

# Research Priorities and Recommendations to Support Interjurisdictional Fisheries Management

## AMERICAN EEL

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### **Fishery-Dependent Priorities**

#### ***High***

- Monitor catch and effort in bait fisheries (commercial and personal-use) and in personal-use fisheries that are not currently covered by MRIP or commercial fisheries monitoring programs.
- Improve knowledge of the proportion of the American eel population and the fisheries occurring south of the US that may affect the US portion of the stock.
- Require standardized reporting of trip-level landings and effort data for all states in inland waters. Data should be collected using the ACCSP standards for collection of catch and effort data (ACCSP 2004).
- Compare buyer reports to reported state landings.

#### ***Moderate***

- Collect site specific information on the recreational harvest of American eel in inland waters, potentially through expansion of MRIP to riverine/inland areas.
- Monitor discards in targeted and non-targeted fisheries.
- Require states to collect fishery-dependent biological information by life stage, potentially through collaborative monitoring and research programs with dealers. Samples should be collected from gear types that target each life stage.<sup>1</sup>
- Review the historical participation level of subsistence fishers and relevant issues brought forth with respect to those subsistence fishers involved with American eel to provide information on the changing exploitation of American eels.
- Investigate American eel harvest and resource by subsistence harvesters (e.g., Native American tribes, Asian and European ethnic groups).

### **Fishery-Independent Priorities**

#### ***High***

- Maintain and update the list of fishery-independent surveys that have caught American eels and note the appropriate contact person for each survey.
- Request that states record the number of eels caught by fishery-independent surveys. Recommend states collect biological information by life stage including length, weight, age,

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<sup>1</sup> SASC is developing a draft protocol for sampling fisheries.

and sex of eels caught in fishery-independent sampling programs; at a minimum, length samples should be routinely collected from fishery-independent surveys.

- Encourage states to implement surveys that directly target and measure abundance of yellow and silver stage American eels, especially in states where few targeted eel surveys are conducted.
- Develop a coastwide sampling program for yellow and silver stage American eels using standardized and statistically robust methodologies.
- Continue the ASMFC-mandated YOY surveys; these surveys could be particularly valuable as an early warning signal of recruitment failure. Standardize sampling across all surveys. Develop proceedings document for the 2006 ASMFC YOY Survey Workshop. Follow-up on decisions and recommendations made at the workshop.

#### ***Moderate***

- Develop standardized sampling gear, habitat, and ageing methods and conduct intensive age and growth studies at regional index sites to support development of reference points and estimates of exploitation.

### **Modeling / Quantitative Priorities**

#### ***High***

- Perform periodic stock assessments (every 5-7 years) and establish sustainable reference points for American eel required to develop a sustainable harvest rate in addition to determining whether the population is stable, decreasing, or increasing. Investigate if a longer time interval (8-10 years) between assessments will improve population trend estimates. Longer time periods may better reflect eel generation time.

#### ***Moderate***

- Develop new assessment models (e.g., delay-difference model) specific to eel life history and fit to available indices.
- Develop GIS-type model incorporating habitat type, abundance, contamination, and other environmental factors.

### **Life History, Biological, and Habitat Priorities**

#### ***High***

- Monitor non-harvest losses due to barriers such as impingement, entrainment, spill, and hydropower turbine mortality.
- Develop, investigate, and improve technologies for upstream and downstream American eel passage at various barriers for each life stage. Identify effective low-cost alternatives to traditional passage designs. Develop design standards for upstream passage devices.<sup>2</sup>
- Evaluate the impact, both upstream and downstream, of barriers to eel movement with respect to population and distribution effects. Determine relative contribution of historic loss of habitat to potential eel population and reproductive capacity.
- Implement large-scale (coastwide or regional) tagging studies of eels at different life stages to determine growth, passage mortality, movement and migration, validated ageing methods, reporting rates, and tag shredding/tag attrition rates.<sup>3</sup>

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<sup>2</sup> An ASMFC Eel Passage Workshop occurred in 2011 reviewing details on passage design.

- Identify the mechanism driving sexual determination and the potential management implications.
- Identify spatially explicit, sex specific, triggering mechanism for metamorphosis to mature adult and silver eel life stage, with specific emphasis on the size and age at onset of maturity. A maturity schedule (proportion mature by size or age) would be extremely useful in combination with migration rates.
- Improve understanding of the effects of contaminants on fecundity, natural mortality, and overall health (non-lethal population stressors). Research the effects of bioaccumulation with respect to impacts on survival and growth by age and effect on maturation and reproductive success.<sup>4</sup>
- Conduct research on the prevalence, incidence of infection, and effects of the swim bladder parasite *Anguillicola crassus* on American eel growth and maturation, migration to the Sargasso Sea, and spawning potential. Investigate the impact of the introduction of *A. crassus* into areas that are presently free of the parasite.

