May 2016

HARBOR SEAL (*Phoca vitulina concolor*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal (*Phoca vitulina concolor*) is found in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above about 30ºN (Burns 2009; Desportes *et al*. 2010). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona *et al.* 1993; Gilbert and Guldager 1998; Baird 2001;Desportes *et al*. 2010). Stanley *et al.* (1996) examined worldwide patterns in harbor seal mitochondrial DNA, which indicate that western and eastern North Atlantic harbor seal populations are highly differentiated. Further, they suggested that harbor seal females are only regionally philopatric, thus population or management units are on the scale of a few hundred kilometers. High philopatry has been reported in other North Atlantic populations (Goodman 1998; Andersen and Olsen 2010). Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (Temte *et al.* 1991; Andersen and Olsen 2010). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.* 1991; Katona *et al.* 1993).

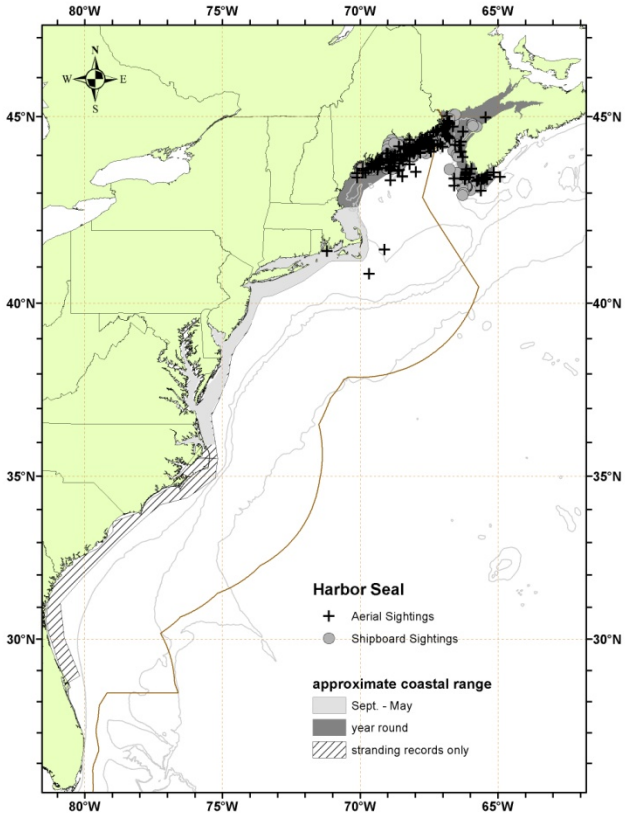

Figure 1. *Approximate coastal range of harbor seals, and distribution of harbor seal sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona *et al*. 1993), and occur seasonally along the southern New England to New Jersey coasts from September through late May (Schneider and Payne 1983; Barlas 1999; Schroeder 2000; deHart 2002). In recent years small numbers of seals (<50) have established winter haul-out sites in the Chesapeake Bay and near Oregon Inlet, North Carolina (Todd Pusser, pers. comm. June 2011; Virginia Institute of Marine Science; http://www.vims.edu/bayinfo/faqs/marine_mammal.php, accessed 14 February, 2013). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al.* 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). Earlier research identified no pupping areas in southern New England (Payne and Schneider 1984; Barlas 1999); however, more recent anecdotal reports suggest that some pupping is occurring at high-use haulout

sites off Manomet, Massachusetts and the Isles of Shoals, Maine. The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

Prior to the spring 2001 live-capture and radio-tagging of adult harbor seals, it was believed that the majority of seals moving into southern New England and mid-Atlantic waters were subadults and juveniles (Whitman and Payne 1990; Katona *et al.* 1993). The 2001 study established that adult animals also made this migration. Seventy-five percent (9/12) of the seals tagged in March in Chatham Harbor were detected at least once during the May/June 2001 abundance survey along the Maine coast (Gilbert *et al.* 2005; Waring *et al.* 2006). Similar findings were made in spring 2011 and 2012 work.

POPULATION SIZE

The best current abundance estimate of harbor seals is 75,834 (CV=0.15) which is from the 2012 survey.

Earlier abundance estimates

Coast-wide aerial surveys along the Maine coast were conducted in May/June 1981, 1986, 1993, 1997, 2001, and 2012 during pupping (Gilbert and Stein 1981; Gilbert and Wynne 1983, 1984; Kenney 1994; Gilbert and Guldager 1998; Gilbert *et al.* 2005; Waring *et al.* 2015a). Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR.

