MINKE WHALE (*Balaenoptera acutorostrata acutorostrata*): Canadian East Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution in temperate, tropical and high-latitude waters. They are common and widely distributed within the U.S. Atlantic Exclusive Economic Zone (EEZ) (CETAP 1982). There appears to be a strong seasonal component to minke whale distribution on both the continental shelf and in deeper, off-shelf waters. Spring to fall are times of relatively widespread and common acoustic occurrence on the shelf (e.g., Risch *et al.* 2013), while September through April is the period of highest acoustic occurance in deep-ocean waters throughout most of the Western North Atlantic (Clark and Gagnon 2002; *Risch et al.* 2014). During the spring-fall period the whales are most abundant in New England waters. Records based on visual sightings and summarized by Mitchell (1991) hinted at a possible winter distribution in the West Indies, and in the mid-ocean south and east of Bermuda, a suggestion that has been validated by acoustic detections throughout broad ocean areas off the Caribbean from late September through early June (Clark and Gagnon 2002; Risch *et al.* 2014).

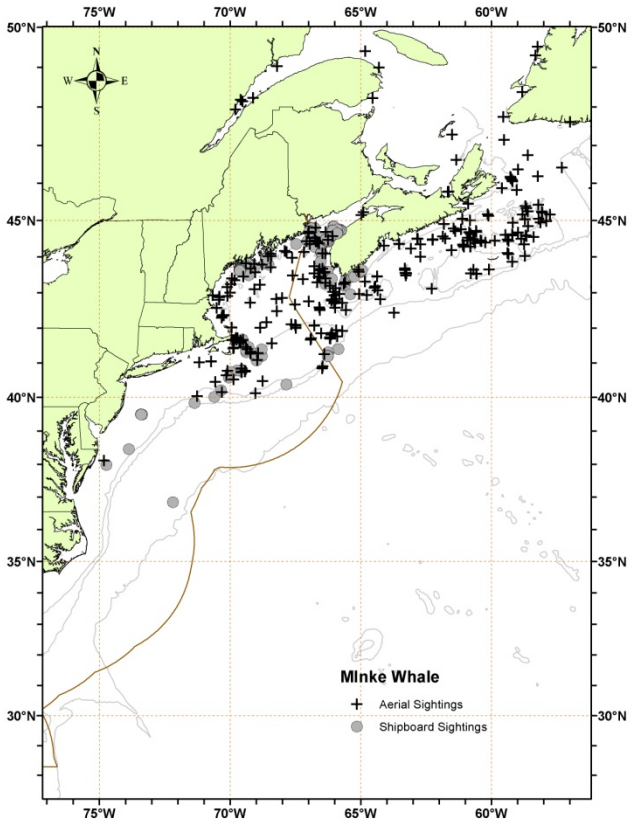

Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011and DFO's 2007 TNASS survey. Isobaths are the 100-m, 1000-m and 4000-m countours.*

In the North Atlantic, there are four recognized populations—Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). These divisions were defined by examining segregation by sex and length, catch distributions, sightings, marking data, and pre-existing ICES boundaries. However, there were very few data from the Canadian East Coast population. Anderwald *et al.* (2011) found no evidence for geographic structure comparing these putative populations but did, using individual genotypes and likelihood assignment methods, identify two cryptic stocks distributed across the North Atlantic. Until better information is available, common minke whales off the eastern coast of the United States are considered to be part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45ºW) to the Gulf of Mexico.

In summary, key uncertainties about stock structure are due to the limited understanding of the distribution, movements, and genetic structure of this stock. It is unknown whether the stock may contain multiple demographically independent populations that should be separate stocks. To date, no analyses of stock structure within this stock have been performed.

POPULATION SIZE

The abundance estimate for this stock is 2,591 (CV=0.81; Palka 2012) common minke whales. This estimate,

derived from 2011 shipboard and aerial surveys, is the only current estimate available. This estimate is substantially lower than the estimate from the 2015 SAR (20,741, CV=.30). This is because the previous estimate included data from the 2007 TNASS surveys of Canadian waters. For the purposes of this SAR, as recommended in the 2016 guidelines for preparing stock assessment reports (NMFS 2016), estimates older than eight years are deemed unreliable, so this new estimate must not include data from the 2007 TNASS survey. This new estimate should not be interpreted as a decline in abundance of this stock, as previous estimates are not directly comparable.

