ABUNDANCE AND PRODUCTIVITY ESTIMATES – 2016 UPDATE
ATLANTIC COAST PIPING PLOVER POPULATION

Population monitoring on the breeding grounds has been an integral part of the recovery program for Atlantic Coast piping plovers since 1986, providing information to inform protection of breeding piping plovers and their habitat. Annual coastwide censuses are one component of monitoring that track local and regional progress toward recovery. This update describes the delisting criteria established in the recovery plan, discusses the role of abundance and distribution of breeding pairs in Atlantic Coast piping plover conservation, and summarizes the most current information about abundance and productivity.

Recovery criteria and strategy

The objective of the 1996 revised Atlantic Coast Recovery Plan is to assure the long-term viability of the Atlantic Coast piping plover population in the wild, thereby allowing removal of this population from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The Atlantic Coast piping plover population may be considered for delisting when the following recovery criteria, established in the recovery plan, have been met:

1. Increase and maintain for 5 years a total of 2,000 breeding pairs, distributed among four recovery units.

Recovery Unit	Minimum Subpopulation
Atlantic (Eastern) Canada[1]	400 pairs
New England	625 pairs
New York-New Jersey	575 pairs
Southern (DE-MD-VA-NC)	400 pairs

2. Verify the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.

3. Achieve a 5-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units described in criterion 1, based on data from sites that collectively support at least 90 percent of the recovery unit's population[2].

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[1] Recent Canadian Wildlife Service documents and published literature refer to piping plovers breeding in Nova Scotia, New Brunswick, Prince Edward Island, Quebec, and Newfoundland as the piping plover *melodus* subspecies or the "eastern Canada population." This subpopulation coincides exactly with the geographic area termed "Atlantic Canada Recovery Unit" in the Service's 1996 Recovery Plan. To reduce confusion, we refer henceforth in this status review to the Eastern Canada recovery unit.

[2] With regard to delisting criterion #3, the recovery plan further states that "The PVA [the population viability analysis, conducted to support development of the delisting criteria] shows that a population of only 2,000 pairs would remain highly vulnerable to extinction unless average productivity is sustained above 1.5 chicks per pair. However, since the PVA is based on several assumptions that *may* underestimate survival rates for some or all recovery units and/or the percentage of one-year old adults that breed, this productivity figure may be revised downward if (1) it is demonstrated that survival rates are higher in some regions, and (2) a scientifically credible, stochastic model that incorporates the best available estimates of survival and other demographic variables shows

4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit.

5. Ensure long-term maintenance of wintering habitat sufficient in quantity, quality, and distribution to maintain survival rates needed for a 2,000-pair population.

The recovery strategy, as articulated in the plan, recognizes that attainment of abundance targets for each recovery unit increases the probability of survival and recovery of the entire population: "Dispersal of the population across its breeding range serves as a hedge against catastrophes, such as hurricanes, oil spills, or disease, which might depress regional survival and/or productivity. Maintaining robust, well-distributed subpopulations should reduce variance in survival and productivity of the Atlantic Coast population as a whole, facilitate interchange of genetic material between subpopulations, and promote recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat succession (USFWS 1996)."

Role of Breeding Abundance and Distribution in Recovery

As discussed below, the subpopulation abundance and distribution targets in recovery criterion #1 ensure **representation, redundancy, and resiliency** for Atlantic Coast piping plovers in their breeding range, consistent with recent Service recovery planning guidance[3] (see also Schaffer and Stein 2000).

Representation supports the adaptability and evolutionary capacity of a species to accommodate long-term environmental changes (e.g., climate, habitat conditions or structure across large areas, emerging pathogens, novel competitors and/or predators, invasive species). The breadth of genetic, ecological, demographic, and behavioral diversity across a range of ecologically diverse locations or niches on the landscape are the best available and most useful expressions of representation (USFWS 2016b). A comprehensive molecular-genetic investigation of piping plovers by Miller et al. (2010) found strong genetic structure, supported by significant correlations between genetic and geographic distances in both mitochondrial and microsatellite data sets for birds breeding along the Atlantic Coast from Newfoundland to North Carolina. Atlantic birds showed evidence of isolation-by-distance patterns, indicating that dispersal, when it occurs, is generally associated with movement to relatively proximal breeding territories.

