Interagency Ecological Program for the San Francisco Estuary

IEP NEWSLETTER

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Year	Index
1995	4.4
1996	33.9
1997	19.3
1998	7.7
1999	39.7
2000	23.8
2001	11.3
2002	8.0
2003	13.1
2004	8.2
2005	15.4
2006	9.9
2007	1.0
2008	2.9
2009	2.3
2010	3.8
2011	8.0
2012	11.1
2013	7.8

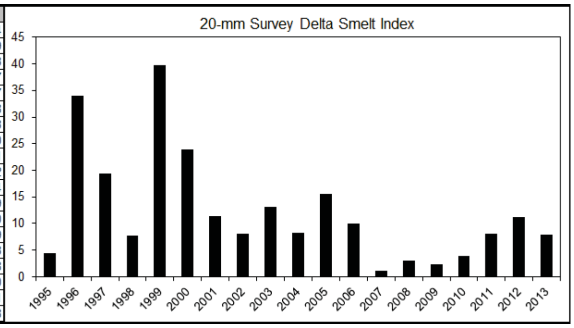

Figure 3 Time series of YOY Delta Smelt relative abundance by year from the CDFW 20 mm Survey

Fish distribution maps, length distributions, and catch per unit effort (CPUE) by station for the current year are reported on the 20 mm Survey webpage (http://dfg.ca.gov/delta/projects.asp?ProjectID=20mm). Existing data and metadata can be found at our FTP site (ftp://ftp.dfg.ca.gov/Delta%20Smelt/) and detailed methods on the calculation of the 20 mm abundance index are available through this author.

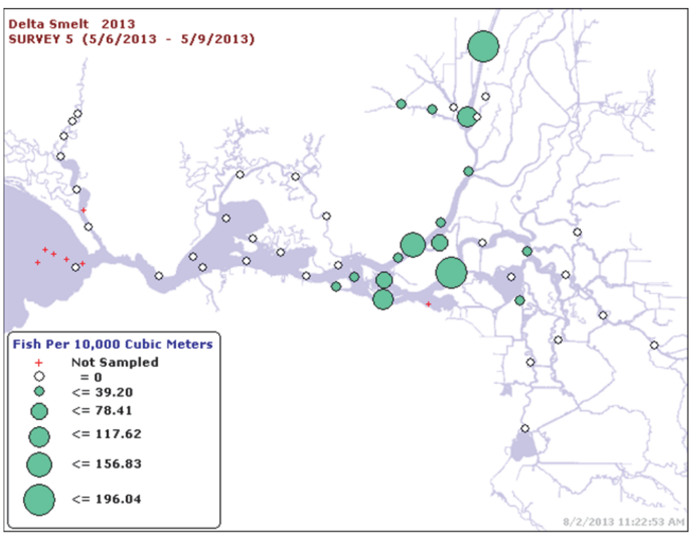

Figure 4 Delta Smelt distribution map from CDFW 20 mm Survey 5 (taken from http://dfg.ca.gov/delta/projects.asp?ProjectID=20mm). Green bubbles represent the relative abundance of YOY Delta Smelt at each site (see legend). White bubbles are sampled stations with no YOY Delta Smelt caught. Red crosses indicate the station was not sampled (not part of current routine survey).

Notes

Water Year Index (preliminary 08/01/2013) from http://cdec.water.ca.gov/cgi-progs/reports/EXECSUM

X2 data from cdec.water.ca.gov/ (station CX2)

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Monitoring Progress Toward a CVPIA Recovery Objective: Estimating White Sturgeon Abundance by Age

Marty Gingras (DFW), marty.gingras@wildlife.ca.gov and Jason DuBois (DFW), jason.dubois@wildlife.ca.gov

Introduction

The Central Valley Project Improvement Act (CVPIA) objective of a sustained increase in the number of age-15 White Sturgeon to 11,000 is the only quantitative management objective for White Sturgeon in California. The California Department of Fish and Wildlife monitors progress toward the objective by using routine abundance estimates from a mark-recapture study and — because routine aging of sturgeon has not been funded — an age-length key is used to assign ages to fish captured during tagging. We have previously described the routine abundance estimates as coming from a complicated algorithm that includes periodic updates with recapture data collected up to several years after tagging, assumptions about growth rate and about mortality attributable to tagging, and more professional judgment than we would like (DuBois and others 2011).

