Partial migration in juvenile white perch (*Morone americana*) within the Hudson River Estuary

Brian K. Gallagher[1], David H. Secor[1] and Philip M. Piccoli[2]

[1]University of Maryland Center for Environmental Sciences
Chesapeake Biological Laboratory
PO Box 38, Solomons, MD

[2]University of Maryland
Department of Geology
College Park, MD 20742

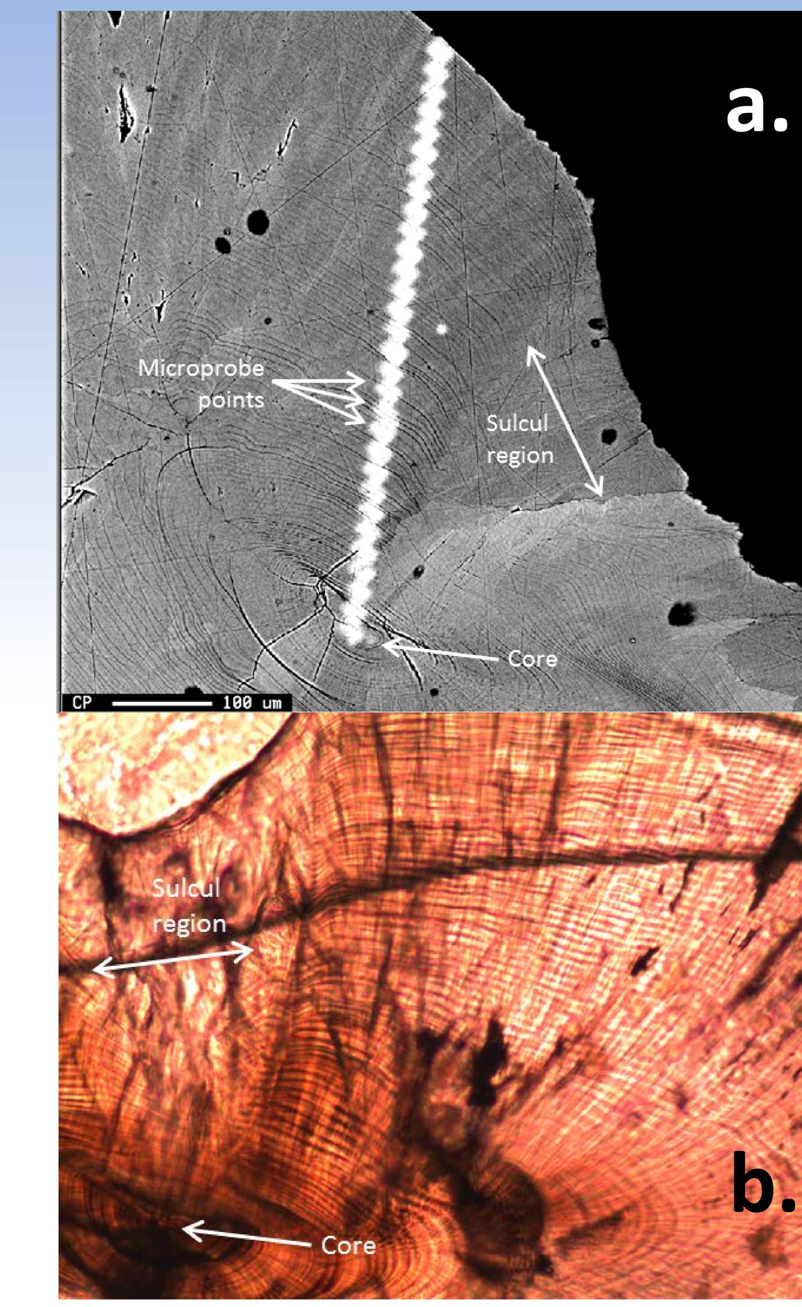


Figure 10: Images of a white perch otolith under an electron microprobe (top; *a*) and light microscope (bottom; *b*)

Introduction:

Partial migration, the presence of different migratory groups (contingents) within the same population, is likely common in marine fishes, but less well documented than for birds and terrestrial vertebrates. Previous work in Chesapeake Bay tributaries has established white perch *(Morone americana)* as a model species for studying partial migration in estuarine fishes, wherein some individuals migrate between freshwater and brackish habitats (migratory contingent) and others remain in freshwater throughout their lifetime (resident contingent). However, studies of white perch partial migration have not occurred in other systems.