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that lower productivity rates will assure a 95 percent probability of survival for 100 years (see task 3.5). Adjustments to this criterion may be applied to the population as a whole or to one or more of the four recovery units, as supported by observed productivity and population trend data (USFWS 1996)." Citing findings of latitudinal variation in productivity needed to maintain a stationary population (Calvert et al. 2006, Hecht and Melvin 2009), the 2009 Piping Plover 5-Year Review (USFWS 2009) recommends demographic modeling that explores effects of variation in productivity, survival rates, and carrying capacity of habitat on population viability within individual recovery units and the Atlantic Coast population as a whole to support revision of criterion #3.

[3] USFWS (2016a) states: "Recovery criteria: The objective, measurable thresholds for the parameters that contribute to the resiliency, redundancy, representation, including the level of amelioration of the factors negatively affecting the 3Rs (i.e., threats) needed to achieve the recovery vision for any species (delisting)."

Maintaining geographically distributed subpopulations across the four recovery units serves to conserve representation of genetic diversity and adaptability to variable environmental selective pressures.

Further evidence of adaptive variability across recovery unit subpopulations is found in latitudinal differences in Atlantic Coast piping plover breeding habitat requirements. Although piping plovers breeding in the northern part of their Atlantic Coast range avoid sections of beach with high steep foredunes (Strauss 1990, Fraser et al. 2005), they are capable of thriving on beaches where chick access is limited to ocean foraging habitats[4] (Jones 1997, Boyne et al. 2014). In New York and New Jersey, however, the species demonstrates strong preference for sites that also offer chick access to ephemeral pools and bayside tidal flats (Elias et al. 2000, Cohen et al. 2009). In Delaware, Maryland, Virginia, and North Carolina, Southern recovery unit breeding sites are almost completely restricted to low-lying barrier island flats and spits that also feature moist foraging substrates away from the ocean intertidal zone (McConnaughey et al. 1990, Loegering and Fraser 1995, Boettcher et al. 2007, NPS 2008). In addition to these well-documented geographic differences in habitat preferences, latitudinal variability may also provide Atlantic Coast piping plovers with adaptive capacity for changing climatic factors such as breeding season temperatures and storm patterns that may affect the birds directly or indirectly (e.g., via changes in prey composition or phenology).

Another line of evidence for latitudinal adaptation within Atlantic Coast piping plovers is manifested in a strong pattern of higher productivity rates needed to maintain stable populations with increasing latitude (Hecht and Melvin 2009) and concomitant differences in annual survival rates. Although the underlying causes and mechanisms are not yet well understood, this striking demographic variability among recovery units may also contribute to evolutionary capacity. In summary, maintaining geographically well-distributed populations across the four recovery units serves to conserve representation of genetic diversity and adaptations to variable environmental selective pressures evidenced by genetic structure, diverse habitat requirements, and differences in vital rates.

Redundancy safeguards the ability of representative units to withstand catastrophic events. The number and distribution of resilient populations within each representative unit contribute to redundancy, thereby assuring that the loss of an individual population does not lead to loss of representation (USFWS 2016b). The 1996 recovery plan articulates the role of the recovery units in buffering Atlantic Coast piping plovers against catastrophic events such as large storms and oil spills during the breeding season, and this need is likewise served by attaining and maintaining robust, well-distributed populations within each recovery unit. The probability of piping plover dispersal is inversely proportional to distance from previous breeding and natal sites, and movements of piping plovers between recovery units are rare (Wilcox 1959, MacIvor et al. 1987, Loegering 1992, Cross 1996, Cohen et al. 2006, Hecht and Melvin 2009, Rioux et al. 2011, Stantial pers. comm. 2016). Thus, the ability of piping plovers in each recovery unit to rebound from events that depress unit-wide productivity or survival and to colonize newly formed or improved habitat (e.g., after storms or artificial habitat enhancement projects) depends on within-unit redundancy that is measured via progress towards abundance targets.