In an effort to speed the production of abundance estimates and perhaps improve the accuracy of abundance estimates, we have been and are taking a number of steps. One key step was development of an alternative method of estimating the abundance of legally-harvestable White Sturgeon (DuBois and Gingras 2011) that uses estimates of harvest rate, uses harvest data from Sturgeon Fishing Report Cards (Report Cards), and can be finalized relatively quickly. White Sturgeon 117-168 cm Total Length (TL, i.e., 46-66” TL) were legal to harvest February 28, 2007–December 31, 2012.

Another key step is assessing the degree to which the age-specific abundance estimates are biased due to size selectivity of the (trammel) nets used to capture fish during tagging, when and where tagging occurs, and how many fish are sampled. The nets have been standardized for many years and include panels of 3 different mesh sizes (DuBois and others 2012), and tagging occurs August-October in San Pablo Bay and/or Suisun Bay. It is plausible the length distribution of fish caught during tagging is not representative of the true length distribution of the population, and if so the age-specific abundance estimates made using the age-length key are inaccurate and possibly biased.

Here we compare and contrast age-specific estimates of 117-168 cm TL (i.e., 46-66” TL) White Sturgeon abundance using length frequency data from tagging and from Report Cards, the alternative method of abundance estimation, and an age-length key. Anglers are required by CCR Title 14 Sections 5.79 and 27.92 to report lengths of harvested White Sturgeon on Report Cards and to submit Report Cards by January 31 of the following year. Use of the length dataset from Report Cards for the present purpose is intuitively appealing because it contains more White Sturgeon lengths per year than the tagging dataset and any other dataset.

Table 1 White Sturgeon age-length key (data in Kohlhorst and others 1980); note: matrix within dashed border contains data on fish within legal slot limit; ages 0-6 and bins 21-95 cm TL omitted for formatting purposes (values represent proportions)

Bins	*White Sturgeon Ages*															
(cm TL)	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
96-100	0.2568	0.3108	0.2838	0.0811	0.0135	0	0	0	0	0	0	0	0	0	0	0
101-105	0.2281	0.1842	0.307	0.1579	0.0702	0	0	0	0	0	0	0	0	0	0	0
106-110	0.0571	0.2143	0.3	0.2429	0.1	0.0286	0.0286	0	0	0	0	0	0	0	0	0
111-115	0	0.1186	0.3051	0.4237	0.1017	0.0169	0.0339	0	0	0	0	0	0	0	0	0
116-120	0	0.1136	0.1818	0.1818	0.1591	0.1591	0.0455	0.0909	0.0455	0.0227	0	0	0	0	0	0
121-125	0	0	0.0833	0.1111	0.1944	0.1389	0.1389	0.1389	0.1667	0.0278	0	0	0	0	0	0
126-130	0	0	0.0541	0.0811	0.2162	0.1351	0.0541	0.1622	0.0541	0.0811	0.0811	0.027	0.027	0.027	0	0
131-135	0	0	0	0.0882	0.1176	0.1471	0.1176	0.0294	0.1176	0.1471	0.1176	0.0294	0	0.0882	0	0
136-140	0	0	0	0	0	0.1154	0	0.2308	0.1538	0.2308	0.1538	0.0385	0.0769	0	0	0
141-145	0	0	0	0	0	0.0286	0.0571	0.1429	0.1429	0.2286	0.1714	0.1143	0	0.0857	0.0286	0
146-150	0	0	0	0	0	0.027	0.1081	0.1622	0.1622	0.1351	0.0541	0.1892	0.1622	0	0	0
151-155	0	0	0	0	0	0	0.0435	0.1304	0.087	0.087	0.1304	0.3478	0	0.087	0.087	0
156-160	0	0	0	0	0	0	0	0.0769	0.0769	0.1538	0.0769	0.1538	0.0769	0.3077	0	0.0769
161-165	0	0	0	0	0	0	0	0	0	0.25	0.1667	0.1667	0.0833	0.1667	0.1667	0
166-170	0	0	0	0	0	0	0	0	0	0.125	0	0.125	0.5	0.25	0	0
171-175	0	0	0	0	0	0	0	0	0	0.125	0.25	0.25	0.375	0	0	0
176-180	0	0	0	0	0	0	0	0	0	0	0	0.1667	0.1667	0.3333	0.1667	0.1667
181-185	0	0	0	0	0	0	0	0	0	0	0	0.3333	0	0.3333	0	0.3333
>185	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0.25