A key uncertainty in the current abundance estimate is the number of animals in Canadian waters. The northern part of the stock's range was not surveyed in the 2011 shipboard survey (Palka 2012). This new abundance estimate largely represents only the U.S. portion of this stock, and a small portion in Canadian waters. Additionally, the current abundance estimate does not account for availability bias due to submerged animals. Without a correction for this bias, the abundance estimate is likely biased low. Finally, since the most current estimate dates from a survey done in 2011, it is not certain that the 2011 estimate accurately represents the present population size.

Earlier estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the 2016 guidelines for preparing stock assessment reports (NMFS 2016), estimates older than eight years are deemed unreliable for the determination of the current PBR.

Recent surveys and abundance estimates

An abundance estimate of 2,591 (CV=0.81) common minke whales was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of central Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the visually detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the multiple-covariate distance sampling (MCDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of recent abundance estimates for the Canadian East Coast stock of common minke whales (*Balaenoptera acutorostrata acutorostrata*) by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation. (CV).

Month/Year	Area	N_{best}	CV
Jul-Aug 2011	Central Virginia to lower Bay of Fundy	2,591	0.81

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Canadian East Coast stock of common minke whales is 2,591animals (CV=0.81). The minimum population estimate is 1,425 animals.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and variable survey design (see Appendix IV for a survey history of this stock). For example, the power to detect a precipitous decline in abundance (i.e., 50% decrease in 15 years) with estimates of low precision (e.g., CV>0.30) remains below 80% (alpha=0.30) unless surveys are conducted on an annual basis (Taylor *et al.* 2007).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity are that females mature between 6 and 8 years of age, and pregnancy rates are approximately 0.86 to 0.93. Based on these parameters, the mean calving interval is between 1 and 2 years. Calves are probably born during October to March after 10 to 11 months gestation and nursing lasts for less than 6 months. Maximum ages are not known, but for Southern Hemisphere minke whales maximum age appears to be about 50 years (IWC 1991).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995). Key uncertainties about the maximum net productivity rate are due to the limited understanding of the stock-specific life history parameters; thus the default value was used.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,425. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5, the default value for stocks of unknown status relative to OSP and with the CV of the average mortality estimate less than 0.3 (Wade and Angliss 1997). PBR for the Canadian east coast common minke whale is 14.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

During 2011 to 2015, the average annual minimum detected human-caused mortality and serious injury was 9.15 common minke whales per year, which is the sum of 7.75 (1.9 U.S/3.25 Canada/2.6 unassigned but first reported in the U.S.) minke whales per year (unknown CV) from U.S. and Canadian fisheries using strandings and entanglement data, and 1.4 (1.2 U.S./0.2 Canada) per year from vessel strikes.

A key uncertainty in the estimate of the annual human-caused mortality and serious injury for this stock, along with other large whales, is due to using strandings and entanglement data as the primary data source. Detected interactions in the strandings and entanglement data should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate, which is almost certainly biased low.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

See Appendix V for information on historical takes.

U.S.

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

In July 2013, one minke whale was observed dead in the mid-water otter trawl fishery on Georges Bank. This animal was too decomposed to have been taken in a haul that was only 3 hours long. Annual average estimated minke whale mortality and serious injury from the mid-Atlantic mid-water trawl (including pair trawl) during 2011 to 2015 was 0.

Other Fisheries

Confirmed mortalities and serious injuries of common minke whales in the last five years as recorded in the audited Greater Atlantic Regional Office/NMFS entanglement/stranding database are reported in Table 2. During 2011 to 2015, as determined from stranding and entanglement records confirmed to be of U.S. origin or first sighted in U.S. waters, yielded a minimum detected average annual mortality and serious injury of 4.35 common minke whales per year in U.S. fisheries (Table 2a). Most cases in which gear was recovered and identified involved gillnet or pot/trap gear.

CANADA

Read (1994) reported interactions between common minke whales and gillnets in Newfoundland and Labrador, in cod traps in Newfoundland, and in herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on

approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no common minke whales were observed taken. More current observer data are not available.

Herring Weirs

Weir interactions that may have resulted in serious injury to minke whales are reported in Table 2b.

Other Fisheries

Mortalities and serious injuries that were likely a result of an interaction with an unknown Canadian fishery are detailed in Table 2b. During 2011 to 2015, as determined from stranding and entanglement records confirmed to be of Canadian origin or first sighted in Canadian waters, the minimum detected average annual mortality and serious injury was 3.25 minke whales per year in Canadian fisheries (Table 2b; prorated value).

