Appendix A8:

Comprehensive Wildlife Conservation Strategy Species Group Reports for Mollusks

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: Mollusk
Species Group: Bay scallop

Threats:
Habitat loss: The lost of eelgrass beds in the 1930's along the Atlantic Coast of the United States (and again in Peconic Bays in the late 1980's) probably had the greatest impact on bay scallop populations. Currently, local bay scallop recruitment can be strongly affected by the presence or absence of the appropriate submerged aquatic vegetation for habitat, especially necessary for juvenile scallops.

Toxic algal blooms: The severe brown tide blooms in the 1980's and early 1990's caused the scallop population to drop precipitously low and it has never recovered from the impact of the blooms.

Predation: Predators such as crabs and starfish are a major threat to bay scallops. Juvenile bay scallops are especially vulnerable to predation by crabs.

Trends:
Bay scallops are short-lived broadcast spawners and most live only long enough to spawn once at age 1. Consequently, bay scallop populations can vary widely from year to year, depending on the success of the spawn from the previous year.

In the 1930's the bay scallop population along the Atlantic coast significantly decreased following the drastic decline of eelgrass beds, their preferred habitat. The scallop population remained low for several years, but eventually recovered. The bay scallop population was stable and self-sustaining in New York when the initial brown tide bloom appeared in 1985. The initial bloom was severe and had a deleterious effect on larval, juvenile, and adult bay scallops and their habitat, eelgrass. The bay scallop population plummeted and remained low in the face of repeated blooms in the late 1980's and early 1990's. In 1994 there was a significant resurgence of bay scallops; however, in 1995 a particularly severe bloom occurred and bay scallops never recovered. The population remains low and recruitment poor.

SEQR - No Action Alternative:
The current status of the bay scallop population in New York is poor. If the No Action Alternative were adopted, it would be unlikely that bay scallop population levels would reach the same levels achieved before the first brown tide bloom in 1985. The drastic reduction in bay scallop population has most likely decreased the spawning success of these animals in Long Island bays. Bay scallops are broadcast spawners, simultaneously releasing their gametes into the water column in response to an environmental trigger. It is possible that the effects of brown tide have so reduced bay scallop densities that once scallops do spawn, their gametes are less likely to encounter other gametes in a timely fashion for fertilization.

In addition, bay scallops are filter feeders, grazing on microscopic plants. When present in greater numbers than currently present in local bays, they may influence the phytoplankton assemblage in local bays, thereby affecting local estuarine faunal assemblages. If no action is taken to restore the bay scallop population to stable levels, the ecology of many eastern Long Island bays will be altered by the absence of this primary consumer in New York's estuarine environment. Bay scallops will not fill the ecological niche they once had before the population was decimated by the effects of the brown tide blooms, but more likely will remain as a remnant population in local areas of the eastern bays of Long Island.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Bay scallop (Argopecten irradians)					P	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Bay scallop (Argopecten irradians)	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Decreasing

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Bay scallop (Argopecten irradians)	North Atlantic Coast	North Atlantic Coast	Decreasing

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Bay scallop (Argopecten irradians)				
	all	Estuarine	deep subtidal	submerged aquatic vegetation
	all	Estuarine	shallow subtidal	submerged aquatic vegetation
	Breeding	Estuarine	deep subtidal	sand/gravel
	Breeding	Estuarine	shallow subtidal	sand/gravel
	Nursery/Juvenile	Estuarine	deep subtidal	pelagic
	Nursery/Juvenile	Estuarine	shallow subtidal	pelagic

Goal and Objectives for Bay scallop

Goal: Restore the bay scallop population in the Lower Hudson/Long Island Bays to a level that sustains commercial and recreational harvest and maintains ecosystem function.

Objective 1 : 1. Achieve by 2015 an annual fall standing stock of adult bay scallops in excess of 60,000 bushels in the Lower Hudson/Long Island Bays Watershed.

Measure: *Number of bushels of bay scallops recruited to the fishery*

Objective 2 : 2. Inventory eelgrass in major bay systems of the Lower Hudson/Long Island Bays Watershed at least every 5 years.

Measure: *Routine assessments of the condition of the critical habitat of bay scallops*

Objective 3 : 3. Restore by 2015 eelgrass beds in major bays of Lower Hudson/Long Island Bays watershed to pre-1980 acreages as determined by individual estuary management plans.

Measure: *Number of acres restored to a condition that can be effective habitat for bay scallops*

Objective 4 : 4. Develop a restoration plan by 2008 for bay scallops that will consider the effects of habitat loss, predation, and low adult spawning densities on the achievement of a sustainable scallop population in the Lower Hudson/Long Island Bay Watershed.

Measure: *A restoration plan that outlines an effective program to enhance bay scallop productivity.*

Recommended Actions

Captive breeding:

* Bay scallops may be held in spawner sanctuaries (lantern nets or confined in nets to specific areas) to increase their densities and increase spawning success.

Curriculum development:

* The role of the bay scallop in the estuarine bays of Long Island may play a role as one aspect of public education.

Educational signs:

* Kiosk signs identifying bay scallops and scallop habitat can also play a part in public education.

Fact sheet:

* More public education.

Habitat management:

* Management steps may be taken to protect eelgrass and other submerged aquatic vegetation. Boating may be curtailed in shallow areas with eelgrass. Dredging activities may be limited or prohibited in established eelgrass beds.

Habitat monitoring:

* Eelgrass beds have been mapped in eastern Long Island bays. It would prudent to continue to update maps and assess the status of submerged aquatic vegetation as essential habitat for bay scallops.

Recommended Actions

Habitat research:

* The role of eelgrass beds as habitat for bay scallops has been examined by researchers. The roles of other submerged aquatic vegetation should be studied further. Causes of potential habitat degradation should be examined and mitigation procedures should be developed. The characteristics of the key habitats of the bay scallop should be identified.

Habitat restoration:

* Eelgrass bed restoration activities have already been conducted in eastern Long Island bays. These activities should be continued to enhance the habitat of bay scallops and other estuarine organisms.

Invasive species control:

* The European green crab (Carcinus maenus) is an invasive crustacean that first arrived on the east coast about 150 years ago. It consumes large numbers of juvenile bivalves. There is little that may be done to control this species at this time.

Life history research:

* Spat collectors may be used to determine recruitment success and to collect larvae that may not otherwise successfully settle elsewhere. These larvae may be retained and later seeded in areas where bay scallops are likely to survive and grow. Spat collectors also allow a measurement of larval settlement in the bays.

New regulation:

* Adopt regulations that may be determined necessary to manage and protect bay scallop resources in New York.

Other action:

* Toxic algal blooms have wreaked havoc with the bay scallop populations in eastern Long Island bays. Possible causes of the blooms have been studied, but a single causative agent has not been identified. Toxic algal blooms, their causes and impacts on the bay scallops and their habitat must be continued to be studied. The impact of predators (crabs, sea stars, gulls) on bay scallop populations must also be studied and actions that may lessen the impact of predators on scallops should be explored.

Other management plan:

* A management plan for the protection and enhancement of bay scallops in New York state waters must be developed. Such a plan should examine the history of research related to the bay scallop, assess the current status of the population, evaluate threats to bay scallops, assess the condition of bay scallop habitats and develop a strategy for the restoration of the scallop to NY waters.

Population monitoring:

* Bay scallop populations should be monitored to learn the distribution and status of the current population, the level of recruitment success, and the impacts of predators on local populations.

Recommended Actions

Relocation/reintroduction:

* Juvenile bay scallops may be cultured and seeded in areas where bay scallops are likely to survive and grow. Scallops may also be transplanted from areas of high scallop density to areas where scallops are scarce. Bay scallop blown ashore during winter are returned to the water by volunteers.

Web page:

* Another tool for public education concerning the role of the bay scallop in the estuarine waters of eastern Long Island.

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Taxa Group: Mollusk
Species Group: Blue mussel

Threats:
In general, blue mussels are subject to common ecological threats affecting all shellfish species which include an increase in the presence of predators, alterations in food supply (phytoplankton communities and detritus), harmful algal blooms (HAB's), water quality degradation and habitat changes. Various predators are able to target blue mussels at a range of sizes from small juvenile forms to larger adults. Large scale changes in phytoplankton assemblages, including HAB events, can have an effect on the growth and survival of all blue mussel life stages. Recent losses of tidal wetlands may negatively affect the food supply of fine detritus for blue mussels and also limit habitat availability. Anthropogenic involvement contributes to changes in habitat resulting from marine construction and dredging, chemical contamination and nutrient enrichment of embayments. Significant mortalities of blue mussels are often seen following large storms when severe wave action dislodges mussel beds. Abnormally high water temperatures, typically during the summer months, can also result in large mortalities when blue mussels become stressed and release from their beds only to be washed on shore.

Trends:
Very little long term survey data exists to track the population trends of blue mussels. Commercial landings show a peak of 68,233 bushels harvested in 1973 whereas less than 300 bushels were harvested in 2003. This apparent decline is more likely a result of changes in harvesting effort rather than a significant collapse in stocks. However, anecdotal reports do indicate that historic mussel beds were more prolific than today. Most regions in the marine district still report relatively stable and healthy beds of mussels although their size is unknown.