[4] Management of human disturbance and human-abetted predation must also be provided.

Maintenance of these abundance targets for at least 5 years provides evidence that recovery will be sustainable.

Resiliency is the ability to sustain populations in the face of demographic variation and environmental stochasticity. Resiliency depends on a number of vital rates that ultimately affect population size and growth rate, as well as distribution (USFWS 2016b). In the case of Atlantic Coast piping plovers, resiliency (like redundancy) is provided via widely distributed populations meeting abundance targets for breeding pairs within each recovery unit. Hecht and Melvin (2009) found significant positive relationships between productivity and population growth in the subsequent year for each of the three U.S. recovery units, and abundance of piping plovers in each recovery unit population is almost entirely dependent on within-recovery unit productivity. As noted above, dispersal rates decline steeply with distance from previous breeding and natal sites. Thus, robust numbers of evenly distributed breeding pairs support dispersal and within-recovery unit recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat succession (Gilpin 1987, Goodman 1987, and Thomas 1994).

Wide distribution of breeding pairs within representative units also provides a buffer against environmental stochasticity. For example, weather events such as storms that flood nests may affect the south-facing beaches within a recovery unit in a given year more than north- and east-facing sites (or vice-versa). When environmental factors adversely affect productivity across a region, more abundant populations are inherently less susceptible to reaching the very low numbers from which it is difficult to rebound and which make them vulnerable to local or regional extirpations if multiple years of poor productivity occur in close succession. Similarly, robust numbers of breeding pairs in each recovery unit will provide Atlantic Coast piping plovers with a buffer against stressors (e.g., weather, habitat degradation, disturbance) in their migration and wintering range that may affect survival rates (Saunders et al. 2014, Gibson et al. 2016).

Representation, redundancy, and resiliency are interconnected. Populations must be resilient in order to contribute to redundancy or representation. Likewise, redundant populations within a representative genotype or ecological setting contribute to maintenance of adaptive and evolutionary capacity (USFWS 2016b). For Atlantic Coast piping plovers, this is provided via subpopulation targets for four representative recovery units, thereby increasing the likelihood of survival and recovery of the Atlantic Coast population as a whole. Dispersal of the population across its breeding range in four robust subpopulations serves to protect against environmental and demographic variation and catastrophic events, and to conserve adaptive capacity.

Abundance and trends

Abundance of Atlantic Coast piping plovers is reported as numbers of breeding pairs, that is, adult pairs that exhibit sustained (≥ 2 weeks) territorial or courtship behavior at a site or are observed with nests or unfledged chicks (USFWS 1996). Annual estimates of breeding pairs of Atlantic Coast piping plovers are based on multiple surveys of almost all breeding habitat, including many currently unoccupied sites. Sites that cannot be monitored repeatedly in May and June (primarily sites with few pairs or inconsistent occupancy) are surveyed at least once during a standard 9-day count period (Hecht and Melvin 2009).

The Atlantic Coast piping plover population estimate reached a post-listing high of 1,941 pairs in 2016, almost two and half times the 1986 estimate of 790 pairs (Table 1). Discounting apparent increases in New York, New Jersey, and North Carolina between 1986 and 1989, which likely were due in part to increased census effort (USFWS 1996), the population doubled between 1989 and 2016.

Overall, population growth is tempered by geographic and temporal variability. By far, the largest net population increase between 1989 and 2016 occurred in New England (329 percent). Net growth in the Southern recovery unit population was over 94 percent between 1989 and 2016. Most of the Southern recovery unit breeding population increase occurred in 2003 to 2005 and 2011 to 2012. Abundance in the New York-New Jersey recovery unit experienced a net increase of 55 percent between 1989 and 2016, but the population declined sharply from a peak of 586 pairs in 2007 to 397 pairs in 2014, before rebounding to 496 pairs in 2016. In Eastern Canada, where increases have often been quickly eroded in subsequent years, the population posted a 24-percent decline between 1989 and 2016.

