MARINE BIRDS OF THE EASTERN UNITED STATES AND THE BAY OF FUNDY

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MARINE BIRDS OF THE EASTERN UNITED STATES AND THE BAY OF FUNDY

DISTRIBUTION, NUMBERS, TRENDS, THREATS, AND MANAGEMENT

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ABSTRACT

THIS publication reviews the status, numbers, trends, and conservation needs of the marine birds of the east coast of the United States and the Bay of Fundy, including the waters of the adjoining continental shelf and slope. Some 600,000 pairs of 31 species of marine birds breed in this area. The numerically dominant species are gulls (300,000 pairs of 7 species), terns (125,000 pairs of 11 species), cormorants (50,000 pairs of 2 species), Common Eiders (43,000 pairs), and Leach's Storm-Petrels (40,000 pairs). Almost all breeding seabirds were extirpated from the area or severely reduced by human persecution in the 19th century, but most species recovered under protection and increased for most or all of the 20th century. Several species that had been increasing during the first half of the 20th century fluctuated in numbers during the second half, but only 7 breeding species are now thought to be decreasing and at least 16 are still increasing. Nine species have recently colonized or recolonized the area from the north or from the eastern Atlantic.

In contrast to the relatively small numbers of breeders, many million birds of 83 marine species occur regularly in the area on migration and/or in their nonbreeding seasons. Three of the most abundant species are migrants from the Southern Hemisphere: Great Shearwater, Sooty Shearwater, and Wilson's Storm-Petrel, each of which occurs in millions. Red Phalarope and Ring-billed Gull probably also occur in millions, Northern Fulmar may do so, and Red-necked Phalarope formerly did so, at least prior to 1983. Other migrants are drawn from the Great Lakes, arctic and boreal North America, Europe, the Mediterranean, and the West Indies. The great disparity in numbers between breeders and migrants is attributable to the paucity of islands suitable for nesting, except for inshore species such as gulls and terns.

Among breeders, both numbers and species richness are higher in the northern half of the area than in the southern half; 21 species of marine birds have bred at least occasionally in the eastern Gulf of Maine and Bay of Fundy. Among nonbreeders, numbers are much higher in the northern half of the area, but species richness is greatest in the vicinity of Cape Hatteras.

The most important threat to marine birds of the area is probably global climate change, which is likely to cause shifts in breeding ranges, rising sea level, fragmentation and submergence of barrier beaches and islands, changes in marine ecosystems, and possibly changes in oceanographic features and in the frequency of severe storms. However, these potential effects on marine birds have received little attention or study and are very difficult to assess. The other major threat is human development of the coastline, which has limited many breeding species to a restricted number of nesting sites, many of which are suboptimal: this requires continuous management of many species at many sites. Management programs have been generally effective in maintaining or restoring nesting sites and in effecting continued increases in numbers, but these programs are labor-intensive and expensive and are not well coordinated; numbers of most breeding species are still lower than those recorded in the past. Other threats to marine birds include deterioration of dredge spoil islands, threats on foreign breeding sites, by-catch and other effects of human fisheries, hunting and other human persecution, toxic chemicals, human disturbance, displacement and predation by large gulls and other species promoted by human activities, offshore wind turbines, oil spills, discarded plastic items, diseases, and biological toxins. Most species that occur in the area are threatened by one or more of these factors. Most of the recorded changes in numbers of breeders can be attributed, directly or indirectly, to human activity.

A number of recommendations are presented for additional research and for management of marine birds in the area. Detailed studies of potential effects of climate change on marine birds are urgently needed. Despite lip-service paid to the importance of monitoring, there has been no coordinated census of the breeding birds of the entire area since the 1970s, and there are no readily-accessible databases from which regional numbers or trends can be compiled. Efforts to manage and restore breeding sites and to control human encroachment should be continued and need better coordination. Contingency plans are needed to prepare for rising sea level and consequential loss of breeding sites. Our list of species under greatest threat and our proposals for research and management differ markedly from those put forward in recent continental and regional Conservation Plans: these discrepancies need to be resolved.

Keywords: Atlantic ocean, Atlantic coast of North America, United States, US, Bay of Fundy, marine birds, seabirds, seaducks, loons, grebes, tubenoses, Pelecaniformes, phalaropes, gulls, terns, jaegers, alcids, distribution, numbers, trends, threats, management.

INTRODUCTION

This study is concerned with the marine birds (broadly defined) of the east coast of the United States and the adjacent Bay of Fundy in southeastern Canada. We describe their distribution, status, and trends during the past 30–40 years, identify threats to them, and recommend measures to conserve and study them.

Marine Birds

There is no one definition of "marine birds" or "seabirds", so any selection of species for coverage is necessarily somewhat arbitrary (Schreiber and Burger 2002). This publication covers all species that occur regularly in the area covered and feed largely or exclusively at sea for all or part of the year. This includes all species treated as seabirds by Croxall et al. (1984), plus seaducks (eiders, Harlequin Duck, scoters, Long-tailed Duck, and Red-breasted Merganser), loons, grebes (excluding Pied-billed Grebe), Red-necked and Red Phalaropes, and Black Tern. [Scientific names of all species mentioned in this paper are listed in Appendix 1; nomenclature follows AOU 1998, with supplements through 2010.] Each of these species that occurs in the waters of the eastern United States or Bay of Fundy on a regular basis (at least once each year) is covered in detail in this publication. Rare species (those reported in the area less than once per year) are listed in Appendix 3. Our focus is on birds that spend at least part of their annual cycle on the open sea, so species that occur primarily in sheltered waters (e.g., bay ducks) or are primarily terrestrial (e.g., Brant, herons, shorebirds other than phalaropes) are excluded, even though they are arguably "marine" (Schreiber and Burger 2002).

Physical Setting and Oceanography

The geographical area covered in this paper comprises the coasts and waters of the eastern United States and the adjacent Bay of Fundy, from Cape Sable Island [see Gazetteer, Appendix 2, for details of all locations mentioned] to the entrance to the Straits of Florida (south to and including Biscayne Bay but excluding the Bahamas and Bermuda). It includes inshore and continental shelf and slope waters out to the 2000-meter (1100-fathom) isobath, plus sounds, bays, estuaries, and tidal rivers up to the limits of salt water intrusion (see Figures 1–4). It includes terrestrial areas along the coast where these are used for breeding by birds that feed in salt waters or, outside the breeding season, by birds that meet the definition of marine birds stated above. The landward limit of the study area is difficult to define, and almost all possible definitions have exceptions. The only place where this is critical is the Christmas Bird Counts (CBCs), where available data do not distinguish between birds at the coast and those inland, so we counted them all. For example, gulls counted during CBCs in coastal circles are included in the tabulation in Table 4, even though many of them were counted in terrestrial environments. All CBCs in our study area that we could identify as within 12 km of the coast were summarized, even though the CBC website does not allow locating individual CBC circles relative to the coastline or sorting by

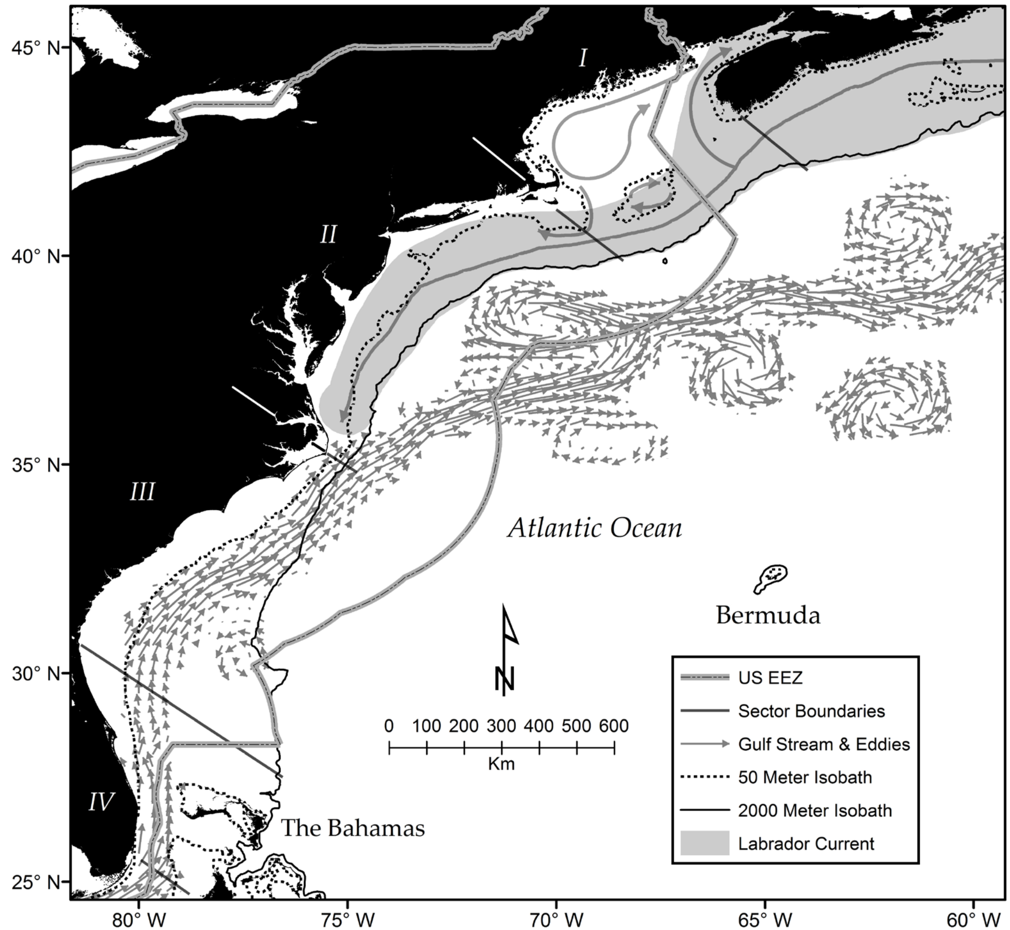

Figure 1. Map of the eastern United States and adjacent Canada showing major ocean currents. Roman numerals indicate the 4 sectors into which the coastal waters are divided for compilations in this publication (Tables 1 and 4): **I, Gulf of Maine/Bay of Fundy; II, Mid-Atlantic Bight; III, South Atlantic Bight; IV, East Florida.** Solid lines indicate sector boundaries. The Labrador Current is shown as a shaded area with continuous arrows indicating directions of flow. The Gulf Stream and its eddies are shown as multiple arrows, with the length of each arrow proportional to speed of flow. The Gulf Stream is a dynamic system: eddies are shed periodically and move slowly in the direction of the main current; the configuration shown is for a single arbitrary date.

categories smaller than states. For brevity, the study area is generally referred to in this paper as "US east coast" or "eastern US waters"; it should be understood that these terms include the Bay of Fundy and contiguous waters in Canada.

Oceanographically, eastern US waters are partitioned into three zoogeographic zones: from Cape Hatteras southwards, Cape Hatteras to Cape Cod, and Cape Cod northwards. These zones have reasonably characteristic assemblages of seabirds, fishes, and plankton. The waters of the Gulf Stream, north to Cape Hatteras, constitute an additional zone, in that the birds that occur there are primarily tropical.

The US east coast is bordered by a broad (100–200 km) continental shelf that plunges from depths of 200 m to 3000 m at its offshore edge, known as the continental slope. Fresher waters of the continental shelf yield to warmer and saltier slope water across a shelf break front that usually occurs seaward of the slope itself. Seaward of the slope water is the Gulf Stream, the western boundary current of the North Atlantic that reaches as close as 100 km from shore at Cape Hatteras, then heads northeastwards towards Europe (note that the Gulf Stream north and east of Cape Hatteras is outside the area covered in this publication: Fig. 1). Several seamounts lie across the Gulf Stream ESE of Cape Cod, but the only one close to our area is Bear Seamount south of Georges Bank (Fig. 2). The Labrador Current moves southward from Newfoundland along the North American coast, reaching its southernmost extent at Cape Hatteras, where it collides with the west wall of the Gulf Stream (Fig. 1). The area covered includes Georges Bank, an exceptionally productive shallow bank at the entrance to the Gulf of Maine (Brown 1986, Backus and Bourne 1987) and Browns Bank, a similar but smaller bank SSW of Nova Scotia. The Northeast Channel is a deepwater channel between Georges and Browns Banks (Fig. 1).

North to Long Island, the immediate coastline is low-lying, with barrier beaches and barrier islands separating the ocean from shallow sounds, bays, and inlets. From eastern Long Island to Boston Harbor, including both shores of Long Island Sound, the coastline consists of barrier beaches alternating with terminal moraines, including large and small islands composed mainly of glacial till. North of Boston, the coast is mostly rocky and glaciated, with many low, rocky islands. The only vertical rock cliffs in the entire area are a few low cliffs (<15 m) on islands in eastern Maine and the Bay of Fundy. Most islands and barrier beaches are close enough to the mainland to be accessible to mainland-based predators (American Mink, Red Fox, Norway Rat, Raccoon, herons, owls, etc.). The entire area is within the normal tracks of tropical hurricanes, as well as the extratropical storms known locally as northeasters.

South of Cape Cod, tidal ranges are usually only 1–1.5 m, but this is sufficient to lead to rapid tidal currents through inlets between barrier islands; these are important feeding areas for terns and other coastal species. In Cape Cod Bay and the Gulf of Maine, tidal ranges are generally 2–4 m. The Bay of Fundy is characterized by exceptionally high tides (up to 20 m) and fast tidal currents that cause locally strong upwellings (Mercier and Gaskin 1985).

General Patterns of Seabird Distribution

Compared with eastern Canada, the east coast of the United States has many more breeding seabird species, but fewer individuals. The only truly pelagic seabirds that

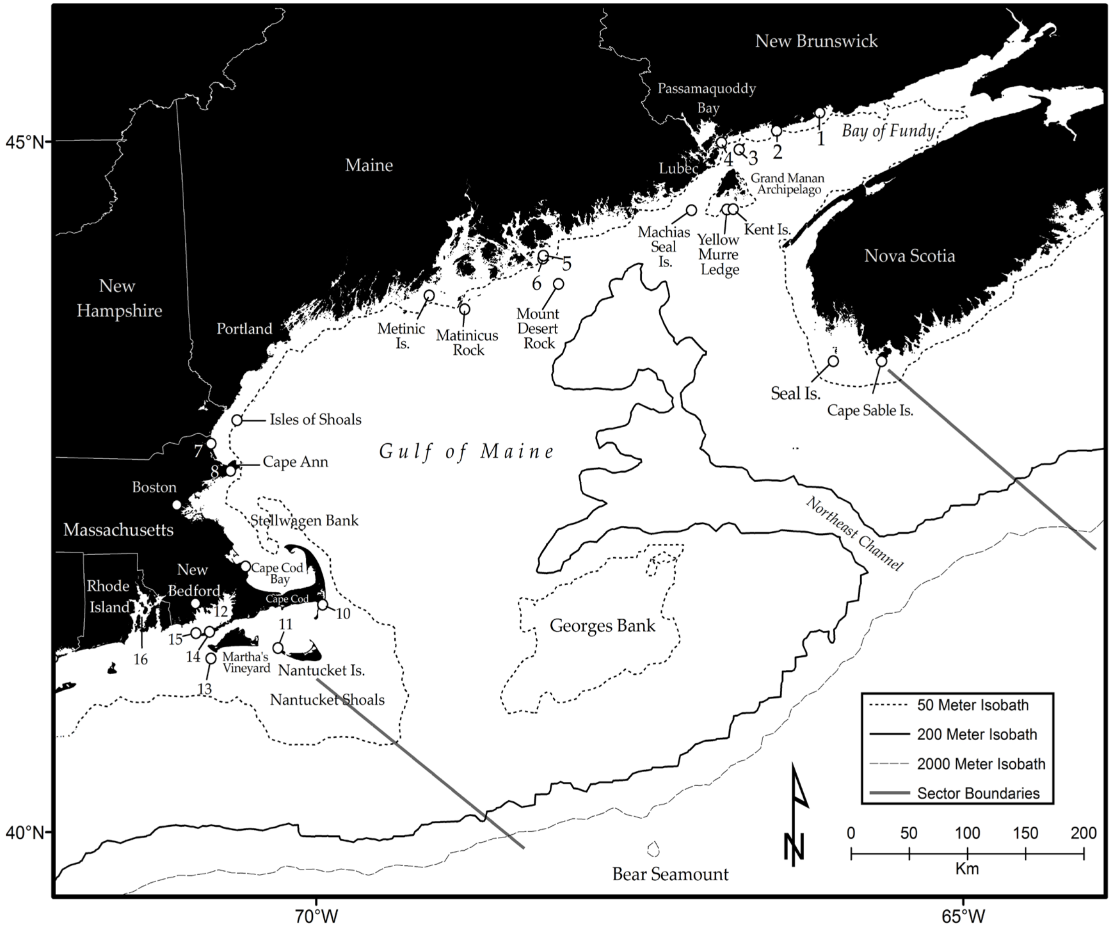

Figure 2. Map of Sector I (Gulf of Maine/Bay of Fundy) showing locations referred to in the text. Key to numbered locations: 1. Manawagonish Island. 2. Point Lepreau. 3. South Wolf Island. 4. Whitehorse Island. 5. Little Duck Island. 6. Great Duck Island. 7. Plum Island. 8. Gloucester. 9. Manomet Point. 10. South Beach. For locations 11–16, see caption to Fig. 3. See also Gazetteer, Appendix 2. The Gulf Stream and its eddies pass outside the 2000 m isobath and only occasionally cross the southeast corner of the area shown in this figure.

breed in the area covered by this publication are the few tens of thousands of Leach's Storm-Petrels and alcids in the Gulf of Maine and Bay of Fundy, plus Northern Gannet and Black-legged Kittiwake, which have colonized the Bay of Fundy in very small numbers in the last few years. South of Cape Cod, the most characteristic breeding seabirds are more inshore species such as Brown Pelican, terns, and Black Skimmer; Laughing Gull is the most abundant breeding species. From Florida north to Cape Hatteras, the predominant breeding seabirds are those characteristic of the Gulf of Mexico and other southern waters: Brown Pelican, Laughing Gull, Royal, Sandwich, and Least Terns, and Black Skimmer. These species extend north in varying numbers to Maryland, New Jersey, and New York, where they mix with more northern species such as Herring and Great Black-backed Gulls, and Common Tern. There is no clear faunal break at Cape Hatteras, in spite of the change in ocean currents there (see **Physical Setting and Oceanography**).

The most decisive faunal break actually occurs at Cape Cod. Although a few southern species such as Laughing Gull, Roseate Tern, and Least Tern extend in small numbers north of Cape Cod into the Gulf of Maine, most of the breeding species in the Gulf of Maine and the Bay of Fundy are of subarctic affinities: Leach's Storm-Petrel, Northern Gannet, Great Cormorant, Common Eider, Red-breasted Merganser, Ring-billed, Herring, and Great Black-backed Gulls, Black-legged Kittiwake, Arctic Tern, Black Guillemot, and other alcids. The main species that bridge the faunal break are Herring and Great Black-backed Gulls (which spread south and west of Cape Cod during the 20th century), and Common Tern, which extends from Labrador south to South Carolina. Double-crested Cormorant is unique in that it is represented in the area by 2 ecologically distinct subspecies. Historically, northern *auritus* bred on coastal islands south to New England, while southern *floridanus* bred on forested lakes from Florida north to North Carolina; in recent decades both have extended their ranges and now appear to overlap in the area from Virginia to New Jersey. Roseate Tern is a highly localized species that in North America breeds mainly from Long Island to Cape Cod, with a few hundred pairs in the Gulf of Maine and a discrete population in the Bahamas and West Indies. The northeast population of Roseate Tern is listed as Endangered in both the United States and Canada. At least 13 other breeding species are regionally or locally threatened, in that they number fewer than 1000 breeding pairs in the entire study area (Table 1), although several of these are common to abundant in neighboring regions.

Migrant seabirds are numerically much more important than breeding seabirds in eastern US waters. The area serves as the principal wintering grounds in eastern North America for a number of northern species, including Common Eider, Harlequin Duck, 3 species of scoter, Long-tailed Duck, Red-breasted Merganser, Red-throated and Common Loons, Horned and Red-necked Grebes, Northern Gannet, Great and Double-crested Cormorants, at least 6 species of gulls, Forster's Tern, and Razorbill. Among these species, Harlequin Duck, Red-necked Grebe, Great Cormorant, and Razorbill winter primarily in the Gulf of Maine and/or Bay of Fundy, with fewer around and south of Cape Cod. Other northern species, such as Northern Fulmar, Iceland Gull, and Black-legged Kittiwake, winter in substantial numbers in the same area, although their main winter ranges are to the north and east. Common Eider and

Long-tailed Duck are concentrated in winter in the Nantucket Shoals area off Cape Cod, and most of the other inshore species are also most numerous in the area between Cape Cod and Cape Hatteras.

Besides wintering species, phalaropes, jaegers, and Black Terns migrate through the area in large numbers on their way to and from more southern wintering areas. The Bay of Fundy is a major staging area for phalaropes and Bonaparte's Gulls in autumn; in spring, phalaropes stage offshore from the Mid-Atlantic Bight to Georges Bank. Among eastern Atlantic species, nonbreeding Cory's Shearwaters occur in the area in large numbers in summer and autumn, and several gadfly petrels and storm-petrels occur in summer and autumn in numbers disproportionate to their small total populations in the eastern Atlantic. These and other rare seabirds are recorded most frequently in the vicinity of Cape Hatteras, an area where the Gulf Stream passes close to shore and where contrasting water bodies support a unique mix of northern, southern, and eastern seabird taxa. The Gulf Stream and its associated eddies have a profound impact on the distribution of seabirds off our coast. Within our area, many primarily tropical and subtropical species, especially Black-capped Petrel, Band-rumped Storm-Petrel, and Bridled Tern, occur almost exclusively over Gulf Stream waters and eddies that spin off from the Gulf Stream (Haney 1986a). Since the Gulf Stream approaches our coastline closely only in the vicinity of Cape Hatteras, a perhaps disproportionate amount of data on these tropical and subtropical species derives from single-day boat trips to the Gulf Stream from that area. Some of these species extend in Gulf Stream waters and eddies far to the northeast, and are probably more frequent southeast of Cape Cod and Georges Bank than the few records indicate; it is not known how often these birds stray inshore into slope waters at the margins of our area.

Not least, 3 Southern Hemisphere species—Great and Sooty Shearwaters, and Wilson's Storm-Petrel—and 2 tropical species—Black-capped Petrel and Audubon's Shearwater—migrate into the area from the south in summer and autumn. The 3 Southern Hemisphere species are among the most abundant seabirds in eastern US waters, occurring primarily as migrants on their way between Southern Hemisphere breeding areas and subarctic areas that they frequent in the Northern Hemisphere summer.

Historical Perspective

Little information is available on seabirds of the eastern United States or Bay of Fundy prior to about 1860. It is likely that breeding seabirds were adversely affected in many areas by egging, harvesting, and introduced predators, especially on islands used for farming, fishing, or manned lighthouses (Drury 1973–74).

The decisive event shaping seabird populations in the eastern United States was the mass slaughter for the millinery trade in the 1870s and 1880s (Doughty 1975). All seabirds were eliminated from most of the east coast, and by the 1890s fewer than 10 seabird breeding sites were known to be still occupied—1 in Virginia, probably 1 in Long Island Sound, 2–3 in Massachusetts, 3–4 in Maine, and 1–2 in New Brunswick (Nisbet 1973; Drury 1973–74). This slaughter was the trigger for the founding of the major wildlife conservation organizations in the United States and Canada, and led to the winning of local, national, and international protection for seabirds and other wild birds. The history of seabird populations in this area in the 20th century was primarily one of recovery from the depredations of the 19th; the recovery has been slow because reproductive rates of most seabirds are low. Some species are still increasing, whereas others reached peak numbers during the second half of the 20th century and have decreased or fluctuated since. This publication makes no further reference to the events of the 1870s and 1880s, but they should be understood as the background lying behind all that has occurred since.

Sources of Information

Despite many recommendations for systematic censuses and record-keeping (e.g., Kushlan et al. 2002), there are no readily-accessible databases on seabird populations in North America. This review, like other regional surveys, has been compiled from many disparate sources.

For the eastern United States, the most complete inventory of breeding seabirds is the Atlas compiled by Spendelow and Patton (1988), which was based on surveys conducted by and for the US Fish and Wildlife Service in 1976–77 (Erwin 1979; Korschgen 1979; Erwin and Korschgen 1979; Portnoy et al. 1981). These surveys were updated to 1983, with incorporation of additional data, in book chapters by Buckley and Buckley (1984) and Clapp and Buckley (1984). A revised atlas for the northern half of the area (Maine to Virginia), based on a partial census conducted in 1984–85, was compiled by Andrews (1990). All these publications included summaries of historical information, but the most complete account of the history of seabirds in the northern half of the area is that of Drury (1973–74). There is no comprehensive information on the history of seabirds in the southern half of the area.

A third regional census for the northern half of the area (Maine–Virginia) was conducted in 1994–95, but remains unpublished except for a few reports for individual states (e.g., Blodget and Livingstone 1996). Unedited data from this census are held in a database at the USGS Patuxent Wildlife Research Center (referred to in this paper as "USGS database"); we compiled total numbers by state and region, and incorporated these totals into Tables 1 and 2. The US Fish and Wildlife Service has plans to edit the data in the near future and to incorporate them into a larger database on colonial waterbirds, which will be publicly accessible (M. Steinkamp, pers. comm.). There has been no similar coordinated census of breeding marine birds in the area south of Virginia since 1976–77.

Estimates of total world and/or North American populations for many species were given in a recent publication *Waterbird Population Estimates* (Wetlands International 2006; hereafter *WPE*). Estimates of total numbers of seabirds breeding in the West Indies were published in a symposium volume edited by Schreiber and Lee (2000), and were updated to 2007 by Bradley and Norton (2009). Estimates of total numbers for several species that breed in Europe are derived from a book by Hagemeijer and Blair (1997), with updates where available. Estimates of total numbers of endangered, threatened, and vulnerable species were published by BirdLife International (2000). Estimates of total numbers of Red and Red-necked Phalaropes in North America were included in an assessment of shorebird populations by Morrison et al. (2000a, b).

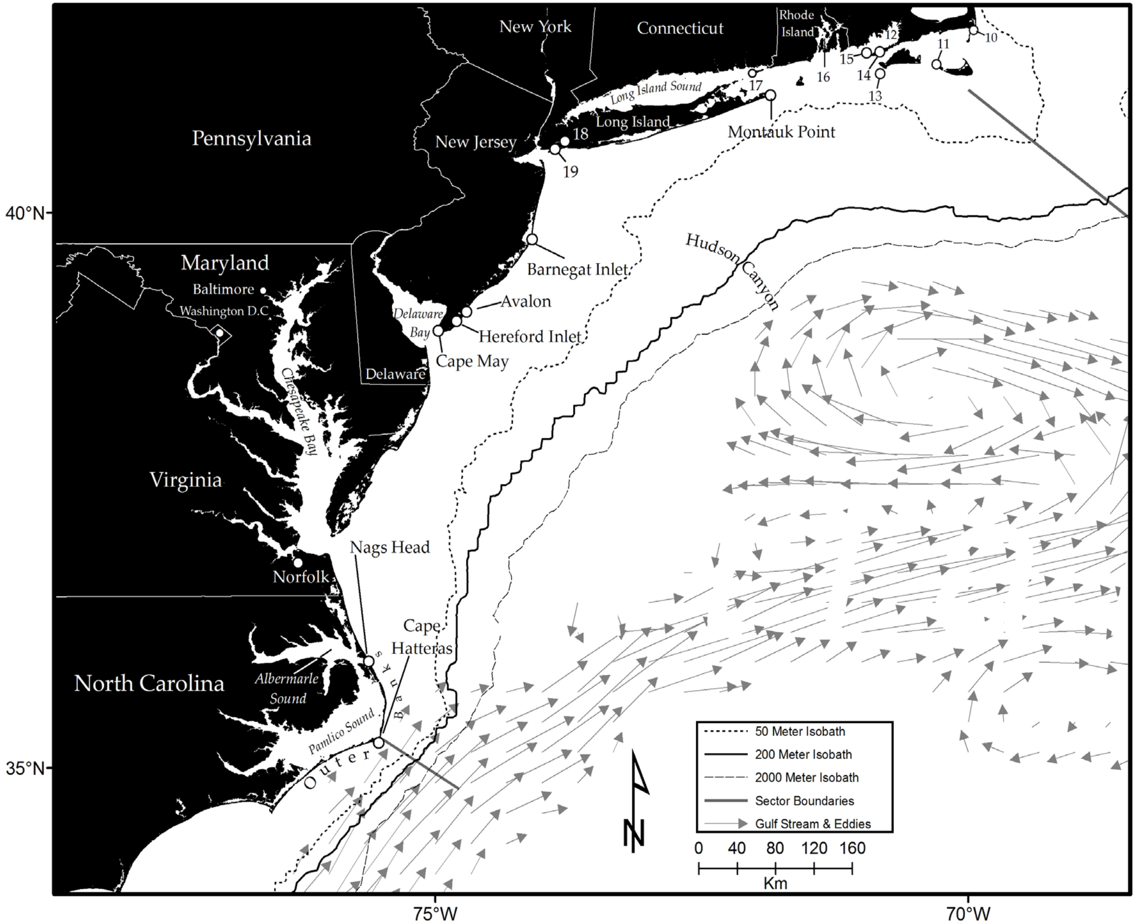

Figure 3. Map of Sector II (Mid-Atlantic Bight) showing locations referred to in the text. Key to numbered locations: 11. Muskeget Island. 12. Buzzards Bay. 13. Noman's Land Island. 14. Elizabeth Islands. 15. Penikese Island. 16. Narragansett Bay. 17. Fisher's Island. 18. JF Kennedy International Airport. 19. Jamaica Bay Wildlife Refuge. See also Gazetteer, Appendix 2.

Besides these general sources, monographs on all marine species that breed in North America (except Black-headed and Lesser Black-backed Gulls) have been published recently in *The Birds of North America* series (hereafter, *BNA*); most of those monographs provided information on total numbers, and some provided detailed breakdown of numbers by states and provinces (e.g., Hatch and Weseloh 1999; Nisbet 2002a). Among individual species, all known Roseate Tern colonies in the region have been censused each year since 1987 (Northeast Roseate Tern Recovery Team 1998 and unpubl. data), and there are several published papers on other species (e.g., Krohn et al. 1992; Hatch 1995; Molina and Erwin 2006; Wires and Cuthbert 2006). Among regions, all known colonies of terns, Laughing Gulls, and most alcids in the Gulf of Maine have been censused in each year since 1984 (Gulf of Maine Seabird Working Group, referred to in this publication as "GOMSWG annual reports"). The entire shoreline of Long Island (not just previously known colony sites) was surveyed and censused for colonial waterbirds from 1974–1978 and in 1983 (Buckley and Buckley 1980, 1984); since the late 1980s, all known tern colonies on Long Island have been censused each year and all known colonies of cormorants and gulls every 3 years (Downer and Liebelt 1990; New York State Department of Environmental Conservation 1992–2009, referred to in this paper as "NYSDEC annual reports"). All colonial waterbirds are censused each year on the Virginia barrier islands (Williams et al. 1990, 2005); there are also many reports on censuses in other states or regions (e.g., Parnell et al. 1995, 1997; Wilkinson 1997; Watts and Byrd 1998; Watts 2004; Jodice et al. 2007, Emslie et al. 2009). The only state for which we have found no detailed information since 1976 is Florida, for which there have been several statewide censuses of seabird species but no readily-available breakdown between Atlantic, Caribbean, and Gulf coasts. Other sources are cited for individual species and areas, where appropriate.

For Canadian islands in the Bay of Fundy, the primary source of data on breeding seabirds is the atlas by Erskine (1992), which presented estimates of numbers by province but did not give separate estimates for the Bay of Fundy or individual sites therein. For most seabirds, estimates of numbers breeding at Machias Seal Island and their histories were published by MacKinnon and Smith (1985), and by Diamond and Devlin (2003); similar estimates and histories for the Grand Manan Archipelago were published by Ronconi and Wong (2003), and references therein. Squires (1952), Christie (1979), and Tufts (1986) presented additional historical data. Boyne and Beukens (2004) reported on a census of gulls and cormorants in Nova Scotia in 2002. Additional data on Common Eiders and other species in Nova Scotia and New Brunswick were supplied by representatives of the provincial Departments of Environmental Conservation.

For at-sea distributions of seabirds, comprehensive surveys for the northern half of the area were conducted in the period 1977–80 and were reported by Powers et al. (1980), Powers (1983), Brown (1986), and Powers and Brown (1987). Some data were collected in 1976 and 1981–88, but most remain unpublished. Virtually no quantitative information has been reported since 1980. In particular, there is no information about changes in at-sea distributions of seabirds off the US east coast that may have occurred following the passage of the Magnuson–Stevens Fishery Management and Conservation Act in 1976, its implementation in subsequent years, the consequent departure of foreign fishing fleets, and the subsequent collapse of the major fish populations and fisheries in the study area.

For the southern half of the area, information on at-sea distributions is more scattered and less systematic; important sources are Lee and Booth (1979), Rowlett (1980), Haney (1983, 1985a, b, c, 1986a, b, 1990), Haney and McGillivary (1985), Lee (1986, 1989, 1995), Patteson and Brinkley (2004), Dias (2007), and Wallace and Wigh (2007). Except for three publications on individual species (Haney 1990; Lee and Haney 1996; Haney et al. 1999), there is no information on densities or estimates of total numbers of seabirds in this area: most of the quantitative information reported to date has been on numbers seen per trip. Tables 5 and 6 summarize such data for two areas where counts of seabirds have been maintained at all seasons throughout multiple years: off Cape Hatteras [http://www.patteson.com], and off eastern Florida (Wallace and Wigh 2007). A tendency for numbers per trip to increase in recent years probably results in part from the observers learning where birds tend to concentrate, although some species appear to have increased in numbers as well.

For information on swimming and diving seabirds such as loons, grebes, and seaducks, the major sources are the *BNA* accounts, plus information collected by the US Fish and Wildlife Service and state and provincial wildlife departments (e.g., Eggeman and Johnson 1989; Krohn et al. 1992; Caithamer et al. 2000), and by the Sea Duck Joint Venture, which has organized two North American Sea Duck Conferences (http://www.pwrc.usgs.gov), prepared a Strategic Plan (Sea Duck Joint Venture Management Board 2008), and issued species profiles in 2003–04 (http://seaduckjv.org). Comprehensive reviews of the status and numbers of Harlequin Ducks wintering in the area were published recently in a special issue of *Waterbirds* (Boyne 2008, Mittelhauser 2008). Earlier information on diving birds was summarized by Palmer (1962, 1976), Bellrose (1976), Clapp et al. (1982a, b), Office of Migratory Bird Management (1993), and Ad Hoc Sea Duck Committee (1994). For coastal birds in winter, an important source is the Christmas Bird Counts (hereafter, CBCs: data available at http://www.audubon.org). CBCs record all individuals and species found by groups of volunteer observers within a 24-km diameter circle in a single midnight-to-midnight period between 14 December and 5 January. These counts are not precise measures of numbers or density, but they probably give reasonable indices of total abundances for conspicuous, localized coastal and inshore seabirds. Early counts (from 1962–63 through 1971–72) were summarized by Root (1988); the present publication summarizes data from 1995–96 through 2004–05 (Table 4).

An index of coastwise migration is provided by the sea watch at Avalon (New Jersey Audubon 2006), where seabirds are counted passing a vantage point throughout daylight hours from 22 September to 22 December each year (see Table 7). Data from this sea watch are currently available through 2004. Another sea watch at Point Lepreau, New Brunswick, has monitored spring migration along the north shore of the Bay of Fundy since 1996: to date, data are available only for scoters (Bond et al. 2007, 2009). Other sea watches have been conducted at Manomet, Massachusetts, Cape Canaveral, Florida, and several other locations, but for fewer years and for shorter periods within years.

Major sources of information on the biology of the seabirds of the area are the *BNA* accounts, with earlier information available from Palmer (1962, 1976), Clapp et al. (1982a, b, 1983), Cramp and Simmons (1977, 1983), and Cramp (1985). Conservation and management issues were discussed by Buckley and Buckley (1983); in a publication by Croxall et al. (1984) that included chapters by Brown and Nettleship (1984), Buckley and Buckley (1984), Clapp and Buckley (1984), and van Halewyn and Norton (1984); by Parnell et al. (1988); and in a publication edited by Nettleship et al. (1994) that included chapters by Blanchard (1994), Duffy and Schneider (1994), and Gochfeld et al. (1994). Conservation issues for seabirds in the West Indies were discussed by Schreiber (2000a), and Bradley and Norton (2009).

Because of the limitations of the available data, this publication "paints with a broad brush" and does not attempt to describe microdistributions. The **Species Accounts** generally devote more space to birds in the northern half of the study area than birds in the southern half: this reflects both the distribution of the birds (more species and many more individuals in the northern half) and the number and quality of the available surveys.

The only review with coverage similar to that in this paper is an unpublished report by Hoopes et al. (1994). That report included species accounts for 190 species of marine and coastal birds (including herons and shorebirds as well as the species covered in this paper), and a bibliography of 9,800 citations, but cited much less quantitative information than this paper, and was focused primarily on vulnerability to oil pollution. An unpublished draft report by Lee (2007) contained brief species profiles for 58 species of seabirds of the western North Atlantic, including several species rare or unrecorded in the area covered by this publication, but not including seaducks or grebes.

The North American Waterbird Conservation Plan, presently under development by Waterbird Conservation for the Americas, is intended to provide an overview of the status of waterbirds and their habitats, together with conservation needs and priorities, throughout North America. The general Plan was published by Kushlan et al. (2002) and is being extended to incorporate Regional Plans for various regions of North America. A Regional Plan has been finalized for the southeastern United States (Hunter et al. 2006) and a Plan for the Mid-Atlantic/New England/Maritimes region (MANEM Waterbird Working Group 2006) is apparently complete (web site last updated August 2006). These Regional Plans cover areas that overlap with the area covered in the present paper, but extend well beyond it. The MANEM Plan covers Biological Conservation Regions 14 and 30 and Pelagic Biological Conservation Regions 78 and 79, including all of Nova Scotia and the southern part of the Gulf of St. Lawrence. The Plan for the southeastern United States covers Biological Conservation Regions 20–21, 25–29, 31, and 36–37, including most of the Gulf of Mexico and land areas west to Texas and Oklahoma, as well as the parts of the Atlantic coast covered in this paper. Both Regional Plans include status assessments, regional priority species, population objectives, habitat management, major threats, conservation actions, education, and outreach. The MANEM Plan also includes species profiles for most waterbird species occurring in the regions. These profiles overlap with the species accounts in this paper, but give less detail, especially on nonbreeding numbers and distributions. They include maps of breeding sites, estimates of breeding pairs by subregion, and estimates of total numbers in the region in the 1970s, 1990s and early 2000s. However, the references

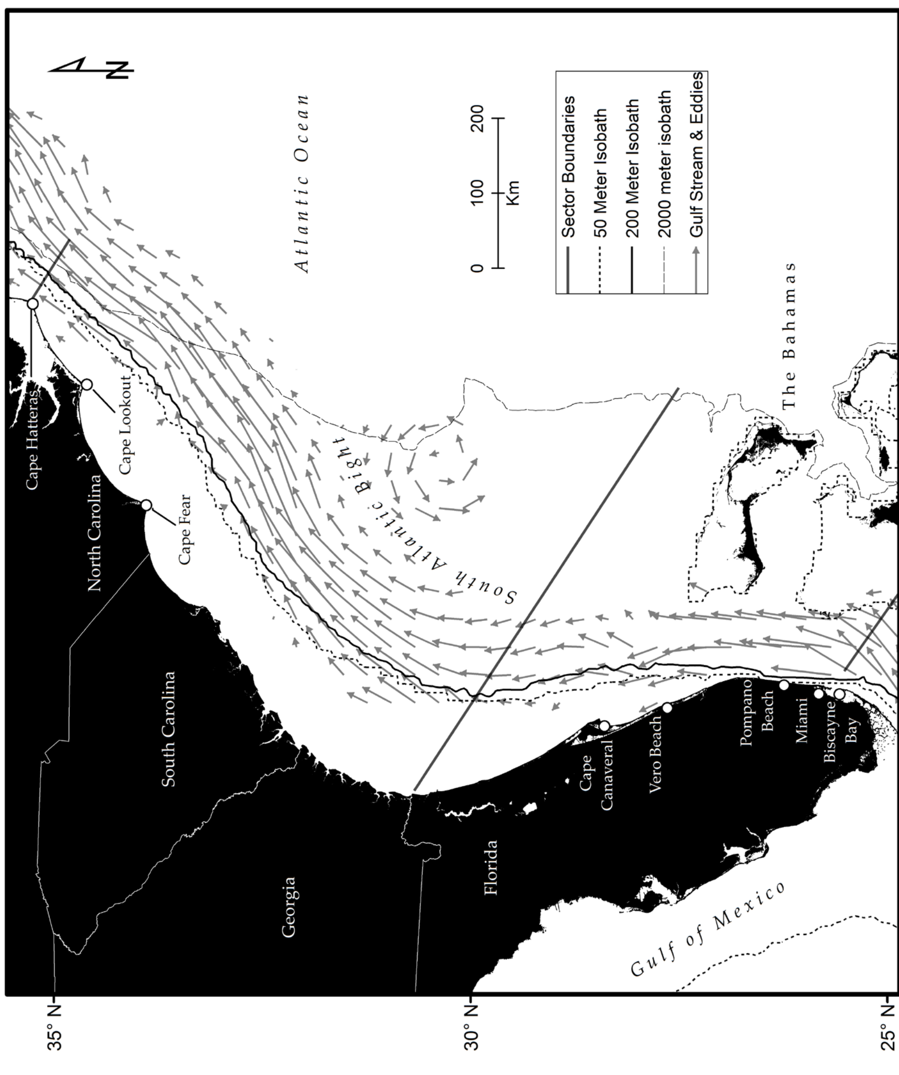

Figure 4. Map of Sectors III (South Atlantic Bight) and IV (East Florida) showing locations referred to in the text. See also Gazetteer, Appendix 2.

given were limited to a few general sources, and we have found no way to check the exact sources of the numbers presented in the MANEM Plan in the many cases where they differ from those given in this paper. The Plan for the southeastern United States lacks species profiles; it gives estimates of numbers of breeding pairs for each species by subregion (revised March 2006), but gives no references as the basis for these estimates. These Regional Plans are useful in providing the basis for conservation goals and management priorities, but are insufficiently documented to serve as reference sources, and do not provide complete descriptions of regional distribution, numbers, or trends. As pointed out at the end of this paper, the assessments they present of threats and conservation needs are markedly different from ours.

Time Frame

This publication summarizes available information on numbers and distribution of each species during the period 1994–2010, plus available information on changes in numbers and distribution since 1970. Information on numbers and distribution prior to 1970 is not considered in detail, except that we have included a short **Historical Perspective**. As stated in the previous section, no synchronized census of breeding birds in the entire area has ever been conducted: the information that is most nearly complete derives from censuses that were conducted in most parts of the area in or about 1976–77 and 1994–95. Quantitative information on distributions of birds at sea is available mainly from the northern part of the area and dates from 1976–88. Where available, we have added information on each species from earlier and later dates. We have continued to add information and references that have become available until the date of completion of this publication (September 2010), but there is no single terminal date that applies to all species.

SPECIES LIST

This section summarizes the status, seasonal distribution, and trends of 83 species of marine birds that occur regularly in the area covered by this publication.

Figures and Tables

Figure 1 shows the geographical area covered in this publication, and Figures 2–4 give details of the 4 sectors into which we have divided the total area (see legend to Table 1). These sectors have been selected to reflect differences in oceanographic regimes and consequent differences in communities of breeding seabirds (see **Physical Setting and Oceanography**). Figures 2–4 mark all locations, geographical and oceanographic features mentioned in the text (for details, see Gazetteer, Appendix 2).

Table 1 summarizes estimated numbers of 31 seabird species breeding in 4 sectors of the East Coast. Counts are from 1994–95 or from the closest year(s) for which comprehensive regional data are available. Sources are summarized in footnotes to Table 1. For the two northern sectors (Gulf of Maine/Bay of Fundy, and Mid-Atlantic Bight), the data are derived from the USGS database, except where stated in footnotes. Data from periods before and after 1994–95, where available, are summarized in the **Species Accounts** to identify trends.

For most species, numbers in Table 1 and in the text are based on nest counts or nest estimates and are probably reasonably reliable (±10–20%). However, the numbers have several limitations. First, although there is an extensive literature on methods for counting colonial birds and several sets of recommended field protocols, the raw data from which Table 1 was ultimately derived (thousands of individual colony estimates) were generated by hundreds of different observers, using widely different methods under widely varying conditions; exact methods were often not specified in the available reports and summaries. All the numbers in Table 1 incorporate some element of scientific judgment, applied either by the original compilers, by us as reviewers, or both; none has been nor can be associated with formal confidence limits. Second, most of the colony estimates were based on single surveys. Although these were often timed to coincide with peak nesting, they would have missed both late nesters and those that had lost nests early. This is a particular problem for species with a high incidence of nest predation and renesting (e.g., Least Tern). Third, species that nest in burrows (Leach's Storm-Petrel, Atlantic Puffin), in crevices (Razorbill, Black Guillemot), or under cover (Roseate Tern) are more difficult to census completely than those that nest in the open. However, Atlantic Puffins and Roseate Terns have recently been the subject of intensive management activities, so that recent annual censuses of these species (since about 1984 for Atlantic Puffin and 1988 for Roseate Tern) have probably been complete and reasonably accurate (±5–10%). Fourth, only nesting birds were counted; nonbreeding individuals are numerous in some species (e.g., alcids). For the species cited in this paragraph (except Roseate Tern and Atlantic Puffin), reported counts are likely to have been more uncertain and generally too low. Finally, all the censuses cited or summarized in this paper were necessarily limited to

Table 1. Estimated nesting pairs of marine birds breeding in the 4 study sectors. Data are from the USGS 1994–95 database unless otherwise noted. – indicates never recorded breeding in the sector, 0 indicates known to have bred in the sector but not in 1994–95. Numerical estimates are rounded to 2 significant figures and most are thought to be reliable to ±10–20% (see text for detailed discussion).

Species	[1] Gulf of Maine/Bay of Fundy	[2] Mid-Atlantic Bight	[3] South Atlantic Bight	[4] Florida	Totals
Common Eider	[5]43,000	[6]60	–	–	43,000
Red-breasted Merganser	[7]50	0	0	–	50
Manx Shearwater	0	0	–	–	0
Leach's Storm-Petrel	[8]40,000	[9]8	–	–	40,000
Northern Gannet	9	–	–	–	9
[10] Brown Pelican	–	2200	9700	2700	14,000
Great Cormorant	[11]190	0	–	–	190
[12] Double-crested Cormorant	37,000	6100	190	4000	47,000
[13] Black-legged Kittiwake	25	–	–	–	25
Black-headed Gull	0	–	–	–	0
[14] Laughing Gull	2000	130,000	27,000	2800	160,000
Ring-billed Gull	0	0	–	–	0
Herring Gull	[15]57,000	36,000	[16]400	–	94,000
Lesser Black-backed Gull	0	–	–	–	0
Great Black-backed Gull	[15]37,000	13,000	[16]10	–	50,000
Sooty Tern	–	–	0	–	0
[17] Least Tern	2500	9200	3200	1600	17,000
[18] Gull-billed Tern	–	280	490	10	780
Caspian Tern	–	7	37	0	44
Black Tern	1	–	–	–	1
[19] Roseate Tern	180	3300	–	0	3500
[20] Common Tern	15,000	36,000	2100	–	53,000
[21] Arctic Tern	5400	2	–	–	5400
Forster's Tern	0	7200	1100	–	8300
Royal Tern	–	3400	28,000	1000	33,000
Sandwich Tern	–	9	4500	50	4500
Black Skimmer	3	2600	[22]3800	500	6900
Common Murre	120	–	–	–	120
Razorbill	1000	–	–	–	1000
[23] Black Guillemot	15,000	–	–	–	15,000
[24] Atlantic Puffin	4000	–	–	–	4000
Total species	**25**	**21**	**15**	**10**	**31**
Total pairs	**260,000**	**250,000**	**81,000**	**12,000**	**600,000**

[1] US data from USGS database and other sources cited in the text and footnotes; Canadian data from Mawhinney et al. (1999), Ronconi and Wong (2003), Boyne and Beukens (2004), Christie et al. (2004), McAlpine et al. (2005), Diamond and Devlin (2003), Blinn et al. (2008), and unpublished data from Nova Scotia and New Brunswick Departments of Natural Resources.

[2] Census data from USGS database and other sources cited in the text and footnotes.

[3] Census data from S. Cameron (unpublished data for NC), Wilkinson (1997), Jodice et al. (2007), B. Winn (unpublished data for GA), and other sources cited in the text and footnotes.

[4] Census data from Spendelow and Patton (1988) based on compilations by Clapp et al. (1983), except where otherwise stated.

breeding sites that were found in the year(s) of the surveys. Although most of these censuses were reasonably complete in geographical coverage and should have covered all sites with substantial numbers of breeding birds, any of them may have missed some breeding sites. Based on our knowledge of the species and areas covered, and/or on personal communications from the compilers, we believe that the numbers of breeding birds missed in this way would have been relatively small, except in a few specific cases mentioned in the **Species Accounts** (see under Leach's Storm-Petrel, Herring Gull, Common Tern, Forster's Tern, and Black Guillemot).

Table 2 compares estimates of breeding seabirds for the coastal segment from Maine to Virginia, compiled from regional censuses conducted in 1976–77 (Erwin 1979; Korschgen 1979; Erwin and Korschgen 1979; Portnoy et al. 1981; summarized in Spendelow and Patton 1988), 1984–85 (Andrews 1990), and 1994–95 (USGS database). Field protocols were similar in these 3 censuses, so that the results should be reasonably comparable among periods for most species. However, Table 2 does not include data for the Bay of Fundy or for North Carolina north of Cape Hatteras,

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[5] Data for Maine from Krohn et al. (1992) based on survey in 1986; for New Brunswick from Mawhinney et al. (1999) and Blinn et al. (2008) based on surveys in 1990–2006; for Nova Scotia from Nova Scotia DNR based on surveys in 1995–2005.
[6] Data from Blodget and Livingstone (1996); has increased since 1996.
[7] No census or survey data; likely numbers estimated from statements in Erskine (1992), Adamus (1987), and Christie et al. (2004).
[8] Data for the Bay of Fundy incomplete (see text).
[9] Data for 2001 from French (2002).
[10] Data for 1999 from Shields (2002).
[11] Data for 1995 from J. Drury (pers. comm.); has decreased since 1995 (see text); no breeding sites documented in Bay of Fundy.
[12] Data for 1990–92 from Hatch (1995); includes inland colonies near the coast from Virginia southwards; see text for changes in numbers by 1994–95.
[13] Data for 1992 (Kehoe 1994).
[14] Data for Maine–Delaware and South Carolina from Belant and Dolbeer (1993a), based on surveys in 1990–91; for Virginia from Watts and Byrd (1998) based on survey in 1993; for North Carolina from S. Cameron (pers. comm.) based on survey in 1995; for Georgia from B. Winn (pers. comm.) based on survey in 1995; for Florida from Spendelow and Patton (1988) based on Clapp et al. (1983).
[15] Estimates compiled from Blodget and Livingstone (1996), Schauffler (1998), Ronconi and Wong (2003), Boyne and Beukens (2004), Christie et al. (2004), and McAlpine et al. (2005); see text for discussion of discrepancies among numbers from different sources.
[16] Data for 1983 from Clapp and Buckley (1984).
[17] Composite of data from USGS database and Thompson et al. (1997), but discrepancies between these sources raise questions about the reliability and completeness of both (see text); data for Georgia from B. Winn (pers. comm.), for East Florida from Spendelow and Patton (1988).
[18] Data for 2000–03 from Molina and Erwin (2006).
[19] Data for 2008 from Northeast Roseate Tern Recovery Team.
[20] Data for 1995–99 from Nisbet (2002a).
[21] Data for 2005 from Gulf of Maine Seabird Working Group.
[22] Data for Virginia from Watts and Byrd (1998) based on census in 1993.
[23] No numerical estimates available for Bay of Fundy since 1972; numbers there interpolated as 25% of numbers in Maine based on number and shoreline of suitable islands.
[24] Data for 2007 compiled by S. Kress from Gulf of Maine Seabird Working Group.