SEQR - No Action Alternative:
Because the size, distribution and health of blue mussel beds is largely unknown surveys should be conducted to track the population trends of this species. Without such information management of blue mussels is not possible. If a no action strategy was adopted this species could easily recess into decline without a record to document it. Large scale mortalities, in particular summer wash-ups, should be diagnosed and monitored for their implications on the species.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Blue mussel (Mytilus edulis)					U	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Blue mussel (Mytilus edulis)	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Unknown
	Atlantic Ocean - NY Bight	Atlantic Ocean - NY Bight	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Blue mussel (Mytilus edulis)	Lower New England Piedmont	North Atlantic Coast	Unknown
	North Atlantic Coast	Lower New England Piedmont	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Blue mussel (Mytilus edulis)				
	all	Marine	deep subtidal	rocky
	all	Marine	intertidal	mudflats
	all	Marine	intertidal	sand/gravel
	Nursery/Juvenile	Marine	deep subtidal	pelagic

Goal and Objectives for Blue mussel

Goal: Survey and monitor the Lower Hudson/Long Island Bays watershed for long term trends in the size, health and distribution of blue mussels while providing protective measures against possible threats.

Objective 1 : Determine the size and distribution of blue mussel populations in the Lower Hudson/Long Island Bays watershed by 2010.

Measure: *Number of population surveys for blue mussel populations, within major embayments, recording distribution and biomass, performed on a bi-yearly basis .*

Objective 2 : Establish a monitoring program testing the general health as well as chemical and PSP contamination of significant blue mussel populations by 2010.

Measure: *Number of sample locations and samples of blue mussels from major embayments tested for chemical and PSP contamination and general pathology taken on a yearly basis.*

Objective 3 : Establish a monitoring program to determine the environmental and biological condition of blue mussels during mass mortality events in the Lower Hudson/Long Island Bays watershed, by 2010.

Measure: *Number of blue mussel mass mortality events that were monitored and characterized each year.*

Recommended Actions

Habitat monitoring:

* Monitor the environmental and biological condition of blue mussels during mass mortality events including water quality parameters and pathology of blue mussels.

Other action:

* As necessary, implement management measures needed to protect, conserve and support sustainable blue mussel populations in the Lower Hudson/Long Island bays watershed.

Population monitoring:

* Conduct monitoring of the contamination and accumulation of chemicals and Paralytic Shellfish Poisoning within blue mussels.
* Conduct populations surveys to track the distribution, biomass and health of blue mussels.

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Taxa Group: Mollusk
Species Group: Eastern oyster

Threats:
The most significant threats which impact the growth, survival and recruitment of oysters in estuarine waters of the marine district are diseases, anthropogenic inputs, sedimentation, heavy metal contamination, nutrient enrichment from runoff, physical disturbance by storms, dredging which removes important habitat, predators, water quality degradation, environmental changes in temperature and salinity and lack of suitable hard substrate (habitat) for settlement and attachment of larvae. The two parasitic oyster diseases, MSX (Haplosporidium nelsoni) and Dermo (Perkinsus marinus), have caused significant mortalities of adult oysters and continue to impact restoration efforts in coastal states. Oysters require a hard, relatively undisturbed substrate for setting and attachment. The larvae are planktonic for about 2-3 weeks after fertilization and eventually settle and attach to hard bottom or shell (cultch) material. Adult oysters are sessile and may be found in low profile beds or reefs as part of the benthic community. The lack of suitable and sufficient habitat is a limiting factor which threatens the recruitment and viability of oyster resources in New York. The abundance of predators such as starfish, whelks, crabs and oyster drills also result in significant mortalities of juvenile and adult oysters. Larvae are subject to mortality from predation, disease and food supply. Oyster beds are also important to the ecosystem as a natural filter for removing suspended sediments and algae (phytoplankton) from the water column and can improve water quality and clarity. The filtering action of oysters can significantly alter the phytoplankton assemblage in an embayment. The loss or removal of oysters from an area will also cause a shift in phytoplankton which may not be favorable to oyster growth and survival. Oyster beds can also provide important habitat and refuge for fish assemblages and invertebrates. Presently, the most significant threats affecting oysters resources in New York would be lack of suitable shell substrate for settlement of spat and oyster parasitic diseases such as MSX, Dermo and JOD (Juvenile oyster disease).

Trends:
The Eastern oyster, Crassostrea virginica, was one of the most commercially abundant shellfish resources in New York State prior to the 1950's. Historically, there were extensive oyster beds and shellfish culture leases located in Great South Bay, Long Island Sound, Raritan Bay, Jamaica Bay, Peconic Bays and the Hudson River which supported a significant oyster fishery in New York dating back to the 1800's. The oyster industry observed a steady decline in production after its peak in 1911 due mainly to lack of adequate supply of seed oysters and irregular sets and pollution from urbanization (water quality degradation) which led to the closure of shellfish lands in Raritan Bay, Jamaica Bay, and areas around New York Harbor. Other factors contributing to the decline in oyster resources were diseases, predation, changing hydrographic patterns, storm events, over-harvesting, etc. In 1950, a total of 1.2 million bushels of oysters valued at $6 million dollars was harvested compared to a dramatic decline in abundance of only 62,133 in 2003, representing a 95 percent decline in shellfish landings. In 2003, farmed raised (cultured) oysters produced in Oyster Bay Harbor accounted for more than 92 percent of the State's oyster landings and very few natural oyster beds exist today. The Eastern oyster supported subsistence fishing by native American and early European colonists along the Atlantic and Gulf coasts of North America for centuries. It supported a major commercial fishery for more than a century from the Canadian Maritime Provinces to Texas. However, the oyster fishery is in decline throughout most of its range and in some areas, like Chesapeake Bay, has collapsed. There are a few locations in New York such as Mecox Bay, Southampton, town waters in East Hampton, Huntington - Northport Bay complex, Mattituck Inlet and areas within the Town of Brookhaven that have stable oyster populations. Several towns such as East Hampton, Brookhaven, Southold, Huntington, Smithtown and Oyster Bay supplement natural populations of oysters located within their jurisdiction with cultured oysters produced in shellfish hatcheries.

SEQR - No Action Alternative:
Oyster populations are currently at very low levels, less than 95 percent, of historical abundance. Natural oyster beds which were once plentiful in the Hudson River, Raritan Bay, Great South Bay and Long Island Sound are non-existent

today. Current water quality and food availability in areas such as Great South Bay and Raritan Bay are unlikely to support viable oyster populations. Suitable oyster habitat which consists of hard, unfouled substrate and shell (cultch) are lacking in most areas that historically supported oyster beds. The planting of cultch (shell), hard substrate for spat settlement, has been extensively used in oyster habitat restoration programs to mitigate loss of oyster habitat and increase oyster recovery in the state's of Connecticut, Maryland, Virginia, North and South Carolina, Florida, Louisiana, Alabama and Texas. No significant oyster habitat restoration effort has been conducted in New York with the exception of limited cultch planting activities undertaken by aqua culturists on private leased underwater lands. Restoration and conservation actions are needed in order to rehabilitate oyster resources in New York State. Failure to implement conservation strategies and address the threats affecting oyster abundance, recruitment and lack of suitable habitat will result in the continual decline of remaining natural oyster beds that are already limited in the state.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Oyster (Crassostrea virginica)					P	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Oyster (Crassostrea virginica)	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Decreasing

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Oyster (Crassostrea virginica)	North Atlantic Coast	North Atlantic Coast	Decreasing
	Lower New England Piedmont	Lower New England Piedmont	Decreasing

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Oyster (Crassostrea virginica)				
	all	Estuarine	deep subtidal	mud
	all	Estuarine	deep subtidal	sand/gravel
	all	Estuarine	deep subtidal	structure
	all	Estuarine	shallow subtidal	mud
	all	Estuarine	shallow subtidal	sand/gravel
	all	Estuarine	shallow subtidal	structure

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Oyster (Crassostrea virginica)				
	Nursery/Juvenile	Estuarine	cultural	structure
	Nursery/Juvenile	Estuarine	deep subtidal	pelagic
	Nursery/Juvenile	Estuarine	shallow subtidal	pelagic
	Nursery/Juvenile	Estuarine	shallow subtidal	rocky
	Nursery/Juvenile	Estuarine	shallow subtidal	sand/gravel

Goal and Objectives for Eastern oyster

Goal: By 2020, restore and protect oyster beds in the Lower Hudson/Long Island bays watershed to levels that are naturally recoverable, self-sustaining and support ecosystem function.

Objective 1 : By 2010, determine population abundance and distribution of oysters in the Lower Hudson/Long Island bays watershed.

Measure: *Number of population surveys conducted and estimate of oyster biomass at each embayment.*

Objective 2 : By 2010, document and identify prevalence and locations of oyster disease in the Lower Hudson/Long Island bays watershed in order to minimize the impact of oyster diseases on restoration efforts.

