Interagency Ecological Program for the San Francisco Estuary

IEP NEWSLETTER

VOLUME 26, NUMBER 4, 2013

Sturgeon CPUE from Commercial Passenger Fishing Vessels and White Sturgeon CPUE from a Mark-Recapture Study

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

Introduction

The California Department of Fish and Wildlife (CDFW) began conducting a mark-recapture study of San Francisco Estuary sturgeon in 1954 and estimated White Sturgeon (*Acipenser transmontanus*) abundance is one of many metrics developed from the data. Because the estimates are available for 25 years, can take years to finalize, and are often quite imprecise, we sought to develop one or more catch per unit effort (CPUE) abundance indices that could be produced annually, quickly, and allow for more-timely dissemination of trend information. We have recently explored several ways to calculate sturgeon CPUE from Commercial Passenger Fishing Vessel (CPFV) data and White Sturgeon CPUE from catch during tagging for the CDFW mark-recapture study. This article is a brief summary of comparisons between and among those metrics, and is primarily intended to identify nuances in the data and caveats to interpretation of the indices.

White Sturgeon CPUE from tagging for the mark-recapture study is straightforward to calculate and we routinely publish it in Field Season Summary reports (e.g., DuBois and Harris 2013). However — because the mark-recapture study has only deployed trammel nets in San Pablo Bay and/or Suisun Bay during August, September and October — CPUE from tagging might not index system-wide trends in annual abundance. Interpretation of the White Sturgeon CPUE time series is complicated somewhat because prior to 1990 the nets were composed only of 8" stretched-mesh panels and were composed of 6", 7", and 8" stretched-mesh panels thereafter.

Operators of CPFVs are paid to help passengers target and catch a fish species of interest (e.g., White Sturgeon), and CPFV operators are required to complete and submit to the CDFW a log for each trip. It is possible to calculate CPUE from log data, because each log contains information on catch by species (or species aggregations), number of anglers, time fished, and date fished, as well as the location (called "blocks") where most fish were caught during the trip (Hill and Schneider 1999). Interpretation of a sturgeon CPFV CPUE time series is somewhat confounded because logs contain no length data and because size limits on White Sturgeon since 1980 changed from ≥ 102, 107-183, 112-183, 117-183, and 117-168 cm Total Length (DuBois and others 2012). Furthermore, CPFV sturgeon catch as of 2012 had not been identified to species and CPUE calculated from data prior to March 2007 — when it became illegal to take Green Sturgeon — almost certainly includes catch of White Sturgeon and a relatively few Green Sturgeon whereas thereafter likely includes nearly no Green Sturgeon.

Investigation

We only used CPFV data from 1980-2012, because log data prior to 1980 is now only available as monthly summaries (Hill and Schneider 1999) and thus it is impossible to calculate species-specific effort from that portion of the dataset. We calculated annual CPFV CPUE (per Equation 1, where t = year) based on the following criteria: catch (i.e., at least 1 sturgeon noted; kept fish; kept fish plus released fish) and fishing location (i.e., "blocks," Table 1), as well as on whether or not CPFVs targeted sturgeon and sturgeon fate (i.e., harvested or released; Table 1). Some of these CPUE "permutations" use nearly the same data. When making pair-wise comparisons of 12 CPFV CPUE permutations by way of scatter plots (e.g., see the upper-most 7 rows of Figure 1 for examples of comparisons), we found that the relations often vary substantially. For example, 11 of 66 comparisons had R^2 values > 0.50 (range 0.52-0.99; avg 0.73) and several of those are notably attributable to an apparent outlier (Suisun Bay in 1998).

$$CPUE_t = \left[\frac{\sum catch_t}{\sum anglerhours_t}\right] \times 100 \qquad \text{Equation 1}$$

We calculated annual White Sturgeon CPUE from tagging per Equation 1, except that effort was in terms of net-fathom-hours rather than angler-hours, then made pair-wise comparisons of 12 CPFV CPUE permutations to two permutations of tagging CPUE (e.g., see the lower-most 2 rows of Figure 1 for examples of comparisons).