In addition to the declines between 2007 to 2014 in the New York-New Jersey recovery unit and 2007 to 2016 in Eastern Canada, other periodic regional declines illustrate the continuing risk of rapid reversals in abundance trends. Examples include decreases of 21 percent in the Eastern Canada population in just 3 years (2002 to 2005) and 68 percent in the southern half of the Southern recovery unit during the 7-year period from 1995 to 2001. The 64-percent decline in the Maine population between 2002 and 2008, from 66 pairs to 24 pairs, followed only a few years of decreased productivity.

Productivity

Atlantic Coast piping plover productivity is reported as number of chicks fledged per breeding pair. For purposes of measuring productivity, chicks are counted as fledged if they survive to 25 days of age or are seen flying, whichever occurs first. Productivity for each state and recovery unit is calculated by dividing the number of fledged chicks by the number of pairs that were monitored and for which number of fledglings could be determined. This includes both successful pairs and pairs that fledged no chicks either because they failed to nest or because no eggs hatched or no chicks survived to fledging. Accurate assessment of productivity is facilitated by repeated visits to nesting beaches to monitor individual nests and broods during May, June, July, and, if necessary, August.

Annual productivity estimates for the 1987-2016 period are summarized by recovery unit and state in Table 2. Hecht and Melvin (2009) evaluated latitudinal trends in Atlantic Coast piping plover productivity and relationships between productivity and population growth. Rangewide productivity for the Atlantic Coast population from 1989 through 2006 was 1.35 chicks fledged per pair (annual range = 1.16 to 1.54), and overall productivity within recovery units decreased with decreasing latitude: Eastern Canada = 1.61, New England = 1.44, New York-New Jersey = 1.18, and Southern = 1.19 (Hecht and Melvin 2009). Within recovery units, productivity was variable from year to year and showed no sustained trends. There were significant, positive relationships between productivity and population growth in the subsequent year for each of the three U.S. recovery units, but not for Eastern Canada. Regression analysis indicated a latitudinal trend in predictions of annual productivity needed to support stationary populations within recovery units, increasing from 0.93 chicks fledged per pair in the Southern unit to 1.44 in Eastern Canada. Relatively small coefficients of determination ($r^2 = 0.09$ to 0.59) for the relationships between annual productivity and population increases in the subsequent year indicate that other factors, most likely annual survival rates of both adults and fledged chicks, also had important influences on population growth rates. In some parts of the range, habitat availability may also be constraining recruitment into the breeding population.

Overall U.S. Atlantic Coast productivity estimates in 2015 and 2016 were slightly above the 1989-2006 average. Productivity in 2015 and 2016 was also close to the 1989-2006 average for the New England recovery unit, but it was above average for the New York-New Jersey recovery unit. In Eastern Canada and the Southern recovery unit, productivity was similar to 1989-2006 averages in 2015 but dipped substantially in 2016.

Discussion

Although population growth, from approximately 790 pairs in 1986 to an estimated 1,941 pairs in 2016, has reduced the Atlantic Coast piping plover's vulnerability to extinction since listing under the Endangered Species Act (ESA), the distribution of population growth remains very uneven. The demographic status of each recovery unit and implications for the survival and recovery of the coastwide population are summarized below.

Eastern Canada recovery unit - The 2016 piping plover population estimate of 176 pairs in Eastern Canada was the lowest reported since the species was listed under the United States ESA[5]. Although the Eastern Canada subpopulation fluctuated between 1986 and 2007 (when it reached 266 pairs), the decline since 2007 has been the largest (34 percent) and most prolonged, despite much higher long-term average productivity than in the other recovery units. In-depth evaluation of population and productivity trends and environmental factors by the Wildlife Research Division of the Wildlife and Landscape Science Directorate, Environment Canada, concluded that the limiting factors now impeding recovery are primarily occurring outside Canada, during migration or on the wintering grounds (Gratto-Trevor et al. 2013). Efforts to identify these factors have been initiated, but the difficulties inherent to discerning links between environmental factors in the nonbreeding range and vital demographic rates mean that rapid results are unlikely. Furthermore, the availability of measures to ameliorate causal factors that may be identified is completely unknown. In the meanwhile, Canadian Wildlife Service and other conservation partners continue ongoing intensive efforts to protect habitat and breeding activity to maximize productivity and reverse or slow the population decline. Low abundance, a sharply declining population trend, and lack of identified causal factors that can be remedied make the likelihood of survival and recovery of the Eastern Canada recovery unit highly uncertain.