Table 2a. Confirmed human-caused mortality and serious injury records of common minke whales (*Balaenoptera acutorostrata acutorostrata*) first reported in U.S. waters or attributed to U.S.: 2011–2015[a]

Date[b]	Injury determination	ID	Location[b]	Assigned Cause[f]	Value against PBR[c]	Country[d]	Gear Type[e]	Description
5/6/2011	Mortality	-	off Martha's Vineyard, MA	EN	1	US	PT	Anchored in gear. Embedded line at fluke. Evidence of entanglement w/ associated hemorrhaging at mouth corners & insertion of pectorals
7/17/2011	Prorated Injury	-	off Nahant, MA	EN	0.75	XU	NR	Full configuration unknown.
7/24/2011	Prorated Injury	-	off North Truro, MA	EN	0.75	XU	NR	Full configuration unknown
8/4/2011	Mortality	-	Sandy Hook Bay, NJ	VS	1	US	-	4 propeller lacerations across dorsal surface. Fractured ribs w/associated hemorrhaging
8/26/2011	Mortality	-	Horseshoe Cove, NJ	EN	1	US	NP	Fresh carcass w/ evidence of extensive entanglement
8/29/2011	Mortality	-	Moriches Bay, NY	VS	1	US	-	Extensive hemorrhage & edema along dorsal & both lateral surfaces
10/6/2011	Mortality	-	off Matinicus Island, ME	EN	1	US	PT	Fresh carcass anchored in gear
12/7/2011	Mortality	-	Carolina Beach, NC	VS	1	US	-	Healed deep & superficial propeller lacerations; internal lesions associated w/ deep lacerations indicative of peritonitis & infection

2/4/2012	Prorated Injury	-	off Virginia Beach, VA	EN	0.75	XU	CE	Reported with hook/monofilament gear. Attachment point unknown.
3/16/2012	Mortality	-	Ipswich, MA	EN	1	US	NP	Evidence of extensive, constricting gear w/ associated hemorrhaging
6/21/2012	Serious Injury	-	off Frenchboro, ME	EN	1	XU	NR	Constricting body wrap, flipper pinned, embedded in mouthline; emaciated
6/23/2012	Mortality	-	Newark, NJ	VS	1	US	-	Fresh carcass on bow of ship. Deep laceration across ventral surface; Cause of death - disembowelment & hypovolemic shock
7/1/2012	Prorated Injury	-	off Portsmouth, NH	EN	0.75	XU	NR	Full configuration unknown
7/13/2012	Prorated Injury	-	off Jonesport, ME	EN	0.75	US	NR	Anchored. Partial disentanglement; Final configuration unknown
7/17/2012	Serious Injury	-	off Chatham, MA	EN	1	XU	NR	Tight wrap across back; health decline: emaciated
8/2/2012	Prorated Injury	-	off Provincetown, MA	EN	0.75	XU	NR	Full configuration unknown
8/5/2012	Mortality	-	Chatham, MA	EN	1	US	NR	Multiple constricting wraps through & around mouth and on fluke blades; COD - acute underwater entrapment
10/4/2012	Mortality	-	Cliff Island, ME	EN	1	US	NR	Evidence of constricting gear at mouthline, across ventral pleats, & at peduncle
7/23/2013	Prorated Injury	-	off Newport, RI	EN	0.75	XU	NR	Full configuration unknown
8/17/2013	Serious Injury	-	off Newburyport, MA	EN	1	XU	NR	Constricting rostrum wrap cutting into upper lip
10/04/2013	Prorated Injury	-	off Seal Harbor, ME	EN	0.75	US	NR	Anchored, partially disentangled, final configuration unknown
6/9/2014	Mortality	-	off Truro, MA	EN	1	US	PT	Fresh carcass anchored, hog-tied in gear. COD=peracute underwater entrapment.
7/10/2014	Prorated Injury	-	S of Bristol, ME	EN	0.75	XU	NR	Free-swimming, trailing 2 buoys. Attachment point(s) unknown.