Table 2. Estimated numbers of marine birds nesting between Maine and Virginia, USA, in 3 census periods: 1977, 1984–85 and 1994–95. The area covered comprises that included in the first 2 columns of Table 1, but excludes the Bay of Fundy and coastal North Carolina north of Cape Hatteras. Of the species listed in Table 1, Common Eider and Red-breasted Merganser were not censused; Manx Shearwater, Northern Gannet, Black-legged Kittiwake, Black-headed Gull, Ring-billed Gull, Lesser Black-backed Gull, Sooty Tern, and Common Murre were not found nesting; Black Tern was found nesting but was not reported to the USGS database. All numerical estimates are of nesting pairs and are rounded to 2 significant figures.

Species	[1] 1977	[2] 1984–85	[3] 1994–1995
Leach's Storm-Petrel	[4] 19,000	[4] 20,000	[5] 10,000
Brown Pelican	0	0	940
Great Cormorant	0	47	190
Double-crested Cormorant	17,000	34,000	38,000
Laughing Gull	65,000	97,000	130,000
Herring Gull	92,000	110,000	79,000
Great Black-backed Gull	17,000	31,000	42,000
Least Tern	7600	9400	[6] 11,000
Gull-billed Tern	120	440	280
Caspian Tern	1	6	7
Roseate Tern	2300	3000	3400
Common Tern	29,000	48,000	39,000
Arctic Tern	1700	1700	3500
Forster's Tern	2100	5000	5200
Royal Tern	4700	5800	3400
Sandwich Tern	5	24	9
Black Skimmer	4200	4200	2600
Razorbill	25	46	260
Black Guillemot	2700	2800	12,000
Atlantic Puffin	120	110	190

[1] Data from Erwin and Korschgen (1979).
[2] Data from Andrews (1990). About 15% of colony sites were not counted in 1984–85; data from the 1977 census were used for these sites.
[3] Data from USGS database (for details, see text).
[4] Estimates considered too high because of inclusion of unoccupied burrows (see text).
[5] Including estimates for 2 colonies omitted from the survey (see text).
[6] Including estimate for New Jersey from Thompson et al. (1997) (see text).

and does not incorporate corrections or better data for some species that were used in compiling Table 1. For discussion of problems with the data in Table 2, see comments in the **Species Accounts** under Leach's Storm-Petrel, Herring Gull, Great Black-backed Gull, and Black Guillemot.

Table 3 summarizes estimates of at-sea density for 31 species in the area of Georges Bank during 4 seasons of the year (from Powers and Brown 1987). These estimates of density were derived from extensive shipboard surveys in 1977–80 using standardized transect methods. They are subject to some biases due to differential detectability, and are probably more reliable for within-species than for between-species comparisons.

Table 4 summarizes total numbers of 50 marine bird species recorded on recent CBCs along the Atlantic coast. Numbers given are the means of the summed counts of each species in 10 recent years (1995–96 to 2004–05) in each of 4 regions of the Atlantic coast. Counts are summed over all count circles centered within 12 km of the coast or covering tidal sections of inlets, estuaries, or rivers. The CBC website does not give exact locations of count circles or plot them on maps, so we have included data from all count circles in coastal counties and with substantial numbers of marine birds.

Table 5 summarizes mean and maximum numbers per trip of 37 species encountered on pelagic day-trips in the vicinity of Cape Hatteras in 4 seasons of the year (source: http://www.patteson.com, except some maxima from *North American Birds* and other sources). These numbers per trip are not precise measures of numbers or density, but are expected to be comparable among seasons.

Table 6 summarizes monthly mean numbers per trip of 22 species recorded by a single observer during 1651 pelagic day-trips off Cape Canaveral, Florida, between 1956 and 1980 (source: Wallace and Wigh 2007). Most of these trips were on party-boats hired for fishing rather than for surveying seabirds. Most of the observations were made between 14 km offshore and the western wall of the Gulf Stream, but they also included a few trips up to 110 km offshore.

Table 7 summarizes mean yearly counts, maximum daily counts, and dates of the highest counts, for 37 species migrating past Avalon, New Jersey, in 12 recent years (1993–2004). Birds were counted passing a vantage point throughout daylight hours from 22 September to 22 December each year. The location of this watch extends 1.6 km farther out into the ocean than the coastline to the north, so southbound migrant seabirds following the coastline are concentrated there and pass close to the beachfront.

All numerical estimates for individual sites or regions that are given in the text or tables have been rounded to two significant figures, although in many cases this implies greater precision than is warranted based on the nature of the original sources.

Abbreviations

Citations in the text in the form (*NAB*) are to regional reports in the journal *North American Birds* (including its precursors *Audubon Field Notes, American Birds*, and *Field Notes*), which has been examined for significant information for the period 1986–2010 (volumes 41–64). Records published in *NAB* are biased towards unusual occurrences, locations, and/or numbers, but also include a somewhat haphazard selection of breeding censuses, pelagic surveys, migration counts, etc. *NAB* is not indexed, so we do not claim to have found every relevant record. *BNA* refers to the *Birds of North America* series. *WPE* refers to *Waterbird Population Estimates* (Wetlands International 2006).

Table 3. Seasonal mean densities (birds km^{-2}) of marine birds on Georges Bank 1977–1980. Source: Powers and Brown (1987), Table 34.

Species	**Winter (Dec-Feb)**	**Spring (Mar-May)**	**Summer (Jun-Aug)**	**Autumn (Sep-Nov)**
Northern Fulmar	10.5	7.5	0.7	0.4
Cory's Shearwater	–	0.1	1.0	0.4
Great Shearwater	0.3	0.1	34.0	7.5
Sooty Shearwater	–	0.2	7.6	0.1
Manx Shearwater	–	0.1	0.2	0.1
Audubon's Shearwater	–	–	0.1	–
Wilson's Storm-Petrel	–	1.6	7.3	0.1
Leach's Storm-Petrel	–	0.1	0.3	0.1
Northern Gannet	0.1	0.4	0.1	0.4
Red-necked Phalarope	–	0.1	0.1	0.1
Red Phalarope	0.1	17.2	0.1	0.1
Black-legged Kittiwake	6.9	1.0	–	0.5
Bonaparte's Gull	–	–	–	0.1
Laughing Gull	–	–	0.1	–
Ring-billed Gull	–	–	–	0.1
Herring Gull	1.3	1.5	0.1	3.5
Iceland Gull	0.1	0.1	–	0.1
Glaucous Gull	0.1	0.1	–	–
Great Black-backed Gull	2.0	1.3	0.2	0.5
Common Tern	–	0.1	0.1	0.1
Arctic Tern	–	0.1	0.1	–
Pomarine Jaeger	0.1	0.1	0.1	0.1
Parasitic Jaeger	–	0.1	0.1	0.1
Long-tailed Jaeger	–	0.1	–	0.1
Great Skua	0.1	0.1	0.1	0.1
South Polar Skua	–	0.1	0.1	?
Dovekie	0.7	0.1	–	0.1
Common Murre	0.1	0.1	–	–
Thick-billed Murre	0.1	0.1	–	–
Atlantic Puffin	0.1	0.1	–	0.1

Species Accounts

King Eider

Breeding: On coasts and islands in arctic and subarctic regions of North America and Eurasia, extending south in northeastern Canada as far as Baffin Island. There is no estimate of the world population; numbers breeding in North America have been estimated as in the range 150,000–200,000 pairs, of which 50,000–80,000 pairs breed in the eastern Canadian Arctic and northwest Greenland (*WPE*).

Nonbreeding: North Pacific and North Atlantic Oceans. Birds from northeastern Canada and Greenland winter from West Greenland to Nova Scotia, with small numbers in the Gulf of Maine (Suydam 2000). Along the US east coast, it is a scarce winter visitor, occurring in small flocks (usually <20) along rocky coasts from the Bay of Fundy south to central New Jersey (Table 4). Smaller groups (usually <6) occur sporadically at suitable localities south to North Carolina (*NAB*), and there are a few records south to Florida (Clapp et al. 1982b; McNair and Post 1993; Stevenson and Anderson 1994). The mean annual harvest of King Eiders by hunters in the United States is 33 (Caithamer et al. 2000). Prebreeders irregularly oversummer (usually singly) from Maine south to the mouth of Chesapeake Bay, occasionally farther south.

Migration: Most records in the winter quarters have been from late October to early May. The mean seasonal total at Avalon was 6; the highest daily count was 7 on 9 December (Table 7).

Common Eider

Breeding: On coasts and islands in arctic, subarctic, and boreal North America and Eurasia, extending south in the western North Atlantic as far as eastern New York (but see *Subspecies and Species Limits*). The total world population is estimated to be in the range 1.0–1.2 million pairs; numbers breeding in North America have been estimated in the range 450,000–500,000 pairs, of which 400,000 pairs breed in the eastern Canadian Arctic, northwestern Greenland, and the northeastern United States (*WPE*). This species was almost extirpated as a breeder from the United States and southeastern Canada in the late 19th century, but increased throughout the 20th century. In the Bay of Fundy, numbers of breeders increased from a few in the 1920s (Squires 1952; Tufts 1986; Christie 1979; Ronconi and Wong 2003) to 15,000 pairs in the mid-1990s (Mawhinney et al. 1999; Nova Scotia DNR), but now appear to be decreasing (Ronconi and Wong 2003; Christie et al. 2004; Blinn et al. 2008). In the eastern United States, it breeds on some 320 coastal islands in Maine, where numbers increased from 1 pair in 1905 to 28,000 pairs in 1986, and 29,000 pairs in 2000 (Drury 1973–74; Krohn et al. 1992; Allen and McAulay 2005), but have probably decreased to <25,000 pairs subsequently (B. Allen, pers. comm.). A few hundred pairs breed in New Hampshire (Borror and Holmes 1990), and in Massachusetts where they were introduced to the Elizabeth Islands during the 1970s (Stanton 1977; Veit and Petersen 1993; J.J. Hatch, pers. comm.; R.R. Veit, unpubl. data), and colonized Boston Harbor (probably naturally) in 1982. Breeders from one or both these sources have recently increased and spread throughout southern Massachusetts and west to Rhode Island (Ferren and Myers 1998; Ferren, in press; *NAB*) and Fisher's Island, New York (*NAB*).

Nonbreeding: Winters along coasts of the North Pacific and North Atlantic Oceans. Birds breeding in eastern North America winter from southwestern Greenland south to Cape Cod and Long Island, with very small numbers south to Florida (Goudie et al. 2000). Birds wintering from the Bay of Fundy south to Long Island include both local breeders and migrants from the Maritime Provinces and the Gulf of St. Lawrence. Some 80,000 winter in Maine (Krohn et al. 1992); most of the remainder winter in southeastern Massachusetts from outer Cape Cod to Martha's Vineyard (Veit and Petersen 1993). Caithamer et al. (2000) analyzed results of the Mid-winter Waterfowl Inventory (MWI), Sea Duck Survey, CBCs, and harvest data, and concluded that numbers wintering in US waters had increased between 1972 and 1997. However, none of these surveys consistently surveyed offshore waters: the MWI, for example, detected only about half the numbers reported by Krohn et al. (1992) in Maine, and probably a much smaller proportion of those in Massachusetts. Since 1946, field observers in southeastern Massachusetts have frequently reported several hundred thousand (maxima 500,000 in 1951 and 1960: Veit and Petersen 1993), including an apparent decline by several hundred thousand following oil spills in 1952 (Griscom and Snyder 1954). Erskine (1990) questioned the reliability of these estimates, based on the number of breeding pairs in the potential source areas (Bourget et al. 1986; Reed and Erskine 1986). However, recent winter surveys with improved methodology have continued to yield numbers in the 200,000–300,000 range (S. Perkins, pers. comm.; R.R. Veit, unpubl. data; *NAB*). The discrepancy may indicate that a large fraction of the wintering population does not breed, but more information is needed to resolve these issues. Large flocks now occur in winter as far southwest as Long Island, where the highest count prior to 1995 was 200 (Bull 1985), but 12,000 were counted at Montauk Point in 1996 (Levine 1998), and the MWI detected 22,000 in Long Island waters in 1997 and 15,000 in 2006. Small numbers (flocks rarely >20) occur south to South Carolina, with only a few stragglers south to Florida (Clapp et al. 1982b; McNair and Post 1993; Stevenson and Anderson 1994: *NAB*). The mean annual harvest of Common Eiders in the United States is 26,000 (Caithamer et al. 2000: see **THREATS**). Moderate numbers (hundreds to thousands) of nonbreeders (mainly prebreeders 1–3 years old) remain in summer in southeastern Massachusetts and along the coast of Maine. Prebreeders irregularly oversummer (normally <10 per site) as far south as the mouth of Chesapeake Bay, occasionally farther south.

Migration: Large molting aggregations have been reported off southwest Nova Scotia (40,000 males) and off Metinic Island, Maine (10,000 males; Savard et al. 2005). Large numbers pass south along the Massachusetts coast in October and November (Veit and Petersen 1993); there is no information on spring migration. Most records south of the breeding range have been between late October and late April. The mean seasonal total at Avalon was 50; the highest daily count was 43 on 23 November (Table 7).

Subspecies and Species Limits: Breeders and most wintering birds belong to *Somateria mollissima dresseri*, but there are a few specimen records of the northern subspecies *S. m. borealis* from Massachusetts and New York (Veit and Petersen 1993; Levine 1998). Common Eiders breeding in northwestern North America and eastern Siberia (*S. [m.] v-nigrum* group) may constitute a distinct species (Goudie et al. 2000).

Harlequin Duck

Breeding: On fast-flowing streams and rivers in subarctic and temperate eastern Asia, eastern and western North America, Greenland, and Iceland. In North America, breeds in 2 disjunct areas: from Hudson Bay to Newfoundland and New Brunswick (Robertson et al. 2008), and inland from Alaska to Montana (Robertson and Goudie 1999). The total world population is not known; the North American population has been estimated as 50,000–80,000 pairs, mainly in the west (*WPE*). The eastern population was thought to have been reduced to fewer than 300 pairs by 1988, but has since increased (see below).

Nonbreeding: Winters along rocky coasts in the North Pacific and North Atlantic Oceans. Birds breeding in eastern North America molt off southwestern Greenland, Labrador, Newfoundland, and southern Quebec, and winter in southwestern Greenland and from Newfoundland south to Virginia (Robertson and Goudie 1999). Along the US east coast, this species is a scarce winter visitor to rocky coasts and islands from the Bay of Fundy south to Rhode Island. Small numbers occur at suitable sites south to the mouth of Chesapeake Bay, with stragglers to Florida (Clapp et al. 1982b; McNair and Post 1993; Robertson and Goudie 1999; Mittelhauser 2008). Numbers wintering in the United States declined to fewer than 1000 by the mid-1980s (Vickery 1988; Mittelhauser 2000; Mittelhauser et al. 2002), but have been increasing since the late 1980s and reached about 2000 between 1997–2002 (Boyne 2008, Mittelhauser 2008). This total included about 300 in the Bay of Fundy (Boyne 2008), 1200–1300 in Maine (Mittelhauser 2008), and 300–400 each in Massachusetts and Rhode Island (Veit and Petersen 1993; Ferren and Myers 1998; Ferren, in press; Mittelhauser 2008). The reversal of the population decline after 1988 followed listing of the species as Endangered in Canada and Threatened in Maine, and the consequent cessation of hunting (Robertson and Goudie 1999; Caithamer et al. 2000: see **THREATS**).

Migration: Many Harlequin Ducks that breed in Labrador and Quebec molt and stage off Newfoundland and in the Gulf of St. Lawrence (Savard et al. 2008; Thomas 2008), but others apparently molt off southwestern Greenland before migrating to wintering sites in the United States (Robert et al. 2008). A few arrive in US waters in late September, but most arrive in October and November and depart in April and early May, with only a few records in summer (Veit and Petersen 1993; Robertson and

Goudie 1999; Boyne 2008; Mittelhauser 2008). The mean seasonal total at Avalon was 5; the highest daily count was 6 on 24 October (Table 7).

Surf Scoter

Breeding: Endemic to North America, where it breeds in two disjunct areas: in northwestern Canada and Alaska, and in eastern Quebec and Labrador (Savard et al. 1998). The total population has been estimated as in the range 130,000–380,000 pairs, of which only about 36,000 pairs were in Quebec and Labrador (Savard et al. 1998), but the latter estimate is very uncertain and is probably too low based on numbers seen on the Atlantic coast during autumn and spring (see below).

Nonbreeding: Winters at sea along the east and west coasts of North America, south to Florida and northern Mexico, respectively (Savard et al. 1998). This species is a common winter visitor to the entire US east coast, with largest numbers from New York to Virginia, including Delaware and Chesapeake Bays where it outnumbers all other seaducks (Savard et al. 1998; *NAB*; Table 4). Numbers wintering in eastern North America have been estimated at 200,000–250,000 (*WPE*). Midwinter surveys of scoters (species not distinguished) along the Atlantic coast yielded no evidence of significant changes in numbers from 1973–92 (U.S. Fish and Wildlife Service 1993), but surveys on the breeding grounds suggested a decline at 1.6% per year from 1957–97 (Caithamer et al. 2000). One count of 130,000 at Montauk Point, Long Island, in March 1930 (Levine 1998) has not been approached anywhere in recent decades. Small numbers (usually <6 per site, but one record of 50 on Long Island) remain in the main wintering areas during summer (Veit and Petersen 1993; Levine 1998).

Migration: Eastern birds molt in Labrador and the Gulf of St. Lawrence in June–August before migrating south along the Atlantic coast; they stage again in the Gulf of St. Lawrence in spring (Savard et al. 1998). Most migrate south in October–November, and return north in April–May (Savard et al. 1998). Numbers counted passing Manomet Point, Massachusetts, in October in four years, 1967–76, ranged from 9200 to 13,500 (Veit and Petersen 1993). The mean annual number of "dark-winged" scoters passing Avalon is 360,000, with this species comprising 52% of those identified; the highest daily count was 46,000 on 28 October (Table 7). In spring, thousands migrate northeast in late April and May through Buzzards Bay and the Bay of Fundy, making short overland crossings to Cape Cod Bay and Baie de Chaleur, respectively (Veit and Petersen 1993; Savard et al. 1998; Bond et al. 2007; I.C.T. Nisbet, unpubl. data); the mean number passing Point Lepreau, New Brunswick, annually was 90,000, with a maximum of 200,000 in 2000 (Bond et al. 2007, 2009).

White-winged Scoter

Breeding: On freshwater lakes and wetlands in interior northwestern North America and Eurasia (see *Species Limits*). North American birds breed from western Alaska east to Manitoba and northern Ontario, rarely Quebec. The total world population is on the order of 1 million pairs (*WPE*); the North American population was estimated as 560,000–680,000 pairs in 1955–1973 (Bellrose 1976), but present numbers are thought to be much lower (*WPE*), consistent with greatly reduced numbers in the winter quarters in recent decades (see below). This species was formerly the most numerous scoter in the main wintering areas off the eastern United States during summer, with counts of 50–150 prior to 1965 (Veit and Petersen 1993; Levine 1998), but current counts rarely exceed 5.

Nonbreeding: North American birds winter at sea on the Atlantic and Pacific coasts (Brown and Frederickson 1997). Along the US east coast, it is a common winter visitor from the Bay of Fundy south to North Carolina, uncommon in South Carolina, and rare south to Florida (Brown and Frederickson 1997). This is the least numerous of the 3 scoter species in the eastern United States, but there are no firm estimates of total numbers, in part because the scoter species were not consistently identified in past surveys (Caithamer et al. 2000). Recent CBCs have recorded largest numbers between Massachusetts and New York (Table 4), but older sources indicated large numbers south to Chesapeake Bay (Brown and Frederickson 1997). Numbers in the main wintering area were much greater in the past: for example, Levine (1998) cited counts of 180,000 off Long Island in 1930 and 75,000 in 1952, and Veit and Petersen (1993) cited counts of 100,000 off Massachusetts in 1939 and 1960, but numbers were much lower in both areas by the 1970s and recent counts have not exceeded 10,000 on migration and 3000 in winter (Table 4). Numbers passing count sites in Massachusetts and New Jersey declined during the period 1967–2004 (see below). The annual harvest of White-winged Scoters in the Atlantic Flyway declined from >44,000 in 1975 to 11,000 in 1995–97; 55% of the harvest was in the United States (Caithamer et al. 2000: see **THREATS**). All this information indicates that the species has declined drastically and that its wintering range has contracted.

Migration: Molting and staging areas are unknown. Most eastern birds migrate ESE in October, reaching the Atlantic coast north of Massachusetts, and then passing southwest down the coast in October–November. Counts of birds passing Manomet Point in October declined from 7600 in 1967 to 4000 in 1976 (Veit and Petersen 1993). Counts at Avalon declined from 3000–6000 in 1993–95 to fewer than 2000 in 2002–04 (New Jersey Audubon 2006). The maximum count at Avalon was on 23 November, much later than that for the other 2 scoter species (Table 7). Spring migration extends from late March to mid-May (Brown and Frederickson 1997). Large numbers (hundreds to low thousands) fly northeast through Buzzards Bay and Nantucket Sound, Massachusetts, in May (Veit and Petersen 1993; I.C.T. Nisbet, unpubl. data). The mean number passing Point Lepreau, New Brunswick, annually in late April–May was 5900, with a maximum of 8500 in 2000 (Bond et al. 2007, 2009).

Table 4. Mean numbers of marine birds on Christmas Bird Counts in the 4 study sectors, 1995–2004. Each value is the 10-year mean of the total number of birds in coastal count circles within each sector. All numbers are rounded to 2 significant figures, but values <10 are rounded to the nearest integer; + indicates a mean of <0.5 birds $year^{-1}$. The right-hand column gives the stretch of the coast (contiguous states and provinces) within which 80% or more of the total birds were reported. For additional details, see text.

Species	Gulf of Maine/ Bay of Fundy	Mid-Atlantic Bight	South Atlantic Bight	East Florida	Total	Main Range (>80%)
King Eider	6	28	+	0	35	ME–NJ (87%)
Common Eider	49,000	49,000	4	+	98,000	ME–MA (92%)
Harlequin Duck	150	220	+	0	370	ME–RI (88%)
Surf Scoter	1900	15,000	560	+	18,000	ME–VA (92%)
White-winged Scoter	5900	13,000	60	1	19,000	ME–NY (86%)
Black Scoter	1400	17,000	2600	40	21,000	MA–VA (82%)
Long-tailed Duck	5700	250,000	15	1	260,000	MA (93%)
Red-breasted Merganser	7900	27,000	5700	700	41,000	MA–NC (87%)
Red-throated Loon	340	5500	1900	2	7700	NY–NC (83%)
Pacific Loon	1	2	1	0	3	MA–NC (90%)
Common Loon	1500	4400	1500	80	7400	ME–NC (91%)
Horned Grebe	1200	2900	580	170	4800	ME–VA (84%)
Red-necked Grebe	1100	110	3	0	1200	NB–ME (94%)
Eared Grebe	1	2	13	+	16	NC–GA (84%)
Northern Fulmar	23	+	0	0	23	NS (90%)
Great Shearwater	2	0	+	0	2	NS (90%)
Northern Gannet	2500	21,000	14,000	1400	38,000	MA–NC (93%)
Brown Pelican	0	400	9500	5900	16,000	NC–FL (98%)
Great Cormorant	1700	1800	30	0	3600	NS–NY (89%)
Double-crested Cormorant	80	9900	70,000	12,000	92,000	VA–FL (98%)
Magnificent Frigatebird	0	0	0	42	42	FL (100%)
Red Phalarope	0	0	+	2	2	FL (95%)
Black-legged Kittiwake	12,000	1300	2	+	13,000	NS–MA (98%)
Bonaparte's Gull	2300	17,000	3000	180	22,000	MA–VA (81%)
Black-headed Gull	19	8	+	+	27	NS–CT (81%)
Little Gull	1	7	+	0	7	MA–VA (93%)
Laughing Gull	3	2700	6700	24,000	33,000	GA–FL (84%)
Franklin's Gull	0	1	+	0	1	DE–VA (90%)
Ring-billed Gull	12,000	270,000	76,000	22,000	380,000	NY–NC (85%)
Herring Gull	84,000	200,000	11,000	2700	300,000	MA–VA (88%)
Thayer's Gull	+	2	1	0	3	NJ–NC (84%)
Iceland Gull	260	86	1	0	350	NS–MA (91%)
Lesser Black-backed Gull	6	140	28	29	200	NJ–FL (88%)
Glaucous Gull	23	12	2	0	38	NS–NJ (88%)
Great Black-backed Gull	13,000	49,000	3800	190	66,000	ME–DE (82%)
Caspian Tern	0	+	70	270	340	FL (80%)
Common Tern	0	+	33	4	37	SC (89%)
Forster's Tern	0	1400	2500	1000	4900	VA–FL (85%)
Royal Tern	0	4	490	2300	2800	FL (82%)

Table 4. (*continued*)

Species	Gulf of Maine/ Bay of Fundy	Mid-Atlantic Bight	South Atlantic Bight	East Florida	Total	Main Range (>80%)
Sandwich Tern	0	0	3	98	100	FL (97%)
Black Skimmer	0	10	1100	2400	3500	GA–FL (94%)
Pomarine Jaeger	4	2	1	2	9	MA–FL (100%)
Parasitic Jaeger	+	1	3	2	5	NC-FL (85%)
Dovekie	74	20	0	0	94	NB–MA (91%)
Common Murre	240	4	0	0	240	NB (93%)
Thick-billed Murre	120	5	0	0	130	NB (83%)
Razorbill	7400	1900	2	0	9300	NS-MA (94%)
Black Guillemot	810	5	0	0	820	NS–ME (85%)
Atlantic Puffin	13	+	0	0	13	NS–ME (92%)

Species Limits: North American birds belong to *Melanitta [fusca] deglandi*. White-winged Scoters breeding in western and eastern Eurasia (*M. [f.] fusca* and *M. [f.] stejnegeri*, respectively) may constitute 1 or 2 distinct species (Livezey 1995; Sangster et al. 2007).

Black Scoter

Breeding: Endemic to North America (see *Species Limits*), where it breeds on subarctic lakes and ponds. It breeds in 2 disjunct areas, in northwestern Canada and Alaska in the west and from Ontario to Labrador in the east (Bordage and Savard 1995). Total numbers breeding in these two areas have been estimated as 40,000–70,000 pairs and 30,000–40,000 pairs, respectively (*WPE*), but the latter figure may be too low (Bordage and Savard 1995). Very few (usually <10 together) oversummer in the main wintering areas off the eastern United States (Veit and Petersen 1993; Levine 1998).

Nonbreeding: Winters at sea along Atlantic, Gulf, and Pacific coasts (Bordage and Savard 1995). It is a common winter visitor along the entire US east coast from the Bay of Fundy to Florida, extending farther south than the other 2 scoter species. Largest numbers occur from Massachusetts to Virginia (*NAB*, Table 4), but there are records of up to 30,000 as far south as Georgia (Clapp et al. 1982b); it is rare in Florida. Total numbers are >300,000, based counts on spring migration (see *Migration*). Midwinter surveys of scoters (species not distinguished) along the Atlantic coast provided no evidence of significant changes in numbers in the period 1973–92 (U.S. Fish and Wildlife Service 1993), but surveys on the breeding grounds suggested a decline at 1.6% per year from 1957–97 (Caithamer et al. 2000). Coastal aggregations appear to have been larger in the past—e.g., 40,000 in Massachusetts in 1952 and 18,000 off Long Island in 1936; current counts in these areas are usually <1000 (Veit and Petersen 1993; Levine 1998).

Migration: Eastern birds molt in James Bay, and stage in the St. Lawrence River on both migrations (counts 90,000 and >200,000, respectively: Bordage and Savard 1995; *WPE*). Most migrate southeast to Northumberland Strait and then continue southwest down the Atlantic coast in October–November (Brown and Frederickson 1997). The mean seasonal total at Avalon was 130,000; the highest daily count was 43,000 on 26 October (Table 7). Spring migration extends from late March to mid-May; the mean number passing Point Lepreau, NB, in spring (mostly in April) was 180,000, with a maximum of 320,000 in 1998 (Bond et al. 2007, 2009). Black Scoters arrive in the St. Lawrence River in mid-April, peaking in mid-May (Brown and Frederickson 1997).

Species Limits: This species was formerly known as Black Scoter and considered conspecific with *Melanitta [n.] nigra* (Common Scoter) of Eurasia (Livezey 1995; Sangster et al. 2007; AOU 2010).

Long-tailed Duck

Breeding: On lakes and ponds throughout arctic and subarctic North America and Eurasia. The world population is estimated as about 2 million pairs, of which 500,000 pairs breed in North America (*WPE*). Until recently, known as Oldsquaw in the Western Hemisphere.

Nonbreeding: North American birds winter at sea in the North Pacific and Atlantic Oceans, and on the Great Lakes (Robertson and Savard 2002). Along the US east coast, it is a common winter visitor from the Bay of Fundy south to Chesapeake Bay, fairly common in Pamlico Sound, scarce farther south and rare in Florida (Clapp et al. 1982b; Stevenson and Anderson 1994; Robertson and Savard 2002). The largest concentration is in the Nantucket Shoals area, where evening counts of birds returning to Nantucket Sound in November–January commonly range from 230,000–530,000 (Davis 1997; White et al. 2009; *NAB*); at least 90,000 winter in Chesapeake Bay (Forsell 1999a). There are no reliable estimates of total numbers or trends for the Atlantic coast as a whole (Robertson and Savard 2002), and breeding-ground surveys did not include eastern areas (Caithamer et al. 2000). It is rare in wintering areas in summer: the largest reported group was 5 in Massachusetts (Veit and Petersen 1993).

Migration: Molting and staging areas are not known, although some eastern birds may stage in James Bay and the Great Lakes (Robertson and Savard 2002). Most migrate south from late October to early December, and return north from late March to late April (Robertson and Savard 2002). The mean seasonal total at Avalon was 3500; the highest daily count was 1600 on 8 December (Table 7).

Red-breasted Merganser

Breeding: On lakes and rivers throughout subarctic and boreal North America and Eurasia, extending south in North America as far as the Great Lakes states and New Brunswick. Data on world and North American populations are incomplete, but at least 120,000 pairs breed in the Pacific Rim (Titman 1999; *WPE*). On the Atlantic coast, small numbers breed in the Grand Manan Archipelago and on the lower reaches of rivers in New Brunswick (Erskine 1992); there are isolated breeding records from coastal regions of Nova Scotia, Maine, Massachusetts, New York, New Jersey, North and South Carolina (Clapp et al. 1982b; Erskine 1992; Adamus 1993; McNair and Post 1993; Veit and Petersen 1993; Levine 1998; Walsh et al. 1999). Singles and small groups (usually <5) occur in summer along the entire coast south to Florida (Clapp et al. 1982b), but some of these may be breeders.

Nonbreeding: Winters mainly along coasts of the North Pacific and Atlantic Oceans; also on inland seas in Eurasia. North American birds winter on all coasts of southern Canada, United States, and northern Mexico (Titman 1999). It is a common winter visitor to the entire US east coast from the Bay of Fundy to southern Florida, with largest numbers reported from Massachusetts to North Carolina (Table 4). The only published estimate of total numbers in the Atlantic Flyway is 38,000 (Bellrose 1976), but current numbers must be much larger, as CBCs record a mean of 41,000 each year (Table 4) and there are single counts of up to 40,000 in New York (Levine 1998), 15,000 in Massachusetts (Veit and Petersen 1993) and 10,000 in North Carolina (Clapp et al. 1982b; see also under *Migration*). The mean annual harvest reported by hunters in the period 1971–80 was 19,000 (Carney et al. 1983: see **THREATS**). Information on trends is conflicting, with evidence of severe declines from breeding bird surveys, but increases in numbers staging in the Great Lakes (Titman 1999).

Migration: Molting areas have not been characterized. Large numbers stage in the Great Lakes (Titman 1999), with spectacular flights (5000–20,000 hr^{-1}) passing along the south shore of western Lake Erie and daily counts up to 250,000 there in late October–November; these large numbers were first recorded in the 1960s (Peterjohn 1989, 2001). Most arrive on the Atlantic coast and pass south in October–November (Titman 1999). The mean seasonal total at Avalon was 4000; the highest daily count was 1300 on 19 November (Table 7). Wintering birds depart from late March–mid-May (Titman 1999); some stage on Lake Ontario, with flocks up to 12,000 (Levine 1998).

Red-throated Loon

Breeding: On lakes in arctic and subarctic North America and Eurasia, extending south to British Columbia, the Gulf of St. Lawrence, the British Isles, Lake Baikal, and the Kurile Islands. There is no estimate of the total world population, but numbers in North America have been estimated as about 13,000 pairs, including 5,000 pairs in Alaska (Barr et al. 2000; *WPE*). However, this estimate must be much too low in view of the numbers seen on migration (see below). The Alaskan population has declined since 1997, but there are no data on trends in the Atlantic population (Barr et al. 2000; *WPE*).

Nonbreeding: Winters along coasts of the North Pacific and Atlantic Oceans. North American birds winter south to Baja California and Georgia (Barr et al. 2000). It is a common winter visitor to the entire US east coast from Nova Scotia to Georgia and uncommon in Florida (Clapp et al. 1982a; Stevenson and Anderson 1994; Barr et al. 2000); largest numbers occur between New York and North Carolina (Table 4). Winter concentrations (some counts of 1000–3000) have been reported from Delaware Bay and from Albemarle Sound and Cape Fear (Root 1988); also in South Carolina (Clapp et al. 1982a). Red-throated Loons prefer inshore waters with sandy bottoms. Prebreeders uncommonly but regularly oversummer in small numbers south to North Carolina.

Migration: Most migrate south in October–November (Barr et al. 2000). Large numbers (annual mean 7800) pass west along the south shore of Lake Ontario, peaking in late November; these probably cross Pennsylvania to the Atlantic coast (Sherony et al. 2000). The mean seasonal total at Avalon was 58,000; the highest daily count was 11,000 on 12 November (Table 7). Spring migration extends from late March to early June (Barr et al. 2000); large numbers (hundreds to thousands) stage around Nantucket in April and pass through the Bay of Fundy in May (Veit and Petersen 1993; Maybank 1997).

Pacific Loon

Breeding: On tundra and taiga lakes from Arctic coasts of Siberia and North America south to southern Alaska and northwestern Quebec (Russell 2002). The North American population has been estimated at 300,000–500,000 pairs (*WPE*).

Nonbreeding: Winters along both coasts of the North Pacific Ocean; in North America, from Alaska to western Mexico (Russell 2002). It is very scarce on the US east coast, but is being reported in increasing numbers from Maine south to North Carolina and more rarely to Florida. Since about 1990, ≤5 have been found annually in coastal Massachusetts (Table 4; *NAB*); 8 were seen in Rhode Island in May 2009 (*NAB*).

Species Limits: This species is closely related to and was formerly treated as conspecific with Arctic Loon (northern Eurasia and western Alaska).

Common Loon

Breeding: On freshwater lakes, predominantly in boreal and mixed forests, across North America, Greenland, and Iceland; it extends south to the northern United States from Washington to Maine, much farther south than other loons (McIntyre and Barr 1997). The North American population is estimated at 150,000 pairs (Evers 2004; *WPE*). Numbers declined across the southern portion of the range during the first half of the 20th century, but have increased again since the 1960s (McIntyre and Barr 1997). Along the Atlantic coast, it breeds on lakes in New Brunswick, Nova Scotia, Maine, New Hampshire, and Massachusetts. Numbers are increasing throughout this area (McIntyre and Barr 1997; Evers 2004); counts of individuals in southern Maine increased from 1400 in 1983 to 2800 in 2005, but it is not known how many of these were breeding pairs (Gallo 2006; S. Gallo, unpubl. data).

Nonbreeding: Winters along the Pacific and Atlantic coasts of North America south to Mexico and Florida; also in northwest Europe (McIntyre and Barr 1997). On the US east coast, it is common but well dispersed from the Bay of Fundy to south Florida, with largest numbers north of Cape Fear (Table 4). It is much more pelagic than Red-throated Loon, wintering across the entire continental shelf. Off the Georgia coast, it ranges up to 80 km offshore and in water ≤100 m deep; it is infrequent in turbid water within 5–15 km of the shore, and most frequent around 15 km offshore in water <20 m deep (Haney 1990). Total numbers wintering in the area offshore from Cape Hatteras to Cape Canaveral were estimated at 8700–20,000 (Haney 1990). Nonbreeders (mainly prebreeders 1–3 years old) oversummer at sea south to North Carolina, especially in the Bay of Fundy and Gulf of Maine, where local breeders sometimes fly to and from the coast in May–July and disperse to the sea in August–September.

Migration: Southbound movements take place mainly in October–November; northbound movements mainly in April–May. It migrates on a broad front over land and sea, without marked concentrations along the shore (McIntyre and Barr 1997). The mean seasonal total at Avalon was 3600; the highest daily count was 690 on 31 October (Table 7). Migrants cross Georges Bank in November and May (Powers and Cherry 1983); the mean density there was 0.1 km^{-2} in autumn, winter, and spring (Powers and Brown 1987; Table 3). Birds nesting in northeastern United States winter mainly inshore from Maine to New Jersey (Kenow et al. 2009), so those wintering farther south must be from the Great Lakes (Kenow et al. 2002) or farther north in Canada.

Horned Grebe

Breeding: On freshwater ponds and marshes in north temperate and subarctic regions of North America and Eurasia. In North America, it breeds from Alaska south and east to western Ontario and northern Minnesota, with a disjunct population on the Iles de la Madeleine in the Gulf of St Lawrence (Stedman 2000). The North American population was estimated at >100,000 pairs (O'Donnell and Fjeldså 1997), including those wintering on the Pacific coast. Available data suggest a slow decline over recent decades (Stedman 2000). It is very rare along the Atlantic coast in summer, but single birds have been recorded as far south as North Carolina (Clapp et al. 1982a).

Nonbreeding: Winters along both coasts of the North Pacific and North Atlantic; also inland in southern United States and in Eurasia (Stedman 2000). It is common along the entire US east coast from the Bay of Fundy to southern Florida, with largest numbers from Virginia northward (Table 4); it is usually found within 1–2 km of shore or in sheltered sounds, bays, and lagoons. Significant aggregations include >6000 off Nags Head, North Carolina, in February 1972 (Clapp et al. 1982a), and several records of ≥2000 in Massachusetts, Long Island, and Chesapeake Bay (Veit and Petersen 1993; Levine 1998; *NAB*). Most of these high counts were made prior to 1985; recent high counts have been much smaller (Veit and Petersen 1993; Levine 1998; P.A. Buckley, pers. comm.; *NAB*), but no systematic comparisons have been made.

Migration: Southbound movements take place mainly from mid-October to late November; northbound movements mainly from early April to mid-May. The mean seasonal total at Avalon was 160; the highest daily count was 100 on 12 November (Table 7).

Red-necked Grebe

Breeding: On lakes and ponds in north temperate and subarctic North America and Eurasia. In North America, it breeds from western and northern Alaska south and east to Minnesota and western Ontario, occasionally east to western Quebec. The total world population has been estimated as 60,000–100,000 pairs (*WPE*). The North American population has been estimated as >15,000 pairs (O'Donnell and Fjeldså 1997; *WPE*), including those wintering on the Pacific coast, but this number is probably too low in view of numbers seen on migration (see below). There is no information on trends.

Nonbreeding: Winters on both coasts of the North Pacific and North Atlantic, and in the Great Lakes and the Black and Caspian Seas. North American birds winter on the Pacific coast from Alaska to California, on the lower Great Lakes, and on the Atlantic coast from Newfoundland to North Carolina. On the US east coast, it is an uncommon winter visitor to the Bay of Fundy and Gulf of Maine, extending in small numbers south to Virginia (Table 4) and rarely south to Florida (Clapp et al. 1982a; Stevenson and Anderson 1994).

Migration: Most arrive in winter quarters in late October and November and depart from late March to late April (Stout and Nuechterlein 1999). Eastern birds migrate via the northern Great Lakes, where >18,000 have been counted migrating past a single site in Lake Huron, mostly from mid-August to mid-September (Stout and Nuechterlein 1999). There is little evidence of coastwise migration: the mean seasonal total at Avalon was 7; the highest daily count was 3 on 14 December (Table 7). At the southern fringe of the winter range (Massachusetts–Maryland), large influxes have been recorded in late February or early March in several years (e.g., 1934, 1977, 1994, and 2003). In these and other years, largest numbers have been seen in Massachusetts and Rhode Island from early March to early April (e.g., 2000 in Cape Cod Bay in early April 1979: Veit and Petersen 1993). These late winter movements could result either from birds being forced seaward by the freezing of the Great Lakes (Veit and Petersen 1993; Kaufman 1994; Levine 1998; Walsh et al. 1999; *NAB*), or simply staging prior to spring migration (Stout and Nuechterlein 1999).

Western Grebe

Breeding: Endemic to North America, where it breeds on freshwater lakes and marshes from northern Alberta east to Wisconsin and south to California and northern Mexico. No information is available on numbers or trends (Storer and Nuechterlein 1992).

Nonbreeding: Winters mainly on the Pacific coast from British Columbia to central Mexico. It is a very scarce visitor to the US east coast, mainly between Massachusetts and North Carolina; at least 10 are now reported annually (*NAB*). It is probably most numerous in Massachusetts, where there are >40 records, including a flock of 10–12 in 1946–47 (Veit and Petersen 1993). Most records have been from December–April.

Species Limits: This species has only recently (1982) been separated from Clark's Grebe (Storer and Nuechterlein 1992), which is all but unknown on the Atlantic coast (see Appendix 3).

Eared Grebe

Breeding: On freshwater lakes and marshes throughout temperate regions of western North America, Eurasia, and southern Africa. In North America, it breeds inland from British Columbia and California east to Manitoba and Iowa. The North American population was estimated as >1 million pairs (4.1 million birds) in fall 1997 (Cullen et al. 1999).

Nonbreeding: Winters on coasts of the North Pacific and eastern North Atlantic; also on the Mediterranean, Black and Caspian Seas, and in the Persian Gulf. North American birds winter mainly in the Sea of Cortez. Along the US east coast, Eared Grebes are scarce visitors, occurring in September–March from Maine to Florida; they are most numerous from North Carolina to Georgia (Table 4). The mean number reported annually has increased in recent years and now numbers at least 40, with individual counts up to 5 (*NAB*).

Atlantic Yellow-nosed Albatross

Breeding: On Tristan da Cunha and Gough in the South Atlantic, where the most recent estimate of numbers was 37,000 pairs (Gales 1998).

Nonbreeding: Most disperse in the South Atlantic between 30° and 50° S. Vagrants appear annually and with increasing frequency in the western North Atlantic. There have been at least 60 records of single birds (mainly adults) between New Brunswick and Florida, with a concentration during May and June (Veit 2005). Since 2000, there have been several records of adults (possibly multiple records of the same individuals) flying over or even landing on islands from New Brunswick to Massachusetts, as if prospecting (Veit 2005; GOMSWG annual reports).

Species Limits: This species has recently been separated from Indian Yellow-nosed Albatross, which breeds on islands in the Indian Ocean (Robertson and Nunn 1998; Brooke 2004).

Northern Fulmar

Breeding: On cliffs on islands around the Arctic Ocean and in western Europe; its breeding range has extended since the 18th century in the eastern North Atlantic south to France, and since 1970 in the western North Atlantic south to southern Newfoundland (Hatch and Nettleship 1998; Stenhouse and Montevecchi 1999). The world population has been estimated as 5.4–7.1 million pairs, of which 300,000 pairs nest in eastern Canada and 80,000 pairs in Greenland (Tasker 2004).

Nonbreeding: Winters south to 35°–40° N in the North Pacific and 40° N in the North Atlantic (Hatch and Nettleship 1998). In eastern coastal waters, it is an abundant winter visitor to the Gulf of Maine, Georges Bank, and adjacent Canadian waters, where densities locally exceeded 100 km^{-2}, at least prior to 1983 when it was the third most abundant species on Georges Bank, after Great Shearwater and Red Phalarope (Table 3). Numbers peak in January–April, with many remaining into May or June; some have been seen on Georges Bank and inshore in every month of the year (Powers and Brown 1987; Veit and Petersen 1993). It is seen in varying numbers (occasionally in hundreds) from the shore south and west to Rhode Island (*NAB*). It also occurs in small numbers south along the continental slope to 35° N off Cape Hatteras, where ≤550 have been seen per day (Rowlett 1980; Lee 1986; Powers and Brown 1987; *NAB*; Table 5). There are a few records off South Carolina and Georgia, and at least 5 off Florida (Haney 1983, 1986b; Dias 2007; Wallace and Wigh 2007; *NAB*). This species was formerly regarded as rare in the entire area (Palmer 1962) and has evidently increased in numbers (Brown 1970), but was probably overlooked in offshore waters in the past. In recent years, ≤830 have been seen from the coast and inshore (R. Heil, pers. comm.; *NAB*), but it is unknown if numbers offshore have followed the decline of the offshore fishery.

Herald [Trindade] Petrel

Breeding: As currently classified by AOU, this species breeds on a few islands in the tropical Atlantic, Indian, and Pacific Oceans (but see *Species Limits*). In the South Atlantic, it breeds on Trindade and Martim Vaz Rocks off Brazil. There is no estimate of numbers at Martim Vaz; the population at Trindade has been variously estimated at 1000–2500 pairs (BirdLife International 2000), or 300–500 pairs (Imber 2004).

Nonbreeding: The at-sea distribution is poorly known, but it is said to disperse southwards into the subtropical South Atlantic (Onley and Scofield 2007); it is rare in the North Atlantic. However, it now occurs annually in Gulf Stream waters off Cape Hatteras, with an annual mean of 10 (daily maximum 4), mainly between mid-

May and September (Lee 2000a; Patteson and Brinkley 2004; *NAB*; Table 5). Some probably regularly disperse in the Gulf Stream farther northeast than Cape Hatteras, but that area has been poorly covered. Hurricane-carried individuals have appeared north to New York.

Species Limits: Atlantic birds are *Pterodroma [arminjoniana] arminjoniana*, known as Trindade Petrel; Pacific birds (*P. [a.] heraldica*) are probably a separate species (Brooke 2004).

Cahow (=Bermuda Petrel)

Breeding: This critically endangered species is endemic to Bermuda, where it breeds on a few isolated islets from November–May. Numbers have increased under intensive management from a low of 18 pairs in 1962–63 to 85 pairs in 2008–09 (Wingate 1977; Madeiros 2009; D.B. Wingate, pers. comm.).

Nonbreeding: Preliminary data from geotagged birds indicate that Cahows disperse widely in the western North Atlantic, including the Gulf Stream and its eddies (Madeiros 2012), but geotag data are not sufficiently precise to determine how often birds reach the continental slope or enter our area. Since 2000 a handful (daily maximum 3) have been seen annually in Gulf Stream waters off Cape Hatteras, chiefly from late May to August but once in December (Patteson and Brinkley 2004; Lee 2007; *NAB*; Table 5); one was photographed over the Northeast Channel on 28 June 2009 (M.-C. Martin and P. Duley, pers. comm.).

Fea's Petrel

Breeding: This critically endangered species breeds on the Cape Verdes and Desertas and possibly also the Azores (see *Species Limits*). Total numbers were reported as ≥880 pairs by BirdLife International (2000), but the current estimate of population size is 180–250 pairs (P. Geraldes, *per* M. Nunes, pers. comm.).

Nonbreeding: The main at-sea range is unknown, but since 1992 they have appeared annually in Gulf Stream waters off Cape Hatteras. About 80 individuals were seen between 1981 and 2008, with more (7–10 annually) since 2004 (Patteson and Brinkley 2004; *NAB*; Table 5); most records have been in May–August, with a daily maximum of 2. There is one record for Georgia (Haney et al. 1993); it may range throughout the Gulf Stream.

Species Limits: This species has recently been separated from Zino's Petrel (Madeira) and Soft-plumaged Petrel (South Atlantic and Indian Oceans: Bourne 1983; Brooke 2004; Onley and Schofield 2007). Fea's and Zino's Petrels are difficult to distinguish in the field, but sight-records in US waters have possibly included a few Zino's (Patteson and Brinkley 2004; see Appendix 3). Robb et al. (2008) also treat *P. desertae* (Desertas Islands) as a separate species from Fea's (Cape Verdes).

Table 5. Numbers of marine birds recorded on single-day pelagic trips in the vicinity of Cape Hatteras, North Carolina. Numbers tabulated are the mean number of birds recorded per trip, with the daily maximum in parentheses. All means are rounded to 2 significant figures, except that means <1 are rounded to 1 significant figure; + indicates a mean of <0.005 birds $trip^{-1}$. Source B. Patteson and K. Sutherland: http://www.patteson.com/htm.

