



Interagency Ecological Program

Newsletter - Spring 97 Vol 10 No. 2

CONTENTS

- [Interagency Program Quarterly Highlights](#)
- [EZMAN Heads for the Hills](#)

Status and Trends

- [Introduction](#)
- [Water Year 1996 in Review](#)
- [Delta Hydrologic Trends](#)
- [1996 Temperature Trends and Potential Impacts to Salmon, Delta Smelt, and Splittail](#)
- [X2 Update](#)
- [Suisun Marsh Salinity](#)
- [Neomysis/Zooplankton Abundance](#)
- [Biological Invasions in the Estuary](#)
- [Green Crab and Chinese Mitten Crab](#)
- [*Potamocorbula amurensis*](#)
- [Selenium Trends in North San Francisco Bay](#)
- [Contaminants and Their Potential Effects at the Rivers Confluence and Northern Estuary](#)
- [Suisun Marsh Fish Trends](#)
- [Delta Smelt Investigation](#)
- [Splittail and Longfin Smelt Abundance](#)
- [Bay Species](#)
- [Juvenile Salmon Abundance and Survival](#)

- [Chinook Salmon Catch and Escapement](#)
- [American Shad](#)
- [Young Striped Bass](#)
- [Adult Striped Bass](#)
- [Fish Salvage Program at the SWP and CVP Facilities](#)

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The Interagency Ecological Program is a
Cooperative Effort of the:
California Department of Water Resources
California Department of Fish and Game
State Water Resources Control Board
U.S. Fish and Wildlife Service
U.S. Bureau of Reclamation
U.S. Geological Survey
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
National Marine Fisheries

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Delta Smelt Investigations

Dale Sweetnam

Both 1995 and 1996 were wet years, but delta smelt responded differently to environmental conditions. The 1995 water year (wet) was a stressor year to delta smelt because of extremely high outflow; the 1996 water year (above normal) should have been good for delta smelt because the X₂ isohaline was in Suisun Bay for most of the spring. Because we now sample for delta smelt nearly year round, we can better determine what periods are critical to their survival.

Delta smelt abundance indices from both the summer tow-net survey (Figure 1) and the fall midwater trawl survey (Figure 2) vary dramatically from year to year and do not necessarily track each other. In 1995, the summer tow-net survey was low and the fall midwater trawl index was high. In 1996, the situation was the opposite — the tow-net index was up and the fall abundance was a near-record low. The 1996 results are disturbing because spring habitat conditions in Suisun Bay (X₂ isohaline was in Suisun Bay for 80 days) predicted a relatively good fall abundance (Figure 3). In contrast, spring habitat conditions in Suisun Bay in 1995 predicted fall abundance would be low, because the X₂ isohaline was downstream of Suisun Bay in February-June. The X₂/abundance relationship has only accounted for about one-fourth of the variability in delta smelt abundance in the fall. Addition of the 1995 and 1996 results further weakens this relationship, suggesting other factors were more important in determining delta smelt population strength in these years.

Because of the low fall abundance index, average delta smelt density as measured by three sampling programs were compared for 1995 and 1996 (Figure 4). Although each

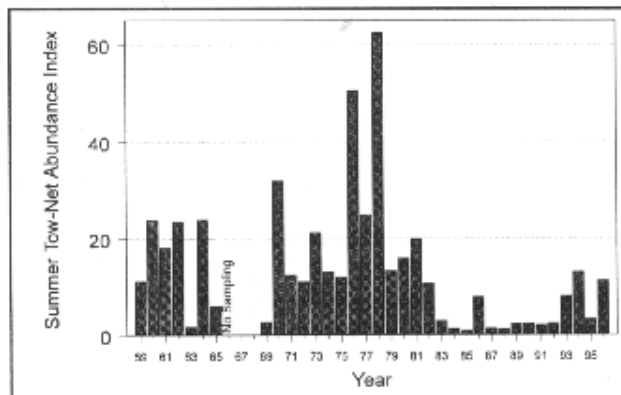


Figure 1
SUMMER TOW-NET ABUNDANCE INDEX FOR DELTA SMELT
Values represent the sum of volume-weighted means of 8 sampling areas.
The average of the first two surveys is used. No sampling in 1996-1999.

