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# STATUS OF WHITE STURGEON IN THE SACRAMENTO-SAN JOAQUIN ESTUARY

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Two species of sturgeon, white, *Acipenser transmontanus*, and green, *A. medirostris*, inhabit the Sacramento-San Joaquin Estuary; white sturgeon is the most abundant. In the late 1800s, the commercial fishery for sturgeon in the Sacramento-San Joaquin Estuary depressed the populations to the point where all fishing was prohibited in 1917. In 1954, the sturgeon fishery was re-opened for sport fishing with a 102 cm total length (TL) minimum size and a limit of 1 fish per day and in possession.

Coincident with the reopening of the sport fishery, the California Department of Fish and Game (CDFG) and others began studies of white sturgeon life history and population dynamics. These studies described white sturgeon spawning time and location (Stevens and Miller 1970, Kohlhorst 1976, Schaffter 1997), size at maturity and spawning periodicity (Chapman et al. 1996), food habits (Schreiber 1962, McKechnie and Fenner 1971), mortality rates (Chadwick 1959, Miller 1972b, Kohlhorst 1979, Kohlhorst et al. 1991), migrations (Miller 1972a), growth (Kohlhorst et al. 1980), abundance (Pycha 1956, Miller 1972b, Kohlhorst 1980, Kohlhorst et al. 1991), and factors affecting abundance (Kohlhorst et al. 1991).

The CDFG intermittently monitors the status of white sturgeon primarily with a mark-recapture program to estimate abundance and mortality rates. Legal-sized (presently 117–183 cm TL) fish are captured in trammel nets in San Pablo Bay in fall and tagged with disk-dangler reward tags (Chadwick 1963, Kohlhorst 1979). Abundance is estimated with multiple-census or, if recaptures during tagging in subsequent years are numerous enough, Petersen techniques (Ricker 1975). Annual exploitation rate is estimated from angler returns of tags by dividing the number of tags returned within 1 year by the number of tags released. Annual survival rate is estimated using Ricker's (1975) equation 5.1 when tagging occurs in 2 consecutive years; otherwise, lengths are converted to ages using an age-length key developed in 1973–1976 (Kohlhorst et al. 1980) and survival is estimated from the slope of the right-hand limb of the resultant catch curve (Ricker 1975). To assure nearly complete reporting of tagged fish, rewards have varied from $5 to $100 over the years. In response to potential overexploitation in the mid-1980s, the present "slot" size limit was instituted in 1990 by increasing the minimum size from 102 to 117 cm in 5-cm annual increments and setting a 183-cm maximum length. Catch of white sturgeon outside the "slot" is still recorded during tagging and estimated abundance and exploitation rate are adjusted to make them comparable to the pre-1990 estimates.

Adult (≥102 cm TL) white sturgeon abundance varied greatly between 1967 and 1998 (Fig. 1). The abundance estimate reached its highest level (142,000) in 1997. This abundance pattern is largely the result of irregular recruitment to the adult population by highly variable year classes. Strong year classes are produced in years with high spring freshwater outflows from the Sacramento-San Joaquin Delta (Kohlhorst et al. 1991), so much of the present high white sturgeon abundance is attributable to the very wet 1982–1983 period.

Unfortunately, the severe drought that gripped California from 1987 to 1992 will soon begin to affect the adult white sturgeon population because reproductive success was low in most of those years. This incipient meager recruitment already is evident in length frequencies from catches in trammel nets during tagging in the 1990s (Fig. 2). The strong year classes from the early 1980s were recruited starting in about 1994 and, by 1997 and 1998, few fish smaller than the minimum size limit of 117 cm were caught. Thus, the population should decline substantially as recruitment almost ceases and growth and mortality reduce the abundance of fish now in the fishable population. However, another cycle of strong recruitment can be expected when fish from a series of wet years starting in 1993 begin to enter the fishery late in the next decade.