Measure: *Number of samples of oysters collected and processed for oyster disease testing under an MOU with the Marine Animal Disease Laboratory at Stony Brook University.*

Objective 3 : By 2010, identify locations of historical and current oyster abundance and establish a list of potential oyster habitat restoration sites based on current water quality parameters necessary to support viable oyster populations.

Measure: *Number of locations of historical oyster beds identified and also targeted for oyster habitat restoration.*

Objective 4 : By 2015, establish oyster reefs at a minimum of 3 locations in the Lower Hudson/Long Island bays watershed that are sustainable and support ecosystem function and increased biodiversity.

Measure: *Number of oyster reefs established in the Lower Hudson/Long Island bays watershed.*

Objective 5 : By 2015, increase our understanding and knowledge of the beneficial role oyster reefs may have on biodiversity, water quality and ecosystem function.

Measure: *Number of oyster reefs evaluated for changes in biodiversity, water quality and ecosystem function.*

Objective 6 : Monitor population abundance of oyster beds in the Lower Hudson/Long Island bays watershed and evaluate success of restoration efforts no less than every five years.

Measure: *Number of oyster beds surveyed and total biomass of oysters attained compared to baseline population data.*

Recommended Actions

Habitat research:

* Research and monitoring is needed to determine the scale and size of oyster habitat restoration along with planting of sufficient quantities of juvenile and adult oysters necessary to support viable and sustainable oyster populations.
* Research is needed to evaluate and determine the habitat value of a restored oyster bar or reef for fish and other invertebrates (increase in biodiversity).

Habitat restoration:

* Identify locations of historical oyster abundance and evaluate the potential use of these sites for oyster habitat restoration.

Other action:

* As necessary, implement management measures needed to protect, conserve and support sustainable oyster populations in the Lower Hudson/Long Island bays watershed.
* Develop Policy and Permit Requirements Manual for establishment of oyster reefs/bars in New York. There has been considerable interest in oyster gardening programs and establishment of oyster reefs/bars in locations around New York Harbor and Long Island bays. These projects have received mixed reviews from DEC based on their site location, scale and project design. There are public health concerns associated with establishment of oyster reefs in uncertified areas and habitat tradeoff vs. enhancement issues that must be addressed. Development of Policy that provides specific criteria for applicants and assists staff in the review process is needed.
* Conduct research on disease resistant strains of native oysters.
* Conduct oyster disease monitoring on cultured and natural "wild" oysters in the state to determine presence of oyster diseases, MSX, Dermo, JOD (Juvenile Oyster Disease) which can significantly impact oyster restoration efforts and viability of oyster resources in natural and cultured beds. This information is needed in order to minimize the spread and transmission of disease from relocation of oysters to other areas within the marine district. Develop criteria for importation of oyster seed from out-of-state sources and screening of oysters for in-state transfer to minimize spread of disease and introduction of exotic species.

Other management plan:

* Develop Comprehensive Oyster Restoration Management Plan for the Lower Hudson/Long Island bays watershed.

Recommended Actions

Population monitoring:

* Conduct oyster population surveys in the Lower Hudson/Long Island bays watershed in order to identify and map the locations of natural oyster beds.

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Taxa Group: Mollusk
Species Group: Freshwater bivalves

Threats:
In general, negative impacts to freshwater systems are threats to freshwater mussels: sedimentation, pollution, in-steam gravel mining, algal blooms, alteration of flows, dams interrupting habitat continuity. IN addition some populations are threatened by cold water from dam releases causing them to become non-breeding throughout the year. Other species may be affected by loss of their fish hosts. A very large threat in some water systems, especially the Hudson River and Mohawk Rivers, Lake Champlain, the Great Lakes and other large lakes, is competition and fouling from the introduced zebra and quaga mussels. A lesser threat may come from competition from the introduced Asian clam. Larger, thicker shelled species such as Amblema plicata may be at risk from poaching for the pearl trade.

Trends:
For most species trends are not known because of a lack of baseline data beyond historic documentation in particular watersheds. Little is known of population sizes or changes over time.

SEQR - No Action Alternative:
Without action, populations in severely impacted watersheds will quickly disappear, while other populations may be unaffected or experience long slow declines due to gradual degradation of their habitat.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Green floater (Lasmigona subviridis)		X	S1S2	G3	T	Resident
Round pigtoe (Pleurobema sintoxia)			S1	G4	U	Resident
Clubshell (Pleurobema clava)	E		SH	G2	E	Resident
Sheepnose (Plethobasus cyphus)		X				Resident
Round hickorynut (Obovaria subrotunda)			SH	G4	U	Resident
Hickorynut (Obovaria olivaria)			SH	G4	U	Resident
Eastern pearlshell (Margaritifera margaritifera)			S2	G4	U	Resident
Black sandshell (Ligumia recta)		X	S2S3	G5	U	Resident
Snuffbox (Epioblasma triquetra)		X	SH	G3	U	Resident
Tidewater mucket (Leptodea ochracea)		X	S1	G4	U	Resident
Kidneyshell (Ptychobranchus fasciolaris)			S2	G4G5	U	Resident
White heelsplitter (Lasmigona complanata)			SH	G5	U	Resident
Yellow sandshell (Lampsilis teres)			SH	G5	U	Resident
Pocketbook (Lampsilis ovata)			S2S3	G5	U	Resident

Pink mucket (Lampsilis abrupta)	E		SH	G2	E	Resident
Wavyrayed lampmussel (Lampsilis fasciola)			S1	G4	T	Resident
Yellow lamp mussel (Lampsilis cariosa)		X	S3	G3G4	U	Resident
Wabash pigtoe (Fusconaia flava)			S2	G5	U	Resident
Eastern pondmussel (Ligumia nasuta)		X	S2S3	G4G5	U	Resident
Paper pondshell (Utterbackia imbecillis)			SH	G5	U	Resident
Tubercled blossom (Epioblasma torulosa)	E		SH	G2	U	Resident
Alewife floater (Anodonta implicata)			S1S2	G5	U	Resident
Threeridge (Amblema plicata)			S1	G5	U	Resident
Slippershell mussel (Alasmidonta viridis)			S1S2	G4G5	U	Resident
Elktoe (Alasmidonta marginata)		X	S4	G4	U	Resident
Brook floater (Alasmidonta varicosa)		X	S1	G3	T	Resident
Mucket (Actinonaias ligamentina)			S1S2	G5	U	Resident
Pink heelsplitter (Potamilus alatus)			S2S3	G5	U	Resident
Rainbow (Villosa iris)			S2S3	G5	U	Resident
Fat pocketbook (Potamilus capax)	E		SH	G1	E	Resident
Rayed bean (Villosa fabalis)		X	S1	G1G2	E	Resident
Deertoe (Truncilla truncata)			S1	G5	U	Resident
Fawnsfoot (Truncilla donaciformis)			SH	G5	U	Resident
Lilliput (Toxolasma parvum)			SH	G5	U	Resident
Salamander mussel (Simpsonaias ambigua)		X	SH	G3	U	Resident
Mapleleaf (Quadrula quadrula)			SH	G5	U	Resident
Pimpleback (Quadrula pustulosa)			SH	G5	U	Resident
Northern rifffleshell (Epioblasma torulosa rangiana)	E		SNA	G2T2	U	Resident
Dwarf wedgemussel (Alasmidonta heterodon)	E		S1	G1G2	E	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Snuffbox (Epioblasma triquetra)	Lake Erie	Unknown	Unknown
Wabash pigtoe (Fusconaia flava)	SW Lake Ontario	Lake Erie	Unknown
		SW Lake Ontario	Unknown

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Yellow lamp mussel (Lampsilis cariosa)	SE Lake Ontario	NE Lake Ontario - St. Lawrence	Unknown
	NE Lake Ontario - St. Lawrence	Susquehanna	Stable
	Upper Hudson	Upper Hudson	Unknown
	Susquehanna		
Wavyrayed lampmussel (Lampsilis fasciola)	SW Lake Ontario	Unknown	Unknown
	Allegheny		
Pink mucket (Lampsilis abrupta)	Unknown	Unknown	Unknown
Pocketbook (Lampsilis ovata)	NE Lake Ontario - St. Lawrence	Lake Champlain	Unknown
	SE Lake Ontario	NE Lake Ontario - St. Lawrence	Unknown
	Upper Hudson	SW Lake Ontario	Unknown
	Lake Erie		
	Allegheny		
	SW Lake Ontario		
Yellow sandshell (Lampsilis teres)	Lake Erie	Unknown	Unknown
White heelsplitter (Lasmigona complanata)	SE Lake Ontario	Unknown	Unknown
Green floater (Lasmigona subviridis)	Susquehanna	Susquehanna	Unknown
	Upper Hudson		
	SE Lake Ontario		
Tidewater mucket (Leptodea ochracea)	Susquehanna	Unknown	Unknown
	Upper Hudson		
	Lower Hudson - Long Island Bays		
	SW Lake Ontario		

