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Quarterly Report

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To: CALFED Bay-Delta Program

Project: B81581, Delta Smelt Culture, State Water Project site - Byron
Date: 7/15/99

The objective of this project is to develop methods to culture the threatened fish, delta smelt. Numerous researchers are looking for a supply of smelt for basic and applied research, such as toxicology testing and improved fish screen design work. We are funded by CALFED for the first year of a three year grant. Emphasis in the first year is on improving the physical facilities at our site, optimizing spawn performance and larval culture procedures. Developing methods for the capture of post-larvae from the field for culture will be a minor emphasis this year.

This progress report briefly summarizes the progress from July 98 to present, and indicates the progress made in the current quarter: Jan - Mar 99.

I. Task 1: COMPLETED. Physical improvements at the site, and development of method to sterilize the delta water; Jul 98 - Jun 99

Initial preparations included converting an empty shipping container to a fish hatchery and live prey culture facility, requiring plumbing, carpentry and installation of water heating, cooling and purification units.

- Hatchery is partitioned to accommodate culture of the following life stages of delta smelt: eggs, larvae, and post-larvae to juvenile stages. Room has been allocated for rotifer and *Artemia* cultures.
- Disinfected water supply is produced with an ozone generator and liquid oxygen supply (rental equipment) and plumbed to service incubating eggs, larval rearing tanks, post-larval rearing tanks, and rotifer and *Artemia* prey cultures.
- New water chilling unit installed, provides temperature control of ozonated delta water.
- Re-circulating water supply with bio-filtration is built and operable.
- System preparations for rotifer culture complete: system built to circulate warm water (in-line heater) at 15 ppt NaCl through hatchery and back to an outdoor storage tank; incorporates UV sterilization.

Rearing trials with larvae include use of both an ozonated water supply in a flow-through system, and a "mature" re-circulating water supply which is bio-filtered. Use of the mature supply of water has shown advantages with some larval species.

II. Task 2: COMPLETED. Collection and maintenance of broodfish and initiation of rotifer culture; Nov 98 - Jun 99

Broodfish spawned late this year probably due to the cold spring. Spawning occurred primarily in May and extended to mid July. Rotifer production was extensive to cover our needs. And larval rearing systems were completed.

Broodfish and Rotifer culture:

- Collection of broodstock was accomplished quickly in late October - 360 fish in four field trips; initial transfer mortalities accounted for about 20% of the total. Broodfish were maintained daily since capture. Survival has been good from Jan - Jul (87%).
- Daily maintenance of broodfish includes siphoning, and wiping down of tanks and feeding. Fish are treated twice weekly with an anti-bacterial agent (nitrofurazone) to prevent spread of disease.
- Rotifer culture has been steady at a standing stock of 100-150 million/day since mid-March. Daily harvest ranges from 15-40 million/day. Daily maintenance includes 4 feedings (0800 - 2000h) of Bakers yeast/day, harvesting, straining and washing of rotifers and re-inoculation of one spare tank/day on a rotating schedule. Rotifers counted (#/ml) and inspected daily from all tanks.

Egg Incubation:

- Eggs develop normally in the ozonated delta water.
- Total spawn is still to be calculated, but appears to be similar to last year's (50,000 eggs).

III. Task 3: Larval Smelt Rearing Trials and Short-term Feeding Experiments, Apr-Sep '99. - Preliminary data.

- Larvae were stocked at two densities (40 or 100 larvae/liter) in 20-liter tanks (2 replicates/treatment). Larvae stocked at the higher density were larger at 20, 30 and 40 days post hatch, and survival was higher (10 vs. 32%) at 30 days for larvae stocked at the high density (see Figure 1A).
- Effect of rearing tank size is being tested currently and preliminary data indicate that fish stocked in larger (80 liter) tanks grow and survive better (52 % survival at 30 days post hatch) than fish reared at either density in the smaller tanks (20 liter). The 80-liter tanks were stocked at the lower density of 40 larvae/liter, when sufficient larvae become available, it will be interesting to stock the 80-liter tanks at a higher density to see if growth and survival can be further increased.
- Best rearing methods to date include use of the bio-filtered water in the recirculating system. Larvae fail to survive beyond about 25 days when reared with the ozone-treated water in a flow-through system. A higher stocking density results in higher growth and survival of fish, perhaps due to removal of excess prey by the larvae thereby improving tank hygiene. Feedings: rotifers (density 5/ml) or Artemia nauplii (2-3/ml) and algae added four times/day (0800-2000h). Tanks are siphoned 2-3 times/week, and siphon water is inspected for live (returned to tank) and dead larvae.
- Increased efficiency is expected for the culture program in the future we have observed growth *and* survival with higher stocking densities and larger rearing tanks.
- Short-term larval feeding experiments were conducted to look at the effects of algal density and algal cell filtrate on rotifer intake in larvae. We also ran experiments to test the effects of suspended particles (non-organic) and an effect of light level on rotifer intake. We are in the process of quantifying gut contents of larvae in the various expermients.

