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Relating CPUE of Striped Bass from Partyboats and Mark-recapture Estimates of Striped Bass Abundance

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) has been conducting a mark-recapture study of anadromous striped bass age-3 and older since 1969 (Stevens et al. 1985), and striped bass abundance is one of many metrics estimated from the data. Because these abundance estimates are time-consuming, expensive, and sometimes infeasible to produce, development of an abundance index that is easier to calculate (e.g., catch per unit effort (CPUE)) would be helpful.

Commercial passenger fishing vessels (partyboats; CPFVs) are chartered by anglers for the express purpose of targeting and catching a fish species of interest (e.g., striped bass). Partyboat operators are required to complete a log for each trip (Hill and Schneider 1999). Logs contain information on catch by species, number of anglers, time fished, location (called 'blocks') fished, and the date fished. From this information, it is possible to calculate CPUE.

The CDFW has been collecting and summarizing partyboat data since 1936 (Calhoun 1949, McKechnie and Miller 1971), and CPUE calculated from partyboat data is often assumed to be an index of abundance. We have recently explored a range of ways to calculate CPUE of striped bass from partyboat data (DuBois 2011), and here we present a brief summary of the relation between striped bass CPUE from partyboat data and mark-recapture estimates of striped bass abundance.

Investigation

The relation between CPUE and abundance can be defined by Equation 1 (Ricker 1975), where q = catchability, and N_t = mean abundance at time t. For the present purposes, we assume a constant q.

$$CPUE_t = q \times N_t$$

Equation 1

We estimated annual striped bass abundance (N) by age and sex from mark-recapture data using Equation 2 (Ricker 1975). As of this writing, abundance estimates for 2007, 2008, and 2009 are preliminary.

$$N = \frac{M \times (C+1)}{(R+1)}$$

Equation 2

Where M = number of fish marked (tagged)
C = number of fish caught
R = number of recaptured tags

We calculated CPUE using data from 1980 – 2009 only, because partyboat log data prior to 1980 is 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 felt it proper to calculate CPUE using many criteria, due to the migratory nature of striped bass, the improvements in technology used to track fish, and possible variations in the catch-and-release fishery component. To explore likely spatial and temporal variations in CPUE as they might pertain to the development of a robust index of abundance, we calculated annual CPUE (per Equation 3, where t = year) by using criteria based on catch (e.g., all trips; successful), 'blocks' (i.e., fishing areas), and season (Table 1, DuBois 2011). We also looked at how CPUE varied based on whether or not partyboats targeted striped bass and by considering striped bass fate (i.e., harvested or released).

Table 1 Definition of CPUE abbreviations

Abbreviation	*Definition*
success	successful trips; kept only; no target
All	kept only; no target
all.mon.6.11	"all trips; kept only; no target; only months June through November"
suc.targ	successful trips; kept only; target striped bass
all.targ	all trips; kept only; target striped bass
all.kept.rel	all trips; kept and released; no target
CPUE.303.304	combined blocks 303 and 304; successful trips; no target
CPUE.sfe.less.303.304	SFE less blocks 303 and 304; successful trips; no target
CPUE.303.304.305	"combined blocks 303, 304, and 305; successful trips; no target"
CPUE.sfe. less.303.304.305	"SFE less blocks 303, 304, and 305; successful trips; no target"
CPUE.less.5	excluding five vessels identified as specifically targeting striped bass; successful trips; kept only
CPUE.only.5	including only the five vessels identified as specifically targeting striped bass; successful trips; kept only
successful trips means trips where at least one angler kept at least one fish	
kept only means only using number of fish that were kept	
no target means vessel did not target a particular species	
block 303 represents the Sacramento River from the confluence to about Rio Vista	
block 303 also includes some of the San Joaquin River just east of the confluence	
block 304 represents the Sacramento River from about Rio Vista to the City of Sacramento	
block 305 represents the Sacramento River from the City of Sacramento northward	

We examined the relation between each permutation of CPUE and the others by way of scatter plots (see Figure 1 for an example), and found that the relations vary substantially, especially when filtered by geographic criteria (DuBois 2011). We then compared 12 CPUE permutations to estimated annual striped bass abundance. Correlation coefficients (R^2) for five of the 12 exceeded 0.4 (Figure 2). Two of those five contained the complete CPUE time series (1980-2009; N=25) while, as some information was not required of partyboats prior to 1995, the remainder used data from 1995-2009.

Figure 3 is a typical time series of partyboat CPUE for striped bass, showing the substantial increase in abundance (relative and absolute) from 1995-2000 and several short-duration extreme variations in CPUE.

$$CPUE_t = \frac{\sum catch}{\sum anglerhours}$$

Equation 3

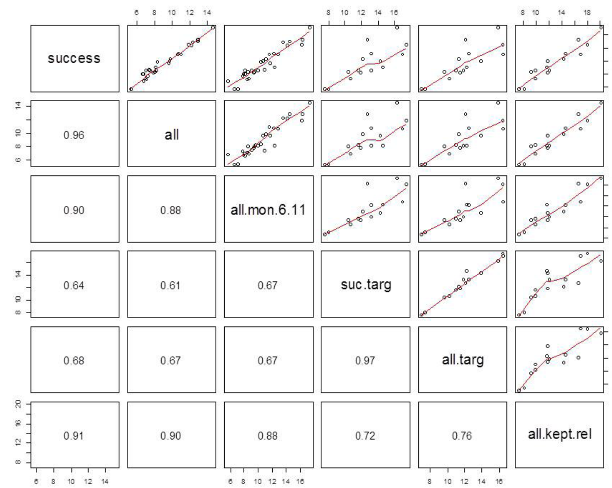

Figure 1 Scatter plot matrix comparing annual partyboat CPUE (effort as 100 angler-hours) for striped bass from trips inside the San Francisco Estuary and various other criteria; upper panels with loess line, lower panels values = R2; data 1980-2009