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Eastern pondmussel (Ligumia nasuta)	Unknown	Upper Hudson	Unknown
	Lake Erie	Delaware	Unknown
	NE Lake Ontario - St. Lawrence	SW Lake Ontario	Unknown
	SE Lake Ontario		
Black sandshell (Ligumia recta)	Allegheny	Lake Champlain	Unknown
	Lake Erie	SW Lake Ontario	Unknown
	SW Lake Ontario		
	Lower Hudson - Long Island Bays		
Eastern pearlshell (Margaritifera margaritifera)	Lower Hudson - Long Island Bays	Delaware	Unknown
		Upper Hudson	Unknown
	SE Lake Ontario	Lower Hudson - Long Island Bays	Unknown
	NE Lake Ontario - St. Lawrence	NE Lake Ontario - St. Lawrence	Unknown
		SE Lake Ontario	Unknown
Hickorynut (Obovaria olivaria)	NE Lake Ontario - St. Lawrence	Unknown	Unknown
	SE Lake Ontario		
Round hickorynut (Obovaria subrotunda)	Allegheny	Unknown	Unknown
Sheepnose (Plethobasus cyphus)	Unknown	Unknown	Unknown
Clubshell (Pleurobema clava)	Allegheny	Unknown	Unknown
Round pigtoe (Pleurobema sintoxia)	SW Lake Ontario	Unknown	Unknown
Pink heelsplitter (Potamilus alatus)	Allegheny	Lake Champlain	Unknown
	Upper Hudson	SW Lake Ontario	Unknown
Fat pocketbook (Potamilus capax)	SW Lake Ontario	Unknown	Unknown
Kidneyshell (Ptychobranchus fasciolaris)	Lake Erie	Lake Erie	Unknown
	SW Lake Ontario	SW Lake Ontario	Unknown
		Lake Champlain	Unknown

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Pimpleback (Quadrula pustulosa)	Lake Erie	Unknown	Unknown
	SW Lake Ontario		
Mapleleaf (Quadrula quadrula)	Lake Erie	Unknown	Unknown
Salamander mussel (Simpsonaias ambigua)	Lake Erie	Unknown	Unknown
Lilliput (Toxolasma parvum)	SE Lake Ontario	Unknown	Unknown
	SW Lake Ontario		
Fawnsfoot (Truncilla donaciformis)	Lake Erie	Unknown	Unknown
Deertoe (Truncilla truncata)	SW Lake Ontario	Unknown	Unknown
Rayed bean (Villosa fabalis)	Allegheny		
Paper pondshell (Utterbackia imbecillis)	SE Lake Ontario	Unknown	Unknown
	SW Lake Ontario		
	Allegheny		
	NE Lake Ontario - St. Lawrence		
	Upper Hudson		
Rainbow (Villosa iris)	SE Lake Ontario	SW Lake Ontario	Unknown
	SW Lake Ontario	SE Lake Ontario	Unknown
	Allegheny		
Dwarf wedgemussel (Alasmidonta heterodon)	Delaware	Delaware	Stable
Mucket (Actinonaias ligamentina)	Allegheny	Allegheny	Unknown
	Lake Erie		
Brook floater (Alasmidonta varicosa)	Delaware	Delaware	Unknown
	Susquehanna	Susquehanna	Unknown

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Elktoe (Alasmidonta marginata)	NE Lake Ontario - St. Lawrence	NE Lake Ontario - St. Lawrence	Unknown
	SE Lake Ontario	SE Lake Ontario	Unknown
	SW Lake Ontario	SW Lake Ontario	Unknown
	Allegheny	Lake Erie	Unknown
	Susquehanna	Upper Hudson	Unknown
	Lake Erie		
	Upper Hudson		
Slippershell mussel (Alasmidonta viridis)	Lake Erie	Lake Erie	Unknown
	SE Lake Ontario		
Threeridge (Amblema plicata)	Allegheny	Lake Erie	Unknown
	Lake Erie	SW Lake Ontario	Unknown
	SW Lake Ontario		
	SE Lake Ontario		
Alewife floater (Anodonta implicata)	Upper Hudson	Upper Hudson	Decreasing
	Delaware	Delaware	Unknown
Tubercled blossom (Epioblasma torulosa)	Unknown	Unknown	Unknown
Northern riffleshell (Epioblasma torulosa rangiana)	Unknown	Unknown	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Snuffbox (Epioblasma triquetra)	Great Lakes	Unknown	Unknown
Wabash pigtoe (Fusconaia flava)	Great Lakes	Great Lakes	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Yellow lamp mussel (Lampsilis cariosa)	Great Lakes	High Allegheny Plateau	Unknown
	High Allegheny Plateau	Lower New England Piedmont	Unknown
	Lower New England Piedmont	Northern Appalachian/Boreal Forest	Stable
	St. Lawrence-Lake Champlain Valley		
Wavyrayed lampmussel (Lampsilis fasciola)	Great Lakes	High Allegheny Plateau	Unknown
	Western Allegheny Plateau	Western Allegheny Plateau	Unknown
Pink mucket (Lampsilis abrupta)	Unknown	Unknown	Unknown
Pocketbook (Lampsilis ovata)	Great Lakes	Northern Appalachian/Boreal Forest	Unknown
	St. Lawrence-Lake Champlain Valley	St. Lawrence-Lake Champlain Valley	Unknown
	Lower New England Piedmont	Western Allegheny Plateau	Unknown
	Western Allegheny Plateau	Great Lakes	Unknown
Yellow sandshell (Lampsilis teres)	Great Lakes	Unknown	Unknown
White heelsplitter (Lasmigona complanata)	Great Lakes	Unknown	Unknown
Green floater (Lasmigona subviridis)	High Allegheny Plateau	High Allegheny Plateau	Unknown
	Lower New England Piedmont		
	Great Lakes		
Tidewater mucket (Leptodea ochracea)	Lower New England Piedmont	Western Allegheny Plateau	Unknown
	Great Lakes	Lower New England Piedmont	Unknown
	St. Lawrence-Lake Champlain Valley	High Allegheny Plateau	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Eastern pondmussel (Ligumia nasuta)	Lower New England Piedmont	High Allegheny Plateau	Unknown
	Great Lakes	Lower New England Piedmont	Unknown
	St. Lawrence-Lake Champlain Valley	Western Allegheny Plateau	Unknown
Black sandshell (Ligumia recta)	High Allegheny Plateau	Lower New England Piedmont	Unknown
	Great Lakes	High Allegheny Plateau	Unknown
	St. Lawrence-Lake Champlain Valley	Great Lakes	Unknown
		St. Lawrence-Lake Champlain Valley	Unknown
Eastern pearlshell (Margaritifera margaritifera)	Lower New England Piedmont	Lower New England Piedmont	Unknown
	Great Lakes	Great Lakes	Unknown
	St. Lawrence-Lake Champlain Valley	Northern Appalachian/Boreal Forest	Unknown
		High Allegheny Plateau	Unknown
Hickorynut (Obovaria olivaria)	St. Lawrence-Lake Champlain Valley	Unknown	Unknown
	Great Lakes		
Round hickorynut (Obovaria subrotunda)	Unknown	St. Lawrence-Lake Champlain Valley	Unknown
Sheepnose (Plethobasus cyphus)	Unknown	Unknown	Unknown
Clubshell (Pleurobema clava)	Western Allegheny Plateau	Unknown	Unknown
Round pigtoe (Pleurobema sintoxia)	Unknown	Unknown	Unknown
Pink heelsplitter (Potamilus alatus)	Lower New England Piedmont	Lower New England Piedmont	Unknown
		St. Lawrence-Lake Champlain Valley	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Fat pocketbook (Potamilus capax)	Great Lakes	Unknown	Unknown
Kidneyshell (Ptychobranchus fasciolaris)	Great Lakes	Great Lakes	Unknown
	Northern Appalachian/Boreal Forest	Western Allegheny Plateau	Unknown
Pimpleback (Quadrula pustulosa)	Great Lakes	Unknown	Unknown
Mapleleaf (Quadrula quadrula)	Great Lakes	Unknown	Unknown
Salamander mussel (Simpsonaias ambigua)	Great Lakes	Unknown	Unknown
Lilliput (Toxolasma parvum)	Great Lakes	Unknown	Unknown
Fawnsfoot (Truncilla donaciformis)	Great Lakes	Unknown	Unknown
Deertoe (Truncilla truncata)	Great Lakes	Unknown	Unknown
Rayed bean (Villosa fabalis)	Western Allegheny Plateau	Western Allegheny Plateau	Unknown
	High Allegheny Plateau	High Allegheny Plateau	Unknown
Paper pondshell (Utterbackia imbecillis)	Great Lakes	Unknown	Unknown
	Northern Appalachian/Boreal Forest		
	Western Allegheny Plateau		
Rainbow (Villosa iris)	Great Lakes	Great Lakes	Unknown
	Western Allegheny Plateau		
Dwarf wedgemussel (Alasmidonta heterodon)	High Allegheny Plateau	High Allegheny Plateau	Stable