### ***Moderate***

- Recommend monitoring of upstream and downstream movement at migratory barriers that are efficient at passing eels (e.g., fish ladder/lift counts). Data that should be collected include presence/absence, abundance, and biological information. Provide standardized protocols for monitoring eels at passage facilities, coordinate compilation of these data, and provide guidance on the need and purpose of site-specific monitoring.
- Evaluate eel impingement and entrainment at facilities with NPDES authorization for large water withdrawals. Quantify regional mortality and determine if indices of abundance could be established at specific facilities.
- Assess available drainage area over time to account for temporal changes in carrying capacity and sex ratio. Develop GIS of major passage barriers.
- Assess characteristics and distribution of American eel habitat and value of habitat with respect to growth and sex determination. Develop GIS of American eel habitat in US. This will have to be a habitat-specific analysis based on past studies that show high habitat-specific variability in sex ratios within a drainage system.
- Improve understanding of within-drainage behavior and movement and the exchange between freshwater and estuarine systems.
- Improve understanding of predator-prey relationships, behavior and movement of eel during their freshwater residency, oceanic behavior, and movement and specific spawning location of adult mature eel in the Sargasso Sea. Determine if larger females have a size refuge during the freshwater phase.
- Examine the mechanisms for exit from the Sargasso Sea and transport across the continental shelf to determine implications for recruitment. Examine migratory routes and guidance mechanisms for silver eel in the ocean.
- Research mechanisms of recognition of the spawning area by silver eel, mate location in the Sargasso Sea, spawning behavior, and gonadal development in maturation.
- Continue investigation of the length and weight specific fecundities of American eel.

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<sup>3</sup> Current tagging studies are ongoing in the St. Lawrence River system. A tagging study to examine local and regional movement has been completed by a graduate student at Delaware State University.

<sup>4</sup> USFWS currently has a project examining maternal transfer of contaminants in American eel.

- Examine age-at-entry of glass eel into estuaries and freshwater to determine time lag between spawner escapement and glass eel recruitment.
- Improve understanding of all information on the leptocephalus and glass stages of eel, including mode of nutrition and transport/recruitment mechanisms.
- Develop a monitoring framework to collect and provide coastwide information on the influence of environmental factors and climate change on recruitment for future modeling.

***Additional Habitat Research Recommendations***

- Research the behavior of silver eels at downstream passages; determine specific behavior of eels migrating downstream, and research how they negotiate and pass hydropower facilities.
- Research the behavior of American eel approaching hydropower dams to determine searching behavior and preferred routes of approach to confirm best siting options for upstream passage.
- Investigate how river flow, lunar phase, water temperature, and behavior near artificial lighting impact the behavior of American eel, and influence the amount of time that the eels spend at a dam.
- Investigate the impact of stream velocity/discharge and stream morphology on upstream migration of glass eel and elvers.
- Research the factors that cause American eel to initiate downstream migration and affect their patterns of movement.
- Examine the environmental conditions required for the hatching success of American eel.
- Research the changes in ocean climate and environmental quality that might influence larval and adult eel migration, spawning, recruitment, and survival, including oceanic heat transport and interactions with the atmosphere and greenhouse gas warming.
- Determine the importance of coastal lakes and reservoirs to American eel populations.
- Investigate the impact of seaweed harvesting on American eel.

**Management, Law Enforcement, and Socioeconomic Priorities**

***High***

- Implement a special permit for use of commercial fixed gear (e.g., pots and traps) to harvest American eels for personal use. Special-use permit holders should be subject to the same reporting requirements for landings and effort as the commercial fishery.
- Coordinate monitoring, assessment, and management among agencies that have jurisdiction within the species' range.
- Perform a joint US-Canadian stock assessment.
- Improve compliance with landing and effort reporting requirements as outlined in the ASMFC FMP for American eel.

***Moderate***

- Continue to require states to report non-harvest losses in their annual compliance reports.
- Conduct socioeconomic studies to determine the value of the fishery and the impact of regulatory management.
- Develop population targets based on habitat availability at the local level.