In this study, we evaluated whether juvenile white perch in the Hudson River Estuary exhibit partial migration. In addition, we tested for differences in hatch dates, larval size-at-age and late-juvenile growth rates between contingents.

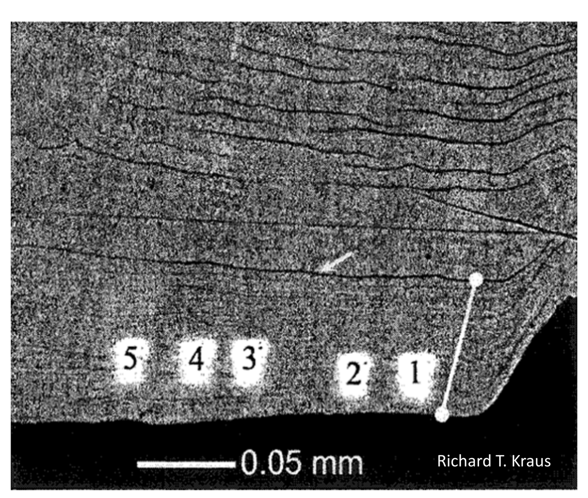


Figure 1: Image of otolith edge sampled for Sr:Ca using electron microprobe

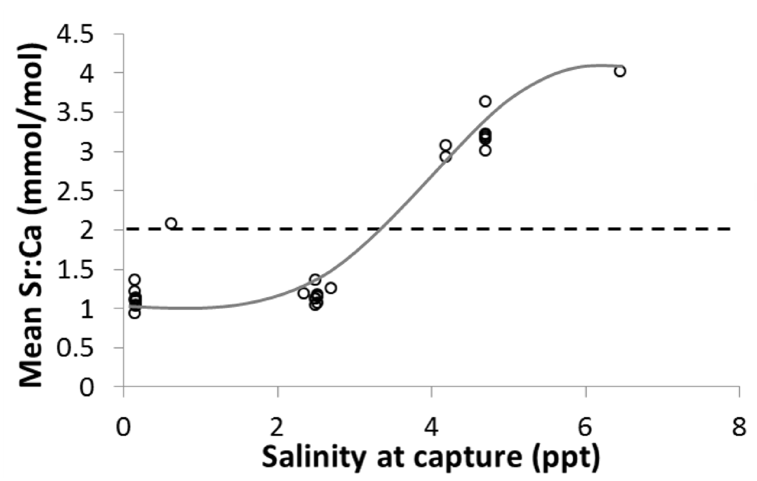


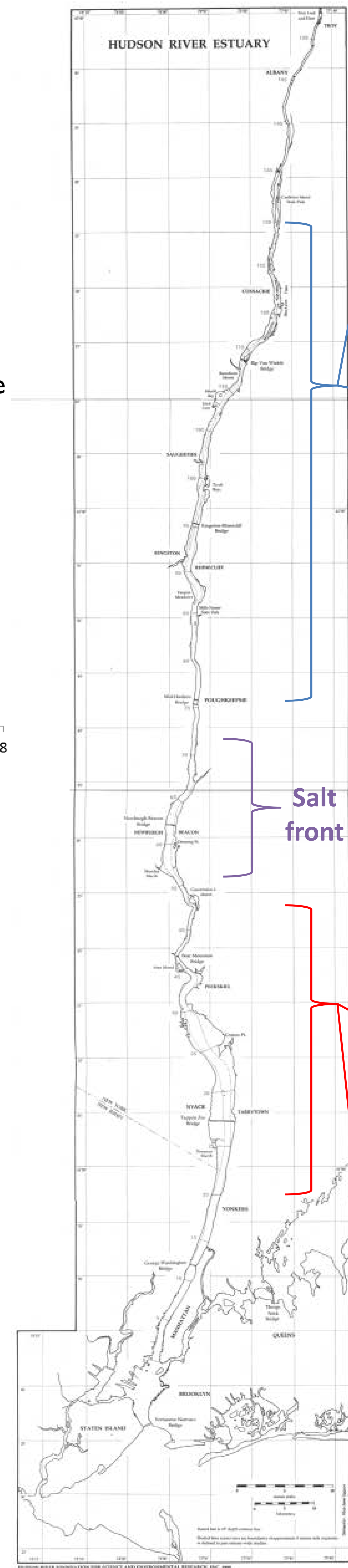
Figure 2: Mixing curve depicting logistic relationship between mean edge Sr:Ca and salinity