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Mucket (Actinonaias ligamentina)	Great Lakes	Western Allegheny Plateau	Unknown
	Western Allegheny Plateau		
Brook floater (Alasmidonta varicosa)	High Allegheny Plateau	High Allegheny Plateau	Unknown
Elktoe (Alasmidonta marginata)	Great Lakes	Great Lakes	Unknown
	St. Lawrence-Lake Champlain Valley	St. Lawrence-Lake Champlain Valley	Unknown
	High Allegheny Plateau	High Allegheny Plateau	Unknown
	Lower New England Piedmont	Lower New England Piedmont	Unknown
Slippershell mussel (Alasmidonta viridis)	Great Lakes	Great Lakes	Unknown
Threeridge (Amblema plicata)	Western Allegheny Plateau	Western Allegheny Plateau	Unknown
	Great Lakes	Great Lakes	Unknown
Alewife floater (Anodonta implicata)	Lower New England Piedmont	Lower New England Piedmont	Decreasing
	High Allegheny Plateau	High Allegheny Plateau	Unknown
Tubercled blossom (Epioblasma torulosa)	Unknown	Unknown	Unknown
Northern riffleshell (Epioblasma torulosa rangiana)	Unknown	Unknown	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Snuffbox (Epioblasma triquetra)	all	Riverine	coldwater stream	sand/gravel bottom
Wabash pigtoe (Fusconaia flava)	all	Riverine	coldwater stream	mud bottom
Yellow lamp mussel (Lampsilis cariosa)				

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Yellow lamp mussel (Lampsilis cariosa)				
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Wavyrayed lampmussel (Lampsilis fasciola)				
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Pink mucket (Lampsilis abrupta)				
	all	Riverine	deepwater river	rocky bottom
Pocketbook (Lampsilis ovata)				
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	deepwater river	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Yellow sandshell (Lampsilis teres)				
	all	Riverine	deepwater river	sand/gravel bottom
White heelsplitter (Lasmigona complanata)				
	all	Lacustrine	cold water shallow	mud bottom
	all	Lacustrine	cultural	mud bottom
	all	Lacustrine	warm water shallow	mud bottom
	all	Riverine	coldwater stream	mud bottom
	all	Riverine	warmwater stream	mud bottom
Green floater (Lasmigona subviridis)				
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Tidewater mucket (Leptodea ochracea)				
	all	Riverine	coastal plain stream	sand/gravel bottom
Eastern pondmussel (Ligumia nasuta)				
	all	Estuarine	unknown	unknown
	all	Riverine	cultural	unknown
	all	Riverine	deepwater river	mud bottom
Black sandshell (Ligumia recta)				
	all	Lacustrine	cold water shallow	sand/gravel bottom
	all	Lacustrine	warm water shallow	sand/gravel bottom
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Eastern pearlshell (Margaritifera margaritifera)				
	all	Riverine	coldwater stream	sand/gravel bottom

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Eastern pearlshell (Margaritifera margaritifera)				
Hickorynut (Obovaria olivaria)				
	all	Riverine	deepwater river	sand/gravel bottom
Round hickorynut (Obovaria subrotunda)				
	all	Lacustrine	unknown	unknown
	all	Riverine	warmwater stream	sand/gravel bottom
Sheepnose (Plethobasus cyphus)				
	all	Riverine	deepwater river	sand/gravel bottom
Clubshell (Pleurobema clava)				
	all	Riverine	warmwater stream	sand/gravel bottom
Round pigtoe (Pleurobema sintoxia)				
	all	Riverine	deepwater river	sand/gravel bottom
Pink heelsplitter (Potamilus alatus)				
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
	Breeding	Lacustrine	unknown	unknown
Fat pocketbook (Potamilus capax)				
	all	Riverine	deepwater river	mud bottom
	all	Riverine	deepwater river	sand/gravel bottom
Kidneyshell (Ptychobranchus fasciolaris)				
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	deepwater river	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Pimpleback (Quadrula pustulosa)				
	all	Lacustrine	unknown	unknown
	all	Riverine	unknown	unknown
Mapleleaf (Quadrula quadrula)				
	all	Lacustrine	cultural	unknown
	all	Riverine	deepwater river	unknown
Salamander mussel (Simpsonaias ambigua)				
	all	Lacustrine	unknown	unknown
	all	Riverine	coldwater stream	rocky bottom
	all	Riverine	deepwater river	rocky bottom
	all	Riverine	warmwater stream	rocky bottom

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Lilliput (Toxolasma parvum)				
	all	Lacustrine	cold water shallow	unknown
	all	Lacustrine	warm water shallow	unknown
	all	Riverine	coldwater stream	mud bottom
	all	Riverine	warmwater stream	mud bottom
Fawnsfoot (Truncilla donaciformis)				
	all	Lacustrine	unknown	unknown
	all	Riverine	deepwater river	sand/gravel bottom
Deertoe (Truncilla truncata)				
	all	Lacustrine	warm water shallow	mud bottom
	all	Riverine	deepwater river	sand/gravel bottom
Rayed bean (Villosa fabalis)				
	all	Lacustrine	unknown	unknown
	all	Riverine	coldwater stream	SAV
	all	Riverine	warmwater stream	SAV
Paper pondshell (Utterbackia imbecillis)				
	all	Lacustrine	unknown	unknown
	all	Riverine	coldwater stream	mud bottom
	all	Riverine	deepwater river	mud bottom
	all	Riverine	warmwater stream	mud bottom
Rainbow (Villosa iris)				
	all	Lacustrine	unknown	unknown
	all	Riverine	coldwater stream	sand/gravel bottom
	all	Riverine	deepwater river	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Dwarf wedgemussel (Alasmidonta heterodon)				
	all	Riverine	coldwater stream	rocky bottom
	all	Riverine	coldwater stream	sand/gravel bottom
Mucket (Actinonaias ligamentina)				
	all	Riverine	coldwater stream	mud bottom
	all	Riverine	coldwater stream	rocky bottom
	all	Riverine	deepwater river	mud bottom
	all	Riverine	deepwater river	rocky bottom
	all	Riverine	warmwater stream	mud bottom
	all	Riverine	warmwater stream	mud bottom
Brook floater (Alasmidonta varicosa)				
	all	Riverine	coldwater stream	sand/gravel bottom

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Brook floater (Alasmidonta varicosa)				
	all	Riverine	deepwater river	sand/gravel bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Elktoe (Alasmidonta marginata)				
	all	Riverine	coldwater stream	other
	all	Riverine	deepwater river	unknown
	all	Riverine	warmwater stream	unknown
Slippershell mussel (Alasmidonta viridis)				
	all	Lacustrine	unknown	unknown
	all	Riverine	coldwater stream	unknown
	all	Riverine	deepwater river	unknown
	all	Riverine	warmwater stream	unknown
Threeridge (Amblema plicata)				
	all	Lacustrine	unknown	unknown
	all	Riverine	coldwater stream	mud bottom
	all	Riverine	deepwater river	mud bottom
	all	Riverine	warmwater stream	mud bottom
Alewife floater (Anodonta implicata)				
	all	Riverine	deepwater river	rocky bottom
Tubercled blossom (Epioblasma torulosa)				
	all	Riverine	deepwater river	unknown
Northern riffleshell (Epioblasma torulosa rangiana)				
	all	Lacustrine	unknown	unknown
	all	Riverine	unknown	unknown

Goal and Objectives for Freshwater bivalves

Goal: Maintain healthy populations of all native species of freshwater bivalves throughout their historic ranges in New York.

Objective 1 : Develop a management strategy to maintain data sets on mussel populations and to eliminate or mitigate negative impacts on declining populations

Measure: *A strategy for monitoring and management of mussel populations is developed and implemented.*

Objective 2 : Maintain up-to-date knowledge of mussel research, development of new technology or techniques in mussel work, protection and management issues

Measure: *DEC staff working on mussels and water quality issues participate in international and regional mollusk symposia. DEC convenes or participates in regional and local mussel working grps, exchanges data with professionals and mussel conservation societies.*

Objective 3 : Understand the causes of declines in listed mussel populations.

Measure: *Field monitoring of populations indicate threats present including exotic species competition, habitat degradation, fish host availability, fragmentation from impoundments, flow alteration, etc.*

Objective 4 : Understand the current distribution of listed species in New York State.

Measure: *Surveys determine where extant populations of listed mussels are located in the watersheds of New York State*

Objective 5 : Understand the current status of listed mussel populations where they are located in New York.

Measure: *Periodic population estimates of listed mussels give baseline data and trend data for listed mussel species in NY.*

Recommended Actions

Curriculum development:

* Develop an curriculum to educate the public about freshwater mussel life history and protection issues at all DEC environmental education centers and Project Wild programs

Development rights acquisition:

* In key locations acquire development rights to protect water quality for listed mussel populations.

Educational signs:

* Develop and post educational signs, in appropriate languages, for markets dealing in live bivalves, fish and crustacea explaining the dangers of releasing exotic invasive animals into New York.
* Post educational signs at boater access points to reduce introduction of zebra and quagga mussels in water bodies.

Fact sheet:

* Develop fact sheets on each species of listed freshwater mussels.