[5] The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) currently recognizes piping plovers breeding in Eastern Canada as *Charadrius melodus melodus* and designates the subspecies as "Endangered" (Department of Justice Canada 2002). This supersedes 1978 and 1985 designations assigned to the entire Canadian population of piping plovers (COSEWIC 2001). The Canadian piping plover recovery strategy recognizes the importance of conserving migration and wintering habitat (Environment Canada 2012). Canadian piping plover breeding sites identified as critical habitat receive legal protections under the Species at Risk Act (Environment Canada 2012).

New England recovery unit - The largest and most sustained population increase has occurred in New England, where the recovery unit population has exceeded (or been within 3 pairs of) its 625-pair abundance goal since 1998, attaining estimates of 918 and 883 pairs, respectively, in 2015 and 2016. Although effects from past habitat loss and modification have diminished the piping plover's habitat base in New England, many high quality habitats remain (Rice 2016, 2017), and piping plovers breed productively on a wide range of microhabitats. Notwithstanding the relatively robust status of piping plovers in the New England recovery unit, continued vigilance is warranted. For example, abundance declined 11 percent between 2002 and 2005, and productivity estimates in 2012 and 2013 were the lowest since ESA listing and far below average.

New York-New Jersey recovery unit – Abundance in the New York-New Jersey recovery unit attained a post-listing peak of 586 pairs in 2007, then declined 35 percent to 378 pairs in 2014 following 7 years of low productivity (including 4 years when it was less than 1.0 chicks per pair). Improved productivity in 2014 and 2015 fueled a partial rebound to 496 pairs in 2016, and high productivity in 2016 (1.62 chicks per pair) is auspicious. The New Jersey piping plover population has fluctuated at low numbers (1989–2016 range = 92 to 144 pairs), and totaled 115 pairs in 2016, when 85 percent of the New Jersey nesting pairs were concentrated along less than 14 percent of the State's ocean shoreline (Rice 2017, Pover and Davis 2016). Changes in the Long Island population account for most of the increases and decreases in the recovery unit population. It is uncertain whether the New York-New Jersey population can attain and sustain abundance necessary to assure long-term resiliency without changes in shoreline stabilization practices.

Southern recovery unit - Net growth in the Southern recovery unit piping plover population was over 94 percent between 1989 and 2016, when abundance attained a post-listing high of 386 breeding pairs. The population has responded positively to habitat creation events such as the 1992-1993 Nor'easters, Hurricane Isabel in 2003, Hurricane Ophelia in 2005, and Hurricane Irene in 2011 (Boettcher et al. 2007, NPS 2009, Schupp et al. 2013, USFWS 2014). However, lower productivity in 2016 (0.88 chicks per pair) may slow or reverse population growth in 2017. The North Carolina population is particularly vulnerable following very low productivity in 2016.

Summary - Concerns regarding increasingly uneven distribution of Atlantic Coast piping plovers as articulated in the 2009 5-Year Review have partially shifted with respect to their geographic focus, with improving status of the Southern recovery unit and an overall decline in the New York-New Jersey recovery unit. Although abundance has remained high in New England, no substantial dispersal from New England to either Eastern Canada or New York-New Jersey has occurred, and any future inter-recovery unit "rescue" will be very slow. The survival and recovery of Atlantic Coast piping plovers remain highly dependent on rangewide conservation of remaining habitats and habitat-formation processes, as well as annual implementation of labor-intensive management to minimize the effects of pervasive and persistent threats from predation and disturbance by humans and pets (USFWS 2009).

