

dry years and higher catches during wet years, reinforcing the concept of a strong outflow-production relationship. This general relationship may, however, be due to other factors. For example, turbidity may be higher in high outflow years, thus rendering fish more vulnerable to capture.

#### *Summer Towntnet Survey*

The CDFG summer townnet survey began in 1959 to provide an index of striped bass abundance. It samples YOY fish twice monthly at 30 sites using oblique tows in mid-channel. Starting and ending dates vary from year to year. Sample sites are located throughout the Delta, Suisun Bay, and San Pablo Bay. Data for species other than striped bass were not regularly recorded until after 1962, but were also not recorded in 1966, 1967, and 1968 (Sommer *et al.* 1997). The survey catches only low numbers of YOY splittail, presumably because it focuses on pelagic (open water) habitats while splittail are benthic in orientation. Not surprisingly, splittail catch varies widely and the index reflects only gross changes in YOY splittail abundance. The index peaked in 1982, was low during the 1987 to 1992 drought years, and abruptly rebounded in 1995 and 1998 (Baxter 1999a, 1999b).

#### *Napa River Survey*

This survey exists in association with a flood control and ecosystem restoration project in the Napa River. It is performed by consultants under contract to USACE, and involves a range of sampling techniques including beach seine, purse seine, otter trawl, fyke nets, and a 20 mm (0.8 in) size class surveys. The Napa River Survey began sampling in March 2001 and has detected splittail (USACE 2002a, 2002b) but the data are too recent and of too short a term (two years, including 2002 unpublished data) to be useful for an abundance index. The survey is scheduled to be completed in 2007 or 2008, after 7 years of data collection. Additionally, the Napa River is less well understood in terms of relationships between outflow, splittail habitat, and splittail production, than are the Central Valley rivers and the Delta. As such, the variables employed in our current analysis of abundance and trend (*see* Abundance section, below) cannot be applied to this distinct river system at this time.

#### *California Department of Fish and Game Creel Census*

CDFG collects creel census data in association with the Sacramento River System Angler Survey. This survey was

initially conducted from August, 1989, to December, 1994, and was resumed in 1999 and 2000. Adult splittail catch data were only recorded during 1991 through 1994, and in 1999 and 2000. This survey collected angler count, fishing effort and fish catch information on the Sacramento River from Redding to Carquinez Bridge year round with the same effort, 4 week days and 4 weekend days per month per section, so changes in catch can reflect fish presence related to angler effort.

To reflect only the presence of migrating fish, Baxter (2001b) analyzed only catch data from Garcia Bend (RKM 80 (RM 50)) and upstream. Creel census data from 1991 through 1994 indicated a total annual catch of 114, 266, 498, and 110 splittail, respectively. The 1999 and 2000 censuses yielded an annual catch of 103 and 232 splittail, respectively. These catches represent 96 days of survey effort each year and are useful primarily to help establish the periods in which adult splittail migrate upstream. No abundance indices were calculated by any agency, organization, or individual from these data, as they fail to meet the criteria established by Meng and Moyle (1995) and are generally considered inadequate to the task of quantifying splittail abundance.

#### *Survey Summary*

All fish sampling methods may inherently suffer from a selection bias. This bias results from the particular method and must be considered when interpreting results. Because none of the surveys were designed specifically to monitor splittail populations, the survey equipment, survey locations, and sampling frequency must all be taken into consideration when interpreting the data. All the survey methodologies appear to sample young of the year (YOY) most effectively. As a result conclusions regarding YOY abundance appear to be the most accurate and reliable. Combined information from all survey efforts suggest that some successful reproduction occurs every year, but large numbers of young are produced only during years of relatively high outflow (wet years). This suggests that the majority of adult fish in the population result from spawning in wet years and lowest numbers are produced during drought years. The distribution and timing of YOY in the surveys also indicates that most spawning takes place in the bypasses, rivers or upper Delta, although some sporadic spawning also takes place in Suisun Marsh. It must be recognized, however, that YOY abundance may not be an entirely accurate indicator of adult abundance because there exists no observed stock-

recruitment relationship (relationship between the number of adult fish and the number of offspring typically expected to join the adult population) in splittail (Sommer *et al.* 1997; Moyle 2002). Consequently, YOY abundance may not describe the current of future population sizes or trends.

#### **Abundance Trend Analyses**

We initially evaluated and analyzed the aforementioned data series using a method published by Meng and Moyle (1995) in the Transactions of the American Fisheries Society. This method was used during the initial status review for the splittail and was again employed during the development of the proposed rule to list the splittail (59 FR 862). This same method was replicated during the development of the final listing rule published on February 8, 1999, (64 FR 5963) using abundance data provided and updated by CDFG, CDWR, and UC Davis. The Meng and Moyle (1995) methodology (*see* 66 FR 2828 for complete description of methods) has been superseded by more current models employed by CDFG, and was not used to help us make this final determination. Further, this removal does not discuss the more recently available analytical methods such as permutation-based exact calculations of p-values for stratified (as opposed to unstratified) Mann-Whitney U-tests, as appeared in the August 17, 2001, notice (66 FR 43145) where we presented an updated statistical analysis of abundance data for the Sacramento splittail and requested comments on it. While these stratified Mann-Whitney U-tests represented an improvement on what essentially remained a Meng and Moyle (1995) statistical approach, and presented a major alternative to the categorical (*i.e.*, "before" and "after") approaches of both Meng and Moyle (1995) and Sommer *et al.* (1997), substantive scientific and statistical issues raised during the August 17, 2001, (66 FR 43145) public comment period resulted in our using an alternative statistical analysis to help us make this final determination. The following details the history and findings of the current analysis.

In an August 17, 2001, notice (66 FR 43145) we presented an updated statistical analysis of abundance data for the Sacramento splittail and invited public comments on the analysis and data, in specific technical review of the information. We concurrently sought peer review on the statistical analysis from five subject-area experts affiliated with a total of five agencies and organizations. Requests for peer review