Investigation

We used lengths and abundance estimates for the years 2007-2011. The abundance estimates are for fish 117-168 cm TL (Range: ~35,000-57,000 fish) and were calculated using harvest records (Report Card data) and harvest rates (mark-recapture data; DuBois and Gingras 2011). Lengths are those reported by anglers as from fish they kept (N = 8,491) and fish 117-168 cm TL caught during tagging for the Department's mark-recapture study (N = 1,518).

Table 2 White Sturgeon abundance estimates by age (8-21) using Report Card data and tagging data (years 2007-2011)

Age	*Report Card*					*Tagging*				
	2007	*2008*	*2009*	*2010*	*2011*	*2007*	*2008*	*2009*	*2010*	*2011*
8	724	394	573	373	487	867	682	964	375	559
9	2,212	1,380	1,770	1,193	1,588	2,600	2,045	2,411	1,313	1,863
10	3,218	2,094	2,593	1,789	2,459	3,611	2,727	3,375	2,063	2,795
11	4,867	3,277	3,965	2,734	3,817	5,633	4,091	4,822	3,001	4,286
12	4,947	3,425	4,014	2,908	4,226	5,489	3,955	4,983	3,189	4,472
13	3,379	2,587	2,942	2,162	3,099	3,756	2,864	3,215	2,251	3,541
14	6,435	4,928	5,386	4,150	6,250	6,789	4,909	5,625	4,127	6,149
15	5,591	4,361	4,688	3,653	5,430	5,922	4,227	4,983	3,752	5,590
16	7,240	5,766	5,760	4,622	7,018	6,645	5,045	5,143	4,502	6,522
17	4,987	3,942	4,014	3,181	4,892	4,333	3,409	3,536	3,001	4,659
18	4,987	4,337	4,264	3,330	5,200	4,189	3,545	2,732	3,001	4,845
19	2,655	2,341	1,970	1,740	2,587	2,744	2,318	1,607	1,688	2,422
20	3,982	3,376	2,917	2,435	3,612	3,322	3,000	2,089	2,251	3,354
21	1,408	1,158	1,072	795	1,229	867	682	482	563	932

We calculated each estimate of annual age-specific abundance using the age-length key (Table 1) and the following algorithm: (1) Bin the lengths, then (2) multiply the number of fish per bin by the historic fraction of the age distribution from that bin and sum (column-wise) those products, then (3) divide the number of fish at each age by the total number of fish lengths, and then (4) multiply the estimates of White Sturgeon 117-168 cm TL abundance by the fraction of fish at each age. The historic fraction of age at length is from data in Kohlhorst and others (1980).

Estimated abundance of cohorts using length frequency data from tagging and from Report Cards is notably low (range 373-7240; Avg 3330) and — due to recruitment to and from the 117-168 cm TL length range as well as relative imprecision of the estimates — does not clearly show the expected reduction in abundance of each cohort attributable to natural mortality and harvest (Table 2). Note from Table 1 that all or nearly all fish aged 12-16 are 117-168 cm TL and accounted for in these estimates of abundance.