sampling gear has different sampling efficiency, biases, and locations, the comparison gives insight as to when the population declined. The 1996 year class appears to have been more abundant than the 1995 year class until August, when the midwater trawl survey collected very few delta smelt. Concerns over low delta smelt catches prompted the Resident Fishes Project Work Team to discuss possible mechanisms for the decline, including changes in growth rate, food limitation, contaminants, and temperature. Another decision of the team was to move the November Kodiak trawl survey to October to verify the low delta smelt numbers. This survey collected 263 delta smelt at 12 stations in a geographical sweep of the estuary. Although this survey did catch more delta smelt than the October

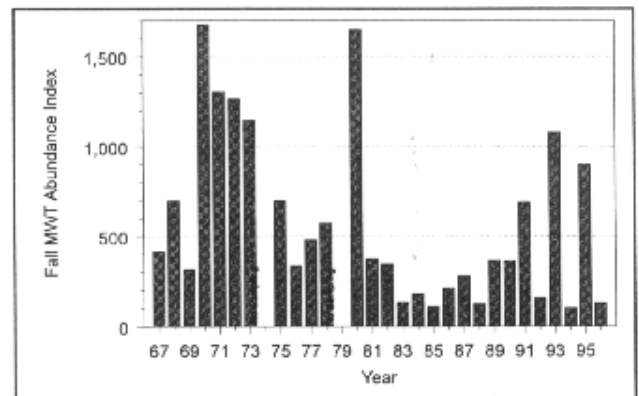


Figure 2
FALL MIDWATER TRAWL ABUNDANCE INDEX FOR DELTA SMELT
Values represent the sum of volume-weighted means of 17 areas sampled monthly, September through December. No sampling in 1974 and 1979.

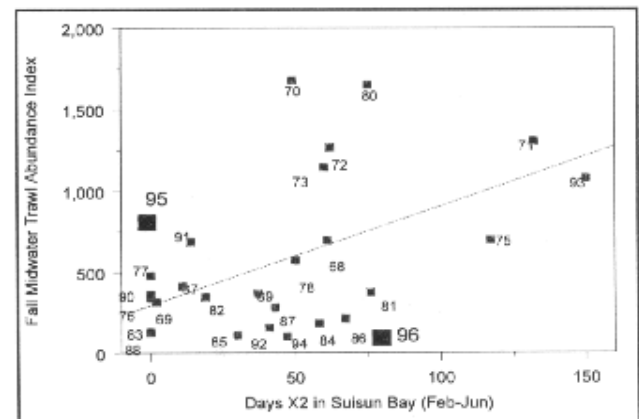


Figure 3
RELATIONSHIP BETWEEN NUMBER OF DAYS THE X₂ ISOHALINE IS IN SUISUN BAY IN FEBRUARY-JUNE AND DELTA SMELT ABUNDANCE AS MEASURED BY THE FALL MIDWATER TRAWL SURVEY
Without years 1995 and 1996: $y=6.128x+296.8$, $r^2=0.28$, $n=26$, $p=0.006$.
With years 1995 and 1996: $y=5.026x+345.2$, $r^2=0.19$, $n=28$, $p=0.02$.

midwater survey in a wider distribution, density was an order of magnitude lower than in the 1995 Kodiak trawl survey. The highest density in 1996 was 139.6 delta smelt/10,000m³; the highest in 1995 was 1156.1 delta smelt/10,000m³. This suggests that numbers of young-of-the-year delta smelt are indeed lower than was expected based on the spring 20mm survey and summer tow-net survey.

Preliminary analyses of the possible mechanisms for the decline suggest that:

- Delta smelt average lengths were smaller in the summer of 1996 than in previous years.
- Zooplankton density in 1996 did not appear to be lower than in previous years.
- There was no evidence of direct contaminant effects on delta smelt, but there was evidence of toxic effects on mysids in Grizzly Bay and near the confluence (see Autumn 1996 *Newsletter*).
- There was no evidence that water temperature was different in 1996 than in previous years.

Further research is underway on these mechanisms and others that would explain the apparent delta smelt mortality in 1996.

