the facility. This focused study has captured the interest of screen designers across the country. As investigations get underway, we should gain a better understanding of the appropriate screen design parameters for large diversion facilities, such as those envisioned in the CALFED Bay-Delta program, or other proposed installations.

For more information on the UC-Davis Hydraulics Lab and this project, please visit their web page at: http://www.engr.ucdavis.edu/~hydlab/. If you are interested in tracking the project (via progress reports, comments, etc.), you may subscribe to an email "listserve" that has just been set up on a DFG Bay-Delta office computer server. Send an email message to majordomo@delta.dfg.ca.gov with the following line in the body of your message: subscribe fish-treadmill [your email address].

## Category III

*Cindy Darling, CALFED*

The December 1994 Bay-Delta Accord contained a commitment to funding for fish restoration projects that addressed "non-flow" factors. This commitment was included under Section III and has become known as Category III. In the first 2 years of this program, 38 projects have been approved, using $21.7 million in contributions from urban water agencies. Funded projects include fish screens and ladders, habitat acquisition and restoration, and programs to reduce pesticide runoff. Many of the projects are partnerships with other funding sources, so the total cost of the projects approved by Category III is over $57 million.

As the program has grown and developed, the Category III steering committee has been working on a more substantial structure to select and implement projects. At the same time, $60 million in state matching funds were approved in Proposition 204, and a federal authorization passed in the closing days of Congress authorized $430 million over 3 years for ecosystem restoration projects.

The CALFED Bay-Delta Program has made significant progress on developing long-term solutions and has committed to help with immediate implementation of ecosystem restoration activities. These developments led to a decision to form the Ecosystem Roundtable to replace the Category III steering committee. This new group operates as a subcommittee of the Bay-Delta Advisory Council and includes 18 representatives of various interest groups. The mission of the Ecosystem Roundtable is to provide stakeholder input on the coordination of existing and anticipated state and federal ecosystem restoration and management programs. CALFED managers will consider input from the Ecosystem Roundtable in deciding which projects to fund for existing restoration programs and for the new sources of funding from Proposition 204 and the federal government.

The next round of projects to be funded will be selected this spring, with a final list expected in late June. In January, the Ecosystem Roundtable will suggest priority species and habitat types for this round of funding. Technical teams comprised of CALFED agency staff, academic experts, and stakeholder representatives will be working with CALFED in January, February, and March to identify the types of projects they would recommend for funding to address high priority species and habitat types. Those who would like to propose projects should look for these to be solicited in April or May. Anyone interested in submitting a proposal should send a brief letter to the CALFED Bay-Delta Program, 1416 Ninth Street, Suite 1155, Sacramento, CA 95814, asking to be placed on the mailing list.



## Calculations of Required Screen Mesh Size and Vertical Bar Interval Based on Delta Smelt Morphometrics

*Paciencia S. Young and Joseph J. Cech, Jr., University of California, Davis, in collaboration with Suzanne Griffin, Paul Raquel, and Dan Odenweller, DFG*

We conducted a morphometric study of delta smelt to help in developing smelt screen criteria. We took morphometric measurements from preserved (10% buffered formalin) specimens and from fresh (moribund and freshly thawed) specimens. We measured again after specimens had been preserved for several months to determine a preservative-related correction factor.

Morphometric measurements from 341 preserved juvenile and adult delta smelt included: total length, fork length, standard length, maximum body depth, maximum head depth, maximum body width, and maximum head width. Total length, fork length, and standard length were measured with a Vernier caliper. Body depth, head depth, body width, and head width were measured using a Nikon Microplan II image-analyzer with IBM Microplan II imaging program. Generally, at least 30 specimens per size class (10mm intervals) over a 20-80mm TL range were used.

Preliminary results showed that many preserved specimens >40mm TL, had flared operculae so that the maximum head width measurements were greater than those without flared operculae. Some preserved specimens also had bulging eyes and some had sunken eyes. Therefore, we measured an additional 154 fresh specimens (41.1-69.9mm TL). Screen mesh size and vertical bar interval calculations followed Margraf *et al* (1985).

$$SL = (0.06564 \times M + 1.199 \times M \times F) / (1 - 0.0209 \times M)$$

where:
M = screen mesh size or vertical bar interval, and
F (Fineness Ratio) = SL/BD for screen mesh size, or SL/HW for vertical bar interval.

