American eel abundance: recent trends in southeastern Pennsylvania

Richard J. Horwitz, Paul F. Overbeck, David H. Keller*, and Shane M. Moser

Patrick Center for Environmental Research, The Academy of Natural Sciences

1900 Benjamin Franklin Parkway, Philadelphia, PA 19103 USA

PA State Wildlife Grants Program

Abstract

Understanding the status and trends of American eel (*Anguilla rostrata*) is important for this ecologically and commercially significant species. We are studying yellow-phase American eels in streams and rivers in Pennsylvania. Goals include re-sampling historically-sampled sites to provide quantitative comparisons of abundance, and assessment of eel abundance upstream and downstream of potential migration blocks. We found few samples with quantitative eel data from before the 1990s, and uncertainties about sampling protocols impeded comparisons with these samples. Most sites which were re-sampled were first sampled between 1997 and 1999, with some sites sampled in the early 1980's. From 2007-2008, we sampled 39 sites with existing eel data using single and multi-pass backpack electrofishing, including forest, meadow, suburban, and urban sites. We sampled several sites following dam removal. Preliminary results indicate variable changes in abundance between the earlier and recent samples. Decreased abundance and shift toward larger eels was seen in some sites. Greatly increased abundance was seen at one Susquehanna River tributary after removal of a dam near the mouth. The results of this study will be important for designing protection and restoration strategies for the American eel in the Delaware drainage.

Introduction and Objectives

The purpose of this study is to determine the abundance and temporal trends of American eel in the Pennsylvania portion of the Delaware River drainage and southeastern Pennsylvania. The goals of this study are to; 1) use historic (1980-2001) and recent data (2007-2008) to assess eel abundance in Pennsylvania, 2) provide tangible information on current and historical eel status based on existing and new data, and 3) determine the timing and movement patterns of young-of-year (YOY) eels (newly transformed glass eels) in non-tidal waters.

Objectives

1. To provide quantitative comparisons of eel abundance for re-sampled sites (historical vs. current) in Pennsylvania.
2. To assess the effects of recent passage enhancements (e.g. dam removal) on eel abundance.
3. To determine upstream movement patterns of YOY American eel in Ridley Creek.

Methods

American eel status

From 2007-2008, historic eel abundance data (from 1980-2001) were compiled from a variety of studies (e.g. PFBC, USGS, and ANSP stream survey data).

Historical data were subdivided by collection method and sampling season
- backpack electrofishing (single or multiple pass)
- boat electrofishing
- habitat specific sampling (riffle, run, pool)
- collection season (spring, summer, fall)

Historical sampling effort repeated in 2008
- primarily backpack electrofishing 75-150 m reaches
- habitat assessment was repeated where historic reach habitat data were available.

YOY American eel movement

In 2008, seven stations on Ridley Creek were sampled from March to August.
- one tidal and six non-tidal stations
- repeated small area (75m^2) backpack electrofishing conducted in 2007
- YOY and 1+ eels differentiated by length and girth (1+ eels ≈ >10cm, YOY<10cm)

Transforming glass (top) and 1+ American eel (bottom)

Backpack electrofishing with PA, Waterways Conservation Officer Lewis Sweigart

Study area

Table 1. List of 39 stations sampled in 2007 and 2008 to determine the status of American eel in PA. Stations sampled for YOY eel movement study are not included.

