Species Status Assessment

Class: **Mammalia (mammals)**
Family: **Physeteridae**
Scientific Name: ***Physeter macrocephalus***
Common Name: **Sperm whale**

Species synopsis:

Sperm whales are the only member of the genus *Physeter*. Initially, Linnaeus described four separate species in the genus, this has since been disproven and today there is only one recognized species of sperm whale (NMFS 2010). There was much debate over whether *P. catodon* or *P. macrocephalus* (both given by Linnaeus) was the correct name for the species. Today, most cetologists recognize Holthuis' (1987) argument that the principle of "First Reviser" should apply, and therefore the correct name for the sperm whale is *P. macrocephalus* (NMFS 2010). Both names are still seen in the literature. Some molecular analyses placed sperm whales as being more closely related to baleen whales than other toothed whales (Milinkovitch et al. 1993, 1994); however, most recent evidence does not support this claim (Heyning 1997, Cassens et al. 2000, Nishida et al. 2003, 2007, Arnason et al. 2004, Agnarsson and May-Collado 2008, Xiong et al. 2009). For the purposes of management sperm whales in the North Atlantic are considered one stock, though finer population structure may exist it is difficult to define (Reeves and Whitehead 1997, Lyrholm and Gyllensten 1998, NMFS 2013).

In general, sperm whales in the U.S. Exclusive Economic Zone (EEZ) are found in areas associated with the edge of the Gulf Stream and other oceanographic factors. These include the continental shelf, the shelf edge and mid-ocean regions beyond (Waring et al 1993, 201, NMFS 2013). Another factor affecting sperm whale distribution is social structure, where animals may group themselves according to social units, with males tending to travel the furthest (Best 1979, Whitehead 2002). In New York, sperm whales have been observed in deep continental shelf waters, as well as in a relatively shallow area off of Montauk Point (Sadove and Cardinale 1993, Scott and Sadove 1997). They are most often seen in spring and early summer in New York waters (Sadove and Cardinale 1993, Scott and Sadove 1997). Most of these whales were sighted in an area that corresponds to a seafloor depression making a channel between Block Island Sound and Block Canyon (Scott and Sadove 1997). Sperm whales occasionally wash on New York beaches. Little current information exists on sperm whales in New York.

The best abundance estimate for sperm whales in the western North Atlantic (from North Carolina to the lower Bay of Fundy) is 1,593 (NMFS 2013). Current population trends are unknown.

I. Status

a. Current and Legal Protected Status

i. **Federal** ______Endangered______________ **Candidate?** ________

ii. **New York** ______Endangered______________________________

b. Natural Heritage Program Rank

i. **Global** ______G3G4______________________________

ii. **New York** ______SNA__________ **Tracked by NYNHP?** __Yes_____

Other Rank:
Depleted under Marine Mammal Protection Act
CITES Appendix I

Status Discussion:
The sperm whale was commercially harvested around the world for over two and a half centuries (NMFS 2010). The first whaling regulations did not appear until 1970, when the first quotas were introduced. The moratorium on commercial whaling put into place by the International Whaling Commission (IWC) gave sperm whales protection beginning in the 1981 – 1982 pelagic whaling season and the 1986 coastal whaling season (IWC 1982). Of the large whale species it is believed that sperm whales remain the highest in terms of abundance (NMFS website). The best available worldwide estimate for sperm whales is 200,000-1,500,000. However, this is based on information from just a few areas within their range (NMFS website). Whitehead (2002) estimated that the entire global population of sperm whales is around 32% of their pre-whaling numbers. It is believed that sperm whales in the North Atlantic most likely are above this level, as sperm whales were not as heavily exploited in the North Atlantic (NMFS 2010).

In the United States, the sperm whale has been listed by the Endangered Species Act since it was enacted in 1973, and the Marine Mammal Act since 1972. The best population estimate for the eastern United States is 1,593 (NMFS 2013). This estimate is based on a combination of shipboard and aerial surveys that took place from North Carolina north to the lower Bay of Fundy (NMFS 2013). It is thought this estimate is low because it does not correct for dive-time, which can be about 30-60 minutes in duration (Whitehead et al 1991, Watkins et al 1993, NMFS 2013,).

II. Abundance and Distribution Trends

a. North America

i. Abundance

____ declining ____increasing _____stable __X__ unknown

ii. Distribution:

____ declining ____increasing _____stable __X__ unknown

Time frame considered: Trends never analyzed.

b. Regional

i. Abundance

____ declining ____increasing ____stable __X__ unknown

ii. Distribution:

____ declining ____increasing ____stable __X__ unknown

Regional Unit Considered: Northeast
Time Frame Considered: Trends never analyzed.

c. Adjacent States and Provinces

CONNECTICUT Not Present _______ No data _______

i. Abundance

____ declining ____increasing ____stable __X__ unknown

ii. Distribution:

____ declining ____increasing ____stable __X__ unknown

Time frame considered: Rare visitor, trends never analyzed.
Listing Status: Not listed SGCN? No

