Appendix 1

Draft comprehensive list of research needs for Mid-Atlantic Council managed species with recommended modifications

Modification Key
Purple text – new priority suggested for addition
~~Red strikethrough~~ – existing priority suggested for deletion
Green text – suggested language modification to existing priority
Highlighted number↑↓ – suggested change in priority order with direction arrow
– work being done or in process to address priority
Highlighted priority – Research Steering Committee recommendation and edits

GENERAL OR CROSS-SPECIES	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
1. Investigate stock structure utilizing otolith microchemistry and other genetic analyses for different Mid-Atlantic stocks (e.g., golden and blueline tilefish, black sea bass, Atlantic mackerel, and surfclam). ##	A, F, G
2. Understand the objectives and performance measures for the fishery from a biological and socioeconomic perspective, to evaluate the balance of costs and benefits of ABC specifications (e.g., variable vs. average ABC).	B, C
3. Explore the utilization of local ecological knowledge to help characterize and understand fisheries habitat change over time to help identify areas of greatest need of protection.	C, F, G
4. Create a framework to improve social science information regarding crew employment, renumeration and job satisfaction for all Mid-Atlantic fisheries.	C
5. Evaluate the potential impacts of offshore wind development, including the impacts from electromagnetic fields and noise, on habitats, ~~and~~ productivity, larval distribution, and changing community structure of Council-managed stocks.	A, F, G
****.** Evaluate the impacts of offshore wind energy development on fisheries-independent surveys (e.g., implications for data collection efforts, survey design, and uncertainty) ##	A, F, G
6. Evaluate the relationship between changes in landings limits and the rates and magnitude of discarding in the commercial and recreational fisheries.	B, C, D, E
7. Evaluate the use of samples collected by the industry study fleet for all Mid-Atlantic stocks.	A, B, F, G
LONG-TERM/LARGER SCALE	
8. Monitor changes in distribution and habitat use for all Mid-Atlantic species and evaluate implications for stock productivity. ##	A, B, D, F, G
9. Collect accurate size and age composition of commercial and recreational catch (including the discarded component of the catch) to develop or improve catch at age matrices for all managed stocks.	A, B, E
10. Incorporate ecosystem level data (predator/prey interactions, trophic dynamics, etc.) into single and multi-species assessment and management models. ##	A, F, G
11. Investigate potential sector and regional allocation changes and adaptive management strategies to respond to changing environmental conditions.	C, D, F, G

12. Develop tools to collect representative economic information on fixed and variable trip costs to understand fleet profitability for all Mid-Atlantic fisheries.	C, E, F
13. Evaluate potential socioeconomic impacts of offshore wind energy development on Council-managed fisheries, including changes in fishing behavior, changes in the distribution of fishing effort, changes in revenues, and differential impacts on commercial and recreational fisheries. ##	C, E, F
14. Implement novel supplemental surveys to derive fishery independent indices of abundance (black sea bass, blueline and golden tilefish, Atlantic mackerel). ##	A

ATLANTIC MACKEREL	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
15. ~~Investigate~~ Revisit stock structure and spawning components ~~through~~ based on ~~additional~~ recent otolith microchemistry and/or genetic ~~projects~~ data. ##	A, F, G
16↑. Continue to collect and evaluate mackerel egg data (ECOMON survey). ##	A
LONG-TERM/LARGER SCALE	
****.** Evaluation of time and age-variant natural mortality and predation mortality for this stock	A, F, G
****.** Evaluate data quality and assessment sensitivities for U.S. recreational data, and unmonitored Canadian data.	A
17. Develop methods for using acoustics to determine Atlantic mackerel abundance and/or catchability.	A
18. Initiate a reproductive study in the U.S. to obtain fecundity estimates and spawning seasonality. Update Canadian fecundity estimates (which are currently based on a 1986 publication) and compare estimates between countries.	A
19. Obtain biological samples from all components of the fishery and covering both spawning contingents.	A
20. Investigate possible growth and maturity differences between spawning contingents.	A
21↑. Continue to pursue modeling approaches that explicitly account for the spatial structure of the stock (i.e. two spawning contingents). ##	A
22. Explore potential changes in environmental conditions (habitat changes, larval diets, cannibalism, etc.) that impact larval survival and recruitment.	A, F, G