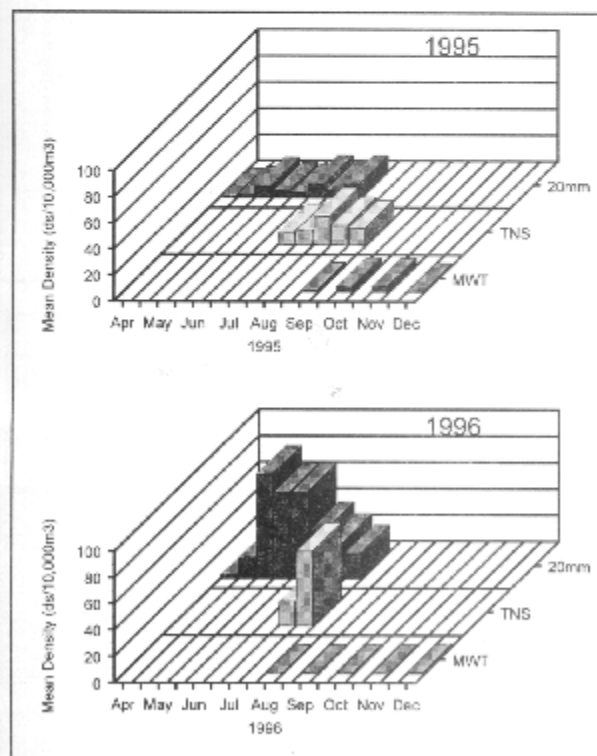


Figure 4
AVERAGE DENSITY OF DELTA SMELT COLLECTED IN
THREE SAMPLING PROGRAMS
Densities are in number of delta smelt/10,000m³.

In spring, delta smelt were widely distributed throughout the estuary, from the lower Sacramento River and the delta to the Napa River. By summer, delta smelt distribution had narrowed to the lower Sacramento River to Suisun Bay (Figure 5). By November, distribution was limited to the lower Sacramento River (Figure 6) until the first large outflow event in December, which shifted distribution to Suisun Bay.

Salvage of delta smelt at the CVP and SWP was much higher in 1996 than in 1995. In all, 91,447 delta smelt were salvaged at both facilities in 1996 as compared to 2,578 in 1995 (Figures 7 and 8). The 1996 salvage exhibits the two characteristic peaks of delta smelt salvage: a small peak in January or February resulting from adult delta smelt moving upstream into fresh water to spawn, and a larger peak in May-July of young-of-the-year delta smelt. The 1995 salvage pattern is interesting in that no young-of-the-year delta smelt were salvaged in May-July. This was the first year of record that no delta smelt were

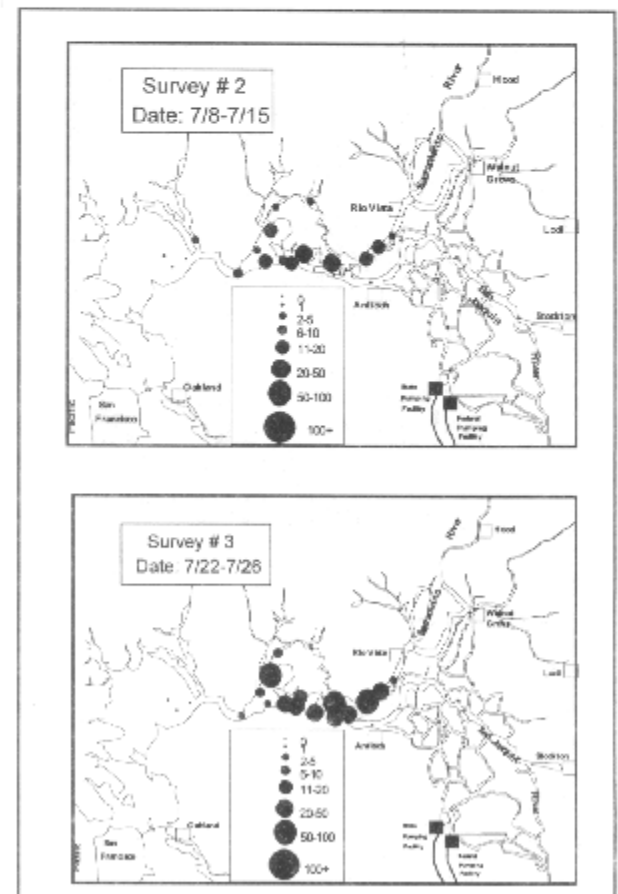


Figure 5
DELTA SMELT CATCH, 1996 SUMMER TOW-NET SURVEY
Circles represent total catch of delta smelt at 38 fixed sampling locations.
Survey 1 was canceled due to boat problems.

