The following supplements accompany the article

Carryover effects of early growth and river flow on partial migration in striped bass *Morone saxatilis*

Christian W. Conroy*, Philip M. Piccoli, David H. Secor

*Corresponding author: conroy.chr@husky.neu.edu

Marine Ecology Progress Series 541: 179–194 (2015)

Supplement 1. Salinity in the Patuxent River

Any description of juvenile estuarine movements based on otolith chemistry requires a well-founded understanding of the ambient chemistry (here salinity) to which the individual is exposed (Elsdon et al. 2008). To ensure an accurate depiction of the estuary for 2009 and 2010, we modeled surface salinity (i.e. ≤1.5 m) using a form of the logistic differential equation, $Sal_{RKM} = \frac{Sal_{max}}{1 + exp^{(\beta\,(RKM - \delta)}}$, and data from biweekly sampling that has been compiled by the Chesapeake Bay Program (2011). The rate of salinity decline (β) and river kilometer where salinity is midway between the maximum and minimum (δ) were estimated using nonlinear least squares regression, while periods for which no data was available (i.e. days between sampling) were linearly interpolated. Patterns of surface salinity were similar in 2009 and 2010, with mid-estuary maxima occurring in early July. The extent of freshwater habitat (i.e. the location of the fresh-brackish water habitat threshold salinity of 3) was similar in both years, fluctuating between RKM 41 and 53 in 2009 (RKM_{mean} = 48) and RKM 42 and 54 in 2010 (RKM_{mean} = 49; Fig. 1; Supplement Fig. S1). The sampling locations bracketing the mean locations of the identified habitat threshold were located at RKM 44 (Eagle Harbor) and RKM 55 (Milltown Landing). Eagle Harbor was designated as brackish habitat based on consistent salinity >3 (82% of the study period in 2009 and 84% of the study period in 2010), salinity did not fall below the threshold after May 8 in either year; Milltown Landing was designated as freshwater habitat, as salinity never reached 3 during the study period in either year. Due to the stability of salinity relative to the threshold and the spatial resolution of seine sampling,

we identified a consistent physical location of the boundary between freshwater and brackish habitats between these 2 sampling locations. The similarity in salinity conditions in both years of our study support the interpretation of measured otolith Sr/Ca as spatial movements within a natal estuary as well as the comparison of these behaviors across year-classes.

LITERATURE CITED

Chesapeake Bay Program (2011) Chesapeake Bay Program Water Quality Database 1984-present. http://www.chesapeakebay.net/data/downloads/ (accessed October 5, 2011)

Elsdon TS, Wells BK, Campana SE, Gillanders BM, Jones CM, Limburg KE, Secor DH, Thorrold SR, Walther BD (2008) Otolith chemistry to describe movements and life-history parameters of fishes: hypotheses, assumptions, limitations and inferences. Oceanography and Marine Biology: An Annual Review 46:297-330

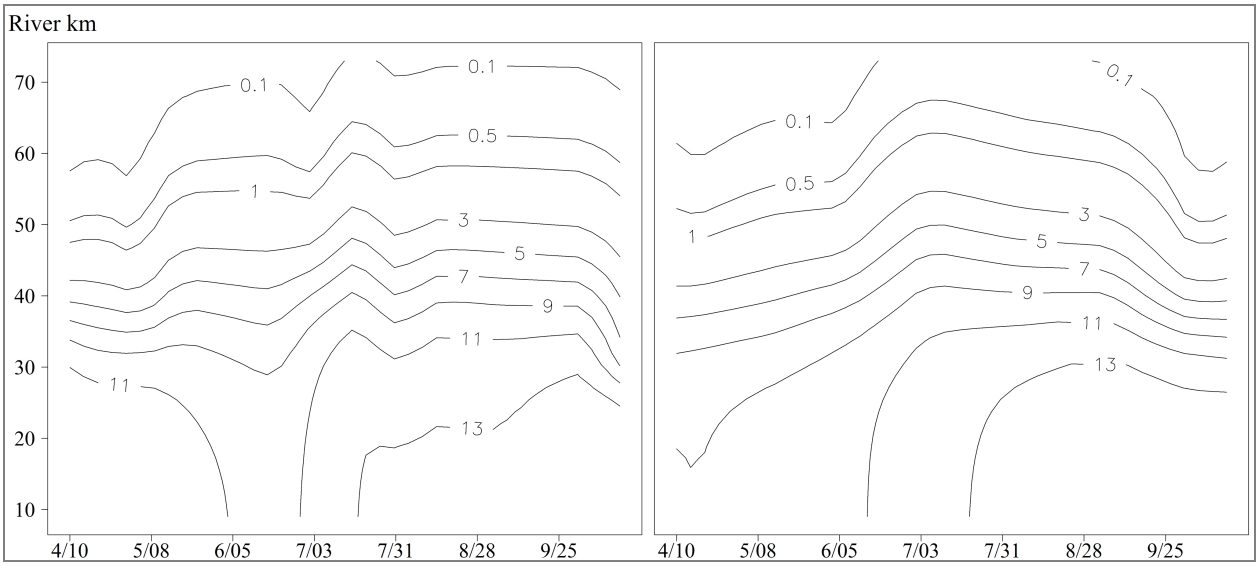

Fig. S1. Weekly modelled surface (≤1.5 m) salinity by river km in the Patuxent River in April-October, 2009 (left) and 2010 (right). Salinity isolines are labelled. The extent of freshwater and brackish water habitats, as defined by the location of the salinity threshold of 3, was consistent in both 2009 (mean 47 km, range 40-52 km) and 2010 (mean 47, range 41-54 km).

Supplement 2. Analysis of Sampling Bias

Sampling bias was evaluated by comparing sub-samples used in otolith and diet analyses against the full distribution of samples with respect to size and time of collection. This entailed binomial regressions (logit link functions) with time of sampling (collection month), fish size (total length), and their interaction included as variables; any significant effects were assumed to be bias that could affect interpretation of results. All analyses were conducted in the R statistical program (R Core Team 2013) unless otherwise indicated.

There was no evidence of bias in the subsamples used in otolith and diet analyses in either year. The subsamples of juveniles selected for otolith analyses from freshwater and brackish habitats had similar body size distributions in both 2009 (total length $Z = 0.64$, $p = 0.52$) and 2010 (total length $Z = –1.54$, $p = 0.12$), were similarly distributed in time (2009 month $Z = 1.33$, $p = 0.18$; 2010 month $Z = –1.16$, $p = 0.25$), and did not differ in size over time (2009 interaction $Z = –0.91$, $p = 0.36$; 2010 interaction $Z = –1.48$, $p = 0.14$). The distributions of body size through time of juveniles neither differed between habitats for stomach content analysis in 2009 (total length $Z = 0.11$, $p = 0.78$; month $Z = 1.60$, $p = 0.11$; interaction $Z = –0.82$, $p = 0.41$) or 2010 (total length $Z = –1.33$, $p = 0.19$; month $Z = 1.59$, $p = 0.11$; interaction $Z = 1.08$, $p = 0.28$), nor for stable isotope analysis in 2010 (total length $Z = –1.54$, $p = 0.12$; month $Z = 1.24$, $p = 0.22$; interaction $Z = 1.48$, $p = 0.14$).

LITERATURE CITED

R Core Team (2013) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria