Softshell Clam

Mya arenaria

Federal Listing	N/A
State Listing	SGCN
Global Rank	NR
State Rank	SNR
Regional Status	

Justification (Reason for Concern in NH)

Softshell clam are a valued recreational harvest resource in New Hampshire. Because of this, they are a highly regulated species with laws and rules controlling their take. Annually, the New Hampshire Fish and Game Department (NHF&G) issues recreational licenses; ranging from over 2,000 licenses to about 1,000 licenses over the past decade. Annual sale of licenses reflect the availability of legally harvestable clams with license sales rising when clam densities rise and drop with declines in their numbers. In addition to softshell clams being the most popular recreational shellfish fishery in New Hampshire, there is also interest in the aquaculture potential of this species.

Distribution

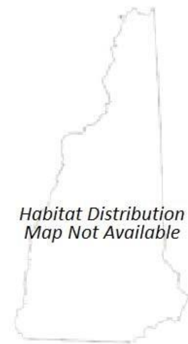
Softshell clam is native to the North American east coast from Labrador to Cape Hatteras. Throughout its range, adult clams occupy the soft (gravel/sand/mud) substrates of the upper intertidal to shallow subtidal zones. There they are found in burrows as deep as 30 cm below the surface and filter-feed by extension of siphons that may project above the substrate surface about an inch. In New Hampshire, the most renowned softshell clam population is within the Hampton- Seabrook Estuary where sizable sandy flats are available. Significant clam flats also exist in Rye, Little Harbor, and throughout the Great Bay/Piscataqua River complex. Currently the population within the Hampton-Seabrook Estuary is monitored by the environmental consulting firm, Normandeau Associates (NAI) who are retained by the owner/operators of Seabrook Station, a large nuclear power generating facility. NAI have annual surveys directed at both the planktonic larval stage and the settled clams from newly set young-of-year to large adults.

Habitat

The softshell clam (*Mya arenaria*) is found on the Atlantic seaboard from Labrador to Cape Hatteras in bays, harbors, and estuarial waters along the coastline (Hanks, 1963). They are found in a wide variety of sediments, but typically intertidally burrowed into sand/mud substrates. Subtidal clams are well established too but far less known as to their distribution. While relatively clean sandy intertidal flats are the most favored habitat, softshell clams are also found in mud/sand/rock intertidal sites. Dependent on temperature and food, softshell clams become sexually mature in their second to third year and spawn from June to September, when they broadcast both sperm and egg into the water column resulting in fertilization. Fertilized eggs develop into free swimming planktonic larvae, during which they are extensively distributed throughout coastal waters as neritic plankters. Larvae in the northeast develop normally at temperatures between 100 – 250C and salinities greater than 15 ppt (NHFG, 1991). During the larval stage they undergo a series of physical changes for a period of 12-21 days, before metamorphosing into an adult form and settling on suitable substrate. Juveniles will wander using their foot, attach to sand grains by byssus threads, or float in the water in search of more suitable habitat. This movement decreases with age and growth before finally establishing permanent burrows in substrate (Newell & Hidu, 1986).

NH Wildlife Action Plan Habitats

- Marine



Distribution Map

Current Species and Habitat Condition in New Hampshire

In New Hampshire, softshell clams exist in the Piscataqua River basin and the coastal basin. The Piscataqua River basin includes Great Bay, Little Bay, Piscataqua River and Little Harbor. The Piscataqua River basin covers 3,275 acres of tidal water clam flats and about 100 miles of shoreline. The coastal basin consists of Rye Harbor and Hampton-Seabrook Estuary. The coastal basin contains over 244 acres of tidal water clam flats (NHF&G, 1991)

Population Management Status

New Hampshire has regulations pertaining to the harvest of softshell clam where harvest is allowed. On Saturdays only one half hour before sunrise to sunset, a ten-liquid quart daily limit (no size limitation) is allowed from the day after Labor Day to May 31st ; except for Hampton/Seabrook Harbor which typically opens in November. Licensing of all residents six years of age and older is required and there is no allowed sale of clams. Handheld tools with handles not greater than 18 inches long are the legal means of digging clams. In addition to the above limitations on clam harvesting, it is worth mentioning that the allowable times for taking may be significantly altered by closures due to unfavorable health related conditions (e.g., high bacterial numbers or red tide conditions). The resource is controlled New Hampshire Fish and Game Department with careful consideration of clam stock biomass.

