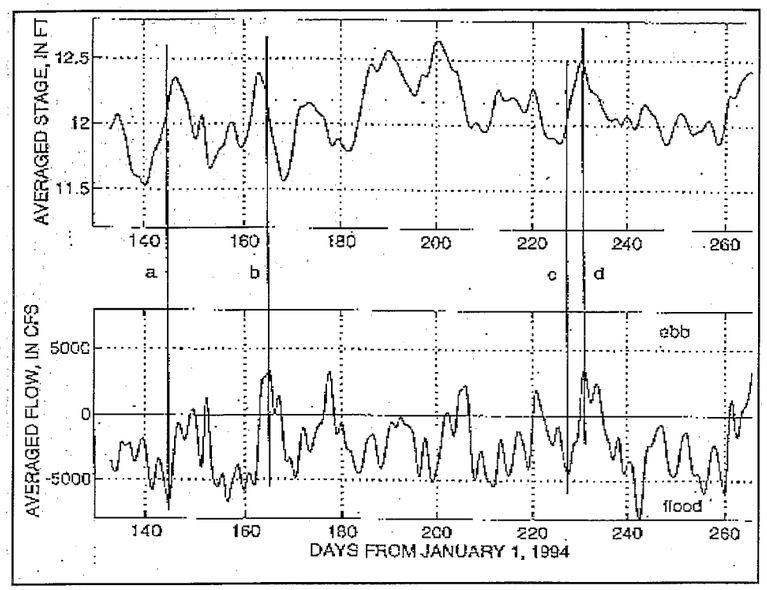

Figure 2
TIDALLY AVERAGED STAGE (top) AND FLOW (bottom) FROM SAN JOAQUIN RIVER AT JERSEY POINT UVM

plots show that during spring tides, when the net elevation of the delta is rising (lines a and c), net flows into the delta (negative flow; delta is filling) are largest, and during neap tides, when the net elevation is decreasing (lines b and d), net flows out of the delta (positive flow; delta is draining) are largest. Figure 2 also shows that the average net flow during this predominantly summer period was about 2,000 cfs upriver.

Threemile Slough

The Threemile Slough UVM station has been operational since February 1994. Maximum ebb and flood tidal flows are about 30,000 cfs. Net flow during conditions other than high flow is generally about 1,500 cfs from the Sacramento River to the San Joaquin River. The magnitude of this net flow varies with the spring/neap tidal cycle, with net flow being reduced as the delta drains and increased as the delta is filling. During the high flows of March 1995, maximum net flow was 22,300 cfs flowing from the Sacramento River to the San Joaquin River. For about 60 days following the peak, the net flow direction through the slough was periodically from the San Joaquin River to the Sacramento River, with a maximum net flow of about 2,000 cfs. The reversal of net flow direction appears to result from high flows entering the delta from the San Joaquin River; San Joaquin River inflow to the delta during the 60-day period never was less than 17,000 cfs.

Sacramento River at Rio Vista and Dutch Slough

Initially, a UVM installation was planned for the Sacramento River just downstream of Decker Island. The plan was to add flow from the Decker Island site to San Joaquin River flow at the Jersey Point site and to estimated flow through Dutch Slough to provide an estimate of delta outflow. The acoustic path length at the proposed Decker Island site was 3,000 feet, which exceeds the capability of the UVM equipment. Therefore, two complete UVM systems with responders (Sacramento Ship Channel), similar to the Jersey Point system, were initially planned for monitoring flow at this site. However, once funding was obtained for installation of the Threemile Slough UVM, we decided that the Decker Island station could be relocated upstream to the Rio Vista Bridge area and still provide the flow data necessary to estimate delta outflow. Three reasons for moving the Decker Island site upstream to Rio Vista were:

- To lessen the chance of obtaining erroneous line-velocity data due to bending of the acoustic signal because of salinity gradients within the acoustic path,
- To simplify installation and operation of the station by making use of the bridge structure, and
- To make use of a DWR compliance monitoring instrument shelter and stilling well.

During March 1995, installation began of two UVMs at the Rio Vista site. One is now operational; the acoustic path is on the northwest side of the channel. The acoustic path for the second UVM will be on the southeast side of the channel. The pile installed for the southeast acoustic path was lost during the March 1995 high flows; a steel replacement pile in addition to a support pile were installed during August. The two line velocities from the two UVMs will be used to compute the flow record. Because there will be two separate UVMs operating at this site, a radio link between the two will be required so that one UVM will be disabled while the other is measuring velocity.