Table 1 provides an overall reference for delta smelt relationships among morphometric measurements in different size classes. The equations incorporate measurements of fresh specimens, corrected values of preserved specimen measurements (based on preservative-correction factor when adequate fresh measurements were not available), and uncorrected preserved measurements (on some SL measurements, when no fresh measurements were available and no correction factors could be calculated). We used body depth for calculations of maximum screen mesh size, and head width for maximum bar interval to retain specific total length and standard length of delta smelt (Figures 1 and 2). These calculations are based solely on the physical dimension (morphometrics) of delta smelt. It is assumed that fish would pass through screens lengthwise and that fish with body depth equal to mesh size would be excluded. However, three other important factors should be considered: behavior of fish in the presence of a screen;

Table 1
EQUATIONS EXPRESSING RELATIONSHIP AMONG MEASUREMENTS IN DIFFERENT SIZE CLASSES OF DELTA SMELT
*Size range = 21.8-82.0.*
*Calculations were based on: fresh, corrected values of preserved specimen measurements; and uncorrected preserved specimen measurements involving standard length, all P<0.001.*

| Relationship | n | Equation | $r^2$ |
|---|---|---|---|
| FL vs TL | 324 | FL = 0.608 + 0.910 TL | 0.998 |
| SL vs TL | 244 | SL = 0.003 + 0.840 TL | 0.997 |
| SL vs FL | 242 | SL = -0.439 + 0.922 FL | 0.999 |
| BD vs TL | 324 | BD = -0.539 + 0.147 TL + 0.00025 TL2 | 0.959 |
| HD vs TL | 244 | HD = -0.776 + 0.133 TL | 0.974 |
| BW vs TL | 244 | BW = 0.095 + 0.086 TL | 0.939 |
| HW vs TL | 324 | HW = -2.66+0.28 TL - 0.004 TL2 +0.000028 TL3 | 0.849 |
| BD vs FL | 324 | BD = -0.615 + 0.160 FL + 0.000314 FL2 | 0.958 |
| HD vs FL | 244 | HD = -0.844 + 0.146 FL | 0.975 |
| BW vs FL | 244 | BW = 0.057 + 0.095 FL | 0.937 |
| HW vs FL | 324 | HW =-1.63 +0.217 FL - 0.003 FL2 +0.00002FL3 | 0.840 |
| BD vs SL | 244 | BD = -1.086 + 0.207 SL | 0.970 |
| HD vs SL | 244 | HD = -1.431 + 0.194 SL - 0.0004 SL2 | 0.977 |
| BW vs SL | 244 | BW = -0.477 + 0.132 SL - 0.0003 SL2 | 0.940 |
| HW vs SL | 244 | HW =-3.724+0.392 SL - 0.006 SL2 +0.00004 SL3 | 0.881 |
| BW vs BD | 242 | BW = 0.194 + 0.649 BD - 0.011 BD2 | 0.926 |
| HD vs HW | 222 | HD = -1.290 + 1.834 HW - 0.059 HW2 | 0.922 |

TL Total length
FL Fork length
SL Standard length
BD Maximum body depth
HD Maximum head depth
BW Maximum body width
HW Maximum head width

velocity of water flow; and survival of the retained fish.

We recommend that before screen criteria are determined for delta smelt, studies also be conducted on delta smelt behavior in the presence of a screen, post-impingement survival, and post-impingement swimming performance.

Some of the preserved juvenile specimens were borrowed through Dr. Johnson Wang (consultant to DWR and USBR) and Lloyd Hess (Tracy Fish Facility). Preserved subadult and adult specimens were lent from collections of Dr. Christina Swanson, Dr. Serge I. Doroshov and Mr. Randy Mager (UC-Davis). We are grateful to Dr. Doroshov for use of the Microplan II image analyzer; to Dr. Swanson for providing us with more than 128 fresh delta smelt; and to Jennifer Lorenzo, Melissa Gonzales, and Megan Sheeley for technical assistance.