Regulatory Protection (for explanations, see Appendix I)

- RSA 211:61- 211:64; 214:11a: Gear/season/harvest/permit regulations
- RSA 143:21: Closures of shellfish beds to harvesting due to high bacteria or red tide
- FIS 606.1- 606.7 NHFG rules on the harvest of softshell clams

Quality of Habitat

Softshell clams inhabit sandy, sand-mud, or sandy-clay bottoms of bays, harbors, estuaries, and inlets. Clams burrow 30 cm in the sediment with maximum adult densities of 6 to 8 clams per square foot, requiring temperatures below 28°C, and salinities not less than 4-5 ppt (Abraham & Dillon, 1986).

Significant clam beds in New Hampshire exist in the Hampton-Seabrook Estuary with lesser densities occurring in the Great Bay Estuary, Little Harbor, and Rye Harbor.

Habitat Protection Status

Softshell clams beds located in shellfish closed areas are protected from harvest. Currently areas in Great Bay, Piscataqua River complex, and New Hampshire's coastal waters have regulations that prohibit the harvest of softshell clams in designated shellfish closed areas. Motor vehicles are prohibited on all designated clam flats, to reduce damage to softshell clam beds.

Habitat Management Status

Currently there is no habitat management for softshell clams in New Hampshire.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat and species impacts from resource depletion resulting from commercial harvest (Threat Rank: High)

Softshell clams are harvested recreationally by New Hampshire residents from the day after Labor Day until May 31st, subject to closures. No commercial harvesting is allowed. Clams are dug with handheld tools only with minimal damage to surrounding habitat. Harvest limits on softshell clams manage the amount harvested.

The harvest of softshell clams occurs in the state of New Hampshire and is therefore managed through issuing licenses and specific harvest regulations (Fis 606.1- 606.7)

Species impacts from disease (neoplacia, oyster-specific and others) (Threat Rank: High)

The effect of disease on shellfish is of great concern. There is an increased risk of exposure to harmful human pollutants as softshell clams inhabit tidal and estuarine waters. Pollutants collect and concentrate in various tissues of bivalves, and these harmful chemicals and pathogens could results in human health risks. Furthermore, the continuous year-round filter feeding behavior of bivalves and their ability to establish large dense shellfish beds, pose serious potential for large pervasive outbreaks.

Sarcomatous neoplasia, a lethal cancer-like disease, has reported correlation with *M. arenaria* mortality and was identified in New Hampshire's Hampton Estuary in 1986 (Normandeau Associates Inc., 2013). A significantly higher mortality among shellfish infected with S. neoplasia in comparison to individuals lacking the disease has been observed (Brousseau & Baglivot, 1991). Although sources of the disease is not well established, temperature and increased contaminants (e.g., heavy metals, PCB's, PAH's, etc.) may increase the vulnerability of young softshell clams to S. neoplasia (Böttger et al., 2013).

Habitat impacts from increased freshwater run-off (Threat Rank: Medium)

Proliferation of impervious surfaces, driven primarily by residential and industrial development, amplifies freshwater runoff to our lakes, rivers, and ultimately our marine environments. The extent this influence has on the environment is dependent on the duration and intensity of the meteorological event.

Fluctuations in salinity found in estuarine environments inhabited by softshell clams are frequent and scientific investigation of the species exposed to diverse salinities reveal the species have a short-term tolerance to such salinity swings (Matthiessen, 1960; Perkins, 1974). Research suggests warm temperatures decrease the tolerance to low salinities, specifically in juveniles (Abraham & Dillon, 1986). Additionally, low salinities have been directly linked to not only a reduction in feeding (Perkins, 1974), but also reduced amino acid uptake (Stewart & Bamford, 1976; Abraham & Dillon, 1986).

Species and habitat impacts from ocean acidification (Threat Rank: Medium)

Anthropogenic CO2 in the atmosphere reacts to form carbonic acid (H2CO3) in the ocean. Carbonic acid dissociates to form bicarbonate (HCO3) and hydrogen (H+) resulting in a decrease in seawater pH. The formation of additional hydrogen ions favors the increased formation of bicarbonate ions over carbonate ions (CO23-). Fewer carbonate ions hinders the formation of calcium carbonate (CaCO3) which is an important process for building and maintaining shells in shellfish.

One third of all anthropogenic sources of CO2 over the past 200 years have been stored in the ocean. More acidic oceans due to increased CO2 would affect organisms that require calcium carbonate to synthesize and maintain shell. The effect of ocean acidification is suggested to inhibit the growth and survival of larval shellfish, which may adversely affect shellfish populations (Talmage et al., 2010).