The national ecosystem initiative program of the USGS funded installation of a UVM on Dutch Slough. This UVM station is needed to measure a small fraction of delta outflow. The equipment shelter has been installed, and the transducer mounting piles were driven during August. The site should be operational in November.

San Joaquin River at Stockton

A UVM flow monitoring station was installed on the San Joaquin River near Stockton in July 1995, with funding provided by the City of Stockton. The site is about a half-mile north of the Highway 4 bridge crossing near the city waste water treatment plant. The National Pollutant Discharge Elimination System permit requires the city to obtain flow data at the location where treated effluent is discharged into the river. This site will monitor the periods and magnitude of net southerly San Joaquin River flow due to operation of the SWP and CVP export facilities and consumptive use in the southern delta. The instrument is recording line velocity and stage data, but it has not yet been calibrated.

Supplemental Flow Data

The UVM network provides a valuable flow database for use in calibrating and validating delta flow and transport models. This database will be supplemented with ADDMS measurements collected periodically at critical flow splits to assess the accuracy of flow magnitude and phasing provided by models. An adequate number of measurements can be made with the ADDMS to simultaneously characterize tidal variations at three or four sites using one boat and a crew of two. The ADDMS is used to make a few measurements at each of the three or four sites in turn. Then the measuring cycle repeated for as long as desired; for example, during half or a complete tidal cycle.

Acknowledgments

The USGS greatly appreciates the funding provided by DWR, USBR, Contra Costa Water District, and the City of Stockton to install and operate the network of UVM flow monitoring stations. The author acknowledges Mike Simpson, Steve Gallanthine (no longer with the project), Rick Adorador, and Scott Posey of the USGS for their dedicated effort in installing, troubleshooting, and operating the UVM network. Without their efforts, these valuable flow data would not have been collected.

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Feather River Fisheries Studies

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The lower Feather River extends from Oroville to its confluence with the Sacramento River at Verona. Fall-run and spring-run chinook salmon spawn on two reaches of the river: the low-flow channel from Oroville to Thermalito Afterbay outlet, and the lower reach from Thermalito Afterbay outlet to Honcut Creek, near the town of Live Oak. The lower reach also provides important habitat for other migratory species such as American shad, splittail, striped bass, and green sturgeon.

Flow into the system is controlled by the Oroville complex, including Oroville Dam, Thermalito Diversion, and Thermalito Afterbay. Recently, Water Resources has initiated several fisheries studies in cooperation with Fish and Game. Major issues to be addressed include chinook salmon spawning, outmigration gravel quality, and the role of Feather River Fish Hatchery.

Flow conditions for salmon spawning were recently examined during development of an instream flow model for the Feather River. A key issue is whether the model, which was based on measurements of spawning preferences during the 6-year drought, is applicable to higher flows. The present study will attempt to resolve this issue empirically by operating the low-flow channel at two different flow levels during the next 4 years. Beginning this fall, a combination of aerial photography and ground-based measurements will be used each year to determine spawning density, location, and conditions.

In early 1996, as part of efforts to provide comprehensive salmon monitoring in the Central Valley, Water Resources will install and operate screw traps below the low-flow channel and lower reach. We plan to operate the traps during winter and spring for at least the next 4 years to provide information about the timing and magnitude of juvenile salmon outmigration. We will also collect data on species such as splittail, green sturgeon, and steelhead.

Feather River Fish Hatchery plays a major role in the management of salmon and steelhead in the system. The hatchery program is being evaluated by marking young salmon produced in the hatchery and in the river. The goals of this study are to determine:

- Distribution of adult Feather River salmon throughout the Sacramento Valley and the Pacific Ocean,
- Hatchery versus in-channel production,
- Conditions affecting juvenile survival.

In 1995, a total of 550,000 fish were tagged and released in the estuary. An additional 400,000 tagged juveniles have been released in the Feather River (200,000 fingerlings, 200,000 smolts). Some of the young salmon collected in the screw traps will also be tagged for comparison with hatchery-produced fish. The tagging program will continue at near the 1 million fish/year level through 1998. Fish and Game will recover the tags from the ocean fishery, returning adults in hatcheries, and carcasses in the Feather River and other streams.