Recommended Actions

Habitat management:

* Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
* Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

* Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
* Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
* Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

* Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

* Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
* Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

* Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults
* Research potential interbreeding between Alasmidonta varicosa and Alasmidonta marginata and, if occurring, evaluate the potential threat to A. varicosa population integrity.
* Determine fish hosts for species where this is not known for populations living in New York .
* Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
* Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

* Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

* Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
* Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York

Recommended Actions

Other action:

* Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
* Increase regional permit control of development and highway projects that may impact native mussels.
* Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
* Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
* Research the best survey methods both for detection of rare species and evaluation of population status and trends.
* Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

* Conduct population estimates of species-at-risk listed mussel species in NY
* Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

* Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

* Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

* Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

References

Strayer, D.L. and K.J.Jirka. 1997. The pearly mussels of New York state. New York State Museum memoir 26. University of the Sate of New York Education Department. 170 pp.

Originator

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Taxa Group: Mollusk
Species Group: Freshwater gastropods

Threats:
We believe that threats to this group are similar to those faces by many freshwater organisms in New York. These include loss of habitat due to water table drawdown, development, alteration of drainage and surface water flows, and change in aquatic vegetation. Threats also include use of pesticides and other chemicals either directly on habitat areas or from non-point source pollution. Competition from exotic species may also be a problem. There may be specific threats to species which need to be researched.

Trends:
Trends need to be determined with surveys.

SEQR - No Action Alternative:
Without action it is likely the species in this group will decline.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
File rams-horn (Planorbella pilsbryi)			SH	G4G5	U	Resident
Banded physa (Physella vinosa)			S1	GU	U	Resident
Lance aplexa (Aplexa elongata)			S2	G5	U	Resident
Coldwater pondsnail (Stagnicola woodruffi)			S?	G1G3	U	Resident
Spindle lymnaea (Acella haldemani)			S?	G3	U	Resident
Gravel pyrg (Pyrgulopsis letsoni)			SH	G1	U	Resident
Buffalo pebblesnail (Gillia altilis)			S1	G5	U SC	Resident
Watercress snail (Fontigens nickliniana)			S1S3	G5	U	Resident
Campeloma spire snail (Cincinnatia cincinnatiensis			S1	G4G5	U	Resident
Globe siltsnail (Birgella subglobosus)						Resident
Canadian duskysnail (Lyogyrus walkeri)			S?	G2G3	U	Resident
Mossy valvata (Valvata sincera)			S1	G5	U SC	Resident
Purplecap valvata (Valvata perdepressa)			SP	G3	U	Resident
Fringed valvata (Valvata lewisi)			S1	G3?	U SC	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Fringed valvata (Valvata lewisi)	Unknown	Unknown	Unknown
Purplecap valvata (Valvata perdepressa)	NE Lake Ontario - St. Lawrence	Unknown	Unknown
Mossy valvata (Valvata sincera)	SE Lake Ontario	Unknown	Unknown
	Allegheny		
	Lake Champlain		
	NE Lake Ontario - St. Lawrence		
	Upper Hudson		
Canadian duskysnail (Lyogyrus walkeri)	Unknown	Unknown	Unknown
Globe siltsnail (Birgella subglobosus)	Lake Champlain	Unknown	Unknown
	Upper Hudson		
	SE Lake Ontario		
	Lake Erie		
Campeloma spire snail (Cincinnatia cincinnatiensis)	SE Lake Ontario	Unknown	Unknown
	Lake Erie		
	Allegheny		
	NE Lake Ontario - St. Lawrence		
	Upper Hudson		
Watercress snail (Fontigens nickliniana)	Upper Hudson	Unknown	Unknown
	Allegheny		
	Lake Erie		
Buffalo pebblesnail (Gillia altilis)	Upper Hudson	Unknown	Unknown
	SE Lake Ontario		
	SW Lake Ontario		
	Lake Erie		

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Gravel pyrg (Pyrgulopsis letsoni)	Lake Erie	Unknown	Unknown
	Allegheny		
Spindle lymnaea (Acella haldemani)	Lake Champlain	Unknown	Unknown
	Susquehanna		
	SE Lake Ontario		
	Lake Erie		
Coldwater pondsnail (Stagnicola woodruffi)	Unknown	Unknown	Unknown
Lance aplexa (Aplexa elongata)	Lake Champlain	Unknown	Unknown
	Upper Hudson		
	SE Lake Ontario		
	SE Lake Ontario		
	Lake Erie		
	Allegheny		
	Susquehanna		
	NE Lake Ontario - St. Lawrence		
	Lower Hudson - Long Island Bays		
Banded physa (Physella vinosa)	Unknown	Unknown	Unknown
File rams-horn (Planorbella pilsbryi)	Unknown	Unknown	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Fringed valvata (Valvata lewisi)	Unknown	Unknown	Unknown
Purplecap valvata (Valvata perdepressa)	Great Lakes	Unknown	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Mossy valvata (Valvata sincera)	St. Lawrence-Lake Champlain Valley Lower New England Piedmont Northern Appalachian/Boreal Forest Great Lakes Western Allegheny Plateau	Unknown	Unknown
Canadian duskysnail (Lyogyrus walkeri)	Unknown	Unknown	Unknown
Globe siltsnail (Birgella subglobosus)	Lower New England Piedmont St. Lawrence-Lake Champlain Valley Great Lakes	Unknown	Unknown
Campeloma spire snail (Cincinnatia cincinnatiensis)	Great Lakes St. Lawrence-Lake Champlain Valley Northern Appalachian/Boreal Forest Western Allegheny Plateau	Unknown	Unknown
Watercress snail (Fontigens nickliniana)	Western Allegheny Plateau Great Lakes	Unknown	Unknown
Buffalo pebblesnail (Gillia altilis)	Great Lakes Lower New England Piedmont	Unknown	Unknown
Gravel pyrg (Pyrgulopsis letsoni)	Western Allegheny Plateau Great Lakes	Unknown	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Spindle lymnaea (Acella haldemani)	Great Lakes St. Lawrence-Lake Champlain Valley High Allegheny Plateau	Unknown	Unknown
Coldwater pondsnail (Stagnicola woodruffi)	Unknown	Unknown	Unknown
Lance aplexa (Aplexa elongata)	All	Unknown	Unknown
Banded physa (Physella vinosa)	Unknown	Unknown	Unknown
File rams-horn (Planorbella pilsbryi)	Unknown	Unknown	Unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Fringed valvata (Valvata lewisi)				
	all	Lacustrine	unknown	unknown
	all	Lacustrine	warm water shallow	sand/gravel bottom
Purplecap valvata (Valvata perdepressa)				
	all	Lacustrine	cold water shallow	mud bottom
	all	Lacustrine	warm water shallow	mud bottom
Mossy valvata (Valvata sincera)				
		Lacustrine	cold water shallow	SAV
	all	Lacustrine	cold water deep	SAV
	all	Lacustrine	warm water shallow	SAV
	all	Riverine	deepwater river	SAV
Canadian duskysnail (Lyogyrus walkeri)				
	all	Unknown		
Globe siltsnail (Birgella subglobosus)				
	all	Lacustrine	unknown	unknown
	all	Riverine	unknown	unknown
Campeloma spire snail (Cincinnatia cincinnatiensis)				

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Campeloma spire snail (Cincinnatia cincinnatiensis)				
	all	Lacustrine	warm water shallow	mud bottom
	all	Lacustrine	warm water shallow	sand/gravel bottom
	all	Riverine	warmwater stream	mud bottom
	all	Riverine	warmwater stream	sand/gravel bottom
Watercress snail (Fontigens nickliniana)				
	all	Riverine	coldwater stream	SAV
Buffalo pebblesnail (Gillia altilis)				
	all	Lacustrine	warm water shallow	mud bottom
Gravel pyrg (Pyrgulopsis letsoni)				
	all	Unknown		
Spindle lymnaea (Acella haldemani)				
	all	Lacustrine	cold water shallow	SAV
	all	Lacustrine	warm water shallow	SAV
Coldwater pondsnail (Stagnicola woodruffi)				
	all	Unknown		
Lance aplexa (Aplexa elongata)				
	all	Palustrine	mineral soil wetland	emergent marsh
	all	Palustrine	mineral soil wetland	pond/lake shore
Banded physa (Physella vinosa)				
	all	Unknown		
File rams-horn (Planorbella pilsbryi)				
	all	Unknown		

Goal and Objectives for Freshwater gastropods

Goal: Secure the status of the freshwater gastropods on the species at risk list.

Objective 1 : Determine the current status of each species on the list through surveys including population trends.

Measure: *Completion of surveys in appropriate habitat via methods designed to provide population and trend data.*

Objective 2 : Develop specific plans for each listed species or appropriate suite of freshwater gastropod species on the list that details status, threats, actions necessary to reverse declines or maintain stable populations.

Measure: *Development and implementation of the plans completed.*

Objective 3 : Identify habitat requirements of all life stages of listed species.

Measure: *Data collected from research and contact with experts on the taxa sufficient to determine habitat needs.*

Objective 4 : Identify threats to each listed species.