Station	Water Body	Drainage	Subdrainage	County
1	Delaware River	Delaware River	Delaware River	Warren
2A	Delaware River	Delaware River	Delaware River	Warren
BC	Ballard Creek	Delaware River	Shohola Creek	Pike
BVF	Beaver Run	Delaware River	Schuylkill River	Chester
BVO	Beaver Run	Delaware River	Schuylkill River	Chester
CC11	Cobbs Creek	Delaware River	Darby Creek	Delaware
CC6	Cobbs Creek	Delaware River	Darby Creek	Delaware
DEL	Delaware River	Delaware River	Delaware River	Warren
DR	Dismal Run	Delaware River	Ridley Creek	Delaware
EWC	East branch Wallenpaupack Creek	Delaware River	Lackawaxen River	Wayne
HP	Darby Creek	Delaware River	Darby Creek	Delaware
INF	Indian Creek of Cobbs	Delaware River	Darby Creek	Philadelphia
INR	Indian Run	Delaware River	Christiana River	Chester
IR1	Indian Run	Delaware River	Christiana River	Chester
KID	Delaware River	Delaware River	Delaware River	Warren
KIP	Delaware River	Delaware River	Delaware River	Warren
KIU	Delaware River	Delaware River	Delaware River	Warren
MCC	McCreary Run	Susquehanna River	Octoraro Creek	Lancaster
MH1L	Marcus Hook Creek	Delaware River	Marcus Hook Creek	Delaware
MH1U	Marcus Hook Creek	Delaware River	Marcus Hook Creek	Delaware
MHSL	Marcus Hook Creek	Delaware River	Marcus Hook Creek	Delaware
MHSU	Marcus Hook Creek	Delaware River	Marcus Hook Creek	Delaware
MHT1	Marcus Hook Creek	Delaware River	Marcus Hook Creek	Delaware
MHT1	Marcus Hook Creek	Delaware River	Marcus Hook Creek	Delaware
OC1	Octoraro Creek	Susquehanna River	Octoraro Creek	Chester
POM	Poquessin Creek	Delaware River	Christiana River	Chester
PPF	Pennypack Creek trib	Delaware River	Pennypack Creek	Montgomery
PPO	Pennypack Creek trib	Delaware River	Pennypack Creek	Montgomery
PRN	Pine Run of Neshaminy Creek	Delaware River	Neshaminy Creek	Bucks
QAO	Queen Anne Creek	Delaware River	Mill Creek, Bristol	Bucks
RCF	Rocky Run	Delaware River	Chester Creek	Delaware
RI1	Ridley Creek	Delaware River	Ridley Creek	Delaware
RI2	Ridley Creek	Delaware River	Ridley Creek	Delaware
RI4	Ridley Creek	Delaware River	Ridley Creek	Chester
RI5	Ridley Creek	Delaware River	Ridley Creek	Chester
SH	Shohola Creek	Delaware River	Shohola Creek	Pike
TW	Tweed Run	Susquehanna River	Octoraro Creek	Chester
WCM	White Clay Creek	Delaware River	Christiana River	Chester
WCW	White Clay Creek	Delaware River	Christiana River	Chester

Results

We found few samples with quantitative eel data from before the 1990s, and uncertainties about sampling protocols impeded comparisons with these samples. Figures of historical stations able to re-sampled are shown below.

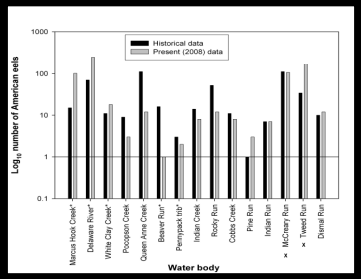

Figure 1. Total numbers of American eels collected at various sampling stations from historical data and present (2008) data. *Represents water bodies where multiple samples were taken and abundance includes all eels from all sampling efforts and stations. x Indicates downstream dam removed prior to present sampling.

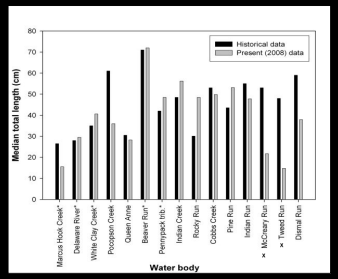

Figure 2. Median American eel total length measurements by sampling station from historical and present (2008) data. *Represents water bodies where multiple samples were taken and abundance includes eels from all sampling efforts and stations. x Indicates downstream dam removed prior to present sampling

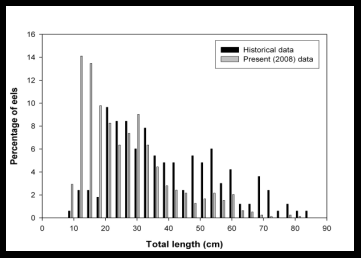

Figure 3. Total length frequency comparison of American eels collected in southeastern Pennsylvania based on historical and present (2008) data.