Estimates of exploitation and survival rates give a mixed picture of the status of white sturgeon mortality. Annual exploitation rate estimates indicate that the angling regulation changes begun in 1990 have had the desired effect: exploitation rates have been reduced by at least half from the levels of the mid- to late 1980s (Fig. 3) and are now <0.05. Conversely, annual survival has exhibited a significant ($F = 7.02$; df = 1, 10; $P < 0.05$), and unexplained, declining trend, mostly since 1987 (Fig. 4). Potential causes of the decline in estimated survival rate include alterations in the food supply due to introductions of exotic benthic invertebrates, pollutants, illegal fishing and associated lack of reporting of tagged fish catches, and the unreliability of catch curve survival estimates when recruitment varies.

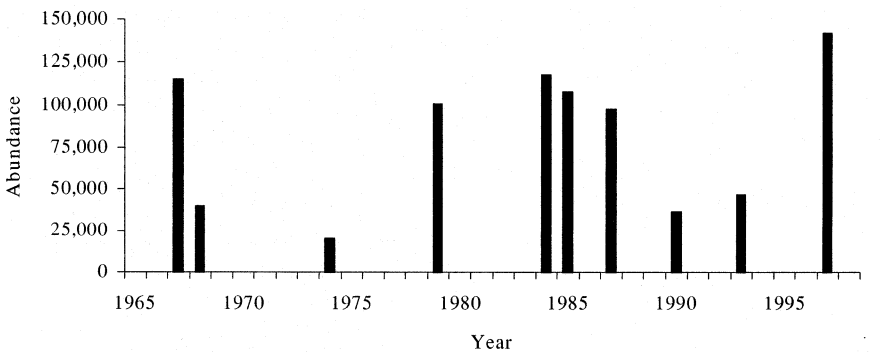


Figure 1. Estimated white sturgeon abundance in the Sacramento-San Joaquin Estuary, 1967–1997.