IV. Task 4: Post-larval Field Collection, Jun-Aug 99.

- Post-larvae were collected from the fish screening operation at the SWP's fish screening facility 194 fish. These fish were collected to evaluate the rearing potential of capturing post-larvae in the

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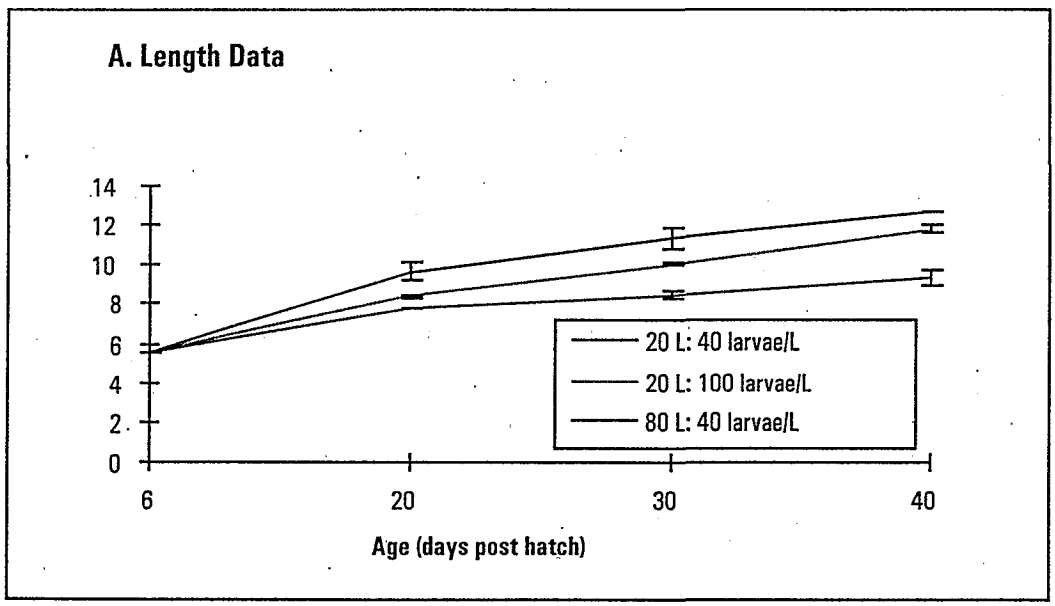
Summary: We have made tremendous headway this spring with the support of the CALFED Bay-Delta Program in developing larval delta smelt culture techniques, obtaining over 50% survival of larvae at 30 days post hatch. This progress is thought to be due primarily to rearing the younger life stages with the bio-filtered, recirculating water system and to stocking the larvae at higher densities or in larger tanks than have been tried in the past. Our plan would be to expand the recirculating water system to accommodate all larvae to the 30-40 day old stage in the coming year, we expect substantially increased production. We will continue to conduct experiments to test for factors important to larval feed intake. We will also be looking at factors (e.g. water velocity) that may influence spawning behavior.



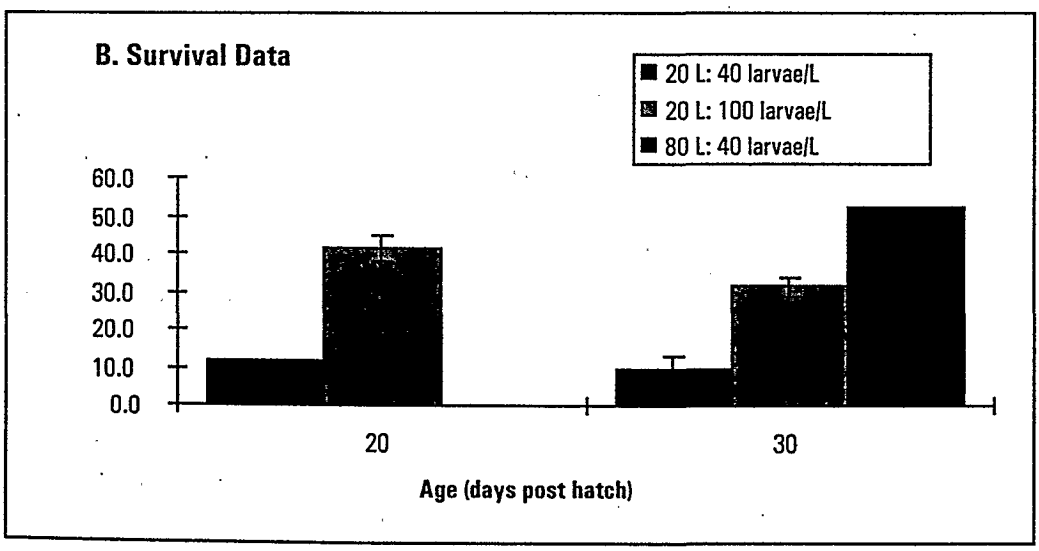


Figure 1. Effect of stocking density and tank size on length and survival of delta smelt larvae. Larvae were stocked at two densities (40 or 100 larvae/liter) into 20-liter tanks and at the lower density (40 larvae/liter) in the 80-liter tanks. Data represent means and standard errors for 2 replicates /treatment at specified days post hatch.

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