Species	Winter (Dec-Feb)	Spring (Mar-May)	Summer (Jun-Aug)	Autumn (Sep-Nov)
Number of trips:	*21*	*122*	*49*	*29*
Northern Fulmar	20 (550)	0	0	0
Herald Petrel	0	0.5 (2)	0.4 (4)	0.2 (2)
Cahow	0	0.1 (2)	0.2 (1)	0
Fea's Petrel	0	0.4 (2)	0.2 (1)	0
Black-capped Petrel	1.4 (36)	73 (290)	99 (590)	35 (100)
Cory's Shearwater	0	54 (220)	220 (1400)	280 (1800)
Great Shearwater	0	8.5 (220)	34 (750)	11 (110)
Sooty Shearwater	0.2 (2)	8.4 (160)	0.04 (1)	0
Manx Shearwater	1.9 (80)	0.4 (4)	0.3 (7)	0.1 (4)
Audubon's Shearwater	0.5 (9)	45 (370)	120 (1200)	71 (290)
Wilson's Storm-Petrel	0	210 (770)	160 (810)	280 (1200)
White-faced Storm-Petrel	0	0	0.04 (1)	0.1 (2)
Leach's Storm-Petrel	0	8.0 (140)	1.8 (15)	0.2 (2)
Band-rumped Storm-Petrel	0	8.6 (58)	17 (150)	0.1 (1)
White-tailed Tropicbird	0	0.2 (4)	0.5 (4)	0
Red-billed Tropicbird	0	0.1 (2)	0.02 (1)	0
Masked Booby	0	0.02 (1)	0.04 (1)	0
Brown Booby	0	0	0.01 (1)	0
Northern Gannet	2200 (10,000)	9.9 (590)	0	3.1 (60)
Red-necked Phalarope	0	1.9 (30)	6.7 (69)	38 (210)
Red Phalarope	480 (3700)	0	0	0
Black-legged Kittiwake	9.9 (110)	0	0	0
Sabine's Gull	0	0	0	0.2 (2)
Sooty Tern	0	1.7 (56)	6.5 (86)	23 (88)
Bridled Tern	0	2.4 (83)	7.9 (100)	9.5 (91)
Arctic Tern	0	0.7 (12)	0.005 (1)	0
Pomarine Jaeger	0	3.6 (78)	1.7 (26)	3.8 (22)
Parasitic Jaeger	0	0.3 (7)	0.3 (4)	0.2 (3)
Long-tailed Jaeger	0	0.3 (4)	0.3 (7)	0.6 (7)
Great Skua	1.4 (9)	0	0	0
South Polar Skua	0	0.2 (2)	0	0.2 (2)
Dovekie	6 (260)	0	0	0
Common Murre	0.05 (1)	0	0	0
Razorbill	170 (830)	0	0	0
Atlantic Puffin	4.3 (31)	0	0	0

Black-capped Petrel

Breeding: In mountains on Hispaniola (Wingate 1964, Lee 2000b), perhaps in Cuba (Norton et al. 2004), and possibly on other Caribbean islands (Douglas 2000). Numbers have been estimated at <2000 pairs (Lee 2000a), but this is conjectural.

Nonbreeding: Ranges north into the western North Atlantic in May–October (the nonbreeding season: Wingate 1964) and through the eastern Caribbean in winter (Onley and Scofield 2007). In eastern US waters, it is a common visitor north to Cape Hatteras and probably throughout Gulf Stream waters from Florida to at least 41° N (southeast of Georges Bank: Clapp et al. 1982a; Lee 1986; Haney 1986a, 1987; Veit and Petersen 1993; Dias 2007; Wallace and Wigh 2007). It has been recorded in all months of the year off North Carolina, with peak numbers in May, July–August, and October (Lee 1984; Patteson and Brinkley 2004); the highest daily count was 590 on 27 July 1997 (Table 5). Its local distribution is strongly associated with Gulf Stream frontal meandering (Haney 1986a). It is rare away from the Gulf Stream except during hurricanes, when it is occasionally driven inshore and has been recorded north to Maine and inland to the Great Lakes (Rowlett 1980; Veit and Petersen 1993; Armistead and Sullivan 2003; *NAB*).

Cory's Shearwater

Breeding: On islands in the eastern North Atlantic and in the Mediterranean (see *Subspecies and Species Limits*). The total population is on the order of 150,000 pairs and is thought to be stable (Hagemeijer and Blair 1997).

Nonbreeding: Migrates south to spend the boreal winter in the South Atlantic and Indian Oceans (Gómez-Díaz and Gonzáles-Solís 2006, Gonzáles-Solís et al. 2007), and disperses into the western North Atlantic in summer. In eastern US waters, it is a common summer visitor to warmer coastal and offshore waters from the southern Gulf of Maine and Georges Bank to Florida. Off southern New England (Block Island to southern Georges Bank), mean densities exceed 10 km^{-2} in summer (Powers and Brown 1987) and numbers seen from shore range up to 7000 (off Nantucket in July 1980: Veit and Petersen 1993); it occurs sporadically in hundreds or thousands south to Florida (Clapp et al. 1982a; Stevenson and Anderson 1994; Dias 2007; Wallace and Wigh 2007; Table 5; *NAB*). Its local distribution off the Georgia coast is strongly associated with Gulf Stream frontal eddies (Haney 1985a). This species breeds from June–October, so those visiting the western Atlantic at that season are most likely nonbreeders (Cramp and Simmons 1977; Brown 1986).

Migration: Generally present in US waters from May–November, with largest numbers during August–October; it is rare in April and December and there has been only 1 record during January–March (Clapp et al. 1982a; Lee 1986; Veit and Petersen 1993; Wallace and Wigh 2007; Tables 3, 5, 6). However, large numbers pass Bermuda in March and May–June (D.B. Wingate, pers. comm.).

Subspecies and Species Limits: Most birds reaching North American waters belong to *Calonectris diomedea borealis*, which breeds on Atlantic islands from the Azores to the Canaries, but small numbers of *C. d. diomedea* (Mediterranean islands) also occur and are increasingly recorded as field distinctions become known; these may represent different species (Gómez-Diaz et al. 2006). *C. edwardsii* (Cape Verdes) was formerly regarded as conspecific and has been reported off North Carolina and Maryland (see Appendix 3).

Great Shearwater

Breeding: In the South Atlantic on Tristan da Cunha and Gough, and in small numbers in the Falklands. Total numbers are on the order of 6 million pairs (Fishpool and Evans 2001).

Nonbreeding: Migrates north to spend the austral winter in the North Atlantic; largest numbers occur from Georges Bank to Greenland, extending east to European waters (see *Migration*). It is an abundant migrant along the US east coast. Largest numbers are found in the Bay of Fundy and on Georges Bank, where it is the most abundant seabird in June–August, with mean density 34 km^{-2} and maximum >100 km^{-2} (Brown 1986; Powers and Brown 1987; Table 3). It is infrequently seen from shore except around Nantucket, Cape Cod, and southwest Nova Scotia, where some counts run into the tens of thousands (Veit and Petersen 1993; *NAB*). Fewer (all counts <1000) occur in the mid-Atlantic Bight south to Cape Hatteras (Rowlett 1980; Table 5), and still fewer (≤200) south to Florida (Clapp et al. 1982a; Dias 2007; Wallace and Wigh 2007; Table 6).

Migration: Most migrate through the western North Atlantic in May–June and spend June–August off Newfoundland and Greenland, returning south through the east-central Atlantic in August–September (Brown 1986; Cramp and Simmons 1977). Adults molt their flight feathers on Georges Bank in June before continuing northeast, whereas birds too young to have bred probably molt off Greenland in July (Brown 1986). In US coastal waters, individuals have been recorded in all months of the year, but are most numerous off Georgia and Florida in June (Dias 2007; Wallace and Wigh 2007; Table 6), North Carolina in late May–July (Clapp et al. 1982a; Table 5), Maryland–New Jersey in June–July (Rowlett 1980), and on Georges Bank in June–September (Powers and Brown 1987). At times large numbers, probably nonbreeders, have been seen in late autumn—e.g., 40,000 off Cape Cod on 25 September 1977 (Veit and Petersen 1993), and 200,000 on Georges Bank on 11 November in the same year (Powers and Van Os 1979). It is very rare in US waters from December–April.

Sooty Shearwater

Breeding: On islands in the South Atlantic, South Pacific, and Southern Oceans. Total numbers are not known but may exceed 10 million pairs (Brown 1986; Marchant and Higgins 1990; Brooke 2004).

Nonbreeding: Migrates to spend the austral winter in North Pacific and (in lesser numbers) North Atlantic Oceans. In the North Atlantic, largest numbers occur from Georges Bank to Greenland, extending east to European waters (see *Migration*). In US east coast waters, it is an abundant spring and early summer migrant from Cape Hatteras northwards. Largest numbers are found on Georges Bank, where the mean density was >30 km^{-2} in June (Powers 1983; Table 3). It is more frequently seen from shore than Great Shearwater, with high counts 8000 off North Carolina (Clapp et al. 1982a), 1000 off Long Island (Levine 1998) and 2500 off Cape Cod, all in late May or early June (see *Migration*). It is much less numerous both inshore and offshore from South Carolina to Florida (all counts ≤10: Clapp et al. 1982a; Stevenson and Anderson 1994; Dias 2007; Wallace and Wigh 2007; Table 6).

Migration: Most arrive in North American waters in mid-May, pass rapidly north in late May–early June, then spread east across the North Atlantic, migrating south down its east side in September (Phillips 1963; Brown 1986; Cramp and Simmons 1977). Migrants pass Bermuda from early May–late May (D.B. Wingate, pers. comm.). There are records of thousands twice in northbound migration at Cape Hatteras and of 1000 once off Long Island, all from 26–31 May (Clapp et al. 1982a; Levine 1998). In the Gulf of Maine and on Georges Bank, it is most numerous in June (Powers 1983; Veit and Petersen 1993). Most have passed on by mid-July, but there is evidence for another influx into inshore waters in late autumn (September–November), when as many as 800 have been seen off Cape Cod (Veit and Petersen 1993). Stragglers have been recorded offshore throughout the winter months.

Manx Shearwater

Breeding: On islands in the eastern North Atlantic from Iceland and the British Isles south to the Canaries (Cramp and Simmons 1977; Brooke 1990; see *Species Limits*). The world population has been estimated as 340,000–410,000 pairs, mostly in Britain and Ireland (Newton et al. 2004). It has recently established a breeding colony in Newfoundland (Storey and Lien 1985), where hundreds are now present in summer but only a few pairs nest (Robertson 2002; G. Fraser, unpubl. data). It is currently prospecting several islands in the Gulf of Maine and occupies several burrows at Matinicus Rock; an egg was laid there in 2005 and a chick was raised in 2009 (Anonymous 2009a; GOMSWG annual reports; J. Drury, pers. comm.). It has been seen regularly in summer in potential breeding areas in Rhode Island (1980s: Buckley and Buckley 1984) and northern Massachusetts (2007–10: R. Stymeist, pers. comm.), and there was an isolated breeding record in southern Massachusetts (Bierregaard et al. 1975).

Nonbreeding: Migrates to spend the boreal winter in the western South Atlantic (Brooke 1990). In eastern US waters, it is a scarce migrant and summer resident in inshore and offshore waters from the Bay of Fundy and Gulf of Maine south to Florida (Rowlett 1980; Clapp et al. 1982a; Buckley and Buckley 1984; Brown 1986; Lee 1987a, 1995; Lee and Haney 1996; Dias 2007; Wallace and Wigh 2007). Total numbers over shelf waters off the northeastern United States have been estimated at 5000 in summer and 2000 in autumn (Powers 1983); those off the southeastern United States have been estimated at 7000 in autumn, 5000 in winter and 1000 in spring (Lee and Haney 1996). As many as 200 have been seen in a day off Cape Cod (Buckley and Buckley 1984; Veit and Petersen 1993; *NAB*), and as many as 600 in a day in the eastern Gulf of Maine (*NAB*). Reported numbers increased from the 1950s through the 1980s (Post 1967; Lee 1995), but may have stabilized or decreased since; no daily maxima >170 have been reported since 1993.

Migration: European birds migrate down the east side of the North Atlantic in September–October, winter off eastern South America, and return in late February–March, probably in midocean (Brooke 1990; Thompson 2002; Guilford et al. 2009); large numbers pass Bermuda in late February–March (D.B. Wingate, pers. comm.). Several British-banded birds have been recovered in North America, including 2 in New England in autumn, 2 in Florida in winter, 1 in North Carolina in spring, and 5 in Nova Scotia and Newfoundland in the breeding season (Thompson 2002). Pelagic surveys confirm that birds in North American waters move south in autumn, and winter off the southeastern United States (Powers 1983; Lee and Haney 1996; see *Nonbreeding*); most of these are probably 1 year old (Brooke 1990). On Georges Bank, they are most frequent from June–August (Brown 1986; Powers and Brown 1987, Table 3).

Species Limits: Manx Shearwater forms part of a superspecies with 8 distinct taxa worldwide; these have been variously treated as 1, 3, 6, or 8 species (Brooke 1990; Lee and Haney 1996; AOU 1998; Onley and Schofield 2007). AOU (1998) treats North Atlantic birds as a single species (*Puffinus puffinus*); two Mediterranean taxa (*P. mauretanicus* and *P. yelkouan*), have been separated recently (Wink et al. 1993; Heidrich et al. 1998, Robb et al. 2008).

Audubon's Shearwater

Breeding: On islands in the Indian and Pacific Oceans, and in the Bahamas and Caribbean (but see *Species Limits*). Information on numbers and trends is scanty for most taxa in the group. The total number breeding in the Bahamas and Caribbean (Audubon's Shearwater *sensu stricto*) has been estimated at 3000–5000 pairs (Lee 2000c) or 2700 pairs (Bradley and Norton 2009), but both are probably too low in view of the numbers seen at sea (see below).

Nonbreeding: Most taxa in the group disperse at sea without extensive migrations (Onley and Scofield 2007). However, birds from the Bahamas and Caribbean migrate north over continental shelf waters at least as far as 41° N (see *Migration*). This form is a common summer visitor to Gulf Stream waters from Florida north to North Carolina (Clapp et al. 1982a; Lee 1986). Off North Carolina, it occurs mostly in warm water >100 m deep; the mean frequency is >10 hr^{-1} (Lee 1986), with daily maxima of 1200–1500 (Table 5; *NAB*). Small numbers (up to 3 km^{-2}) occur in summer over mid-Atlantic Bight slope waters (Post 1967; Rowlett 1980; Powers and Brown 1987; Walsh et al. 1999; *NAB*). There is one record of 225 attending a research vessel in 1000 m of water south of Hudson Canyon (Levine 1998), and records of 1–3 as far east as Georges Bank and Sable Island, Nova Scotia (Brown 1986; Powers and Brown 1987; Table 3; *NAB*).

Migration: It occurs off the US coast from late April to early November, with largest numbers off Florida in June–July (Wallace and Wigh 2007), off Georgia and South Carolina in May–August (Dias 2007), and off North Carolina from mid-July to early October. It is rare or absent from mid-November to mid-April (Clapp et al. 1982a; Lee 1986). Those in the Bahamas and Caribbean breed in spring (Jan–May: Murphy 1936; Mar–Jul: Trimm 2004), except perhaps year-round on Barbados (Buckley et al. 2009), so most recorded in North American waters are postbreeding.

Species Limits: Audubon's Shearwater forms part of a superspecies with about 17 distinct taxa worldwide; these have been variously treated as 4–12 species (Ainley et al. 1997; AOU 1998; Onley and Scofield 2007; Robb et al. 2008). AOU (1998) separated Newell's Shearwater *Puffinus newelli*, Townsend's Shearwater *P. auricularis* (Pacific islands), and *P. assimilis* (east Atlantic and Australia), and grouped all other taxa into *P. lherminieri*, but a molecular phylogeny by Austin et al. (2004) suggested at least 9 distinct species, and Onley and Scofield (2007) recognized 11. Under the last classification, *P. lherminieri* is restricted to the Bahamas and Caribbean and is most closely related to *P. baroli* (Little or Macaronesian Shearwater) of the eastern Atlantic. Robb et al. (2008) further proposed splitting the last species into *P. baroli* (Azores) and *P. boydi* (Cape Verdes). See Sangster et al. (2007) and Appendix 3.

Wilson's Storm-Petrel

Breeding: Widespread on Antarctic coasts and on islands throughout the Southern Ocean. Total numbers are unknown but certainly run into many millions (Croxall et al. 1984).

Nonbreeding: Migrates north to spend the austral winter in the temperate North Atlantic and Indian Oceans and the tropical Pacific (Onley and Scofield 2007). It is an abundant visitor throughout eastern US waters, although less numerous south of North Carolina (Clapp et al. 1982a; Stevenson and Anderson 1994; Dias 2007; Wallace and Wigh 2007; Table 6). Maxima (>100 km^{-2}) occur in June–September in the southern Gulf of Maine and over slope waters east of Georges Bank (Powers and Brown 1987), and there are records of ≤75,000 as far southwest as Hudson Canyon (Levine 1998). Powers (1983) estimated that 1.5 million occur in shelf waters of the northeastern United States in June.

Migration: It migrates north mainly over the continental shelf on the west side of the North Atlantic (Cramp and Simmons 1977; Brown 1986). Early birds reach Florida and Cape Hatteras by mid-April, but largest numbers arrive in mid-May; it is most abundant in all areas from June–September (Clapp et al. 1982a; Powers and Brown 1987; Veit and Petersen 1993). Southward migration is undocumented; it

Table 6. Numbers of marine birds recorded on single-day pelagic trips >14 km offshore from Port Canaveral, Florida, 1956–80. Numbers tabulated are the mean number of birds recorded per trip. All means are rounded to 2 significant figures, except that means <0.1 are rounded to 1 significant figure. + = <0.005 birds per trip.[5] Source: Wallace and Wigh (2007), Table 1.

Species	**Winter (Dec-Feb)**	**Spring (Mar-May)**	**Summer (Jun-Aug)**	**Autumn (Sep-Nov)**
Number of trips:	***367***	***471***	***489***	***378***
[1] Cory's Shearwater	+	0.36	2.3	3.5
[1] Great Shearwater	0.01	0.06	5.6	2.9
[1] Sooty Shearwater	0.01	0.01	0.03	0.01
[1] Audubon's Shearwater	0.05	0	0.28	0.62
Wilson's Storm-Petrel	0	3.1	11	0.01
White-tailed Tropicbird	0	0.03	0.04	0.02
Masked Booby	0	0.01	0.03	0.01
Brown Booby	0.04	0.01	0.03	0.03
Northern Gannet	31	9.1	0	0.43
[2] Red-necked Phalarope	2.7	0.89	0.30	0.51
[2] Red Phalarope	12	3.6	5.8	3.5
Black-legged Kittiwake	2.3	0.06	0	0.17
Sooty Tern	+	0.09	0.37	0.31
Bridled Tern	+	1.2	2.1	1.2
[3] Roseate Tern	0.01	0.17	0.01	0.24
[4] Total jaegers	4.7	1.2	0.03	3.0
Dovekie	0.33	0	0	0

[1] 6% of shearwaters were unidentified, with a similar seasonal distribution to that of the total numbers of identified birds.

[2] 17% of phalaropes were unidentified, with a similar seasonal distribution to that of the total numbers of identified birds.

[3] Published numbers for Roseate Terns were incorrect; correct numbers were supplied by R.D. Wallace (pers. comm.).

[4] 62% of jaegers were unidentified; among those identified, 73% were Pomarine, 26% were Parasitic, and 0.06% were Long-tailed, each with a similar seasonal distribution.

[5] Other species recorded at an overall frequency of <0.005 per trip included Atlantic Yellow-nosed Albatross (1),Black-browed Albatross (1), Manx Shearwater (6), Leach's Storm-Petrel (6), Band-rumped Storm-Petrel (1), Red-billed Tropicbird (1), Brown Noddy (2), Arctic Tern (7), and Thick-billed Murre (1).

is usually rare or absent from US waters from mid-October to late March (Rowlett 1980; Clapp et al. 1982a; Lee 1986; Powers and Brown 1987), but hundreds have been recorded off North Carolina twice in early–mid-December (Lee 1987a, b).

White-faced Storm-Petrel

Breeding: On islands in the temperate and subtropical North and South Atlantic and in Australasia (Onley and Scofield 2007). In the North Atlantic, it breeds on the Selvagens (Madeira), Canaries, and Cape Verdes (see *Subspecies*). There is no estimate of the total world population. At least 40,000 pairs breed in the Selvagens, but there is no estimate for the Cape Verdes (Hagemeijer and Blair 1997).

Nonbreeding: Disperses very widely at sea (Onley and Scofield 2007); North Atlantic birds disperse westwards into the central North Atlantic. In eastern US waters, it is an annual but very scarce late summer visitor to Gulf Stream waters from Cape Hatteras north to Nova Scotia. Watson et al. (1986) compiled 35 records prior to 1986, and reports have become more frequent since then. Singles and groups ≤6 have been recorded 5–10 times annually in recent years, and there is a single daily maximum of 22 off Massachusetts (*NAB*) (Table 5). Most records have been made during August–September.

Subspecies: Watson et al. (1986) suggested that most or all records in US waters referred to *Pelagodroma marina eadesi* from the Cape Verdes, but *P. m. hypoleuca* from the Selvagens and Canaries has been recorded at least once (Veit and Petersen 1993). However, the latest reviewer concluded that *eadesi* is not a valid subspecies (Hazevoet 1995).

Leach's Storm-Petrel

Breeding: On islands in the temperate North Pacific and North Atlantic, extending south in the western North Atlantic to the Gulf of Maine. The total world population has been estimated as 9–11 million pairs (Mitchell 2004a), of which 5 million pairs breed in the western North Atlantic, mostly on 2 islands off Newfoundland (Huntington et al. 1996). We estimate the number breeding in the Bay of Fundy and Gulf of Maine as around 40,000 pairs (Table 1), but that estimate is most uncertain because this nocturnal, burrow-nesting species is extremely difficult to census (Mitchell 2004a), and because there have been major discrepancies among estimates for the same islands. Three of the largest colonies are at Kent Island, where Ronconi and Wong (2003) reported 25,400 pairs, and at Great and Little Duck Islands, where the most recent estimates are 5000 and 2800 pairs, respectively (J.G.T. Anderson, pers. comm.; USGS database). However, Cannell and Maddox (1983) reported only 2300 pairs at Kent Island, Drury (1973–74) reported 1300 pairs at Great and Little Duck Islands, and Korschgen (1979) reported 18,000 pairs. It also nests on other islands in the Grand Manan archipelago (Ronconi and Wong 2003); there are no recent estimates of numbers, but Gross counted 14,000 burrows on 2 of these islands in 1935 (Drury 1973–74). Large numbers have also been reported nesting on islands south of Nova Scotia (Tufts 1986). Smaller numbers (≤500 pairs) nest on about 25 other islands in the Gulf of Maine (Drury 1973–74; Korschgen 1979; USGS database; Table 1). Drury (1973–74) believed that numbers in the Gulf of Maine had been declining steadily since at least 1900, with many colony sites abandoned or almost abandoned. Ronconi and Wong (2003) similarly reported loss of several sites in the Grand Manan Archipelago since 1959. However, this evidence applied primarily to the smaller colonies; there is little information on trends at the largest colonies (C. Huntington, R. Mauck, and J.G.T. Anderson, pers. comm.). South of Cape Cod, a colony on Penikese Island in Buzzards Bay declined from 90–120 pairs in the1930s–50s (Drury 1973–74; Veit and Petersen 1993) to 15–20 pairs in 1975, 7 pairs in 1986, and 3 pairs in 1991 (French 2002), with 3 pairs still present in 2008 (C.S. Mostello, pers. comm.); a few pairs were thought to be nesting at Nomans Land in 2001 (French 2002). Breeders usually feed >50 km offshore; they are widely dispersed (mean density 0.2 km^{-2}: Table 3) during the breeding season (May–November) from Georges Bank eastwards (Brown 1986; Powers and Brown 1987; Table 3). It occurs in small numbers during the breeding season in the Bay of Fundy, Gulf of Maine and in offshore waters south to Cape Hatteras (Rowlett 1980; Lee 1986; Powers and Brown 1987; *NAB*; Table 5). It is rare farther south and usually seen singly (Clapp et al. 1982a; Dias 2007; Wallace and Wigh 2007; Table 7), except that Ruckdeschel et al. (1994) reported a mass stranding on Georgia and Florida beaches in late May 1991.

Nonbreeding: Winters mainly in tropical waters (Onley and Scofield 2007). North Atlantic birds winter mainly off West Africa, but also in the Gulf of Mexico and Caribbean (Huntington et al. 1996). They are very rare in US waters in winter (December–March; Lee 1987a), but scattered records inshore during storms (Veit and Petersen 1993; P.A. Buckley, pers. comm.) suggest that a few may remain throughout the winter.

Migration: It is present at breeding sites from mid-April–late November. Migration takes place at sea and is poorly documented, but many or most North American birds are thought to migrate to European waters in October–November and to stage in the Bay of Biscay before migrating south to winter quarters off West Africa (Hémery and Jouanin 1988; Huntington et al. 1996).

Band-rumped Storm-Petrel

Breeding: On islands in the subtropical and tropical South and North Atlantic and Pacific Oceans (but see *Species Limits*). In the North Atlantic, it breeds from the Azores and Farilhões (Portugal) south to the Cape Verdes (Slotterback 2002; Smith et al. 2007). There are no estimates of the world population, but the North Atlantic population is estimated as 6000–10,000 pairs, mostly in the Azores and Madeira (Hazevoet 1995; Hagemeijer and Blair 1997; Robb et al. 2008; Howell et al. 2010).

Nonbreeding: Disperses widely at sea; European birds are thought to remain in the eastern Atlantic (Cramp and Simmons 1977; Onley and Scofield 2007). In eastern US waters, it is an uncommon but regular visitor to warm waters >1000 m deep off North Carolina from 30 May–19 September (Lee 1984, 1986; Howell et al. 2010; Table 5; *NAB*), with recent daily maxima of 38–234 (*NAB*); Robb et al. (2008) cited a record of "hundreds" at an unspecified location in the Gulf Stream, and 600+ attended a dead whale in Gulf Stream waters 350 km southeast of Nantucket in July 2005 (J. Santora, pers. comm.). It also occurs in smaller numbers off South Carolina, Georgia, and Florida in May–September, with stragglers as late as December (Haney 1985c; Dias 2007; Wallace and Wigh 2007; Table 6). It is rare inshore from the Gulf Stream, but occurs annually west to Hudson Canyon and north to the southern edge of Georges Bank (Veit and Petersen 1993; *NAB*); 11 were seen from shore at Cape May following Hurricane *Bertha* in July 1996 (Walsh et al. 1999), and 30–70 were recorded at various locations from North Carolina to New Jersey following Hurricane *Isabel* in July 1996 (Howell et al. 2010). It may be frequently overlooked among both Leach's and Wilson's Storm-Petrels.

Species Limits: The taxonomy of "Band-rumped Storm-Petrels" is in flux (Smith et al. 2007; Robb et al. 2008). They were treated as one species as recently as 2007 (Onley and Schofield 2007). However, at several island groups in the eastern Atlantic, distinct populations breed in winter and summer, often in the same sites, and have diverged genetically to a degree that warrants species status (Smith et al. 2007; Friesen et al. 2007b). The winter-breeding birds in the Azores have recently been described formally as Monteiro's Storm-Petrel (Bolton et al. 2008). Robb et al. (2008) suggested that the birds breeding in winter in Madeira, Selvagens and Canaries should also be recognized as a separate species; if so, the name *O. castro* would probably apply to these birds and the more widespread birds breeding in summer from Azores to Canaries would need a new name. Cape Verdes birds are also genetically distinct (Smith et al. 2007; Friesen et al. 2007b) and may represent a fourth species (Robb et al. 2008). Howell et al. (2010) report that at least two distinct types occur in Gulf Stream waters off the eastern United States; they suggest that the more abundant type corresponds to the (currently unnamed) summer-breeding population from the Azores, and that most of the rest may be summer-breeding birds from Madeira (*O. castro* according to Robb et al. 2008).

White-tailed Tropicbird

Breeding: On coastal cliffs and offshore islands: it is widely distributed in the Atlantic, Indian, and Pacific Oceans (Lee and Walsh-McGehee 1998). In the North Atlantic, it breeds on Bermuda, the Dry Tortugas (erratically), the Bahamas, and the West Indies. The world population is estimated as 22,000–28,000 pairs; about 2500 pairs breed in Bermuda, and 2100 pairs in the Bahamas and West Indies (Madeiros 2009; Bradley and Norton 2009). Numbers in Bermuda declined until the 1990s, but are probably increasing again (Madeiros 2009; D.B. Wingate, pers. comm.); those in the Bahamas and West Indies have declined dramatically since 1984 and the regional population is classified as Vulnerable (Walsh-McGehee 2000) or Priority At-Risk (Bradley and Norton 2009). Breeders forage over deep water far from the nesting islands (Walsh-McGehee 2000).

Nonbreeding: Disperses widely over tropical seas; North Atlantic birds may spend the nonbreeding period in the Sargasso Sea (Walsh-McGehee 2000). In eastern US waters, it is a scarce but probably annual summer visitor in Gulf Stream waters from Florida to North Carolina. Clapp et al. (1982a) compiled 48 records of 1–3 birds from this area, mostly in June–September. In recent years 5–10 have been seen annually off Cape Hatteras (*NAB*), with up to 4 per day (Table 5). It is also seen regularly in April–October (peaking in May–June) off South Carolina (Dias 2007), and off Florida, where it is recorded on 36% of trips east of the Gulf Stream (Wallace and Wigh 2007). Most of these are adults (Lee and Walsh-McGehee 1998), and probably include birds breeding in Bermuda and the Bahamas. Singles are seen occasionally over Gulf Stream waters north at least to 41° N (southeast of Nantucket) but coverage of Gulf Stream waters at these latitudes is sparse; vagrants occur inshore north to Maine and Nova Scotia, usually after hurricanes (Tufts 1986; Veit and Petersen 1993; *NAB*).

Red-billed Tropicbird

Breeding: In crevices on cliffs; it is distributed spottily on islands in the tropical Atlantic, Indian and eastern Pacific Oceans (Cramp and Simmons 1977). In the western Atlantic, it breeds on islands around the eastern and southern Caribbean from Puerto Rico to Panama (Walsh-McGehee 2000). The total world population is thought to be fewer than 10,000 pairs, of which 1800–2500 pairs breed in the West Indies from Puerto Rico to Tobago and islands off Venezuela; trends are unclear, but the regional population is considered Vulnerable (Walsh-McGehee 2000; Bradley and Norton 2009).

Nonbreeding: Disperses widely over tropical seas (Cramp and Simmons 1977). In the western North Atlantic, it disperses north over Gulf Stream waters in very small numbers to the latitude of Cape Hatteras. Post et al. (1998) compiled 17 records from Florida to New York prior to 1996; more recent records are tabulated in Table 5. Wallace and Wigh (2007) considered it very rare in the Gulf Stream off Florida from April–October. Since 1963, individuals have appeared with increasing frequency from May–August in New Jersey, New York, Rhode Island, Massachusetts, Maine, and New Brunswick (*NAB*), and several (possibly multiple records of the same individuals) flew over or landed on seabird nesting islands. One spent parts of the summers of 1986–88 apparently holding territory on a cliff on Martha's Vineyard (Veit and Petersen 1993); another spent parts of the summers of 2005–10 at several islands in the Gulf of Maine and Bay of Fundy, and was seen to enter crevices at Matinicus Rock and Seal Island (GOMSWG annual reports).

Masked Booby

Breeding: On the ground on tropical and subtropical islands worldwide, except parts of the eastern Pacific (see *Species Limits*); the total world population is not known. In the western North Atlantic, it breeds in the southern Bahamas and locally in the Caribbean and southern Gulf of Mexico (Anderson 1993). Schreiber (2000b) and Bradley and Norton (2009) estimated 550–650 breeding pairs in the West Indies; several colonies have been extirpated in recent decades and the regional population is considered endangered. However, there are several hundred additional pairs in the southern Caribbean, and 4000–5000 pairs off the Yucatan Peninsula in the Gulf of Mexico (Schreiber 2000b).

Nonbreeding: Disperses widely over tropical seas (Anderson 1993); western Atlantic birds disperse north in very small numbers to the northern Gulf of Mexico and Cape Hatteras. In eastern US waters, it is a very scarce summer visitor to Gulf Stream waters. Clapp et al. (1982a) listed 21 records from Florida, and Wallace and Wigh (2007) listed 30 more, all from April–November (Table 6). Post (2004) compiled 7 records for Georgia and 7 for South Carolina; Wallace and Wigh (2007) listed 8 more off Georgia, 1 of them in January. Lee (1986) reported that it occurs in very small numbers off North Carolina in June–August, with 2 October records (Table 5). Farther north, there is a single New Jersey record in August 2001 (Hanson 2005), and there is a possible record in Rhode Island (Ferren, in press).

Species Limits: This species was recently separated from Nazca Booby (Galapagos and other islands in east Pacific): see Pitman and Jehl (1998) and Friesen et al. (2002).

Brown Booby

Breeding: On the ground on tropical and subtropical islands worldwide; the total world population is not known. In the western Atlantic, it breeds in the Bahamas, Caribbean, and southern Gulf of Mexico (Schreiber and Norton 2002). Schreiber (2000b) estimated 10,000–14,000 pairs in this area; several large colonies have been lost and the regional population is considered Vulnerable.

Nonbreeding: Disperses widely over tropical seas (Schreiber and Norton 2002); western Atlantic birds disperse north in very small numbers to the northern Gulf of Mexico and northern Florida. In the eastern United States, most records come from the east coast of Florida, where Stevenson and Anderson (1994) compiled ≥140 records, some of small flocks ≤12; Wallace and Wigh (2007) listed 38 more, and 20 were seen in Biscayne National Park in May 2009 (*NAB*). These records span the year and include 1 that stayed for 20 months. The species was formerly almost unknown north of Florida (Clapp et al. 1982a), but records have increased sharply in recent years. LeGrand et al. (2004) listed 12 records from North Carolina, and 13 were seen on towers off Georgia in September 2008 (*NAB*). It occurs as a vagrant from Virginia to Nova Scotia, including 6 records of 1–2 on Long Island in 1975 and 7 from New Jersey to Rhode Island in 1989–92; only a few records from that area followed hurricanes (Veit and Petersen 1993; Levine 1998; *NAB*).

Table 7. Annual mean numbers of marine birds counted passing Avalon, New Jersey, 1993–2004. Birds were counted passing a vantage point throughout daylight hours from 22 September to 22 December each year. Species with means <1 year^{-1} are omitted from the table. All counts and means are rounded to 2 significant figures, except that means <10 are rounded to the nearest integer. Other species recorded (≤5 total) include Pacific Loon, Northern Fulmar, Cory's Shearwater, Manx Shearwater, Wilson's Storm-Petrel, Sabine's Gull, Black-headed Gull, California Gull, Glaucous Gull, Bridled Tern, Least Tern, Arctic Tern, Thick-billed Murre, Black Guillemot, and Atlantic Puffin. Source: New Jersey Audubon (2006).

Species	Mean (birds year^{-1})	Highest daily count	Date of highest count
King Eider	6	7	9 Dec 1997
Common Eider	50	43	23 Nov 2003
Harlequin Duck	5	6	24 Oct 1993
Surf Scoter	140,000	43,000	28 Oct 2000
White-winged Scoter	3200	960	23 Nov 1995
Black Scoter	130,000	43,000	26 Oct 1998
[1]total scoters	360,000	—	—
Long-tailed Duck	2400	1600	8 Dec 1993
Red-breasted Merganser	4000	1300	19 Nov 1998
Red-throated Loon	58,000	11,000	12 Nov 1997
Common Loon	3600	690	31 Oct 1996
Horned Grebe	160	100	12 Nov 1997
Red-necked Grebe	7	3	14 Dec 1995
Northern Gannet	48,000	6900	12 Dec 1998
Brown Pelican	170	69	1 Oct 2000
Great Cormorant	87	24	27 Oct 1999
Double-crested Cormorant	190,000	24,000	21 Oct 2004
Black-legged Kittiwake	25	57	19 Nov 1996
Bonaparte's Gull	4800	2700	11 Dec 1995
Little Gull	2	2	3 dates
Laughing Gull	17,000	6600	12 Oct 2000
Franklin's Gull	4	28	14 Nov 1998
Ring-billed Gull	13,000	9100	10 Dec 1995
Herring Gull	9100	8300	5 Nov 1996
Iceland Gull	1	1	13 dates
Lesser Black-backed Gull	4	5	12 Oct 2003
Great Black-backed Gull	940	500	13 Nov 1998
Caspian Tern	28	25	24 Sep 1995
Black Tern	1	1	14 dates
Common Tern	880	2400	25 Sep 1997
Forster's Tern	5800	3300	5 Nov 1996
Royal Tern	970	1500	18 Oct 1996
Sandwich Tern	2	8	25 Sep 2003
Black Skimmer	170	120	7 Oct 1999
Pomarine Jaeger	2	2	11 dates
Parasitic Jaeger	160	36	4 Nov 1999
Dovekie	1	1	9 dates
Razorbill	12	19	17 Dec 2004

[1] Probably >99% Surf and Black Scoters.

Northern Gannet

Breeding: On mainland cliffs and islands on both sides of the temperate North Atlantic: in Europe from Iceland and Norway to France, and in Canada from Newfoundland to New Brunswick. The total world population is 390,000 pairs, of which 320,000 pairs nest in Europe, mostly in Britain and Ireland (Wanless and Harris 2004), and 72,000 pairs in Canada (Chardine 2000; Mowbray 2002). The European population has been increasing since the 19th century (Wanless and Harris 2004). The Canadian population has been increasing since 1972 (Mowbray 2002), following a temporary decline in the 1960s (Chapdelaine et al. 1987). A single nest was found at Whitehorse Island, New Brunswick, in 1999, the first in the Bay of Fundy since about 1880 (Corrigan and Diamond 2001). Small numbers of nonbreeders (counts usually ≤5) are present throughout the summer in the Bay of Fundy, Gulf of Maine and around Cape Cod, but are rare off Long Island and farther south.

Nonbreeding: Winters over shelf waters south to West Africa in the eastern Atlantic and the Gulf of Mexico in the western Atlantic (Cramp and Simmons 1977; Mowbray 2002; Wanless and Harris 2002). North American breeders winter off the entire Atlantic coast from Nova Scotia to south Florida, ranging across the full width of the continental shelf; largest numbers are found from Cape Cod south to Cape Fear (Table 4). Veit and Petersen (1993) reported midwinter concentrations around fishing trawlers near the shelf break off Cape Cod, and Powers and Brown (1987) reported a concentration of wintering adults at the shelf break off New Jersey and New York (39°–40° N). Most young and many adults winter offshore from North Carolina to south Florida (Mowbray 2002; Tables 4–6). A few winter on Georges Bank and in the Gulf of Maine (Powers and Brown 1987; Table 3).

Migration: It is present in winter quarters from October–April (Mowbray 2002). Juveniles start to migrate south in late September; they are numerous on Georges Bank and around Cape Cod by mid-October, off Long Island and New Jersey by November, off North Carolina in mid-November, reaching south Florida by late November (Lee 1986; Mowbray 2002; Table 6). Adults and subadults (2–4 years old) migrate later and shorter distances. Large numbers are sometimes driven into Cape Cod Bay by storms in late October–November; the maxima were 12,000 on 25 October 1983 and 19 October 2009 (Veit and Petersen 1993; B. Nikula and P.R. Bono, pers. comm.). The mean seasonal total at Avalon was 48,000; the highest daily count was 6900 on 12 December (Table 7). Spring migration starts in February and most adults are at breeding sites by mid-April; birds 1–4 years old migrate from March–mid-May (Mowbray 2002). Largest numbers pass Cape Cod and over Georges Bank from late March–early May (Veit and Petersen 1993; Powers and Brown 1987).

Brown Pelican

Breeding: In trees or on the ground on islands off both coasts of North America, around the Caribbean and on the west coast of South America (but see *Species Limits*). The total world population is 200,000 pairs (Shields 2002), excluding the population in western South America, which fluctuates according to ENSO events but has numbered millions of pairs in the past (Nelson 1978). In the eastern United States, it is a fairly common and rapidly increasing resident along the coast from Florida to New Jersey. Numbers had been reduced to 2800 pairs in 8 colonies by 1970, but have increased steadily since then (Shields 2002). Censuses in 1976 yielded a total of 5700 nesting pairs (Spendelow and Patton 1988), but Clapp et al. (1982a) enumerated 8600 pairs in 1975–76 and 11,500 pairs in 1977–78. Numbers have continued to increase and reached 13,700 pairs by 1989 and 15,700 pairs by 1999 (Shields 2002). It spread north in 1987 from its former limit in North Carolina to breed in Virginia (1400 pairs by 1999) and Maryland (140 pairs by 1999: Wilkinson et al. 1994; Shields 2002). In 1992–1994, 600 were seen along the coast of New Jersey and 18 pairs built nests at Barnegat Inlet (but no eggs were laid); in the same period, some began summering on Long Island, with additional records in Connecticut, Rhode Island, and Massachusetts (*NAB*). However, there have been few records north of New Jersey since 1994 and no further nesting attempts north of Maryland (Shields 2002), except for an incomplete nest built at Barnegat Inlet in 2001 (*NAB*).

Nonbreeding: Generally winters in inshore waters within the breeding range, except at the most northerly locations on the Atlantic coast (Shields 2002). Birds breeding in the eastern United States formerly wintered south of Cape Hatteras, but since 1980 some have wintered in Virginia and even in Maryland (*NAB*; Table 4), with isolated winter records north to Massachusetts. It is still very rare north and east of Cape Cod (Shields 2002; *NAB*).

Migration: Pacific coast birds move north from California to British Columbia from July–November, but Atlantic birds move north in small numbers only, reaching New Jersey in May–October (Shields 2002). The mean seasonal total at Avalon was 170; the highest daily count was 69 on 1 October (Table 7). Some birds from the northern part of the breeding range move south to Florida in November–December, returning in April–May (Shields 2002).

Species Limits: Pelecanus [occidentalis] thagus (Pacific coast of South America) is sometimes considered a separate species (Shields 2002).

Great Cormorant

Breeding: On cliffs, on the ground, or in trees; it is widespread in Europe, Asia, Africa, and Australasia, but in the Western Hemisphere it is limited to Greenland and the Atlantic coast from Newfoundland and Quebec south to Maine (Hatch et al. 2000). The total world population is estimated as 580,000 pairs (Sellers 2004);

about 5000 pairs nest in Greenland and about 6000 pairs in Atlantic Canada (*WPE*). It started nesting on the Atlantic coast of Nova Scotia about 1940 (Tufts 1986), and numbers increased during the 1970s (Milton and Austin-Smith 1983), but it has apparently not yet colonized the Bay of Fundy (Erskine 1992; Christie et al. 2004). It was first found nesting in Maine in 1983 and in Massachusetts in 1984 (Drury and Hatch 1985). Numbers in Maine peaked at 265 pairs by 1992, then declined steadily to 62 pairs in 2010 (J. Drury, pers. comm.). A single pair bred in southern Massachusetts in 1984–86, but not since (Hatch et al. 2000). A few single birds and groups ≤3 stay into summer months, even in the southern part of the wintering range (Clapp et al. 1982a; *NAB*).

Nonbreeding: Generally sedentary, but northern populations migrate south to ice-free waters (Hatch et al. 2000). In eastern US waters, it is a fairly common and increasing winter visitor to coastal waters of New England and New York (Hatch et al. 2000; Table 4). It was formerly scarce south of New Jersey; Clapp et al. (1982a) compiled only 30 records from North Carolina south to Florida. Since 1985, however, it has been wintering in small numbers (counts ≤10) in Virginia and North Carolina (*NAB*).

Migration: It is present in winter quarters from mid-September–mid-April, with largest numbers from late November–March (Hatch et al. 2000). The mean seasonal total at Avalon was 87; the highest daily count was 24 on 27 October.

Double-crested Cormorant

Breeding: Endemic to North America, where it breeds on cliffs, on the ground, or in trees; it is widespread both inland and coastally, from Alaska, the Prairie Provinces, and Newfoundland south to northwest Mexico, Florida, Bahamas, and Cuba (Hatch 1995, Hatch and Weseloh 1999). The total population in 1990 was 350,000 pairs, including 96,000 pairs on the Atlantic coast (Hatch 1995). Inland and Atlantic coast populations increased greatly from the 1960s to 1990 (Hatch and Weseloh 1999), but Wires and Cuthbert (2006) estimated slightly lower numbers in the late 1990s (300,000 pairs total, 87,000 pairs on the Atlantic coast). On the US east coast, it formerly bred in 2 discrete populations: on mostly rocky islands from Atlantic Canada south to New York, and on freshwater lakes or wooded coastal islands from Florida north to Virginia and North Carolina (see *Subspecies*). Since 1990, the gap in the breeding range has been closed by nesting in coastal Virginia, Maryland, and New Jersey, and on inland lakes in Maryland, New Jersey, and Massachusetts (Watts and Bradshaw 1998; Hatch and Weseloh 1999; *NAB*). The northern coastal population has increased rapidly since the 1960s (Drury 1973–74; Hatch 1984, 1995; Buckley and Buckley 1984; Andrews 1990; Hatch and Weseloh 1999), reaching 40,000 pairs in the United States in 1991–1992 (Hatch 1995). The 1994–95 census found similar numbers (Table 1), but with a marked decrease (from 28,000 to 18,000 pairs) in Maine and a marked increase (from 12,000 to 21,000 pairs) from New Hampshire to Virginia. Numbers in Maine may have started to decline in the late 1980s (Krohn et al. 1995), and have continued to decline since 1994–95 (GOMSWG annual reports; L. Welch, unpubl. data); those in

Massachusetts have declined since 1995 (S. Melvin, unpubl. data). Comparable census data are not available for the Bay of Fundy, but numbers there increased to 3000–4000 pairs in the 1990s (Milton and Austin-Smith 1983; Hatch 1995; Boyne and Beukens 2004; New Brunswick DNR, unpubl. data). Trends in the southern population are poorly documented because most colonies are on inland lakes. Reported numbers from North Carolina to Georgia increased from 190 pairs in 1990 (Hatch 1995) to 1100 pairs in 1993–96 (Wires and Cuthbert 2006); total numbers in Florida have declined markedly since 1970 (Runde 1991; Spendelow and Patton 1988; Wires and Cuthbert 2006), but current numbers for the east coast of Florida are not available.

Nonbreeding: Inland and east coast populations winter in large numbers in the southern United States, Mexico, Bahamas and Cuba (Hatch and Weseloh 1999). The main wintering area for east coast birds is along the coast and in inshore waters from Virginia south to Florida, with small but increasing numbers from Maryland to southern New England and a few north of Cape Cod (Table 4). Counts in the main wintering area have also been increasing: the highest count reported was 120,000 in North Carolina in 1988 (*NAB*).

Migration: Canadian and New England breeders migrate south in September–October, returning in March–April; there is a concentrated migration along the coast from New England south at least as far as Cape Hatteras. The mean seasonal total at Avalon was 190,000; the highest daily count was 24,000 on 21 October (Table 7).

Subspecies: Phalacrocorax a. auritus breeds over most of the species' range in interior and eastern North America except for the southeastern United States, where it is replaced by *P. a. floridanus*; other subspecies breed in other parts of North America and the Bahamas. *P. a. auritus* and *P. a. floridanus* were formerly separated by a gap between Virginia and New York, but this gap has been closed since 1990, probably by expansion of both subspecies (see *Breeding*). The two forms now probably overlap between Virginia and New Jersey (perhaps as far north as Massachusetts), with *P. a. auritus* breeding on coastal islands and *P. a. floridanus* on freshwater lakes. However, this habitat conjecture requires confirmation by identifying the subspecies of birds in both habitats within the putative zone of overlap.

Magnificent Frigatebird

Breeding: In mangroves and other trees and shrubs on tropical islands from western Mexico and the Galapagos through the southern Gulf of Mexico and Caribbean to the Florida Keys, Bahamas, and south to eastern Brazil (Diamond and Schreiber 2002); also in the Cape Verdes, but almost extirpated there (López Suárez et al. 2005). The world population has been estimated as 59,000–71,000 pairs, most of which breed in the eastern Pacific (Diamond and Schreiber 2002). Lindsey et al. (2000) estimated total numbers breeding in the Bahamas and eastern Caribbean (Dry Tortugas and Caymans east and south to Tobago) as 4500–5500 pairs, mostly in 5 large colonies; many colonies have been extirpated and the regional population was considered Threatened. However, Bradley and Norton (2009) estimated 6100 pairs in the same area.

Nonbreeding: Ranges very widely at sea, extending north to coastal California and North Carolina and south to Argentina (Diamond and Schreiber 2002). In eastern Florida, it is uncommon to common in summer and rare to fairly common in winter, with a record of 210 at Vero Beach in January (Stevenson and Anderson 1994; Table 4). Factors associated with northward dispersal within Florida were analyzed by McNair (2000a, b). North of Florida, it is less numerous but is an annual summer visitor in coastal and Gulf Stream waters north to North Carolina, mainly from April to August (Clapp et al. 1982a, Lee 1986; Dias 2007; Wallace and Wigh 2007; *NAB*). It is rare north of Cape Hatteras, usually occurring between May and October, but the frequency of records has increased in recent years to about 5 annually, with 15 records in 2005; it is occasionally transported farther north and even inland by hurricanes (Veit and Petersen 1993; Hanson 2005; *NAB*).

Red-necked Phalarope

Breeding: On the ground beside ponds and lakes in arctic and subarctic regions of North America and Eurasia (Rubega et al. 2000). There is no estimate of the world population: that in North America was estimated at 300,000–1,000,000 pairs (1–3 million individuals: Morrison et al. 2000a, b).

Nonbreeding: Winters at sea, mostly in upwelling zones in the tropical Pacific and Indian Oceans; few in the tropical Atlantic. Most North American birds winter in the eastern South Pacific from Ecuador to northern Chile, with very small numbers in the North Pacific from California to Mexico and off the southeastern United States (Rubega et al. 2000). Up to 400 per trip have recently been found in winter (November–March) off Florida and Georgia (Haney 1985b; Stevenson and Anderson 1994; Wallace and Wigh 2007; Table 6).

Migration: It migrates both offshore and overland; it stages on salt lakes in the southwestern United States and central Asia, and in the Bay of Fundy (Cramp and Simmons 1983). It is a spring and autumn passage migrant along the entire Atlantic coast from the Bay of Fundy to Florida. In August–September, extremely large numbers (≤20,000 km^{-2}, totaling ≤3 million) formerly staged in the southwestern Bay of Fundy, including Passamaquoddy Bay and neighboring US waters (Finch et al. 1978; Vickery 1978; Mercier and Gaskin 1985; Brown and Gaskin 1988; Duncan 1996). These large concentrations disappeared during the 1980s, but ≤100,000 have been seen in some years in the eastern Bay of Fundy (R.G.B. Brown 1991a; Duncan 1996; Rubega et al. 2000; S. Brown et al. 2005a, b). Prior to 1970 there were several records of ≤10,000 inshore in the southern Gulf of Maine in August–September (Veit and Petersen 1993). Only small numbers occur on Georges Bank and farther south down the Atlantic coast in autumn, mostly in August to early October (Rowlett 1980; Clapp et al. 1983; Lee 1986; Powers and Brown 1987; Table 2). On spring migration, moderate numbers occur in late April and May in shelf waters from Florida to western Georges Bank and the Gulf of Maine (Rowlett 1980; Clapp et al. 1983; Lee 1986; Powers and Brown 1987). The largest offshore concentration appears to be 900 off Maryland in May 1976 (Rowlett 1980), but there were several records of 1000–3000 inshore in Massachusetts prior to 1978 (Veit and Petersen 1993). Many thousands were driven inshore in the southern Gulf of Maine by storms in late May 2005, and >25,000 were seen at Mount Desert Rock on 24 May 2008 (*NAB*). It is virtually unknown in US waters between late October and late April, except off Florida and Georgia (see *Nonbreeding*).

Red Phalarope

Breeding: On coastal tundra in arctic North America and Eurasia (Tracy et al. 2002). There is no estimate of the world population; that in North America was estimated as 300,000–800,000 pairs (1.0–2.5 million individuals: Morrison et al. 2000a, b).