Methods:

- Young-of-the-year white perch (n=70) were collected by the NY State Department of Environmental Conservation from the Hudson River during fall, 2013.
- Fish were assigned to resident (freshwater) or migratory (brackish water) contingents based on otolith strontium:calcium (Sr:Ca) profiles (*Figures 1, 2 and 10a).*
- Otolith microstructure was also examined to estimate age and hatch date of each individual (*Figure 10b*).
- The biological intercept method was employed to back-calculate total length at an age of 50 days (*Equation 1*).
- Statistical analyses were used to compare hatch dates, larval size-at-age (t-test) and age-length relationships (ANCOVA) between contingents.

$$TL_a = TL_c + \frac{(OR_a - OR_c) \cdot (TL_c - TL_i)}{OR_c - OR_i}$$

Equation 1: Length back-calculation equation developed by Campana (1990). The equation uses the proportionality between fish size (TL) and otolith radius (OR) to estimate length-at-age.



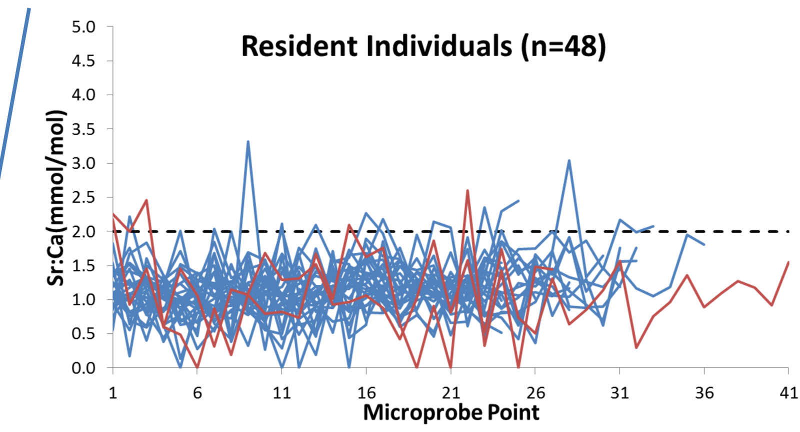


Figure 3: Sr:Ca profiles of resident white perch (n=48), all caught in upriver or mid-river locales. Note that two individuals were caught downriver, but exhibited resident Sr:Ca patterns (in dark red).

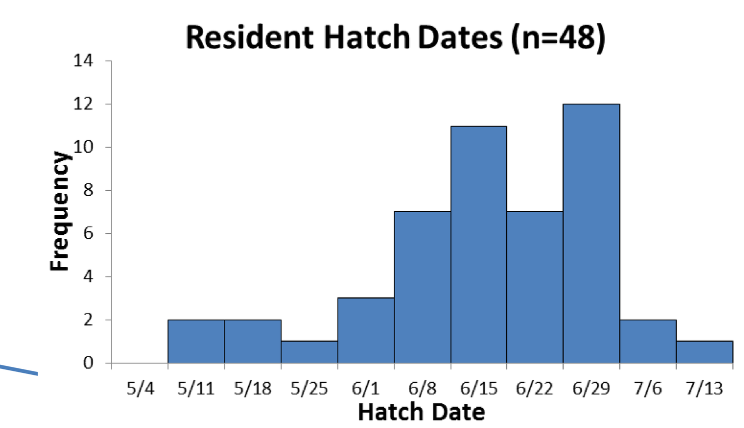


Figure 4: Hatch date distribution of resident white perch (mean=12 June)