MASSACHUSETTS **Not Present** _______ **No data** _______

i. Abundance

____ declining ____increasing ____stable __X__ unknown

ii. Distribution:

____ declining ____increasing ____stable __X__ unknown

Time frame considered: Rare visitor, trends never analyzed.
Listing Status: Endangered SGCN? Yes

NEW JERSEY **Not Present** _______ **No data** _______

i. Abundance

____ declining ____increasing ____stable __X__ unknown

ii. Distribution:

____ declining ____increasing ____stable __X__ unknown

Time frame considered: Trends never analyzed.
Listing Status: Endangered SGCN? Yes

ONTARIO **Not Present** __X__ **No data** _______

i. Abundance

____ declining ____increasing ______stable ____unknown

ii. Distribution:

____ declining ____increasing ______stable ____unknown

Time frame considered: ______________________________
Listing Status: ______________________________

PENNSYLVANIA **Not Present __X__** **No data _______**

i. **Abundance**

____ declining ____increasing ____stable ____unknown

ii. **Distribution:**

____ declining ____increasing ____stable ____unknown

Time frame considered: ____
Listing Status: ____ SGCN? __________

QUEBEC **Not Present _________** **No data _______**

i. **Abundance**

____ declining ____increasing _____stable __X__ unknown

ii. **Distribution:**

____ declining ____increasing ______stable __X__ unknown

Time frame considered: ___Rare visitor, trends never analyzed.______________
Listing Status: ___Not listed____

VERMONT **Not Present __X__** **No data ________**

i. **Abundance**

____ declining ____increasing ____stable ____unknown

ii. **Distribution:**

____ declining ____increasing ____stable ____unknown

Time frame considered: ____
Listing Status: __________ _________________________________ SGCN? __________

RHODE ISLAND **Not Present** _______ **No data** _______

i. Abundance

____ **declining** ____**increasing** ____**stable** __X__ **unknown**

ii. Distribution:

____ **declining** ____**increasing** ____**stable** __X__ **unknown**

Time frame considered: Trends never analyzed.

Listing Status: Not listed. SGCN? Yes

d. NEW YORK **No data** _______

i. Abundance

____ **declining** ____**increasing** ____**stable** __X__ **unknown**

ii. Distribution:

____ **declining** ____**increasing** ____**stable** __X__ **unknown**

Time frame considered: Trends never analyzed.
Listing Status: Endangered SGCN? Yes

Monitoring in New York.

NOAA, NEFSC, Protected Species Branch conducts regular aerial and ship board surveys to determine the abundance and distribution of protected species in the North East. However, sampling, including scale of sampling, is not specific either to large whales in the New York Bight, nor is sampling year round. There are no current monitoring activities or regular surveys conducted by the State of New York or specific to large whales in the New York Bight. However, DEC, Marine Resources and Natural Heritage Program are currently in the planning stages to establish a regular monitoring program for large whales. The monitoring techniques and protocols have not yet been determined. There is currently funding for three years of monitoring.

Trends Discussion:

Trends have not been analyzed for the western North Atlantic population of sperm whales. Although they were heavily exploited by commercial whaling until the 1970s, the sperm whale remains one of the most abundant large whales in the area (NMFS 2010). Using methods developed by Whitehead (2002), NMFS (2010) estimated the Atlantic population of sperm whales to number between 90,000 – 134,000 sperm whales. Vessel and aerial surveys in 2004 from Florida to the Bay of Fundy developed a population estimate of about 4,804 (NMFS 2013). 2,607 was the estimate for the population from Maryland north to the Bay of Fundy (NMFS 2013). These estimates were not corrected for dive time, and thus are most likely an underestimation of actual abundance (NMFS 2013). The best estimate for sperm whale abundance off of the eastern U.S. comes from shipboard and aerial surveys conducted in 2011 (NMFS 2013). These surveys covered the area north of North Carolina to the lower Bay of Fundy, and estimated an abundance of 1,593 sperm whales (NMFS 2013). Because the survey methods changed between years it is not possible to directly compare the 2011 estimate with earlier estimates. This makes it is very difficult to detect trends (NMFS 2013).

However, global population trends have been modeled and it is estimated that he estimated that the worldwide population of sperm whales was at about 32% of its pre-whaling level as of 1999 (Whitehead 2002). The rate of population increase was estimated to be 0.965% per year (Chiquet et al. 2013). However, this rate is sensitive to changes in survivorship especially of mature females, where a decline of just over 2% could lead to population decline (Chiquet et al. 2013).