Two of 24 comparisons had R^2 values > 0.50 (range 0.58-0.70; avg 0.64). Tagging CPUE was most similar to CPFV CPUE when considering fish legal-sized during tagging relative to trips targeting sturgeon in Suisun Bay and system-wide, but was only slightly less similar when considering all trips. Use of fish fate (e.g., kept fish plus released fish) did not usually improve the relation between CPFV CPUE and tagging CPUE.

Table 1 Description of criteria used for sturgeon and White Sturgeon CPUE permutations

CPUE Permutation	*Criteria Used for Calculating CPUE*
suc.stu.sfe	successful trips only; kept only; no target; all blocks east of Golden Gate Bridge
all.stu.sfe	all trips; kept only; no target; all blocks east of Golden Gate Bridge
all.targ.stu.sfe	all trips; kept only; target sturgeon; all blocks east of Golden Gate Bridge
all.kept.rel.sfe	all trips; kept + released; no target; all blocks east of Golden Gate Bridge
suc.stu.spb	successful trips only; kept only; no target; only block 301 (San Pablo Bay)
all.stu.spb	all trips; kept only; no target; only block 301 (San Pablo Bay)
all.targ.stu.spb	all trips; kept only; target sturgeon; only block 301 (San Pablo Bay)
all.kept.rel.spb	all trips; kept + released; no target; only block 301 (San Pablo Bay)
suc.stu.sb	successful trips only; kept only; no target; only blocks 302 and 308 (Suisun Bay)
all.stu.sb	all trips; kept only; no target; only blocks 302 and 308 (Suisun Bay)
all.targ.stu.sb	all trips; kept only; target sturgeon; only blocks 302 and 308 (Suisun Bay)
all.kept.rel.sb	all trips; kept + released; no target; only blocks 302 and 308 (Suisun Bay)
tag.all.stu	white sturgeon caught during tagging, regardless of size (length)
tag.legal.stu	white sturgeon caught during tagging legal-sized at time of capture

Successful trips includes trips where catch (as kept only) ≥ 1

All trips includes trips where catch (as kept or as kept + released) ≥ 0

Kept only means catch includes only number of kept sturgeon

Kept + released means catch includes number of kept + released sturgeon

No target means vessel did not specifically target sturgeon

Annual effort for each CPFV CPUE permutation varied from zero (just 4 instances) to 26,108 hours (avg 7,728 hours), which suggests that relatively few of the CPFV CPUE values are substantially influenced by outliers attributable to relatively little fishing effort. We also noted that the time series of annual effort for several CPFV CPUE permutations (Figure 2) reflects the general trends in CPUE, suggesting that the CPFV fishery responds strongly to variations in CPUE.

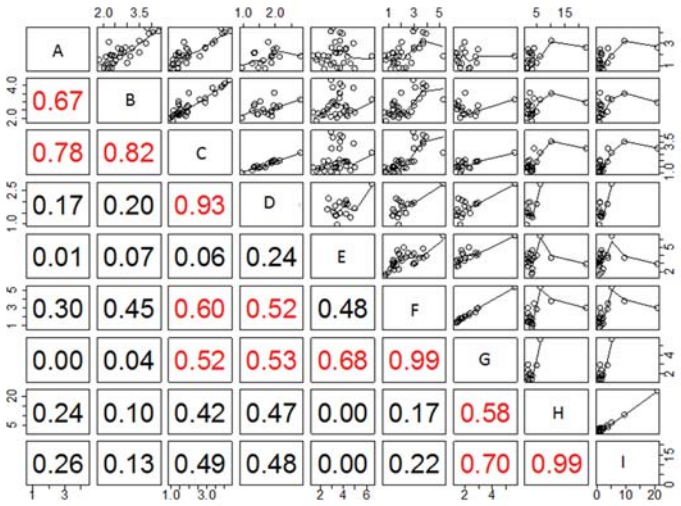

Figure 1 Scatter plot matrix comparing various CPFV CPUE for sturgeon and CPUE for White Sturgeon caught during tagging (Table 1); upper panels with loess line, and R^2 in lower panels (values in red > 0.5). A: all.stu.spb, B: suc.stu.sfe, C: all.stu.sfe, D: all.targ.stu.sfe, E: suc.stu.sb, F: all.stu.sb, G: all.targ.stu.sb, H: tag.all.stu, I: tag.legal.stu.