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Table 1. Estimated abundance of Atlantic Coast piping plovers 1986 – 2016

State/RECOVERY UNIT	Pairs																														
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Maine	15	12	20	16	17	18	24	32	35	40	60	47	60	56	50	55	66	61	55	49	40	35	24	27	30	33	42	44	50	62	66
New Hampshire												5	5	6	6	7	7	7	4	3	3	3	3	5	4	4	6	7	6	8	7
Massachusetts	139	126	134	137	140	160	213	289	352	441	454	483	495	501	496	495	538	511	488	467	482	558	566	593	591	656	676	666	663	687	649
Rhode Island	10	17	19	19	28	26	20	31	32	40	50	51	46	39	49	52	58	71	70	69	72	73	77	84	85	86	90	92	91	99	98
Connecticut	20	24	27	34	43	36	40	24	30	31	26	26	21	22	22	32	31	37	40	34	37	36	41	44	43	52	51	45	51	62	63
NEW ENGLAND	184	179	200	206	228	240	297	376	449	552	590	612	627	624	623	641	700	687	657	622	634	705	711	753	753	831	865	854	861	918	883
New York	106	135	172	191	197	191	187	193	209	249	256	256	245	243	289	309	369	386	384	374	422	457	443	437	390	318	342	289	286	308	381
New Jersey	102	93	105	128	126	126	134	127	124	132	127	115	93	107	112	122	138	144	135	111	116	129	111	105	108	111	121	108	92	108	115
NY-NJ	208	228	277	319	323	317	321	320	333	381	383	371	338	350	401	431	507	530	519	485	538	586	554	542	498	429	463	397	378	416	496
Delaware	8	7	3	3	6	5	2	2	4	5	6	4	6	4	3	6	6	6	7	8	9	9	10	10	9	8	7	6	6	6	8
Maryland	17	23	25	20	14	17	24	19	32	44	61	60	56	58	60	60	60	59	66	63	64	64	49	45	44	36	41	45	38	36	34
Virginia	100	100	103	121	125	131	97	106	96	118	87	88	95	89	96	119	120	114	152	192	202	199	208	193	192	188	259	251	245	256	291
North Carolina	30	30	40	55	55	40	49	53	54	50	35	52	46	31	24	23	23	24	20	37	46	61	64	54	61	62	70	56	65	64	53
South Carolina	3		0		1	1		1			0					0						0									
SOUTHERN	158	160	171	199	201	194	172	181	186	217	189	204	203	182	183	208	209	203	245	300	321	333	331	302	306	294	377	358	354	362	386
U.S. TOTAL	550	567	648	724	752	751	790	877	968	1150	1162	1187	1168	1156	1207	1280	1416	1420	1421	1407	1493	1624	1596	1597	1557	1554	1705	1609	1593	1696	1765
EASTERN CANADA**	240	223	238	233	230	252	223	223	194	200	202	199	211	236	230	250	274	256	237	217	256	266	253	252	225	209	179	184	186	179	176
ATLANTIC COAST TOTAL	790	790	886	957	982	1003	1013	1100	1162	1350	1364	1386	1379	1392	1437	1530	1690	1676	1658	1624	1749	1890	1849	1849	1782	1763	1884	1793	1779	1875	1941

** Includes 1-5 pairs on the French Islands of St. Pierre and Miquelon, reported by Canadian Wildlife Service

Table 2. Estimated productivity of Atlantic Coast piping plovers 1987-2016

State/RECOVERY UNIT	Chicks fledged/pair																													
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Maine	1.75	0.75	2.38	1.53	2.50	2.00	2.38	2.00	2.38	1.63	1.98	1.47	1.63	1.60	1.98	1.39	1.28	1.45	0.55	1.35	1.06	1.75	1.70	1.63	2.12	1.52	1.93	1.94	1.95	1.53
New Hampshire											0.60	2.40	2.67	2.33	2.14	0.14	1.00	1.00	0.00	0.67	0.33	2.00	0.40	1.50	2.00	0.67	1.71	0.33	1.50	2.14
Massachusetts	1.10	1.29	1.59	1.38	1.72	2.03	1.92	1.81	1.62	1.35	1.33	1.50	1.60	1.09	1.49	1.14	1.26	1.38	1.14	1.33	1.25	1.41	0.91	1.50	1.18	0.85	0.87	1.18	1.29	1.44
Rhode Island	1.12	1.58	1.47	0.88	0.77	1.55	1.80	2.00	1.68	1.56	1.34	1.13	1.79	1.20	1.50	1.95	1.03	1.50	1.43	1.03	1.48	1.68	1.46	1.76	1.49	1.06	0.98	1.63	1.58	1.48
Connecticut	1.29	1.70	1.79	1.63	1.39	1.45	0.38	1.47	1.35	1.31	1.69	1.05	1.45	1.86	1.22	1.87	1.30	1.35	1.62	2.14	1.92	2.49	1.68	1.91	1.37	1.18	1.82	2.27	1.81	1.38
NEW ENGLAND	1.19	1.32	1.68	1.38	1.62	1.91	1.85	1.81	1.67	1.40	1.39	1.46	1.62	1.18	1.53	1.26	1.24	1.40	1.15	1.34	1.30	1.51	1.04	1.56	1.27	0.93	1.00	1.33	1.40	1.45
New York	0.90	1.24	1.02	0.80	1.09	0.98	1.24	1.34	0.97	1.14	1.36	1.09	1.35	1.11	1.27	1.62	1.15	1.46	1.44	1.55	1.15	1.21	0.93	0.79	1.07	0.72	0.71	1.30	1.52	1.72
New Jersey	0.85	0.94	1.12	0.93	0.98	1.07	0.93	1.16	0.98	1.00	0.39	1.09	1.34	1.40	1.29	1.17	0.92	0.61	0.77	0.84	0.67	0.64	1.05	1.39	1.18	0.72	0.85	1.36	1.29	1.35
NY-NJ	0.86	1.03	1.08	0.88	1.04	1.02	1.08	1.25	0.97	1.07	1.02	1.09	1.35	1.19	1.28	1.49	1.07	1.23	1.28	1.36	1.03	1.10	0.96	0.92	1.09	0.72	0.74	1.32	1.46	1.62
Delaware		0.00	2.33	2.00	1.60	1.00	0.50	2.50	2.00	0.50	1.00	0.83	1.50	1.67	1.50	1.17	2.33	1.14	1.50	1.44	1.33	0.30	1.30	1.56	1.00	1.00	1.17	1.33	1.17	1.63
Maryland	1.17	0.52	0.90	0.79	0.41	1.00	1.79	2.41	1.73	1.49	1.02	1.30	1.09	0.80	0.92	1.85	1.56	1.86	1.25	1.06	0.78	0.41	1.42	1.09	1.25	1.02	0.76	1.55	1.31	1.47
Virginia		1.02	1.16	0.65	0.88	0.59	1.45	1.66	1.00	1.54	0.71	1.01	1.21	1.42	1.52	1.19	1.90	2.23	1.52	1.19	1.16	0.87	1.19	1.35	1.36	0.95	1.15	1.34	1.26	0.92
North Carolina			0.59	0.43	0.07	0.41	0.74	0.36	0.45	0.86	0.23	0.61	0.48	0.54	0.50	0.17	0.46	0.65	0.92	0.87	0.26	0.30	0.70	0.77	0.77	0.59	0.96	0.22	0.64	0.15
SOUTHERN	1.17	0.85	0.88	0.72	0.68	0.62	1.18	1.37	1.05	1.34	0.68	0.99	1.04	1.09	1.22	1.27	1.63	1.95	1.38	1.12	0.92	0.67	1.14	1.20	1.21	0.89	1.07	1.15	1.15	0.88
U.S. average	1.04	1.11	1.28	1.06	1.22	1.35	1.47	1.56	1.35	1.30	1.16	1.27	1.45	1.17	1.40	1.34	1.24	1.43	1.24	1.30	1.13	1.19	1.03	1.27	1.21	0.86	0.94	1.29	1.37	1.37
EASTERN CANADA**		1.65	1.58	1.62	1.07	1.55	0.69	1.25	1.69	1.72	2.10	1.84	1.74	1.47	1.77	1.18	1.62	1.93	1.82	1.82	1.14	1.47	1.22	1.59	1.19	1.38	1.36	1.37	1.60	1.39

** Includes St. Pierre and Miquelon, reported by Canadian Wildlife Service