Nonbreeding: Winters at sea, mostly in upwelling zones off western South America and West and Southwest Africa; few in the Indian or western Pacific Oceans (Cramp and Simmons 1983); Tracy et al. 2002). The main wintering area for eastern Nearctic breeders is off West Africa (Cramp and Simmons 1983; Brown 1986; Tracy et al. 2002). Moderate numbers (hundreds to thousands) have recently been found in December–March near the shelf break from Florida to Maryland, including 10,000 seen from shore in North Carolina in February 1989 (Lee and Booth 1979; Rowlett 1980; Clapp et al. 1983; Haney 1985b; Lee 1987a; Wallace and Wigh 2007; Tables 5–6; *NAB*).

Migration: It migrates almost entirely over the open sea and is rare inland (Cramp and Simmons 1983; Tracy et al. 2002). In eastern US waters, it is a spring and autumn passage migrant along the entire continental shelf. It is one of the most abundant species on Georges Bank in May (Table 3) and is even more abundant (mean density >30 km^{-2}, peak 5,000 km^{-2}) in outer shelf waters of the Mid-Atlantic Bight in April (Rowlett 1980; Powers and Brown 1987). There are several records of large numbers inshore during May following severe storms—e.g., 12,000 off Montauk Point on 9 May 1969 (Levine 1998). It occurs in small numbers (one record of >1000) in April–May south to Cape Fear, and it is very scarce (<10 per trip) farther south (Clapp et al. 1983; Wallace and Wigh 2007; Table 6). In autumn, many stage in the eastern Bay of Fundy in August–September (Brown and Gaskin 1988), but very few occur on Georges Bank and farther south (Tables 4–6), suggesting that most take a northerly route across the Atlantic (Brown 1986). However, there are several records of thousands in the southern Gulf of Maine during October–December storms (Veit and Petersen 1993)—e.g., 25,000 off Cape Ann on 15 November 1957, and >10,000 in Cape Cod Bay on 12 December 1992 (Forster 1993). Otherwise, only stragglers occur north of Maryland after mid-November, but 200 were seen over Hudson Canyon on 7 December 2002 (*NAB*).

Black-legged Kittiwake

Breeding: On cliffs along arctic, subarctic, and temperate coasts of North America and Eurasia (but see *Subspecies and Species Limits*). The world population has been estimated as 4.3–5.2 million pairs, of which 220,000 pairs nest in eastern Canada and 100,000–200,000 pairs in Greenland (Heubeck 2004). North Atlantic birds have recently extended their range south to Portugal in the east and New Brunswick in the west (Cramp and Simmons 1983; Baird 1994). It was first recorded breeding in the Bay of Fundy in 1992 (25 nests on South Wolf Island: Kehoe 1994); this colony had spread to a second island and increased to over 100 nests by 1999 (Kehoe and Diamond 2001). Since 1978, varying numbers of first-summer birds have come ashore on Cape Cod during summer (maximum 630 in June 1980: Veit and Petersen 1993). Otherwise, it is very rare south of the breeding range in summer.

Nonbreeding: Winters at sea. North Atlantic birds disperse widely across the ocean, extending to 35° N and straggling farther south (Cramp and Simmons 1983; Baird 1994). In eastern US waters, it is an abundant winter visitor to the southern Gulf of Maine and Georges Bank, where densities exceed 30 km^{-2} (Powers and Brown 1987; Table 3). It is fairly common over shelf waters south to Maryland (Rowlett 1980; Powers and Brown 1987), regular but uncommon off North Carolina (Lee 1986, 1987a; Table 5), scarce off South Carolina, and very scarce off Georgia and Florida (Dias 2007; Wallace and Wigh 2007; Table 6). It is normally found ≥10 km offshore, but flocks of thousands are seen occasionally from shore in eastern Maine, Cape Cod, eastern Long Island, and elsewhere. The largest recent count was 25,000 off Lubec, Maine, in December 2001 (*NAB*), but 50,000 were seen off outer Cape Cod in November 1981 and 50,000–100,000 off Nantucket in December 1984, during a population boom of American Sand Lance (Veit and Petersen 1993).

Migration: It migrates almost entirely over the open ocean and is rarely seen migrating along the coast. It is present in offshore waters from mid-October–mid-April, with largest numbers from November–March (Powers and Brown 1987). The mean seasonal total at Avalon was 25; the highest daily count was 57 on 19 November (Table 7).

Subspecies and Species Limits: North Atlantic birds belong to *Rissa t. tridactyla*, North Pacific birds to *R. t. pollicaris*. Chardine (2002) suggested that these might represent different phylogenetic species, but this has not been supported by molecular genetic studies (Friesen et al. 2007a).

Ivory Gull

Breeding: On bare ground on low islands, mountains, or cliffs close to the ice edge in the Arctic from northeastern Canada east to northwestern Russia. The world population was estimated in 1996 as about 14,000 pairs, of which 10,000 pairs were in Russia, <1000 pairs in Greenland, and 1200 pairs in Canada (Mallory et al. 2008).

Numbers in Canada have declined rapidly since the 1970s (Gilchrist and Mallory 2005), but there is no evidence for a decline in Russia (M. Gavrilo, unpubl. data).

Nonbreeding: Winters along the ice edge from Labrador to Greenland and in the Bering, Chukchi, and Beaufort Seas (Mallory et al. 2008, Gilg et al. 2010). In the eastern United States, it is a very rare winter visitor. There were about 30 records prior to 1982, mostly of 1st-winter birds along the coast from New Brunswick to New Jersey. We found only 4 records between 1982 and 2006, but there were about 7 more records (mostly of adults) from New Hampshire to New Jersey in December–March 2007–10 (*NAB*).

Sabine's Gull

Breeding: On tundra in arctic North America and Eurasia (Day et al. 2001). There is no estimate of the world population, but that in North America has been estimated at 100,000–200,000 pairs (*WPE*).

Nonbreeding: At sea, in upwelling zones in the eastern Pacific and eastern Atlantic; those breeding in eastern Canada winter mainly off southwest Africa (Lambert 1973; Day et al. 2001). There have been 3 records in US waters in winter: in New York, New Jersey, and Florida (Stevenson and Anderson 1994; Day et al. 2001).

Migration: It migrates almost entirely over the open ocean and is rarely seen from shore. Pacific birds migrate in large numbers over the continental shelf from British Columbia to California (Day et al. 2001). Those from the eastern Canadian Arctic and Greenland migrate ESE across the North Atlantic to western Europe; they are thought to stage in the Bay of Biscay (Harrison 1983). In US coastal waters, it is a rare visitor, reported 10–20 times annually from the Bay of Fundy south to North Carolina (*NAB*); extremely rare in Georgia and Florida (Stevenson and Anderson 1994; Wallace and Wigh 2007). It is most frequent in August–October, far less frequent in spring when it has been recorded mainly around Cape Cod in late May (Veit and Petersen 1993; *NAB*). It is usually seen in ones and twos, but there are several records of 3–5 off Massachusetts (Veit and Petersen 1993; W. Petersen, pers. comm.).

Bonaparte's Gull

Breeding: Endemic to North America, where it nests in trees in the taiga zone from Alaska east to Quebec (Burger and Gochfeld 2002). The total North American breeding population has been estimated at 85,000–175,000 pairs, but even the high end of this range may be too low (Braune 1989; Burger and Gochfeld 2002). Nonbreeders occur in summer (May–July) along the coast from Virginia north; numbers are usually very small (<10), but 100–300 young birds in their 2nd calendar-year oversummer in northern Massachusetts (Veit and Petersen 1993), and there is one record of 200 in New York (Levine 1998).

Nonbreeding: Winters on the Great Lakes and on all coasts of North America south to central Mexico and Cuba; about 20% of the total winter on the Atlantic coast (Burger and Gochfeld 2002). Along the US east coast, it occurs from southern Maine to southern Florida, but is usually most numerous between Massachusetts and Virginia, where concentrations of several thousand can be seen in many favored locations, especially at inlets (Clapp et al. 1983; Table 4). High counts include 10,000 in New York and 7600 in Massachusetts (Veit and Petersen 1993; Levine 1998; *NAB*). Large numbers arrive in New York and southward in years when there is extensive freezing of the Great Lakes, where tens of thousands overwinter in milder years (Beardslee and Mitchell 1965; Levine 1998).

Migration: It migrates overland, often following major rivers (Burger and Gochfeld 2002). Eastern birds stage in the lower Great Lakes and the southwestern Bay of Fundy (including Passamaquoddy Bay and nearby waters), where ≥50,000 have been seen from late August to early December (Vickery 1978; Braune and Gaskin 1982; *NAB*). Large numbers remain in the southern Gulf of Maine and around Cape Cod into December, moving farther south in years with extensive freezing (Veit and Petersen 1993). The mean seasonal total at Avalon was 4800; the highest daily count was 2700 on 11 December (Table 7). Wintering birds depart in March and April; another predictable concentration is at Cape Hatteras, where up to 20,000 have been seen in March (*NAB*). Otherwise, large concentrations have not been reported north of the main wintering areas, and spring migration appears to be mainly overland.

Black-headed Gull

Breeding: On lakes and marshes across temperate Europe and Asia (Cramp and Simmons 1983); it is very local in eastern North America. Total numbers increased greatly during the 20th century, especially in Europe, and the world population is currently estimated as 2.1–2.8 million pairs (Dunn 2004); Iceland was colonized in 1911 and Greenland in 1969 (Cramp and Simmons 1983). It probably colonized North America in the 1930s (Erskine 1963), but this is poorly documented because there were few observers in the likely breeding areas. Most breeding records in North America have been from Quebec, Labrador, and Newfoundland (Montevecchi et al. 1987; Nikula 1993; Chaulk et al. 2004); total numbers are unknown but may be in the hundreds of pairs based on numbers seen in winter (see below). In the eastern United States, a pair nested in Massachusetts in 1984 (Holt et al. 1986), an unpaired female laid eggs in Maine in 1986 (Drennan et al. 1987), and 2 pairs nested in Maine in 1991 (Nikula 1993). It is rare in the United States in summer, but 1–3 are sometimes recorded from Maine south to New Jersey.

Nonbreeding: Winters in western Europe and south to north Africa, India, and Indochina (Cramp and Simmons 1983). It first appeared in North America in the 1930s (Erskine 1963) and became fairly numerous in winter in Atlantic Canada and New England during the 1950s (Erskine 1963; Cumming 1988; Nikula 1993; Veit and Petersen 1993); numbers wintering in Newfoundland have increased since the

1970s (B. Mactavish, pers. comm.). It is now a scarce but annual winter visitor to the coast from Nova Scotia south to New Jersey (Table 4). It formerly occurred in groups of 10–20 in certain harbors and urban areas, but now occurs more widely and more sparsely. It occurs in progressively smaller numbers from Delaware Bay south to Florida, except for a flock of 23 in North Carolina in 1988 (*NAB*). The largest concentrations in Massachusetts were recorded in the 1970s (Cumming 1988) and declined after discharges of raw sewage were eliminated; since a record of 21 in February 1992 all counts have been <6, and since 2001 most records have been of singles (*NAB*).

Migration: The main period of occurrence in US waters is from December to late April.

Little Gull

Breeding: On lakes and marshes across temperate Europe and Asia from The Netherlands to eastern Siberia (Cramp and Simmons 1983); it is very scarce and local in eastern North America (Ewins and Weseloh 1999). The total world population is not known, but 24,000–58,000 pairs breed in Europe; the North American population has been estimated as 50–100 pairs, based mainly on numbers seen in the Great Lakes on migration (*WPE*). It apparently colonized North America in the 1930s, but this is poorly documented because there were few observers in the likely breeding areas. It has been recorded breeding at scattered localities from the Great Lakes and southern Quebec north to Hudson Bay (Ewins and Weseloh 1999). Veit and Petersen (1993) reported possible breeding in coastal Massachusetts in 1980 (a juvenile begging from an adult) and 1982 (a territorial pair). First summer birds have been recorded in the winter quarters throughout the summer.

Nonbreeding: Winters at sea, mainly off western Europe and northwestern Africa; also in the Mediterranean, Black, and Caspian Seas (Cramp and Simmons 1983). In North America, it winters on the Great Lakes and along the Atlantic coast; very small numbers occur on the Pacific coast and Gulf of Mexico (Ewins and Weseloh 1999). On the US east coast, it is a very scarce winter visitor from Nova Scotia south to South Carolina, rare in Georgia and Florida. About 50 records are published annually in *NAB* (Ewins and Weseloh 1999), but this can be only a partial total. Groups of 5–15 have been seen sporadically from Massachusetts to North Carolina; the largest concentrations reported to date appear to be of 90+ off the outer banks of North Carolina on an unspecified date (Ewins and Weseloh 1999), and 46 in Virginia in February 1989 (*NAB*).

Migration: Many Eurasian birds migrate west to winter off the Atlantic coast (Cramp and Simmons 1983). North American birds stage in the Niagara region of the Great Lakes from late April–late May and mid-July–mid-November. On the US Atlantic coast, it is usually recorded from November–May (Ewins and Weseloh 1999).

Laughing Gull

Breeding: On islands and in saltmarshes along coasts of the southern and eastern United States, Bahamas, Mexico, around the Caribbean, and in French Guiana (Burger 1996; Howell and Dunn 2007; Bradley and Norton 2009). The world population has been estimated as 270,000 pairs (*WPE*; Burger 1996). On the US east coast, it breeds from Maine south to Florida and is the most abundant breeding seabird (Table 1). Numbers increased from 120,000 pairs in the 1977 and 1984–85 censuses (Table 2) to 135,000 pairs by 1988–91 (Belant and Dolbeer 1993a), and 160,000 pairs in 1994–95 (Table 1). Much of the recent increase appears to have taken place from New Jersey to Maine, where numbers increased from 31,000 pairs in 1977 to 62,000 pairs in 1984 (Andrews 1990), 68,000 pairs in 1989–91 (Belant and Dolbeer 1993a) and 92,000 pairs in 1994–95 (USGS database; Tables 1 and 2). From Long Island north, numbers of breeders increased from 300 pairs in 1971 (Nisbet 1971a) to 4300 pairs in 1984 (Andrews 1990), 7600 pairs in 1990 (*NAB*), and 9600 pairs in 1991 (Belant and Dolbeer 1993a), then declined to 7800 pairs in 1994–95 (USGS database) and 6100 pairs in 2004, but increased again to 8200 pairs in 2007 (GOMSWG annual reports; Washburn et al. 2006). The recent decline was localized to Long Island, probably because of the control program at J.F. Kennedy International Airport (Dolbeer et al. 2001; see **THREATS**). It has continued to increase in Massachusetts and Maine, reaching 6300 pairs in 2008 (GOMSWG annual reports). Numbers have also increased markedly in New Jersey, Delaware, and South Carolina (Belant and Dolbeer 1993a), but have remained more or less constant in Virginia (Belant and Dolbeer 1993a; Watts 2004), and have fluctuated in North Carolina (S. Cameron, pers. comm.). It apparently did not nest in Georgia until 1993, but numbered ≥900 pairs by 1995 (B. Winn, pers. comm.). In the Bay of Fundy, it has nested occasionally at Machias Seal Island (McAlpine et al. 2005; A.W. Diamond, pers. comm.).

Nonbreeding: Winters from the southern United States and northern Mexico south to northern South America (Burger 1996). On the US east coast, a few winter as far north as Virginia and even Long Island (Table 4), but the largest numbers are in Georgia and Florida (Southern 1980; Clapp et al. 1983; Table 4). From New Jersey to Florida, Laughing Gulls commonly feed inland in fields and at landfills, as well as at sea and along the shore (Clapp et al. 1983). Thousands of Laughing Gulls are occasionally transported north to Long Island and even Newfoundland by hurricanes in August–October (Tuck 1968; Mills 1969).

Migration: Birds that breed in Florida are resident, whereas northeastern birds are migratory, dispersing north and south along the coast in July–September before migrating south in September–November (Burger 1996). Banding data suggest that northeastern juveniles migrate to the Pacific coast of Central and South America, whereas adults migrate mainly to Florida (Southern 1980; Belant and Dolbeer 1993b). The mean seasonal total at Avalon was 17,000; the highest daily count was 6600 on 12 October (Table 7). Northbound migration takes place in March–April (Burger 1996).

Franklin's Gull

Breeding: Endemic to North America, where it breeds in freshwater marshes in the interior from Alberta east to Manitoba and south to Utah and Iowa (Burger and Gochfeld 2009). Estimates of total numbers have been progressively revised upwards as more complete information has been gathered; the most recent estimates are of 400,000 pairs in the United States (Burger and Gochfeld 2009) and 1.2 million pairs in Canada (W. Calvert, unpubl. data). Numbers at specific sites fluctuate according to the availability of nesting habitat; information on trends is conflicting (Burger and Gochfeld 2009).

Nonbreeding: Winters on the Pacific coast of South America in Peru and northern Chile (Burger and Gochfeld 2009). It wanders in very small numbers to the Atlantic coast, mainly from Massachusetts to Florida. It is rare in spring but is recorded more frequently in September–November; a few have overwintered, mostly in Florida (Clapp et al. 1983; Veit and Petersen 1993; Stevenson and Anderson 1994; Levine 1998; *NAB*). The frequency of reports has increased considerably since the 1960s, probably due in part to increased surveillance (e.g., Veit and Petersen 1993); numbers were largest in 1998 following a major storm in the Great Lakes, when at least 9 were found in Massachusetts, 40 were found at Cape May on 11 November (*NAB*), and 28 passed Avalon on 14 November. The mean seasonal total at Avalon was 4; the highest daily count was the above 28 (Table 7).

Common [Mew] Gull

Breeding: In a wide variety of habitats in boreal and subarctic regions of Eurasia and western North America (Cramp and Simmons 1983; Moskoff and Bevier 2002; but see *Subspecies and Species Limits*). There is no estimate of the world population; that in western North America is estimated as 80,000–120,000 pairs (*WPE*). The European population has increased (Cramp and Simmons 1983), but there is no information on trends in North America (Moskoff and Bevier 2002).

Nonbreeding: Winters from western Europe to the Caspian Sea and on both coasts of the North Pacific (Cramp and Simmons 1983); North American birds winter on the Pacific coast from southern Alaska to Baja California (Moskoff and Bevier 2002). It is a rare visitor in autumn and winter (September–April) to the northeast coast of the United States; most records have been from Massachusetts, where 3–4 now occur each year (Veit and Petersen 1993; *NAB*). Reported numbers have increased since the 1970s, due in part to increased surveillance but perhaps also to the species' recent colonization of Iceland (Cramp and Simmons 1983; Moskoff and Bevier 2002).

Subspecies and Species Limits: Nearly all records in our area have been of the European form (Common Gull, *Larus [c.] canus*), but a few birds of the western North American form (Mew Gull, *L. [c.] brachyrhynchus*) have also occurred during fall, and the east Asian form (Kamchatka Gull *L. [c.] kamtschatschensis*) has been reported in Rhode

Island and Massachusetts (Veit and Petersen 1993; Howell and Dunn 2007; Appendix 3). These taxa may represent several distinct species (Moskoff and Bevier 2002).

Ring-billed Gull

Breeding: Endemic to North America, where it breeds on islands in lakes and marshes in the interior, extending from British Columbia and the Great Lakes to the Gulf of St. Lawrence, New England, and Newfoundland (Ryder 1993). The total population was estimated as 850,000 pairs in 2002 (*WPE*), but that estimate was probably too low. The Great Lakes population increased by 8–11% per year during the 1970s, reaching 720,000 pairs in 1989–90, but declined to 590,000 pairs in 2007–09 (Blokpoel and Tessier 1986; Morris et al. 2011). On the Atlantic coast, the species formerly nested only in coastal Quebec and Newfoundland (Godfrey 1979), but started to nest in northern New Brunswick in 1965 and increased to >4000 pairs there by 2000 (Lock 1988; McAlpine et al. 2005). Several colonies on lower reaches of rivers in southern New Brunswick were mapped by Erskine (1992), but the first coastal breeding was at Manawagonish Island (2 nests in 2002, and 6 in 2004: McAlpine et al. 2005). Small, but increasing, numbers of adults are now summering in coastal New England, and 10 pairs nested inland in eastern Massachusetts in 1977 (but were eradicated: Petersen and Meservey 2004). The first nesting on the coast was a pair in Long Island Sound in Connecticut, in 2004 (S. Lewis, Connecticut Department of Environmental Protection, pers. comm.).

Nonbreeding: Winters on the Pacific coast south to southern Mexico and the Atlantic coast south to Florida; also on the Gulf coast south to northern Mexico and inland in the southern United States (Ryder 1993). It is an abundant winter visitor to the eastern United States, occurring both along the coast and inland near the coast. The main wintering area for those nesting in eastern North America is along the Atlantic coast from Connecticut south to Florida (Southern 1974, 1980; Table 4). Numbers increased enormously during the 20th century (see *Breeding*). CBC and aerial census data in the 1960s suggested that largest numbers wintered in New York–Pennsylvania and Virginia–North Carolina (Kadlec and Drury 1968; Clapp et al. 1983; Table 4). Banding recoveries, however, were concentrated farther south, perhaps because they were disproportionately comprised of first-winter birds: 60% were from Florida, of which 62% were on the Atlantic coast, with 10–20% each from Georgia–North Carolina and Virginia–Connecticut (Kadlec and Drury 1968; Southern 1974, 1980). Until the 1950s, Ring-billed Gulls were scarce transients in Massachusetts and in the Gulf of Maine (Griscom and Snyder 1955), but they have increased steadily and now occur in thousands in Massachusetts even in mid-winter (Forster 1990). Individuals may be encountered in any month of the year along the entire east coast from Florida north, with counts ≤1400 in Long Island and Massachusetts in summer months (Southern 1974, 1980; Veit and Petersen 1993).

Migration: The main periods of migration are October–November and March–April, but southbound movements are preceded by dispersal in August or even July (Southern 1980; Ryder 1993). The mean seasonal total at Avalon was 13,000; the highest daily count was 9100 on 10 December (Table 7).

California Gull

Breeding: Endemic to North America, where it breeds on islands in freshwater or saline lakes in the interior of western North America, from Northwest Territories south to Colorado and west to California. The total population is estimated at 140,000 to 280,000 pairs and probably increased during the 20th century (Winkler 1996).

Nonbreeding: Winters along the Pacific coast from British Columbia south to southern Mexico. It is a rare visitor to the Atlantic Coast during fall and winter, most frequent around Chesapeake Bay and the Outer Banks (Hoffman and Davis 1999; *NAB*). Reports have become more frequent in recent years (probably because of increased surveillance) and now number 1–5 annually (*NAB*).

Herring Gull

Breeding: In a wide variety of habitats in arctic and temperate regions of North America, northern Europe, and northeastern Asia (but see *Species Limits*). There is no estimate of the world population, but that in Europe is estimated as 760,000–1,400,000 pairs (*WPE*). Numbers increased enormously during the 20th century on both sides of the North Atlantic (Kadlec and Drury 1968; Cramp and Simmons 1983; Pierotti and Good 1994). In North America, it breeds along the Atlantic coast from Baffin Island south to North Carolina, and inland across Canada to western Alaska (Pierotti and Good 1994). The North American population has been estimated as 120,000 pairs (*WPE*) or 150,000 pairs (Malling Olsen and Larsson 2003), but those estimates must have been much too low, at least for the 1980s when there were more than 120,000 pairs on the Atlantic coast alone (Pierotti and Good 1994; A. Boyne, pers. comm.; see below). On the US east coast, it is an abundant resident from the Bay of Fundy south to North Carolina (Pierotti and Good 1994). It extended its range south to South Carolina in the 1960s (Post and Gauthreaux 1989), but no longer breeds there (Jodice et al. 2007). Kadlec and Drury (1968) and Drury (1973–74) traced the increase of the coastal breeding population in the United States from a few thousand pairs (all in Maine) in the 1890s to 90,000 pairs (Maine to North Carolina) in 1972. These and other data on numbers and trends of breeding populations are subject to substantial uncertainty because of incompatible census methods and discrepancies among estimates for the same colony sites, especially those with the largest numbers (Drury and Kadlec 1974; Hutchinson 1979; Cannell and Maddox 1983; Buckley and Buckley 1984; Hébert 1989; Andrews 1990; Schauffler 1998; Johnson and Krohn 2001; Nisbet 2001; Ronconi and Wong 2003; Boyne and Beukens 2004). In southwestern Nova Scotia, numbers apparently increased between 1971 and 1987, and then decreased again by

2002 (Boyne and Beukens 2004). At Kent Island, estimates of nesting pairs ranged from 12,000–30,000 between 1935 and 1949, 1400 in 1984 and 1987 (Hébert 1989), and 1000–5900 in 1998–2001 (Ronconi and Wong 2003). At this and other sites in New Brunswick, estimates by different observers diverged widely (Ronconi and Wong 2003; McAlpine et al. 2005). Along the coast from Maine to Virginia, successive censuses yielded totals of 91,000 pairs in 1977, 110,000 pairs in 1984–85, and 79,000 pairs in 1994–95 (Erwin and Korschgen 1979; Andrews 1990; USGS database; Table 2). The 1977 estimate was probably much too low, however, because of undercounts at several major colonies (R.R. Veit and I.C.T. Nisbet, unpubl. data). Surveys in Maine suggested a continuing increase, from 26,000 pairs in 1977 (Erwin and Korschgen 1979) and 28,000 pairs in 1984 (Andrews 1990) to 34,000 pairs in 1995–96 (Schauffler 1998), but these comparisons also are questionable because of differing census methods. Data from all other areas suggest declining numbers prior to 1995: in Nova Scotia since 1987 (Boyne and Beukens 2004), in New Brunswick since about 1949 (Ronconi and Wong 2003), in southern Maine since about 1970 (Borror and Holmes 1990; W.H. Drury, pers. comm.), in Massachusetts since 1980 (Blodget and Livingstone 1996; I.C.T. Nisbet, R.R. Veit, and S. Melvin, unpubl. data), on Long Island since the late 1970s (Buckley and Buckley 1980; NYSDEC), in Rhode Island, Connecticut, New Jersey, Delaware and Maryland since 1977 (Andrews 1990), and in Virginia since 1986 (Williams et al. 1990; Watts and Byrd 1998; Watts 2004). Numbers in North Carolina peaked at 880 pairs in 2001, then decreased to 660 pairs in 2004 (S.E. Cameron, pers. comm.). Pooling this information, the total population along the US east coast probably peaked before 1980 and has decreased by at least 50% since then. A recent census of colonies in Maine, New Hampshire, and Massachusetts indicated a 32% decline between 1995–96 and 2005–08 (L. Welch and S. Melvin, unpubl. data).

Nonbreeding: Winters coastwise and inland from the breeding range south to southern Mexico, the Caribbean, southwestern Europe, and southeast Asia (Cramp and Simmons 1983; Pierotti and Good 1994; but see *Species Limits*). Along the US east coast, it winters in large numbers from the Bay of Fundy to south Florida (Pierotti and Good 1994). In an aerial survey of this entire coast in January 1965, Kadlec and Drury (1968) counted >500,000 birds, including 16,000 in Florida (east and west coasts not separated). More than half of these (270,000) were in Connecticut, New York, and New Jersey. CBC data (Kadlec and Drury 1968; Clapp et al. 1983; Table 4) show a similar distribution, except for large concentrations around inland cities not covered by Kadlec and Drury's survey. In the period 1977–83, it also occurred widely in offshore waters in winter, concentrating around fishing fleets on the outer continental shelf of the Mid-Atlantic Bight and in the southern Gulf of Maine, where densities exceeded 100 km^{-2}. It was much less numerous on Georges Bank (Powers and Brown 1987; Table 3). Powers (1983) estimated 1 million Herring Gulls offshore from the Gulf of Maine to Cape Hatteras in fall, but this number appears unlikely in view of data on breeding populations (see above). There is no information about distribution or numbers offshore since the reduction of fishing activity in the 1980s and 1990s (see **THREATS**).

Migration: This species is a partial migrant (Cramp and Simmons 1983; Pierotti and Good 1996). On the US east coast, juveniles migrate long distances (up to 2400 km); adults are largely sedentary; birds in their 2nd and 3rd calendar-years migrate intermediate distances (Southern 1980). In Kadlec and Drury's (1968) midwinter survey, adults were concentrated in metropolitan areas with major landfills and at fish ports (Portland, Gloucester, Boston, New Bedford, Norfolk, etc.); 1st-winter birds were concentrated in the same areas as adults (45% in Connecticut, New York, and New Jersey), but otherwise occurred farther south, with largest numbers in Virginia, North Carolina, and Florida. Comparison with earlier banding data indicated that 1st-winter birds had wintered farther south in the 1920s and 1930s (Drury and Nisbet 1972). The distribution of birds in their 3rd and 4th calendar-years was intermediate between that of 1st-winter birds and adults (Kadlec and Drury 1968). The main periods of migration for 1st- and 2nd-winter Herring Gulls are October–November and March–April; less than 3% of recoveries in June–July were south of the breeding range (Southern 1980). The mean seasonal total at Avalon was 9100; the highest daily count was 8300 on 5 November (Table 7).

Species Limits: Taxa in the "Herring Gull" complex have been rearranged many times. American Herring Gull *L. [argentatus] smithsonianus* has recently been separated from Yellow-legged Gull *L. michahellis* (southern Europe from Azores to western Mediterranean), *L. cachinnans* (eastern Europe and eastern Mediterranean), and *L. armenicus* (inland Turkey to central Asia). AOU (2008) treated American Herring Gull as conspecific with European Herring Gull *L. [argentatus] argentatus* (northern Europe) and *L. [argentatus] vegae* (northeast Asia), but others treat these as 2 or 3 species (Sangster et al. 2007; see Appendix 3).

Thayer's Gull

Breeding: Endemic to North America, where it breeds on cliffs on islands in the Canadian Arctic Archipelago, south to the northern edge of Hudson Bay (but see *Species Limits*). A rough estimate of the total breeding population is 6300 pairs (Snell 2002); there is no information on trends.

Nonbreeding: Winters mainly on the Pacific Coast of North America from British Columbia south to Baja California; it is regular in very small numbers in the western Great Lakes, but is rare elsewhere in interior and eastern North America (Snell 2002; Howell and Dunn 2007). Thayer's Gulls are reported in very small numbers along the Atlantic Coast south to Florida in winter. In recent years, 5–10 have been reported annually, most between New Jersey and North Carolina; 4 were reported in Massachusetts in 2009 (Table 4; Hanson 2005; *NAB*). Most records have been from November–March. Reported numbers have increased in recent years as field characters have become better known (Howell and Dunn 2007), but it remains difficult to separate from the *kumlieni* race of Iceland Gull; some individuals (perhaps hybrids) appear intermediate and thus some records have been disputed (Snell 2002; Howell and Dunn 2007).

Species Limits: Thayer's Gull has been treated as a subspecies of either Herring Gull or Iceland Gull (AOU 1998); it is uncertain if, where, and how frequently it interbreeds with *kumlieni* Iceland Gulls, so the status of intermediate-appearing birds is uncertain (Snell 2002; Howell and Dunn 2007).

Iceland Gull

Breeding: On cliffs in Greenland and in the eastern Canadian Arctic Archipelago (see *Subspecies*). A rough estimate of the total population is 45,000 pairs (Snell 2002); there is no information on trends.

Nonbreeding: Winters in ice-free areas within the breeding range (polynyas) and south to the northeastern United States and northwestern Europe. Most southbound migrants are immature birds but ages have not been reported precisely (Snell 2002). Along the US east coast, it is a winter visitor in small numbers. It is most numerous in the Bay of Fundy and Gulf of Maine (south to Nantucket), where single-day counts range up to 150 (Veit and Petersen 1993; Table 4), but it also occurs widely at sea on Georges Bank and south to 40° N (Powers 1983; Powers and Brown 1987; Table 3). It occurs sparsely along the coast south to Florida (singles, mainly at landfills), but is rare south of Cape Hatteras (Table 4).

Migration: It is most frequent in all areas along the US east coast from November–May, and very rare in summer (June–August).

Subspecies: There are two subspecies: *Larus g. glaucoides* (Greenland) and *L. g. kumlieni* (eastern Arctic Canada). Most or all birds reaching US waters are *kumlieni*; a few resemble nominate *glaucoides* (which usually migrates to Iceland and northwest Europe and is regular in Newfoundland), but their identity is often uncertain because of overlap in characters (Snell 2002; Howell and Dunn 2007). See above for separation from Thayer's Gull.

Lesser Black-backed Gull

Breeding: In a wide variety of habitats in temperate areas of Europe, including Iceland, in Greenland, and in arctic Russia (Cramp and Simmons 1983). The total world population has been estimated as 270,000–320,000 pairs (Calladine 2004); numbers increased during the 20th century and the breeding range was extended southwest to Portugal (1970s) and northwest to Iceland (1920s: Cramp and Simmons 1983) and Greenland (1990: Boertmann 2008). The population breeding in southwest Greenland increased rapidly to 700 pairs by 2003 (Boertmann 2008), but is unlikely to have been the main source of the wintering birds in eastern North America, because the latter began to increase in the 1970s, before the first record of nesting in Greenland (see below). It seems more likely that the species is nesting somewhere in North America, but it was not found doing so until 2007–2009, when one bred with a

Herring Gull at the Isles of Shoals (Ellis et al. 2008; J. Ellis, pers. comm.); hybrids were seen associating with pure adults in Labrador in summer 2008 (*NAB*).

Nonbreeding: Formerly a long-distance migrant, wintering in southern Europe and Africa; it is now wintering in increasing numbers in northwest Europe (Cramp and Simmons 1983). On the US east coast, it occurs along the entire coast in small but rapidly increasing numbers. It was first recorded in North America in 1934 and was regarded as very rare until the mid-1970s, when it began to increase rapidly (Post and Lewis 1995). It is now recorded regularly along the coast from Massachusetts south to Florida (*NAB*), and is increasing through the Lesser Antilles south to the Guianas (Buckley et al. 2009). Recent high counts have included up to 180 on Nantucket in November–March, 300–400 in the Philadelphia area in November–January and March–April, 500 in Virginia in February, 52 in Georgia in February, and 300–500 in eastern Florida in November–February (*NAB*). Most records in the eastern United States have been from October–May, but a few remain into the summer months.

Migration: European birds migrate over extended periods in August–November and February–April (Cramp and Simmons 1983; Rock 2002). In North America, the dates cited above indicate that the species is developing a regular migration along the Atlantic coast, migrating south in November and north in March, but many also overwinter as far north as Pennsylvania and Massachusetts (*NAB*). The bird that nested in New Hampshire and its hybrid offspring were seen in Florida in winter 2009–10 (J. Ellis, pers. comm.; *NAB*). The mean seasonal total at Avalon was 4; the highest daily count was 5 on 12 October (Table 7).

Subspecies: There are three subspecies: *Larus f. fuscus* (north Norway and Sweden to arctic Russia), *L. f. intermedius* (The Netherlands to south Norway), and *L. f. graellsii* (western Europe from Iceland and British Isles to Portugal: Cramp and Simmons 1983). Most North American records have been of *L. f. graellsii*, but some appear to have been *L. f. intermedius* based on photographs (Post and Lewis 1995).

Glaucous Gull

Breeding: In a variety of habitats on coasts and islands in arctic and subarctic North America and Eurasia, south to western Alaska, Labrador, southern Greenland, and Iceland (Cramp and Simmons 1983; Gilchrist 2001). The total world population is not known, but 45,000–120,000 pairs breed in arctic Europe and western Siberia (*WPE*), and ≥70,000 pairs in the eastern Canadian Arctic (Gilchrist 2001); there is no information on trends.

Nonbreeding: Winters from the southern part of the breeding range south to the British Isles, Japan, British Columbia, and northeast United States; most birds reaching the southern part of the winter range are immatures in their 2nd and 3rd calendar-years (Cramp and Simmons 1983; Gilchrist 2001). On the US east coast, it is a scarce winter visitor to the northern half of the area. It is widely dispersed on Georges

Bank and in the Gulf of Maine (Powers and Brown 1987; Table 3). Along the coast, it is most numerous from Nova Scotia to New Jersey, where single-day counts range up to 15 (Veit and Petersen 1993; Table 4). A few occur south to Cape Hatteras, but it is scarce farther south; Stevenson and Anderson (1994) listed 60 records for Florida.

Migration: Most records in US waters have been from late November to early May; scattered individuals may oversummer.

Great Black-backed Gull

Breeding: On coasts and islands on both sides of the North Atlantic, from Greenland and Labrador south to North Carolina in the west and from northern Russia south to France in the east. The total population has been estimated as 170,000–180,000 pairs, of which 100,000–110,000 pairs breed in Europe, 3000–7000 pairs in Greenland, and 61,000 pairs in North America (Good 1998; BirdLife International 2004; Reid 2004; *WPE*). Numbers increased enormously on both sides of the Atlantic during the 20th century and the range expanded both to the south and to the north (Cramp and Simmons 1983; Good 1998). On the US east coast, it is an abundant breeder from the Bay of Fundy south to Long Island, less numerous in New Jersey and scarce south to North Carolina (USGS database; Table 1). This species was formerly confined to Atlantic Canada; it bred in the Bay of Fundy until about 1880 (Squires 1952) and inland in southwestern Nova Scotia since at least the 1940s (Tufts 1986). It started nesting again in the Bay of Fundy in 1930 (Squires 1952), and spread south to Maine in 1926, Massachusetts in 1931 (Veit and Peterson 1993), Long Island in 1942 (Levine 1998), New Jersey in 1966 (Walsh et al. 1999), Virginia and North Carolina in 1970 (Good 1998). Total numbers breeding in the United States increased rapidly to 12,000 pairs in 1972 (Drury 1973–74), 20,000 pairs in 1977 (Erwin and Korschgen 1979), 31,000 pairs in 1984 (Andrews 1990), and 35,000 pairs in 1994–96 (23,000 pairs in Maine based on aerial surveys by Schauffler [1998], plus 12,000 pairs to the south based on the USGS database). These and other data on numbers and trends of breeding populations are subject to substantial uncertainty because of incompatible census methods and discrepancies among estimates for the same colony sites, especially those with the largest numbers (see discussion in Herring Gull account). In Nova Scotia, numbers appear to have increased between 1971 and 1987, and then probably decreased again (by 20%) by 2001 (Boyne and Beukens 2004). From New Brunswick south, numbers apparently continued to increase between 1984 and 1995 (Table 2; USGS database; Schauffler 1998; Ronconi and Wong 2003), except in New York where they declined steadily from a peak of 10,000 pairs in 1988 to 1900 pairs in 2007 (NYSDEC 2002, 2008). A recent census of colonies in Maine, New Hampshire, and Massachusetts indicated a 36% decline between 1995–96 and 2005–08 (L. Welch and S. Melvin, unpubl. data). There is little numerical information from other areas, except for Virginia, where numbers increased from 360 pairs in 1993 to 720 pairs in 2003 (Watts and Byrd 1998; Watts 2004), and for North Carolina, where numbers peaked at 200 pairs in 1999, declining to 180 pairs in 2004 (S.E. Cameron, pers. comm.). Pooling this information, Great Black-backed Gulls appear to have reached a peak at some time during the 1990s and are now decreasing again.

Nonbreeding: Partial migrant, wintering south to Cape Hatteras in the west and Portugal in the east; it also disperses into offshore waters (Good 1998). On the US east coast, it winters along the coast and offshore from the Bay of Fundy south to Florida. It is most abundant in urban areas and fishing ports and around fishing fleets offshore (Powers and Brown 1987). In the period 1977–83, highest densities (>100 km^{-2}) were recorded in the southern Gulf of Maine, on the eastern edge of Georges Bank, and on the shelf edge of the Mid-Atlantic Bight (Powers and Brown 1987). It is also numerous on the coast south to northern North Carolina, but becomes abruptly scarce south of Cape Hatteras (Clapp et al. 1983; Table 4), although there are several counts of 140–170 in east Florida (Stevenson and Anderson 1994). There is no information about distribution or numbers offshore since the reduction of fishing activity in the 1980s and 1990s (see **THREATS**).

Migration: On the US east coast, adults are largely sedentary or disperse offshore, whereas most juveniles migrate south up to 2400 km, a few reaching south Florida; birds in their 2nd and 3rd calendar-years migrate intermediate distances (Southern 1980). The mean distance between banding and recovery sites reached a maximum of 580 km for recoveries in February, vs. 160 km for recoveries during the breeding season (Southern 1980). Dispersal and migration take place mainly in September–November and March–April (Good 1998). The mean seasonal total at Avalon was 900; the highest daily count was 500 on 13 November (Table 7). It is rare south of its breeding range in May–August (Southern 1980; Clapp et al. 1983).

Brown Noddy

Breeding: Widely distributed on islands throughout tropical oceans, except the eastern North Atlantic (Chardine and Morris 1996). In the western North Atlantic, it breeds in the southern Gulf of Mexico, Caribbean, and Bahamas. The total number breeding in the West Indies (including Bahamas) was estimated as 24,000 pairs in 1984 (van Halewyn and Norton 1984), and was thought to have declined to 12,000–18,000 pairs by 2000 (Chardine et al. 2000a), but Bradley and Norton (2009) reported 42,000 pairs in 2007.

Nonbreeding: Disperses into tropical waters, usually within 100 km of breeding colonies; there is no specific information on nonbreeding distribution in the western North Atlantic (Chardine and Morris 1996). In eastern US waters, it is a summer visitor in small but variable numbers, occurring from June–October in the Gulf Stream from Florida north at least to North Carolina (Clapp et al. 1983). Unlike Sooty and Bridled Terns, Brown Noddies are infrequently transported by hurricanes, a major exception being Hurricane *David* in September 1979, after which 84 were seen on Florida's east coast, with fewer north to Cape Hatteras and ≤8 in New Jersey (Fussell and Allen-Grimes 1980; Hanson 2005; *NAB*). Post et al. (2004), Dias (2007), and Wallace and Wigh (2007) compiled 13 additional records for North Carolina, 14 for South Carolina, and 9 for Georgia; 6 were seen together off Georgia in September 2008 (*NAB*). Wallace and Wigh (2007) recently found the species uncommon (mean

2 per trip in June–August) east of the Gulf Stream off central Florida. Small numbers (≤5) occurred north to Virginia following hurricanes in 2003 and 2006 (*NAB*), and there are scattered records north to Massachusetts (Veit and Petersen 1993).

Sooty Tern

Breeding: On islands throughout the tropical oceans, including the Caribbean and the Bahamas. This is the most abundant tropical seabird; total numbers are estimated as 30–40 million pairs (Schreiber et al. 2002). Numbers breeding in the 'Greater Caribbean' (including the southern Gulf of Mexico and the Bahamas) are estimated as 250,000–450,000 pairs, mostly from the Dry Tortugas and Jamaica east to the Virgin Islands; information on trends is scanty, but there is no evidence for major changes (Saliva 2000a; Schreiber et al. 2002; Bradley and Norton 2009). In the eastern United States, it is a marginal breeder. A few are sometimes present in summer at Cape Hatteras, and 1–2 pairs have attempted to nest there in recent decades, usually without success (Clapp et al. 1983; *NAB*); the most recent nesting that we are aware of was in the early 2000s (P.A. Buckley, pers. comm.). There are scattered records of attempted breeding at other sites in North and South Carolina (McNair and Post 1993; Schreiber et al. 2002).

Nonbreeding: Disperses widely in tropical oceans (Schreiber et al. 2002). In the eastern United States, nonbreeders occur regularly from May–September in small to moderate numbers in the Gulf Stream from Florida north at least to North Carolina (Clapp et al. 1983; Lee 1986; Table 5). Wallace and Wigh (2007) recently found them common to abundant (mean 700 per trip in June–August) east of the Gulf Stream off central Florida. It is usually rare north and east of Cape Hatteras (although observations in Gulf Stream waters are scanty), but large numbers sometimes occur following hurricanes—e.g., Hurricane *David* in September 1979, when hundreds were found onshore and inland from North Carolina to Nova Scotia (Powers 1983; Clapp et al. 1983; Veit and Petersen 1993; *NAB*). It is rare or absent from eastern US waters from November–March.

Migration: Based mainly on banding recoveries from Dry Tortugas, adults from Caribbean colonies are thought to move west to the western Gulf of Mexico and the Caribbean, whereas juveniles move east to winter in the Intertropical Convergence Zone from northern Brazil to West Africa (Robertson 1969; Schreiber et al. 2002). Migration starts in June and continues at least through August (Schreiber et al. 2002).

Bridled Tern

Breeding: On islands throughout tropical and subtropical oceans, including the eastern Caribbean and the Bahamas; a few pairs in the Florida Keys. There is no estimate of the total world population. Total numbers in the eastern Caribbean and Bahamas have been estimated as 4000–6000 pairs (Chardine et al. 2000b), or 8400 pairs (Bradley and Norton 2009; but see below). In recent years, singles have been seen in June–July at several Common Tern colonies from Connecticut to Maine (*NAB*; J.A. Spendelow, pers. comm.), but there have been no breeding attempts.

Nonbreeding: Winters largely at sea; it is apparently scarce in the Caribbean from September–March (Haney et al. 1999). In the eastern United States, it occurs year-round in the Gulf Stream from Florida north at least to Virginia, most frequently in August and September when it is fairly common off Cape Hatteras (Clapp et al. 1983; Lee 1986; Dias 2007; Wallace and Wigh 2007; Table 5). Recent high counts include 111 off Cape Hatteras on 7 August 1999 and 128 off Virginia on 7 September 2002 (*NAB*); there were records of 600–900 off east Florida in the 1960s (Clapp et al. 1983; Stevenson and Anderson 1994). Haney et al. (1999) reported Bridled Terns as present at all seasons over continental shelf waters off the southeastern United States (28°–35° N), with estimates of total numbers largest at 30,000 in autumn and smallest at 3500 in winter. These numbers exceed those known to breed in the entire Caribbean area (Bradley and Norton 2009), a paradox that remains to be resolved. It is considered rare north of Virginia (Rowlett 1980), but it may be more frequent over Gulf Stream waters farther to the northeast than the few records suggest (P.A. Buckley, pers. comm.); 1–3 have been seen on 3 of 17 recent trips southeast of Cape Cod (S. Mirick, unpubl. data). It is often transported by hurricanes and then occurs inshore and even inland north to Massachusetts and Maine, though it is much less numerous than Sooty Tern (Veit and Petersen 1993; *NAB*).

Least Tern

Breeding: Endemic to North America (see *Species Limits*), where it breeds on beaches on both coasts of North America, and on islands in inland rivers, south through Central America and the Caribbean to islands off Venezuela. Total numbers have been estimated at about 30,000 pairs, mostly on the Atlantic and Gulf coasts (Thompson et al. 1997), but these estimates are uncertain because of its scattered breeding distribution on mainland beaches and rooftops, and its frequent movements among sites. Numbers in the interior and in California have increased under intensive management (Thompson et al. 1997). In the eastern United States, it is a fairly common breeder on mainland beaches from Maine to Florida. Numbers listed in Table 1 are composites from the USGS database and from Thompson et al. (1997), but discrepancies between these sources suggest that both were substantially incomplete for certain states. The Atlantic coast population was enhanced by the building of dredge spoil islands along the Intracoastal Waterway during the 1930s, and probably reached its maximum about 1940, when there were thought to be 12,000 pairs in North Carolina alone (Pearson et al. 1942). It then declined until about 1972 (Nisbet 1973), but recorded numbers increased to 12,000 pairs in 1977 and have continued to increase, at least from North Carolina northward (Kress et al. 1983; Buckley and Buckley 1984; Andrews 1990; Downer and Liebelt 1990; NYSDEC; *NAB*). It has recently colonized southern Maine (Nisbet 1973; Andrews 1990). Many nest on gravel roofs near the coast in Florida (at least 33 sites recorded) and locally in other states (Fisk 1975, 1978; Clapp et al. 1983; Gore and Kinnison 1991; Thompson et al. 1997); roof-nesting inland was first reported by Lohr and Ryan (2002). There are no recent census data for eastern Florida; the estimate included in Table 1 is derived from Spendelow and Patton (1988) and refers to 1976.

Nonbreeding: Winters along the Pacific and Atlantic coasts from southern Mexico and Venezuela south to Peru and Brazil; birds that breed in eastern North America apparently winter on the east coast of South America (Thompson et al. 1997; AOU 1998). It is very rare in the eastern United States in winter (Lee 1987a).

Migration: It is present at breeding sites south of Cape Hatteras from late March–early October (Clapp et al. 1983), and north of Cape Hatteras from early May–early September (Veit and Petersen 1993). Most or all have departed by mid-October. Migration is poorly documented: staging flocks up to 500 have been recorded on Cape Cod in August (Veit and Petersen 1993), but not farther south along the Atlantic coast (Clapp et al. 1983).

Species Limits: Least Tern forms a superspecies with six closely similar species worldwide (Thompson et al. 1997; AOU 1998).

Gull-billed Tern

Breeding: On coasts, estuaries, marshes and lakes; it is patchily distributed in temperate and subtropical regions of North America, South America, northwest Africa, Eurasia, and Australia (Cramp 1985; Parnell et al. 1995). The total world population is unknown but includes at least 50,000 pairs in Europe and western Asia (*WPE*), and 4300–5700 pairs in North America (Chardine et al. 2000b; Molina and Erwin 2006). In the eastern United States, it is a scarce and local breeder. There is little information on numbers prior to the 1970s (Parnell et al. 1995). It appears to have declined rapidly during the 1970s and 1980s (Via and Duffy 1992; Molina and Erwin 2006), although Buckley and Buckley (1984) cast doubt on the higher estimates reported in the past. Numbers in eastern Florida declined from 540 pairs in 1975 (Clapp et al. 1983) to 3–6 pairs from 1980–2000 (Smith and Alvear 1997; Molina and Erwin 2006). Numbers in North Carolina declined from 620 pairs in 1977 (Molina and Erwin 2006) to 220 pairs in 1983 (Clapp and Buckley 1984) and 170 pairs in 1985, but increased to 250 pairs in 1995 and to 260 pairs in 2001 (Molina and Erwin 2006). Reported numbers in Virginia apparently increased to a peak around 1975–76, when numbers were variously reported as about 2000 pairs (M. Erwin *in* Kress et al. 1983) and 800–900 pairs (Erwin and Korschgen 1979). They then declined to fewer than 1000 pairs in 1980–82 (M. Erwin *in* Kress et al. 1983), 410 pairs in 1985 (Andrews 1990), 250 pairs in 1988 (Williams et al. 1990), and 240 pairs in 1994 (USGS database; Table 1), but increased to 300 pairs in 1998 and 2003 (Molina and Erwin 2006; Molina et al. 2010). This species colonized New Jersey in 1926 and again in 1956 (Walsh et al. 1999); 30 pairs nested in 1995 (USGS database) and 92 in 2001 (Molina and Erwin 2006). It colonized New York in 1975 (Buckley et al. 1975) and now nests regularly (11 pairs in 2003 and 4 pairs in 2008: NYSDEC 2004, 2009). A pair was seen courting at Plum Island, Massachusetts, in June 2008 (S. Grinley, pers. comm.). Parnell et al. (1995) concluded that the species was "probably stable overall" in most parts of the United States, but the data cited above suggest that numbers declined from a maximum in the 1970s to a minimum around 1990 and have increased again since that date. However, all the numbers cited above may be too low because the species regularly breeds in saltmarshes that may be incompletely covered in censuses (F.G. Buckley 1979; P.A. Buckley, pers. comm.).