Discussion

Partyboat CPUE for striped bass does not vary monotonically with estimated striped bass abundance, but several CPUE permutations appear to be helpful indices of abundance. Some extreme variations in CPUE as yet defy explanation (e.g., steep declines in 1986 and 1996) and weaken relations between CPUE and abundance. The best relations we observed come from data (i.e., species targeted; released fish) that has been required of partyboats only since 1995, such that we expect stronger relations between CPUE and abundance in the future.

Variations in q likely bias the time-trend in CPUE. We have explored ways to estimate q but have not come to any resolution. From Equation 1, q can be estimated by dividing CPUE by estimated abundance (N_t). However, doing so would create "circular logic" in our effort to relate CPUE and estimated abundance. Ricker (1973) offers $F = q \times f$ for estimating the instantaneous rate of fishing (F) given fishing effort (f). Thus, q could be estimated by dividing F by f. Estimating F could be possible by rearranging the Ricker (1975) equation, $\mu = \frac{F \times A}{Z}$ where μ = rate of exploitation, A = total mortality rate, and Z = instantaneous total mortality rate. We may consider further investigations (e.g., calculating F) to better understand the potential effects of q (and variations thereto) in this process.

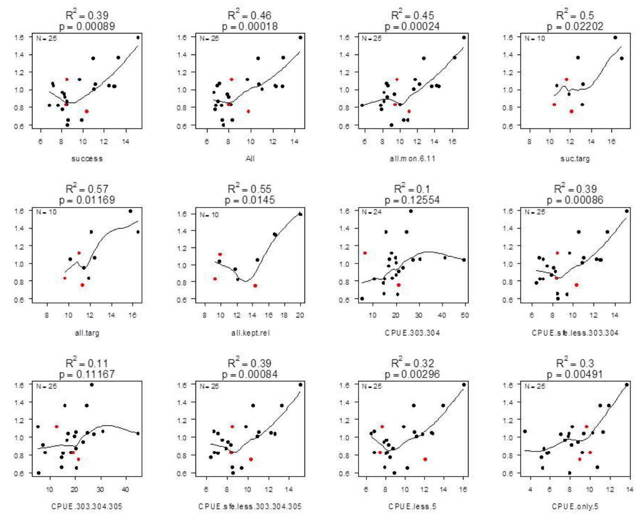

Figure 2 Scatter plot matrix comparing annual partyboat CPUE (x-axis, effort as 100 angler-hours) for striped bass from trips inside the San Francisco Estuary and various other criteria on estimated annual striped bass abundance (y-axis in millions); red dots indicate preliminary abundance estimates for 2007-2009; data 1980-2009

References

Calhoun, AJ. 1949. California Striped Bass Catch Records from the Party Boat Fishery: 1938-1948. California Fish and Game 35(4):211-253.

DuBois J (California Department of Fish and Game). 2011. Striped Bass CPFV CPUE Analysis. Memo. Stockton, California. 11 p.

Hill KT, Schneider N. 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.

McKechnie, RJ, and Miller LW. 1971. The Striped Bass Party Boat Fishery: 1960-1968. California Fish and Game 57(1):4-16.

Ricker WE. 1973. Linear Regressions in Fishery Research. Journal of the Fisheries Research Board of Canada 30(3):409-434.

Ricker WE. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Department of the Environment Fisheries and Marine Science. Bulletin 191. 382 p.

Stevens DE, Kohlhorst DW, and Miller LW. 1985. The Decline of Striped Bass in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 114(1):12-30.

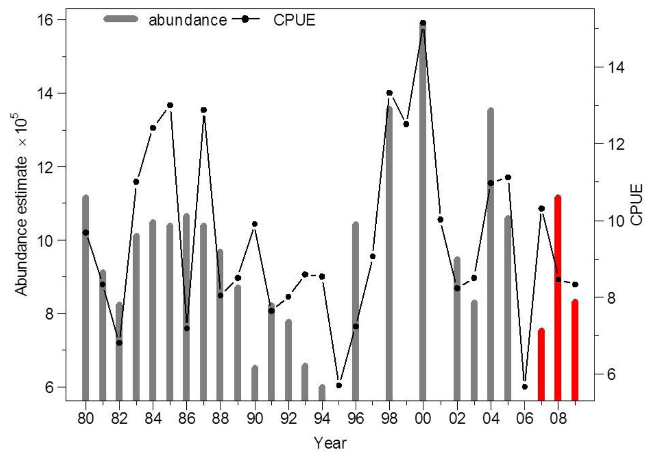

Figure 3 Estimated annual striped bass abundance and partyboat CPUE (success (Table 1); effort as 100 angler-hours); no abundance estimates were made for 1995, 1997, 1999, 2001, and 2006; effort was substantial every year (min: 13,174 hours; max: 117,715 hours; avg: 51,470 hours); red bars indicate preliminary abundance estimates

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