

**SHORT-TERM TRANSPORTATION STRESS AND RECOVERY  
IN DELTA SMELT**

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**EXTENDED ABSTRACT ONLY - DO NOT CITE**

**Introduction**

Water shortages and a growing population in southern California have led to the diversion of water from northern California to meet these demands. Many species of fish, including the threatened delta smelt (*Hypomesus transpacificus*) from the Sacramento-San Joaquin Delta are collected at pumping facilities, transported by truck, and returned upstream. Because delta smelt are delicate, mortalities from collection and transport stress can be high (Moyle, 2002). Swanson et. al. (1996) reported that the addition of salt and NovAqua, a commercial water conditioner, increased post-transport survival of captured delta smelt. However, transport and recovery stress responses were not assessed. To address these concerns, we subjected delta smelt (5-6 cm SL) to collection and short-term transport, and measured physiological stress parameters (plasma cortisol, pH, glucose, and lactate and hematocrit) before and after transport, and during recovery at 12°C.

**Materials and Methods**

Before fish were subjected to collection, resting samples were taken. We bled 3-4 fish (resting sample) by caudal transection from an undisturbed tank at the Center for Aquatic Biology and Aquaculture (CABA) on the University of California,

Davis (UC Davis) campus. Blood was collected using hematocrit tubing and was spun down, hematocrit readings were taken, the plasma collected into a freezer vial, and the plasma pH measured. The plasma was frozen for plasma cortisol, glucose, and lactate analyses. Other fish (n= 22-42) were collected with nets and cups so that the fish were not exposed to the air. They were placed in a cooler with 0.1 ml/L NovAqua and 4-6 g/L NaCl in 50-60 L of aerated water. The cooler was placed on a polyurethane pad in a pick-up truck bed and transported (1.6 km, 10 min) to the UC Davis J. Amorocho Hydraulics Laboratory. Upon arrival, 3-4 fish were immediately sampled, and remaining fish were randomly selected to recover in either 250-L tanks (4-5 fish/tank) or, individually, in 4-L buckets in a 250-L water bath. Four fish from each recovery tank and buckets were sampled at 24 h intervals over 4 d.

## **Results**

Data were analyzed using analysis of variance (ANOVA) and Bonferroni multiple comparison tests. No significant differences were found in any of the measured stress parameters during transport, indicating that our collection and short-term transport methods did not stress the delta smelt. During recovery in the buckets, there was a significant increase in plasma cortisol (a primary stress response) level at 24 h (compared with the resting samples' mean level), with a trend of maintained elevated cortisol level continuing on at 72 h in the buckets. Hematocrit (a secondary response) was significantly decreased at 72 h, indicating possible hemodilution during that sampling time for fish held in the buckets. The other stress parameters (plasma pH, glucose, and lactate) displayed no significant differences for fish held in buckets and tanks. Post-recovery survival decreased significantly at 72 h for fish held in buckets when compared to those held in tanks against all other sampling times (sample size insufficient at 96 h). Our results indicate that transported delta smelt may not recover well in smaller, individual containers after collection and transport.

Our transport techniques do not stress this pelagic fish, however, recovery in small, isolated containers might.

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### **References**

Moyle, P.B. 2002. *Inland Fishes of California*. University of California Press. 576 pp.

Swanson, C., R.C. Mager, S.I. Doroshov, and J.J. Cech, Jr. 1996. Use of salts, anesthetics, and polymers to minimize handling and transport mortality in delta smelt. *Trans. Am. Fish. Soc.* 125:326-329.