Canadian scientists counted 3,500 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler 1994), but noted that the survey was not designed to obtain a population estimate. The Sable Island population was the largest in eastern Canada in the late 1980s, however the number drastically declined in the late 1990s (Baird 2001). Similarly, pup production declined on Sable Island from 600 in 1989 to around a dozen pups or fewer by 2002 (Baird 2001; Bowen *et al.* 2003). A decline in the number of juveniles and adults did not occur immediately, but a decline was observed in these age classes as a result of the reduced number of pups recruiting into the older age classes (Bowen *et al.* 2003). Possible reasons for this decline may be increased use of the island by gray seals and increased predation by sharks (Stobo and Lucas 2000; Bowen *et al.* 2003). Helicopter surveys have also been flown to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St. Lawrence estuary. In the estuary, surveys were flown in June 1995, 1996, and 1997, and in August 1994, 1995, 1996, and 1997; different portions of the Gulf were surveyed in June 1996 and 2001 (Robillard *et al.* 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Although all slopes were positive, only one was significant, indicating numbers are likely stable or increasing slowly. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which is lower than the average count of 621 (SD=41, N=3) hauled-out animals flown under similar conditions in August. Aerial surveys in the Gulf of St. Lawrence resulted in counts of 467 animals in 1996 and 423 animals in 2001 for a different area (Robillard *et al.* 2005). Further, approximately 200 harbor seals breed in the Grand Barachois on the islands of S. Pierre and Miquelon (France) off the southern coast of Newfoundland. This population has been declining since the mid-1980s, when there might have been more than 900 harbor seals there, due to disturbance by tourists and natural alterations of the tidal sand flats of the haul-out area (J. Lawson, pers. comm., DFO, St. Johns, Newfoundland, 21 March 2013).

Recent surveys and abundance estimates

The 2001 survey, conducted in May/June, included replicate surveys and radio-tagged seals to obtain a correction factor for animals not hauled out. The 2012 survey was designed (Waring *et al.* 2015a) to sample bay units using a single aircraft, and it also included a radio-tracking aircraft and obtained a correction factor. The corrected estimates (pups in parenthesis) for 2001 and 2012, respectively, were 99,340 (23,722) and 75,834 (23,830) (Table 1). The 2001 observed count of 38,014 was 28.7% greater than the 1997 count, whereas the 2012 corrected estimate was 24% lower than the 2001 estimate. In addition, the CV of the 2012 estimate is 0.153 compared to 0.091in 2001.

Although the 2012 population estimate was lower than the 2001 estimate, Waring *et al.* (2015a) do not consider the population to be declining because the two estimates are not significantly different and because the actual estimate was lower because some fraction of the population was not in the survey area. Evidence for this is that the 31.4% of the count were pups, a percentage that is biologically unlikely. The estimated number of harbor seal pups did not differ significantly between 2001 and 2012. In 2001, there were an estimated 23,722 (CV=0.096) pups in the study area (Gilbert *et al.* 2005); in 2012 there were an estimated 23,830 (CV=0.159) pups in the study area. Therefore it is likely that there were some non-pups in the population that were not available to be counted because

they were not in the study area of Coastal Maine. Some number of seals could have remained farther south in New England, more northerly in Canada, or offshore.

Table 1. Summary of recent abundance estimates for the western North Atlantic harbor seal (*Phoca vitulina concolor*) 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
May/June 2012	Maine coast	75,834	0.15

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 harbor seals is 75,834 (CV=0.15). The minimum population estimate is 66,884 based on corrected available counts along the Maine coast in 2012.

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 long survey interval. 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.. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

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 66,884 animals. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) is 0.5, the default value for stocks of unknown status relative to optimum sustainable population (OSP), and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of harbor seals is 2,006.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2009–2013 the total human caused mortality and serious injury to harbor seals is estimated to be 420 per year. The average was derived from two components: 1) 408 (CV=0.11; Table 2) from 2009–2013 observed fisheries; and 2) 12 from average 2009–2013 non-fishery-related, human interaction stranding and direct interaction mortalities (NMFS unpublished data). Analysis of bycatch rates from fisheries observer program records likely underestimates lethal (Lyle and Willcox 2008), and greatly under-represents sub-lethal, fishery interactions.

Fishery Information

Detailed fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet:

Harbor seal bycatch is observed year round where they are most frequently observed in the summer in groundfish trips occurring between Boston, MA and Maine in the coastal Gulf of Maine waters. Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (i.e., less than four years old). There were 6, 8, 5, 9, 6 and 8 unidentified seals observed during 2009–2013, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Revised serious injury guidelines were applied for this period

(Waring *et al.* 2014, 2015; Wenzel *et al.* 2015). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Gillnet

Harbor seal bycatch has been onbserved in this fishery in waters off Massachusetts and New Jersey and rarely further south. A study on the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40˚ 40´) in February, March and April. Eight research strings of fourteen nets each were fished, and 159 hauls were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh. There was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. Four harbor seals (3 in mid-Atlantic gillnet and 1 in NE gillnet) were caught in this project during 2010 (AIS 2010).

