I
1.019

REPRINT FROM
Calif. Fish and Game, 65(3) : 173–177. 1979.

EFFECT OF FIRST PECTORAL FIN RAY REMOVAL ON SURVIVAL AND ESTIMATED HARVEST RATE OF WHITE STURGEON IN THE SACRAMENTO-SAN JOAQUIN ESTUARY

INTRODUCTION

Sturgeon ages commonly are estimated from annual growth patterns in cross sections of the first, or anterior, ray of the pectoral fin. However, removal of fin rays during a tagging study may affect survival of the fish and bias estimates of population parameters estimated from tag recoveries. Several authors have released sturgeon after removal of the anterior pectoral fin ray without discussing the effect on subsequent survival (Cuerrier and Roussow 1951; Pycha 1956; Priegel 1973). Bajkov (1949) stated that white sturgeon *(Acipenser transmontanus)* appear to withstand removal of a fin ray without any damage, but offered no evidence for his conclusions.

To determine the effect of pectoral fin ray removal on survival and estimated harvest rate of white sturgeon, I evaluated tag returns from the Sacramento-San Joaquin Estuary, California.

METHODS

In fall 1974 sturgeon were captured with trammel nets in San Pablo Bay and tagged with disc dangler tags placed beneath the anterior part of the dorsal fin. Capture and tagging methods have previously been described (Chadwick 1963; Miller 1972). Five dollar reward tags were used exclusively to assure a high rate of angler response.

To determine the age composition of tagged fish, the first ray of the left pectoral fin was removed from every second sturgeon tagged. Prior to tagging, the fish was placed on its right side on the boat deck and the fin ray was severed as close to its articulation as possible. Large cutting pliers or a small hand saw were used to cut the ray. This procedure required less than 1 minute per fish. To facilitate analysis, fin rays were removed only from fish with odd numbered tags. For convenience, I will refer to fish with the fin ray removed as odd numbered and those with intact pectoral fins as even numbered.

Harvest rates were calculated from first year returns of each tag type. Confidence limits for harvest rates were estimated assuming tag returns followed a Poisson distribution.

I analyzed 3 years of tag returns to determine the effect of pectoral fin ray removal. Returns of odd and even numbered tags were compared using a standard chi-square test of independence (Sokal and Rohlf 1969). Mortality due only to fin ray removal was estimated as: 1—ratio of odd:even tag return percentages. I estimated survival separately for odd and even numbered tags using a linear regression of logarithm of returns against time (Ricker 1975). The antilogarithm of the slope of the regression line is an estimate of annual survival.

RESULTS AND DISCUSSION

A total of 712 legal sized ($\geq$ 101.6 cm total length) white sturgeon was tagged in 1974. Of those, 358 had the first ray of the left pectoral fin removed and 354 did not.

The tag returns indicate fin ray removal caused mortality (Table 1). During the first year, 13 odd numbered and 20 even numbered tags were returned, yielding harvest rate estimates of 0.036 and 0.056, respectively. The respective 95% confidence intervals were 0.019–0.060 and 0.036–0.085. While the difference in these return rates was not statistically significant, the difference was significant at the end of 2 ($X^2 = 5.24$, $P < 0.025$) and 3 ($X^2 = 8.20$, $P < 0.005$) years due to continued higher returns of even numbered tags.

The decrease in the ratio of odd:even tag return percentages was relatively small after the first year, indicating that most mortality due to fin ray removal occurred in the first year. However, the fact that this ratio did decrease suggests some mortality occurred during the second year also (Table 1).

After the first year, estimated annual survival of odd numbered sturgeon was 0.88 and estimated survival of even numbered fish was 0.95 (Figure 1). These estimates are imprecise since return sample sizes are small and the points do not fall in a straight line.

I conclude that removing the first ray of the pectoral fin of white sturgeon causes substantial mortality during the first year and less mortality thereafter. Also, consistently greater returns of even number tags in all 3 years indicates that mortality from pectoral fin ray removal results in an underestimate of exploitation and that the best estimate of exploitation rate is based on even numbered tags alone. If fin ray removal is used in conjunction with a sturgeon tagging program, estimates of population parameters derived from tag recoveries may exhibit serious bias.

TABLE 1. Tags Received During the First 3 Return Years from White Sturgeon Tagged in San Pablo Bay in Fall 1974. Odd numbered tags are from fish with the primary ray of the left pectoral fin removed for age determination. Even numbered tags are from fish without fin ray removal.

Return year	*Odd tags returned*		*Even tags returned*		*Total returns*	*Ratio odd:even percentages*	*Mortality due to fin ray removal (1— ratio odd:even percentages)*	*Estimated annual mortality increment due to fin ray removal*
	Number	*Percent*	*Number*	*Percent*				
1974–75	13	3.6	20	5.6	33	0.64	0.36	0.36
1975–76	10	2.8	20	5.6	30	0.50	0.50	0.14
1976–77	10	2.8	18	5.1	28	0.55	0.45	−0.05
Total	33	9.2	58	16.4	91	0.56		