Measure: *Threat data gathered on listed species from contact with experts on the taxi and those conducting pertinent research. Areas where more research is needed are identified.*

Recommended Actions

Fact sheet:

* Develop fact sheets for each listed species for paper distribution and the DEC website.

Habitat research:

* Determine habitat requirements for all life stages, potential threats, to habitat, and habitat management techniques.

Life history research:

* Determine through research live history phylogeny, population dynamics, distribution.

Other management plan:

* Develop specific plans for each listed species or appropriate suite of freshwater gastropod species on the list that details status, threats, actions necessary to reverse declines or maintain stable populations.

References

Hartling, Joachim W. and Robert Gilbert. 2000. Spatial distribution of surficial sediments in part of the Kingston basin of northeastern Lake Ontario, Canada. Canadian Journal of Earth Sciences, 37:901-911.

Jokinen, Eileen H. 1992. The freshwater snails (Mollusca: Gastropoda) of New York State. New York State Museum Bulletin 482.112pp.

Harmon.W. N. and C. O. Berg. 1971. The freshwater snails of central New York with illustrated keys to the genera and species. Search (1)4 68pp.

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Taxa Group: Mollusk
Species Group: Hard clam

Threats:
Several major factors negatively affect the survival and recovery of hard clam populations including environmental conditions such as an increase in the presence of predators, alterations in food supply (primarily phytoplankton communities), harmful algal bloom (HAB) events, water quality degradation, habitat changes and emergent diseases. Predators significantly reduce the survival of juvenile hard clams and can greatly reduce the effects of restorative seeding projects. Alterations in food quality combined with HAB's and general water quality degradation affect general reproductive success, early life stages and hinder the health and growth of juvenile to mature clams. At the same time habitat loss such as long term sedimentation of estuaries or the loss of suitable submerged aquatic vegetation beds continue to limit existing and future population areas. New disease outbreaks such as Quahog Parasite Unknown (QPX) have been identified in isolated but dense populations of hard clams in Raritan Bay, resulting in mortalities of approximately 30%, and have the threat to impact similar populations elsewhere on Long Island. Also anthropogenic involvement creates a loss of habitat caused by marine construction and dredging, direct population alteration, chemical contamination and nutrient enrichment of embayments.

Trends:
Historically, New York State has maintained some of the most productive hard clam populations in the country based on commercial fishery landings data where Statewide production peaked at over 850,000 bushels in 1947. Most recently, hard clam landings peaked at 750,000 bushels in 1976 with over 700, 000 of those bushels being harvested from Great South Bay. By 2003, total Statewide production had fallen to 106,739 bushels representing a 76% decline while production in Great South Bay had fallen to 12,723 bushels a 98% decline. Elsewhere in the State, hard clam populations could generally be described as having declined from historic highs and are now either stable and low in population density or declining. Notable exceptions are high populations in Raritan Bay, which are now impacted by QPX disease, and Oyster Bay and Huntington Bay regions, the former in part due to long term private aquaculture activities. Populations of hard clams in closed water classification areas are generally unknown, such as in Jamaica Bay and Western Long Island Sound. Currently every major Township in the New York State marine district is involved in the aquaculture or seeding of juvenile hard clams in efforts to increase populations. Mature clam spawner sanctuaries have also been created by many Townships and by private entities notably The Nature Conservancy.

SEQR - No Action Alternative:
Recently, complex statistical modeling has been used to perform population trends for hard clams in Great South Bay. These studies indicate that hard clam populations, in the absence of all negative stresses including commercial harvesting, would take over 10 years under natural conditions to achieve any measurable recovery. By incorporating unfavorable conditions upon the population model, many of which are currently substantial, hard clam populations could easily need more than 20 years to achieve any population increase or be in a state of permanent decline. These predictions have been proven by example where in various hard clam growing areas the density of hard clams has become so low that even in favorable conditions populations have not increased. A no action strategy would likely result in the continued decline of hard clam populations to a point of increasingly unsuccessful reproduction and recruitment resulting in isolated populations with greatly decreased chances for natural recovery.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status

Hard clam (Mercenaria mercenaria) P Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Hard clam (Mercenaria mercenaria)	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Decreasing

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Hard clam (Mercenaria mercenaria)	Lower New England Piedmont	Lower New England Piedmont	Unknown
	North Atlantic Coast	North Atlantic Coast	Decreasing

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Hard clam (Mercenaria mercenaria)				
	all	Marine	deep subtidal	sand/gravel
	all	Marine	intertidal	mudflats
	all	Marine	shallow subtidal	sand/gravel
	Nursery/Juvenile	Marine	deep subtidal	pelagic

Goal and Objectives for Hard clam

Goal: To restore and protect hard clam populations in the Lower Hudson/Long Island Bays watershed, particularly within Great South Bay and the Picnic's Bay system, to levels that are naturally recoverable and self sustaining by 2020.

Objective 1 : Determine embayments with greatest need and potential for restoration by 2007.

Measure: *Complete population surveys identifying low population areas and determine the environmental conditions that would best support restoration.*

Objective 2 : Determine the distribution and abundance of hard clams in major embayments, by 2010.

Measure: *Completion of hard clam population surveys every 2 years within major embayments.*

Objective 3 : Establish 5 spawner sanctuaries in the major embayments of the Lower Hudson/Long Island Bays watershed, 2 in the Peconic Bay system, 2 in south shore estuaries and 1 along LI Sound - all closed to commercial harvesting, by 2010.

Measure: *Creation of 5 spawner sanctuaries, closed to commercial harvest, by 2010.*

Objective 4 : Establish the distribution and effects of QPX disease upon hard clams populations, by 2010.

Measure: *Completion of studies outlining the distribution of QPX in major embayments and which determine the transmission and effects of QPX upon wild populations of hard clams by 2010.*

Objective 5 : Increase successfully recruiting populations of juvenile hard clams by 2010.

Measure: *Perform juvenile hard clam seeding projects in embayments of greatest need and potential using hatchery reared stock on a yearly basis.*

Objective 6 : Know factors affecting hard clam population dynamics including reproductive success, food availability and water quality parameters.

Measure: *Number of research projects studying hard clam population dynamics and physiology completed by 2010.*

Recommended Actions

Captive breeding:

* Continue to promote shellfish hatchery spawning of hard clams and their use in the seeding of public waters.

Habitat monitoring:

* Record and monitor HAB events and continue further research into their effect on hard clams.

Habitat research:

* Promote and continue ongoing research into the survival and growth of hard clams, focusing on phytoplankton dynamics, predator prey relationships and water quality parameters.

Life history research:

* Promote and continue species research testing the success and effectiveness of spawner sanctuaries and seeding efforts as well as research into the success of wild hard clam reproduction and recruitment.

Other action:

* As necessary, implement management measures needed to protect, conserve and support sustainable hard clam populations in the Lower Hudson/Long Island bays watershed.
* Continue population restoration via juvenile hard clam seeding projects and via mature hard clam spawner sanctuaries.

Recommended Actions

* Promote and continue research into the distribution and effects of QPX disease on hard clams.

Other management plan:

* Develop Comprehensive Hard Clam Management Plan for the marine district.

Population monitoring:

* Conduct shellfish surveys of major embayments, especially where little population data are known. Also compile population data from involved hard clam industry representatives and from areas where surveys are impractical. This combined data will be used in the long term monitoring of hard clam populations.

References

Workshop on Hard Clam Population Dynamics: Research Priorities for the South Shore of Long Island. (1999). New York Sea Grant, Stony Brook, New York.

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Strategies and Recommendations for Revitalizing the Hard Clam Fisheries in Suffolk County. (1987). Suffolk County Planning Department, Happaugue, New York.

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Proceedings of Northeast Clam Industries: Management for the Future. (1978). Massachusetts Cooperative Extension Service, Amherst, Massachusetts.

Lewis, D., Kassner, J., Cerrato, R., Finch, R. (1995). An Assessment of Shellfish Resources in the Deep Water Areas of the Peconic Estuary. Marine Sciences Research Center, State University of New York, Stony Brook, NY.

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Taxa Group: Mollusk
Species Group: Ribbed mussel

Threats:
Threats to ribbed mussel populations are mostly unknown.

1.) One local expert commented that the fate of ribbed mussels is tied to that of smooth cord grass (Spartina alterniflora). It is believed by DEC tidal wetland staff that smooth cord grass populations are in decline locally. Any threat to smooth cord grass should be considered a threat to ribbed mussels. Some of the important ecological roles played by ribbed mussels are included:

Ribbed mussels should be considered a species of concern because of their significant ecological role. Since they are not a commercially important species they tend to be the dominant filter feeding invertebrate in shallow quiescent creeks. "They are classified as both autogenic and allogenic bioengineers because they both provide habitat and convert resources from one state to another. Bioengineers are species determined to play a major role in the structure and function of most natural communities" (from Bertness, 1999).

In creeks where populations are significant, ribbed mussels can apply both top down (control of populations and community structure by consumers) and bottom up (control of populations and community structure by control over natural resources) forces on phytoplankton populations as well as provide nutrient support and erosion control to smooth cord grass.

