

conditions for splittail, water must remain on the bypasses until fish have completed spawning, and larvae are able to swim out on their own, during the draining process. The Cosumnes River also possesses natural and restored floodplain features. This river is unique in that it is not dammed and the hydrograph is relatively natural. The contributions made by this habitat are somewhat limited by the fact that the Cosumnes River watershed is lower in elevation than most adjacent rivers. It is therefore somewhat less dominated by the extended spring peak flow characteristic of a higher altitude watershed with greater snowmelt potential.

In summary, the current distribution of splittail habitat is certainly reduced at least 20% and may be much more reduced in extent from that which may have historically been present. Clearly, perhaps the largest portion of the splittail's habitat is contained in the natural and newly restored floodplains of the Cosumnes River, managed floodplains such as the Yolo and Sutter bypasses, disjunct segments adjacent to the Sacramento and San Joaquin rivers and in lower reaches of their respective tributaries.

In years where the Yolo and Sutter bypasses are not sufficiently inundated, splittail spawning is confined primarily to the natural and newly restored floodplains of the Cosumnes River and the margins of rivers and other floodplain features that are inundated at lower river stages. These areas likely represent only a fraction of the area which was historically subject to inundation; levees preclude access to reclaimed floodplains and basins. There are indications, based on presence of larvae and juveniles, that spawning in the Sacramento River occurs relatively far upstream at Colusa (Baxter 1999a; 1999b). Splittail appear to utilize the San Joaquin River in wet years when appreciable runoff exceeds the capacity for storage and diversion of runoff. The Tuolumne, Cosumnes, Feather, American, Napa, and Petaluma rivers, and numerous other smaller waters support splittail spawning activity. Early indications are that the Napa River may contain a robust subpopulation of splittail (USACE 2002a, 2002b).

Abundance

Seven sampling programs capture splittail frequently enough to allow the calculation of useful abundance indices. These programs are: (1) CDFG's Fall Midwater Trawl (Fall MWT); (2) CDFG's San Francisco Bay Midwater Trawl (Bay Study MW); (3) CDFG's San Francisco Bay Otter Trawl (Bay Study OT); (4)

University of California (UC) Davis's Suisun Marsh Otter Trawl (Suisun Marsh OT); (5) Service's Chippis Island Trawl survey (Chippis Is. Trawl); (6) fish salvage operations (which repatriate fish taken from water intake screens) at the CVP Tracy Fish Collection Facility (CVP); and (7) fish salvage at the SWP Skinner Delta Fish Protective Facility in the south Delta (SWP).

Four other sampling programs provide additional splittail information but the data are insufficient to support useful indices. These are: (1) Service's Delta Beach Seine Survey; (2) CDFG's Summer Towntnet Survey; (3) U.S. Army Corps of Engineers' (USACE) Napa River Survey; and (4) CDFG's Creel Census.

Surveys Employed in Abundance Analyses

The data available even today on splittail abundance are not optimal. There are a number of survey programs which generate data, each of which have more or less limiting factors. This has made analysis of the status of the species based on this survey data problematic. Descriptions of all fisheries sampling programs that routinely detect splittail follow, and are differentiated into two categories: those that were used in the calculation of abundance indices and those that were not.

Fall Midwater Trawl Survey

The Fall MWT was initiated by CDFG in 1967 to sample striped bass, a non-native sport fish. In addition to striped bass, CDFG has maintained records of other fish species captured in the samples in most years. This monitoring program currently samples 100 sites from San Pablo Bay in the west to Rio Vista on the lower Sacramento River and to Stockton on the San Joaquin River. Data are collected from September through December using a midwater trawl with a 3.7 square m (39.8 square ft) wide mouth. Unlike the summer towntnet survey, the Fall MWT survey catches all splittail size classes, although larger fish are more likely to evade capture. Catches of splittail are generally low in number because splittail generally reside and feed on the channel bottom. Furthermore, splittail apparently use shallow (less than 6 m (19.7 ft)) and near-shore waters to a higher degree than open channels. The Fall MWT does not sample edge waters, and the proportion of samples in shallow water stations varies by region: 20 of 35 stations in San Pablo Bay; 1 of 18 in Carquinez Strait; 8 of 25 in Suisun Bay/Marsh; and 1 of 38 in the Delta. A monthly abundance index for splittail captured by the Fall MWT is calculated by grouping the samples by area (17

areas) and then calculating an area weighted average catch from each area; the index is the sum of these area weighted mean catches. The annual Fall MWT Index is the sum of the four monthly indices. Splittail lengths were not recorded until 1975, so for data collected prior to 1975, Young Of Year (YOY) (age 1) fish could not be differentiated from other age classes. Fall MWT data from 1967 through 2002 was used in our abundance analysis.

San Francisco Bay Studies

The San Francisco Bay Studies sample waters west of the Delta seaward to south San Francisco Bay using both a midwater trawl (Bay Study MWT) and an otter trawl (Bay Study OT) (Baxter 1999a). These programs capture relatively few splittail, but are still considered important because they involve two types of sampling equipment and frequent sampling (Baxter 1999a). Much of the sampling takes place in San Francisco Bay in deep water channels that are not characteristic splittail habitat. Monthly indices are calculated as the sum of regional volume-weighted average catch per 10,000 cubic meters (m^3) (353,147 cubic feet (cf)) for the Bay Study MWT and the sum of regional area-weighted average catch per 10,000 m^3 (353,147 cf) for the Bay Study OT (Sommer *et al.* 1997). During the 1997 index period, the Bay Study MWT collected only one YOY, and the Bay Study OT collected none at index stations. The tremendous variability in this survey's catch is likely due to the rare or limited occurrence of individuals splittails at the periphery of its range, which would result in limited detectability during sampling. Splittail can be expected to be captured in San Francisco and San Pablo bays only during time of infrequent, high outflow, when captures appear to increase for all net-based gear types. San Francisco Bay Studies data from 1980 through 2002 was used in our abundance analysis.

Suisun Marsh Otter Trawl

The Suisun Marsh OT surveys began in 1979 and are conducted by the University of California (UC) Davis as part of a long-term study of the ecology of the entire fish community of the marsh. Data from the 1979 survey have been excluded from our abundance analysis as greater sampling effort was employed in 1979 than in all subsequent years (Dr. Peter Moyle, pers. comm.). The survey is funded by California Department of Water Resources (CDWR) in part to determine if management actions in Suisun Marsh are affecting fish communities. The program samples 21 sites monthly in