### Literature


Margraf, F.J., D.M. Chase, and K. Strawn. 1985. Intake screens for sampling fish populations: the size-selectivity problem. *North American Journal of Fisheries Management*. 210-213.


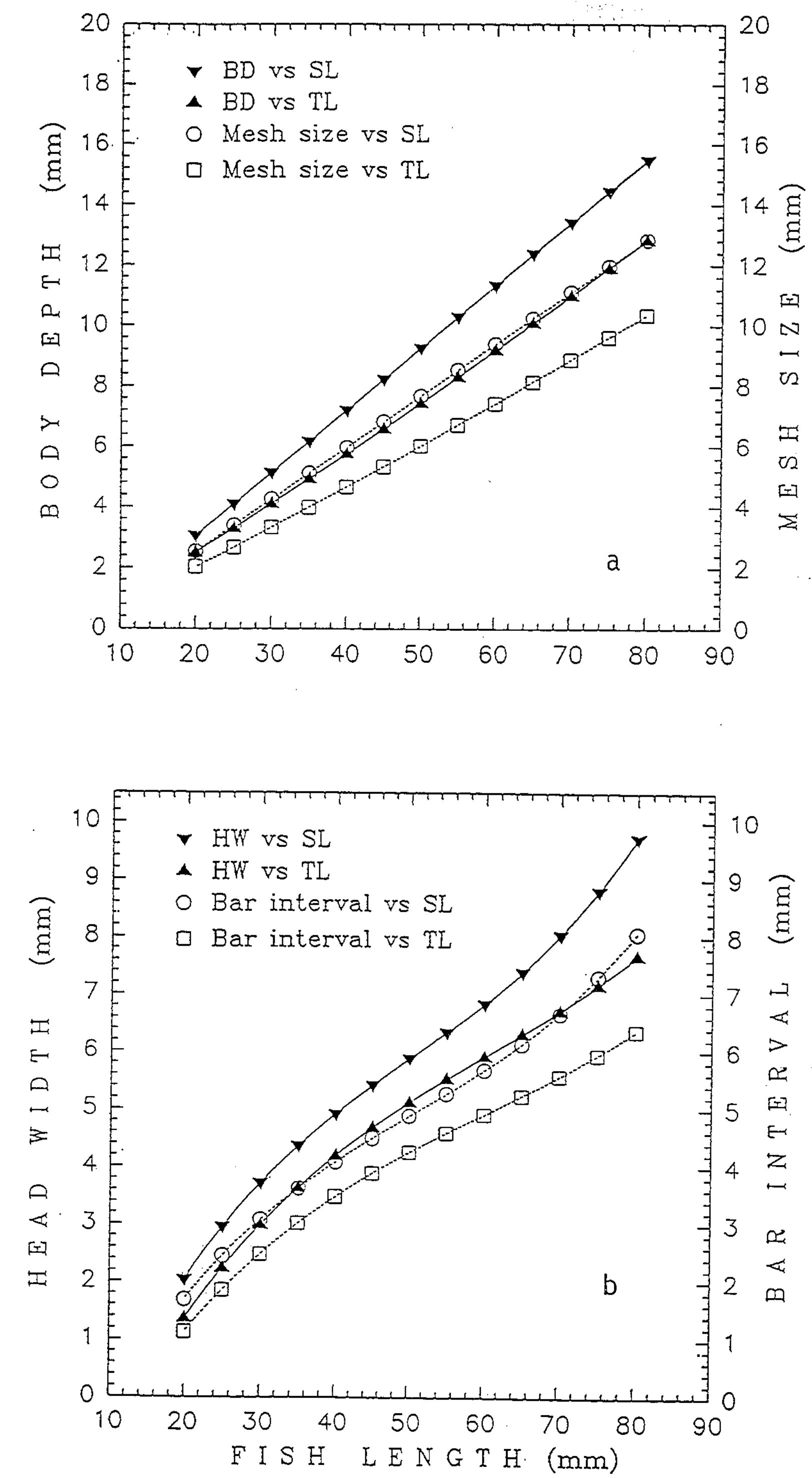


Figure 1
CALCULATED MAXIMUM BODY DEPTH AND SCREEN MESH SIZE (top) AND CALCULATED MAXIMUM HEAD WIDTH AND VERTICAL INTERVAL (bottom) IN RELATION TO TOTAL LENGTH AND STANDARD LENGTH IN DELTA SMELT