An effect of the top down control of phytoplankton coupled with filtration of suspended solids (with the production of pseudofeces) is reduced turbidity resulting in greater photosynthetically active radiation penetration and improved submerged aquatic vegetation and benthic phytoplankton growth and survival. This is accomplished due primarily to the fact that ribbed mussels increase clearance rates (the rate at which bivalves pass water through their bodies and over their gills) with increases in suspended solids significantly past the point where hard and soft shell clams shut down (from Newell, 2004). Dense communities of ribbed mussels have the ability to filter a great percentage of the water within their water body on a daily basis.

An additional effect of the redistribution of particulate organic nitrogen from the water column to the water sediment interface (pelagic benthic coupling) is the increased potential for Nitrification / Denitrification (the process in which dissolved inorganic nitrogen is converted to elemental nitrogen) and the removal of anthropogenic nitrogen as N2 (from Newell, 2004).

An effect of the bottom up control of nitrogen concentrations is the potential to affect salt marsh zonation, which is in part controlled by nitrogen limitation. Smooth cord grass is a competitive subordinate to marsh hay, but can displace marsh hay when exposed to elevated nitrogen levels (from Bertness, 1999).

2.) A second local expert speculated that the harvest of ribbed mussels for bait may damage smooth cord grass stands (see above). Additionally, he stated that ribbed mussel beds may become habitat refuges for soft shell clams, and individual harvesters may be digging up smooth cord grass and ribbed mussels to get at soft shell clams beneath.

Trends:
Trends in ribbed mussel populations are mostly unknown.

Because smooth cord grass populations are declining locally, we can assume that ribbed mussel populations are declining in those same locations (see Threats section).

Both local experts agreed that trends in population distribution and abundance are unknown except for localized embayments. In Jamaica Bay, even though the bay is suffering from major smooth cord grass loss, populations of ribbed mussels appear to be thriving on the remaining marsh.

SEQR - No Action Alternative:

Too little is known about ribbed mussel population trends and health to determine what the impact would be of a "No Action Alternative".

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Ribbed mussel (Geukensia demissa)						Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Ribbed mussel (Geukensia demissa)	Lower Hudson - Long Island Bays	Lower Hudson - Long Island Bays	Unknown

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Ribbed mussel (Geukensia demissa)	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
Ribbed mussel (Geukensia demissa)				
	Breeding	Estuarine	intertidal	emergent marsh
	Breeding	Estuarine	intertidal	structure
	Breeding	Estuarine	shallow subtidal	structure
	Feeding	Estuarine	intertidal	emergent marsh
	Feeding	Estuarine	intertidal	structure
	Feeding	Estuarine	shallow subtidal	structure
	Nursery/Juvenile	Estuarine	shallow subtidal	pelagic
	Nursery/Juvenile	Marine	shallow subtidal	pelagic

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Ribbed mussel (Geukensia demissa)				

Goal and Objectives for Ribbed mussel

Goal: Develop baseline data on abundance and distribution. Determine the interactions between ecological parameters, population status and trends and anthropogenic and natural impacts

Objective 1 : By 2015 a region specific ribbed mussel baseline database 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 complete information.*

Objective 2 : By 2015 know how habitat loss relates to ribbed mussel population trends.

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

Objective 3 : 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 monitoring program.*

Objective 4 : Have a protocol for integrated marsh species monitoring that can be implemented by 2008.

Measure: *Completion of the monitoring protocol.*

Recommended Actions

Habitat management:

* If ribbed mussel populations are in decline due to loss of smooth cordgrass habitat, increased protections to tidal wetlands would be required. Salt marsh habitat protection and restoration are crucial elements in any ribbed mussel conservation plan. Aspects of salt marsh protection and restoration will be included in the final watershed recommendations.

Habitat monitoring:

* Because of the link with smooth cordgrass, continued tidal wetland habitat monitoring is necessary to determine if ribbed mussel populations are being impacted.

Recommended Actions

Population monitoring:

* After baseline population data is gathered, further monitoring is necessary to determine trends.

References

Roger I. E. Newell. 2004. Ecosystem influences of natural and cultivated populations of suspension-feeding bivalve mollusks: a review. Journal of Shellfis Research. 23: 51-61.

Many scientific papers exist that describe the ecological role that ribbed mussels play. However, literature on distribution, abundance and trend data is limited. See reference section of Bertness' book (referenced above) for many ecological role papers. Additionally, many papers by David R. Franz or Roge I. E. Newell describe the ecology, physiology, age structure, recruitment and fecundity of ribbed mussels.

Mark D. Bertness. 1999. The Ecology of Atlantic Shorelines. Sinauer Associates Inc., 23 Plumtree Road, Sunderland, MA USA 01375. This book gives a good introduction to the ecology of salt marshes and the interactions between smooth cordgrass and ribbed mussels. This book also contains a decent bibliography for salt marsh ecology.

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Taxa Group: Mollusk

Species Group: Terrestrial gastropods

Threats:

The primary threats to the Chittenango ovate amber snail (COAS) is its small population size and fact that the population at Chittenango Falls State Park is the only known population in the world. There is also an apparent negative interaction with an introduced snail, Succinea sp. B.

Trends:

The population is considerably smaller than when first discovered in 1905. The snail apparently reached lowest numbers about the time that S. sp. B was found in the habitat circa 1980. Since then the snail has maintained itself at low numbers, approximately 250 to 500 individuals as the total worldwide population.

SEQR - No Action Alternative:

Leslie Hubright, a prominent malacologist, noted than when Succinea sp. B invades an area all other Succineid snails disappear. It is expected that without intervention, COAS will disappear from this site and therefore become extinct.

Species in the Group and their Management Status

Species	Federal Listing	NE Concern	State Rank	Global Rank	State Protection	Migratory Status
Chittenango ovate amber snail (Novisuccinea chitte	T		S1	G1	E	Resident

Species Distribution - Watershed Basin

Species	Historical	Current	Stability
Chittenango ovate amber snail (Novisuccinea chittenang	SE Lake Ontario	SE Lake Ontario	Decreasing

Species Distribution - Ecoregion

Species	Historical	Current	Stability
Chittenango ovate amber snail (Novisuccinea chittenango	Great Lakes	Great Lakes	Decreasing

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Chittenango ovate amber snail (Novisuccinea chittenangoensis)	all	Terrestrial	unknown	unknown

Critical Habitats for Species in the Group

Species	Life Stage or Use	System	SubSystem	Habitat
Chittenango ovate amber snail (Novisuccinea chittenangoensis)				

Goal and Objectives for Terrestrial gastropods

Goal: To establish long term sustainability of COAS in the wild and ultimately delist the species.

Objective 1 : Coordinate statewide management and protection actions with involved staff of the State Park and the USFWS.

Measure: *Number of protection and management actions coordinated.*

Objective 2 : Determine genetic distinctiveness of COAS and other closely related succineids.

Measure: *Identify genetic markers for determining whether a snail at other locations is COAS or not.*

Objective 3 : Establish additional populations of COAS within Chittenango Falls State Park so that species is not threatened with extinction due to isolated stochastic events.

Measure: *Number of additional populations established.*

Objective 4 : Reduce competition with S. sp. B

Measure: *Assess change in abundance of COAS and S. sp. B over time.*

Objective 5 : Search for additional sites where COAS might occur.

Measure: *Number of sites surveyed that have suitable habitat.*

Objective 6 : Stabilize population at Chittenango Falls

Measure: *Using M-R-R techniques, show that population is stable or increasing for 5 generations (i.e., 10 years)*

Recommended Actions

Captive breeding:

* Use captive breeding to augment existing population if necessary, establish new populations, and conduct laboratory and field experiments to quantify life history parameters and competitive interactions with S. sp. B.

Recommended Actions

Educational signs:

* Revise educational signs at Chittenango Falls State Park and develop educational signs at zoos that participate in captive breeding experiments

Habitat research:

* Conduct habitat research to determine if there are microhabitat differences preferred by COAS and S. sp. B.

Invasive species control:

* Investigate methods of removing S. sp. B from the habitat without harming COAS

Life history research:

* Continue life history research including analysis of DNA

Other action:

* Continue to participate as part of the federal COAS Recovery Team

Population monitoring:

* Continue M-R-R studies as a method of determining population size, seasonal movement and habitat use.

Relocation/reintroduction:

* Identify possible sites for relocation COAS so as to establish 3 additional self sustaining populations.

References

Arrigoni, J.E., Jr. 2002. Mark-release-recapture study of the Chittenango ovate amber snail (Novisuccinea chittenangoensis Pilsbry), July-October 2002. Final Report to New York State Department of Environmental Conservation Endangered Species Unit.

Molloy, A. W. 1995. Studies of the endangered Chittenango ovate amber snail (Novisuccinea chittenangoensis) and related species of the Chittenango Creek watershed. M.S. Thesis. SUNY, College of Environmental Sciences and Forestry. Syracuse, NY. 149 pp.

U. S. Fish and wildlife Service. 2003. Chittenango ovate amber snail (Novisuccinea chittenangoensis) Recovery Plan, Fiorst Revision. Technical Agency Draft. Hadley, MA 57 pp

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