Nonbreeding: Winters mainly in the tropics (Cramp 1985, Parnell et al. 1995). North American birds winter mainly in South America (Parnell et al. 1995), but also in small numbers around the Gulf coast from southwestern Florida to southeastern Mexico, where CBCs have recorded up to 200 (Molina and Erwin 2006). It is rare in winter on the US Atlantic coast, where only a few singles have been recorded on CBCs, but it has been recorded north to North Carolina (Clapp et al. 1983; Parnell et al. 1995).

Migration: It is present at breeding sites from April–August, but there is virtually no information on staging or migration (Clapp et al. 1983; Parnell et al. 1995). Small numbers (≤14) occur in New York and Massachusetts after hurricanes (Veit and Petersen 1993; Levine 1998; *NAB*), and it has been recorded as far north as Newfoundland (P.A. Buckley, pers. comm.).

Caspian Tern

Breeding: In a wide variety of coastal and inland habitats; its distribution is disjunct in temperate regions of North America, southern Africa, Eurasia, and Australasia; locally in the tropics. The total world population is unknown but exceeds 100,000 pairs (*WPE*). The North American population was estimated as about 33,000 pairs during the 1990s and had increased in all parts of the range except perhaps on the Atlantic coast (Cuthbert and Wires 1999). On the Atlantic coast, numbers were estimated as about 140 pairs in 1995–97, mostly in Labrador and Newfoundland, where an apparent increase since 1986 has been offset by near-extirpation from the Gulf of St Lawrence (Cuthbert and Wires 1999; A. Boyne, pers. comm.). On the US east coast, it is a marginal breeder, with fewer than 50 pairs in 9 shifting sites between New Jersey and South Carolina (Tables 1 and 2). Available data suggest that numbers in this area are slowly increasing (Tables 1 and 2; Cuthbert and Wires 1999); New Jersey was colonized in the early 1980s (Burger and Gochfeld 1985), but held only 4 pairs at 3 sites in 1994 (USGS database). It formerly nested in eastern Florida (Spendelow and Patton 1988) but apparently no longer does so, although it still breeds elsewhere in the state (Pranty 1997). Nonbreeders are rare in summer (June–July) away from breeding sites.

Nonbreeding: Temperate populations are migratory, wintering both coastally and inland (Cramp 1985). North American breeders winter from the southern United States to South America (Cuthbert and Wires 1999). On the US east coast, it winters in small but probably increasing numbers from southern North Carolina to south Florida (Table 4). Most wintering birds are from the Great Lakes population (L'Arrivée and Blokpoel 1988), which has increased considerably since 1963 and now probably numbers over 8000 pairs (Ludwig 1979; Kress et al. 1983; Blokpoel and Scharf 1991; Ewins et al. 1994).

Migration: It is present at breeding sites from April–August (Cuthbert and Wires 1999). In addition to east coast breeders, many that breed in the Great Lakes migrate along the coast from Delaware south to Florida; most movements are in August–early October and April–May (L'Arrivée and Blokpoel 1988; Cuthbert and Wires 1999). There is little numerical information on these migrants, but numbers have probably increased following the increase in numbers breeding on the Great Lakes (Cuthbert and Wires 1999). North of Delaware Bay this species is an uncommon but regular migrant, mostly in April–May and September; recent high counts include 5 in New York (Levine 1998), 20 in Massachusetts (*NAB*), and 48 in New Hampshire (S. Mirick, pers. comm.). The mean seasonal total at Avalon was 28; the highest daily count was 25 on 24 September (Table 7). Small numbers are sometimes transported north by hurricanes; 400 were counted on Long Island following Hurricane *Donna* in September 1960 (Bull 1985).

Black Tern

Breeding: In freshwater marshes in temperate North America, Europe and western Asia. The total world population has been estimated as 200,000–600,000 pairs, of which 50,000–250,000 pairs breed in North America (*WPE*), but these estimates are conjectural because breeders are scattered among large numbers of freshwater marshes that are poorly surveyed. In eastern North America, Black Tern is primarily an inland breeder, most numerous in the Canadian Prairie Provinces, but extending east through the Great Lakes region to northern Vermont, eastern Maine, and eastern New Brunswick (Dunn and Agro 1995). Numbers apparently declined throughout North America in the 1960s and 1970s (Tate and Tate 1982), and fewer than 400 pairs were found in the northeastern United States (New York to Maine) in 1991 (Novak 1992; Muller et al. 1992). However, recent data from Maine and New Brunswick suggest that numbers may have stabilized (GOMSWG annual reports; L. Bernard, pers. comm.). A report of nesting at Cape May in 1984 (Novak 1992) was erroneous (B. Boyle, pers. comm.). In several years since 1995, 1–2 pairs (sometimes unmated single birds) have nested on 3 islands in the Gulf of Maine and 1 in the Bay of Fundy; eggs were laid in at least 5 cases and a chick hatched in at least 1 case, but no chicks were raised to fledging (S. Hall, L. Welch, and C.M. Devlin, pers. comm.). Very small numbers of nonbreeders (mostly birds in their 2nd calendar-year: recent counts ≤5) occur at coastal tern colonies during summer (late May–July).

Nonbreeding: Winters almost exclusively at sea, mostly off Central and South America and West Africa (Cramp 1985; Dunn and Agro 1995). North American birds winter off Central and South America, with especially large numbers on the Pacific coast from Panama to Ecuador (Dunn and Agro 1995). It is very rare or absent from the United States in winter (November–March: Clapp et al. 1983; Table 4).

Migration: Black Terns are common to abundant southbound migrants along the Atlantic coast from North Carolina south, fairly common from Massachusetts to New Jersey, and scarce in the Gulf of Maine and Bay of Fundy. They occur in large numbers in coastal and inshore waters in autumn (July–October), but are less common along the coast in spring (mid-April–May), especially north of Virginia where most counts are ≤10; they are more often seen inland on spring migration. Although little systematic information on numbers is available, they appear to have become much less numerous since the 1960s. Prior to 1970, they were sometimes seen in thousands in North Carolina and Florida, and in hundreds on Long Island and in Massachusetts; there were no recent records of comparable numbers until the late 1990s. Numbers may have increased again since then: recent high counts include 340 at Montauk Point in September 1998, 400 at South Beach in September 1998, and 350 there in September 2008 (Clapp et al. 1983; Veit and Petersen 1993; *NAB*; B. Nikula, pers. comm.).

Roseate Tern

Breeding: Scattered on islands in the tropical western Pacific, Indian, and western North Atlantic Oceans; also in temperate waters in Japan, Western Australia, South Africa, northwestern Europe, and northeastern North America (Gochfeld et al. 1998; Nisbet and Ratcliffe 2008). The total world population is unknown but probably exceeds 100,000 pairs (Newton 2004; Nisbet and Ratcliffe 2008). On the US east coast, Roseate Tern is a very local summer resident, nesting exclusively in association with Common Terns. Most breed in a small area from eastern Long Island to Cape Cod, with a few small colonies in New Hampshire (in the 1930s and since 1999), Maine, and Nova Scotia. It formerly bred in Virginia, Maryland, and New Jersey, but no longer does so (Nisbet 1980a; Gochfeld et al. 1998). This regional population reached a peak of 8500 pairs in the 1930s, declined to a low of 2500 pairs in 1978–79, then increased steadily to 3500 pairs in 1994–95 and 4900 pairs in 2000, but declined again to 3300 pairs in 2008–09 (Nisbet and Spendelow 1999; Spendelow et al. 2008; Northeast Roseate Tern Recovery Team, unpubl. data). In 1994, 21 colony sites were occupied, but 80% of the population nested on only 2 islands in New York and Massachusetts; in 2008, 17 sites were occupied, but 85% of the population nested on 3 islands (Spendelow et al. 2008; Northeast Roseate Tern Recovery Team, unpubl.). This population was listed as endangered in 1987 because of the concentration of its breeding population into a few sites (US Fish and Wildlife Service 1989). Roseate Terns also have a discrete breeding population (estimated as 4000–6000 pairs) in the Bahamas and Caribbean, including the Florida Keys (Saliva 2000b; Bradley and Norton 2009); 6 pairs (reported as Common Terns but probably this species) nested on a rooftop at Pompano Beach, southeast Florida, in 1969 (McGowan 1969; Fisk 1978; Stevenson and Anderson 1994). They are rare away from breeding sites in summer (June–mid-July).

Nonbreeding: Temperate populations winter in tropical waters; wintering areas of tropical populations are not known (Ratcliffe et al. 2004; Nisbet and Ratcliffe 2008). Roseate Terns from both the northeastern and Caribbean populations winter in South America, mainly on the east coast of Brazil (Nisbet 1984a; Hays et al. 1999). A few singles have been reported in winter in southwestern Florida (Stevenson and Anderson 1994), but not on the US east coast except for 3 reports off east Florida (Table 6).

Migration: Roseate Terns are present at northeastern breeding sites from May–September and at Caribbean sites from April–October (Gochfeld et al. 1998). Northeastern birds disperse throughout the breeding area in July–August, and then concentrate into a major staging area on Cape Cod in late August–September (Nisbet 1984a; Trull et al. 1999; Jedrey et al. 2010; J. Spendelow, B. Harris, and E. Jedrey, unpubl. data). They migrate directly SSE across the western North Atlantic to and from the West Indies, and are very rare on the North American coast south of their breeding area in autumn, but very small numbers (usually 1–2 birds) occur from South Carolina to New Jersey in May (Clapp et al. 1983; Gochfeld et al. 1998; *NAB*). Those seen in eastern Florida in April–June and September (Clapp et al. 1983; Stevenson and Anderson 1994; Wallace and Wigh 2007) may be migrants or stragglers from the breeding population in the Bahamas.

Common Tern

Breeding: On islands, beaches, and in marshes across temperate and subarctic Eurasia and North America; isolated tropical populations breed in the Caribbean and West Africa (Nisbet 2002a). The total world population is in the range 500,000–900,000 pairs (Ratcliffe 2004a), including 270,000–570,000 pairs in Europe (Becker and Ludwigs 2004; BirdLife International 2004; *WPE*) and ≥150,000 pairs in North America (Nisbet 2002a). North American birds breed on the Atlantic coast from Labrador south to South Carolina, and inland across Canada and the northern United States to the Rocky Mountains, with small isolated populations in Louisiana (probably extirpated), Bermuda, and the Netherlands Lesser Antilles; breeding records in the eastern Caribbean and Bahamas have been questioned and require confirmation (Nisbet 2002a, Lee 2009). On the US east coast, it is a very common coastal breeder from the Bay of Fundy south to South Carolina. Historical data were reviewed by Nisbet (1973, 2002a), Drury (1973–74) and Erwin and Korschgen (1979). The total population in the area covered in this publication increased to a peak of 50,000 pairs in the 1930s, declined to 30,000 pairs in 1972, and increased again to 45,000 pairs in 1984 (Kress et al. 1983; Andrews 1990; Kress and Hall 2004; Table 2). The increase continued through the 1980s, 1990s, and early 2000s, at least from Long Island to the Bay of Fundy (Tables 1 and 2; NYSDEC; GOMSWG; C. Mostello, unpubl. data), but may have stopped or reversed south of Long Island; the total population is now about 60,000 pairs (Nisbet 2002a; I.C.T. Nisbet, unpubl. data). Numbers in North Carolina declined from 2100 pairs in 1993 to 570 pairs in 2004 (Parnell et al. 1995, 1997; S. Cameron, pers. comm.); only 16 pairs now nest in South Carolina (F. Sanders, pers. comm.). Over most of their coastal range (New Hampshire to North Carolina), Common Terns commonly nest in saltmarshes as well as on islands and beaches (F. G. Buckley 1978, 1979; Buckley and Buckley 1980, 2000; Burger and Gochfeld 1991); the saltmarsh segment of the population may have been overlooked prior to the 1970s and may still be under-counted today (P.A. Buckley, pers. comm.); see also **THREATS**. Nonbreeders are fairly common throughout the breeding range in summer (June–early July).

Nonbreeding: Winters mainly along coasts. Most populations are long-distance migrants, wintering mainly in the tropics or south temperate zones, but also in smaller numbers in the southern United States and southwestern Europe (Nisbet 2002a; Becker and Ludwigs 2004). On the US east coast, small numbers winter in Florida, with stragglers occurring north to North Carolina (Clapp et al. 1983; Table 4); these are mainly 1st-winter birds from the Great Lakes (Haymes and Blokpoel 1978; Nisbet 2002a).

Migration: It is present in the breeding areas from late April to mid-October, with stragglers into November and even December; spring transients continue passing in May–June. Migrants are common along the Atlantic coast south to Florida in April–May and September–October, and continue passing through Florida in November (Clapp et al. 1983; Stevenson and Anderson 1994). Migrants along the coast from Cape Hatteras north are mainly breeders from the northeastern United States and Atlantic Canada, whereas migrants south of Cape Hatteras are mainly breeders from the Great Lakes (Haymes and Blokpoel 1978; Nisbet 2002a). The mean seasonal total at Avalon was 880; the highest daily count was 2400 on 25 September (Table 7).

Arctic Tern

Breeding: Holarctic: on tundra throughout arctic and subarctic Eurasia and North America; also on islands on both sides of the temperate North Atlantic, extending south to France and northeastern United States (Hatch 2002). The total world population has been estimated as 1–2 million pairs (Hatch 2002; *WPE*), but this must be too low in view of estimates of 500,000–900,000 pairs in Europe (*WPE*), and 300,000–900,000 pairs in Alaska (Lensink 1984); even the maximum of 2.7 million pairs suggested by Ratcliffe (2004b) is probably too low. On the US east coast, it is a locally common summer resident on offshore islands in the Bay of Fundy and Gulf of Maine, extending south in very small numbers to New Hampshire and Massachusetts (Hatch 2002). Historical data were summarized by Nisbet (1973), Drury (1973–74), and Hatch (2002). Numbers breeding in the Gulf of Maine and Bay of Fundy peaked at 8000 pairs in 1931 and 1945, and were probably still about 8000 pairs in 1972 (Drury 1973–74), including 4500 pairs on Machias Seal Island, the major colony from 1932–72 (Squires 1952; MacKinnon and Smith 1985; S. Hall, pers. comm.). They declined to <4000 pairs by 1984 (GOMSWG 1995; Kirkham 1986), but then increased to 5400 pairs in 1995 and to 6000 pairs in 2002–03 (GOMSWG 1995, 2004; A. Boyne, pers. comm.), declining again in 2005–10 after the Machias Seal colony was broken up by gull predation (A.W. Diamond, pers. comm.). However, the accuracy and comparability of all these counts are uncertain owing to difficulty in separating species in mixed Common/Arctic Tern colonies (S. Kress, S. Hall and J.G.T. Anderson, pers. comm.). In Massachusetts, numbers peaked at 300–400 pairs in the 1950s, declining by 2010 to 5 individuals—2 pairs north of Cape Cod, and a single bird that hybridized with a Common Tern at Penikese Island, the southernmost limit of the species (Nisbet 1973; C.S. Mostello, pers. comm.). Nonbreeders are rare away from breeding sites in summer (June–July), but ≤5 have been seen on Long Island in several recent years (Levine 1998; S. Mitra, pers. comm.). Birds in their 2nd calendar-year (in so-called *"portlandica"* plumage) occur in June–July from Long Island and Cape Cod north to the Bay of Fundy; numbers fluctuate from year to year, but sometimes run into hundreds (maximum: 600 on Cape Cod in June 1975: Veit and Petersen 1993; I.C.T. Nisbet, unpubl. data; S. Mitra and P.A. Buckley, pers. comms.).

Nonbreeding: Arctic Terns from all breeding areas winter mainly in the Antarctic, except that many birds in their 1st and 2nd calendar-years winter off southwest Africa and western South America. They are very rare or absent from the United States in winter (November–March: Hatch 2002).

Migration: Arctic Terns' globe-spanning migrations were reviewed most recently by Hatch (2002); new tracking data were reported by Egevang et al. (2010). They are present at United States breeding sites from late May–early August, when they depart eastward, probably staging in the Bay of Fundy before crossing the Atlantic to western Europe or West Africa (Hatch 2002). They are very rare south of their breeding range in autumn and were formerly rare onshore in spring, but small numbers occur offshore and occasionally onshore from Florida north to Long Island in April–early June (Rowlett 1980; Lee 1986; Powers and Brown 1987; Levine 1998; Walsh et al. 1999; Hanson 2005; Dias 2007; Wallace and Wigh 2007; Table 5; *NAB*).

Forster's Tern

Breeding: Endemic to North America, where it breeds widely in freshwater marshes in the interior of North America from Baja California and Alberta east to the central Great Lakes, and in saltmarshes on the southern Atlantic and Gulf coasts (McNicholl et al. 2001). Total numbers were estimated as 42,000 pairs by McNicholl et al. (2001), but as only about 25,000 pairs by Kushlan et al. (2002); overall trends are uncertain, but it has increased considerably in California (McNicholl et al. 2001) and on the Atlantic coast. On the US east coast, it is a locally common saltmarsh breeder from South Carolina to Long Island. Reported numbers have been increasing very rapidly: from 0 before 1971 to 1400 pairs in 1977 in North Carolina (Clapp et al. 1983), declining to 1100 pairs in 1995 (USGS database); and from 2100 pairs in 1977 to 5000 pairs in 1985 and to 7200 pairs in 1994–95 in the area from Virginia to New Jersey (Andrews 1990; Table 1). However, some of the apparent increases during the 1970s may have resulted from improved coverage of their saltmarsh habitat (Clapp and Buckley 1984). It was first recorded nesting in South Carolina in 1987 and continues to do so in small numbers (Wilkinson and Marsh 1988; Wilkinson 1997). Single pairs nested in New York in 1981, 1984, and 1989 (Downer and Liebelt 1990), after which the species became established (Riepe 1994), reaching 485 pairs by 2004, but declining again to 300 pairs in 2007 (NYSDEC 1994–2009). In Massachusetts, a pair nested at Plum Island in 1991 (Veit and Petersen 1993); earlier records were erroneous (Nisbet 2002b).

Nonbreeding: Winters mostly in the southern United States and Mexico, rarely in the West Indies (McNicholl et al. 2001). On the US east coast, Forster's Terns winter commonly from North Carolina south to Florida, with some counts of 3000–8000 (Clapp et al. 1983; McNair and Post 1993; I.C.T. Nisbet, unpubl. data; Table 4). Tens or hundreds are recorded on CBCs in Virginia, Maryland, and Delaware (Table 4), most leave by mid-January (McNicholl et al. 2001). Stragglers remain into mid-January from New Jersey north to Massachusetts.

Migration: It is present at east coast breeding sites from April–August; spring migration continues into May in Florida, probably involving birds breeding in the interior (McNicholl et al. 2001). Autumn migration is mainly from August–October, but continues through November on Long Island and in New England, with some flocks >200 in Massachusetts (Veit and Petersen 1993). The mean seasonal total at Avalon was 5800; the highest daily count was 3300 on 5 November (Table 7).

Royal Tern

Breeding: On low-lying islands in the southern United States, around the Caribbean and in French Guiana, with isolated breeding populations in West Africa and southeastern South America (but see *Subspecies and Species Limits*). The total world population is >150,000 pairs, including 67,000 pairs on the Atlantic and Gulf coasts of North America, 10,000 pairs in the Sea of Cortez (Buckley and Buckley 2002), and 75,000 pairs in West Africa (*WPE*). On the US east coast, it is a locally abundant breeder; 39,000 pairs were counted in censuses in the early 1980s, mostly in 12 large colonies from southern Virginia to central Florida (Buckley and Buckley 1984; Clapp and Buckley 1984). Trends are difficult to discern because of large fluctuations in numbers at individual sites as entire colonies routinely move from site to site, especially when disturbed (Buckley and Buckley 2002). The following interpretation of trends along the US east coast differs from those of other reviewers (Buckley and Buckley 2002; MANEM Waterbird Working Group 2006; Emslie et al. 2009). Numbers apparently declined from 1973, when Parnell and Soots (1978) reported 35,000 pairs in North Carolina alone, to 1994–95, when there were only about 32,000 pairs from Maryland to Georgia, including only 14,000 pairs in North Carolina (USGS database; Emslie et al. 2009). Spendelow and Patton (1988) reported 6800 pairs in east Florida in 1976, but Clapp and Buckley (1984) knew of only about 1000 pairs in the entire state in 1983. Data compiled by Emslie et al. (2009) indicate that the population from Maryland to Georgia has stabilized, with nest counts indicating a decline of less than 2% from 1994–95 to 2004. The species recently colonized New Jersey and 150–200 pairs bred at Hereford Inlet in 2008 (Fritz 2008; R.O. Paxton, pers. comm.; *NAB*); others have been seen prospecting at potential nesting sites on Long Island (Buckley and Buckley 1984), and a few are seen in summer at tern colonies in Massachusetts (Veit and Petersen 1993).

Nonbreeding: Temperate populations are migratory, but tropical populations disperse; breeding and winter ranges overlap widely. North American birds winter from the southern United States to northern South America (Buckley and Buckley 2002). Banding data indicate that birds breeding on the US east coast winter mainly from

Florida south through the Greater Antilles to northwestern South America (Van Velzen and Benedict 1972a, b; J.S. Weske *in* Clapp et al. 1983). Small numbers occur in winter from North Carolina south to Florida, with stragglers north to New Jersey (Table 4).

Migration: Royal Terns are present at east coast breeding sites from April–August; they disperse after breeding in July–August, some birds moving north of the breeding range (Buckley and Buckley 2002). Migration takes place mainly in October and March, with counts up to 8800 in east Florida (Clapp et al. 1983). In recent years, numbers reaching Long Island and Rhode Island in July–September have been increasing, with at least 150 on Long Island in September 2006 (*NAB*). The mean seasonal total at Avalon was 970; the highest daily count was 1500 on 18 October (Table 7). Hundreds have been seen in Long Island and tens in Massachusetts after hurricanes (Levine 1998; Veit and Petersen 1993).

Subspecies and Species Limits: Two subspecies are usually recognized: *Thalasseus m. maximus* in North America and southeastern South America, and *T. m. albididorsalis* in West Africa, but these allopatric populations may represent 2 or even 3 species (Buckley and Buckley 2002).

Sandwich [Cabot's] Tern

Breeding: On islands on temperate coasts of Europe, extending east to the Caspian Sea, and on temperate and tropical coasts of North and South America (Shealer 1999, but see *Subspecies and Species Limits*). The world population was estimated at 150,000 pairs by Shealer (1999) and 160,000–170,000 pairs by Ratcliffe (2004c), but *WPE* gave larger estimates (180,000–220,000 pairs); the US population was estimated at 47,000 pairs (Shealer 1999). In the eastern United States, it is a very local breeding species, nesting exclusively with Royal Terns. The 1976 census recorded 880 pairs on the east coast from Virginia south, two-thirds of which were on a single island in North Carolina (Portnoy et al. 1981). However, Emslie et al. (2009) reported at least 1200 pairs in North Carolina in 1977. Numbers had increased considerably by 1993, when there were 5200 pairs in North and South Carolina alone. Since then numbers in those 2 states have stabilized at 4000–4500 pairs (Jodice et al. 2007; Emslie et al. 2009; S. Cameron, pers. comm.), but numbers have increased in Georgia (to 610 pairs in 1999: B. Winn, pers. comm.), and in Virginia (to >320 pairs in 2005: Emslie et al. 2009). Hence, numbers appear to have been stable since about 1993. Single pairs bred in Maryland in 1976 and 1994 (Emslie et al. 2009). In recent years, a few Sandwich Terns have appeared in early summer at potential breeding sites in New Jersey and on Long Island (Buckley and Buckley 1984; Walsh et al. 1999), and one pair nested in the new Royal Tern colony in New Jersey in 2008 (R.O. Paxton, pers. comm.).

Nonbreeding: Temperate populations are migratory, wintering mainly in the tropics; North American birds winter mainly in the Caribbean and in South America (Cramp 1985; Shealer 1999). Small numbers winter in Florida (Stevenson and Anderson 1994; Table 4).

Migration: It is present at breeding sites from April–August. Migration takes place mainly in April and August–October, with small numbers remaining into November as far north as North Carolina (Shealer 1999). Comparatively few disperse north of the breeding area after breeding; they are rare north of Virginia except following hurricanes (Veit and Petersen 1993), but are increasing in frequency in New York (now annual in numbers up to 5) and Massachusetts (*NAB*). The mean seasonal total at Avalon was 2; the highest daily count was 8 on 25 September (Table 7).

Subspecies and Species Limits: Birds breeding in North America (*Thalasseus [sandvicensis] acuflavidus*) are currently (AOU 1998, 2008) treated as conspecific with those breeding in Europe and Asia (*T. s. sandvicensis*); those breeding in South America (Cayenne Tern *T. [s.] eurygnatha*) are sometimes treated as a separate species, but *acuflavidus* and *eurygnatha* co-occur in several Caribbean colonies and appear to interbreed at some of these sites (Norton 1984; Shealer 1999; Bradley and Norton 2009). Recent genetic evidence suggests that *acuflavidus* and *sandvicensis* are genetically distinct and should be treated as separate species, while *acuflavidus* and *eurygnatha* are very closely related and may not merit separation even as subspecies (Efe et al. 2009). If these suggestions are accepted, the specific name of Western Hemisphere birds would become Cabot's Tern. See Appendix 3.

Black Skimmer

Breeding: On islands on all coasts of North, Central, and South America south to Argentina; also on rivers in northern South America (Gochfeld and Burger 1994). The total world population is not known, but most appear to breed on the Atlantic and Gulf coasts of the United States, where numbers are estimated as 32,000–35,000 pairs (*WPE*). On the US coast, it is a locally common breeder from Florida north to Massachusetts. Numbers appear to have been stable until about 1985 (Clapp et al. 1983; Buckley and Buckley 1984; Clapp and Buckley 1984; Andrews 1990; Burger and Gochfeld 1990; Williams et al. 1990; Gochfeld and Burger 1994; Table 1). The USGS database suggests a decline in the area from Virginia north by 1995 (Table 2), but this is questionable because Watts and Byrd (1998) had reported many more in Virginia in 1993. Since 1995, reported numbers have declined in North Carolina (820 pairs in 1995, 620 pairs in 2004: S. Cameron, pers. comm.), South Carolina (1000 pairs in 1994–1995, 680 pairs in 1996: Wilkinson 1997), and Virginia (2500 pairs in 1993, 1700 pairs in 2003: Watts 2004), but have remained stable on Long Island (600 pairs in 1995, 620 pairs in 2008: NYSDEC), and have increased in New Jersey (1100 pairs in 1995, 1400 pairs in 2003: USGS database; *NAB*). Although there have been no synchronized censuses since 1995, these data suggest that the total population in the area has declined slowly since 1993. Since 1980, the species has spread north and now breeds regularly in Massachusetts (≤7 pairs: Blodget and Livingstone 1996; C.S. Mostello, pers. comm.).

Nonbreeding: North American birds migrate short distances and winter from North Carolina south, but are numerous only in Georgia and Florida; only very small numbers remain north of Cape Fear after mid-December (Clapp et al. 1983; Gochfeld and Burger 1994; Table 4).

Migration: Breeders are present at northern colony sites from March or April to October, sometimes remaining until mid-December (maximum >1100 on Long Island: Gochfeld and Burger 1994). Migration takes place from March–May and September–October, with large concentrations (≤10,000) in southeastern North Carolina in October–November (Clapp et al. 1983; Gochfeld and Burger 1994). The mean seasonal total at Avalon was 170; maximum 120 on 7 October (Table 7). Black Skimmers are routinely transported in the hundreds by hurricanes in September–October north to Long Island, Massachusetts, and even to Atlantic Canada (Squires 1952; Tuck 1968; Mills 1969; Tufts 1986; Veit and Petersen 1993; *NAB*). Unlike southern terns, these hurricane-transported birds usually remain for long periods (into late October and November) before returning south (Veit and Petersen 1993).

Pomarine Jaeger

Breeding: Holarctic: on tundra around the Arctic Ocean and in the Canadian Arctic archipelago (Furness 1987). No information is available on total numbers or trends.

Nonbreeding: Winters mainly in the tropical Atlantic and Pacific Oceans. The main winter quarters of western Atlantic birds are in the Caribbean and Gulf of Mexico (Furness 1987; Wiley and Lee 2000). In US east coastal waters, a few linger into late December or early January from Georges Bank to Florida (Rowlett 1980; Lee 1986, 1987a; Tables 2 and 4), and throughout the winter (November–March) off central Florida (Stevenson and Anderson 1994; Wallace and Wigh 2007; Table 6).

Migration: It migrates along the entire US east coast, but is usually seen farther at sea than Parasitic Jaeger. Autumn migrants are most numerous in September–October on Georges Bank (Powers and Brown 1987), in October off North Carolina (Lee 1986), and in October–November off eastern Florida (Stevenson and Anderson 1994; *NAB*). At times large numbers are seen inshore during storms—e.g., >1100 in Cape Cod Bay in late October 1991 (Veit and Petersen 1993). Largest numbers have been seen passing south off Cape Canaveral—e.g., 4600 in late autumn 1991 and 2200 on 9 November 1992 (Stevenson and Anderson 1994). However, the mean seasonal total at Avalon was only 2, with highest counts 2 on 11 dates (Table 7), confirming its usual scarcity close to shore. Northbound passage is mainly in April–May; small numbers (daily counts usually ≤3) occur throughout the summer as far south as North Carolina.

Parasitic Jaeger

Breeding: Holarctic: on tundra and islands in arctic and subarctic regions of North America and Eurasia (Furness 1987). The world population has been estimated as 85,000–340,000 pairs (Furness and Ratcliffe 2004a), but little information is available on numbers or trends in North America (Wiley and Lee 1999).

Nonbreeding: Winters mainly in temperate seas in the Southern Hemisphere (Furness 1987). The main western Atlantic winter quarters are off southern South America (Furness 1987); most or all winter reports from the Sargasso Sea, Gulf of Mexico, and Caribbean probably involve misidentified Pomarine Jaegers. However, stragglers remain off the coast from North Carolina south until the end of December (Table 4), with a few midwinter records off eastern Florida (Stevenson and Anderson 1994; Wallace and Wigh 2007; Table 6).

Migration: This species is an uncommon spring and autumn migrant to shelf waters along the entire Atlantic coast. It is generally seen closer to the coast and more frequently from shore in nonstorm conditions than Pomarine Jaeger, especially north of Cape Hatteras. Southbound migration is mainly in September–October (Brown 1986, Lee 1986). The mean seasonal total at Avalon was 160; the highest daily count was 36 on 4 November (Table 7). However, 1600 passed Cape Canaveral in autumn 1991 (Stevenson and Anderson 1994). Small numbers (daily counts usually ≤3) remain off Maryland and North Carolina into early December (Rowlett 1980, Lee 1986). Northbound migration occurs in April–May; small numbers (daily counts usually ≤2) of nonbreeders remain in summer in waters off New England.

Long-tailed Jaeger

Breeding: Holarctic: on sea-level and alpine tundra around the Arctic Ocean and in the Canadian Arctic Archipelago (Furness 1987; Wiley and Lee 1998). Furness (1987) suggested that the world population was in the low hundreds of thousands of pairs. There is no information on numbers or trends in North America, but numbers of breeders fluctuate markedly according to the lemming cycle (Wiley and Lee 1998).

Nonbreeding: Winters in the temperate South Atlantic and South Pacific Oceans (Furness 1987). Western Hemisphere breeders winter off southern South America and southwest Africa (Veit 1985; Furness 1987; Wiley and Lee 1998).

Migration: It migrates mainly in midocean (Furness 1987), but sporadic records inland suggest long overland migrations as well (Wiley and Lee 1998). It is a regular but very scarce annual migrant along the US Atlantic coast, usually encountered far offshore. It is rare on Georges Bank, mainly in August–September and May–June (Table 2). It is usually rare around Cape Cod, but ≤5 together were seen on Stellwagen Bank and even onshore in August–September 2008 and in May and August–October 2009, with 7 on Nantucket Shoals in September 2009 (B. Nikula and J. Hoye, pers. comm.;

NAB). It is annual (<3 per day) at the shelf break but extremely infrequent inshore south of New England, but it has been seen in every month from April to December off North Carolina, mainly on the outer continental shelf and the western edge of the Gulf Stream. It is considered a regular and "rather common" migrant off Cape Hatteras (Lee 1986, 1989), with ≤11 per day in late May and ≤7 in August–October (Table 5; *NAB*). It is virtually unknown from US waters between December and March; records off eastern Florida (Stevenson and Anderson 1994; Table 6) need confirmation.

Great Skua

Breeding: On islands in the eastern North Atlantic from Iceland east to northwestern Russia and south to Ireland, migrating south and west to the Equator and the Caribbean (Furness 1987). The world population has been estimated as 16,000 pairs, of which 60% breed in Scotland and 34% in Iceland (Furness and Ratcliffe 2004b). The Scottish population increased enormously during the 20th century, whereas the Icelandic population has probably not changed greatly (Furness and Ratcliffe 2004b).

Nonbreeding: Winters over wide areas of the temperate and tropical North Atlantic; birds in their 3rd calendar-year (2 years old) also disperse north into Arctic waters in summer (Furness 1987). The area from the Grand Banks southwest to Georges Bank is an important wintering area for adults from Iceland, and for subadults (2–3 years old) from Scottish colonies; subadults also winter in the tropics from the eastern Caribbean to West Africa (Furness 1987). In the eastern United States, Great Skua is an uncommon visitor to Georges Bank from October–March, with occasional individuals seen throughout the year (Table 3). South and west of Georges Bank, its status is poorly documented because of difficulty in distinguishing it from South Polar Skua (see next species) and a paucity of far-offshore trips, especially in winter, but ≤6 have been seen south of Martha's Vineyard and ≤9 off Cape Hatteras in winter (Veit and Petersen 1993, Table 5). Winter records off Maryland, Virginia, and South Carolina (Rowlett 1980; Wallace and Wigh 2007; *NAB*) probably involve this species. It is rarely seen close to land, but ≤12 skuas (probably mainly this species) have been seen from shore on Cape Cod during storms in October–December (Veit and Petersen 1993; B. Nikula, pers. comm.).

Migration: Most records in US waters are from October–March. There is no evidence of coastwise migration, except for 2 adults passing Cape Hatteras 31 May and 2 June 1970 (Buckley 1973). Birds wintering in the Caribbean are thought to migrate north through the western North Atlantic (Furness 1987).

South Polar Skua

Breeding: Around the Antarctic continent and on islands off the Antarctic Peninsula. Furness (1987) estimated the total population as several thousand pairs, possibly as many as 10,000 pairs.

Nonbreeding: Birds reported as "immatures" (ages not specified) winter in the North Pacific and North Atlantic Oceans, extending north as far as Greenland; it is not clear whether adults migrate similarly or remain in Antarctic waters (Furness 1987). First recognized in eastern US waters in 1977 (Veit 1978), this species is now known to be a scarce summer visitor to outer shelf waters from Florida to Georges Bank and the Bay of Fundy (Rowlett 1980; Lee 1986, 1989; Furness 1987; Powers and Brown 1987; Stevenson and Anderson 1994; Dias 2007; Wallace and Wigh 2007; *NAB*; Tables 3 and 5); 47 were seen off Cape Hatteras in May–June 2009, including at least 30 on 20 May (*NAB*). It is occasionally seen inshore from the Gulf of Maine to Long Island, typically during or following storms (*NAB*).

Migration: All firm occurrences in US waters have been from mid-April to October, although some might occur at other times and be misidentified as Great Skuas.

Hybridization: Three similar species of skua breed in Antarctic or subantarctic waters, and at least one (Brown Skua) sometimes hybridizes with South Polar Skua (Furness 1987), causing potential problems of identification. To date, there is no evidence that any of these species or hybrids migrate to the Northern Hemisphere: one record of Brown Skua in the North Atlantic has been retracted (Votier et al. 2007).

Dovekie

Breeding: On cliffs or rocky slopes in the high arctic from Baffin Island east to Novaya Zemlya, extending south to Iceland; also on islands in the Bering Strait. The world population has been estimated as in the range 15–50 million pairs; about half the total nest in Greenland, but <1000 pairs nest in Canada (Montevecchi and Stenhouse 2002).

Nonbreeding: Winters at sea in the North Atlantic, south to 42° N (Montevecchi and Stenhouse 2002). In eastern U.S. waters, it is a common but erratic winter visitor to Georges Bank and the Gulf of Maine, where densities range from 3–10 km^{-2} (Powers and Brown 1987; Table 3). However, their main winter quarters are in Canadian waters to the east and north of Georges Bank (Brown 1986). Systematic surveys of Rhode Island waters in winter 2009–10 found 6000 (Paton et al. 2010). They are usually uncommon south to waters off Maryland (Rowlett 1980) and North Carolina (Lee 1986), but there is one recent record of 260 off Cape Hatteras (Table 5). This species is more prone than most alcids to being driven inshore or even inland by storms (Murphy and Vogt 1933; Cramp 1985). On occasion, thousands can be seen from shore in Massachusetts (Griscom and Snyder 1955; Veit and Petersen 1993), and tens or hundreds occur on the coast and inland as far south as South Carolina (Murphy and Vogt 1933; McNair and Post 1993). These incursions appear to have become less frequent in recent decades, and are apparently correlated with oceanographic conditions (Veit and Petersen 1993; Veit and Juris 2009). Only 9 singles have been seen passing Avalon (Table 7).

Migration: Most records in US waters are from November–March. Most of the southward incursions have occurred in November (Stenhouse and Montevecchi 1996).

Common Murre

Breeding: On cliffs on islands in temperate and subarctic regions of the North Atlantic and North Pacific, extending south in the eastern North Atlantic to Portugal and in the western North Atlantic to Nova Scotia and the Bay of Fundy (Cramp 1985; Ainley et al. 2002). The world population has been estimated as 7.4 million pairs (Harris and Wanless 2004), of which 600,000 pairs breed in the eastern Canadian Arctic (Ainley et al. 2002). It was extirpated as a breeder from the Bay of Fundy in the mid-19th century (Squires 1952), but recolonized by 1993, when 120 pairs were found nesting at Yellow Murre Ledge (Christie et al. 2004). A second breeding colony was established at Machias Seal Island in 2003; 150 pairs bred there in 2004 (Bond and Diamond 2006). In the Gulf of Maine, Common Murres were attracted to decoys at Matinicus Rock in increasing numbers from 1993 until 2009, when an egg was laid (Anonymous 2009b).

Nonbreeding: Winters at sea, dispersing widely over continental shelf waters, extending south in the western North Atlantic to 42° N (Ainley et al. 2002). Along the US east coast, this species is a scarce winter visitor to Georges Bank and other shelf waters from the Bay of Fundy to Virginia (Powers and Brown 1987; Table 3). It was formerly rarely seen from shore (Table 4) except when oiled individuals came ashore, but numbers have increased dramatically since 1995 and it is now seen regularly in small numbers from land at Cape Ann and Cape Cod, with counts of 200–420 on several dates in 2002, 2005, and 2007 (Veit and Guris 2009). In the same period, counts of 7–49 were made on several boat trips off Long Island and New Jersey, and more single birds were recorded from shore (Veit and Guris 2009). However, it has never been recorded passing Avalon (Table 7).

Migration: It is most frequently recorded in US waters south of the breeding range in December–March; occasional nonbreeders remain in summer south to Cape Cod.

Thick-billed Murre

Breeding: On cliffs on islands in arctic and subarctic regions of the North Atlantic and North Pacific Oceans, south in the western North Atlantic to Newfoundland. The world population has been estimated as 7.5–10 million pairs, of which 16% breed in the eastern Canadian Arctic and 6% in Greenland (Gaston and Hipfner 2000).

Nonbreeding: Winters at sea, dispersing widely over continental shelf waters, extending south in the western North Atlantic to 42° N. Birds breeding in the eastern Canadian Arctic winter mainly off eastern Newfoundland and Labrador (Gaston and Hipfner 2000). Along the US east coast, it is a scarce winter visitor to Georges Bank and other shelf waters south to Maryland. Its seasonal distribution and numbers are similar to those of Common Murre (Table 4), except that Thick-billed Murre has also occurred in very small numbers off North Carolina (Lee 1986) and has been recorded as far south as Florida (Stevenson and Anderson 1994; Wallace and Wigh 2007; *NAB*). However, it has not been recorded during recent pelagic trips off Cape Hatteras (Table 5). Formerly (through the 1960s) it was thought to be the most numerous alcid in the Gulf of Maine (Finch et al. 1978), and was much more frequently seen from shore, even in small flocks (≤200). It is nowadays greatly outnumbered by Razorbill in the Gulf of Maine, although it still occurs in hundreds in the Bay of Fundy (Huettmann et al. 2005; Table 4). Recent counts from shore have been ≤20 in Massachusetts and ≤4 in New Jersey, but there were exceptional counts of ≥5000 passing Cape Ann and Cape Cod on several days in December 1976 and January 1977 (Veit and Petersen 1993; Veit and Guris 2009). It was formerly more numerous on Long Island, with many records in Long Island Sound, the Hudson River, and even inland; there were major incursions in the winters of 1883–84 and 1890–91 (Cruickshank 1942; Levine 1998). However, it seems to have become rare after 1932; another major incursion in 1950 was recorded only inland and was thought to have originated in the Gulf of St. Lawrence (Bull 1985). It is now rare throughout Long Island, except offshore.

Migration: It is most frequently recorded in US waters from November–March; occasional nonbreeders remain in summer south to Long Island.

Razorbill

Breeding: On cliffs or in crevices on islands in temperate and subarctic regions of the North Atlantic, south in the eastern North Atlantic to France and in the western North Atlantic to the Gulf of Maine. The world population has been estimated as 620,000 pairs (Merne and Mitchell 2004). The breeding population in eastern North America was estimated as 38,000 pairs and has increased considerably in recent decades (Chapdelaine et al. 2001). On the US east coast, it breeds in small but increasing numbers in the Gulf of Maine and Bay of Fundy. It was almost extirpated in the 19th century, but had begun to increase by 1924 (Squires 1952) and has now spread to 3 sites in New Brunswick and 6 in Maine, where it is still increasing. In the Bay of Fundy, numbers at Machias Seal Island increased from a single pair in 1922 to 100 pairs in 1982 and 540 pairs in 2000, with an additional 150 pairs at Yellow Murre Ledge in 1999 and 2 pairs at South Wolf Island in 1995 (MacKinnon and Smith 1985; Chapdelaine et al. 2001). In the Gulf of Maine, numbers increased from 25 pairs at Matinicus Rock in 1977 (Erwin and Korschgen 1979) to 68 pairs at 3 sites in 1986 (Podolsky 1989), 260 pairs at 3 sites in 1995 (USGS database), 280 pairs at 5 sites in 2000 (Chapdelaine et al. 2001), and 600 pairs at 6 sites in 2006 (GOMSWG annual reports).

Nonbreeding: Winters at sea, dispersing widely in flocks over inshore and shelf waters south to 40° N. On the US east coast, it is a widespread and fairly common visitor from the Bay of Fundy south to North Carolina. Largest numbers occur in the Bay of Fundy, where Huettmann et al. (2005) found up to 52,000 alcids, mostly Razorbills, around the Grand Manan archipelago in 1997–98. It is also numerous around Cape Cod and shallow parts of Georges Bank (Powers and Brown 1987; Tables 3 and 4), and in Nantucket Sound, where aerial surveys indicated several thousands (US Army Corps of Engineers 2004). Occasionally, thousands can be seen from shore north and east of Cape Cod (Veit and Petersen 1993; *NAB*). Numbers off Massachusetts and Long Island have increased considerably since the 1970s (Veit and Guris 2009), and it has become numerous off Virginia and Cape Hatteras (daily counts ≤830: Veit and Guris 2009; Table 5), and even off Georgia, where Wallace and Wigh (2007) compiled records of 196 on 13 trips in February. This is the sole migratory alcid species for which the more southerly waters covered in this survey (US continental shelf and Bay of Fundy) appear to be a major wintering area (Powers and Brown 1987).

Migration: Outside the breeding range, most occur in US waters from October–April. Migration appears to take place offshore and is not systematically recorded from land. The mean seasonal total at Avalon was 12; the highest daily count was 19 on 17 December (Table 7).

Black Guillemot

Breeding: On cliffs or in crevices on islands around the edge of the Arctic Ocean from Ellesmere Island east to northeastern Russia, extending south in the eastern North Atlantic as far as Ireland and in the western North Atlantic as far as the Gulf of Maine; also in east Siberia and Alaska (Butler and Buckley 2002). The total world population was estimated as 130,000–200,000 pairs by Mitchell (2004b), but as 250,000–500,000 pairs by Gaston and Jones (1998). Total numbers in eastern Canada and eastern United States were estimated as 76,000 pairs (Mitchell 2004b). On the US east coast, it is a locally common and increasing breeding species on islands in the Bay of Fundy and Gulf of Maine south to the Isles of Shoals. Although occasionally seen in summer in northern Massachusetts, it has yet to be proved breeding there. In the Gulf of Maine and Bay of Fundy, numbers increased during the 20th century from 85 pairs in 1901 to 600 pairs in 1931, 1500 pairs in 1945, and 3800 pairs in 1970–72 (Drury 1973–74). In Maine, 3400 pairs were recorded in 1970–72 (Drury 1973–74), declining to 2700 pairs in 1977 (Korschgen 1979) and 2800 pairs in 1984 (Andrews 1990), but >12,000 pairs were estimated at 231 sites in 1995 (Tables 1–2). Precise numbers are uncertain because of the difficulty in counting this crevice-nesting species, but the increase appears reliable because census methods were similar in all surveys. Numbers recorded in the Grand Manan archipelago and the Bay of Fundy show no clear trends (Drury 1973–74; Ronconi and Wong 2003).

Nonbreeding: Disperses in winter into unfrozen inshore waters, but does not regularly migrate south of its breeding range (Butler and Buckley 2002). Gulf of Maine birds disperse into deeper water in winter and a few move south to Long Island and New Jersey (Table 4), with stragglers as far south as South Carolina (McNair and Post 1993). Numbers recorded south of the breeding range have increased considerably since the 1950s, and daily counts off Cape Cod now range up to 270 (Veit and Petersen 1993). The species is rare south of New Jersey.

Migration: Most records south of the breeding range are from late October–early May (Veit and Petersen 1993; Veit and Guris 2009). Only 2 singles have been recorded at Avalon (Table 7).

Atlantic Puffin

Breeding: In burrows on islands in temperate and arctic regions of the North Atlantic, south in the eastern North Atlantic to France and in the western North Atlantic to the Gulf of Maine. The total population has been estimated as 5.5–6.6 million pairs (Harris 2004), of which 400,000 pairs breed in North America, most in Newfoundland (Lowther et al. 2002). It is a local breeder in the Bay of Fundy and Gulf of Maine, where numbers have increased steadily for >100 years. At the beginning of the 20th century, there were <100 pairs at 2 sites, Machias Seal Island and Matinicus Rock (Drury 1973–74; MacKinnon and Smith 1985; Christie et al. 2004). It has increased throughout the 20th century and now numbers 4000 pairs at 8 sites (Drury 1973–74; MacKinnon and Smith 1985; Christie et al. 2004; GOMSWG annual reports; S.W. Kress, pers. comm.). The natural increase has been augmented by a program of reintroducing the species to new sites in midcoast Maine (Kress 1982, 1983; Kress and Nettleship 1988; GOMSWG annual reports).

Nonbreeding: Winters at sea over a wide area of the North Atlantic, south to 42° N (Lowther et al. 2002). Atlantic Puffins are scarce on Georges Bank (Powers and Brown 1987; Table 3) and rare inshore except close to breeding colonies. Maxima at Cape Ann and Cape Cod in autumn and winter were usually 4–20 (Veit and Petersen 1993; *Bird Observer*), but have increased since 2001 with a high count of 100 in October 2002 (R. Heil, pers. comm.). It was formerly very scarce south of Cape Cod, but numbers have increased in recent years, including counts of 22 off Long Island and 49 off Delaware in December 2007, 50 off Virginia in February 1999 and 2001, and 31 off Cape Hatteras in February 2005 (Veit and Guris 2009; *NAB*; Table 5). A few singles have reached Florida (Stevenson and Anderson 1994; Wallace and Wigh 2007).

Migration: Most records south of the breeding range are from October–April (Veit and Petersen 1993; Veit and Guris 2009). Only 1 has been recorded at Avalon (Table 7).

Numbers, Distribution, and Species Richness

Table 8 summarizes the numerical status of each of the 83 species included in the **Species Accounts**. Total numbers of each species that occur in eastern US waters and the Bay of Fundy in the breeding and nonbreeding seasons are given at least to order of magnitude. Estimates of numerical abundance are derived from Table 1 for the breeding species and from sources cited in the text for the nonbreeding seasons. In some cases, estimates of numerical abundance for species visiting US waters in the nonbreeding seasons are derived from publications reporting numbers breeding in other areas (e.g., Cramp and Simmons 1977; Furness 1987; Hagemeijer and Blair 1997; BirdLife International 2000; Schreiber and Lee 2000; *BNA* series; *WPE*).

Table 8 illustrates a point made in the Introduction—that migrant seabirds are numerically much more important than breeding seabirds off the eastern United States and in the Bay of Fundy. The total number of marine birds (as defined in this paper) breeding in this area is now close to 600,000 pairs of 25 species, plus a few pairs of 6 species that have bred sporadically or are colonizing the area (Table 1). In contrast, 83 species of seabirds occur regularly in the area, many of them throughout the year, and at least 5 species—Sooty and Great Shearwaters, Wilson's Storm-Petrel, Red Phalarope, and Ring-billed Gull—probably occur in the millions; several other species may do so also. Migrants are drawn from widely separated areas: the Great Lakes, arctic and boreal North America, Greenland, the eastern North Atlantic, the Mediterranean, the Caribbean, and the Southern Hemisphere. The disparity between the breeding and nonbreeding seabird faunas is attributable primarily to the fact that eastern US waters include 3 areas of locally high productivity—Georges Bank, inshore bays and estuaries, and the Gulf Stream from Florida to Cape Hatteras—that can support large numbers of feeding seabirds, while breeding sites for seabirds are very limited, both by natural factors (lack of cliffs and paucity of islands) and by anthropogenic factors (development, disturbance, and commensal predators). Thus, it appears that the numbers and variety of breeding seabirds on the east coast of the United States are, in general, limited by the availability of suitable nesting sites.

Table 1 shows that the number of breeding species is greatest (25, including new colonists and sporadic breeders) in the northernmost sector (Gulf of Maine/Bay of Fundy) and declines progressively southwards. The highest species richness is in the Bay of Fundy and adjacent parts of the Gulf of Maine, where 21 species have bred at least occasionally. Total numbers of breeding pairs are also highest in the northernmost sector and decline southwards, although numbers in the Mid-Atlantic Bight are similar to those in the Gulf of Maine/Bay of Fundy, mainly because of the abundance of breeding Laughing Gulls, which outnumber all other breeding species combined in that sector. The northern half of the area not only has more species and more breeding birds, but also more birds in the nonbreeding seasons, and more and better surveys (see **Sources of Information**). For this reason, more space is devoted to the northern half of the area than to the southern half in most of the **Species Accounts**.