Habitat impacts from gear effects related to commercial harvest (Threat Rank: Medium)

Habitat degradation from dredging and the dumping of spoils (Threat Rank: Medium)

Dredging is a process typically used to remove or dispose sediments (sand/mud) to assist shipping and boat traffic. The physical process of dredging can result in disturbance of structure among benthic communities, the loss of seafloor habitat and the suspension of materials, potentially resulting in the release of nutrients and metal contaminants into the water column (Mercaldo-Allen & Goldberg, 2011).

Dredging can alter the arrangement of benthic substrate, potentially reducing the conditions of the original habitat. Research on the recovery of benthic communities (biomass and taxonomic richness) following a dredge suggests that some benthic biota will reestablish in a matter of hours, days, weeks and often complete recovery in one year (Mercaldo-Allen & Goldberg, 2011). Altering the bathymetry of the seafloor can change the circulation and mixing of freshwater and saltwater within an estuary and the scale of the alteration could diminish water quality, ultimately leading to reduced settlement of juvenile shellfish.

Habitat degradation from shoreline hardening (Threat Rank: Medium)

Global sea level rise driven by thermal expansion, melting of glaciers, and ice sheets, and to some extent reduction of liquid water storage on land is a growing concern to coastal regions (Church et al., 2013). Shoreline hardening or armoring, often by the construction of seawalls, has proven beneficial in preserving valuable yet vulnerable waterfront properties thus reducing, if not eliminating damage caused by coastal storm surge. Shoreline barriers can interfere with the formation of beaches, dunes, and intertidal areas, and conceivably devalue the beneficial function of those areas lost (O'Connell, 2010). Collectively, the construction of shoreline barriers and accelerated rate of sea level rise pose environmental risks to coastal marine dwellers, notably shellfish.

Research has revealed that intertidal rocky shores adjacent to seawalls had less biological diversity than areas not fragmented by anthropogenic structures (Goodsell et al., 2007). Additionally, artificial infrastructure (i.e., breakwater) can prompt a shift from consumer- to producer-dominated communities, resulting in a dynamic alteration of the ecosystem structure (Martins et al., 2009).

Habitat degradation due to siltation and turbidity from multiple sources (Threat Rank: Medium)

The majority of marine pollutants originate from terrestrial environments. Erosion from farmland and urban development can result in siltation of aquatic environments (turbidity), although more recent extensive dredging for shipping channels has contributed. Reduced light and poor water quality typically result, and can limit or conceivably eliminate the ability for bivalves to filter feed.

Urbanization along coastal areas is undergoing continuous growth and expansion, and this growth is resulting in increased runoff which intensifies siltation, and could alter circulation patterns in tidal zones typically inhabited by shellfish. Research on the effects of suspended intertidal sediments results in reduced oxygen consumption by softshell clams, and the long-term effects of turbidity may cause starvation (Grant & Thorpe., 1991).

Habitat impacts from introduced or invasive species (Threat Rank: Medium)

Introduced or invasive species are commonly transported and introduced into marine environments not previously inhabited by them through vessels, bilge water, and marine debris. Some exotic pets or aquarium fish released also have the potential to become established and compete with native species. Warming sea temperatures and large storm events play a role in introducing historically non-native species into new environments.

Green crabs (*Carcinus maenas*) are well known predators of softshell clam and many species of shellfish. Green crabs are a pervasive threat to native shellfish communities and have been implicated in drastic reductions in softshell clams (Hanks, 1963). Research indicates the presence of green crabs resulted in reduced clam bed densities, and increased burrowing depth and longer siphons (Whitlow, 2010).

Habitat degradation from contamination of studied contaminants (Threat Rank: Medium)

The immediate proximity to the intertidal zone, an area generally colonized by shellfish, can result in an increased risk and susceptibility to anthropogenic pollutants. Contaminants enter the marine environment through waste treatment facilities discharge, industrial processes, along with domestic and agricultural runoff.

Untreated sewage discharged to marine environments has triggered numerous shellfish bed closures, and in effect, large economic losses, along with cultural, social and ecological benefits (Abraham and Dillon, 1986). Shellfish exposed to PCB and PAH contaminants can result in reduce growth, survival, reproductive success, and increased susceptibility to disease (McDowell et al., 1999).