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Northeast Bottom Trawl

Harbor seal are occasionally observed taken in this fishery See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Bottom Trawl

Harbor seal are rarely observed taken in this fishery. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information. .

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

One harbor seal mortality was observed in this fishery in 2009, 2 in 2010 and 1 in 2012 (Table 2). The resultant estimated annual fishery-related mortality and serious injury (CV in parentheses) was 1.3 (0.81) in 2009 but an extended bycatch rate has not been calculated for 2010 or 2012. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2009–2013 was calculated as 0.9 animals (3 animals +1.3 animals/5 years). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)

A harbor seal mortality was observed in this fishery in 2010. An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2009–2013 was calculated as 0.2 animals (1 animal/5 years). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003. No mortalities have been observed, but 3 harbor seals were captured and released alive in 2011, 1 in 2012, and 1 in 2013. In addition, 8 seals of unknown species were captured and released alive in 2011, and 0 in 2012-2013. One harbor seal and two unknown species in were designated as serious injuries/mortalities in 2011, based on fisheries monitoring logs (Waring *et al.* 2014). An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2009–2013 was calculated as 0.2 animals (1 animal/5 years). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

CANADA

Currently, scant data are available on bycatch in Atlantic Canada fisheries due to a lack of observer programs (Baird 2001). An unknown number of harbor seals have been taken in Newfoundland, Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; Atlantic Canada cod traps; and in Bay of Fundy herring weirs (Read 1994; Cairns *et al.* 2000). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting under nuisance permits.

Table 2. Summary of the incidental mortality of harbor seals (*Phoca vitulina concolor*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Serious Injury [e]	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Northeast [c] Sink Gillnet	09-13	Obs. Data, Weighout, Logbooks	.04, .17, .19, .15, .11	0, 0, 0, 0, 0	21, 71, 91, 37, 22	0, 0, 0, 0, 0	513, 540, 343, 252, 142	513, 540, 343, 252, 142	.28, .25, .19, .26, .31	358 (0.12)
Mid-Atlantic Gillnet	09-13	Obs. Data, Weighout	.03, .04, .02, .02, .03	0, 0, 0, 0, 0	2, 9, 2, 0	0, 0, 0, 0, 0	47, 89, 21, 0, 0	47, 89, 21, 0, 0	.68, .39, .67, 0, 0	31.4 (0.31)
Northeast Bottom Trawl [d]	09-13	Obs. Data, Weighout	.09, .16, .26, .17, .15	0, 0, 0, 0, 0	0, 0, 3, 1, 1	0, 0, 0, 0, 0	0, 0, 9, 3, 4	0, 0, 9, 3, 4	0, 0, .58, 1, .96	3.2 (.44)
Mid-Atlantic Bottom Trawl	09-13	Obs. Data Dealer	.05, .06, .08, .05, .06	0, 0, 0, 0, 0	0, 1 ,1, 0, 3	0, 0, 0, 0, 0	24, 11, 0, 23, 11	24, 11, 0, 23, 11	.92, 1.1, 0, 1, .96	13.8 (.53)
Northeast Mid-water Trawl - Including Pair Trawl	09-13	Obs. Data Weighout Trip Logbook	.42, .53, .41, .45, .37	0, 0, 0, 0, 0	1, 2, 0, 1, 0	0, 0, 0, 0, 0	1.3, na, 0, na, 0	1.3, na, 0, na, 0	.81, na, 0, na, 0	0.9 (.24)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	09-13	Obs. Data Weighout Trip Logbook	.13, .25, .41, .21, .07	0, 0, 0, 0, 0	0, 1, 0, 0, 0	0, 0, 0, 0, 0	0, 0, na, 0, 0	0, 0, na, 0, 0	0, 0, na, 0, 0	0.2 (na) [e]
Herring Purse Seine	09-13	Obs. Data	.21, .12 .33, .17, .17	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, na, 0, 0	0, 0, 0, 0, 0	0, 0, na, 0, 0	0, 0, na, 0, 0	0.2 (na)
TOTAL										408 (0.11)

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the northeast sink gillnet fishery.

[b] The observer coverages for the northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed and coverages for the northeast bottom trawl are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear in the year 2010–2013 includes samples collected from traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP).