In the nonbreeding seasons, most of the 83 species listed in Table 8 have occurred throughout the length of the US east coast. The greatest species richness is in the vicinity of Cape Hatteras, where at least 78 species have been recorded one or more times in recent years; several scarce pelagic species have been recorded in larger

Table 8. Synoptic summary of numbers and trends of 83 species of marine birds in the eastern United States and the Bay of Fundy.

Species	Breeding		Nonbreeding	
	[1]Number of pairs	[2]Trend	[3]Estimated total of individuals	[4]Trend
King Eider	–	–	100s	Unknown
Common Eider	43,000	Inc→Dec	300,000–400,000	Unknown
Harlequin Duck	–	–	2000	Dec→Inc
Surf Scoter	–	–	300,000	Decreasing?
White-winged Scoter	–	–	10,000s	Decreasing
Black Scoter	–	–	300,000	Decreasing?
Long-tailed Duck	–	–	100,000s	Unknown
Red-breasted Merganser	50	Unknown	Low 100,000s	Increasing
Red-throated Loon	–	–	High 10,000s	Unknown
Pacific Loon	–	–	1s–10s	Increasing?
Common Loon	–	–	High 10,000s	Increasing?
Horned Grebe	–	–	10,000s	Decreasing?
Red-necked Grebe	–	–	1000s	Unknown
Western Grebe	–	–	10s	Unknown
Eared Grebe	–	–	10s-100s	Increasing?
Atlantic Yellow-nosed Albatross	–	–	1s	Increasing?
Northern Fulmar	–	–	100,000s	Unknown
Herald Petrel	–	–	10s	Increasing?
Cahow	–	–	1s	Increasing
Fea's Petrel	–	–	1s	Unknown
Black-capped Petrel	–	–	1000s	Unknown
Cory's Shearwater	–	–	10,000s	Unknown
Great Shearwater	–	–	10,000,000	Unknown
Sooty Shearwater	–	–	1,000,000s	Unknown
Manx Shearwater	1	Increasing	10,000	Increasing
Audubon's Shearwater	–	–	10,000	Unknown
Wilson's Storm-Petrel	–	–	1,000,000s	Unknown
White-faced Storm-Petrel	–	–	100s	Increasing?
Leach's Storm-Petrel	40,000	Unknown	Low 100,000s	Unknown
Band-rumped Storm-Petrel	–	–	1000s	Unknown
White-tailed Tropicbird	–	–	10s	Unknown
Red-billed Tropicbird	–	–	1s	Increasing
Masked Booby	–	–	1s	Unknown
Brown Booby	–	–	10s	Increasing?
Northern Gannet	1	Increasing	200,000	Increasing
Brown Pelican	15,700	Increasing	[4]50,000	Increasing
Great Cormorant	77	Inc→Dec	High 1000s	Increasing
Double-crested Cormorant	47,000	Inc→Stable	Low 100,000s	Increasing
Magnificent Frigatebird	–	–	100s	Unknown
Red Necked Phalarope	–	–	[5]Low 1,000,000s	Dec→Inc?
Red Phalarope	–	–	Low 1,000,000s	Unknown
Black-legged Kittiwake	100	Increasing	100,000s	Unknown
Ivory Gull	–	–	1s	Increasing?
Sabine's Gull	–	–	10s	Unknown
Bonaparte's Gull	–	–	Low 100,000s	Unknown
Black-headed Gull	0	Sporadic	10s	Increasing
Little Gull	–	–	Low 100s	Unknown
Laughing Gull	160,000	Increasing	[4]500,000	Increasing

Table 8. (*continued*)

Species	Breeding		Nonbreeding	
	[1]Number of pairs	[2]Trend	[3]Estimated total of individuals	[4]Trend
Franklin's Gull	–	–	10s	Increasing
Common Gull	–	–	1s	Increasing
Ring-billed Gull	7	Increasing	Low 1,000,000s	Inc→Dec
California Gull	–	–	1s	Increasing
Herring Gull	94,000	Decreasing	[4]300,000	Decreasing
Thayer's Gull	–	–	1s	Unknown
Iceland Gull	–	–	Low 1000s	Unknown
Lesser Black-backed Gull	1	Increasing	Low 1000s	Increasing
Glaucous Gull	–	–	100s	Unknown
Great Black-backed Gull	50,000	Inc→Dec	[4]200,000	Inc→Dec
Brown Noddy	–	–	10s–100s	Unknown
Sooty Tern	0	Sporadic	1000s	Unknown
Bridled Tern	–	–	30,000	Unknown
Least Tern	17,000	Increasing	[4]50,000	Increasing
Gull-billed Tern	780	Dec→Inc	[4]3000	Dec→Inc
Caspian Tern	44	Increasing	1000s	Increasing
Black Tern	1	Sporadic	1000s	Dec→Inc
Roseate Tern	3300	Inc→Dec	[4]10,000	Inc→Dec
Common Tern	60,000	Increasing	300,000	Increasing
Arctic Tern	4000	Fluctuated	[4]10,000	Fluctuated
Forster's Tern	8300	Increasing	Low 10,000s	Increasing
Royal Tern	33,000	Dec→Stable	[4]100,000	Dec→Stable
Sandwich Tern	5000	Inc→Stable	[4]15,000	Inc→Stable
Black Skimmer	6000	Stable→Dec	[4]20,000	Stable→Dec
Pomarine Jaeger	–	–	1000s	Unknown
Parasitic Jaeger	–	–	1000s	Unknown
Long-tailed Jaeger	–	–	10s	Unknown
Great Skua	–	–	100s	Increasing
South Polar Skua	–	–	10s	Increasing?
Dovekie	–	–	100,000s	Unknown
Common Murre	150	Increasing	1000s–10,000s	Unknown
Thick-billed Murre	–	–	1000s–10,000s	Unknown
Razorbill	600	Increasing	100,000	Increasing
Black Guillemot	15,000	Increasing	[4]50,000	Increasing
Atlantic Puffin	4000	Increasing	Low 10,000s	Increasing

[1] Estimated number of breeding pairs from Table 1, except in a few cases where more recent data are reported in the text.

[2] Trend during period 1970–2010, where known (see text for details). Inc: increased. Dec: Decreased. Sporadic: occasional nesting during the period. → indicates that the trend changed or reversed during the period. Fluctuated: 2 or more reversals in trend (see text). ? indicates uncertainty.

[3] Estimated total numbers occurring in the area annually (based on numbers reported in Tables 1–7 and on information cited in the text). In most cases, numbers can be estimated only to order of magnitude: 1s = 1–9; 10s = 10–99, etc. In other cases, estimates are given to one significant figure, but it should be understood that these estimates are very rough except for the species referred to in footnote 4.

[4] Most or all birds occurring in the area are from the regional breeding population; estimates include pre-breeders, nonbreeders, and young produced during the year.

[5] Estimate from the 1970s; current numbers are thought to be much lower, although perhaps increasing again (see text).

numbers there than anywhere else off the US east coast (Table 5). Otherwise, by far the largest numbers of pelagic seabirds occur in the northernmost sector, especially on Georges Bank where at least 6 species (Northern Fulmar, Great and Sooty Shearwaters, Wilson's Storm-Petrel, Red Phalarope, and Black-legged Kittiwake) occur in hundreds of thousands or millions (Table 3). Two other "hot spots" for nonbreeding marine birds are the Bay of Fundy (shearwaters, phalaropes, Bonaparte's Gulls, and Razorbills) and the waters around Nantucket Shoals (Common Eiders and Long-tailed Ducks). Including the last two species, most inshore species that winter in the area (seaducks, loons, cormorants, and gulls) are most abundant between Cape Cod and Cape Fear (Table 4). Although at least 74 of the species listed in Table 8 have occurred in eastern Florida one or more times, many of them are only stragglers there, and numbers of most of the others are very small compared to those in more northerly sectors (compare numbers in Table 4 with those in Table 6). The only species that are more numerous in eastern Florida than in the sectors to the north are Laughing Gull, 5 species of tern, and Black Skimmer in winter (Table 4), and a few tropical species (Magnificent Frigatebird, Brown Booby, Brown Noddy) at other seasons.

Trends

Table 8 indicates current or recent (since 1970) population trends, where known. These designations are based on the information summarized in the **Species Accounts**. Trends can be identified for all breeding species except Red-breasted Merganser, Leach's Storm-Petrel and 3 species that are marginal and sporadic breeders in the area (Black-headed Gull, Sooty and Black Terns). Among the remaining species, 3 are thought to be stable in numbers (Double-crested Cormorant, Royal and Sandwich Terns), 16 are increasing and 6 are currently decreasing; Arctic Tern has fluctuated in numbers but has decreased since 2005. Five of the 7 species (including Arctic Tern) that are currently decreasing had increased markedly in previous decades and are still breeding in much larger numbers than recorded in the early and mid-20th century.

Information on total numbers and trends is much less complete for the nonbreeding seasons, but trends can be identified for 35 of the 83 species and are suggested for 13 others (Table 8). As a broad generalization, most seaducks and many tropical seabirds that visit the area from the south appear to be decreasing, whereas Northern Gannet, Brown Pelican, and most loons, gulls, terns, and alcids appear to be increasing.

Increasing Species. Species that are increasing fall into 5 main categories:

1. Breeding species that were reduced to very low numbers during the 19th century and increased again over many decades during the 20th: Laughing Gull, at least 3 species of tern, and 4 species of alcid. Except for the alcids, these increases were interrupted during the second half of the 20th century and numbers have fluctuated in recent decades. Five other species that recovered from human persecution and showed long-term increases during the 20th century (Common Eider, Roseate and Arctic Terns, Herring and Great Black-backed Gulls) now appear to be decreasing again (see next section).

2. Breeding species that have colonized or recolonized the area from the north or from Europe: Manx Shearwater, Northern Gannet, Great Cormorant, Black-headed Gull, Ring-billed Gull, Lesser Black-backed Gull, Great Black-backed Gull, Black-legged Kittiwake, and Common Murre. However, Great Cormorant and Great Black-backed Gull have begun to decline again. Black-headed Gull also started to colonize the area in 1984, but has not been recorded breeding since 1993. In addition, Black Tern has bred several times in recent years, but suitable habitat is lacking along the coast and it appears unlikely to colonize the area permanently.

3. Two species that were severely reduced in numbers by anthropogenic factors in the 1950s–1970s, but have subsequently recovered: Brown Pelican and Double-crested Cormorant.

4. Wintering species that appear to have responded to protection and/or factors acting in their breeding areas: Harlequin Duck, Red-breasted Merganser, Common Loon, Northern Gannet, and Caspian Tern.

5. Scarce migrants or vagrants that are being reported in increasing numbers, probably mainly because of increasing numbers and skill of observers, but in at least some cases because of true increases in the numbers occurring in the area: Pacific Loon, Western and Eared Grebes, Atlantic Yellow-nosed Albatross, Herald and Fea's Petrels, Cahow, Red-billed Tropicbird, Brown Booby, 5 species of gull, and South Polar Skua.

Decreasing Species. Species that are decreasing fall into 3 main categories:

1. Breeding species that had been increasing for many years, but which started to decline again during the period 1970–2009 covered by this publication: Common Eider, Great Cormorant, Herring Gull, Great Black-backed Gull, Roseate Tern, and Arctic Tern. Double-crested Cormorant is similar in that a long-term increase was reversed in Maine about 1990, but its total population in the area covered by this report has remained more or less stable, maintained by increases farther south. Four of these species (Common Eider, Herring Gull, Roseate and Arctic Terns) had been reduced to low numbers by human persecution in the 19th century and increased over many decades during the 20th. Common Eiders have continued to increase in the southern part of their range, but now appear to be decreasing in Maine and the Bay of Fundy. Black Skimmer was probably stable in numbers until the 1980s, but now appears to be decreasing.

2. Wintering species that are poorly surveyed but are thought to have declined in numbers: all 3 species of scoter, Horned Grebe.

3. Two species that migrate through the area to distant wintering grounds and that appear to have declined greatly in the 1960s–80s: Red-necked Phalarope and Black Tern. However, both may have stabilized or started to increase again in recent years.

Recent Fluctuations. A number of breeding species that recovered from human persecution and increased during the first half of the 20th century have fluctuated in numbers during the second half. Six that currently appear to be declining have been discussed in the previous section. In addition, Brown Pelican, Double-crested Cormorant, and several species of terns (Gull-billed, Royal, Common, and Least) appear to have declined for all or part of the period 1955–90 but have stabilized or increased again subsequently. Wintering and migrant species that have shown a similar pattern include Harlequin Duck, Northern Gannet, and probably Red-necked Phalarope and Black Tern. Sandwich Terns increased considerably in numbers, and Royal Terns decreased between the 1970s and 1990s, but both now appear to have stabilized. Besides these changes in total numbers, many species have shown increases or decreases in some parts of the area but opposite trends in others: for examples, see the **Species Accounts** for Common Eider, Double-crested Cormorant, Herring and Great Black-backed Gulls, Gull-billed and Royal Terns.

Conclusions. Most, if not all, marine bird species for which sufficient information is available have shown marked changes in numbers during the period covered in this publication (1970–2010: Table 8). In several cases, these changes were continuations of those that started earlier than 1970, in some cases even in the 19th century. As discussed in the next section (**THREATS**), most or all of these changes can be attributed, in whole or in part, to human activities.

THREATS

This section identifies and assesses threats to the marine birds of the eastern United States and Bay of Fundy, including factors that operate while they are in distant breeding or wintering areas. It also describes and discusses adverse effects that have been reported in the past, and which serve as part of the basis for identifying current and future threats. The threats are listed in descending order of their perceived importance.

Climate Change

In the medium and long term, the largest threats posed to marine birds by human activity are those resulting from global climate changes (Crick 2004; Veit and Montevecchi 2006). Despite early papers drawing attention to these potential threats (Burger 1990; Brown 1991b; Nisbet 1994), there has been very little research or assessment of effects on marine birds in the northwest Atlantic (but see Montevecchi and Myers 1997): most published studies refer to other areas (Aebischer et al. 1990; Veit et al. 1996, 1997; Guinet et al. 1998; Thompson and Ollason 2001; Durant et al. 2003; Gjerdrum et al. 2003; Sandvik et al. 2005; Møller et al. 2006, 2009; Wanless et al. 2007, 2009; Irons et al. 2008); see reviews by Crick (2004) and Veit and Montevecchi (2006).

Brown (1991b) identified three important ways in which global climatic change might affect seabirds of the western North Atlantic: (1) warming of the atmosphere and oceans, with consequent northward shifts in climatic zones; (2) modification of oceanographic features that concentrate prey and thus provide critical feeding habitats; and (3) anthropogenically accelerated rises in sea level. We would broaden (2) to cover all modifications of marine ecosystems, including links to climatic oscillations such as El Niño–Southern Oscillation (ENSO) or the North Atlantic Oscillation (NAO). We would also add two other mechanisms: (4) changes in phenology of breeding and other events in the annual cycle; and (5) increases in the frequency or intensity of severe storms.

Increasing Temperatures. The most recent assessment by IPCC (2007) reports that global mean temperature has already risen by 0.3°C, and predicts that it will increase further by 2°–6°C by 2100; more recent data suggest that changes will probably be larger and more rapid than this projection. Temperature changes affect birds both directly through heat stress, and indirectly through primary and secondary productivity of the oceans, which in turn affect prey abundance. Temperature increases have been and are expected to be especially pronounced in polar regions, and this has already been manifested by rapid melting of permafrost and reduction in sea ice cover in the Arctic Ocean. If continued, this is likely to have profound effects on arctic birds, including Red Phalarope, Ivory, Sabine's, Thayer's, and Iceland Gulls, Pomarine and Long-tailed Jaegers, and Dovekie (also Ross's Gull, which is only a vagrant in US east coast waters); most of these species are likely to decline and may eventually disappear. In the south, increased temperatures may exceed the thermal tolerance of breeding birds, especially those that nest in the open, such as boobies, Magnificent Frigatebird, and terns; ground-nesting and roof-nesting species such as Least Terns and Black Skimmers are already heat-stressed at times, even in mid-latitudes (Thompson et al. 1997).

Generally, climatic zones are expected to shift towards higher latitudes, and this is expected to lead to corresponding latitudinal shifts in distribution. In the area covered by this publication, it is likely that most breeding species will shift their distributions to the north; in particular, it is likely that the species currently colonizing from the north will retreat again, and that other northern species such as Leach's Storm-Petrel and alcids will decline or be extirpated from the Gulf of Maine and Bay of Fundy. At the southern end of the area, the coast from Florida to North Carolina will become climatically suitable for species that are nowadays characteristic of the West Indies or Bahamas, such as Audubon's Shearwater, Magnificent Frigatebird, Brown Booby, Sooty and Bridled Terns, and Brown Noddy. However, there are currently few suitable breeding sites for these species in eastern Florida, Georgia, or South Carolina, so they are unlikely to colonize unless new sites become available (e.g., if mangroves spread northwards or new islands are formed).

Changes in Marine Ecosystems. Unambiguous, if complex, changes have already occurred in the physical and biological characteristics of the North Atlantic Ocean during the 20th century (Hurrell et al. 2003; Durant et al. 2004; Stenseth et al. 2004). Changing ocean temperature affects seabirds through their food supply by changing rates of upwelling and advection of nutrients, and thereby primary productivity. Unlike the situation in the eastern Pacific (Roemmich 1992), where a comparatively straightforward pattern of warming and reduced upwelling and advection is evident, the pattern in the North Atlantic is complicated by many local variations. The North Atlantic Oscillation (NAO) is a multivariate physical index used to characterize the overall climatological state of the North Atlantic (Hurrell et al. 2003). The NAO is designed to reflect the distribution of sea-level pressure, but its values correlate strongly with predominant flows of winds and surface currents. The NAO has changed from a pattern of negative values during 1930–75 to one of predominantly positive ones from 1975–2000 (Hurrell and Dickson 2004). It is difficult to say whether positive or negative values will predominate as climate change progresses, but for our purposes what is important is that noticeable, statistically significant shifts have occurred in recent years, and these shifts have clearly changed the biology of the North Atlantic.

Dramatic changes in the pelagic communities of the North Atlantic have occurred since 1900. Many of these changes are clearly due to fishery pressure rather than climate change. For example, the spectacular collapse of Atlantic Cod stock in the early 1990s and the decline of the Atlantic Herring fishery in the late 1960s and early 1970s were almost certainly primarily the result of overfishing. The collapse of these stocks has had broad-reaching impacts on other components of the ecosystem, including seabirds (Fogarty and Murawski 1998; Montevecchi 2002). Other changes are not so easily attributed to any one particular cause. For example, the spectacular increase of American Sand Lance during the 1970s (Sherman et al. 1981) may have resulted from the disappearance of Atlantic Herring due to overfishing, but other factors may have been important as well. Many seabirds benefitted from the increase in sand lance (Veit and Petersen 1993), but whether any of these changes had a link to climate forcing is unknown.

Links among sand lance, seabirds, and climate in the North Atlantic were obscure until very recently, and remain complex (Frederiksen et al. 2004; Wanless et al. 2007). Part of the apparent absence of such a link was due to the complicated effects that changing temperatures have had upon atmospheric and oceanic circulation in the North Atlantic (as compared, for example, with either the Antarctic or eastern Pacific). The relationships have now been somewhat disentangled, and there is consensus that seabirds have been affected by changing climate. Aebischer et al. (1990) pointed to a link between NAO and laying date, clutch size, and chick production of Black-legged Kittiwakes in the northeast Atlantic. These demographic parameters of kittiwakes seem to have been related to NAO through changes in phytoplankton, zooplankton, and herring abundance. Breeding numbers of a number of species of gulls, terns, and alcids were correlated with the NAO during the years 1983–96 (Drinkwater et al. 2003), and more specific links were subsequently identified. For example, fledging success of Atlantic Puffins in Norway was found to depend on availability of yearling Atlantic Herring, which in turn depends on sea temperature (Durant et al. 2003). Reproductive success of Black-legged Kittiwakes in the North Sea depends on the condition of sand lance eaten by kittiwakes just prior to breeding, and sand lance condition depends on sea temperature, mediated through phytoplankton and copepods (Frederiksen et al. 2004; Wanless et al. 2007).

Thus the picture from the northeast Atlantic is that changing climate is having a measurable effect upon seabirds, so it is highly likely that such effects have occurred in the northwest Atlantic as well. There are, however, interesting differences in the direction of climate-related effects between the two sides of the North Atlantic. For example, abundance of the abundant and widespread copepod *Calanus finmarchicus* is negatively correlated with NAO in the eastern, but positively correlated with NAO in the western North Atlantic (Conversi et al. 2001; Drinkwater et al. 2003). There is no question that climate-related changes are occurring, and these are likely to affect seabirds in the northwest Atlantic in similar ways to those documented in the northeast Atlantic. Montevecchi and Myers (1997) reported decadal changes in population sizes and diets of Northern Gannets in Newfoundland, and related them—fairly plausibly—to climate change. Similar studies of other species are badly needed.

Rising Sea Level. The most recent assessment by IPCC (2007) projects that mean sea level will increase by 0.2–0.6 m by 2100; more recent data on melting of glaciers and ice sheets suggest that changes will be larger and more rapid than this projection. Most of the US east coast from Cape Cod southwards lies within a few meters of current sea level, so rising sea levels will have profound effects on the geography of the coastline. Immediate effects are likely to be increased tidal flooding of saltmarshes and saltmarsh islands, and fragmentation of barrier beaches and barrier islands (Nicholls and Cazenave 2010). If sea levels rise by more than 1–1.5 m, it is likely that large sections of the barrier beaches that currently extend from Long Island to Florida will be fragmented or destroyed, so that the saltmarshes and sounds that they currently protect will be subject to erosion. However, we have found no projections of the magnitude and extent of these potential changes, nor predictions of the conformation of the coastline in future decades. In a natural state, saltmarshes and barrier beaches would migrate landward as sea level rises, to be replaced by new marshes and beaches at slightly higher elevations. However, in most areas of the US east coast, landward migration of saltmarshes is precluded by sea walls or other hard structures designed to protect and "stabilize" adjacent land areas, and migration of barrier beaches is vigorously resisted by property owners and the government agencies that serve their interests.

Seabird nesting sites tend to be at relatively low elevations on barrier beaches or at relatively high elevations on saltmarshes, so are likely to be affected first. The entire east coast populations of Gull-billed, Least, and Forster's Terns nest in these flood-prone sites, and substantial numbers of Laughing Gulls, Royal, Sandwich, Caspian, and Common Terns, and Black Skimmers nest in similar or slightly higher sites. The nests of these species are already subject to periodic flooding in high tides or storms, and this limits their breeding success in spite of adaptations to counter the effects of flooding (Burger 1979; Storey 1987a, b; Burger and Gochfeld 1990, 1991; Erwin et al. 1998; Nisbet 2002a). The precarious state of these marsh-nesting species is illustrated by the finding that an increase in elevation of nest sites by only 20 cm would substantially improve nesting success of Gull-billed Terns in Virginia (Erwin et al. 1998). The immediate response of marsh-nesting birds to flooding is to move to new sites (Burger and Gochfeld 1990; Erwin et al. 1998), but the number of such sites at slightly higher elevations is already limited. In the long term, rising sea levels might fragment existing barrier beaches and actually increase the number of nesting sites available for nesting seabirds. However, such changes will undoubtedly be resisted by human interventions to protect existing developments on barrier beaches. In the medium term, the number of suitable nesting sites for seabirds that currently nest within 1–2 m of mean high water is likely to decrease, and consequently most of these species are at serious risk.

Changes in Phenology. In theory, increasing temperatures or other manifestations of climate change are likely to result in changes in the phenology of both seabirds and their prey species. If the changes are sufficiently rapid, the phenology of the seabirds and their prey might fall out of phase, with adverse effects on reproduction and/or survival. In the eastern North Pacific, Abraham and Sydeman (2004) and Lee et al. (2007) reported that Cassin's Auklets were able to track changes in the availability and phenology of their prey in most years, but that this tracking failed in some years, resulting in reduced productivity and declining population. In the northeast Atlantic, changes in breeding dates have been reported for a number of seabird species (Aebischer et al. 1990; Møller et al. 2006, 2009; Wanless et al. 2009). However, in the most extensive study, trends differed among species, with terns breeding earlier over the period 1970–2006, while alcids and Black-legged Kittiwakes bred later (Wanless et al. 2009). Even in that area, where seabirds have been studied intensively for decades, the relationship between the phenology of seabirds and that of their prey is poorly understood, so it is not clear whether the observed changes are attributable to climate change, nor whether they should be classified as adverse effects. No similar studies of northwest Atlantic seabirds have been published, but the productivity of terns, for example, is strongly dependent on breeding date (Burger et al. 1996; Arnold et al. 2004), so there is a clear potential for adverse effects.

Increase in Severe Storms. Another potential manifestation of climate change is an increase in the frequency and/or severity of severe storms. There is some evidence for increases in both frequency and severity of North Atlantic hurricanes, although the relationship to climate change is disputed (Webster et al. 2005). The entire US east coast is subject to hurricanes, and adverse effects on terns have been reported, both at a breeding site and at a postfledging staging site (Nisbet 1978a; Lebreton et al. 2003). However, there is no information on effects of hurricanes on breeding seabirds over most of the coast. Hurricanes also displace Laughing Gulls, terns, and Black Skimmers long distances from their breeding areas (see **Species Accounts**). Presumably some of the affected birds are killed, although effects on population sizes in the next year have been reported in only one case: Hurricane *Bob*, which passed through the main staging area of Roseate Terns in August 1991, apparently eliminated most of the juveniles raised in that year and many adults, so that the breeding population declined by 15% in the next year (Nisbet and Spendelow 1999; Spendelow et al. 2008). Most of the breeding seabirds of the area would be at increased risk from more severe hurricanes, especially in the southeast United States.

Human Development of the Coastline

Human development of the coastline has been a major factor affecting the local distribution of many breeding seabirds in the eastern United States. Except in a few remote areas (outer islands in Maine, Virginia, and Georgia), the entire coastline is heavily used for human recreation. Many barrier beaches and barrier islands (especially in New York, New Jersey, Delaware, Maryland, South Carolina, and Florida) are heavily built up and the beaches are intensively used for recreation, so that they are largely unavailable to nesting seabirds. Historical records are fragmentary, but suggest that some of these barrier beaches and barrier islands supported large numbers of breeding terns and Black Skimmers prior to 1890 (Giraud 1844; Schick 1890; Bent 1921; Stone 1937; Nisbet 1973). The number of beach sites occupied by these species is now limited to a few undeveloped and protected sites, such as National Wildlife Refuges and the Virginia Barrier Islands (Buckley and Buckley 1977; Erwin 1980; Kress et al. 1983; Spendelow and Patton 1988; Andrews 1990; Williams et al. 1990, 2005). However, many of the species also occupy other habitats and breed successfully there. From Maryland south, for example, Least Terns nest commonly on gravel roofs of flat-topped buildings, and in Florida this is their predominant breeding habitat (Fisk 1978; Clapp et al. 1983; Stevenson and Anderson 1994). However, gravel roofs are being replaced on many buildings by other materials that are unsuitable as nest-sites: this may pose a significant regional threat to Least Terns (DeVries and Forys 2004).

Another alternative habitat for beach-nesting birds is saltmarshes, which are commonly used by Laughing Gulls, Herring Gulls, Gull-billed Terns, Common Terns, Forster's Terns, and Black Skimmers, especially in New York and New Jersey (Buckley and Buckley 1980, 1982, 2000; Safina et al. 1989; Burger and Gochfeld 1990, 1991). Although human development of barrier beaches and barrier islands has evidently displaced some colonies of these species into saltmarshes, it is not entirely clear whether it has had major effects on their reproductive success or numbers. Saltmarsh sites are sometimes regarded as unsuitable habitat for terns and Black Skimmers because of the frequency of flooding, but this is offset by the lower intensity of predation in saltmarshes. Recent studies have shown that the breeding success of terns and Black Skimmers at saltmarsh sites is at least comparable with that on the remaining barrier beach sites (Buckley and Buckley 1982, 2000; Safina et al. 1989; Burger and Gochfeld 1990, 1991). Least Terns can breed successfully on protected beach sites and on roofs (Fisk 1975, 1978; Gore and Kinnison 1991; Brunton 1999). Common and Least Terns have maintained and increased their populations from Virginia north, whereas Black Skimmers maintained roughly stable populations through 1985, although they appear to have declined since then (see **Species Accounts**). This, however, is not evidence that the populations have not been impaired. All of these species are subject to predation on both beach and alternative sites (Kress et al. 1983; Nisbet and Welton 1984; Burger and Gochfeld 1990, 1991; see **Human-enhanced Predation**). Although Least Terns sometimes breed with high success at their customary beach sites, opportunities for moving to alternative sites in response to predation are now limited in many areas. It thus seems likely that human development of the barrier beaches has limited these species to sites that, on average, may be suboptimal (Kress et al. 1983). Although their populations have remained stable or increased, they would probably have increased faster if more and better sites had been available. At least for Common and Least Terns, present-day populations in the eastern United States are well below those that existed prior to the era of human persecution in the 1880s (Nisbet 1973; Kress et al. 1983; Kress and Hall 2004).

A special case of human development is the creation of islands and other nesting sites through the deposition of dredge spoil. The US Army Corps of Engineers has constructed more than 2000 islands from dredged material during the past 130 years (Soots and Parnell 1975). In particular, construction of the Intracoastal Waterway during the 1930s led to the creation of a chain of spoil islands in protected sites from Florida to New Jersey. These islands were settled by many species of colonial waterbirds, including Brown Pelican, Double-crested Cormorant, gulls, and terns, and appear to have promoted the rapid increase of many species (e.g., Pearson et al. 1942). Since the 1960s, however, many of these sites have deteriorated as sites for ground-nesters because of progressive development of vegetation on old sites, diking of new sites, and a general lack of management (Buckley and Buckley 1975; Soots and Parnell 1975; Buckley 1978; Parnell and Soots 1978; Schreiber and Schreiber 1978; Clapp and Buckley 1984; Parnell et al. 1986; Spear et al. 2007, Emslie et al. 2009). Although clean dredge spoil is continually generated through maintenance dredging, current anti-sedimentation regulations—often without scientific basis—make it difficult to dispose of spoil on existing islands or to create new undiked islands. When fresh spoil is added to islands that have become vegetated, ground-nesting species such as Royal Terns often respond immediately (Emslie et al. 2009). Continued deterioration of most of these sites, however, in combination with the paucity of suitable alternative sites, represents a threat to regional populations of several ground-nesting species.

Threats on Foreign Breeding Sites

Preceding **THREATS** sections have discussed effects that have occurred or are likely to occur on breeding seabirds in the study area. Species that breed elsewhere and migrate into or through US and Bay of Fundy waters may also be subject to similar effects on their foreign breeding grounds. This section summarizes some of these threats that have been reported in reviews such as those of Cramp and Simmons (1977, 1983), Croxall et al. (1984), Cramp (1985), Nettleship et al. (1994), Hagemeijer and Blair (1997), BirdLife International (2000), Schreiber and Lee (2000), and Bradley and Norton (2009). The general threats posed by climate change to tundra-nesting birds such as jaegers and phalaropes, and to tropical seabirds nesting in the West Indies, are discussed under **Climate Change**, above. West Indies seabirds are also threatened by a variety of other factors, summarized by Schreiber and Lee (2000), Bradley (2009), and Bradley and Norton (2009). Case reports for individual species include the following:

Atlantic Yellow-nosed Albatross. This species breeds on Gough Island and the Tristan da Cunha Archipelago in the South Atlantic, where the most recent estimate of numbers was 37,000 pairs (Gales 1998). Like other albatrosses, it is subject to mortality in longline fisheries, and its numbers are thought to be declining (Gales 1998; BirdLife International 2000). The major cause of declines in the closely-related Indian Yellow-nosed Albatross has recently been identified as a combination of avian cholera and another bacterial infection (*Erysipelas*) which together raise chick mortality (Weimerskirch 2004); such pathogens are difficult to detect and might well be important for other species.

Herald [Trindade] Petrel. Trindade Petrel (*Pterodroma [a.] arminjoniana*) is endemic to Trindade and Martim Vaz Islands in the South Atlantic and may only number a few hundred pairs (see **Species Accounts**). It is threatened by introduced grazing mammals and perhaps by military activities of the Brazilian Navy (BirdLife International 2000).

Cahow (=Bermuda Petrel). This species is endemic to Bermuda, where numbers have increased under protection from 18 pairs in 1962–63 to 85 pairs in 2008–09 (Wingate 1977; Madeiros 2009; D.B. Wingate, pers. comm.). It is intensively managed, but is currently threatened by rising sea level and increasingly intense hurricanes, which are damaging its nest sites on low-lying islets. A program of translocating chicks to higher and more secure sites has begun to show promising results towards relieving this threat (Madeiros 2009).

Fea's Petrel. This species breeds only on the Cape Verdes and Desertas off West Africa (possibly two distinct species: see **Species Accounts**), where it is threatened by introduced predators, grazing by introduced goats and rabbits, and collection for pseudomedicinal purposes (Hagemeijer and Blair 1997; BirdLife International 2000). An Action Plan for the species was published by Zino et al. (1996).

Black-capped Petrel. This species is threatened by human predation and increasing human activity at its only known nesting sites in Haiti and the Dominican Republic (van Halewyn and Norton 1984). Total numbers were estimated at fewer than 2000 breeding pairs by Lee (2000b). In Haiti, it is exploited for food by local residents who catch the adults by luring them to fires as they pass over mountain ridges at night. The extent of exploitation is unknown, but is thought likely to be a significant drain on the population (Gochfeld et al. 1994). It is also threatened by predation by introduced mammals, destruction of its fragile breeding habitat in the high mountains, and potentially by oil and gas development in its feeding area off Cape Hatteras (BirdLife International 2000; Lee 2000b; D.B. Wingate, pers. comm.).

White-faced Storm-Petrel. 40,000 pairs breed in the Selvagens (Portugal), where they are well protected, but are subject to increasing predation by Yellow-legged Gulls (Hagemeijer and Blair 1997). About 10,000 pairs breed on 3 small islets in the Cape Verdes; there is evidence of a major decrease in numbers since 1955 (Hazevoet 1994). Le Grand et al. (1984) thought that this population was threatened by human disturbance and exploitation, but Hazevoet (1994) reported that a more serious threat appeared to be the trampling and collapse of burrows caused by fishermen taking other species or crossing the colonies when searching for shellfish and debris on the coast.

Masked Booby. The West Indies population of this species is limited to about a dozen sites scattered through the Caribbean and southern Gulf of Mexico; total numbers are about 600 pairs (van Halewyn and Norton 1984; Gochfeld et al. 1994; Schreiber 2000b; Bradley and Norton 2009). It has almost disappeared from the Bahamas and has been extirpated from several other sites. However, 4000–5000 pairs nest on islands off Venezuela and Mexico (Schreiber 2000b). The IXTOC oil spill in the Gulf of Mexico in 1979 probably killed hundreds of Masked Boobies (van Halewyn and Norton 1984), but other reasons for its apparent decline are not well defined.

Magnificent Frigatebird. This species nests at about 30 sites in the West Indies; the total population was estimated as 6100 pairs by Bradley and Norton (2009). It is reported to have declined in numbers over several centuries (van Halewyn and Norton 1984), and is currently regarded as threatened (Lindsay et al. 2000; Bradley and Norton 2009). Specific threats identified include collection of eggs and young, shooting of adults for sport and for pseudomedicinal purposes, disturbance at breeding colonies, and degradation of mangrove habitat (van Halewyn and Norton 1984; Lindsay et al. 2000).

Other seabirds nesting in the West Indies. Based on a detailed review of the status of all species (Schreiber and Lee 2000), an Action Plan for Conservation of West Indies Seabirds (Schreiber 2000a) designated a number of other species as of varying degrees of concern: critically endangered: Gull-billed, Cayenne*, and Common Terns, and Black Noddy*; endangered: Brown Pelican and Royal Tern; vulnerable: White-tailed* and Red-billed Tropicbirds*, Audubon's Shearwater*. Several of these species are numerous and less threatened as breeders on the US east coast, but for those marked with an asterisk, the West Indies (including Bermuda and the Bahamas) are the source for all the individuals that disperse into US waters.

Thick-billed and Common Murres. Thick-billed Murre has been threatened for several decades by hunting at breeding colonies in Greenland, by winter hunting at sea off Newfoundland, entanglement in fishing nets, and oil pollution (Brown and Nettleship 1984; Evans and Nettleship 1985; Gaston and Hipfner 2000; Wiese et al. 2004). Numbers in the Canadian Arctic are thought now to be stable, but studies during the 1980s revealed continuing declines at several colony sites in Greenland (Kampp et al. 1994), thought to be attributable mainly to summer hunting at the breeding sites in Greenland. Winter hunting primarily affects birds from breeding colonies in Arctic Canada and Svalbard, and few are nowadays killed in fishing nets (Kampp et al. 1994). Common Murres also are threatened by winter hunting off Newfoundland, oil spills, and drowning in gill nets (Brown and Nettleship 1984; Ainley et al. 2002).

Interactions with Fisheries

Little definitive information is available on interactions between fisheries and seabird populations in the area covered by this paper. Compared to other maritime regions, such as the northeastern Atlantic (Montevecchi 2002; Furness 2002), the southeastern Atlantic (Crawford 2007), or the northeastern Pacific (Ainley et al. 1981; King 1984; Montevecchi 2002), there has been little quantitative analysis of the interaction between seabirds and fisheries in the northwest Atlantic. This lack of scientific attention derives in part from the low numbers of breeding seabirds in the area (Table 1), but is inappropriate in view of the large numbers of nonbreeding seabirds (Table 8).

Direct Mortality. Estimates of seabirds killed in fishing gear have recently been compiled by the US National Oceanographic and Atmospheric Administration (NOAA: Hata 2006; Soczek 2006; Palka and Warden 2007). These were based on programs that placed observers on 5% of commercial fishing vessels operating between Maine and North Carolina. The observers were trained primarily to record species and ages of fish being caught, plus marine mammals. Starting in 2003, however, observers were specifically trained to identify and record seabirds. Some inshore fisheries, especially gill netters in Pamlico Sound, have not been covered by observer programs. For offshore fisheries, most bird mortality was from gill nets (set for ground fish such as flatfish, cod, and haddock) and from long-lines (set mainly for swordfish). The species most frequently killed were Great and Sooty Shearwaters, loons, cormorants, and gulls. Estimated annual mortality for Great Shearwater, the numerically dominant species, was 400–1400 annually for 1989–2006 (the latter number including "unidentified shearwaters"). Estimated annual mortality for Common and Red-throated Loons was 200 of each species. This is consistent with an assessment by Soczek (2006), who estimated seabird mortality in the New England fisheries to have been around 2200 annually (mainly shearwaters) in 1994–99, and around 750 annually in 2000–03. Even allowing for bias due to limited sampling, these numbers would probably have accounted for less than 0.1% of the adult population of Great Shearwaters (Fishpool and Evans 2001). However, they might be important for species such as Iceland, Glaucous, and Great Black-backed Gulls, whose total numbers in the northwest Atlantic are probably on the order of 100,000 (see **Species Accounts**). If any of the endangered gadfly petrels such as Cahow, Black-capped, or Fea's Petrels are being killed in longline fisheries, even a single death could have population significance.

Gill nets are also used inshore and are known to kill diving birds such as seaducks, loons, cormorants, and Northern Gannets. Forsell (1999b) conducted a limited study of seabird bycatch in gill nets set along the coast (mostly less than 2 km from shore) between New Jersey and Virginia from February–April 1998, and estimated that at least 2400 seabirds were killed, mostly Red-throated Loons. This suggests that this species may be at especially high risk because it frequents inshore waters where gill nets are also concentrated. Like Red-throated Loons, Red-breasted Mergansers and cormorants also frequent inshore waters and pursue fish under water, so they might be expected to be at similar high risk. More intensive regional studies of gill netting operations are needed in critical areas such as Georges Bank, Pamlico and Albermarle Sounds, and the Outer Banks of North Carolina.

Competition. Hypothetically, commercial fisheries might affect seabirds through direct competition in cases where both are taking the same fish. However, the relationships between seabirds and commercial fisheries are complex (Nettleship et al. 1984; Croxall 1987; Bailey 1989; Overholtz et al. 1991; Rice 1992; Schneider et al. 1992; Duffy and Schneider 1994; Camphuysen et al. 1995; Montevecchi and Myers 1997; Camphuysen and Garthe 2000; Tasker et al. 2000; Montevecchi 2002; Furness 2002; Camphuysen 2005; Wanless et al. 2007; Crawford 2007), and the detailed multispecies assessments required to demonstrate interactions have not been carried out for the seabirds and fisheries of the northwest Atlantic.

In the northwest Atlantic, most commercial fisheries utilize species and age-classes larger than any fish eaten by birds. One exception is the fishery for Atlantic Mackerel on Georges Bank and in the Gulf of Maine, which might deplete the fish population sought by Northern Gannets. The potential for competition of this kind has not been studied, but is unlikely to be major at the present time because Northern Gannets have been increasing in numbers since the mid-1970s (Nettleship and Chapdelaine 1988).

Better-documented examples are provided by the fisheries for clupeids, specifically Atlantic Herring in the northern part of the area, and Menhaden in the southern part of the area. These fish are taken by many seabirds, especially gulls, terns, and alcids. During the 1960s and early 1970s, the population growth of Herring Gulls was positively associated with the fishery for Atlantic Herring (Nisbet 1978b) and the winter distribution of juvenile Herring Gulls was positively associated with the fishery for Menhaden (Kadlec and Drury 1968; Drury and Nisbet 1972). These positive associations may have resulted from opportunistic feeding on discards, but no detailed studies were reported. The fisheries generally take older age-classes of fish than those eaten by birds, but there is potential for adverse effects on birds through direct competition for the younger fish and overfishing of spawning stock, leading to reduced recruitment.

On Georges Bank, the stock of Atlantic Herring collapsed in 1976–77, following overfishing coinciding with a series of years with poor recruitment (Sindermann 1979; Anthony and Waring 1980), and it did not recover until the early 1990s (Northeast Fisheries Science Center 1993). However, there is no evidence for adverse effects of this collapse on birds frequenting Georges Bank (Powers and Brown 1987). Interactions are complicated by the fact that Atlantic Herring compete with other planktivorous fish, including American Sand Lance (Bailey 1989); sand lance are more important as a food of seabirds than are Atlantic Herrings. The collapse of Atlantic Herring populations on Georges Bank in the 1970s coincided with a boom in offshore populations of sand lance, and their recovery coincided with the end of the sand lance boom in 1988 (Meyer et al. 1979; Sherman et al. 1981; Fogarty et al. 1991; Fogarty and Murawski 1998; Link and Garrison 2002; Overholtz and Friedland 2002), although it is unclear if these changes were causally related. The concentrations of sand lance attracted unusually large aggregations of several seabirds, including shearwaters, Herring and Great Black-backed Gulls, and Black-legged Kittiwakes (Powers and Van Os 1979; Veit and Petersen 1993; White et al. 2009). During this period, however, there was little evidence of changes in populations of sand lance in inshore waters of New England, or in their availability to seabirds. For example, Roseate Terns, which are sand lance specialists (Gochfeld et al. 1998), maintained high productivity at inshore colonies before, during, and after the offshore sand lance boom in the 1970s and 1980s (Nisbet 1981; Burger et al. 1996; Northeast Roseate Tern Recovery Team 1998). Numbers of sand lance fluctuate reciprocally with those of one of their amphipod prey species, *Gammarus annulatus*, and Long-tailed Ducks and other species appear to have switched to feeding on amphipods after the end of the sand lance boom (White et al. 2009). Overall, therefore, there is no evidence for adverse effects of the offshore herring fishery on seabird populations during this period, despite its large effects on the herring population and apparent reciprocal effects on the sand lance population.

In the Gulf of Maine, where 2-year-old Atlantic Herring are caught for marketing as "sardines," there were no marked changes in recruitment between 1965 and 1985, despite a large reduction in the spawning stock that may have been due to fishing pressure (Anthony and Fogarty 1985; Northeast Fisheries Science Center 1993). Seabirds such as terns maintained high reproductive success and increased in numbers at inshore sites in New England during this period (Kress et al. 1983; Nisbet 2002a; GOMSWG annual reports). At Machias Seal Island in the Bay of Fundy, there was a strong predictive relationship between the proportion of herrings (mostly 0-group: hatched the previous autumn) in the diet of Arctic Terns and the catch-per-unit-effort in the nearby fishery for 2-year-old herrings 2 years later (Amey 1998). There was no relationship between seabird productivity and the proportion of herrings in their diet, but there was a strong positive relationship between the productivity of seabirds (terns and alcids) and the energy density (i.e., condition) of 0-group herrings (Diamond and Devlin 2003). These findings suggest that the productivities of both seabirds and fisheries were driven by the same oceanographic factors, and suggest that seabird biology can be used to predict fishery outcomes, rather than *vice versa*; they do not demonstrate any effects of the fisheries on the birds.

In northwestern Europe, reproduction of Black-legged Kittiwakes is linked to sand lance abundance, but the connection is difficult to establish using data collected at the coarse scale of most fisheries and seabird research (Frederiksen et al. 2007). As both sand lance and herring are of major importance in the diets of many marine birds (Shealer 2001; Barrett et al. 2007), it would be of interest to explore how birds in the northwest Atlantic may have been affected by the reciprocal changes in their abundance in recent decades. Strong links between ocean climate, sand lance, and seabirds, while controversial in the past, seem now to be generally accepted (Wanless et al. 2007). Given these findings, the potential for similar links in the northwest Atlantic should be investigated.

On Georges Bank and in the Gulf of Maine, Northern Fulmars, Great and Sooty Shearwaters, and gulls exploit offal, bycatch, and other discards from fishing vessels (Brown 1970; Powers and Brown 1987); see Garthe et al. (1996, 1999) for the importance of discards for seabirds in northwestern Europe. The collapse of the offshore fishery since the 1980s has presumably reduced the quantity of these discards drastically, and this would be expected to have had adverse effects on the birds that exploited them (see Camphuysen et al. [1995], and Camphuysen and Garthe [2000] for effects of similar reduction in fishery discards in northwestern Europe). At the same time, the severe overfishing of predatory fish such as Haddock and Atlantic Cod may have resulted in increases in populations of prey fish such as sand lance and herrings (Fogarty and Murawski 1998), and of squid, all of which are important as food for seabirds; this could have led to positive effects on some species. However, there is virtually no information on the numbers or feeding habits of seabirds on Georges Bank since 1983.

In the Gulf of Maine and Bay of Fundy, large numbers of Herring and Great Black-backed Gulls follow lobster boats to feed on discarded bait (Hunt 1972) and this has remained an important source of food in some areas as other sources have been reduced (Goodale 2001; GOMSWG annual reports). Along with bycatch from inshore and offshore fisheries, these subsidies were probably important factors in the population increases of these species during the first three-quarters of the 20th century (Hunt 1972; Drury 1973–74). As noted under **Large Gulls** the increases in gull populations resulted in negative effects on other seabirds. Since about 1970, reductions in the quantity of fish discarded at sea and improvements in waste handling in the ports have reduced the subsidies to these species, and the collapse of the Georges Bank fishery in the 1980s and 1990s reduced them still further. The changes have already been manifested in a decline in numbers of Herring Gulls breeding in the area during and since the 1980s, and other changes may be anticipated. The decline in numbers of Herring Gulls has made them easier to control, allowing restoration of several important tern colonies (Nisbet 2002a). However, Great Black-backed Gulls continued to increase for 1–2 decades after Herring Gulls had peaked, leading to increased predation on cormorants and Common Eiders (see **Large Gulls**).

Conclusions. In summary, interactions between fisheries and seabirds in the waters of the northwest Atlantic are complex and constantly changing. They are also poorly documented and cause-and-effect relationships are difficult to establish. Positive effects have been reported on some species and negative effects on others, acting through a variety of mechanisms. Negative effects have been reported for terns and alcids, mediated through increases in the populations of large gulls and now declining in importance. Negative effects have probably occurred for several pelagic species because of reductions in bycatch and discards, although direct observations

Table 9. Summary evaluation of threats to marine birds of the eastern United States and the Bay of Fundy. Species thought to be at highest risk are in boldface.

Type of threat	Species affected	Potential importance
Climate Change		
Warming of Arctic	**Phalaropes, Ivory Gull, Sabine's Gull, Iceland Gull, Thayer's Gull, Pomarine Jaeger, Long-tailed Jaeger, Dovekie**	Major long-term threat to all arctic birds
Heating of tropics	**Magnificent Frigate-bird, boobies, terns**	Major threat to all tropical birds that nest in the open, unless new breeding sites become available farther north
Warming at mid-latitudes	All species currently nesting in the area	Northward shifts in distribution expected; most northern species likely to vacate the area; mid-latitude species may benefit because northern sectors have more islands
Rising sea level	Laughing Gull, terns (especially **Gull-billed, Least, Forster's), Black Skimmer**	Loss of low-lying nest sites is a serious threat, but may be offset by generation of new islands as barrier beaches fragment
Changes in marine ecosystems	**Red-necked Phalarope?**, all other species	Potentially serious effects on many species, but nature and magnitude of changes are difficult to predict
Changes in phenology	All species	Rapid changes in temperature could lead to mismatches between phenology of seabirds and prey
Increase in severe storms	All species	Increase in severe hurricanes during breeding season could have major impact on several species
Human development of coastline	**Brown Pelican, terns, Black Skimmer**	Rising sea level is likely to increase competition for beach habitats as currently-protected sites are submerged; Least Terns are threatened by phasing out of gravel roofs
Deterioration of dredge spoil islands	**Brown Pelican, terns, Black Skimmer**	Dredge spoil islands are deteriorating as nesting habitat because of inappropriate or no maintenance

Table 9. *(continued)*

Type of threat	Species affected	Potential importance
Threats on foreign breeding sites (other than climate change)	Atlantic Yellow-nosed Albatross, **gadfly petrels, Audubon's Shearwater, Magnificent Frigatebird, Masked Booby, tropicbirds**, murres	Major threats of various types to highlighted species; poorly documented in other cases
Interactions with fisheries		
Direct mortality	Red-breasted Merganser, **Red-throated Loon**, Great Shearwater, large gulls	Mortality in gill nets and on longlines is poorly documented but probably important in some inshore areas
Direct competition	Northern Gannet?	Human fishery usually takes larger fish than seabirds; little evidence of effects via changes in fish populations
Reduction in discards	Northern Fulmar, shearwaters, **large gulls**, skuas	Scavenging species benefited greatly for many decades from abundant discards; subsequent reduction in discards very important for gulls, poorly documented for other species
Hunting	Common Eider, **White-winged Scoter**; other seaducks, loons?	Present level of hunting is major threat to White-winged Scoter; probably unsustainable for other seaducks
Toxic chemicals		
Organochlorine pesticides, PCBs	Common Eider, **Great Cormorant**, Double-crested Cormorant, Least Tern, Black Guillemot	These species benefited for decades from pesticide-caused absence of large predators; now subject to heavy predation as DDE has declined and predators have become reestablished
PBDEs	Common Tern?	An emerging threat to Common Terns and other species
Human Disturbance	Brown Pelican?, Double-crested Cormorant, Least Tern	Most breeding seabirds can habituate to human disturbance, but intensive management required

Table 9. *(continued)*

Type of threat	Species affected	Potential importance
Human-enhanced Preation	Terns, Black Skimmer	Not a major threat to any species, but reduces breeding success at many locations and forces Least Terns and other species to breed in unfavorable sites
Large gulls	Leach's Storm-Petrel, Laughing Gull, Common, Arctic and Least Terns, alcids	Large gulls have excluded these species from many of the most suitable sites, requiring intensive management; threat receding as large gulls decline
Offshore wind turbines	Northern Gannet, Brown Pelican, cormorants, gulls, terns	Potentially a serious threat to many species, but lack of appropriate data makes threat difficult to assess
Oil spills	Loons, seaducks, Roseate Tern, alcids	Important in the past; now not major threat to any species, but Common Eider, Harlequin Duck, Long-tailed Duck, Roseate Tern, and Razorbill remain vulnerable
Plastics and other artifacts	Pelagic species, Brown Pelican	Brown Pelicans are frequently entangled in fishing lines; pelagic species ingest plastic particles, but effects unknown
Diseases and biological toxins	Common Eider, Common Tern, others?	Botulism, avian cholera and paralytic shellfish poisoning are increasing and may become important; highly pathogenic avian influenza might be important in the future

are lacking. Otherwise, many or most of the reported effects have been positive. However, the nature and importance of interactions that may take place in the future are difficult to predict. The severe overfishing of Georges Bank and other areas during the 1970s, 1980s, and 1990s has resulted in profound changes in marine ecosystems, which could have major and unpredictable effects on the seabirds that depend on these ecosystems. Climate change will also affect these ecosystems, increasing both the size and unpredictability of effects (see **Climate Change**). If a commercial fishery for American Sand Lance should be instituted in the future, this would probably have severe adverse effects on many seabird species.