Habitat degradation from excess nutrients (including algal blooms) (Threat Rank: Medium)

Eutrophication is an environmental response to excess nutrients, primarily nitrogen (N) and phosphorous (P) that enter an aquatic environment though industrial, domestic, and agricultural runoff. Surplus nutrients stimulate algae and phytoplankton growth, resulting in blooms. Large concentrations of algae can reduce light penetration to ecologically important species that inhabit the seafloor, ultimately reducing biological diversity if prolonged. Typically, the algae eventually die and settle to the seafloor, where biological decay of the organism results in reduced oxygen levels (anoxia) in the environment.

Large rain events can result in nutrient runoff from farmlands which may create large algae blooms, eventually leading to a dead zone, an area of low oxygen where species struggle to obtain oxygen to survive. While food (phytoplankton) quality (C: N ratio) remains unchanged in nitrogen enriched estuaries, food quantity proliferates and subsequent increases in growth rates of softshell clams result (Weiss et al., 2002).

Habitat impacts from mercury deposition (Threat Rank: Medium)

Mercury is released into the environment as a result of human activity such as coal burning, mining, and industrial processes. Mercury ultimately makes its way into the marine environment through river and watershed inputs, as well as atmospheric deposition.

Shellfish which live sedentary benthic lives filtering seawater are susceptible to chemical influences, which collect and concentrate in their tissues. Mercury and other heavy metals have been shown to affect oysters on the cellular level, impacting their immune functions (Gagnaire et al., 2004).

Habitat degradation from oil spills (Threat Rank: Medium)

Oil introduced into the marine environment can have lethal and sublethal effects on a variety of marine life across all life stages. Oil has the potential to come in contact with marine life through various industrial and shipping processes that occur in our coastal waters. Oil spills pose the biggest threat with the potential to disperse large amounts of oil into the marine environment.

Shellfish exposed to crude oil have been shown to exhibit changes in respiration, reproductive development, feeding, growth rates, behavior, biochemistry, and increased mortality. Shellfish exposed to crude oil in the marine environment could lead to population decreases (Stekoll et al., 1980).

List of Lower Ranking Threats:

Habitat impacts from marine debris

Habitat impacts and mortality from power plant effluent causing thermal pollution

Habitat degradation from emerging or unmonitored contaminants

Habitat impacts from moorings

Habitat degradation from docks

Habitat impacts from non-motorized boating

Habitat impacts from motorized boating (eelgrass)

Habitat conversion from turbine development and underwater lines, and oil and gas drilling

Habitat impacts from increased wave action that causes bottom disturbance

Habitat impacts from increased storm events that send plumes including erosion, sedimentation, and salinity changes

Habitat and species impacts from phenology shifts

Habitat impacts from higher temperatures that cause anoxia

Habitat degradation from sea level rise that alters communities

Actions to benefit this Species or Habitat in NH

Assess impacts of invasive species and other anthropogenic-threats on softshell clam populations

Primary Threat Addressed: Habitat impacts from introduced or invasive species

Specific Threat (IUCN Threat Levels): Invasive & other problematic species, genes & diseases / Invasive non-native/alien species/diseases / Invasive & other problematic species, genes & diseases

Objective:
Assess impact of invasive and anthropogenic threats on softshell clams.

General Strategy:
Collect and analyze data on the impacts of invasive or introduced species on softshell clam populations and habitat. Research other threats to softshell clams to better understand the impacts in New Hampshire.

Political Location:
Rockingham County

Watershed Location:
Coastal Watershed

Evaluate the distribution and abundance of softshell clams in New Hampshire waters

Primary Threat Addressed: Habitat and species impacts from resource depletion resulting from commercial harvest

Specific Threat (IUCN Threat Levels): Biological resource use / Fishing & harvesting aquatic resources/ Biological resource use

Objective:
Have a complete dataset of the distribution & abundance of softshell clams and use this information to update harvest limits.

General Strategy:
Conduct a complete evaluation of the distribution and abundance of softshell clams in New Hampshire waters. In conjunction, assess recreational harvest limits.

Political Location:
Rockingham County

Watershed Location:
Coastal Watershed

References, Data Sources and Authors

Data Sources
Information on population management was obtained from New Hampshire Fish and Game Department data, technical reports, and scientific literature.

Data Quality
The softshell clam population has been monitored in the Hampton-Seabrook Estuary extensively since 1974 by Normandeau Associates, with additional mapping done in 1991 by New Hampshire Fish and

Game Department. In Great Bay various surveys have been conducted on softshell clam bed distribution and abundance (Smith, 2002; Grizzle et al., 2006) but these surveys lack the long term value that the Hampton-Seabrook Estuary receives.

2015 Authors:
NH Fish and Game

2005 Authors:
N/A

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