Chinook salmon	Inland silverside	Red shiner
3/2/2008	0	2.43	0	1.25	0
3/9/2008	0	0	0	1.56	0
3/16/2008	0	0	0	1.27	1.23
3/23/2008	0	1.30	1.12	1.37	1.11
3/30/2008	0	2.70	2.02	0	1.34
4/6/2008	0	1.97	1.57	2.96	1.12
4/13/2008	1.45	3.31	1.90	1.73	1.10
4/20/2008	3.64	1.43	6.30	1.34	0.00
4/27/2008	4.17	2.98	5.38	1.51	0.00
5/4/2008	2.76	2.33	2.48	1.96	2.18
5/11/2008	9.71	4.62	5.53	1.85	0
5/18/2008	7.23	6.81	2.42	2.04	2.25
5/25/2008	5.04	6.85	1.22	2.32	4.01
sum of catch	1183	552	480	127	49
% of catch	30.80	14.37	12.50	3.31	1.28
Ave CPUE (SE)	2.61 (1.74)	2.83 (1.18)	2.30 (1.16)	1.62 (0.37)	1.10 (0.65)

Table 4 Weekly catch per unit effort (fish/10,000 m^3) of the 5 most abundant fish species between March 9 and May 25, 2008 at Chipps Island

Week starting	American shad	Fall-run sized Chinook salmon	Pacific Herring	Spring-run sized Chinook salmon	Winter-run sized Chinook salmon
3/9/2008	6.44	0	0	0	2.14
3/16/2008	9.45	0	1.74	0	4.09
3/23/2008	16.52	0	2.82	0	3.00
3/30/2008	7.73	0	1.76	4.24	4.91
4/6/2008	5.29	0	3.07	2.39	1.87
4/13/2008	4.60	0	4.14	4.14	0
4/20/2008	5.17	3.17	9.10	6.10	0
4/27/2008	3.81	4.35	7.16	6.00	2.21
5/4/2008	3.37	13.71	2.23	3.46	0
5/11/2008	3.27	10.85	5.30	4.70	0
5/18/2008	2.64	3.21	4.33	0	0
5/25/2008	6.01	5.51	6.90	2.05	0
sum of catch	624	353	225	163	28
% of catch	35.17	19.90	12.68	9.19	1.58
Ave CPUE (SE)	6.20 (2.15)	3.20 (2.59)	3.79 (1.41)	2.81 (1.32)	1.66 (0.97)

Table 5 Weekly catch per unit effort (fish/10,000 $m^{3)}$ of the 5 most abundant fish species between February 24 and March 2, 2008 at Benicia

Week starting	American shad	Pacific Herring	Rainbow trout	Sacramento splittail	Threadfin shad
2/24/2008	4.44	1.62	1.87	0	0
3/2/2008	7.04	2.03	1.75	1.47	4.92
sum of catch	116	11	9	3	3
% of catch	60.10	5.70	4.66	1.55	1.55
Ave CPUE (SE)	5.74 (2.54)	1.62 (0.40)	1.81 (0.11)	0.74 (1.44)	2.46 (4.81)

A total of 17,181 fishes representing 51 species was captured using beach seines during the sample period: 4,850 fishes from the lower Sacramento River; 11,678 fishes from the Delta, and 653 fishes from the Bay region. Sacramento sucker *Catostomus occidentalis* was the most abundant species of fish sampled in the lower Sacramento River beach seines, followed by Sacramento pikeminnow *Ptychocheilus*, fall-run sized Chinook salmon, red shiner *Cyprinella lutrensis*, and Sacramento splittail *Pogonichthys macrolepidotus* (Table 6). The Delta seines represent catch from regions north to Sacramento, south to Antioch, and east toward the pumping facilities. High abundances of red shiners and inland silversides *Menidia beryllina* occurred throughout the Delta seines (Table 7). Pacific staghorn sculpin *Leptocottus armatus* and top smelt *Antherinops affinis* were the predominant species caught in the Bay seines.

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Table 6 Weekly catch per unit effort (fish /10,000 m^3) of the 5 most abundant fish species between March 2 and May 25, 2008 in lower Sacramento region beach seines

Week starting	Sacramento sucker	Sacramento pikeminnow	Fall-run sized Chinook salmon	Red shiner	Sacramento splittail
3/2/2008	0.17	0.12	0.40	0.13	0
3/9/2008	0.19	0.44	0.27	0.28	0
3/16/2008	0.32	0.44	0.60	0.55	0
3/23/2008	2.37	0.17	0.19	0.49	0
3/30/2008	3.50	0.63	0.25	0.04	0
4/6/2008	0.43	0.16	0.09	0.04	0
4/13/2008	0.05	0.15	0.07	0.19	0.03
4/20/2008	0.86	0.21	0.15	0.28	0.15
4/27/2008	2.07	0.24	0.09	0.16	0
5/4/2008	10.24	0.52	0.03	0.11	0.44
5/11/2008	3.24	0.28	0	0.05	0.40
5/18/2008	7.01	0.16	0	0.44	0.38
5/25/2008	2.88	0.10	0	0.31	0.37
sum of catch	3620	287	192	157	150
% of catch	74.65	5.92	3.96	3.24	3.09
Ave CPUE (SE)	2.56 (1.65)	0.28 (0.09)	0.17 (0.09)	0.24 (0.09)	0.14 (0.10)