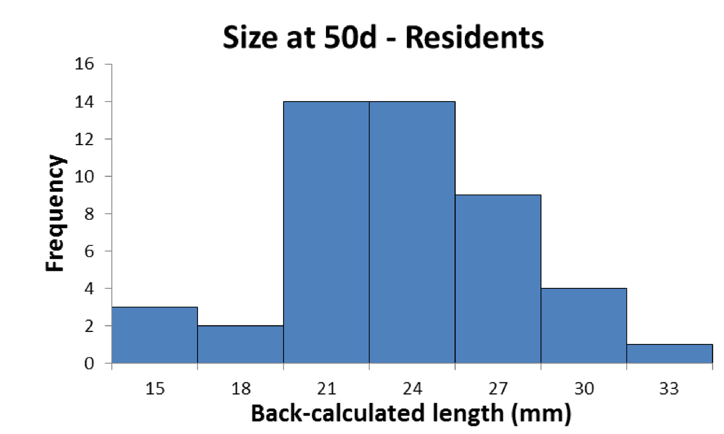
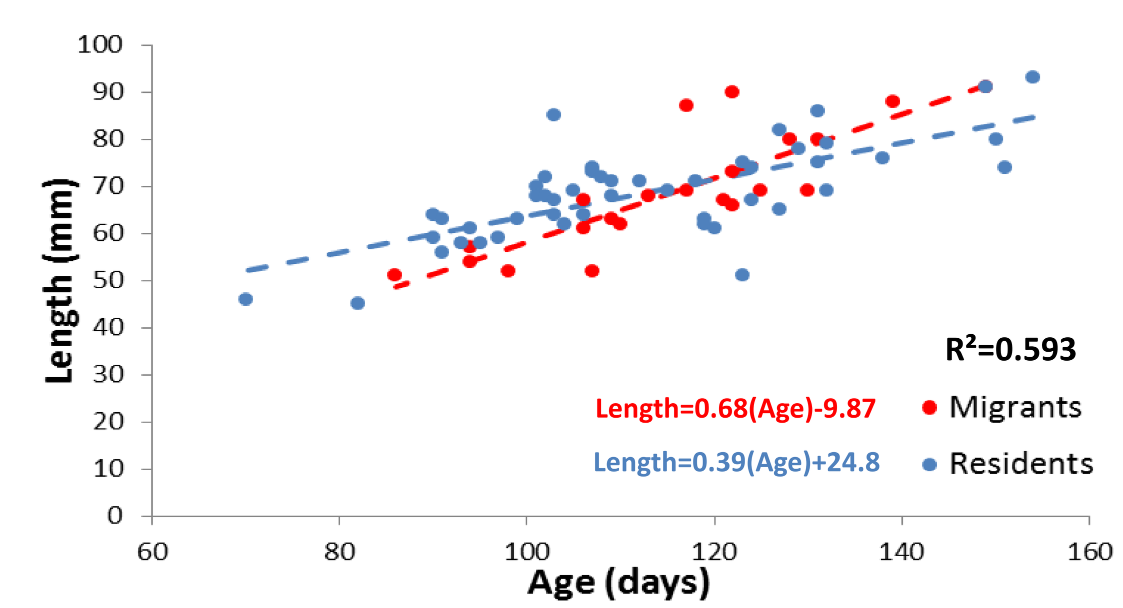


Figure 5: Distribution of length at 50d for resident white perch (mean=22.1mm)

Figure 9: Age-length relationships and corresponding ANCOVA equations for resident (blue) and migratory (red) white perch



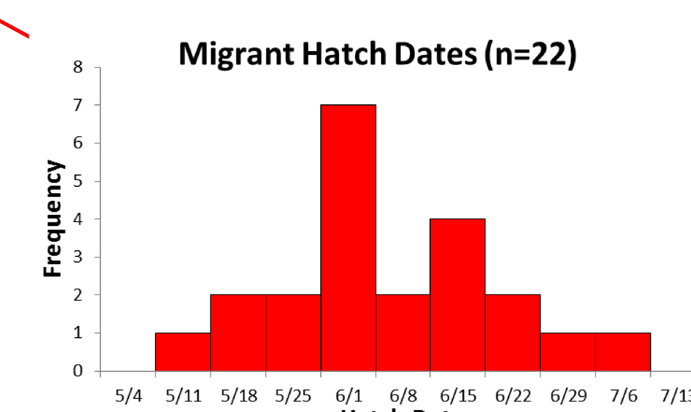


Figure 7: Hatch date distribution of migratory white perch (mean=3 June)