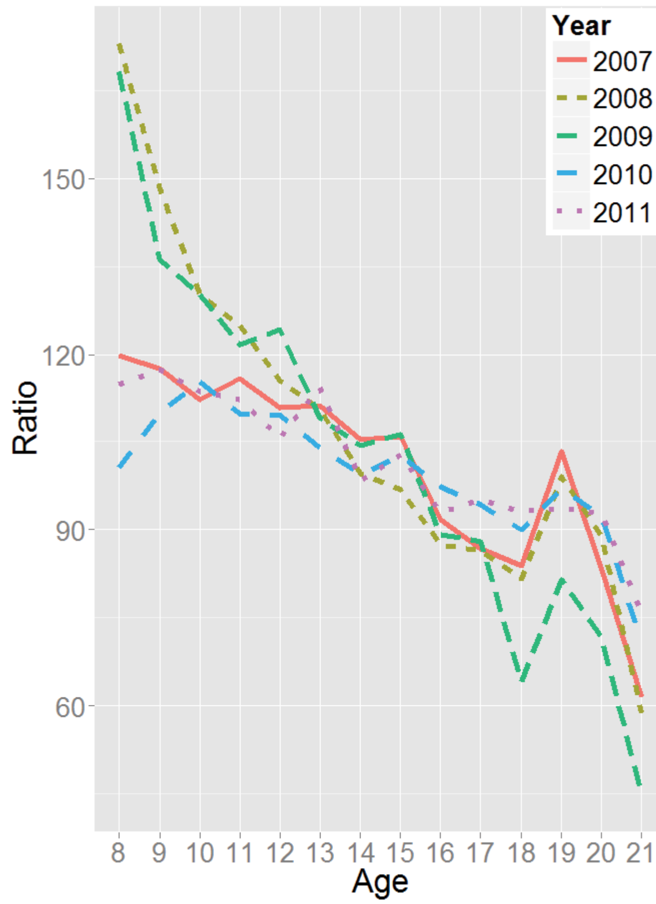

Figure 1 Ratio (tagging data/Card data) of White Sturgeon estimates (years 2007-2011) at age (8-21)

Annual estimates of abundance for each brood year using length frequency data from Report Cards and from tagging are strongly correlated (*r* range: 0.895-0.988; average: 0.953) and linear with slopes slightly less than 1 (range 0.8323-0.9833; average 0.935). The slopes suggest that one of the sets of length data is biased.

The ratio between abundance estimates for each age using the two sets of length data (e.g., 867 age-8 fish in 2007 from tagging divided by 724 age-8 fish in 2007 from Report Cards) ranged between 0.45-1.73% (average:

1.02%). Declining trends in ratio with age are typical and the greatest differences in ratio occur among estimates for relatively young fish and for relatively old fish (Figure 1). The slopes suggest that one of the sets of length data is biased, and the range of ratios per age suggests similar distributions of lengths near the middle of the length range in both datasets.

Discussion

From our brief investigation, it is clear that the selection of length frequency distribution is important when using length frequencies to estimate the age-specific abundance of White Sturgeon.

Length frequency distributions from Report Cards are affected by whatever selectivity anglers apply (e.g., hook size; 'high grading' through catch-and-release), but we suspect and have been repeatedly told by anglers that selectivity is low because the legal size limit is narrow (presently 40-60 inches Fork Length) and catch rates are low (e.g., < 3 fish per 100 hours effort; DuBois and others 2011). We suspect that abundance estimates made using lengths from Report Cards are more accurate than those made using lengths from tagging, because anglers fish throughout the year and throughout the range of White Sturgeon, use a variety of angling techniques, and use a variety of angling gear — whereas catch during tagging is substantially constrained by season, location, and gear requirements.

Estimates of 117-168 cm TL White Sturgeon abundance using harvest rate (from mark-recapture) and harvest records (from Report Cards) can be developed more quickly and are more precise than routine mark-recapture estimates, lengths from Report Cards are likely representative of the true length distribution, and essentially all age-15 White Sturgeon are 117-168 cm TL. For those reasons, we recommend that progress toward CVPIA's recovery goal of 11,000 age-15 White Sturgeon be monitored using those data and that approach.

NOTE TO MANAGERS: The CVPIA objective of a sustained increase in the number of age-15 White Sturgeon to 11,000 has not been achieved approximately 2 decades after being established (DuBois and Gingras 2011). From our work here on the estimation of White Sturgeon abundance, from work to index young-of-the-year White Sturgeon abundance (Fish 2010; CDFW 2013), and from work to relate the relative abundance of White Sturgeon to Sacramento-San Joaquin Delta outflow (Fish 2010), it is likely that the number of age-15 White Sturgeon will not increase to 11,000 for at least another 5 years and it is nearly certain that there will be no sustained increase in the number of age-15 White Sturgeon without substantial reduction of harvest, hatchery augmentation, major improvement in fish passage (e.g., re-watering the San Joaquin; dam removal), and/or beneficial climate change.

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3500 Industrial Blvd.
West Sacramento, CA 95691

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