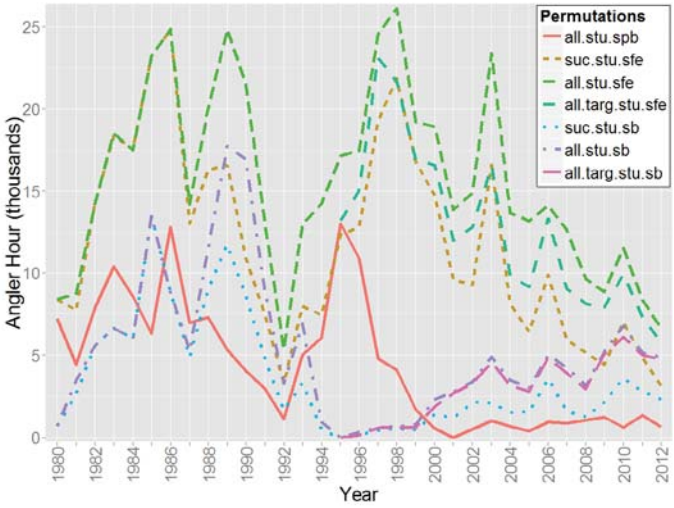

Figure 2 Time series (1980-2012) of effort (as angler-hours) from CPFVs for various permutations (Table 1)

Trends in CPFV CPUE for sturgeon and CPUE for White Sturgeon from tagging are generally similar (Figure 3). The trends include variations that correspond to the

recruitment and subsequent decline of strong year-classes that (a) must have been produced during 1969-1975 when most years were classified as wet (see Kohlhorst 1980 for evidence regarding 1969 and 1970), (b) were produced during some wet years in the early 1980s (Kohlhorst and others 1991) and were augmented by hatchery production (Monaco 1983; Steinhart 1986), and (c) were produced in the mid-to-late 1990s (Fish 2010).

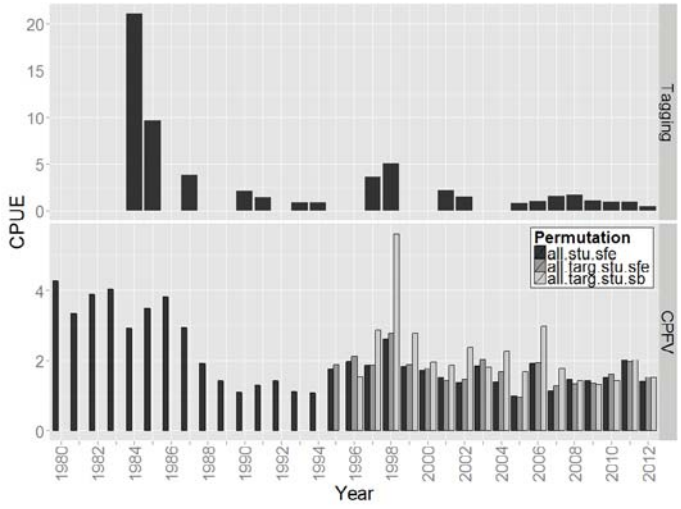

Figure 3 Time series (1980-2012) of tagging CPUE (tag.legal.stu; as catch per 100 net-fathom-hours; top figure) and of CPFV CPUE (as catch per 100 angler-hours; bottom figure) for select permutations (Table 1)

Discussion

The CPFV CPUE for sturgeon varied substantially (e.g., by location and angler motivation) and did not vary monotonically with CPUE for White Sturgeon from tagging. However, a similar trend was tracked by some permutations of tagging CPUE, system-wide CPFV CPUE, and Suisun Bay CPFV CPUE — and from that we consider those as complementary 'caveated indices' of system-wide White Sturgeon abundance.