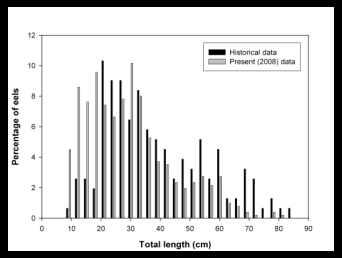

Figure 4. Total length frequency comparison of American eels collected in southeastern Pennsylvania based on historical and present (2008) data. This data excludes historic and present sampling from both Tweed Run and McCreary Run due to downstream dam taken out prior to 2008 sampling.

Results cont'd

Tweed and McCreary Runs showed dramatic increases in both abundance and range of eel lengths (Figure 5)

Seven dead American eels (>60 cm) were found downstream of dam in Octoraro Creek, a tributary to the Susquehanna River, suggesting turbine passage mortality.

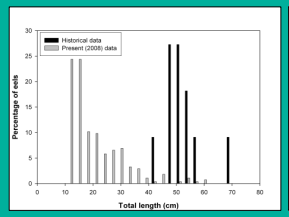

Figure 5. Total length frequency of American eels collected at Tweed Run and McCreary Run based on historical (2001) and present (2008) data; a downstream dam was removed in 2005.

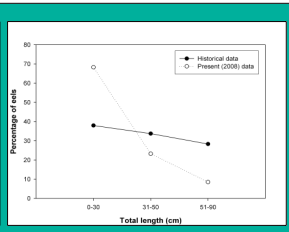

Figure 6. Total length frequency of American eels collected in southeastern Pennsylvania based on historical (1981-2001) and present (2008) data.

Small area (75m^2) backpack electrofishing for YOY American eel in Ridley Creek

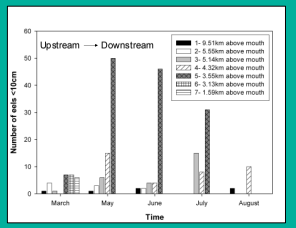

Figure 7. Number of American eels <10cm at seven stations in Ridley Creek between March and August 2008. Head-of-tide is approximately 3 km above mouth.

Discussion

Increased abundance of American eels <30 cm in the most recent samples may be due to greater attention to sampling small eels or may reflect a resurgence in eel abundance possibly due to local and regional management actions.

Increased abundances of American eel in Tweed Run and McCreary Run appear to be due to a dam removal on Octoraro Creek, a tributary to the Susquehanna River.

The overall status of American eel abundance in southeastern Pennsylvania appears to have changed little in recent years (10-15 yrs) except where dam removal has increased upstream passage. Decreases in frequency of larger eels reflects the increased percentages of smaller eels in these samples.

In southeastern Pennsylvania in both this and other studies (2006-2007) we have found that YOY American eels move into areas near and above the head-of-tide in March and April. In May and June, abundances above the head-of-tide increase and by July (this study) some YOY have moved as much as 2 km upstream from the head-of-tide.

In southeastern Pennsylvania, YOY American eels appear to prefer sand-gravel substrate. The amount of sand-gravel substrate decreases with upstream movement and along with distance may be a limiting factor for upstream recruitment. In areas near the head-of-tide, small area (75m^2) backpack electrofishing in late spring may be a suitable technique for monitoring YOY eels.

Acknowledgements

We thank the Pennsylvania State Wildlife Grants Program for sponsoring this study, Roger Thomas (ANSP) and Sylvan Klein (ANSP) for assisting with field work, Jerry Mead (ANSP) for assisting with map production, Gerry Waterfield (Normandeau), Mike Kaufmann (PFBC) and Robin Brightbill (USGS) for providing data.