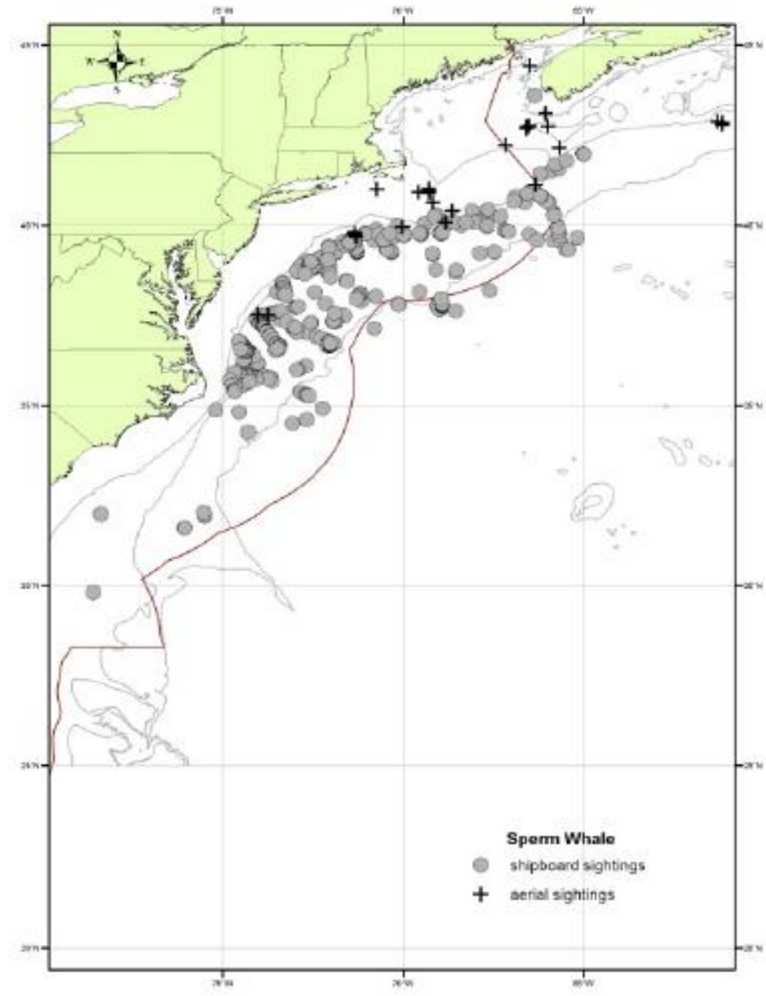

Figure 1. Distribution of sperm whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998, 1999, 2002, 2004, 2006 and 2011. Isobaths are the 100m, 1000m, and 4000m depth contours. Figure from NOAA. Fisheries 2013.

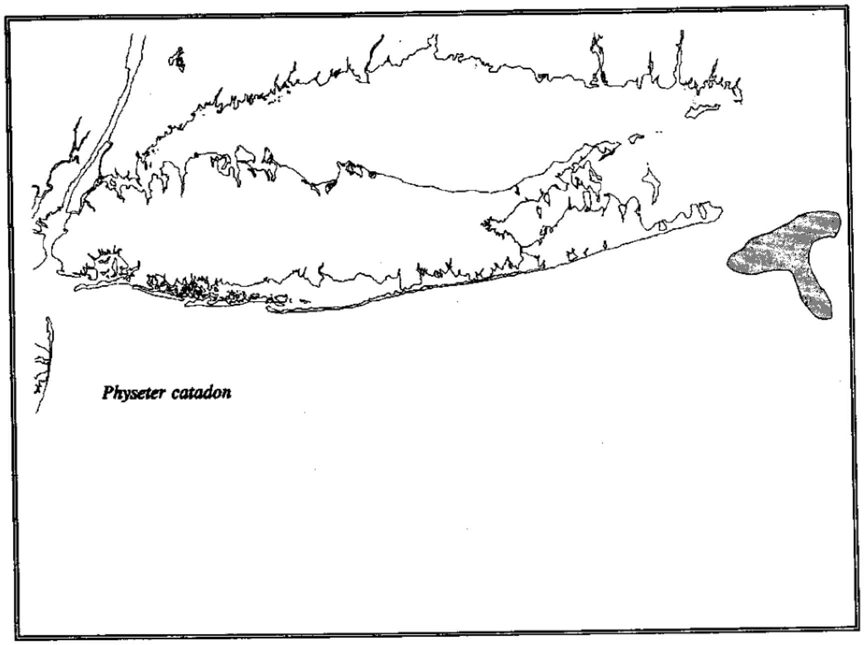

Figure 2. Locations of sightings of sperm whales by surveys conducted by the Okeanos Ocean Research Foundation from 15 years of research from the 1970s – early 1990s. From Sadove & Cardinale 1993.