BLACK SEA BASS	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
****.** Evaluate the biological, management, and socioeconomic drivers of recreational harvest and discards. ##	B, C, E
23. ~~Increase sea sampling in both stated and federal waters to verify information from commercial logbooks to provide better estimates of discards (~~ Improve the precision of recreational and commercial discard estimates and estimate the uncertainty of recreational and commercial discards with emphasis on commercial pot trap and hook and line gear. ##	A, B
~~**24.** Evaluate the implications of continued ABC overages on stock projections.~~	A
~~**25.** Utilize a management strategy evaluation to consider alternative allocation schemes.~~	C, D
26. Continued evaluation of the appropriateness of the current model structure with two spatial sub-units. ##	A
LONG-TERM/LARGER SCALE	
27. Investigate movement rates and cues within the population, and spatial patterns in growth, recruitment, and mortality.	A, G

28. Investigate the impact of a changing environment due to climate change on the life history and spatial dynamics of the stock and fisheries.	A, F, G
~~**29.** Develop a reliable fishery independent index for black sea bass for habitats not effectively sampled with existing methodologies.~~ **29.** Consider or investigate new or alternative methods that effectively sample in black sea bass habitats.	A

BLUEFISH	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
30. Enhance the data collection of recreational discard lengths and weights to develop a more reliable recreational discard estimate in weight. ##	A, B, E
31. Evaluate species associations with recreational angler trips targeting bluefish to potentially modify the bluefish recreational CPUE index used in the assessment. ##	A
32. Evaluate methods for integrating disparate indices produced at multiple spatial and temporal scales into a stock-wide assessment model. ##	A
33. Evaluate changes in selectivity of age-0 bluefish in fishery independent surveys due to shifting environmental conditions. Investigate trends in recruitment.	A, G
34. Conduct a post-release mortality study to determine if the recreational discard mortality rate has changed over time.	A, B, E
35. Investigate the assumption of zero discards in the commercial fishery. ##	A, B
LONG-TERM/LARGER SCALE	
36. Develop a fishery independent index and/or fishery dependent sampling program of offshore populations of bluefish to capture larger, older fish.	A, G
37. Investigate how environmental variability may affect timing of migration patterns of juvenile bluefish and the distribution of adults, which in turn, may affect availability. ##	A, G

BLUELINE TILEFISH	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
38. Identify data sources and sampling methods to improve the biological length samples of commercial and recreational landings to better characterize the size distribution of removals.	A, E
39. ~~Incorporate~~ Review and consider enhancements to improve mandatory logbook reporting for all recreational anglers and collect fishery-dependent information such as effort, total catch and length information on harvested and discarded fish. ##	A, B, E
40. Collect additional biological samples to enhance understanding of life history dynamics and biological characteristics of the stock (e.g., age and size of maturity, maximum age, fecundity, spawning periods).	A
LONG-TERM/LARGER SCALE	
41↓(to #42). Research the reliability of aging methods and determination of growth parameters (e.g., intensive tagging survey). Collect additional age information from the commercial and recreational sectors.	A
42↑ (to #41). Investigate new stock assessment approaches, including non-equilibrium methods, should be explored.	A
43. Conduct habitat studies of deep-water sites in the mid-Atlantic (Norfolk Canyon, Baltimore Canyon, and Hudson Canyon).	A, G

BUTTERFISH	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
44. Examine the efficiency (including day vs. night) of survey gear and potential changes in butterfish catchability including a parallel catchability estimate for NEFSC Spring surveys so that both Spring and Fall surveys can be included in the model. ##	A
45. Evaluate approaches to include additional surveys (e.g., states) in the assessment model. ##	A
46. Evaluate the uncertainty in the ad hoc F_{MSY} proxy and effects on catch advice. ##	A
47. Consider development of reference points that are internal to the stock assessment model. ##	A
LONG-TERM/LARGER SCALE	
****.** Further investigate methods to inform population scaling within assessments.	A
48. Further investigate the role of butterfish in the ecosystem and refine predation estimates. ##	A, F
49. Reconsider stock structure and degree of exchange with south Atlantic stock component (i.e., stock ID).	A, G

CHUB MACKEREL	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
****.** Develop expanded discard estimates for the region and better quantify South Atlantic catch.	A
50. Collect length, age, growth, maturity information from fishery independent and dependent data sources throughout U.S. Atlantic water. ##	A
51. Evaluate catch per unit effort including the influence of environmental and socioeconomic factors.	A, C, G
52. Investigate existing egg and larval surveys throughout the U.S. Atlantic coast to better understand chub mackerel recruitment dynamics. ##	A
LONG-TERM/LARGER SCALE	
53. Investigate stock mixing throughout Atlantic waters, as applicable.	A
54. Investigate habitat use at different life stages.	A, F

GOLDEN TILEFISH	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
55. Continue to utilize fishery-independent information to assess whether the dome-shaped selectivity curve used in the assessment reflects fishery selectivity or availability, or both. ##	A
56↓ (to #59). Evaluate data collection methods to increase information on gear conflicts, species interactions (i.e., spiny dogfish), and bait type to understand their effects on the commercial CPUE index.	A, B, F
57. Continue to collect and analyze biological samples to create year specific age-length keys and to improve life history, maturity and distribution information. ##	A
58. Develop sampling programs to increase information of recreational landings at size and age.	A, E
59. Continue to assess the accuracy and reliability of aging techniques. ##	A
LONG-TERM/LARGER SCALE	
60. Evaluate the role of the golden tilefish gear restricted areas on the stock and its fisheries.	A, F
61. Evaluate the effects of climate and environmental indices on stock dynamics.	A, F, G

ILLEX SQUID	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
62. Collect demographic information on growth, mortality, reproduction by sex, season, and cohort. ##	A
63. Investigate feasibility of real-time management, including undertaking cooperative research with the fishing industry. ##	A, C
64. Analyze the change in availability of *Illex* to the survey and fishery, resulting from long-term changes in climate or other oceanographic factors.	A, F
65. Expand investigations into oceanographic correlates with trends in recruitment and abundance.	A, F
LONG-TERM/LARGER SCALE	
**. Quantify escapement over the headrope and wings of the NEFSC survey trawl.	A
66. Investigate beyond-shelf availability.	A

LONGFIN SQUID	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
67. Further develop practicable ways to reduce bycatch.	B
68. Refine understanding of availability and catchability in surveys (e.g., ~~especially~~ fall NEAMAP-Bigelow comparisons and conversion factors).	A
69. Collect more age, sex and maturity data for each seasonal cohort.	A
70. Evaluate effectiveness of current mesh regulations.	B
71↓. Determine what portion of stock is outside current research trawl surveys.	A
LONG-TERM/LARGER SCALE	
**. Quantify escapement over the headrope and wings of the NEFSC survey trawl.	A
72. Until real-time assessment is feasible, expand cohort analysis to refine stock assessments and their incorporation of seasonal indices (currently spring and fall are just averaged).	A
73. Evaluate approaches to real time management including expanding age and growth studies to better estimate average growth patterns and to discern seasonal productivity/catchability patterns.	A
74. Evaluate methods of incorporating ecological relationships, predation, and oceanic events that influence abundance and availability.	A, F
75. Refine understanding of stock range and structure. ##	A, G

OCEAN QUAHOG	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
76. Conduct research to better understand life history for an extremely long-lived species at appropriate temporal and spatial scales (growth, size-at-age, recruitment, natural mortality, maturity-at-length, and fecundity – in order of priority).	A
77. Evaluate the cost and benefit of different technological methods (e.g., HABCAM, EM, AI, and optical surveys) for measuring ocean quahog abundance, length frequency, and habitat. ##	A, F
LONG-TERM/LARGER SCALE	
78. Conduct work to support spatially explicit stock assessments that account for source and sink differences in productivity (i.e., are some areas more important to productivity than others).	A

79. Development of techniques to age ocean quahogs in a cost-effective manner.	A

SCUP	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
80. Evaluate the spatial and temporal overlap of scup and squid to better understand and characterize scup discard patterns.	A, B, F
81. Characterize the pattern of selectivity for older ages of scup in both surveys and fisheries.	A
82↑ (to #80). Explore the relationship between scup market trends, regulatory changes, and commercial landings and discards.	B, C, F
LONG-TERM/LARGER SCALE	
83. Continue to evaluate the role and relative importance of implemented management strategies (i.e., gear restricted areas, increased minimum mesh size, and minimizing scup and squid fishery interactions) ~~versus~~ and expand analysis to consider the long-term climate variability to the increases in stock abundance and high recruitment events since 2000. ##	A, B, D, F, G
84. Characterize the current scup market and explore the development of new markets.	C
~~**85.** Explore the applicability of the pattern of fishery selectivity in the model to the most recent catch data to determine whether a new selectivity block in the model is warranted.~~	A

SPINY DOGFISH	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
86. Integrate recent information on the efficiency of the NEFSC survey gear as it relates to: distribution of spiny dogfish beyond the current NEFSC trawl survey geographic footprint (including inter annual differences); gear efficiency; depth utilization within the footprint; distribution within the survey footprint under different environmental conditions. ##	A, G
87. Explore model-based methods to derive survey indices for spiny dogfish. ##	A
88. Investigate alternative stock assessment modeling frameworks that evaluate: the effects of stock structure; distribution; updated biological information such as sex ratio and spiny dogfish productivity; state-space models; and sex-specific models. ##	A
89. Evaluate the utility of the study fleet information as it relates to issues identified under priority #86 above. ##	A
LONG-TERM/LARGER SCALE	
90. Research opportunities to increase domestic and/or international market demand.	C
91. Expand information on the efficiency of the NEFSC survey gear as it relates to: distribution of spiny dogfish beyond the current NEFSC trawl survey geographic footprint (including inter annual differences); gear efficiency; depth utilization within the footprint; distribution within the survey footprint under different environmental conditions.	A, G
92. Continue aging studies for spiny dogfish age structures (e.g., fins, spines) obtained from all sampling programs (include additional age validation and age structure exchanges), and conduct an aging workshop for spiny dogfish, encouraging participation by NEFSC, Canada DFO, other interested state agencies, academia, and other international investigators with an interest in dogfish aging (US and Canada Pacific Coast, ICES).	A
93. Evaluate ecosystem effects on spiny dogfish acting through changes in dogfish vital rates.	A, F, G

SUMMER FLOUNDER	Corresponding Theme(s)
SHORT-TERM/SMALLER SCALE	
94. Collect length, weight, and age data by sex to fully evaluate the sex and size distributions of landed and discarded fish in the summer flounder fisheries.	A, B, E
95. Evaluate summer flounder discard survival under different environmental variables and gear configurations with survey design considerations that account for feeding and predation.	A, B, E
LONG-TERM/LARGER SCALE	
96. Continue to evaluate the causes for decreased recruitment, changes in recruitment distribution, and changes in the recruit-per-spawner relationship in recent years. Develop studies, sampling programs, or analyses to better understand how and why these changes are occurring, and the implications to stock productivity.	A, F, G
97. Evaluate range expansion and/or changes in distribution and their implications for stock assessment and management.	A, F, G
98. Explore the potential mechanisms for recent slower growth that is observed in both sexes.	A, F, G
99. Incorporate sex-specific differences in size-at-age into the stock assessment through model structures as well as data streams.	A
****.** Reconsider stock structure based on modern approaches.	A, F, G

SURFCLAM	Corresponding Theme(s)
SHORT-TERM/SHORTER SCALE	
100. Conduct research to better understand life history at appropriate temporal and spatial scales (~~fecundity, maturity-at-length, age and growth, recruitment, and natural mortality information~~ growth, size-at-age, recruitment, natural mortality, maturity-at-length, and fecundity – in order of priority).	A
101. Evaluate the cost and benefits of different technological methods (e.g., HABCAM, EM, AI, or optical surveys) for measuring surfclam abundance and habitat, including ~~patch size~~ clam density. ##	A, F
LONG-TERM/LARGER SCALE	
102. Examine the effects of climate change on the spatial distribution of clams, on the operation of the fishery, and patterns of discarding/incidental mortality, and on the overall productivity of the stock.	A, B, F, G
103. Evaluate small-scale surfclam patch density and the connectivity of the two stock areas (Mid-Atlantic and Georges Bank) and the implications on stock dynamics, particularly reproductive success and recruitment exchange.	A