## Clam-Stuffed Sturgeon

*Heather Peterson, DWR*

In my studies of the introduced species *Potamocorbula amurensis* and its impact on the food web dynamics of the estuary, I have encountered some argument about whether *P. amurensis* was actually being used as a food resource. Analysis of the fore and hind gut of a white sturgeon found in San Pablo Bay in October 1996 may help explain the role of *P. amurensis* in providing a food resource for bottom-feeding fish, particularly sturgeon. The gut contents were analyzed by Wayne Fields of Hydrozoology Inc, Newcastle, California. Following is a portion of his report:

> In a typical analysis of a fish stomach, attention is paid only to the contents of the foregut since this consists of recently eaten food, and easily digested items may still be evident, giving a relatively true picture of the feeding habits of the fish in question (food items with no hard structures to resist digestion may be dissolved immediately). The hindgut contents are usually ignored since indigestible foods tend to lodge there for varying and unknown periods and there are no easily digested items left. In the current analysis, however, since the stomach sample was available, I chose to look at both parts of the stomach.
>
> Foregut:
> The foregut contained 214 countable (and essentially intact) clams, all *Potamocorbula amurensis*, parts of seven Idoteid isopods (probably *Syniodtea laevidorsalis*) and a single amphipod (*Ampelisca abdita*). Recognizable items made up about 1/4 of the volume of the foregut (total volume about 150 mL). The remaining volume was all pieces of *P. amurensis* shell.
>
> Hindgut:
> The hindgut contained 501 countable clams, all *P. amurensis*, parts of two Idoteid isopods (probably *S. laevidorsalis*) and the posterior end of a single shrimp (probably *Palaemon macrodactylus*) These items made up about 40% of the hindgut volume, the rest being *P. amurensis* pieces. The total volume was about 250 mL.
>
> Given the muscular nature of a foregut adapted to crushing food items, it was surprising to find that anything in the hindgut was in one piece. It was even more surprising that there was a larger ratio of whole clams to clam pieces (in terms of volume) in the hindgut than in the foregut, and that the clams in the hindgut (as well as other softer food items which should have been digested) were in about the same shape as the same type of food in the foregut. This suggests that food items were moving through the gut at a relatively rapid pace, apparently not staying around long enough for complete digestion. It may be that there is now so much food available (in the form of *P. amurensis*) to bottom feeding fish like the white sturgeon that complete digestion of every food item is unnecessary.

Although one analysis does not represent conclusive evidence about the feeding habits of other fish in the estuary, results of this analysis indicate that *P. amurensis* is providing a generous food resource to bottom-feeding fish.

## New Technical Reports

Several Interagency Technical Reports have been released in the past few months. If you would like a copy of any of these, please contact Lisa at 916/227-7541 or lbatiste@cd-eso.water.ca.gov.

47 *1995 Pilot Real-Time Monitoring Program: Evaluation and Recommendations*
(C. Armor, L. Winternitz, D. Sweetnam, P. Brandes, R. Baxter)

49 *Winter-Run Chinook Salmon Captive Broodstock Program: Progress Report through April 1996*
(K. Arkush, M. Banks, S. Hamelberg, D. Hedgecock, P. Siri)

50 *Adult Salmon Migration Monitoring, Suisun Marsh Salinity Control Gates, September-November 1994*
(G. Edwards, K. Urquhart, T. Tillman)

51 *Otolith Aging of Larval and Juvenile Striped Bass in California*
(S. Foss, L. Miller)

52 *An Assessment of the Likely Mechanisms Underlying the "Fish-X2" Relationships*
(Estuarine Ecology Team)

54 *A Telemetry Study of Striped Bass Emigration from Clifton Court Forebay: Implications for Predator Enumeration and Control*
(M. Gingras, M. McGee)