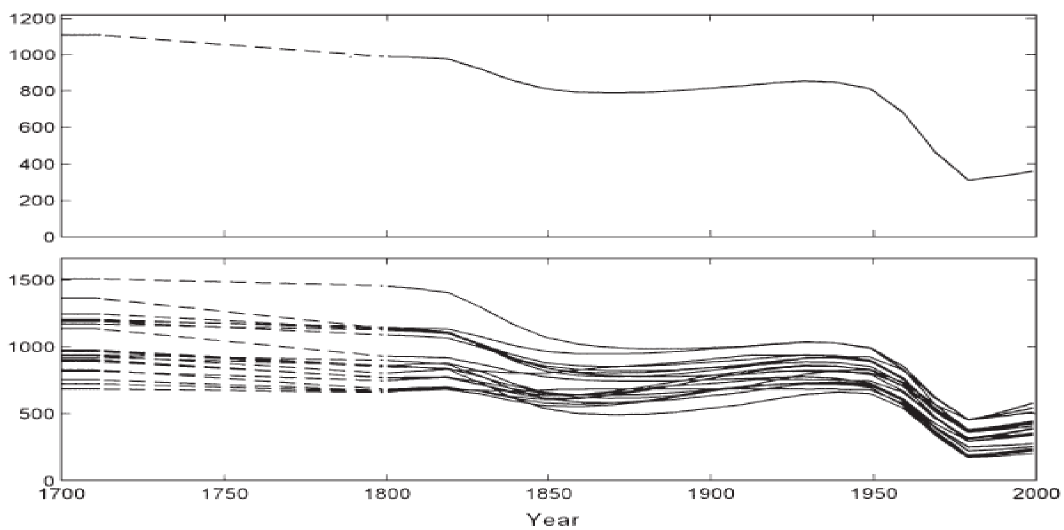

Figure 3. *Physeter macrocephalus.* Estimated population trajectories for the global sperm whale population from 1700 to 1999. The upper plot shows the trajectory calculated from Whitehead (2002)'s best estimate of the population and model parameters, the lower plot shows twenty trajectories calculated using randomly chosen parameters within reasonable ranges. The period from 1712 to 1800 is dashed as information about this time period is very limited. Figure from Whitehead (2002).

III. New York Rarity, if known:

Historic (select one)	**# of Animals**	**# of Locations**	**% of State**
prior to 1970	________	________	________
prior to 1980	________	________	________
prior to 1990	________	12	________

Details of historic occurrence:

The Okeanos Ocean Research Foundation documented sperm whales on 12 separate occasions from 1983 – 1989 (Scott and Sadove 1997). In most instances, it is unknown whether these were the same animals seen multiple times or previously unseen individuals. In 1987, the same individual was sighted on four occasions (Scott and Sadove 1997). The whale was in a group of four individuals during each event, so it is believed that these sightings all consisted of the same group of individuals (Scott and Sadove 1997). Many of these sightings came from the Okeanos Foundation's whale-watch vessel, and were not a product of systematic surveys (Scott and Sadove 1997). Due to the nature of these sightings, it is possible that other groups of sperm whales could have been present in the area and were not sighted (Scott and Sadove 1997).

Table 1. Sperm whale sightings from 1983 – 1989 as documented by Okeanos Ocean Research Foundation. n = number of individuals sighted and T_s = sea surface temperature. As adapted from Scott and Sadove (1997).

Date	*n*	Latitude (N)	Longitude (W)	T_S (C)	Depth (m)
06/25/83[a]	3	40°53.0′	71°40.9′	—	55.5
07/09/83	1	40°52.3′	71°38.0′	19°	51.8
07/12/83[a]	1	40°51.1′	71°41.6′	—	58.0
07/23/83[b]	1	40°46.5′	71°38.1′	—	65.2
06/30/85[a]	1	40°49.6′	71°37.0′	—	58.2
07/05/85[a]	4	40°45.0′	71°39.8′	—	68.0
05/27/87	4	40°50.5′	71°40.6′	11°	61.0
06/07/87[a]	2	40°44.2′	71°31.1′	—	63.0
06/10/87	4	40°00.4′	71°40.3′	14°	41.5
06/14/87	4	40°52.1′	71°41.2′	13°	57.9
06/16/87	4	40°54.5′	71°40.1′	17°	53.3
06/17/87[a]	1	40°03.5′	71°24.7′	—	42.9

Notes: No *P. macrocephalus* were sighted during 1982, 1984, 1986, 1988, and 1989; [a] sighted from the whale-watching vessel *Sunbeam*. [b] sighted from the sport fishing vessel *Bluefin*.

Current	**# of Animals**	**# of Locations**	**% of State**

1,593 for the western North Atlantic, # unknown for New York Bight

Details of current occurrence:

Surveys done by NOAA. Fisheries show consistent presence in the New York Bight at the edge of the continental shelf (Figure 1). For state waters the most recent accessible information comes from Okeanos Foundation. Scott and Sadove (1997) reported sperm whales in New York waters on sixteen occasions from 1990 – 1994. It is unknown whether sightings were of the same individuals (Scott and Sadove 1997). Subsequent reports of sperm whales in state waters have either not been published or are not accessible.

Table 2. Sperm whale sightings from 1990 – 1994 as documented by Okeanos Ocean Research Foundation. n = number of individuals sighted and T_s = sea surface temperature. As adapted from Scott and Sadove (1997).

Date	*n*	Latitude (N)	Longitude (W)	T_S (C)	Depth (m)
05/22/90	5	40°58.0′	71°32.7′	11°	51.8
05/27/90	1	40°50.9′	71°45.4′	11°	53.3
05/28/90	3	40°50.9′	71°44.0′	11°	56.4
05/29/90	3	40°51.5′	71°41.9′	12°	58.2
10/19/91	4	40°53.1′	71°42.5′	15°	58.0
06/08/92	1	40°52.3′	71°41.1′	12°	58.2
06/10/92	4	40°50.8′	71°42.4′	13°	61.9
06/13/92	3	40°56.1′	71°43.7′	13°	55.5
05/31/93	3	40°44.1′	71°37.8′	13°	66.8
05/16/94	2	40°57.6′	71°29.5′	9°	54.9
05/20/94	1	40°59.7′	71°29.5′	9°	51.0
05/21/94	4	40°58.0′	71°38.4′	10°	51.0
05/25/94	2	40°59.6′	71°37.0′	11°	41.0
05/28/94	4	40°57.2′	71°36.7′	12°	43.2
06/04/94	4	40°58.9′	71°27.0′	14°	55.1
09/04/94	4	40°55.1′	71°40.6′	20°	51.8

New York's Contribution to Species North American Range:

% of NA Range in New York	Classification of New York Range
____ 100 (endemic)	____ Core
____ 76-99	__X__ Peripheral
____ 51-75	____ Disjunct
____ 26-50	Distance to core population:
__X__ 1-25	____________

IV. Primary Habitat or Community Type:

1. Pelagic
2. Marine, Deep Subtidal

Habitat or Community Type Trend in New York:

____ Declining ____Stable ____ Increasing __X__ Unknown

Time frame of decline/increase: ____

Habitat Specialist? ______ Yes __X__ No

Indicator Species? __X__ Yes ______ No

Habitat Discussion:

Sperm whales can be found across the entire North Atlantic (NMFS 2010). Currently, the International Whaling Commission recognizes one stock of sperm whales that encompasses the entire North Atlantic (NMFS 2013). Lack of genetic differentiation and documented movements of male sperm whales across the ocean basin suggest that there is not well-defined segregation between the western North Atlantic and eastern North Atlantic populations (Mitchell 1975, Reeves and Whitehead 1997, Dufault et al. 1999, Englehaupt et al. 2009).

In the waters off of the eastern U.S., sperm whales appear to follow a seasonal cycle in distribution (CETAP 1982, Scott and Sadove 1997). Sperm whales can be found concentrated near Cape

Hatteras, North Carolina in the winter (NMFS 2013). During the spring, sperm whales are most often found off of Delaware and Virginia, and spread throughout the mid-Atlantic bight and southern Georges Bank; in the summer this range expands to include the continental shelf south of New England and north of Georges Bank into the Northeast Channel (NMFS 2013). During the fall, sperm whales are found along the continental shelf south of New England and also along the edge of the continental shelf in the mid-Atlantic bight (NMFS 2013).

Sperm whales are often found in deep water areas along the outer shelf edge and open ocean waters (Waring et al. 2001). They are often found near seamounts and underwater canyons (Waring et al. 2001). Sperm whales are also believed to be associated with the Gulf Stream edge and warm-core rings (Waring et al. 1993, 2001). Typically, males range farther north into cooler waters than females, who remain in temperate to tropical waters with calves and immature animals (NMFS 2010). Distribution seems to be driven primarily by suitability of the area for breeding and the availability of prey. Sperm whale diet consists of sharks, skates, fishes and large squid (NMFS website). They are able to perform long, deep dives to access their prey. Dives may last from 30-60 minutes and be to depths of 400 m (1,312 ft) (NMFS website).

In New York state waters, the majority of sperm whale sightings have occurred in the late spring to early summer period (Sadove and Cardinale 1993, Scott and Sadove 1997). Two of the 28 sightings of sperm whales from 1983 – 1994 were in the fall; sampling was not as intense during this period of time, so it is unknown whether whales return to the area during this time (Scott and Sadove 1997). The average water depth of the sightings was 55 m (Scott and Sadove 1997). The sightings reported by Scott and Sadove (1997) centered on a bathymetric depression that marks the channel running between Block Island Sound and Block Canyon, just under 30 km SSE of Montauk Point. Although feeding was not confirmed, Scott and Sadove (1997) believed that foraging was occurring and hypothesized the sperm whales used the channel to follow prey inshore. In New York Bight waters sperm whales have been sighted at and over the edge of the continental shelf (NMFS 2013).

V. New York Species Demographics and Life History

_____ **Breeder in New York**

____ **Summer Resident**

____ **Winter Resident**

____ **Anadromous**

____ **Non-breeder in New York**

____ **Summer Resident**

____ **Winter Resident**

____ **Catadromous**

____ **Migratory only**

__X__ **Unknown**

Species Demographics and Life History Discussion:

Sperm whales have a complex, multilevel society. Females form 'social units', which contain females and immature animals that travel together, care for each other's offspring, and defend each other (Whitehead 1998, Christal et al. 1998, Pitman et al. 2001, Gero et al. 2008, Ortega-Ortiz et al. 2012). These units are typically found in temperate and tropical waters south of around 45°N, although they can be found farther north (NMFS 2010). Sexually mature males travel to these areas to breed with females in the winter (NMFS 2010). The inter-birth interval is around 4 – 6 years (Best et al. 1984). Females sperm whales reach sexual maturity at around 9 years of age and rarely give birth after the age of 40 (Whitehead 2003). Sexual maturity among males is prolonged and may occur between the ages of 10-20, though they are not active breeders until their late twenties (Best 1979, NMFS website).

Gestation is believed to range from 15 months to over a year and a half (NMFS 2010). Females nurse their offspring communally for at least two years (Best et al. 1984). Most females remain within their social unit for life (Christal et al. 1998). Males typically leave their mothers around the age of ten to move to cold waters and form bachelor groups (Whitehead 2003). Males are usually solitary once they reach their prime breeding age (Christal and Whitehead 2001). Sperm whales are known to live for at least 60 years (Rice 1989).

Sperm whales are known to be capable of long-distance movements. One male sperm whale tagged in Nova Scotia in 1966 was killed off of Spain in 1973 (Mitchell 1975). Sperm whales killed off of Iceland and Spain have had harpoon fragments from the Azores embedded within them (Martin 1982, Aguilar 1985). Tagged sperm whales have also crossed the equator (Ivashin and Rovnin 1967).

Sperm whales occasionally fall victim to predation events. There have been several accounts of sperm whales harassing and/or attacking sperm whales; occasionally these attacks have resulted in a kill (Pitman and Chivers 1998, Pitman et al. 2001). There has been at least one record of a group of killer whales killing a seemingly healthy adult female sperm whale off the coast of California (Pitman and Chivers 1998). All of the existing published records of attacks on sperm whales by killer whales took place in either the Pacific or Southern Oceans. Sperm whale males also fight among each other (NMFS 2010).

Sperm whales are a species that occasionally mass strand. The causes of these stranding events are usually unknown (Rice 1989, NMFS 2010). There has been some evidence that sperm whale strandings are influenced by lunar and solar cycles (Wright 2005). While the exact mechanisms are currently poorly understood, it is believed that the strandings could be related to the effects that light levels have on the vertical migration of sperm whale prey (Wright 2005) or variations in the magnetic field as a result of solar cycles (Vanselow and Ricklefs 2005).

Disease appears to play some role in natural mortality of sperm whales, although little is known on the full extent it has on sperm whale populations (Lambertsen 1997, NMFS 2010). Lambertsen (1997) identified two potentially lethal diseases in sperm whales: myocardial infarction associated with coronary atherosclerosis and gastric ulceration as a result of nematode infection. Additionally, bone lesions in the rib and chevron area of sperm whales have been observed; Moore and Early (2005) hypothesized that this necrosis could be caused by the formation of nitrogen bubbles after deep dives and ascents. The bone necrosis appeared to be cumulative, with the bone damage increasing in severity as the size of the whale increased (Moore and Early 2005).

Primary human causes of mortality in sperm whales include ship strike and entanglement in fishing gear. However, entanglement may be less of a problem for sperm whales than for other large whales due to their offshore distribution (NMFS 2013).

Little is known on the demographic and life history of sperm whales in New York. The Okeanos Foundation documented two periods of abundance in state waters: one during the late spring and early summer, and another potentially during the fall (Sadove and Cardinale 1993, Scott and Sadove 1997). Based on animal size and head to body size ratio, it is believed that both sexes and all age classes except for calves have been sighted (Sadove and Cardinale 1993, Scott and Sadove 1997). No direct observations of feeding have been made, but on at least one instance parts of squid were observed near where sperm whales were diving (Scott and Sadove 1997). Scott and Sadove (1997) believed that sperm whales take up a short-term residence in the spring/early summer (whales were usually sighted for a duration of one to four weeks) before migrating farther east. The Okeanos Foundation did not usually survey in the fall and winter, so it is unknown whether the few additional fall sightings represented a seasonal return to New York waters or were random, chance sightings (Scott and Sadove 1997).

VI. Threats:

Two of the best known anthropogenic threats to large whale populations include vessel strikes and fishery interactions, specifically entanglement in fishing gear. Both of these threats are believed to be more of a problem than observational studies suggest, as many events are most likely not reported, and affected whales may die at sea and not be recovered (Heyning and Lewis 1990). Unfortunately, it is extremely difficult to track a specific event to a geographic location, so it is nearly impossible to know whether an event occurred in New York waters.

Jensen and Silber (2004) compiled information on reported ship strikes from 1975 – 2002. They found that sperm whales were involved in seventeen out of 292 records (Jensen and Silber 2004). Sperm whales often spend relatively long periods of time (up to ten minutes or more) on the surface between deep dives (Jaquet et al. 1998, Whitehead 2003), which could make them more vulnerable to ship strikes (NMFS 2010). In May 2000, a merchant ship reported a collision with a sperm whale in Block Canyon, off of Long Island (Waring et al. 2009). From 2006 – 2010, NMFS (2013) estimated the average number of sperm whales struck by a ship annually to be 0.2. Because of their offshore distribution, it is likely that sperm whales are struck by vessels more often than reported, however, ship strikes are believed to have a relatively low effect on sperm whale populations overall (NMFS 2010).