7/12/2014	Serious Injury	-	South Shinnecock Inlet, NY	EN	1	XU	NR	Free-swimming with yellow plastic strapping cutting into top and sides of rostrum. No trailing gear.
7/17/2014	Mortality	-	South Addison, ME	EN	1	XU	NP	Fresh carcass with line impression across ventral surface & evidence of constricting gear around peduncle and fluke insertion. Bruising evident at fluke injuries. No gear present.
12/24/2014	Mortality	-	Dam Neck, VA	VS	1	US	-	Fresh carcass with broken ribs & fractured vertebrae w/ extensive hemorrhage & edema.
03/26/2015	Serious Injury		off Cape Canaveral, FL	EN	1	XU	NR	Evidence of constricting rostrum wrap, but unable to determine if gear still present. Emaciated.
05/09/2015	Mortality		Duck, NC	EN	1	XU	GU	Live stranded and euthanized. Embedded gear cutting into bone of mandible. Emaciated. Proximate COD - entanglement. Ultimate COD - euthanasia.
06/06/2015	Mortality		Coney Island, NY	VS	1	US	-	Fresh carcass with deep lacerations to throat area and head missing. Large area of bruising on dorsal surface.
06/14/2015	Prorated Injury		off Chatham, MA	EN	.75	XU	NR	Free-swimming with acorn buoy trailing 20-30 ft. Attachment point(s) and configuration unknown.
09/01/2015	Mortality		Gloucester, MA	EN	1	US	NP	Evidence of extensive, constricting gear with associated hemorrhaging. No gear present.
Five-year averages		Vessel strike (US/ XU)			1.2 (1.2/ 0.0)			
		Entanglement (US/ XU)			4.5 (1.9/ 2.6)			

a. For more details on events please see Henry *et al.* 2017.

b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.

c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012)
d. US=United States, XU=Unassigned 1st sight in US
e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, MT=midwater trawl, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir
f. Assigned cause: EN=entanglement, VS=vessel strike, ET=entrapment (summed with entanglement).

Table 2b. Confirmed human-caused mortality and serious injury records of common minke whales (*Balaenoptera acutorostrata acutorostrata*) first reported in Canadian waters or attributed to Canada: 2011–2015[a]

Date[b]	Injury determination	ID	Location[b]	Assigned Cause[f]	Value against PBR[c]	Country[d]	Gear Type[e]	Description
6/3/2011	Serious Injury	-	Tadoussac, Quebec	EN	1	CN	NR	Tight rostrum wrap.
9/7/2011	Prorated Injury	-	Greenspond, NL	EN	0.75	CN	GN	Partially disentangled from anchoring gear. Final configuration unknown.
9/19/2011	Prorated Injury	-	Northumberland Strait, PEI	EN	0.75	CN	NR	Partially disentangled from anchoring gear. Final configuration unknown.
12/19/2011	Mortality	-	off Grand Manan Island, NB	EN	1	CN	PT	Live entanglement; recovered dead in gear the following day. Constricting peduncle wraps
5/15/2012	Serious Injury	-	Sable Island Bank, Canada	EN	1	CN	PT	Disentangled from gear embedded down to bone of peduncle.
6/26/2012	Mortality	-	Renews Rock, NL	EN	1	CN	PT	Fresh carcass w/ constricting gear around peduncle
6/30/2012	Mortality	-	off Naufrage, PEI	EN	1	CN	PT	Fresh carcass anchored in gear
7/1/2012	Mortality	-	Northern Lake Harbor, PEI	EN	1	CN	PT	Constricting gear w/ associated hemorrhaging; COD - drowning
8/31/2013	Mortality	-	Miminegash, PEI	EN	1	CN	NP	Fresh carcass w/ evidence of extensive, constricting gear
7/2/2014	Mortality	-	Northumberland Strait, NB	EN	1	CN	NR	Carcass with constricting gear around lower jaw. Large open injury at attachment point on the left side.

7/10/2014	Mortality	-	Cape George, Antigonish, NS	VS	1	CN	-	Fresh carcass with jaw fractures.
7/29/2014	Mortality	-	5 nm E of Herring Cove, NS	EN	1	CN	-	Live animal w/ tongue completely ballooned out, forcing its jaws 90 degrees apart. Found dead at same location the next day. Carcass recovered with two traps & constricting line around the peduncle. Necropsy found indication of blunt trauma to right jaw. Animal anchored in gear was subsequently struck by a vessel (primary cause of death)
04/16/2015	Mortality		Lockes Island, Shelburne, NS	EN	1	CN	NP	Fresh carcass with evidence of constricting wraps. No gear present. Robust, pregnant, fish in stomach and intestines. No other abnormalities noted.
06/23/2015	Prorated Injury		off Ingonish, NS	EN	.75	CN	PT	Entangled in traps and buoys. Partially disentangled by fisherman. Original and final configuration unknown.
07/07/2015	Mortality		off Funk Island, NL	EN	1	CN	PT	Found at 340m depth inbetween two pots. Gear through mouth and wrapped around peduncle.
08/18/2015	Mortality		Roseville, PEI	EN	1	CN	NP	Evidence of constricting body, peduncle, and fluke wraps. No gear present. No necropsy but robust body condition supports entanglement as COD.
09/21/2015	Mortality		Cape Wolfe, Burton, PEI	EN	1	CN	NP	Evidence of constricting body wraps. No gear present. No necropsy but experts state peractute underwater entrapment most parsimonious.
12/06/2015	Mortality		off Port Joli, NS	EN	1	CN	PT	Live animal anchored in gear. Carcass recovered 4 days later.
Five-year averages		Vessel strike (CN/ XC)			0.20 (0.20/ 0.00)			

