Research Priorities and Recommendations to Support Interjurisdictional Fisheries Management

AMERICAN SHAD

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System-specific research recommendations are provided for some systems under *Research Recommendations* subheadings in Section 3 of the stock assessment report. The following research recommendations are broadly applicable to most or all systems and/or mixed-stock aggregations.

Data Collection Recommendations

- Transition historical biological sampling data and store all future biological sampling data into digital, query-able databases with standardized fields and format. Unique identifiers should be assigned to individual fish to link all associated data collected. (short-term, moderate priority)

- Develop a centralized repository for agencies to submit and store genetic sampling data for future analysis. The Atlantic sturgeon repository at the United States Geological Survey (USGS) Leetown Science Center should serve as an example. (long-term, high priority)

- Collect genetic samples from young-of-year (YOY) and returning mature adults during spawning runs for future analysis of baseline genetic population structure and site fidelity/straying rates. These data will help define stock structure, identify stock composition from genetic sampling of American shad catch in mixed-stock fisheries, and provide information on recolonization capabilities in defunct American shad systems. (long-term, high priority)

- Conduct annual stock composition sampling through existing and new observer programs from all mixed-stock fisheries (bycatch and directed). Potential methods include tagging (conventional external tags or acoustic tags) of discarded catch and genetic sampling of retained and discarded catch. Mortality rates of juvenile fish in all systems remain unknown and improvement in advice from future stock assessments is not possible without this monitoring. Known fisheries include the Delaware Bay mixed-stock fishery and all fisheries operating in the Atlantic Ocean (U.S. and Canada) that encounter American shad (see Section 4.1.4 in the stock assessment report). (long-term, high priority)

- Otoliths should be collected as the preferred age structure. If collection of otoliths presents perceived impact to conservation of the stock, an annual subsample of paired otolith and

scales (at least 100 samples if possible) should be collected to quantify error between structures. (short-term, high priority)

- Repeated estimates of spawn mark counts should be incorporated into data collection protocols to improve understanding of error in these data. (short-term, moderate priority)

- Conduct tagging studies to increase sample size of fish with known spawn mark histories. Focus tagging efforts on fish most likely to be virgin spawners. (long-term, moderate priority)

- Add age at first spawn, identification of skip spawning, and the age at which skip spawning occurred as standard data fields from spawn mark counts. (short-term, low priority)

- Error between structures, if scales are the primary age structure collected, and for spawn mark count estimates (either between multiple readers or within reader) should be quantified on an annual basis. A mean coefficient of variation (CV) of 5% and detection of no systematic bias should serve as targets for comparisons. (short-term, high priority)

- Two readers should determine consensus ages and spawn mark counts based on improvements in ageing error in the Delaware system when consensus-based estimates were part of the ageing protocol. (short-term, high priority)

- Conduct a coastwide age/spawn mark workshop to develop a standardized ageing/spawn mark count protocol for American shad. The example protocol included in this assessment (section 1.1.4.1 in the stock assessment report) can be used as a foundation for a final protocol. (short-term, moderate priority)

- Collect standardized maturity status data to provide greater resolution on data for length-weigh relationships. Maturity status codes should be: Immature, mature resting, gravid/not yet ripe, flowing, or spent. (short-term, moderate priority)

- Conduct acoustic tagging studies to determine skip spawning behavior and iteroparity rates. This information will also improve understanding of selectivity by in-river fisheries and monitoring programs. (short-term, moderate priority)

- Implement fishery-independent YOY and spawning run surveys in all systems with open fisheries. Surveys should collect catch rates, length, individual weight, sex (spawning runs), and age (spawning runs) data at a minimum to allow for assessment of stocks with legal harvest. Require these surveys be in operation in systems with requested fisheries before opening fisheries. (long-term, high priority)

- Task survey leads with providing as much insight as possible on suspected catchability effects (e.g. environmental covariates) with catch rate data during future stock assessments to improve standardization of abundance trends. Collect necessary data to support standardization model estimation of catchability effects. (short-term, moderate priority)

- Mark hatchery-reared fish and sample nursery habitat after stocking to obtain data that could be used to estimate absolute YOY abundance. (long-term, moderate priority)

- Conduct complete in-river catch monitoring in all systems with open fisheries. Monitoring programs should collect total catch, effort, size, individual weight, and age data at a minimum. Require these surveys be in operation in systems with requested fisheries before opening fisheries. (long-term, high priority)

- Require total catch and biological sampling of fish removed for broodstock purposes as these are useful data that can be obtained with little additional costs. (long-term, moderate priority)

- As catch of other bait species (i.e., Atlantic herring) is reduced, characterize changes in use of American shad as bait to supplement these primary bait species. (long-term, low priority)

Assessment Methodology Recommendations

- Determine appropriate uses of age composition data collected from semelparous stocks. (short-term, moderate priority)

- Investigate how anthropogenic sources of production (i.e., YOY stocking) affect population dynamics and assessment of stocks against traditional biological reference points. (long-term, low priority)

- Develop density-based reference points (number of fish per acre of habitat) from GIS mapping analysis that can be compared to passage counts at fishways. See Maine Department of Marine Resources river herring Sustainable Fishery Management Plan (SFMP) as an example. (long-term, moderate priority)

- Conduct more frequent analyses connecting YOY abundance trends with mature adult abundance trends to provide warning of unfavorable stock conditions due to changes in mortality during the data gap between these life stages. (short term, moderate priority)

- Develop targets for power of abundance indices. (short-term, low priority)

Future Research Recommendations

- Explore implications (predator-prey relationships, recruitment success, interactions with various fisheries) of climate change on environmental spawning cues. (long-term, moderate priority)

- Quantify precision of Oxytetracycline (OTC) mark identification. (long-term, moderate priority)

- Conduct maturity studies designed to accommodate the unique challenges American shad reproductive behavior (i.e., segregating by maturity status during spawning runs) poses on traditional monitoring programs. This information will also improve understanding of selectivity by in-river fisheries and monitoring programs. (long-term high priority)

- Investigate hooking and handling induced mortality in recreational fisheries. This pertains to all system because catch-and-release fisheries are still allowed for systems under moratoria. (long-term, moderate priority)

- Conduct fish passage research at barriers with adults for both upstream and downstream migration and movements and with juveniles for downstream as discussed in Section 1.1.9.5 of the stock assessment report. (long-term, high priority)

Management-related Recommendations

- As additional stock structure information becomes available, continue working on standard definitions of stock systems for use in future assessment and management of unique stocks. These should be described in text and associated maps included in SFMPs to capture all inland waterbodies with shad habitat considered part of the stock system. (long-term, low priority)

- Request managers provide future guidance on management goals in terms of productivity potential. Are goals to rebuild populations to historic levels of productivity or manage stocks relative to recent productivity potential? Clear guidance would help provide assessment advice on stock status. (short-term, low priority)