Hunting

Among the species considered in this paper, only the seaducks (eiders, scoters, Long-tailed Duck, and Red-breasted Merganser) are hunted legally in the United States and Canada. Hunting is nominally regulated through hunting seasons and bag limits, but both these limitations are very liberal in most areas of the United States (up to 107 days per season and 5–7 birds per day in most states). Although enforcement is generally light, hunting mortality is limited in practice by the logistic difficulties of hunting birds that frequent the open sea, and by the low palatability of seaducks. However, where hunting takes place, the bag limits are habitually reached (B. Allen, pers. comm.). Concern has been expressed about increasing hunting pressure on these species following more restrictive regulations on other waterfowl (Ad Hoc Sea Duck Committee 1994).

In the period 1974–97, the mean total yearly harvests of these species reported by hunters in the eastern United States were: 33 King Eiders, 26,000 Common Eiders, 41 Harlequin Ducks, 14,000 Long-tailed Ducks, 15,000 Surf Scoters, 14,000 White-winged Scoters, and 8800 American Scoters; most of these were harvested in Maine, Massachusetts, and Maryland (Caithamer et al. 2000). Harvests of all the major species increased during the period 1963–71; thereafter harvests of Common Eiders continued to increase at 3% per year, those of Long-tailed Ducks remained constant, and those of the 3 scoter species declined at 6–8% per year. These changes appeared to have been responsive to changes in hunting regulations (Caithamer et al. 2000). The daily bag limit for scoters (all species) in the United States was reduced from 7 to 5 in 1993 (Caithamer et al. 2000), and that for Common Eiders in Maine was reduced from 7 to 5 in 1999 (Allen and McAuley 2005). A mean annual harvest of 19,000 Red-breasted Mergansers was reported by hunters in the period 1971–80 (Carney et al. 1983). Harvests are probably under-reported by hunters, and the reported numbers do not include crippling losses; moreover, many ducks from the same populations are also harvested in Canada.

Based on population estimates summarized in Table 8, hunting pressure is probably greatest on White-winged Scoter and Common Eider. For White-winged Scoter, available data suggest that the total number wintering in the Atlantic Flyway is currently only in the tens of thousands, numbers appear to have declined, and the wintering range appears to have contracted in recent decades (see **Species Accounts**). The entire annual harvest in the Atlantic Flyway (including Canada) declined from >44,000 in 1975 to 11,000 in 1995–97. Part of this decline was due to the reduction in bag limits in 1993, but the harvest of White-winged Scoters declined much more rapidly after 1993 than those of the other 2 scoter species (Caithamer et al. 2000). These data suggest that hunting has contributed significantly to the decline of this species, and that the current level of hunting mortality is unsustainable.

For Common Eider, Krohn et al. (1992) estimated that the annual harvest of 25,000 in the period 1981–88 accounted for 12–15% of the wintering population in the United States. Although this conclusion may have been valid for the Gulf of Maine, their estimate of the total wintering population probably omitted large numbers in southeastern Massachusetts (see **Species Accounts**). Hicklin (cited by Ad Hoc Sea Duck Committee 1994) calculated that the annual harvest of Common

Eiders in the United States and Maritime Canada combined was similar to or exceeded annual production. This conclusion also is implausible, however, because the level of hunting mortality during the 1980s did not prevent a rapid increase in the breeding population of Common Eiders in Maine (Krohn et al. 1992). However, Common Eiders now appear to be decreasing in the Gulf of Maine and the Bay of Fundy, despite reduction in bag limits in 1999, and the current level of hunting mortality is probably unsustainable for this species also, at least as it affects breeders in that area.

The clearest evidence for the importance of hunting mortality for seaduck populations is provided by Harlequin Duck. This species declined to a critical level in the early 1990s under heavy hunting pressure, mainly in Canada (where 4400 were taken in 1986–88: Caithamer et al. 2000), but rebounded immediately after hunting ceased, following its listing as endangered in Canada and threatened in the eastern United States (Robertson and Goudie 1999; Mittelhauser et al. 2002).

Hunting mortality may also be significant for Red-breasted Merganser, but this is difficult to assess because there are no reliable data on total numbers or trends (see **Species Accounts**). Hunting mortality could also be significant for King Eider, because the reported annual hunting mortality is similar to total numbers reported in the only numerical survey available (Table 4). For the remaining 3 species—Surf and American Scoters and Long-tailed Duck—annual hunting mortality is probably in the range 3–5% of total numbers, about the highest level at which Goudie et al. (1994) estimated that seaduck populations can be sustained. In summary, hunting at current levels appears to pose threats to all seaducks except for the recently-protected Harlequin Duck.

Illegal hunting or accidental shooting may pose a threat to loons in the eastern United States. In a recent study of causes of loon mortality in New England, >30% of Common Loons found dead or dying had shot embedded in their tissues (M. Pokras, pers. comm.). Although shooting was infrequently identified as the proximate cause of death of these loons, this indicates that a large fraction of the loons breeding or wintering in this area had been shot at least once.

Other Direct Human Persecution

Direct human persecution was extremely important in reducing seabird populations in the eastern United States during the 19th century, as summarized in **Historical Perspective**. Killing of adults and chicks for food and collection of their eggs probably caused major population declines in cormorants, gulls, terns, and alcids during the 18th and 19th centuries (Drury 1973–74). This was followed by large-scale killing of breeding adult seabirds for feathers during the 1870s and 1880s (Doughty 1975), which eliminated most of the remaining seabirds from the entire US east coast (Nisbet 1973, Drury 1973–74). All these forms of persecution were gradually brought under control in the early decades of the 20th century by protective legislation and wardening of major colonies (Drury 1973–74). Deliberate taking of eggs or adults for food or feathers is probably unimportant today for any breeding seabird species in the eastern United States.

Many attempts have been made to control populations of "nuisance" species such as cormorants and gulls. In most areas along the Atlantic coast, Double-crested

Cormorants have traditionally been persecuted by fishermen in the mistaken belief that the cormorants competed with them for stocks of commercial fish species (Mendall 1936; Palmer 1949; Drury 1973–74; Krohn et al. 1995). In the period 1944–53, Gross (1951) conducted a large-scale program of spraying eggs of Double-crested Cormorants in New England, with the goals of reducing the breeding population in Maine and preventing further spread south into Massachusetts. During this period, 187,821 eggs were sprayed, mostly in Maine (Krohn et al. 1995). Although this program was judged to have been a failure and was discontinued in 1954, it appears to have been successful in reversing the growth in the population; numbers nesting in New England declined by roughly 25% between 1945 and 1950 (Drury 1973–74).

Gross also conducted a large-scale program of spraying Herring and Great Black-backed Gull eggs in Maine and Massachusetts. From 1938–53, he and his employees sprayed >800,000 gull eggs (Gross 1951; Drury and Nisbet 1972; Drury 1973–74). Although this program also was judged to have been a failure and was discontinued in 1954, it appears to have been successful in stopping the growth of the Herring Gull population for about a decade (Drury 1973–74). However, it did not stop the southward expansion of breeding gulls into Massachusetts and New York, and may actually have promoted the southward spread of both species by reducing their breeding success in Maine (Drury and Nisbet 1972). Since 1954, a number of smaller-scale programs have been conducted to control local populations of these same species in the vicinity of airports, reservoirs, buildings, and tern colonies (Blodget 1988). Some of these programs have been successful in alleviating local problems (e.g., Kress 1983; Harlow 1995), but they were not designed to reduce regional gull populations and have not done so.

An intensive program of shooting Laughing Gulls was started at J.F. Kennedy International Airport, New York, in 1991. The program was directed at a breeding colony in adjoining Jamaica Bay Wildlife Refuge, a unit of Gateway National Recreation Area, which had increased to 7900 pairs in 1990. Even though the evidence that Laughing Gulls posed a hazard to aircraft was disputed by many biologists (e.g., K. Brown et al. 2001), and a nonlethal control program had been proved effective on the airport (Buckley and Gurien 1986; Buckley and McCarthy 1994), a permit to shoot them was issued and 57,000 were killed between 1991 and 2000 (Dolbeer et al. 2001). The shooting program has continued at about the same level since 2000 (R. Dolbeer, pers. comm.), so the total number of Laughing Gulls killed is now probably >100,000. Many of those killed appear to have been juveniles dispersing from the expanding population in New Jersey to the south, so the program reduced the local colony only from 7900 pairs in 1990 to 5800 pairs in 1995, 2700 pairs in 2000, and 2500 pairs in 2006 (USGS database; Dolbeer et al. 2001; Washburn et al. 2006). Although numbers breeding in New Jersey and south continued to increase, those from Long Island north remained more or less constant during this period, with a marked decrease on Long Island offset by continuing increases in Massachusetts and Maine (see **Species Accounts**). About 6000 other gulls, mostly Herring Gulls, were also killed in this program between 1991 and 2000 (Dolbeer et al. 2001): this might have contributed to the reported decline in numbers of Herring Gulls nesting in western Long Island during that period, although few adults were killed (P.A. Buckley, pers. comm.). More recently, programs to control numbers of breeding Laughing Gulls have been conducted at several tern colonies in the Gulf of Maine, and may have halted or reversed the increase in numbers in that area also (GOMSWG annual reports; L. Welch, unpubl. data).

Deliberate human persecution in their winter quarters may be important for several seabirds. This problem has been documented most fully for Common and Roseate Terns, which are (or were) killed for food in winter in Guyana (Blokpoel et al. 1982; Nisbet 1984a; P. Trull, pers. comm.) and in Brazil (M. Amaral, pers. comm.). Many Common and Roseate Terns were also caught on fishing boats off Guyana, although at least some were released alive (P. Trull, pers. comm.; I.C.T. Nisbet, unpubl. data). During the 1970s, 2.5% of the Roseate Terns banded in the northeastern United States were killed and reported from a small area in northeastern Guyana, mostly by a single trapper (Nisbet 1984a). That individual stopped trapping during the 1980s and the number of recoveries declined precipitously; there is no recent information on the extent of trapping in Guyana or in other parts of South America. The annual mortality rate of adult Roseate Terns appears to be unusually high (Spendelow et al. 1995, 2008; Lebreton et al. 2003) and it has been suggested that human persecution in their South American winter quarters may be an important factor in this mortality (Nisbet 1989). This remains conjectural, however, without better data on the extent of human predation in South America. Other species that may be at risk from human persecution include Gull-billed, Royal, Sandwich, and Least Terns, and perhaps Laughing Gull.

Human Disturbance

Human disturbance is a pervasive threat to nesting seabirds in the eastern United States, because of the development and heavy use of beaches and islands for recreation (see **Human Development**). There is an extensive literature describing apparent adverse effects of human disturbance on nesting seabirds, or documenting apparent inverse relationships between human disturbance and seabird distribution or breeding performance (Gillett et al. 1975; Kury and Gochfeld 1975; Buckley and Buckley 1977; Ellison and Cleary 1978; Manuwal 1978; Anderson and Keith 1980; Erwin 1980; Godfrey et al. 1980; Burger 1981; Rodgers and Burger 1981; Kress et al. 1983; Safina and Burger 1983; Clapp and Buckley 1984; Burger and Gochfeld 1994; Burger et al. 1995; Rodway et al. 1996). Much of this literature is anecdotal, however, and it is difficult to draw generalizations because of wide variations in the characteristics of human disturbance and in the birds' responses to it. Nisbet (2000) reviewed the literature on the effects of human disturbance on breeding colonial waterbirds, concluding that many of the published studies were of low scientific quality, and that most reports of adverse effects were equivocal or erroneous. Specifically, he concluded that there was little scientifically acceptable evidence that human disturbance causes substantial harm to breeding terns or gulls, although he thought it likely that sporadic incidents of deliberate harassment and vandalism were under-reported. These and other seabirds readily habituate to human activity when it is frequent and predictable (e.g., well-planned research activities). However, there is sound evidence that pelicans, cormorants, and alcids are adversely affected by human activity that is infrequent or sporadic (Nisbet 2000). Nisbet pointed out several cases where intensively-studied colonies of terns had become extremely tolerant of human activity, and recommended that seabird colonies in areas of high human activity should be deliberately managed to increase tolerance.

Least Tern is probably the species that is most vulnerable to human disturbance, because of its preference for nesting on mainland beaches heavily used for recreation (Kress et al. 1983; Burger et al. 1995). However, Least Terns readily habituate to human activity close to breeding colonies, if the sites are managed so that humans do not enter the nesting areas (e.g., Brubeck et al. 1981). Other species that appear especially sensitive to disturbance include Brown Pelican (although all documented cases refer to Pacific coast birds) and Double-crested Cormorant, which tends to leave its eggs and chicks open to predation when disturbed (Kury and Gochfeld 1975; Ellison and Cleary 1978). Breeding colonies of these and other species on islands that are generally undisturbed tend to be relatively sensitive to the effects of occasional visits, because the birds have never had the opportunity to habituate to disturbance. The species least vulnerable to disturbance are those that nest on saltmarshes or other sites that are unattractive to visitors, such as Common Tern (Burger and Gochfeld 1991) and Forster's Tern (McNicholl et al. 2001), and those that nest in burrows or other inaccessible sites, such as Leach's Storm-Petrel and Black Guillemot. Clapp and Buckley (1984), and Via and Duffy (1992) cited evidence that human disturbance might be a significant threat to Gull-billed Terns. Otherwise, human disturbance is probably not a critical threat to any species in the area, but acts as a general stressor, preventing birds from breeding at many suitable sites and reducing their breeding success in an irregular fashion at others. Human disturbance is successfully managed at many sites (Kress et al. 1983; Parnell et al. 1988; Nisbet 2000; Kress and Hall 2004), but this requires great expenditure of time and resources on enforcement, wardening, public relations, and education.

Human-enhanced Predation

Another way in which human activity can affect seabirds is by promoting populations of alien or native predators in the vicinity of seabird colonies. Predatory species involved include cats (both domestic and feral), dogs, rats, Red Foxes, skunks, Coyotes, Raccoons, crows, and gulls (Kress and Hall 2004). Humans promote these predators by deliberate introduction (cats and dogs), by building bridges and causeways to barrier islands (Red Foxes, Coyotes, Raccoons, and other terrestrial predators), and by providing food for commensal species (rats, Red Foxes, Coyotes, Raccoons, skunks, crows, and gulls). Feral cats are an especially serious problem both because they are efficient predators and because they are often deliberately released and sometimes fed by people. Other predators may be facilitated by the habitat modifications that accompany development: Red Foxes, Coyotes, and Great Horned Owls benefit from increases in rabbit, rodent, and cat populations in developed areas.

Except for predation by gulls, discussed in the next section, most of the effects of these predators occur near human habitations—on islands in city harbors (including Portland, Boston, New York, and Baltimore), and on barrier beaches or barrier islands developed for human residence and recreation. Mammalian predators are usually limited to mainland sites or to islands readily accessible from the mainland (e.g., Austin 1948; Burger and Gochfeld 1991). Consequently, the effects of human-promoted predators are greatest on seabird species that use such sites, especially terns and Black Skimmers (Kress et al. 1983; Burger and Gochfeld 1990, 1991, 1994b; Kress and Hall 2004). Burger and Gochfeld (1990, 1991) found that Black Skimmers and Common Terns nesting on barrier beaches in New York and New Jersey suffered much higher rates of predation than those nesting in saltmarshes, and that human commensals (rats, cats, and dogs) were the most important predators at the beach sites. Buckley and Buckley (1980) found that saltmarsh-nesting Roseate Terns in their concealed nests on Long Island, New York, were far more susceptible to rat predation than Common Terns were in their open nests, and were consequently extirpated from saltmarshes. Nisbet (1981, 1989) and Nisbet and Welton (1984) reported that Great Horned Owls were the most important predators limiting breeding success in Common and Roseate Terns in Massachusetts, and suggested that this predation was much more severe in inshore colonies than on the offshore island sites that were formerly the preferred breeding sites for these species. For Least Terns, however, the literature summarized by Kress et al. (1983) and Kress and Hall (2004) suggests that the most important threats are mammalian predators such as Red Foxes and Striped Skunks, and this suggestion has been verified by fencing some colonies to exclude these predators (Minsky 1980; Rimmer and Deblinger 1992; Spear et al. 2007). At the Elizabeth Islands in Massachusetts, large colonies of Herring Gulls and small colonies of Common and Least Terns disappeared abruptly after Coyotes became established there in the 1980s (J.J. Hatch and I.C.T. Nisbet, unpubl. data). Feral cats are important predators at many tern and skimmer colonies on barrier beaches (Kress and Hall 2004; P.A. Buckley, unpubl. data), and their effects are often overlooked or underestimated because they hunt at night and leave fewer traces than other predators.

The overall impact of human-promoted predators is difficult to assess, because much of the evidence for their effects is anecdotal or correlational. Currently, no seabird species in the eastern United States appears to be seriously threatened throughout the area by human-promoted predators. However, these predators appear to augment the effects of human development and disturbance, preventing seabirds of several species from breeding at many suitable sites (especially sites attached to or accessible from the mainland) and reducing their breeding success in an irregular fashion at many others. This may help to explain why so few marine birds breed in states with few islands (Rhode Island and Connecticut) and why so many breed in saltmarshes in other states (New York, New Jersey, and Maryland).

Large Gulls

Herring and Great Black-backed Gulls are seabirds whose numbers in the eastern United States have been promoted by human activity and that have been identified as threats to several other seabird species. Historical information on the increase and spread of both species was reviewed by Kadlec and Drury (1968) and Drury (1973–74); more recent data are summarized in the **Species Accounts**. Both species increased through about 1980 (except for a period in the 1940s and 1950s when large-scale control activities were carried out) and spread from Maine to North Carolina. Since 1980, Herring Gulls appear to have decreased in numbers in most areas; Great

Black-backed Gulls continued to increase until the 1990s, but appear to have decreased since then. The population explosions in both species have been attributed, in varying degrees, to relaxation of persecution and to provision of excess food in the form of municipal wastes, fisheries wastes, pig food, and sewage. The relative roles of these factors have been debated, and probably vary among species and regions (Drury and Nisbet 1972; Nisbet 1978b; Pierotti and Good 1994; Good 1998). The recent decline in the regional population of Herring Gulls is probably attributable to improved management of all these types of waste, resulting in decreased food availability, although predation by Great Black-backed Gulls may also play a role. The apparent decline in the regional population of Great Black-backed Gulls since the 1990s must be due to reduced food availability, at least in the southern part of its range, because this species has no significant predators on most of the islands where it nests, except Bald Eagles at a few sites in Maine.

The increase and spread of large gulls have been associated with adverse effects on many other seabird species. These include Common Eiders (Mawhinney et al. 1999), Common, Arctic, and Roseate Terns (Drury 1965, 1973–74; Hatch 1970; Nisbet 1971b, 1973, 1981, 1989; Houde 1977; Kress 1983; Kress et al. 1983; Kress and Hall 2004); Laughing Gull (Nisbet 1971a, b); Double-crested Cormorant (Kury and Gochfeld 1975); Leach's Storm-Petrel (Drury 1973–74); and Atlantic Puffin (Drury 1973–74; Kress and Nettleship 1988). Large gulls have two distinct types of effect on these seabird species. First, they prey directly on eggs, chicks, and adults of all these species (Hatch 1970; Nettleship 1972; Drury 1973–74; Kury and Gochfeld 1975; Nisbet 1981; Kress and Hall 2004; W.H. Drury, pers. comm.). This predation may have contributed to the decline in numbers of Leach's Storm-Petrels on several islands in Maine (Drury 1973–74), and in Massachusetts (I.C.T. Nisbet, unpubl. data), and may also have been responsible for the very slow population recovery of Atlantic Puffins in Maine and New Brunswick during most of the 20th century (Drury 1973–74; MacKinnon and Smith 1985). Recently, Great Black-backed Gulls have become major predators on Common Eider chicks at some sites in Maine and New Brunswick. In that area, Common Eiders nest almost exclusively in association with Herring Gulls (Bourget 1973), probably thereby gaining some protection from predation by other species. In recent decades, the ratio of Great Black-backed Gulls to Herring Gulls has continued to increase, locally reaching the point where this protection has become ineffective (Mawhinney et al. 1999; B. Allen, pers. comm.; GOMSWG annual reports).

Second, large gulls displaced terns and Laughing Gulls from many colony sites in New England, including almost all the sites occupied by large colonies prior to 1930 (Nisbet 1971a, 1973, 1980a; Drury 1973–74; Kress et al. 1983; Kress and Hall 2004). The terns and Laughing Gulls were displaced to less suitable colony sites on or near the mainland, where they were subject to human disturbance and to predation by Great Horned Owls and other mainland predators (Nisbet 1981, 1989; Kress et al. 1983; Nisbet and Welton 1984; Kress and Hall 2004; I.C.T. Nisbet, unpubl. data). At least in Massachusetts, these indirect effects of large gulls were much more important than direct effects of predation (Nisbet and Welton 1984; Nisbet 1989). In several cases, the inferred effects of large gulls on colony occupation and breeding success of other species have been verified by removal or displacement of the gulls, which has led to restoration of several major tern colonies that had been occupied by gulls for many years (Kress 1982, 1983, 1997; Drennan et al. 1986; Harlow 1995; Anderson and Devlin 1996; Nisbet 2002a; Kress and Hall 2004). Some of these projects have also permitted reintroduction or resettlement by other species such as Laughing Gull, Atlantic Puffin, and Razorbill (Kress 1982, 1997; Kress and Nettleship 1988; GOMSWG annual reports).

Although Laughing Gulls suffered from displacement by larger gulls, they themselves have been implicated in displacing terns from preferred nesting sites. An early example was at Muskeget Island, Massachusetts, where one of the largest colonies of Common and Roseate Terns was completely displaced by Laughing Gulls in the 1930s, and the Laughing Gulls were in turn displaced by Herring Gulls in 1971–72 (Nisbet 1971a, 1980; Wetherbee et al. 1972). More recently, Laughing Gulls have increased as breeders at several islands in Massachusetts and Maine and are spreading into areas occupied by terns, despite attempts to control them (GOMSWG annual reports; L. Welch, unpubl. data).

South of New England, large gulls have been implicated as factors limiting tern populations (Kress et al. 1983), but little definitive information is available. In New Jersey, Herring Gulls have displaced Common Terns from some colony sites in saltmarshes (Burger and Lesser 1979; Burger and Gochfeld 1991), but it is not known if these displacements resulted in demonstrable population effects.

Offshore Wind Turbines

An emerging threat to marine birds is the use of wind turbines for electricity generation. Offshore sites are attractive to developers because they generally have stronger and more consistent winds than onshore sites, but offshore facilities are more difficult to construct and maintain, and their environmental hazards are more difficult to study. To date, no wind power facilities have been constructed off the Atlantic coast, but a major facility has been approved for Nantucket Sound, Massachusetts; several other sites are under consideration off Massachusetts, Rhode Island, Long Island, and New Jersey. All proposed sites are in shallow inshore waters where marine birds such as seaducks, loons, Brown Pelican, cormorants, terns, and Razorbill are most numerous. Modern turbines typically have rotors that extend from 50 m to 150 m above the sea, thus posing collision hazards to seabirds (as well as migrating landbirds) flying at these heights. Assessing the magnitude and significance of these hazards requires information about the numbers and heights of flight of birds in the area of each project; this site-specific information is difficult to obtain, especially at night and in bad weather when the hazards are expected to be greatest. Early results of studies of wind facilities already constructed offshore and onshore in Europe suggest that many birds are able to avoid turbines that lie across their flight paths, but that some seabirds such as terns and gulls are nevertheless killed (Desholm and Kahlert 2005; Everaert and Stienen 2007; Newton and Little 2009). With the limited evidence currently available, the species at greatest risk appear to be those that habitually fly at rotor heights, such as Northern Gannet, Brown Pelican, cormorants, and gulls, but other species such as terns and seaducks also fly at these heights under some circumstances. Species with low maneuverability like the Brown Pelican may be at especially high risk of collision. Arrays of turbines dispersed in shallow waters may also displace birds such as seaducks that would otherwise forage in or migrate through the same areas, although there is evidence that the structures may locally enhance prey populations by serving as artificial reefs.

Oil Spills

Although major oil spills occurred in waters off the eastern United States in the past, they appear to have become much less frequent in recent decades. The largest series of spills was in early 1942, when at least 42 ships were sunk off the coast between Florida and Georges Bank, spilling at least 3 million barrels of oil (Campbell et al. 1977). Subsequently, there were major spills in the Nantucket Shoals area in 1952 (Burnett and Snyder 1954), 1969 (Grose and Mattison 1977), and 1976 (Grose and Mattison 1977; Powers and Rumage 1978). The extent of bird mortality in these and smaller offshore spills is unknown, because the prevailing winds are offshore; most of the spilled oil moved away from the coast and very little came ashore. The 1952 spills were said to have killed hundreds of thousands of Common Eiders (Griscom and Snyder 1955; Hill 1965), but this conclusion was based on a comparison of single shore-based estimates and has been disputed by Erskine (1990); see discussion in the **Species Accounts**.

The only offshore spill in this area that has been investigated *in situ* for effects on birds was the wreck of the *Argo Merchant* east of Cape Cod in 1976 (Powers and Rumage 1978). Although mortality in this spill was poorly documented because of stormy winter weather and offshore winds, the spill appears to have killed substantial numbers of Razorbills and Common Murres, and it may have had an important population-level effect on Razorbill, a geographically restricted species. Many Herring and Great Black-backed Gulls were also oiled in this incident (Powers and Rumage 1978). However, no major offshore spill has occurred in the area since 1976.

The *Deepwater Horizon* oil spill in the northern Gulf of Mexico in 2010 is unlikely to have affected any seabird population that breeds in or migrates through east coast waters, with the possible exception of Northern Gannet. All other marine birds that occur in the area affected by the spill are derived from breeding populations either in the Gulf itself or in the interior of North America.

Despite improved handling and safety procedures, small oil spills still occur quite frequently in inshore waters, especially in Delaware and Chesapeake Bays, but also in other semi-enclosed waters such as Narragansett Bay, Buzzards Bay, and New York Harbor (Burger 1997). These small spills in semi-enclosed waters may have more serious impacts on birds than larger spills in the open Atlantic. They generally affect birds such as loons, grebes, and seaducks, and may still represent a significant source of mortality for them. However, much larger mortality of these species was reported in earlier oil spills in these waters. For example, 40,000 birds were oiled in oil spills in Chesapeake Bay in 1976 and 1978, including 16,000 Long-tailed Ducks (Perry et al. 1979). A small spill of fuel oil in North Carolina in 1982 affected a number of Brown Pelicans (Parnell et al. 1984). Another relatively small spill of fuel oil in Buzzards Bay in 2003 caused heavy oiling of a major tern colony and lighter oiling of 2 others; these sites supported about half the Roseate Terns nesting in North America and several thousand pairs of Common Terns (Buzzards Bay National Estuary Program 2003;

NOAA 2005). Few adult terns appear to have been killed outright in this incident; effects on reproduction have been reported (US Fish and Wildlife Service 2004) but are still under study.

"Chronic" oil pollution, attributable to small discharges during bilge pumping, tank washing, etc., continues to occur throughout the area, although apparently at lower levels than in the past. Marine birds undoubtedly are affected by these discharges, but the extent of mortality has not been documented reliably because the prevailing winds are offshore and few carcasses reach the shore (Wiese and Robertson 2004).

At present, no oil or gas wells are operating in the region and lease sales have been under a moratorium for many years. This moratorium was lifted in late 2008, but it is uncertain whether, when, and where leases will be sold and exploited. It seems unlikely that substantial reserves of hydrocarbons will be discovered off the US east coast; if they should be, they are more likely to yield gas (with low hazard to birds) than oil (National Research Council 1991).

Overall, it appears that oil presents less serious threats to marine birds off the Atlantic coast of the United States than in other regions of North America. Generally, the species most at risk from oil spills are surface swimmers such as loons, grebes, seaducks, and alcids. The individual species most at risk in the area covered by this paper are probably Roseate Tern (largely confined to 3 breeding colonies close to a major transportation route for refined oil products) and Razorbill (with a limited population concentrated in winter in the Bay of Fundy and around Cape Cod). Inshore spills at critical locations could also threaten Harlequin Ducks, Brown Pelicans, or breeding alcids. A major offshore spill near Georges Bank could affect significant numbers of Great Shearwaters or phalaropes if it were to coincide with aggregations of these species (National Research Council 1991). Another major spill near Nantucket Shoals could affect large numbers of Long-tailed Ducks and Common Eiders.

Toxic Chemicals

During the 1950s and 1960s, several species of seabirds were adversely affected by contamination of marine food webs with chlorinated hydrocarbons, primarily DDE (reviews by Nisbet 1980b, 1994; Burger and Gochfeld 2002). On the Atlantic coast, the best-documented effects were on Northern Gannet (Chapdelaine et al. 1987) and Brown Pelican (Blus 1982), but other species were probably affected also, including Common Tern (Nisbet and Reynolds 1984; Nisbet 2002a) and Double-crested Cormorant (Drury 1973–74). The principal effect reported was impaired reproduction, which led to reductions in regional populations of Northern Gannet and Brown Pelican and probably contributed to declines in regional populations of Common Tern and Double-crested Cormorant (both the last two species were more seriously affected at inland sites). Following reductions in DDE levels in the environment during the 1970s, all of these species have recovered and have increased in numbers (see **Species Accounts**). Except for low-level effects of PCBs (Nisbet 1994, 2002a), there is little evidence for adverse effects of chlorinated hydrocarbons on seabirds in the eastern United States at the present time. It has been conjectured that toxic chemicals might have contributed to the population decline in Gull-billed Terns in the 1970s and 1980s (Williams et al. 1990); this possibility merits investigation in view of the terrestrial diet of this species and the intensity of pesticide use within its range. Increasing levels of brominated flame retardants (PBDEs) have been detected recently in Common Terns (I.C.T. Nisbet and S. Jayaraman, unpubl. data), but no adverse effects have yet been reported.

Elevated levels of mercury, lead, and other metals have been found in Common Terns in Massachusetts and New York (Burger et al. 1992, 1994). Generally, higher levels of metals occur in the tissues of pelagic seabirds than in inshore seabirds (Nisbet 1994), but few data are available from pelagic seabirds breeding in the eastern United States. It is not yet clear whether the high levels of metals in pelagic seabirds pose threats to their survival (review in Nisbet 1994). However, an ongoing study of causes of death in Common Loons in New England has revealed that about 30% died from lead poisoning, resulting from ingestion of lead sinkers lost or discarded by fishermen (M. Pokras, unpubl. data).

An indirect effect of toxic chemicals was mediated through their effect on two species that were formerly important predators on seabirds: Peregrine Falcon and Bald Eagle. Peregrine Falcons formerly bred at a few sites in coastal Maine; Bald Eagles formerly bred in most coastal regions of the eastern United States and Nova Scotia. As a consequence of exposure to pesticides, primarily DDE and dieldrin, Peregrine Falcons were extirpated as breeders from most of eastern North America by the early 1960s (Berger et al. 1965), and Bald Eagles were severely reduced during the 1950s and 1960s. Control of these pesticides led to recovery of both species starting in the mid-1970s (Buehler 2000; White et al. 2002). Bald Eagles have now recovered their pre-pesticide numbers in most coastal areas and are continuing to increase (Buehler 2000; McCollough et al. 2003). Peregrine Falcons have been reintroduced successfully to many areas in eastern North America and now breed at two sites on the Maine coast (L. Welch, pers. comm.); they were also introduced to artificial breeding sites well outside their historical habitat along the coast from New Jersey to South Carolina (White et al. 2002). During the period when these predators were absent, terns, gulls, and cormorants increased along the entire coast, and several of these species spread in Maine from outer islands to islands closer inshore (Drury 1973–74). As numbers of Peregrine Falcons and Bald Eagles along the coast increased in the 1980s and 1990s, both species again became important predators on seabirds, mainly in coastal colonies from Massachusetts north. Peregrine Falcons prey on terns and Laughing Gulls (Nisbet 1992; J.G.T. Anderson and L. Welch, pers. comm.), whereas Bald Eagles take Common Eiders, cormorants, and gulls (L. Welch and J. Drury, pers. comm.). In combination with predation by Great Black-backed Gulls, Bald Eagles have contributed to breeding failures at several Common Eider colonies in Maine, and appear to be primarily responsible for the recent decline in numbers of Double-crested and Great Cormorants there; Great Cormorant is now in danger of extirpation from the entire area (L. Welch and J. Drury, pers comm). Predation by Peregrine Falcons has adversely affected several colonies of terns and gulls (Nisbet 1992; L. Welch, pers. comm.), but appears to be important only locally or sporadically and does not threaten any regional population. There is little information on predation by these species on seabirds south of Massachusetts, but Peregrine Falcons introduced to coastal New Jersey are reported to have preyed on Least Terns (P.A. Buckley, pers. comm.). Bald Eagles have become numerous along the entire coast from New Jersey to Florida (Buehler 2000), and pose threats to breeding seabirds such as Brown Pelicans and gulls.

It is possible that similar effects may have occurred with American Mink, which have become significant predators on terns and Black Guillemots in Maine in the past 15 years, even on islands 10–20 km from the mainland (J. Drury, pers. comm.; GOMSWG annual reports). Mink are extremely sensitive to toxic effects of PCBs (Brunström et al. 2001), and it is possible that these chemicals may have limited the distribution of American Mink along the Maine coast from the 1960s until contamination levels declined in the 1990s (I.C.T. Nisbet, unpubl. data).

In summary, toxic chemicals eliminated two (perhaps three) important predators from several areas of the US east coast for several decades; several species of seabirds increased and spread during that period, but are now declining and contracting their ranges as the predators increase again. These positive effects of toxic chemicals on seabirds, albeit temporary, appear to have offset the negative effects of the same chemicals on some of the same species during the same period. The net effect was negative for Northern Gannets and Brown Pelicans, but was probably positive for terns and cormorants.

Plastics and Other Artifacts

Plastic objects and other long-lasting human artifacts have become abundant at sea and along the shore during the past 50 years. Seabirds encounter such artifacts and may ingest small objects (such as industrial pellets or small fragments of plastic) or become entangled in larger objects (such as fishing lines or nets). Nisbet (1994) reviewed the literature and concluded that plastics posed potential threats to several species of seabirds, but that significant effects had not yet been demonstrated. Moser and Lee (1992) reported on a 14-year survey of plastic ingestion by seabirds in the western North Atlantic. They collected seabirds of 38 species off North Carolina and found plastic particles and artifacts in the guts of 21 species. Plastic particles were found at the highest frequencies and in largest quantities in Northern Fulmars, Great Shearwaters, and Red Phalaropes. However, Moser and Lee were unable to find evidence of adverse effects even in these species.

Schreiber (1975) reported that 80% of wild Brown Pelicans in Florida showed signs of injury from entanglement with fishing gear. Buckley and Buckley (1974) reported cases in which Royal Terns were entangled in fishing lines. Gochfeld (1973) reported that Common Terns at a colony on Long Island were occasionally entangled in kite strings. Entanglement with fishing lures may be a significant source of mortality for Great Black-backed Gulls in the northeast (I.C.T. Nisbet, unpubl. data).

Overall, it appears unlikely that ingestion of plastic particles poses significant threats to seabirds off the eastern United States. However, continued study of shearwaters and petrels is warranted, because their exposure to plastic particles and artifacts appears to be still increasing. More quantitative information is needed on threats to Brown Pelicans and other species from fishing gear.

Diseases and Biological Toxins

The roles of diseases, parasites, and biological toxins in affecting or controlling seabird populations are very poorly understood. To date, the evidence that pollution or other human activities can act to modify these roles has been equivocal (Nisbet 1994). Paralytic shellfish poisoning (caused by toxins of dinoflagellates or other marine algae) has been recorded occasionally in both fish-eating and mollusk-eating seabirds (Nisbet 1984b). The frequency of blooms of toxic algae has been increasing and new types of toxin have appeared in recent years, probably a consequence of increased pollution loads in inshore waters (Work et al. 1993). Outbreaks of botulism (poisoning by toxin of the bacterium *Clostridium botulinum* type C) have been recorded occasionally in gulls (Brand et al. 1988). An outbreak of avian cholera at a tern colony in Maine in 1988 killed 60 Common and Arctic Terns; all survivors deserted the colony and only about one-third resettled later in the season (Kress 1997). See **Threats on Foreign Breeding Sites** for effects of avian cholera and *Erysipelas* on albatrosses. Recent die-offs of Common Eiders and Common Terns in Massachusetts have been associated with parasitism by *Acanthocephala* (spiny-headed worms) and to *Salmonella* infections, respectively, but it is not clear that either was the primary cause of the deaths (B. Harris and J. Ellis, pers. comm.). All these incidents were isolated and sporadic: to date, there is little evidence that these agents have affected seabird populations in a substantial way. However, they may become more important in the future, especially for gulls, terns, and seaducks. West Nile Virus and Highly Pathogenic Avian Influenza (HPAI) have not yet been recorded in marine birds in North America (Muzaffar et al. 2006; Kilpatrick et al. 2007), but HPAI could pose a serious threat should it reach the area, because terns are known to be highly susceptible (Becker 1967).

Threats Specific to Red-necked Phalarope

Red-necked Phalarope is a unique case, in that it has shown the largest population crash of any marine species in the area since the 1880s, but this crash cannot be clearly associated with any of the major threats discussed earlier in this section. Until about 1983, Red-necked Phalaropes staged in very large numbers (>1 million) in the southwestern Bay of Fundy on southward migration. Their abundance there was associated with the abundance of their main prey, the copepod *Calanus finmarchicus*, which was brought to the surface by strong upwellings resulting from rapid tidal flows over shallow ledges (Mercier and Gaskin 1985; Brown and Gaskin 1988). These large concentrations of phalaropes disappeared abruptly between 1982 and 1985, although smaller aggregations ≤100,000) were found in the early 1990s on the east side of the Bay of Fundy (R.G.B. Brown 1991a; Duncan 1996; Rubega et al. 2000; S. Brown et al. 2005a, b; *NAB*). Numbers remained low into the 2000s (S. Brown et al. 2005a, b), although there has been some sign of increased numbers since 2005, at least on spring migration (see **Species Accounts**). The population crash has been tentatively attributed to reduction in numbers of their copepod prey and perhaps to climate change (S. Brown et al. 2005a, b). However, there was otherwise no evidence of effects of climate change in the Bay of Fundy ecosystem as early as the 1980s, and other species that stage there, including Red Phalaropes (which depend on the same species of copepod: Brown and Gaskin 1988), and Bonaparte's Gulls have not declined measurably. Another possible cause was the exceptionally strong El Niño–Southern Oscillation (ENSO) event in 1982–83, which caused population crashes of several seabirds that frequent the Humboldt Current system off western South America (Schreiber 2001). Red-necked Phalarope is the only species that stages on the Atlantic coast and winters in the Humboldt Current, so it would have been uniquely exposed to that event. Whatever the cause of the population crash, it would not have been foreseen from a review of known threats to Atlantic coast birds; this event illustrates the fallibility of prediction.

Summary and Conclusions: Threats to Marine Birds

Table 9 summarizes the threats to seabirds in the eastern United States, with an evaluation of the importance of each based on the information presented in the preceding sections. Two types of threat stand out for their importance: climate change, and human development and disturbance (including the promotion of gulls and other predators). Although it is difficult to weigh the "importance" of one type of threat against another, our analysis has identified 4 categories of marine birds that appear to be at greatest risk: (1) Arctic-breeding species that will be severely affected by the predicted rapid warming of the Arctic Ocean and tundra, including Red Phalarope, Ivory, Sabine's, Thayer's, and Iceland Gulls, and Pomarine and Long-tailed Jaegers (also Ross's Gull, only a vagrant to our area); (2) species that are already threatened or endangered in the West Indies, and will be increasingly threatened by climate change, including Black-capped Petrel, Audubon's Shearwater, Magnificent Frigatebird, Masked Booby, and White-tailed and Red-billed Tropicbirds; (3) other seabird species that are already endangered at foreign breeding sites where they are difficult to manage, including Herald and Fea's Petrels; and (4) species that breed mainly at very low elevations on barrier beaches or saltmarshes, and hence will be increasingly threatened by rising sea level, including Gull-billed, Forster's, and Least Terns.

RECOMMENDATIONS FOR RESEARCH AND MANAGEMENT

The information summarized in the **Species List** and Table 8 suggests that the breeding seabirds of the eastern United States and the Bay of Fundy are generally flourishing, with many species increasing in numbers and only a few species decreasing; 9 species have recently colonized the area from the north or from Europe. The information summarized in **THREATS**, however, indicates that there is little reason for complacency about the marine birds of the area. Although some of the recent increases (Brown Pelican, Northern Gannet, terns) reflect successful efforts to conserve and manage populations that were depleted in the 1950s and 1960s, at least 3 other species in this category are now decreasing again. One of the species that have shown the largest increases (Great Black-backed Gull) is a human commensal that threatens other seabirds. Some of the long-term increases represent recovery from human depredation in the 19th century, and several species have not yet regained their historical numbers. Moreover, there is little or no information about population trends in many of the nonbreeding visitors, including several of the most abundant marine birds of the area. Among the nonbreeding species for which trends can be discerned, Northern Gannet, and most loons, gulls, terns, and alcids appear to be increasing, whereas most seaducks and many tropical seabirds that visit the area from the south appear to be decreasing. Several of the scarcer species such as gadfly petrels and boobies, although apparently increasing as nonbreeding visitors or vagrants to U.S. waters, are threatened or endangered in their tropical or subtropical nesting areas.

Despite recent increases in many seabird populations, most of the marine birds of the area are still threatened by human activities in the coastal zone, as documented in **THREATS**. Although some adverse factors (oil spills and synthetic organic chemicals) have been substantially reduced during the past 30 years, others (human development of the coastline, offshore wind turbines, floating plastics, and biological toxins) are continuing and intensifying. The entire coastal zone is still subject to intense pressure from residential and industrial development, recreation, transportation, fishing, and waste disposal. Although some of these activities are being brought under control as a result of environmental protection activities, the pressures on the limited resources of the coastal zone are continuing to grow. Overfishing of Georges Bank and other productive areas has caused profound changes in marine ecosystems, including the food chains on which seabirds depend. The progressive tendency for human fisheries to "fish down the food chain" means that fisheries are starting to compete directly with seabirds for small planktivorous fish. Overshadowing all these problems is the pervasive threat of climate change and rising sea level, with potentially major changes in climate, oceanography, and physiography of the coastline.

This section of the publication presents recommendations for improved or intensified management of seabird populations in the eastern United States and

Bay of Fundy. The recommendations are based on and follow from the discussion of threats in the previous section. Because scientific information on many of the threats is incomplete or lacking, this section also presents recommendations for research before listing recommendations for management. However, this is not intended to imply that management actions should be delayed until research is completed. Many of the management actions are urgent and should be implemented immediately, even though some may be fine-tuned as more information becomes available. Both the recommendations for research and the recommendations for management are listed in descending order of perceived importance, taking into consideration the size and uniqueness of the populations and species at risk, and the gravity and urgency of threats facing them.

Research Recommendations

Climate Change. A systematic program should be undertaken to assess the ways in which seabirds are likely to be affected by global warming and other large-scale environmental changes. Of course, seabirds are not the only resources at risk from global warming and threats to them cannot be evaluated in isolation. Other marine and coastal resources that may be at risk from global climatic changes and rising sea levels include residential, commercial, and industrial developments, communications, recreation, storm protection, fisheries, marine mammals, and other wildlife. Existing studies of global climate changes tend to be focused on resources to which economic values can be easily assigned; this recommendation is to expand the scope of these studies to incorporate natural resources, including seabirds. An issue of particular importance is the likely effect of sea-level rise on saltmarshes and barrier islands, which serve as nesting sites for many marine birds of the area. Research is urgently needed: (a) to predict the changes that are likely to occur (such as loss of saltmarshes and fragmentation of barrier islands); and (b) to predict the likely consequences for marine birds (specifically, the loss of current nesting sites and the future availability of alternative sites). An assessment by Galbraith et al. (2002) of likely changes in intertidal mudflats and the consequences of these changes for migrant shorebirds provides a good model: similar assessments could and should be carried out for marine birds. Another important need is for assessment of likely effects of warming climate on tundra-breeding species such as Red Phalarope, Pomarine and Long-tailed Jaegers, Ivory and Sabine's Gulls: this assessment could be integrated with studies in other disciplines of likely physical and biological changes in tundra and in the Arctic Ocean.

Seabird–fishery Interactions. More intensive studies are needed of interactions between commercial fisheries and seabirds. There is an unusual opportunity for new analytical studies in areas such as Georges Bank and the Gulf of Maine, where major changes in fish populations have been documented in recent years and where further changes in fishing activities are expected to follow. Because fishery biologists and ornithologists tend to conduct studies at different scales and use different concepts, there is a need for new approaches and for interdisciplinary cooperation (Bailey 1989; Rice 1992; Schneider et al. 1992; Duffy and Schneider 1994; Camphuysen and Garthe 2000; Furness 2002; Montevecchi 2002). Recent studies of the relationships between seabirds and the Atlantic Herring fishery in the Gulf of Maine and Bay of Fundy (Diamond and Devlin 2003) provide a good model. Another fishery for which it would be important to investigate seabird interactions is that for Menhaden in the central and south Atlantic states. At a more basic level, extensive surveys of the distribution and ecology of pelagic birds are needed, for comparison with the last round of surveys in the late 1970s and early 1980s; these studies could be combined with recording the dependence of pelagic birds on discards, and with assessing mortality from gill nets and long lines.

Threats on Foreign Breeding Sites. Several species that visit US waters in their nonbreeding seasons have declined or are threatened in their foreign breeding sites. Among the species discussed in this publication, new information on the nature of these threats and present-day numbers is especially needed for Black-capped Petrel, Audubon's Shearwater, Masked Booby, and Magnificent Frigatebird. For many other species, there is incomplete or no information on population sizes, trends, or factors threatening the populations, so that investigation or monitoring of populations on the breeding sites would be very desirable. These include species as disparate as shearwaters from the Southern Hemisphere, phalaropes and jaegers from the Canadian arctic, Bonaparte's Gulls from the taiga zone, Black Terns from interior North America, and tropical terns from the Caribbean.

Threats in the Winter Quarters. Direct investigation is needed of the nature and magnitude of threats to terns and other migratory seabird species in their Caribbean and South American winter quarters. This should be focused initially on Roseate Tern, an endangered species with a reportedly low adult survival rate.

Offshore Wind Turbines. Systematic information is needed on the extent to which seabirds habitually fly at the 50–150 m heights where they are at risk of collision with wind turbines. Investigations should focus not only on the frequency with which various species fly at these heights, but also the circumstances in which they do so, especially in darkness and/or bad weather. More information is also needed on the extent to which foraging and migrating seabirds might avoid turbines.

Toxic Algal Blooms. If and how much seabirds are affected by toxic algal blooms should be investigated systematically, rather than opportunistically as at present. This would require a program to sample seabird prey in the vicinity of blooms, as well as to monitor the health of the seabirds that feed on prey that is subject to contamination; in both cases, baseline data are needed and should be collected prior to blooms.

Periodic Censuses. Although there is reasonably good information on numbers for all breeding species in the area, no comprehensive census has been carried out since the 1970s, and that census had many gaps and other limitations (Spendelow and Patton 1988). Although most breeding species are censused periodically in most states and provinces, these data are of limited value without wider coordination and synchronization. Compilations like this paper, or those conducted by Kress and Hall

(2004) and MANEM (2006) for overlapping species and areas, require intensive work and cooperation from many local compilers or holders of unpublished data. To maintain reliable information on population trends, comprehensive censuses should be conducted simultaneously along the entire coast at least once each decade, and the data should be compiled, reviewed, edited, and made available in a public database. This will require much better coordination between state and federal government agencies than presently exists, plus institutional and individual commitments to completing each census, editing and managing the data, conducting quality assurance, and making the results available.

Red-necked Phalaropes. A focused field investigation is needed in the Bay of Fundy to investigate the current numbers and feeding ecology of Red-necked Phalaropes staging there on southbound migration, and to determine the extent to which they may have merely shifted to other waters nearby (Brown et al. 2005b). If the reported changes in the availability of the critical prey species *Calanus finmarchicus* are confirmed, reasons for these changes should be investigated, and possible effects on other species (Red Phalaropes and Bonaparte's Gulls) should be examined. Brown et al. (2005a) have already prepared a study and monitoring plan: this plan should be implemented.

Management Recommendations

Human development and disturbance pose threats to all breeding seabirds of the area (except those on remote islands in the Gulf of Maine). The nature and effects of these threats are reasonably well documented, and they are currently being mitigated and managed by a wide variety of local responses. These include state and local ordinances to limit development of barrier beaches and islands, designation of colony sites as wildlife refuges or sanctuaries, wardening and other forms of protection, habitat modification, management of gulls and other predators, education, and other measures (Parnell et al. 1988; for individual species, see accounts in the *Birds of North America* series, and coded summaries in the Regional Waterbird Conservation Plans). These programs have all been broadly effective in preserving major colony sites and in permitting continued increases in many breeding species. However, they are labor-intensive and expensive in time and resources, and many are focused on single sites or single species. Despite such management efforts, colony sites continue to be lost to human development or predation on several parts of the coast, and some species (e.g., terns) are increasingly concentrated in a few large colonies, or are increasingly confined to sites that are marginally suitable. Continued maintenance of healthy breeding populations of seabirds in the eastern United States will require more intensive and extensive management programs.

Global climate changes probably pose much larger threats to seabirds in the eastern United States (and elsewhere in the world), but their potential effects have received almost no study or evaluation. Seabirds rely on fringes of the land for breeding, and often exploit localized or unusual oceanographic processes for feeding. These features of the global environment are among those that are most vulnerable to changes in climate. Yet there are no clear predictions of how they are likely to change in the area covered by this paper, nor any studies of how these changes might affect marine birds of the area.