	Entanglement (CN/ XC)	3.25 (3.25/ 0.00)
a. For more details on events please see Henry *et al.* 2017.		
b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.		
c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012)		
d. CN=Canada, US=United States, XC=Unassigned 1st sight in CN, XU=Unassigned 1st sight in US		
e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, MT=midwater trawl, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir		
f. Assigned cause: EN=entanglement, VS=vessel strike, ET=entrapment (summed with entanglement).		

Other Mortality

North Atlantic common minke whales have been and continue to be hunted. From the Canadian East Coast population, documented whaling occurred from 1948 to 1972 with a total kill of 1,103 animals (IWC 1992). Animals from other North Atlantic common minke populations (e.g., Iceland) are presently being harvested.

U.S.

Common minke whales inhabit coastal waters during much of the year and are thus susceptible to collision with vessels. In 2011, three juvenile common minkes were confirmed dead due to vessel strikes: a female off Sandy Hook, New Jersey, a female off Moriches, New York, and a male off Carolina Beach, North Carolina. In 2012, a confirmed vessel strike resulted in a mortality off Newark, New Jersey. In 2014, a confirmed vessel strike resulted in a mortality off Dam Neck, Virginia. In 2015, a fresh carcass of a common minke whale was reported off Coney Island, New York with wounds consistent with vessel strike. Thus, during 2011–2015, as determined from stranding and entanglement records, the minimum detected annual average was 1.2 common minke whales per year struck by vessels in U.S. waters or first seen in U.S. waters (Table 2a; Henry *et al.* 2017).

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia between 1991 and 1996 (Hooker *et al.* 1997). Researchers with the Department of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island (Lucas and Hooker 2000). Starting in 1997, common minke whales stranded on the coast of Nova Scotia were recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network. The events that were determined to be human-caused serious injury or mortality are included in Table 2b.

The Whale Release and Strandings program reported the following common minke whale stranding mortalities in Newfoundland and Labrador for the time period of this report: 0 in 2011, 3 in 2012, and 0 in 2013 and 1 in 2014, and 2 in 2015. Those that have been determined to be human-caused serious injury or mortality are included in Table 2b (Ledwell and Huntington 2011, 2012a, 2012b, 2013, 2014, 2015).

During 2011–2015, as determined from stranding and entanglement records, the minimum detected annual average was 0.2 common minke whales per year struck by vessels in Canadian waters or first seen in Canadian waters (Table 2b; Henry *et al.* 2017).

STATUS OF STOCK

Common minke whales are not listed as threatened or endangered under the Endangered Species Act, and the Canadian East Coast stock is not considered strategic under the Marine Mammal Protection Act. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of common minke whales relative to OSP in the U.S. Atlantic EEZ is unknown.

It is expected that the uncertainties described above will have little effect on the designation of the status of the entire stock. Even though the estimate of human-caused mortality and serious injury in this assessment is negatively biased due to using strandings and entanglement data as the primary source, the abundance estimate is a very negatively-biased estimate for the entire stock as it only includes the U.S. portion of the Canadian East Coast common minke whale stock's habitat and the habitat in Canadian waters. If the current PBR representing only the U.S. portion of the stock (9.4) is compared to only the negatively-biased U.S. mortalities and serious injuries (5.7), the stock would still be designated as not strategic. However, this designation may be reversed if the negative bias in the mortality estimate is large. Thus, key uncertainties that need to be resolved include the stock structure, particularly as it is influenced by movement patterns between US and Canadian waters, and the estimated human-caused mortalities and serious injuries.

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