[c] Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of

samples taken from the stratum and used to estimate the mortality. In 2009–2013, respectively, 8, 23, 32, 12 and 11 takes were observed in nets with pingers. In 2009–2013, respectively, 13, 48, 59, 25 and 11 takes were observed in nets without known pingers.

[d] Fishery related bycatch rates for years 2009–2013 were estimated using an annual stratified ratio-estimator.

[e] Analyses of bycatch mortality attributed to the mid-water trawl fisheries for 2010 – 2013 have not been generated.

f. Serious injuries were evaluated for the 2009–2013 period using new guidelines and include both at-sea monitor and traditional observer data (Waring *et al.* 2014, 2015b; Wenzel *et al.* 2015.)

Other Mortality

U.S.

Historically, harbor seals were bounty-hunted in New England waters, which may have caused a severe decline of this stock in U.S. waters (Katona *et al*. 1993; Lelli *et al*. 2009). Bounty-hunting ended in the mid-1960s.

Other sources of harbor seal mortality include human interactions, storms, abandonment by the mother, disease (Anthony *et al.* 2012), and predation (Katona *et al.* 1993; Jacobs and Terhune 2000). Mortalities caused by human interactions include boat strikes, fishing gear interactions, oil spill/exposure, harassment, boat strikes, and shooting.

Harbor seals strand each year throughout their migratory range. Stranding data provide insight into some of these sources of mortality. From 2009 to 2013, 1,318 harbor seal stranding mortalities were reported between Maine and Florida (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 20 August 2014). Seventy (5.3%) of the dead harbor seals stranded during this five-year period showed signs of human interaction (6 in 2009, 20 in 2010, 20 in 2011, 9 in 2012, and 15 in 2013), with 13 (0.9%) having some sign of fishery interaction (0 in 2009, 6 in 2010, 2 in 2011, 2 in 2012, and 3 in 2013). Two harbor seals during this period were reported as having been shot.

An Unusual Mortality Event (UME) was declared for harbor seals in northern Gulf of Maine waters in 2003 and continued into 2004. No consistent cause of death could be determined. The UME was declared over in spring 2005 (MMC 2006). NMFS declared another UME in the Gulf of Maine in autumn 2006 based on infectious disease. A UME was declared in November of 2011 that involved 567 harbor seal stranding mortalities between June 2011 and October 2012 in Maine, New Hampshire, and Massachusetts. The UME was declared closed in February 2013.

Stobo and Lucas (2000) have documented shark predation as an important source of natural mortality at Sable Island, Nova Scotia. They suggest that shark-inflicted mortality in pups, as a proportion of total production, was less than 10% in 1980-1993, approximately 25% in 1994–1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. The decline in the Sable Island population appears to result from a combination of shark-inflicted mortality on both pups and adult females and inter-specific competition with the much more abundant gray seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).

CANADA

Aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Jacobs and Terhune 2000; Baird 2001). Small numbers of harbor seals are taken in subsistence hunting in northern Canada, and Canada also issues personal hunting licenses which allow the holder to take six seals annually (DFO 2008).

Table 3. Harbor seal (*Phoca vitulina concolor*) stranding mortalities along the U.S. Atlantic coast (2009–2013) with subtotals of animals recorded as pups in parentheses[a].

State	2009	2010	2011	2012	2013	Total
Maine[b]	72 (61)	70 (64)	147 (115)	131 (101)	99 (74)	519
New Hamphire[b]	15 (12)	20 (15)	77 (63)	24 (18)	16 (6)	152
Massachusetts[b]	74 (36)	82 (26)	133 (80)	54 (35)	95 (39)	438
Rhode Island	5 (2)	4 (0)	7 (0)	14 (0)	9 (3)	39
Connecticut	0	0	1 (1)	1 (1)	2 (1)	4
New York	14 (1)	15 (0)	17 (0)	14 (1)	11 (2)	71
New Jersey	11 (2)	21 (0)	10 (0)	7 (0)	4 (0)	53
Maryland	2 (0)	0	1 (0)	0	1 (0)	4
Virginia	3	1 (0)	4 (0)	0	5 (0)	13

North Carolina	6 (5)	11 (1)	2 (0)	2 (0)	3 (0)	24
South Carolina	0	1	0	0	0	1
Total	202	225	399	247	245	1318
Unspecified seals (all states)	34	22	63	28	25	172

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Records of live releases and rehabbed animals have been eliminated. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

b. Unusual Mortality event (UME) declared for harbor seals in southern Maine to northern Massachusetts in 2011.

STATUS OF STOCK

Harbor seals are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The 2009–2013 average annual human-caused mortality and serious injury does not exceed PBR. The status of the western North Atlantic harbor seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown. Total 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.

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