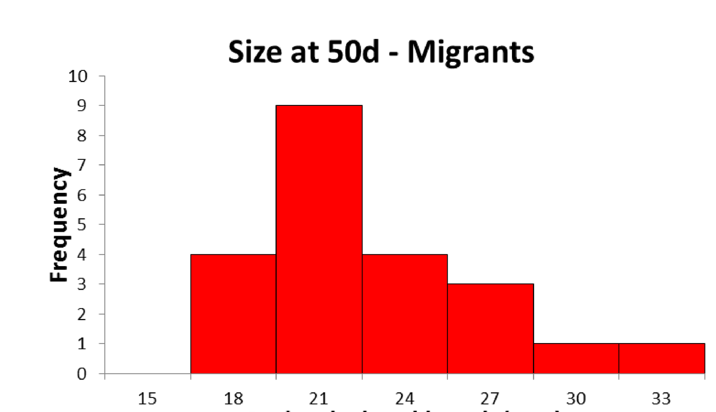


Figure 8: Distribution of length at 50d for migratory white perch (mean=21.5mm)

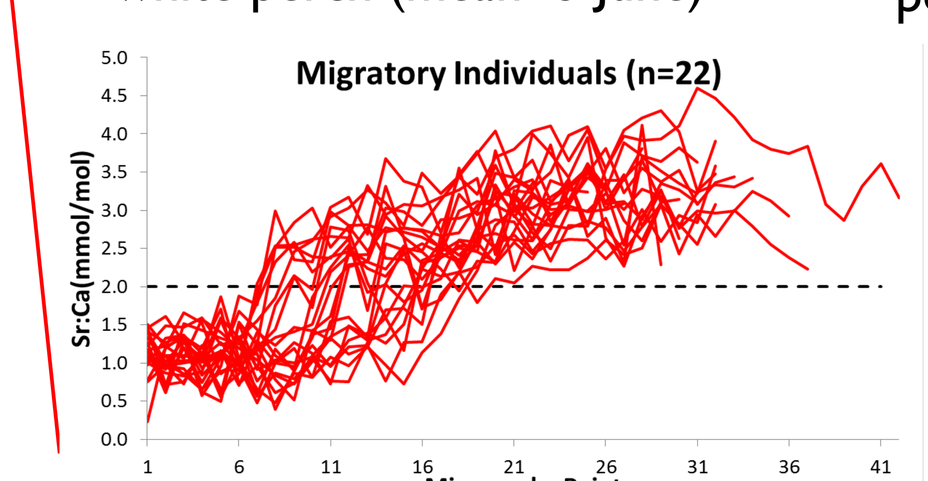


Figure 6: Sr:Ca profiles of migratory white perch (n=22), all caught in downriver locales

Results:

- Sr:Ca profiles identified resident and migratory contingents, but two fish caught downriver did not show expected patterns (*Figures 3 and 6*).
- Migratory individuals originated from significantly earlier hatch dates on average ($p<0.01$) than residents (*Figures 4 and 7*).
- Migratory individuals were slightly smaller early in life, but not significantly different ($p>0.5$; *Figures 5 and 8*).
- There were differences in the intercepts and slopes of the age-length relationships between contingents, indicating that migratory fish grew over 1.5x faster as juveniles after dispersing to brackish habitat ($p<0.05$; *Figure 9*).

Conclusions:

These analyses indicate that white perch in the Hudson River Estuary conform to the pattern of white perch partial migration observed in the Chesapeake Bay. Earlier hatch dates, smaller initial sizes, and faster late-juvenile growth rates of migratory fish align with previous observations by Kerr et al (2010) and Kraus and Secor (2004).

Future work will include increasing sample size of the 2013 cohort, analyzing another young-of-the-year cohort collected in 2014, and investigating inter-generational contingent structure in Hudson River white perch.

Acknowledgements:

We thank the Hudson River Foundation for financial support, and NYSDEC for fish collections.

HUDSON RIVER FOUNDATION

Innovation for a better future
University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE