Appendix A2:

Comprehensive Wildlife Conservation Strategy Species Group Reports for Crustacea/Meristomata

Prepared by New York State Department of Environmental Conservation staff in cooperation with Cazenovia College and the Riverhead Foundation for Marine Research in support of the Comprehensive Wildlife Conservation Strategy prepared for New York as required by the United States Fish and Wildlife Service's State Wildlife Grants Program

27-Sep-05

Taxa Group: Crustacea/Meristomata
Species Group: American lobster

Threats:
The American lobster population in New York faces a number of serious threats. Any single one of the stressors may not be fatal, but in combination they are potentially very harmful. In Long Island Sound (LIS), fishing effort increased dramatically as the lobster population increased in the 1990's. A large die off occurred to the western LIS lobster population during 1999, and the population has continued to decline through 2003. Fishing effort declined as the population size decreased, but not at the same rate. The number of traps set in LIS is two to three times higher than the 1980's when the lobster population was at a similar size. A large research initiative was conducted to determine the cause (s) of the 1999 die off. Final results indicate that the die off was probably due to a number or factors. During 1999, a combination of high bottom water temperature, low dissolved oxygen, a storm at the end of August that mixed the water column and increased bottom water temperatures 1 - 2 degrees in 24 hours, and paramoeba infection probably combined to cause the lobster die off. Research suggests that temperature alone could account for the die off, or at least stress the lobsters so they would be more susceptible to hypoxia, ammonia, and paramoeba infection. Lobsters in the east end of Long Island and off the south shore have shown increasing incidence and severity of shell disease.

Trends:
Long Island Sound (LIS) lobster harvest and indices of relative abundance from CT Department of Environmental Protection (CT DEP) increased steadily from the late 1980's to a peak in 1997 or 1998. Landings and indices have declined by 65 to 80% since the peak. CT DEP larval lobster survey indicate that larval abundance in 2002 was the poorest on record. Current lobster abundance in LIS is similar to levels seen in the 1980's.

Fishery Independent survey off Rhode Island has shown a similar decline in lobster catches.

No fishery independent surveys are conducted in the ocean off the south shore of Long Island. Harvest of lobsters has decreased since the late 1990's, but so has effort, so therefore the status of the lobster population in the ocean off Long Island is unclear.

SEQR - No Action Alternative:
It would be detrimental for New York State to take no further actions in monitoring and managing the American lobster in its inshore waters. The current fishery independent lobster trap survey in western Long Island Sound was developed to monitor the resource in the area of the major lobster die off in 1999. This survey needs to be extended for the long term. It is necessary to monitor water and habitat quality to understand seasonal changes in lobster populations related to small and large scale die-offs. Management regulations need to be put into place to protect lobsters from over-harvest during particularly stressful times. Without further research and management, it is possible that the lobster population may continue to decline. It is the responsibility of New York State to do its best to ensure a healthy lobster population for the future.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
American lobster (Homarus americanus)					P	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
American lobster (Homarus americanus)	Lower Hudson - Long Island Bays	Atlantic Ocean - NY Bight	Unknown
	Atlantic Ocean - NY Bight	Lower Hudson - Long Island Bays	Decreasing

Species Distribution - Ecoregion

Species	Historical	Current	Stability
American lobster (Homarus americanus)	North Atlantic Coast	North Atlantic Coast	Decreasing

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
American lobster (Homarus americanus)				
	all	Estuarine	deep subtidal	mud
	all	Estuarine	deep subtidal	rocky
	all	Estuarine	deep subtidal	structure
	all	Marine	cultural	structure
	all	Marine	deep subtidal	mud
	all	Marine	deep subtidal	rocky
	all	Marine	deep subtidal	structure
	Nursery/Juvenile	Estuarine	shallow subtidal	rocky

Goal and Objectives for American lobster

Goal: Maintain and restore lobster stocks in New York to a population size and structure that is robust and resilient to environmental stress which can support ecosystem function and commercial and recreational fisheries.

Objective 1 : Based on information from the Long Island Sound Health Program and physical and biological monitoring, develop plan to remediate the effects of the Long Island Sound Lobster die if remediation is deemed possible by 2010.

Measure: *Implementation of remediation program.*

Objective 2 : Based on the monitoring recommendations from the Long Island Sound Health Program, develop or continue monitoring of the Long Island Sound Lobster population by 2006.

Measure: *Implementation of lobster monitoring program.*

Objective 3 : Based on the monitoring recommendations from the Long Island Sound Health Program, develop or continue monitoring of the physical environment of Long Island Sound by 2006.

Measure: *Implementation of physical monitoring program.*

Objective 4 : Collect harvest and landings data consistent with the Atlantic Coastal Cooperative Statistics Program (ACCSP).

Measure: *Implement all aspects of the ACCSP program relative to lobster in New York.*

Objective 5 : Develop a monitoring program of the physical environment of the ocean waters off the south shore of Long Island by 2008.

Measure: *Implementation of physical monitoring program.*

Objective 6 : Develop a monitoring of the Lobster population in the ocean waters off the south shore of Long Island by 2008.

Measure: *Implementation of lobster monitoring program.*

Objective 7 : Develop monitoring program for juvenile lobsters in the marine district of New York by 2010.

Measure: *Implementation of juvenile lobster monitoring program*

Recommended Actions

Habitat management:

* Benthic habitat protection and restoration are crucial elements in any lobster conservation and management plan. Aspects of benthic habitat protection and restoration will be included in the final watershed recommendations.
* Improve water quality in Long Island Sound. Research from the Long Island Sound Lobster Health Program indicates that lobsters are stressed by a combination of high water temperature and low dissolved oxygen. Improving bottom dissolved oxygen levels would be beneficial to lobster populations.

Habitat monitoring:

* Develop or continue monitoring of the physical environment of the ocean waters off the south shore of Long Island
* Develop or continue monitoring of the physical environment of Long Island Sound

Recommended Actions

Other action:

* Collect harvest and landings data for lobsters in New York.
* Fishery independent monitoring all life stages of the lobster population both in Long Island Sound and off the south shore of Long Island is recommended

Regional management plan:

* Implement appropriate management measures to meet the ASMFC's targets and thresholds of the lobster FMP

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Taxa Group: Crustacea/Meristomata
Species Group: Blue crab

Threats:
Overwintering mortality

Blue crabs in New York are on the northern extreme of their geographic range and are subject to high mortality in particularly cold winters.

Fishing

Expanding commercial and recreational fisheries may threaten population levels.

Water quality

Contaminants and conditions that contribute to anoxic conditions may affect the health and overall abundance of blue crabs.

Trends:
The limited data available on blue crab populations in the state of New York, based largely on landings reports of commercial fishers, indicate that blue crab abundance is highly variable and appears to be severely affected by environmental factors, particularly water temperature. Populations levels of blue crabs in other Atlantic systems, particularly the Chesapeake, have suffered severe declines in recent years.

SEQR - No Action Alternative:
Blue crab population levels in New York State may decrease like populations in Chesapeake bay without management actions. Without increased monitoring of blue crab populations it will be hard to assess the changes in blue crab population levels.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Blue crab (Callinectes sapidus)					P	Migratory

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Blue crab (Callinectes sapidus)	Atlantic Ocean - NY Bight	Atlantic Ocean - NY Bight	Unknown
	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Unknown
	Upper Hudson	Upper Hudson	Unknown
	Susquehanna		

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Blue crab (Callinectes sapidus)	North Atlantic Coast	North Atlantic Coast	Unknown
	Lower New England Piedmont	Lower New England Piedmont	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Blue crab (Callinectes sapidus)				
	Breeding	Estuarine	shallow subtidal	mud
	Breeding	Estuarine	shallow subtidal	sand/gravel
	Breeding	Estuarine	shallow subtidal	SAV
	Feeding	Estuarine	shallow subtidal	mud
	Feeding	Estuarine	shallow subtidal	rocky
	Feeding	Estuarine	shallow subtidal	sand/gravel
	Feeding	Estuarine	shallow subtidal	SAV
	Feeding	Estuarine	shallow subtidal	structure
	Feeding	Marine	shallow subtidal	mud
	Feeding	Marine	shallow subtidal	rocky
	Feeding	Marine	shallow subtidal	sand/gravel
	Feeding	Marine	shallow subtidal	SAV
	Feeding	Marine	shallow subtidal	structure
	Hibernating/Overwintering	Estuarine	deep subtidal	mud
	Hibernating/Overwintering	Marine	deep subtidal	mud
	Nursery/Juvenile	Estuarine	shallow subtidal	SAV
	Nursery/Juvenile	Estuarine	shallow subtidal	structure
	Nursery/Juvenile	Marine	shallow subtidal	pelagic

Goal and Objectives for Blue crab

Goal: Maintain or increase blue crab population levels while continuing to allow popular recreational and commercial fisheries for blue crab.

Objective 1 : By 2008, identify important habitats in blue crab life history for inclusion in statewide management plan.

Measure: *Identify overwintering habitat and quantify natural winter mortality. Compile existing information about important habitats (e.g.. Submerged aquatic vegetation) for blue crabs in New York.*

Objective 2 : By 2010, incorporate population and habitat data, as well as other pertinent information for blue crabs, into a statewide management.

Measure: *Development of that plan.*

Objective 3 : Continue to monitor sources of mortality for blue crabs.

Measure: *Continue on board commercial monitoring of blue crabs for Hudson River fishers, continue NMFS dealer reports for statewide commercial reporting and fully implement the MRFSS survey for statewide recreational harvest information.*

Recommended Actions

Habitat management:

* Submerged aquatic vegetation and wintering area protection may be crucial elements to any blue crab conservation and management plan. Aspects of submerged aquatic vegetation and wintering area protection will be included in the final statewide management plan.

Habitat research:

* Identify over wintering habitat and determine if winter conditions are the limiting factor for blue crab abundance.

Life history research:

* Identify time and space distribution of blue crab life stages and provide protections for habitats used.

Other action:

* Evaluate the potential public health threat of blue crabs harvested from polluted areas (e.g. Hudson River, NY Harbor).

Population monitoring:

* Continue monitoring of sources of mortality, including recreational and commercial harvest and wasteful sources of mortality.

Statewide management plan:

* Develop a statewide management plan for blue crabs

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Taxa Group: Crustacea/Meristomata

Species Group: Fiddler crab

Threats:

Oil Spills, substrate contamination, tidal wetlands loss, human activities, invasive floral and faunal species including Phragmites australis.

Trends:

None available. The species has not been extensively studied in this regard. See proposal described in the goals and objectives.

SEQR - No Action Alternative:

There is insufficient information about fiddler crab populations in New York to surmise the consequences of a no action alternative. Taking no action would leave the state ill prepared to deal with an emergency like a disease outbreak as seen in other marine fauna like American lobster and Eastern oyster. The role of fiddler crabs as habitat engineers in salt marshes makes their possible loss or decline a threat to other salt marsh dependant species.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
fiddler crab (Uca pugnax)					U	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
fiddler crab (Uca pugnax)	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
fiddler crab (Uca pugnax)	North Atlantic Coast	North Atlantic Coast	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
fiddler crab (Uca pugnax)				

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
fiddler crab (Uca pugnax)				
	all	Estuarine	intertidal	emergent marsh
	all	Estuarine	intertidal	mudflats

Goal and Objectives for Fiddler crab

Goal: Increase our knowledge of the three species of fiddler crab, specifically their life history, inter- and intra- species relationships, habitat, ecology, response to anthropogenic and natural impacts, and determine their population status and trends.

Objective 1 : By 2015 a region specific fiddler crab baseline data base will be completed which includes, abundance, distribution, and other parameters in 10 reference and 20 impacted wetlands throughout the NY marine district.

Measure: *The number of reference and impacted wetlands that have completed information*

Objective 2 : By 2015 know how habitat loss relates to fiddler crab population tends

Measure: *Understand the relationship of habitat loss and population trends*

Objective 3 : Develop region specific life histories of the 3 species of fiddler crabs, by increasing knowledge of food requirements at various life stages,

Measure:

Objective 4 : Have a program for integrated species monitoring in the lower Hudson/Long Island Bays watershed that can be implemented by 2010

Measure: *Implementation of the program*

Objective 5 : Have a protocol for integrated marsh species monitoring that can be implemented by 2008

Measure: *Completion of monitoring protocol*

Recommended Actions

Recommended Actions

Habitat management:

* The fiddlers are directly connected to tidal wetlands, the proper management and prevention of a wetland will undoubtedly protect the fiddler as well. While the wetlands are protected from filling and building by the land Use Regulations (Art 25 part 661) we have yet to determine the causes of the marsh loss phenomenon. This may be more devastating to the marsh and the fiddler since causes are unknown and varied depending on the subject marsh.

Habitat monitoring:

* Habitat monitoring and research: There are three fiddler crab species, genus Uca, whose range includes the marsh complexes of New York's marine district: the sand fiddler, Uca pugilator, the mud fiddler U. pugnax and the brackish water fiddler U. minax. The crabs and there burrows are seen within specific zones in the marsh, but little research has been done on their effect on the marsh and the effect of marsh loss on them. Specifically the mud fiddler U. pugnax, since it has a direct relationship with the intertidal marsh where there is a preponderance of vegetative marsh loss. Bertness (1985) calls the fiddlers "the earth worms of the marsh". What happens to the crab when the marsh is lost; when the peat becomes a slurry? Is there greater intra- and interspecies competition as a result? What are the limiting factors, just real estate? During the research and monitoring phase other actions may become necessary to address

Habitat restoration:

* If marsh restoration becomes a viable alternative, fiddler crab re-population may become an indicator of success. Since the crab aerates the marsh and promotes oxygenation of the peat and increases peat surface area for chemical absorption, perhaps fiddler crab populations should be restored as well.

Life history research:

* Information available is generic and does not address all 3 species specifically within NY's marine district and does not address abundance and distribution within the region. However, this information can be used and combined with new information gathered in NY marine district. During the research phase other actions may become necessary to address.

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Taxa Group: Crustacea/Meristomata

Species Group: Freshwater crustacea

Threats:

The major threat to these crustacea is pollution but the loss of streams and wetlands will also affect survival of these species. The introduction of exotic species, which appear to outnumber native species, is another factor which could cause decline in native populations.

Trends:

The American Fisheries Association lists Cambarus diogenes as stable but the status of Stygobromus tenuis tenuis is unknown.

SEQR - No Action Alternative:

Because the range of Cambarus diogenes is limited to the Lake Erie and SW Lake Ontario watersheds, any loss or degradation of habitat in those regions will lead to a decline in its population. The distribution of Stygobromus tenuis tenuis is unknown and as such, immediate threats remain unknown. Lack of habitat management will endanger existing populations of both species.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Devil crawfish (Cambarus diogenes)			S2	G5	U	Resident
Piedmont groundwater amphipod (Stygobromus te			SNR	G4G5T2T3Q	U	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Piedmont groundwater amphipod (Stygobromus tenuis te	Susquehanna	Unknown	Unknown
	Upper Hudson		
	Lower Hudson - Long Island Bays		
	SE Lake Ontario		
	Delaware		
Devil crawfish (Cambarus diogenes)	Lake Erie	Lake Erie	Unknown
	SW Lake Ontario	SW Lake Ontario	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Piedmont groundwater amphipod (Stygobromus tenuis te	High Allegheny Plateau	Unknown	Unknown
	Lower New England Piedmont		
	Great Lakes		
Devil crawfish (Cambarus diogenes)	Great Lakes	Great Lakes	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Piedmont groundwater amphipod (Stygobromus tenuis tenuis)				
	all	Subterranean	natural	aquatic caves
Devil crawfish (Cambarus diogenes)				
	all	Palustrine	mineral soil wetland	shrub swamp
	all	Riverine	coldwater stream	SAV
	all	Subterranean	natural	aquatic caves
	Breeding	Riverine	unknown	unknown

Goal and Objectives for Freshwater crustacea

Goal: To maintain viable populations of Cambarus diogenes and Stygobromus tenuis tenuis in their historic ranges.

Objective 1 : Complete an inventory of Cambarus diogenes in waters that are part of its historic range.

Measure: *Completed inventory.*

Objective 2 : Complete an inventory of Stygobromus tenuis tenuis in waters that are part of its historic range.

Measure: *Completed inventory.*

Objective 3 : Maintain self-sustaining populations of Cambarus diogenes in the Lake Erie and SW Lake Ontario watersheds.

Measure: *Number of populations maintained.*

Objective 4 : Maintain self-sustaining populations of Stygobromus tenuis tenuis in its historic range.

Measure: *Number of populations maintained.*

Recommended Actions

Habitat monitoring:

* Investigate the degree of alteration to natural flow regime of waters containing the species.
* The immediate threats to these populations need to be determined.

Habitat research:

* The critical habitat needs of both species need to be evaluated.

Life history research:

* Investigate the impacts of modified flow regime on species life cycle.

Population monitoring:

* Inventories of Stygobromus tenuis tenuis and Cambarus diogenes need to be conducted in their respective historical ranges.

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Taxa Group: Crustacea/Meristomata
Species Group: Horseshoe crab

Threats:
Direct threats to the horseshoe crab include fishing pressure and loss of spawning habitat due to beach development and modification and also from dredging.

Horseshoe crabs are used as bait for the killifish (Fundulus spp.), eel (Anguilla rostrata) and conch (Busycon spp.) fisheries. In 2003, there were 311 commercial horseshoe crab bait permit holders who were responsible for harvesting 133,064 crabs for bait and other purposes. Over the past 3 years, the average harvest for horseshoe crabs in New York state was approximately 150,000 crabs. In prior years the landings were even higher, however current reporting practices were not yet in place and the reliability of these earlier numbers is suspect.

The bait industry in the past has preferentially harvested female horseshoe crabs, especially the eel fishery. This is due to the belief by fishermen that females are better at attracting eels. In addition the females are generally of larger size (Loveland, 1997). According to reports received by commercial fishermen, in 2001, over 60% of the crabs harvested were female, in 2002 and 2003 the male/female ratio has become approximately 50/50. This could be an indication of less females available, less crabs available, fishermen no longer caring which sex is used for bait or an increased awareness of sexing the crabs (in previous years many fishermen listed all of their catch as female) or from a combination of reasons. Targeting large breeding females can impact a species' ability experience population growth and potentially leads to declines in abundance.

The blood of the horseshoe crab is the sole source for Limulus Amebocyte Lysate (LAL), an important biomedical product. The LAL test is the standard for screening medical equipment for endotoxin contamination. Crabs that are harvested for LAL production must then, as stated in regulations, be returned to their place of capture. These crabs are usually shipped to one of the four biomedical companies that are licensed by the FDA to produce LAL (Tanacredi, 2001). Mortality rates for the whole process is unclear; however the bleeding process alone has been associated with as much as a 15% mortality level (Berkson, J. 1999). Botton argues out that although Rudloe's 1983 study found only a 10% mortality rate of bled crabs to those in the control, it may be advisable to test mortality rates over different environmental conditions, suggesting that the rates for mortality during the bleeding process may indeed be higher (1987).

An unknown number of horseshoe crabs are harvested in New York and sent to Massachusetts to a biomedical company for bleeding and then used as bait in MA. Massachusetts regulations state that all bled horseshoe crabs go into their bait industry. Although this process helps the coast-wide population in general because it uses the same crabs for the bait as the LAL, and thus reduces overall horseshoe crab mortality, this may impact New York's ability to meet its own bait needs by increasing the demand for crabs that are used out-of-state.

With the introduction of bulkheads, jetties, and groins, the shape, location and accessibility to spawning beaches may change such that they are no longer suitable for the horseshoe crabs or their eggs. Horseshoe crabs need low energy sandy beaches upon which to spawn as well as appropriate adjacent nursery habitats (tidal flats) and adult habitats (Shuster 1979). Availability of sandy beaches may limit their reproductive success and bulk headed beaches are unsuitable for horseshoe crabs (Loveland, 1997). Dredging along Long Island's coast can severely alter the existing suitable nursery habitat. Modification of habitat is considered a principle factor in the declining population of the ecologically similar Japanese horseshoe crab (Botton, 1987). Many beach stabilization practices; such as "clean fill" being added to the intertidal zone may affect spawning and juvenile recruitment (Botton, 1987).

Like many other species, horseshoe crabs (adults and juveniles) along with their eggs can be affected by pollutants. In

bioassays, signs of sublethal stress (delayed molting and elevated oxygen consumption) have been found after exposure to oil or chlorinated hydrocarbons (Botton, 1987).

In Delaware Bay, horseshoe crabs have been linked with declines in migrating shorebird populations such as the red knot (Calidris canutus), ruddy turnstone (Arenaria interpres) and semipalmated sandpipers (Calidris pusilla). These birds feed almost exclusively on the eggs as they migrate northward (Smith, et al, 2002). Due to this unique interaction, the status of these endangered birds depends heavily on the health of the horseshoe crab population. Further research needs to be conducted with reference to the percent of the birds' diet comprised of horseshoe crab eggs as they pass through New York as well as whether or not their migration through this area coincides with peak horseshoe crab spawning season as it does in Delaware.

Trends:

The overall trend for the horseshoe crab in New York's Waters is not clear. Certain surveys, such as the NYS DEC Peconic Small Mesh Trawl Survey and DNC Millstone Trawl Survey, show a parabolic change in relative abundance, where others, such as the NYS DEC Western Long Island Sound Beach Seine Survey and the CT DEP Long Island Sound Trawl Survey, show them as increasing or steady. As no directed study currently exists for the horseshoe crabs, absolute abundance can not be estimated. More research and more detailed studies are needed to determine the status of the stock and interactions with other species in New York's Waters.

SEQR - No Action Alternative:

The no action alternative would leave existing management actions in place without consideration for the future well being of the resource, resource users as well as dependent wildlife species, many of which are federally protected.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Horseshoe crab (Limulus polyphemus)					P	Unknown

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Horseshoe crab (Limulus polyphemus)	Atlantic Ocean - NY Bight	Atlantic Ocean - NY Bight	Unknown
	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Horseshoe crab (Limulus polyphemus)	North Atlantic Coast	North Atlantic Coast	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Horseshoe crab (Limulus polyphemus)				
	all	Marine	deep subtidal	sand/gravel
	all	Marine	deep subtidal	sand/gravel
	Breeding	Estuarine	shallow subtidal	sand/gravel
	Breeding	Estuarine	shallow subtidal	sand/gravel
	Breeding	Terrestrial	coastal	beach/shoreline
	Breeding	Terrestrial	coastal	beach/shoreline
	Nursery/Juvenile	Estuarine	intertidal	mud
	Nursery/Juvenile	Estuarine	intertidal	mud
	Nursery/Juvenile	Estuarine	intertidal	sand/gravel
	Nursery/Juvenile	Estuarine	intertidal	sand/gravel

Goal and Objectives for Horseshoe crab

Goal: Maintain sustainable levels of spawning stock biomass to ensure its continued role in the ecology of coastal ecosystems, while providing the for continued use over time.

Objective 1 : Complete documentation of horseshoe crab harvest by 2006

Measure: *Compliance rate of fishery submitting VTR or other harvest reporting*

Objective 2 : Develop a protocol for examining the interaction of shorebirds and spawning horseshoe crabs in the Lower Hudson/ Long Island Bays watershed by 2010.

Measure: *Completion of protocol examining shorebird horseshoe crab interactions.*

Objective 3 : Develop a program for examining the interactions between shorebirds and horseshoe crabs in Lower Hudson and Long Island Bays watershed by 2015.

Measure: *Implement program for examining interactions between shorebirds and horseshoe crabs in Lower Hudson and Long Island Bays watershed.*

Objective 4 : Develop a program for monitoring spawning horseshoe crabs in the Lower Hudson/ Long Island Bays watershed that can be implemented by 2010.

Measure: *Implement the spawning monitoring program.*

Objective 5 : Develop a program to determine habitat use of juvenile horseshoe crabs in Lower Hudson and Long Island Bays by 2010.

Measure: *Implement program to determine habitat use of juvenile horseshoe crabs in Lower Hudson and Long Island Bays.*

Objective 6 : Develop a protocol for monitoring spawning horseshoe crabs in the Lower Hudson/ Long Island Bays watershed that can be then implemented by 2008.

Measure: *Completion of spawning monitoring protocol.*

Objective 7 : Develop a protocol for program to determine habitat use of juvenile horseshoe crabs in Lower Hudson and Long Island Bays by 2010.

Measure: *Completion of protocol for program to determine habitat use of juvenile horseshoe crabs in Lower Hudson and Long Island Bays.*

Objective 8 : Utilizing fishery independent and fishery dependent data to determine appropriate harvest levels by 2020.

Measure: *Harvest targets and thresholds established.*

Recommended Actions

Habitat management:

* Tidal flats are important nursery areas for horseshoe crabs. Tidal flat habitat protection and restoration are crucial elements in any lobster conservation and management plan. Aspects of tidal flat habitat protection and restoration will be included in the final watershed recommendations.
* Beaches are important spawning areas for horseshoe crabs. Beach habitat protection and restoration are crucial elements in any lobster conservation and management plan. Aspects of beach habitat protection and restoration will be included in the final watershed
* Shellfish beds are important foraging areas for horseshoe crabs. Shellfish habitat protection and restoration are crucial elements in any horseshoe crab conservation and management plan. Aspects of shellfish habitat protection and restoration will be included in the final watershed recommendations.
* Salt marshes are utilized as nursery areas for horseshoe crabs in some systems. Salt marsh habitat protection and restoration are crucial elements in any horseshoe crab conservation and management plan. Aspects of salt march habitat protection and restoration will be included in the final watershed recommendations.

Habitat research:

* Determine key spawning beaches and nursery habitat.

Recommended Actions

Life history research:

* Determine if there truly is a terminal molt for adult horseshoe crabs of either sex.
* Determine reliable field methods for aging horseshoe crabs

Modify regulation:

* Require bait bag usage in order to reduce number of crabs necessary to support the eel and conch fishery needs.
* Modify existing regulations as necessary to protect the Horseshoe crab consistent with the ASMFC FMP for the species.

Other action:

* Investigate interactions (if any) with migratory bird species and horseshoe crab eggs along NY's Coastline.

Population monitoring:

* Determine stock uniqueness by coordinating tagging studies with other states.
* Explore effectiveness of different tagging methods and implement coordinated tagging program in NY's Waters
* Design and implement a directed fishery independent spawning and abundance surveys

Statewide management plan:

* Implement horseshoe crab management consistent with the Interstate Fishery Management Plan for the species and the needs of the resource in New York.

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Taxa Group: Crustacea/Meristomata
Species Group: Zooplankton

Threats:
Chemical contaminants may be transported to other organisms in the food chain via zooplankton, but there is no indication that changes in zooplankton distribution are related to chemical concentrations in the water column. It is likely that zooplankton have developed resistance to chemical contaminants and can live in polluted environments where all other necessary conditions for survival exist.

Other threats to zooplankton include predation and cannibalism. Eggs, nauplii, and adult crustacean plankters are subject to predation by fish, molluscan shellfish, and gelatinous plankters, such as ctenophores and jellyfish.

Another factor that affects the zooplankton population is egg removal. There are two mechanisms by which this happens: sinking and horizontal advective removal from an area.

Entrainment of planktonic organisms through cooling systems of electric generating stations can also affect zooplankton populations locally. Typically, mortality of organisms entrained is high, due to thermal and mechanical stresses.

Trends:
Most trends in zooplankton are seasonal in nature; that is, different plankters will dominate at different times of year. For example, Acartia clausi is more dominant during winter months, while A. tonsa is more widely found during summer. In Long Island Sound and the Hudson River estuary, copepods are the dominant zooplankter. In terms of biomass, zooplankton peaks are timed to phytoplankton peaks, with peak densities found during spring and summer.

Little is known about collective trends in local zooplankton and information/data on year-to-year zooplankton abundance is depauperate.

SEQR - No Action Alternative:
A no action alternative could have one or more effects on the zooplankton population:

1) If water quality is allowed to deteriorate, it may result in conditions that would affect zooplankton growth and reproduction, which could result in a decrease in the zooplankton population.

2) Deterioration of habitat and water quality could affect predators of zooplankton, which could increase the zooplankton population.

3) Failure to manage nutrients in waterways could result in increase phytoplankton blooms which could either kill off zooplankton, or increase their food supply, depending on the type of phytoplankton and the degree of the bloom.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Marine zooplankton (Various species of invertebrat			N/A	N/A		Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Marine zooplankton (Various species of invertebrates)	Atlantic Ocean - NY Bight	Atlantic Ocean - NY Bight	Unknown
	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Marine zooplankton (Various species of invertebrates)	North Atlantic Coast	North Atlantic Coast	Unknown
	Lower New England Piedmont	Lower New England Piedmont	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Marine zooplankton (Various species of invertebrates)				
	all	Estuarine	shallow subtidal	pelagic
	all	Marine	deep subtidal	pelagic

Goal and Objectives for Zooplankton

Goal: Maintain a healthy population of zooplankton in the estuarine and marine environment

Objective 1 : Assess zooplankton population

Measure: *Increase survey frequency to obtain more information on the zooplankton population. Currently, useful data for any management of zooplankton in NYS marine and estuarine waters are severely inadequate.*

Objective 2 : Maintain a healthy environment for zooplankton.

Measure: *Implement water pollution control measures and habitat restoration projects, as per Long Island Sound Study, Peconic Estuary Program, Hudson River Estuarine Reserve, and South Shore Estuarine Reserve management plans.*

Objective 3 : Manage environmental conditions to maintain conditions conducive to zooplankton.

Measure: *Water quality monitoring and pollution controls.*

Objective 4 : Prevent introduction of exotic species.

Measure: *Ballast water discharge prohibitions.*

Recommended Actions

Educational signs:

* Develop appropriate fact sheets about this insufficiently understood component of the marine environment.

Habitat management:

* Species management of zooplankton is virtually impossible, given the seasonal nature of the population. However, it is possible to manage environmental conditions to maintain an environment favorable to plankton.

Habitat monitoring:

* Field surveys for water quality and habitat suitability can help determine whether or not the water column is suitable for a healthy zooplankton population.

Habitat research:

* Conduct studies to determine what environmental conditions increase habitat suitability for zooplankton. Habitat suitability should include growth and reproduction, as well as survival.

Habitat restoration:

* Habitat restoration, particularly projects that help control storm water runoff or increase circulation in an embayment, can contribute to suitable habitat for zooplankton, particularly in near shore waters.

Invasive species control:

* Controls on ballast discharges from oceangoing vessels should be implemented and enforced to prevent exotic planktonic organisms from invading local waterways.

Life history research:

* Research should be conducted to determine egg reproduction rate and hatching success for planktonic organisms of concern.

Modify regulation:

* Other than the aforementioned prohibition on ballast dumping, current regulations should be adequate to protect the endemic zooplankton population.

Regional management plan:

* Implement as appropriate recommendations of management plans for Long Island Sound, Peconic Estuary, NY/NJ Harbor, the Hudson River Estuary, and the South Shore Estuaries should be implemented.

Recommended Actions

Statewide baseline survey:

* Baseline studies on zooplankton should be conducted to determine future trends in populations.

Web page:

* Develop appropriate web page information about this group of species.

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