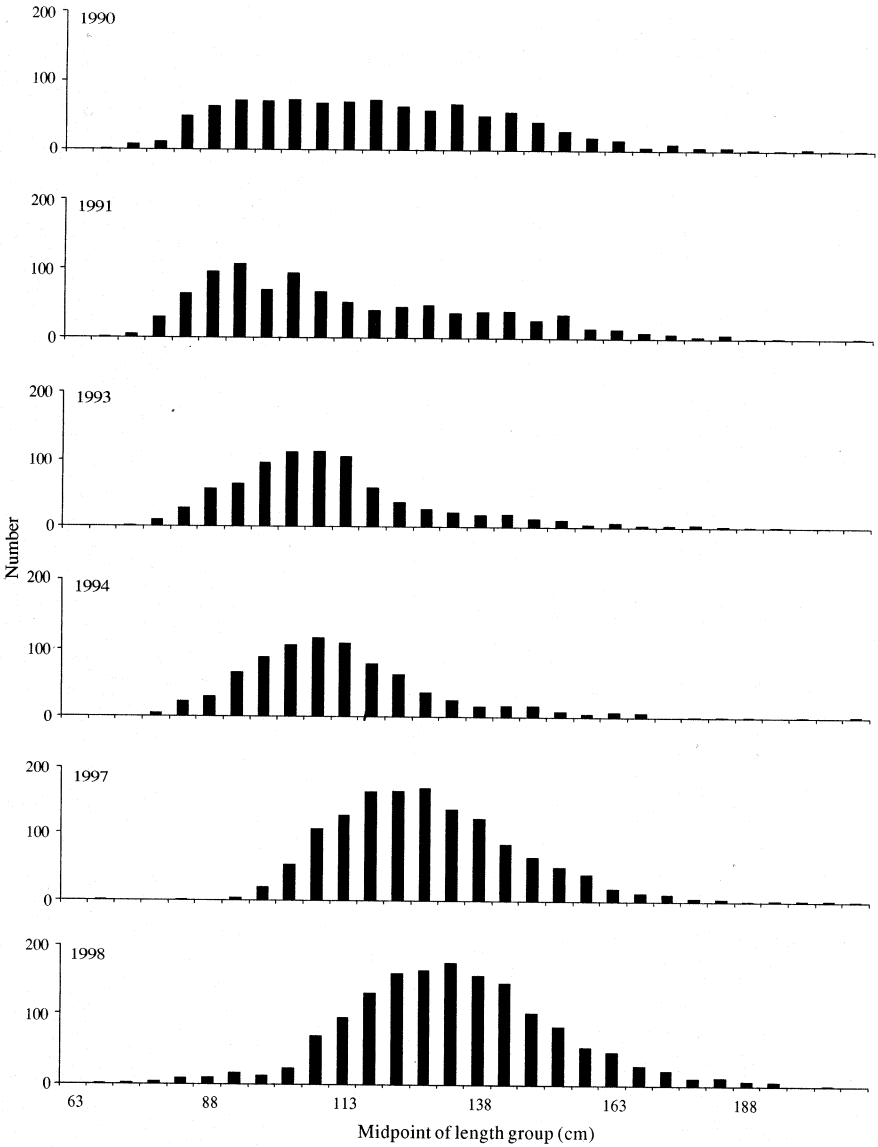


Figure 2. Total length frequencies of white sturgeon captured in trammel nets in fall in San Pablo Bay during the 1990s.

The present low exploitation rates, past rapid recoveries from population lows in the mid-1970s and early 1990s, and current protection of the most fecund females by the 183-cm maximum size limit suggest that no further angling restrictions are needed. Continued monitoring of the abundance and mortality rates, especially in light of the potential reduction in survival rates over the last 30 years and the long time from year class formation to recruitment, are necessary to assure a sustainable population.

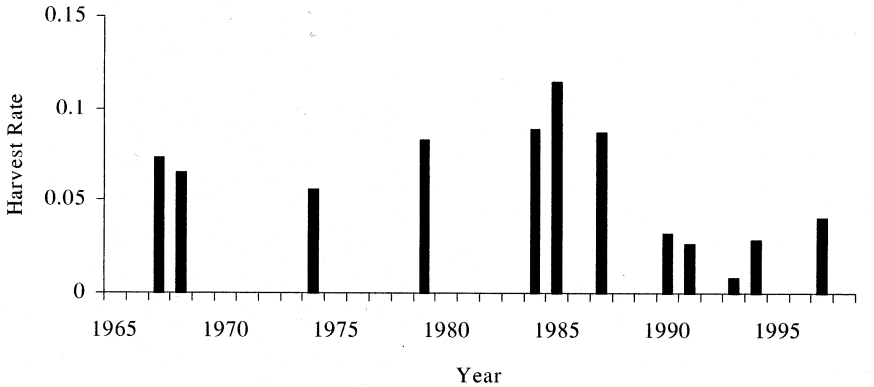


Figure 3. Estimated exploitation rate of white sturgeon in the Sacramento-San Joaquin Estuary, 1967–1997.

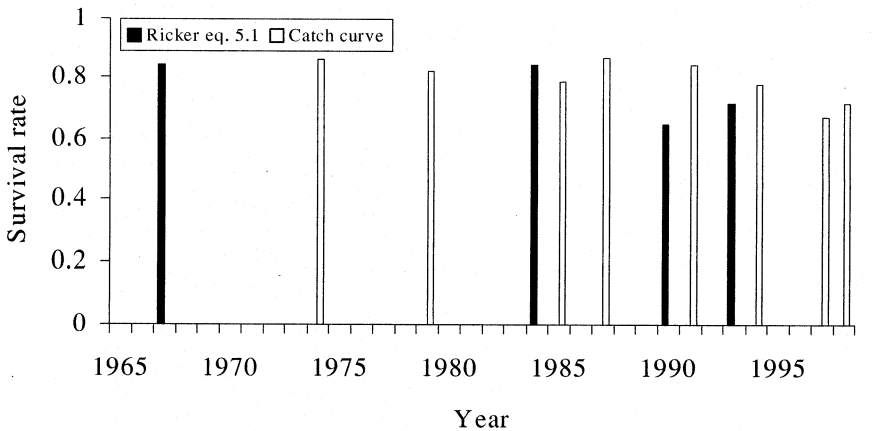


Figure 4. Survival rates of white sturgeon in the Sacramento-San Joaquin Estuary, 1967–1998 estimated using Ricker (1975) equation 5.1 or catch curves from tagging catches.

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