Table 7 Weekly catch per unit effort (fish /10,000 m^3) of the 5 most abundant fish species between March 2 and May 25, 2008 in Delta region beach seines

Week starting	Red shiner	Inland silverside	Sacramento sucker	Yellowfin goby	Fall-run sized Chinook salmon
3/2/2008	2.18	0.29	0.19	0	0.53
3/9/2008	0.48	0.38	0.20	0	0.39
3/16/2008	0.64	0.33	0.06	0.03	0.18
3/23/2008	0.03	0.19	0.03	0	0.06
3/30/2008	1.76	1.05	0.02	0	0.06
4/6/2008	3.72	1.59	0.06	0.03	0
4/13/2008	1.68	0.41	0.08	0	0.15
4/20/2008	8.66	0.95	0.49	0	0.02
4/27/2008	0.95	0.23	0.74	0	0.28
5/4/2008	4.74	0.17	0.64	0.08	0.06
5/11/2008	1.45	0.26	0.72	0.39	0.14
5/18/2008	4.51	0.12	0.57	0.50	0.03
5/25/2008	1.12	0.17	0.33	0.61	0
sum of catch	5393	2520	1422	563	480
% of catch	45.99	21.49	12.13	4.80	4.09
Ave CPUE (SE)	2.46 (1.30)	0.47 (0.24)	0.32 (0.15)	0.13 (0.12)	0.15 (0.09)

Yolo Bypass Study Highlights 2007-2008

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Sampling has been conducted for over a decade in the Yolo Bypass, a research and monitoring effort to understand fish and invertebrate use of this seasonal floodplain (Sommer et al. 2001; Sommer et al. 2004: Feyrer et al. 2006). The program continued its monitoring efforts this year, employing a suite of sampling methods designed to monitor adult, juvenile and larval fish populations, as well as drift invertebrates, zooplankton and chlorophyll. Overall, this sampling season represented the driest winter in the history of the survey. Inundation events were brief, with no inflow from the Sacramento River (via Fremont Weir) and only modest inundation of seasonal floodplain from smaller Yolo tributaries. Moreover, spring was extremely dry, with little net flow until the conclusion of the season in June.

Our core sampling includes fyke trapping during fall through late spring to capture large fish, particularly migrants. The highlight of this season's fyke trapping effort was the catch of 295 adult splittail caught December-April. This represents the greatest number of adult splittail sampled in the 10-year history of the Yolo Bypass investigations. A total of 81 adult white sturgeon were caught in late-January through mid-April; less than the 120 caught in 2007, but much better than the lone white sturgeon captured in 2006. A total of 13 adult American shad were caught in May and June, comparable to our average catch. Adult striped bass catch was above average at 378. Overall, most native (Sacramento blackfish, Sacramento pikeminnow, Sacramento sucker, splittail, and white sturgeon) catches were above average, while Chinook salmon was comparable to our typical modest catches of this species.

In addition to the fyke trap, we conducted beach seine hauls and operated a rotary screw trap throughout the winter and spring to sample juveniles and other small-bodied fishes. As in 2001, another low flow year, we captured juvenile Chinook salmon despite the fact that there was no inflow from the Sacramento River. Moreover, Chinook salmon were the dominant native fish collected in February and March (n=17 wild and 4 tagged) beach seine sampling. While some of these fish may be juveniles that first entered the estuary, then migrated upstream into Yolo Bypass, we expect that at least a portion of these fish were locally spawned in tributaries such as Putah Creek. The rotary screw trap showed a somewhat different pattern than the beach seine, where the majority of the Chinook salmon were tagged hatchery fish (n=35 of 37), most likely from 2 upstream Yolo Bypass releases of tagged (CWT) fish in February.

Juvenile splittail were the dominant native collected in the rotary screw trap during May and June (n=388), although catches were relatively low compared to previous years (Feyrer et al. 2006). This poor level of splittail production is expected given the extreme low flow conditions during the key March-April reproduction period for the species (Moyle et al. 2004; Sommer et al. 2007).

Beach seine sampling was expanded somewhat this season to gain better insight into how fish assemblages change along the upstream gradient from tidal freshwater to seasonal floodplain. This longitudinal study spanned the months of May-August, with weekly or biweekly sampling of 15 sites, 8 of which are tidally influenced. Spring sampling allowed us to visit the majority of our sites without interruption.

As part of baseline food web monitoring, zooplankton, drift invertebrate and chlorophyll sampling occurred February-June. Fluorometry and grab samples continue to demonstrate that Yolo Bypass chlorophyll levels are typically much higher than the adjacent Sacramento River (Sommer et al. 2004).

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Compiled by Ted Sommer, DWR

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