Sperm whales do not appear to become entangled in fishing gear as often as several other species of large whales (NMFS 2010). However, there have been reports of sperm whales caught in the pelagic gillnet fishery off of the East Coast in the past. This fishery closed in 1997, and drift gillnets were banned in 1999 (NMFS 2013). One sperm whale was taken by the Canadian halibut longline fishery in 2009 and another in 2010. Currently, sperm whales have not been documented as bycatch in U.S. Atlantic commercial fisheries, although abandoned “ghost gear” from the pelagic gillnet and other fisheries could potentially pose a threat to them (NMFS 2013). Additionally, sperm whales can break through or carry away fishing gear once they become entangled, even when injured (NMFS 2010). This ability coupled with their typically offshore distribution most likely leads to an underreporting of sperm whale entanglement. Even if entangled whales do not die from the entanglements, they could suffer from reduced survival and fecundity, as has been documented in North Atlantic right whales (Knowlton and Kraus 2001).

Stranding and entanglement response and outreach in New York are currently provided by Riverhead Foundation. They respond to all marine mammal strandings; however, they are not authorized to disentangle large whales. The nearest group authorized by NOAA to perform such entanglements is the Rhode Island Division of Fish and Wildlife.

Climate change has led to temperature and current shifts throughout the North Atlantic Ocean. These changes could lead to shifts in distribution of sperm whales as occupied habitats may become unsuitable and previously unsuitable habitats may become occupied. There is some evidence from Pacific equatorial waters that sperm whale feeding success and calf production are negatively affected by increases in sea surface temperatures (Smith and Whitehead 1993, Whitehead 1997). The effects of climate change on both sperm whales and their prey need to be further researched.

The effects of other anthropogenic activities, such as offshore energy development are also largely unknown. Oil spills threaten marine mammals including the sperm whale. Ackleh et al. (2012) used passive acoustics to document an apparent shift in sperm whale distribution away from the spill site of the Deepwater Horizon oil spill in the Gulf of Mexico. The other major threat of development and other human activities is noise pollution. Sperm whales rely heavily on sound to both communicate and also for echolocation. Increasing levels of anthropogenic noise in the ocean could hamper these abilities. Ross (1987, 1993) estimated that the ambient noise level in the oceans rose 10 dB from 1950 – 1975 because of shipping; background noise has been estimated to be increasing by 1.5 dB per decade at the 100 Hz level since propeller-driven ships were invented (National Research Council 2003). The oceans are getting progressively louder, and the waters off of New York are no exception (BRP 2010). Acoustic monitoring in the New York Bight region in 2008 and 2009 found elevated levels of background noise (due in large part to shipping traffic) (BRP 2010). High levels of noise could have several effects on marine mammals from changes in foraging success to death (Richardson et al. 1995).

Currently, there is a large level of uncertainty regarding the effects of anthropogenic noise on sperm whales. Sperm whales have been reported to stop echolocating above certain noise thresholds and when echosounders are in the vicinity (Watkins and Schevill 1975, NMFS 2010). Goold (1996) reported a group of sperm whales being driven through a narrow channel by boats and emissions from echosounders and fishfinders, indicating a change of behavior. Several other species of large whales have been found to increase the amplitude of their calls in response to large levels of noise, which could lead to increased energy consumption (See Holt et al. 2008, Parks et al. 2010). It is currently unknown whether sperm whales exhibit this same behavior.

Seismic surveys, often used for oil and gas exploration, may have effects on sperm whale behavior. Sperm whales in the Gulf of Mexico appeared to move away from the area when surveys began (Mate et al. 1994, Davis et al. 1995, Johnson and Miller 2002). However, other studies found no avoidance (NRC 2003, Miller et al. 2009, Stone 2003).

Recreational vessel activity, such as whale-watching, has been known to affect some species of cetaceans. Whether this is a product of whale-watching vessels not frequenting areas where sperm whales are typically located or whether the whales exhibit an avoidance response to vessels is currently unknown (NMFS 2010). In the waters off of New York and the East Coast, sperm whales are rarely sighted by whale-watching vessels, so this unlikely to be much of a threat.

There has been some recent concern about contaminant levels in odontocetes (toothed whales) such as the sperm whale. Odontocetes generally feed at a higher trophic level than most baleen whales, so they are more at risk of bioaccumulation of various contaminants. Since the 1980s, western Europe has observed an increase in sperm whale strandings, leading to concerns that pollution may be a factor (Goold et al. 2002). Some of the stranded whales were tested for various contaminants; while no direct link between the contaminant level and the strandings was found (Jacques and Lambertsen 1997), the levels of mercury, cadmium and organochlorines were high enough to be concerning (Bouquegneau et al. 1997, Law et al. 1997). Holsbeek et al (1999) found that a sample of sperm whales stranded in the North Atlantic had average levels of mercury, PCBs, DDE and polycyclic aromatic hydrocarbons but had levels of cadmium that were twice as high as measurements in the North Pacific. Many of these contaminants have been linked to deleterious health effects and decreased reproductive success in mammal species, but it is currently largely unknown how elevated levels of contaminants affect sperm whales.

Marine solid pollutants can also threaten sperm whales. Sperm whales often feed at the bottom, and are believed to use a suction method to ingest prey (NMFS 2010). In 1989, a necropsy on a sperm whale in the Mediterranean Sea revealed the cause of death to be stomach obstruction by plastic bags and sheets (Viale et al. 1992). Lambertsen (1990) reported that one of 32 sperm whales examined in Iceland was killed by an illness believed to be caused by ingested plastic obstructing the gut. Overall, there are relatively few instances of injury to sperm whales due to marine solid pollutants, so the perceived threat to the population is generally considered to be low.

Are there regulatory mechanisms that protect the species or its habitat in New York?

_______ **No** _____ **Unknown**

__X__ **Yes**

The sperm whale is protected in the United States by its status as a federally Endangered species. In addition, the sperm whale (along with all other marine mammals) receives federal protection under the Marine Mammal Protection Act of 1972 (MMPA). The sperm whale is protected internationally from commercial hunting under the International Whaling Commission's (IWC) global moratorium on whaling. The moratorium was introduced in 1986, and is voted on by member countries (including the United States) at the IWC's annual meeting.

Sperm whales are also protected under the Environmental Conservation Law (ECL) of New York. The sperm whale is listed as a state endangered species in New York. Section 11 – 0535 protects all state-listed endangered and threatened species and makes it illegal to take, import, transport, possess or sell any listed species or part of a listed species. In addition, Article 17 of the ECL works to limit water pollution, and Article 14 presents the New York Ocean and Great Lakes Ecosystem Conservation Act. This act is responsible for the conservation and restoration of coastal ecosystems "so that they are healthy, productive and resilient and able to deliver the resources people want and need." Both of these help to protect the habitat of the sperm whale. Whether they are adequate to protect the habitat is currently unknown. Unfortunately, we have limited understanding of where sperm whales occur in New York, so it is impossible to assess whether the habitat protection afforded by these acts are effective.

The majority of documented sperm whale entanglements occurred in gear used by the pelagic gillnet fishery (NMFS 2013). This fishery was closed in 1997, and drift gillnets were banned in 1999 (NMFS 2013). The North Atlantic Large Whale Take Reduction Plan identified floating groundline used in the trap and pot fisheries as an entanglement threat for large whales. The National Marine Fisheries Service subsequently passed a new law making it mandatory for all pot and trap fisheries to switch over to sinking groundline by 2008. To encourage compliance by fishermen, DEC's Marine Endangered Species and Crustacean Unit partnered with the Cornell Cooperative Extension of

Suffolk County and initiated gear buyback programs, which removed 16.9 tons of floating rope from New York's commercial lobster fishery. Further analysis is required before it is known if any real reduction in large whale entanglement has occurred as a result of the switch from floating to sinking groundline.

More could be done to protect all large whales in the New York Bight from ship strike. Particularly around the shipping lanes.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

The extent of sperm whale use of New York waters is poorly understood. What information is available comes from surveys done in the 1970s – early 1990s, though surveys by NMFS show generally the same pattern of distribution. However, these surveys are only carried out at certain times a year so they do not give a complete picture. Long-term surveys and monitoring strategies should be developed. Historically, vessel and aerial survey techniques have been used. Passive acoustics also has promise as a monitoring technique. Sperm whales can be especially difficult to spot during aerial and ship board surveys, as they frequently dive for long periods of time (40+ minutes), so passive acoustics may be needed (NOAA., Fisheries 2010).

If it is known where and when sperm whales are occurring in New York waters, more effective management and conservation strategies can be deployed. Seasonal speed restrictions on vessels in high use areas could be put into effect. In addition, seasonal and/or area closures on certain fisheries where the gear poses the largest threat to large whales may help minimize entanglement in gear.

Near real-time acoustic monitoring of large whales, specifically right whales, is currently being used off of the coast of Massachusetts in an effort to reduce vessel collisions with large whales. When a right whale is detected, an alert goes out to all large shipping vessels in the area, and a speed restriction goes into place. Similar monitoring in New York could help reduce the threat of vessel collisions with large whales in coastal waters. Even if a speed restriction only goes into place for the critically endangered right whale, knowledge that there are large whales in the area could lead to increased awareness and alertness and possibly reduce the potential of a collision.

The sperm whale would benefit greatly from further research. Little is known about general life history and demography of this species in New York, and the real effects of the threats in state waters are largely unknown. Further research into the actual effects that threats such as climate change are having on sperm whales is warranted. In addition, education on this species and the importance of reporting ship strikes and entanglements is encouraged.

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