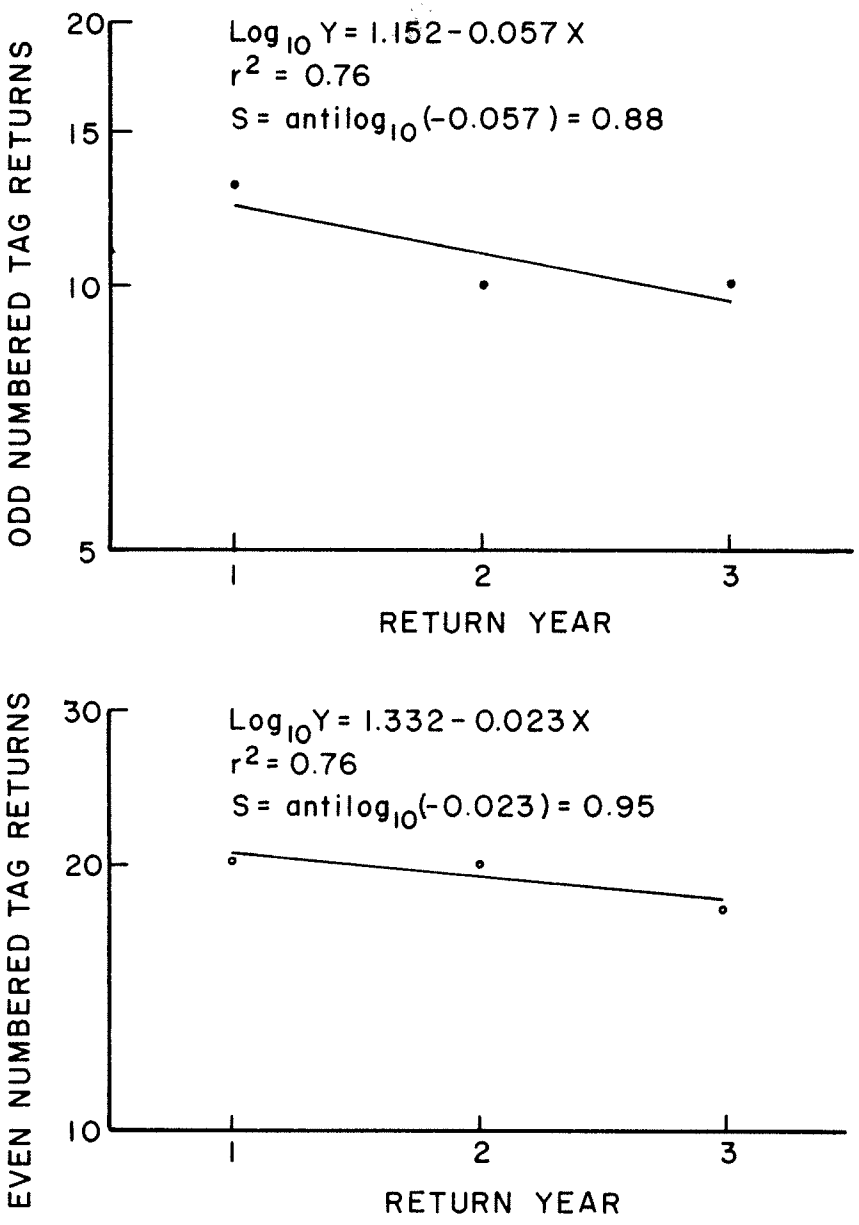

FIGURE 1. Tag returns from white sturgeon tagged in San Pablo Bay in fall 1974. The antilogarithm of slope is an estimate of annual survival rate (S). Slope and survival are calculated separately for odd numbered fish with the first ray of the left pectoral fin removed (a) and even numbered fish with no fin ray removed (b).

ACKNOWLEDGMENTS

Richard Fenner and Salvatore Mercurio assisted in the tagging operation and Donald Stevens reviewed the manuscript. I thank these individuals for their help. This work was performed as part of Dingell-Johnson Project California F-9-R, "A Study of Sturgeon and Striped Bass", supported by Federal Aid to Fish Restoration funds.

REFERENCES

Bajkov, A. D. 1949. A preliminary report on the Columbia River sturgeon. Oregon Fish Comm. Res. Briefs 2(2): 3–10.

Chadwick, H. K. 1963. An evaluation of five tag types used in a striped bass mortality rate and migration study. Calif. Fish Game 49(2): 64–83.

Cuerrier, J.-P., and G. Roussow. 1951. Age and growth of lake sturgeon from Lake St. Francis, St. Lawrence River. Report on material collected in 1947. Can. Fish Cult. 10: 17–29.

Miller, L. W. 1972. White sturgeon population characteristics in the Sacramento-San Joaquin Estuary as measured by tagging. Calif. Fish Game 58(2): 94–101.

Priegel, G. R. 1973. Lake sturgeon management on the Menominee River. Wisc. Dept. Nat. Res., Tech. Bull. No. 67, 20 pp.

Pycha, R. L. 1956. Progress report on white sturgeon studies. Calif. Fish Game 42(1): 23–35.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Bd. Can. Bull. 191, 382 pp.

Sokal, R. R., and F. J. Rohlf. 1969. Biometry. W. H. Freeman and Company, San Francisco, 776 pp.

—David W. Kohlhorst, California Department of Fish and Game, 4001 North Wilson Way, Stockton, California 95205. *Accepted for publication August 1978.*