The best relations between tagging and CPFV CPUE came from data that has been required of CPFVs only since 1995. For that reason and because in 2011 and again in 2013 the CDFW instructed CPFV operators to identify sturgeon to species, we expect stronger relations between tagging and CPFV CPUE in the future.

We attribute the extremely large CPUE values from the mark-recapture study in 1984 and 1985 to unusual distributions of fish rather than rapid changes in the system-wide abundance of fish or bias attributable to mesh size. In hopes of learning more about White Sturgeon distributions and ecology (e.g., responses to Sacramento-San Joaquin Delta outflow), we plan to look into those 1984 and 1985 tagging CPUE outliers as well as the CPFV CPUE outlier from Suisun Bay in 1998.

References

DuBois, J., and M. D. Harris. 2013. 2013 field season summary for adult sturgeon population study. California Department of Fish and Wildlife, Stockton, California. 8 p. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=75544

DuBois, J., M. Gingras, and G. Aasen. 2012. Status and trends of San Francisco Estuary White Sturgeon. Interagency Ecological Program for the San Francisco Estuary Newsletter 24(1): 50-55.

Fish, M.A. 2010. A white sturgeon year-class index for the San Francisco Estuary and its relation to Delta outflow. Interagency Ecological Program for the San Francisco Estuary Newsletter 23(2): 80-84.

Hill, K.T, and N. Schneider. 1999. Historical Logbook Databases from California's Commercial Passenger Fishing Vessel (Partyboat) Fishery, 1936-1997. Scripps Institution of Oceanography, Ref. Series No. 99-19, 65 p.

Kohlhorst, D.W. 1980. Recent trends in the white sturgeon population in California's Sacramento-San Joaquin Estuary. California Fish and Game 66(4): 210-219 (1980).

Kohlhorst, D.W., L.W. Botsford, J.S. Brennan, and G.M. Cailliet. 1991. Aspects of the structure and dynamics of an exploited central California population of white sturgeon (*Acipenser transmontanus*). In P. Williot (ed.). *Acipenser*. Proceedings of the First International Symposium on the Sturgeon. Bordeaux: CEMAGREF. pages 227-293.

Monaco, G. 1983. A general description of sturgeon aquaculture currently being conducted at the University of California at Davis. Transactions of the Western Section of the Wildlife Society. 19:190.

Steinhart, P. 1986. The caviar connection. National Wildlife. December/January.

■ Interagency Ecological Program for the San Francisco Estuary ■

IEP NEWSLETTER

3500 Industrial Blvd.
West Sacramento, CA 95691

For information about the Interagency Ecological Program, log on to our Web site at http://www.water.ca.gov/iep/. Readers are encouraged to submit brief articles or ideas for articles. Correspondence—including submissions for publication, requests for copies, and mailing list changes—should be addressed to Frank Keeley, California Department of Water Resources, P.O. Box 942836, Sacramento, CA, 94236-0001. Questions and submissions can also be sent by e-mail to: frank.keeley@water.ca.gov.

■ Interagency Ecological Program for the San Francisco Estuary ■

IEP NEWSLETTER

The Interagency Ecological Program for the San Francisco Estuary
is a cooperative effort of the following agencies:

California Department of Water Resources
State Water Resources Control Board
U.S. Bureau of Reclamation
U.S. Army Corps of Engineers
California Department of Fish and Wildlife
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Environmental Protection Agency
National Marine Fisheries Service

BEFORE CITING INFORMATION HEREIN,
CONSIDER THAT ARTICLES HAVE NOT RECEIVED PEER REVIEW.