This section presents management recommendations, listed in descending order of perceived priority.

Climate Change. Global warming and related environmental changes, if they occur as currently predicted, are expected to induce major changes in human welfare, including physical, social, and economic disruption as well as profound changes in the environment. Although the recent increase in the attention paid to these changes in North America is encouraging, they deserve much greater actions from society than they are receiving at the moment, including both measures to reduce the magnitude of the changes and preparation for changes that are unavoidable. In the context of seabird management, the most appropriate response—beyond intensive study—is preparation for change. For example, colony sites that would be threatened by rising sea level should be identified; then, alternative sites should be designated and incorporated into regional or local plans for modified land uses.

Modifications in Human Use of the Coastal Zone. Greater efforts should be made to remove or reverse the incentives that have led to human development of barrier beaches, barrier islands, and other areas important to seabirds. Much of this development is inappropriate for other reasons, because barrier beaches are dynamic systems, subject to overwash and erosion in hurricanes and other storms, and hence unsuitable for fixed structures. Development has been permitted and often subsidized by a variety of government programs, including zoning regulations, flood insurance, erosion control, and construction of roads, bridges, and causeways. Efforts are already being made through public information and legislative action to reverse these institutional subsidies, but are making slow progress against strong economic interests of landowners and developers. Conflicts are likely to intensify if—as seems likely—rising sea level or other climatic changes increase the pressures on these interests. Although the issues will only be resolved through a lengthy process of debate in the political arena, this recommendation is for those with an interest in the welfare of seabirds and other natural resources to increase their participation in this process. This participation can take place at all levels, from local land use decisions, through regional planning, to state and federal legislation. Individuals can participate through education, membership in environmental groups, and grassroots political activity. At the governmental level, changes are needed in state and federal government programs to remove subsidies for private development in the coastal zone, and to increase funding for agency management of natural resources.

Colony Site Protection. More systematic programs are needed to protect and manage sites already known to be important for breeding seabirds, as well as those that may be designated as alternative sites. At present, many of the more important sites in the region are protected or managed in one way or another. However, ownership and management comprise a mishmash of federal, state, local, and private programs. Many management programs are focused on single sites or species, and there is insufficient coordination or even communication among the agencies and individuals conducting the programs. Disproportionate resources are expended on management of some sites and species, whereas others are neglected or mismanaged. In general, management of seabirds (even endangered species such as Roseate Tern) has low priority for funding and attention by government agencies, despite the lip-service paid to nongame wildlife programs. Although some private organizations and individuals conduct active programs, these programs also tend to be poorly funded and are not always based on good scientific information. Effective management of seabird colonies and populations will require better-funded and better-managed programs, with a better regional perspective, better use of scientific information, and better coordination. At many sites, improved management will require increased efforts to control alien or commensal predators, especially American Mink, feral cats, and Brown Rats (see **Human-enhanced Predation**). Kress and Hall (2004) summarized methods for effective control of these and other predators.

Colony Restoration. Many of the best sites for breeding seabirds on offshore islands have been occupied by large gulls for decades. Several programs in Maine, New Hampshire, Massachusetts, and New York have shown that colonies of terns and Atlantic Puffins can be restored through modest programs of gull control and habitat management. These programs should be extended to other sites where major colonies have been displaced by gulls. In cases where it would be difficult or impractical to restore historical colonies, the sites to which the birds have been displaced need to be managed to prevent settlement by large gulls and to protect the other seabirds against disturbance and other predators.

Management of Breeding Seabirds in Foreign Countries. An important fact pointed out in this paper is that most seabirds that utilize waters off the eastern United States are nonbreeding visitors there. Accordingly, their conservation requires management of populations breeding in foreign countries. Although such management is the immediate responsibility of the foreign countries, the birds form part of the United States and Canadian faunas also, so it is in the interest of US and Canadian biologists to support their management to the extent possible. For species breeding in developing countries, this can be achieved by providing skilled personnel, financial assistance, training, or education, and should be promoted both by government agencies and by nongovernmental organizations. Case-studies are described by Blanchard (1994), other contributors to the volume by Nettleship et al. (1984), and Blanchard and Nettleship (2002). At the intergovernmental level, seabirds are protected (at least nominally) under several international treaties and conventions. Specific programs to protect threatened species could and should be developed under existing authorities such as the Bonn and Cartagena Conventions. One of the most pressing needs is an effective program to conserve and manage Black-capped Petrels at their threatened breeding sites in Haiti and the Dominican Republic, but several other species that breed in the West Indies also need improved management (Schreiber and Lee 2000; Bradley and Norton 2009).

Protection of Seabirds in Winter Quarters. Many seabirds that breed in the United States winter in other countries and some (e.g., Roseate and other terns) may be threatened by human activities there. This publication has recommended investigation of some of these threats. If they prove to be significant, measures to reduce them should be undertaken. Specific proposals cannot be developed until more information on the location and nature of the threats is obtained, but the considerations discussed in the previous paragraph will be applicable to this case also.

Dredge Spoil Islands. Revised management programs are needed to restore and improve dredge spoil islands, especially those along the Intracoastal Waterway, as habitat for ground-nesting seabirds. In general, this will require revision of regulations and/or changes in disposal practices to permit disposal of spoil on existing islands or the creation of new undiked islands with low slopes. A comprehensive schedule of spoil deposition rotation will be required (and must be adhered to rigorously) to preserve a balance of sites at all successional stages. Ownership of and jurisdiction over spoil islands—major problems for their management at the moment—also must be resolved unambiguously, and all parties brought to a common table.

Hunting. Information reviewed in this publication suggests that the present level of hunting mortality is too high for most species of seaducks, especially for White-winged Scoter (see **THREATS**). Our conclusion is stronger than those reached by earlier reviewers (e.g., Caithamer et al. 2000), in large part because we used sources of information on regional populations that were not considered by those reviewers. We recommend that hunting levels should be reassessed, with consideration of data from a wider variety of sources, and should be revised on a regular basis in light of similar reviews.

Plastics. Measures should be taken to reduce the disposal of plastic particles and manufactured objects into the marine environment. An important step would be better enforcement of the International Convention for the Prevention of Pollution from Ships (Annex V), which prohibits dumping of plastics and other wastes from ships.

Fishery Interactions. Current information on seabird-fishery interactions is generally inconclusive or uncertain, as discussed in **THREATS**, so it is difficult to make specific management proposals. As new information becomes available, it may become possible to incorporate seabird protection into programs for managing fisheries. One of the few specific recommendations that can be formulated at present is that commercial fishing for sand lance would pose a major threat to seabirds and should not be permitted without very careful management to prevent adverse effects on seabirds (and other valuable species such as marine mammals).

Need for Consensus on Threats, Species at Risk, and Recommendations for Research and Management

Comparison of the findings and recommendations in this paper with those in the various North American Plans for conservation of waterfowl, shorebirds, and other waterbirds, reveals some striking discrepancies. For example, Red and Red-necked Phalaropes were not included among 28 shorebird species listed as "Priority Species" in the United States Shorebird Conservation Plan (Brown et al. 2001). The species profiles issued by the Sea Duck Joint Venture in 2003–04 (Sea Duck Joint Venture Management Board 2008) indicated that scoters of all three species were probably declining, but stated that these declines were primarily in western North America. The profile for White-winged Scoter stated that this species is "thought to be the most abundant of the scoter species on both coasts," and that "total harvest is low." The North American Waterbird Conservation Plan (Kushlan et al. 2002) did not even mention climate change as a threat, and listed arctic-breeding species (Ivory, Sabine's, Thayer's and Iceland Gulls, jaegers, and Dovekie) as of "Low" or "Moderate Concern." It also listed Herring Gull as of Low Concern and Brown Noddy as "Not Currently at Risk." Otherwise, its lists of species of concern were similar to ours, but it did not consider loons or grebes. The Regional Waterbird Conservation Plans (MANEM Waterbird Working Group 2006; Hunter et al. 2006) similarly listed all the arctic-breeding species as of low priority. The MANEM plan listed sea-level rise as a threat to Least, Arctic, Gull-billed, and Forster's Terns, and climate change as a "possible" threat to Pomarine Jaeger and Iceland Gull, but not to other arctic-breeding species. MANEM listed as of "Highest" or "High" conservation concern a number of species that we consider of lower concern, including Horned and Red-necked Grebes, Great and Cory's Shearwaters, Laughing Gull, Black, Common, and Royal Terns. Otherwise, MANEM's lists of conservation priorities are similar to ours. However, MANEM's list of 50 conservation projects for marine birds included only 6 that are similar to our recommendations, and 4 of these were similar to each other in addressing the need for information on the distribution and abundance of pelagic species (MANEM has not yet issued specific recommendations for achieving its conservation goals). The Conservation Plan for the southeast United States (Hunter et al. 2006) did not mention climate change or sea-level rise as threats to any species, and it did not list any arctic-breeding species as at risk. Hunter et al. listed Cahow and Magnificent Frigatebird as the only species requiring "Critical Recovery" action, and Red-throated Loon, Audubon's Shearwater, and Common Tern as requiring "Immediate Management;" Magnificent Frigatebird and Common Tern received these designations only because of local conservation issues. Hunter at al.'s list of species at the next level of priority, "Management Attention," included several species that we consider of low concern, including Cory's, Great, and Sooty Shearwaters, and Common Tern; they did not consider Herald or Fea's Petrels, or tropicbirds, at all.

Whatever the reasons for these discrepancies, it would be important to resolve them and to develop a consensus on the species that are at greatest risk and the threats that need to be addressed. If our assessment of the species at greatest risk and threats to them are correct, then the projects proposed in the various Conservation Plans are largely misdirected, and *vice versa*.

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LITERATURE CITED

Abraham, C.L., and W.J. Sydeman. 2004. Ocean climate, euphasiids and auklet nesting: interannual trends and variations in phenology, diet and growth of a planktivorous seabird, Cassin's Auklet *Ptychoramphus aleuticus. Marine Ecology Progress Series* 74: 235–250.

Adamus, P.R. 1987. *Atlas of Breeding Birds in Maine, 1978–1983*. Augusta: Maine Breeding Bird Atlas Committee. 366 pp.

Ad Hoc Sea Duck Committee. 1994. *Status of Sea Ducks in the Atlantic Flyway*. Unpublished report. Fredericton, NB: Fish and Wildlife Branch. 71 pp.

Aebischer, N.J., J.C. Coulson, and J.M. Colebrook. 1990. Parallel long-term trends across four marine trophic levels and weather. *Nature* 347: 753–755.

Ainley, D.G., A.R. DeGange, L.L. Jones, and R.J. Beach. 1981. Mortality of seabirds in high seas salmon gill nets. *Fisheries Bulletin* 79: 800–806.

Ainley, D.G., D.N. Nettleship, H.R. Carter, and A.E. Storey. 2002. Common Murre (*Uria aalge*). No. 666 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 44 pp.

Ainley, D.G., T.C. Telfer, and M.H. Reynolds. 1997. Townsend's and Newell's Shearwater (*Puffinus auricularis*). No. 297 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 20 pp.

Allen, R.B., and D.G. McAulay. 2005. *Status of the Common Eider in Maine*. Unpublished report. Bangor: Maine Dept. of Inland Fisheries and Wildlife. 11 pp.

Amey, K.D. 1998. *Seabirds as Indicators of Changes in Availability and Commercial Weir Landings of Herring*. M.S. thesis. University of New Brunswick, Fredericton: 89 pp.

Anderson, D.J. 1993. Masked Booby (*Sula dactylatra*). No. 73 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 16 pp.

Anderson, D.W., and J.O. Keith. 1980. The human influence on seabird nesting success: conservation implications. *Biological Conservation* 18: 65–80.

Anderson, J.G.T., and C.M. Devlin. 1996. Conservation biology and human ecology: umbrellas, flagships, and keystones. *Human Ecology Reviews* 3: 238–242.

Andrews, R. 1990. *Coastal Waterbird Colonies: Maine to Virginia 1984–85: An Update of an Atlas Based on 1977 Data, Showing Colony Locations, Species and Nesting Pairs at Both Time Periods*. Newton Corner, MA: US Fish and Wildlife Service. 807 pp.

Anonymous. 2009a. Matinicus Rock Manx Shearwaters raise a chick. *Egg Rock Update* 2009: 2.

Anonymous. 2009b. Common Murres nest at Matinicus Rock. *Egg Rock Update* 2009: 1.

Anthony, V.C., and M.J. Fogarty. 1985. Environmental effects on recruitment, growth, and vulnerability of Atlantic Herring (*Clupea harengus harengus*) in the Gulf of Maine region. *Canadian Journal of Fisheries and Aquatic Sciences* 42 (*Supplement 1*): 158–173.

Anthony, V.C., and G.T. Waring. 1980. The assessment and management of the Georges Bank herring fishery. *International Commission on Northwest Atlantic Fisheries Research Bulletin* 5: 91–98.

AOU (American Ornithologists' Union). 1998. *Check-List of North American Birds, 7th edn*. Lawrence, Kansas: Allen Press. 829 pp. [plus Supplements through No. 51: *Auk* 127: 726–744, 2010]

Armistead, G.L., and B.L. Sullivan. 2003. Birding hurricane Isabel. *Birding* 36: 617–624.

Arnold, J.M., J.J. Hatch, and I.C.T. Nisbet. 2004. Seasonal declines in reproductive success of the Common Tern: timing or parental quality? *Journal of Avian Biology* 35: 33–45.

Austin, J.J., V. Bretagnolle, and E. Pasquet. 2004. A global phylogeny of the small *Puffinus* shearwaters and implications for systematics of the Little–Audubon's Shearwater complex. *Auk* 121: 847–864.

Austin, O.L. 1948. Predation by the Common Rat (*Rattus norvegicus*) in the Cape Cod colonies of nesting terns. *Bird-Banding* 19: 60–65.

Backus, R.H., and D.W. Bourne (eds.). 1987. *Georges Bank*. Cambridge, MA: MIT Press. 593 pp.

Bailey, R.S. 1989. Interactions between fisheries, fish stocks and seabirds. *Marine Pollution Bulletin* 20: 427–430.

Baird, P.H. 1994. Black-legged Kittiwake (*Rissa tridactyla*). No. 92 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Barr, J.F., C. Eberl, and J.W. McIntyre. 2000. Red-throated Loon (*Gavia stellata*). No. 513 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Barrett, R.T., C.J. Camphuysen, T. Anker-Nilssen, J.W. Chardine, R.W. Furness, S. Garthe, O. Hüppop, M.F. Leopold, W.A. Montevecchi, and R.R. Veit. 2007. Diet studies of seabirds: a review and recommendations. *ICES Journal of Marine Science* 64: 1675–1691.

Beardslee, C.S., and H.D. Mitchell. 1965. *Birds of the Niagara Frontier Region*. Bulletin of the Buffalo Society of Natural Sciences, Vol. 22. Buffalo, NY: Buffalo Society of Natural Sciences. 478 pp.

Becker, P. H., and J.-D. Ludwigs. 2004. *Sterna hirundo* Common Tern. *BWP Update* 6: 91–138.

Becker, W.B. 1967. Experimental infection of Common Terns with tern virus: influenza A/tern/South Africa/1961. *Journal of Hygiene* 61: 61–65.

Belant, J.L., and R.A. Dolbeer. 1993a. Population status of nesting Laughing Gulls in the United States, 1977–1991. *American Birds* 47: 220–224.

Belant, J.L., and R.A. Dolbeer. 1993b. Migration and dispersal of Laughing Gulls in the United States, 1977–1991. *Journal of Field Ornithology* 64: 557–565.

Bellrose, F.C. 1976. *Ducks, Geese and Swans of North America*. Harrisburg, PA: Stackpole Books. 544 pp.

Bent, A.C. 1921. Life histories of North American gulls and terns. *US National Museum Bulletin* 113: 1–345.

Berger, D.D., C.R. Sindelar, Jr., and K.E. Gamble. 1965. The status of breeding Peregrines in the eastern United States. Pages 165–173 in *Peregrine Falcon Populations: Their Biology and Decline* (Hickey, J.J., ed.). Madison: University of Wisconsin Press. 596 pp.

Bierregaard, R.O., Jr., A.B. David, II, T.D. Baird, and R.E. Woodruff. 1975. First northwestern Atlantic breeding record of the Manx Shearwater. *Auk* 92: 145.

BirdLife International. 2000. *Threatened Birds of the World*. Barcelona: Lynx Edicions, and Cambridge, UK: BirdLife International. 852 pp.

BirdLife International. 2004. *Birds in Europe: Population Estimates, Trends and Conservation Status*. BirdLife Conservation Series 12. Cambridge, UK: BirdLife International. 374 pp.

Blanchard, K.A. 1994. Culture and seabird conservation: the North Shore of the Gulf of St. Lawrence, Canada. Pages 294–310 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger, and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Blanchard, K.A., and D.N. Nettleship. 2002. Education and seabird conservation: a conceptual framework. Pages 616–632 in *Wildlife 2001: Populations* (McCullough, D.R., and R.H. Barrett, eds.). London: Elsevier Science Publishers. 1163 pp.

Blinn, D.M., A.W. Diamond, and D.J. Hamilton. 2008. Factors affecting brood-rearing habitat by Common Eiders (*Somateria mollissima*) in the Bay of Fundy, New Brunswick. *Waterbirds* 31: 520–529.

Blodget, B. 1988. The half-century battle for gull control. *Massachusetts Wildlife* 38: 4–10.

Blodget, B.G., and J.E. Livingstone. 1996. Coastal colony-nesting waterbirds. *Massachusetts Wildlife* 46: 10–20.

Blokpoel, H., R. Morris, and P. Trull. 1982. Winter observations of Common Terns in Trinidad, Guyana and Suriname. *Colonial Waterbirds* 5: 144–147.

Blokpoel, H., and W.G. Scharf. 1991. Status and conservation of seabirds nesting in the Great Lakes of North America. Pages 17–41 in *Seabird Status and Conservation: A Supplement* (Croxall, J.P., ed.). ICBP Technical Publication 11. Cambridge, UK: International Council for Bird Preservation. 308 pp.

Blokpoel, H., and G. Tessier. 1986. *The Ring-billed Gull in Ontario: A Review of a New Problem Species*. Canadian Wildlife Service Occasional Paper 57. Ottawa: Canadian Wildlife Service. 32 pp.

Blus, L.J. 1982. Further interpretation of the relation of organochlorine residues in Brown Pelican eggs to reproductive success. *Environmental Pollution* A28: 15–33.

Boertmann, D. 2008. The Lesser Black-backed Gull, *Larus fuscus*, in Greenland (Technical Report). *Arctic* 61: 129–133.

Bolton, M., A.L. Smith, E. Gómez-Díaz, V.L. Friesen, R. Medeiros, J. Bried, J.L. Roscales, and R.W. Furness. 2008. Monteiro's Storm-petrel *Oceanodroma monteiroi*: a new species from the Azores. *Ibis* 150: 717–727.

Bond, A.L., and A.W. Diamond. 2006. The Common Murre (*Uria aalge*) on Machias Seal Island, 1999–2005. Appendix IV in *Machias Seal Island: 1999–2005 Progress Report* (Bond, A.L., A.M. Black, M.-P. McNutt, and A.W. Diamond, eds.). Fredericton: Atlantic Co-operative Wildlife Ecology Research Network and University of New Brunswick. 61 pp.

Bond, A.L., P.W. Hicklin, and M. Evans. 2007. Daytime spring migration of scoters (*Melanitta* spp.) in the Bay of Fundy. *Waterbirds* 30: 566–572.

Bond, A.L., P.W. Hicklin, and M. Evans. 2009. Erratum: Daytime spring migration of scoters (*Melanitta* spp.) in the Bay of Fundy. *Waterbirds* 32: 197.

Bordage, D., and J.L. Savard. 1995. Black Scoter (*Melanitta nigra*). No. 177 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 20 pp.

Borror, A.C., and D.W. Holmes. 1990. *Breeding Birds of the Isles of Shoals*. Ithaca, NY: Cornell University, Shoals Marine Laboratory. 76 pp.

Bourget, A. 1973. Relation of eiders and gulls nesting in mixed colonies in Penobscot Bay, Maine. *Auk* 90: 809–820.

Bourget, A., P. Dupuis, and W.R. Whitman. 1986. Les eiders hivernant dans le golfe du Saint-Laurent: effectifs et distribution. Pages 94–99 in *Eider ducks in Canada* (Reed, A., ed.). Canadian Wildlife Service Report Series 47. Ottawa: Canadian Wildlife Service. 177 pp.

Bourne, W.R.P. 1983. The Soft-plumaged Petrel, the Gon-Gon, and the Freira, *Pterodroma mollis. Bulletin of the British Ornithologists' Club* 103: 52–58.

Boyne, A.W. 2008. Harlequin Ducks in the Canadian Maritime Provinces. *Waterbirds 31, Special Publication* 2: 50–57.

Boyne, A.W., and J.T. Beukens. 2004. *Census of Gulls and Other Seabirds along the Coast of Mainland Nova Scotia–2002*. Canadian Wildlife Service Technical Report Series 409. Fredericton, NB: Canadian Wildlife Service, Atlantic Region. 23 pp.

Bradley, P.E. 2009. Conservation of Caribbean seabirds. Pages 283–293 in *An Inventory of Breeding Seabirds of the Caribbean* (Bradley, P.E., and R.L. Norton, eds.). Gainesville, FL: University of Florida Press. 353 pp.

Bradley, P.E., and R.L. Norton. 2009. Status of Caribbean seabirds. Pages 270–282 in *An Inventory of Breeding Seabirds of the Caribbean* (Bradley, P.E., and R.L. Norton, eds.). Gainesville, FL: University of Florida Press. 353 pp.

Brand, C.J., R.M. Windingstad, L.M. Siegfried, R.M. Duncan, and R.M. Cook. 1988. Avian morbidity and mortality from botulism, aspergillosis, and salmonellosis at Jamaica Bay Wildlife Refuge, New York, USA. *Colonial Waterbirds* 11: 284–292.

Braune, B.M. 1989. Autumn migration and comments on the breeding range of Bonaparte's Gull (*Larus philadelphia*) in eastern North America. *Canadian Field-Naturalist* 103: 524–530.

Braune, B.M., and D.E. Gaskin. 1982. Feeding methods and diving rates of migrating larids off Deer Island, New Brunswick. *Canadian Journal of Zoology* 60: 2190–2197.

Brooke, M.L. 1990. *The Manx Shearwater*. London: T & A D Poyser. 246 pp.

Brooke, M.L. 2004. *Albatrosses and Petrels across the World*. Oxford: Oxford University Press. 499 pp.

Brown, K.M., R.M. Erwin, M. Richmond, P.A. Buckley, J.T. Tanacredi, and D. Avrin. 2001. Managing birds and controlling aircraft in the Kennedy Airport–Jamaica Bay Wildlife Refuge complex: the need for hard data and soft opinions. *Environmental Management* 28: 207–224.

Brown, P.W., and L.H. Fredrickson. 1997. White-winged Scoter (*Melanitta fusca*). No. 274 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Brown, R.G.B. 1970. Fulmar distribution: a Canadian perspective. *Ibis* 112: 44–51.

Brown, R.G.B. 1986. *Revised Atlas of Canadian Seabirds. I. Shipboard Surveys by R.G.B. Brown*. Ottawa: Canadian Wildlife Service. 111 pp.

Brown, R.G.B. 1991a. The great Fundy phalarope mystery. *Nova Scotia Birds* 33: 58–59.

Brown, R.G.B. 1991b. Marine birds and climatic warming in the northwest Atlantic. Pages 49–54 in *Studies of High-latitude Seabirds. 1. Behavioural, Energetic and Oceanographic Aspects of Seabird Feeding Ecology* (Montevecchi, W.A., and A.J. Gaston, eds.). Canadian Wildlife Service Occasional Paper 68. Ottawa: Canadian Wildlife Service. 56 pp.

Brown, R.G.B., and D.E. Gaskin. 1988. The pelagic ecology of the Grey and Red-necked Phalaropes *Phalaropus fulicarius* and *P. lobatus* in the Bay of Fundy, eastern Canada. *Ibis* 130: 234–250.

Brown, R.G.B., and D.N. Nettleship. 1984. The seabirds of northeastern North America: their present status and conservation requirements. Pages 85–100 in *Status and Conservation of the World's Seabirds* (Croxall, J.P., P.G.H. Evans, and R.W. Schreiber, eds.). ICBP Technical Publication 2. Cambridge, UK: International Council for Bird Preservation. 778 pp.

Brown, S., C. Hickey, B. Harrington, and R. Gill (eds.). 2001. *United States Shorebird Conservation Plan, 2nd edn.* Manomet, MA: Manomet Center for Conservation Sciences. 62 pp.

Brown, S., M. Howe, J. Chardine, and C. Duncan. 2005a. *Red-necked Phalarope Research, Monitoring and Conservation Plan for the Northeastern US and Maritime Canada*. Version 1.0. Unpublished report. 12 pp. [http://www.whsrn.org.html]

Brown, S., M. Howe, J. Chardine, C. Duncan, and the Red-necked Phalarope working group. 2005b. *Red-necked Phalaropes* (Phalaropus lobatus) *in the Northeast: Report from a Workshop on Population Status and Research/Monitoring Needs*. Manomet, MA: Manomet Center for Conservation Sciences. 32 pp.

Brubeck, M.V., B.C. Thompson, and R.D. Slack. 1981. The effects of trapping, banding and patagial tagging on the parental behavior of Least Terns in Texas. *Colonial Waterbirds* 4: 54–60.

Brunström, B., B.-O. Lund, A. Bergman, L. Asplund, I. Athanassiadis, M. Athanassiadou, S. Jensen, and J. Örberg. 2001. Reproductive toxicity in Mink (*Mustela vison*) chronically exposed to environmentally relevant polychlorinated biphenyl compounds. *Environmental Toxicology and Chemistry* 20: 2318–2327.

Brunton, D. 1999. "Optimal" colony size for Least Terns: an inter-colony study of opposing selective pressures by predators. *Condor* 101: 607–615.

Buckley, F.G. 1978. *Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in New Jersey*. US Army Corps of Engineers Technical Report D–78–1. Vicksburg, MS: US Army Corps of Engineers. 300 pp.

Buckley, F.G. 1979. Colony site selection by colonial waterbirds in coastal New Jersey. *Proceedings of the 1978 Conference of the Colonial Waterbird Group 2*: 17–26.

Buckley, P.A. 1973. A massive spring seabird movement, including three species new to North Carolina, at Cape Hatteras National Seashore. *American Birds* 27: 8–10.

Buckley, P.A., and F.G. Buckley. 1974. Comparative feeding ecology of wintering adult and juvenile Royal Terns (Aves: Laridae, Sterninae). *Ecology* 55: 1053–1063.

Buckley, P.A., and F.G. Buckley. 1975. The significance of dredge spoil islands to colonially nesting waterbirds in certain national parks. Pages 35–45 in *Proceedings of a Conference on Management of Dredge Islands in North Carolina Estuaries* (Parnell, J., ed.). University of North Carolina Sea Grant Publication UNC–SC–75–01. Wilmington: University of North Carolina. 139 pp.

Buckley, P.A., and F.G. Buckley. 1977. Human encroachment on barrier beaches of the northeastern US and its impact on coastal birds. Pages 68–76 in *Coastal Recreation Resources in an Urbanizing Environment* (Noyes, J.H., and E.H. Zube, eds.). Agricultural Experiment Station Monograph. Amherst: University of Massachusetts. 129 pp.

Buckley, P.A., and F.G. Buckley. 1980. Population and colony site trends of Long Island waterbirds for five years in the mid 1970s. *Transactions of the Linnaean Society of New York* 9: 23–56.

Buckley, P.A., and F.G. Buckley. 1982. Microenvironmental determinants of survival in saltmarsh-nesting Common Terns. *Colonial Waterbirds* 5: 39–48.

Buckley, P.A., and F.G. Buckley. 1983. Conservation of colonial waterbirds. *Oceanus* 26: 55–61.

Buckley, P.A., and F.G. Buckley. 1984. Seabirds of the north and middle Atlantic Coast of the United States: their status and conservation. Pages 101–133 in *Status and Conservation of the World's Seabirds* (Croxall, J.P., P.G.H. Evans, and R.W. Schreiber, eds.). ICBP Technical Publication 2. Cambridge, UK: International Council for Bird Preservation. 778 pp.

Buckley, P.A., and F.G. Buckley. 2000. Patterns of colony site use and disuse in saltmarsh-nesting Common and Roseate Terns. *Journal of Field Ornithology* 71: 356–369.

Buckley, P.A., and F.G. Buckley. 2002. Royal Tern (*Sterna maxima*). No. 700 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Buckley, P.A., F.G. Buckley, and M. Gochfeld. 1975. Gull-billed Tern: New York State's newest breeding species. *Kingbird* 25: 178–183.

Buckley, P.A., and M.M. Gurien. 1986. *An Ecological Approach to the Control of Laughing Gulls at John F. Kennedy International Airport, New York City*. New Brunswick, NJ: Rutgers University. 71 pp.

Buckley, P.A., E.B. Massiah, M.B. Hutt, F.G. Buckley, and H.F. Hutt. 2009. *The Birds of Barbados: An Annotated Checklist.* BOU Checklist No. 24. Peterborough, UK: British Ornithologists' Union. 295 pp.

Buckley, P.A., and M.G. McCarthy. 1994. Insects, vegetation, and the control of Laughing Gulls (*Larus atricilla*) at Kennedy International Airport, New York. *Journal of Applied Ecology* 31: 291–302.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). No. 506 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 40 pp.

Bull, J. 1985. *Birds of New York State, Including the 1976 Supplement*. Ithaca, NY: Cornell University Press. 703 pp.

Burger, J. 1979. Nest repair behavior in birds nesting in salt marshes. *Journal of Comparative Physiology and Psychology* 11: 189–199.

Burger, J. 1981. Overall effects of human disturbance on colonial species, particularly gulls. *Colonial Waterbirds* 4: 28–36.

Burger, J. 1990. Seabirds, tropical biology and global warming: are we missing the ark? *Colonial Waterbirds* 13: 81–84.

Burger, J. 1996. Laughing Gull (*Larus atricilla*). No. 225 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

B**urger, J.** 1997. *Oil Spills*. New Brunswick, NJ: Rutgers University Press. 260 pp.

Burger, J., and M. Gochfeld. 1985. Caspian Tern nesting in New Jersey. *New Jersey Audubon Society* 10: 74–76.

Burger, J., and M. Gochfeld. 1990. *The Black Skimmer: Social Dynamics of a Colonial Species*. New York: Columbia University Press. 355 pp.

Burger, J., and M. Gochfeld. 1991. *The Common Tern: Its Breeding Biology and Social Behavior*. New York: Columbia University Press. 413 pp.

Burger, J., and M. Gochfeld. 1994. Predation and effects of humans on island-nesting seabirds. Pages 39–67 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger, and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Burger, J., and M. Gochfeld. 2002a. Effects of chemicals and pollutants on seabirds. Pages 485–527 in *Biology of Marine Birds* (Schreiber, E.A., and J. Burger, eds.). Boca Raton, FL: CRC Press. 722 pp.

Burger, J., and M. Gochfeld. 2002. Bonaparte's Gull (*Larus philadelphia*). No. 634 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Burger, J., and M. Gochfeld. 2009. Franklin's Gull *(Larus pipixcan*). No. 116 in *The Birds of North America online* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Burger, J., M. Gochfeld, and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: contrasting responses of birds, tourists, and managers. *Environmental Conservation* 22: 56–65.

Burger, J., and F. Lesser. 1979. Breeding behavior and success in salt marsh Common Tern colonies. *Bird-Banding* 50: 332–337.

Burger, J., I.C.T. Nisbet, and M. Gochfeld. 1992. Mercury levels in regrown feathers: assessment of exposure in the breeding grounds and winter quarters in the same individuals. *Journal of Toxicology and Environmental Health* 37: 363–374.

Burger, J., I.C.T. Nisbet, and M. Gochfeld. 1994. Heavy metal and selenium levels in feathers of known-age Common Terns (*Sterna hirundo*). *Archives of Environmental Contamination and Toxicology*: 26: 351–355.

Burger, J., I.C.T. Nisbet, C. Safina, and M. Gochfeld. 1996. Temporal patterns in reproductive success in the endangered Roseate Tern (*Sterna dougallii*) nesting on Long Island, New York, and Bird Island, Massachusetts. *Auk* 113: 131–142.

Burnett, F.L., and D.L. Snyder. 1954. Blue crab as starvation food of oiled American Eiders. *Auk* 71: 315–316.

Butler, R.G., and D.E. Buckley. 2002. Black Guillemot (*Cepphus grylle*). No. 675 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Buzzards Bay National Estuary Program. 2003. *B120 Oil Spill. Areas Impacted by the Buzzards Bay Oil Spill.* [http://www.buzzardsbay.org]

Caithamer, D.F., M. Otto, P.I. Padding, J.R. Sauer, and G.H. Haas. 2000. *Sea Ducks in the Atlantic Flyway: Population Status and a Review of Special Hunting Seasons*. Laurel, MD: US Fish and Wildlife Service. 68 pp.

Calladine, J. 2004. Lesser Black-backed Gull *Larus fuscus*. Pages 226–241 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Campbell, B., E. Kern, and D. Horn. 1977. *Impact of Oil Spillage from World War II Tanker Sinkings*. MIT Sea Grant Program Report MITSG 77–4. Cambridge, MA: Massachusetts Institute of Technology. 85 pp.

Camphuysen, C.J. (ed.). 2005. *Understanding Marine Foodweb Processes: An Ecosystem Approach to Sustainable Sandeel Fisheries in the North Sea*. IMPRESS Final report: Project Q5RS–2000–30864. Texel, The Netherlands: Netherlands Institute for Sea Research. 240 pp.

Camphuysen, C.J., B. Calvo, J. Durninck, K. Eensor, A. Folkestad, R.W. Furness, S. Garthe, G. Leaper, H. Skov, M.L. Tasker, and C.J.N. Winter. 1995. *Consumption of Discards by Seabirds in the North Sea*. Final Report EC DG XIV Res. Com. BIOECO/93/10. NIOZ–Report 1995–5. Texel, The Netherlands: Netherlands Institute for Sea Research. 202 pp.

Camphuysen, C.J., and S. Garthe. 2000. Seabirds and commercial fisheries: population trends of piscivorous seabirds explained? Pages 163–184 in *The Effects of Fishing on Non-target Species and Habitats: Biology, Conservation and Socio-economic Issues* (Kaiser, M.J., and S.J. de Groot, eds.). Oxford: Blackwell Scientific. 399 pp.

Cannell, P.F., and G.D. Maddox. 1983. Population changes in three species of seabirds at Kent Island, New Brunswick. *Journal of Field Ornithology* 54: 29–35.

Carney, S.M., M.F. Sorensen, and E.M. Martin. 1983. *Distribution of Waterfowl Species Harvested in States and Counties During 1971–80 Hunting Seasons*. US Department of the Interior, Special Scientific Report Wildlife 254: 1–114.

Chapdelaine, G., A.W. Diamond, R.D. Elliott, and G.J. Robertson. 2001. *Status and Population Trends of the Razorbill in North America*. Canadian Wildlife Service Occasional Paper 105. Ottawa: Canadian Wildlife Service. 21 pp.

Chapdelaine, G., P. Laporte, and D.N. Nettleship. 1987. Population, productivity, and DDT contamination of Northern Gannets at Bonaventure Island, Quebec, 1967–1984. *Canadian Journal of Zoology* 65: 2922–2926.

Chardine, J. 2000. *Census of Northern Gannet Colonies in the Atlantic Region in 1999*. Canadian Wildlife Service Technical Report Series 361. Fredericton, NB: Canadian Wildlife Service, Atlantic Region. 23 pp.

Chardine, J.W. 2002. Geographic variation in the wingtip patterns of Black-legged Kittiwakes. *Condor* 104: 687–693.

Chardine, J., and R.W. Morris. 1996. Brown Noddy (*Anous stolidus*). No. 220 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Chardine, J.W., R.D. Morris, and R. Norton. 2000a. Status and conservation needs of Brown Noddies and Black Noddies in the West Indies. Pages 118–125 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Chardine, J.W., R.D. Morris, J.F. Parnell, and J. Pierce. 2000b. Conservation priorities for Laughing Gulls, Gull-billed Terns, Royal Terns and Bridled Terns in the West Indies. Pages 65–79 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Chaulk, K.G., G.J. Robertson, and W. Montevecchi. 2004. Breeding range update for three seabird species in Labrador. *Northeastern Naturalist* 11: 479–585.

Christie, D.S. 1979. Changes in Maritime bird populations, 1878–1978. *Journal of the New Brunswick Museum 1979*: 132–146.

Christie, D.S., B.E. Dalzell, M. David, R. Doiron, D.G. Gibson, M.H. Lushington, P.A. Pearce, S.I. Tingley, and J.G. Wilson. 2004. *Birds of New Brunswick: An Annotated List*. New Brunswick Museum, Monograph Series (Natural Sciences) No. 10. St. John: New Brunswick Museum. 84 pp.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982a. *Marine Birds of the Southeastern United States and Gulf of Mexico. Part I: Gaviiformes through Pelecaniformes*. FWS/OBS–82/01. Washington, DC: US Fish and Wildlife Service, Office of Biological Services. 637 pp.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982b. *Marine Birds of the Southeastern United States and Gulf of Mexico. Part II: Anseriformes*. FWS/OBS–82/20. Washington, DC: US Fish and Wildlife Service, Office of Biological Services. 491 pp.

Clapp, R B., and P.A. Buckley. 1984. Status and conservation of seabirds in the southeastern United States. Pages 135–155 in *Status and Conservation of the World's Seabirds* (Croxall, J.P., P.G.H. Evans, and R.W. Schreiber, eds.). ICBP Technical Publication 2. Cambridge, UK: International Council for Bird Preservation. 778 pp.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1983. *Marine Birds of the Southeastern United States and Gulf of Mexico. Part III: Charadriiformes*. FWS/OBS–83/30. Washington, DC: US Fish and Wildlife Service, Office of Biological Services. 853 pp.

Conversi, A., S. Piontkovski, and S. Hameed. 2001. Seasonal and interannual dynamics of *Calanus finmarchicus* in the Gulf of Maine (Northeastern US shelf) with reference to the North Atlantic oscillation. *Deep-Sea Research II* 48: 519–530.

Corrigan, S., and A.W. Diamond. 2001. Northern Gannet, *Morus bassanus*, nesting on Whitehorse Island, New Brunswick. *Canadian Field-Naturalist* 115: 176–177.

Cramp, S. (ed.). 1985. *The Birds of the Western Palearctic. Vol. IV: Terns to Woodpeckers*. Oxford: Oxford University Press. 960 pp.

Cramp, S., and K.E.L. Simmons (eds.). 1977. *The Birds of the Western Palearctic. Vol. I: Ostrich to Ducks*. Oxford: Oxford University Press. 722 pp.

Cramp, S., and K.E.L. Simmons (eds.). 1983. *The Birds of the Western Palearctic. Vol. III: Waders to Gulls*. Oxford: Oxford University Press. 913 pp.

Crawford, R.J.M. 2007. Food, fishing and seabirds in the Benguela upwelling system. *Journal of Ornithology* 148, *Supplement* 2: 253–260.

Crick, H. 2004. The impact of climate change on birds. *Ibis* 146: 48–56.

Croxall, J.P. (ed.). 1987. *Seabirds: Feeding Ecology and Role in Marine Ecosystems*. Cambridge, UK: Cambridge University Press. 408 pp.

Croxall, J.P., P.G.H. Evans, and R.W. Schreiber (eds.). 1984. *Status and Conservation of the World's Seabirds*. ICBP Technical Publication 2. Cambridge, UK: International Council for Bird Preservation. 778 pp.

Cruickshank, A.D. 1942. *Birds Around New York City: Where and When to Find Them*. The American Museum of Natural History Handbook Series, No. 13. New York: American Museum Press. 487 pp.

Cullen, S.A., J.R. Jehl, Jr., and G.L. Nuechterlein. 1999. Eared Grebe (*Podiceps nigricollis*). No. 433 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Cumming, J. 1988. Massachusetts's newest immigrant: the Black-headed Gull. *Bird Observer* 16: 314–323.

Cuthbert, F.J., and L.R. Wires. 1999. Caspian Tern (*Sterna caspia*). No. 403 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Davis, W.E., Jr. 1997. The Nantucket Oldsquaw flight: New England's greatest bird show? *Bird Observer* 25: 16–22.

Day, R.H., I J. Stenhouse, and H.G. Gilchrist. 2001. Sabine's Gull (*Xema sabini*). No. 593 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Desholm, M., and J. Kahlert. 2005. Avian collision risk at an offshore wind farm. *Biological Letters* 1: 296–298.

DeVries, E.A., and E.A. Forys. 2004. Loss of tar and gravel roofs in Pinellas County, Florida and potential effects on Least Tern populations. *Florida Field Naturalist* 31: 1–6.

Diamond, A.W., and C.M. Devlin. 2003. Seabirds as indicators of changes in marine ecosystems: ecological monitoring on Machias Seal Island. *Environmental Monitoring and Assessment* 88: 153–175.

Diamond, A.W., and E.A. Schreiber. 2002. Magnificent Frigatebird (*Fregata magnificens*). No. 601 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Dias, N.W. 2007. Pelagic birds off South Carolina and northern Georgia: an update on status of selected species. *North American Birds* 61: 188–197.

Dolbeer, R.A., S.C. Barras, and R.B. Chipman. 2001. Integrated management program to reduce bird strikes with aircraft at John F. Kennedy International Airport, 1991–2000 (Abstract). [http://www.icao.int]

Doughty, R. 1975. *Feather Fashions and Bird Preservation: A Study in Nature Conservation*. Berkeley: University of California Press. 184 pp.

Douglas, L. 2000. The Jamaica Petrel in the Caribbean. Pages 19–24 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Downer, R H., and C.E. Liebelt. 1990. *1989 Long Island Colonial Waterbird and Piping Plover Survey*. Stony Brook: New York State Department of Environmental Conservation, and Islip, NY: Seatuck Research Foundation. 200 pp.

Drennan, M.P., D.C. Folger, and C. Treyball. 1986. P*etit Manan National Wildlife Refuge, 1985: Changes in Nesting Seabird Populations after Two Years of Gull Management*. Unpublished report to US Fish and Wildlife Service, Augusta, ME. Bar Harbor, Maine: College of the Atlantic. 43 pp.

Drennan, M.P., D.C. Folger, and C. Treyball. 1987. Black-headed Gulls on Petit Manan Island, Maine. *American Birds* 41: 195–196.

Drinkwater, K.F., A. Belgrano, A. Borja, A. Conversi, M. Edwards, C.H. Greene, G. Ottersen, A.J. Pershing, and H. Walker. 2003. The response of marine ecosystems to climate variability associated with the North Atlantic Oscillation. Pages 211–234 in *The North Atlantic Oscillation: Climatic Significance and Environmental Impact* (Hurrell, J.W., Y. Kushnir, G. Ottersen, and M. Visbeck, eds.). Geophysical Monograph 134. Washington, DC: American Geophysical Union. 287 pp.

Drury, W.H. 1965. Gulls vs terns: clash of coastal nesters. *Massachusetts Audubon* 49: 207–211.

Drury, W.H. 1973–74. Population changes in New England seabirds. *Bird-Banding* 44: 267–313; 45: 1–15.

Drury, W.H., and J.J. Hatch. 1985. Great Cormorants nesting on the New England coast. *American Birds* 39: 259.

Drury, W.H., and J.A. Kadlec. 1974. The current status of the Herring Gull population in the northeastern United States. *Bird-Banding* 45: 297–306.

Drury, W.H., and I.C.T. Nisbet. 1972. The importance of movements in the biology of Herring Gulls in New England. Pages 173–212 in *Population Ecology of Migratory Birds*. US Fish and Wildlife Service, Wildlife Research Report 2. Washington, DC: US Bureau of Sport Fisheries and Wildlife.

Duffy, D.C., and D.C. Schneider. 1994. Seabird-fishery interactions: a manager's guide. Pages 26–38 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger, and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Duncan, C.D. 1996. The migration of Red-necked Phalaropes: ecological mysteries and conservation concerns. *Birding* 28: 482–488.

Dunn, E.H., and D.J. Agro. 1995. Black Tern (*Chlidonias niger*). No. 147 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Dunn, T.E. 2004. Black-headed Gull *Larus ridibundus*. Pages 196–213 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Durant, J.M., T. Anker-Nilssen, and N.C. Stenseth. 2003. Trophic interactions under climate fluctuations: the Atlantic Puffin as an example. *Proceedings of the Royal Society of London* B 270: 1461–1466.

Durant, J.M., N.C. Stenseth, T. Anker-Nilssen, M.P. Harris, P.M. Thompson and S. Wanless. 2004. Marine birds and climate fluctuation in the North Atlantic. Pages 95–105 in *Marine Ecosystems and Climate Variation* (N.C. Stenseth, G. Ottersen, J.W. Hurrell, and A. Belgrano, eds.). Oxford: Oxford University Press. 252 pp.

Efe, M.A., E.S. Tavares, A.J. Baker, and S.L. Bonatto. 2009. Multigene phylogeny and DNA barcoding indicate that the Sandwich Tern complex (*Thalasseus sandvicensis*, Laridae, Sternini) comprises two species. *Molecular Phylogenetics and Evolution* 52: 263–267.

Egevang, C., I.J. Stenhouse, R.A. Phillips, A. Petersen, J.W. Fox and J.R.D. Silk. 2010. Tracking of Arctic Terns *Sterna paradisaea* reveals longest animal migration. *Proceedings of the National Academy of Sciences of the USA* 107: 2078–2081.

Eggeman, D.R., and F.A. Johnson. 1989. Variation in effort and methodology for the midwinter inventory in the Atlantic Flyway. *Wildlife Society Bulletin* 17: 227–233.

Ellis, J.C., M.C. Stoddard, and L.W. Clark. 2008. Breeding by a Lesser Black-backed Gull (*Larus fuscus*) on the Atlantic coast of North America. *North American Birds* 61: 546–548.

Ellison, L.N., and L. Cleary. 1978. Effects of human disturbance on breeding of Double-crested Cormorants. *Auk* 95: 510–517.

Emslie, S.D., J. Weske, M. Browne, S. Cameron, R. Boettcher, D. Brinker, W. Golder, and F. Sanders. 2009. Population trends in Royal and Sandwich Terns along the mid-Atlantic seaboard, USA, 1975–2005. *Waterbirds* 32: 54–63.

Erskine, A.J. 1963. The Black-headed Gull (*Larus ridibundus*) in eastern North America. *Audubon Field Notes* 17: 334–338.

Erskine, A.J. 1990. Half a million eiders off Cape Cod: compounded errors or changed populations? *Auk* 107: 208–209.

Erskine, A.J. 1992. *Atlas of Breeding Birds of the Maritime Provinces*. Halifax: Nova Scotia Museum. 270 pp.

Erwin, R.M. 1979. *Coastal Waterbird Colonies: Cape Elizabeth, Maine to Virginia, 1977*. US Fish and Wildlife Service, Biological Services Program, FWS/OBS–79/10. 212 pp.

Erwin, R.M. 1980. Breeding habitat use by colonial nesting waterbirds in two mid-Atlantic US regions under two different regimes of human disturbance. *Biological Conservation* 18: 39–51.

Erwin, R.M., and C. Korschgen. 1979. *Coastal Waterbird Colonies: Maine to Virginia, 1977*. US Fish and Wildlife Service, Biological Services Program, FWS/OBS–79/08. 647 pp.

Erwin, R.M., J.D. Nichols, T.B. Eyler, D.B. Stotts, and B. Truitt. 1998. Modeling colony-site dynamics: a case study of the Gull-billed Tern in coastal Virginia. *Auk* 115: 970–978.

Evans, P.G. H., and D.N. Nettleship. 1985. Conservation of the Atlantic Alcidae. Pages 428–488 in *The Atlantic Alcidae* (Nettleship, D.N., and T.R. Birkhead, eds.). London: Academic Press. 642 pp.

Everaert, J., and E.W.M. Stienen. 2007. Impact of wind turbines on seabirds breeding at Zeebrugge (Belgium). *Biodiversity and Conservation* 16: 1–14.

Evers, D.C. 2004. *Status Assessment and Conservation Plan for the Common Loon* (Gavia immer) *in North America*. Hadley, MA: US Fish and Wildlife Service. 95 pp.

Ewins, P.J., and D.V. Weseloh. 1999. Little Gull (*Larus minutus*). No. 428 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 20 pp.

Ewins, P.J., D.V. Weseloh, R.J. Norstrom, K. Legierse, H.J. Auman, and J.P. Ludwig. 1994. *Caspian Terns on the Great Lakes: Organochlorine Contamination, Reproduction, Diet, and Population Changes, 1972–91*. Canadian Wildlife Service Occasional Paper 85. Ottawa: Canadian Wildlife Service. 28 pp.

Ferren, R.L. In press. *The Birds of Rhode Island: Their Seasonal Distribution and Ecological History*. Nuttall Ornithological Monographs.

Ferren, R.L., and J.E. Myers. 1998. *Rhode Island's Maritime Nesting Birds: A History and Survey of the State's Beach and Island Breeders—Cormorants, Gulls, Terns, Herons, Plovers, Oystercatchers, and More*. West Kingston: Rhode Island Division of Fish and Wildlife. 222 pp.

Finch, D.W., W.C. Russell, and E.V. Thompson. 1978. Pelagic birds in the Gulf of Maine. *American Birds* 32: 281–294.

Fishpool, L., and M. Evans (eds.). 2001. *Important Bird Areas in Africa and Associated Islands*. BirdLife Conservation Series No. 11. Newbury, UK: Pisces Publications, and Cambridge, UK: BirdLife International. 1144 pp.

Fisk, E.J. 1975. Least Tern: beleaguered, opportunistic and roof-nesting. *American Birds* 29: 15–16.

Fisk, E.J. 1978. The growing use of roofs by nesting birds. *Bird-Banding* 49: 134–141.

Fogarty, M.J., E.B. Cohen, W.L. Michaels, and W.W. Morse. 1991. Predation and the regulation of sand lance populations: an exploratory analysis. *ICES Marine Sciences Symposia* 193: 120–124.

Fogarty, M J., and S.A. Murawski. 1998. Large-scale disturbance and the structure of marine systems: fishery impacts on Georges Bank. *Ecological Applications* 8 (*Supplement*): S6–S22.

Forsell, D.J. 1999a. Distribution and abundance of sea ducks wintering in Chesapeake Bay. Pages 81–90 in *Behavior and Ecology of Sea Ducks* (Goudie, R.I., M.R. Petersen, and G.J. Robertson, eds.). Canadian Wildlife Service Occasional Paper No. 100. Ottawa: Canadian Wildlife Service. 88 pp.

Forsell, D.J. 1999b. *Mortality of Migratory Waterbirds in Mid-Atlantic Coastal Anchored Gillnets during March and April, 1998*. Unpublished Report. Annapolis, MD: US Fish and Wildlife Service. 29 pp.

Forster, R.A. 1990. Changes in the Ring-billed Gull population in Massachusetts. *Bird Observer* 17: 304–310.

Forster, R.A. 1993. Phalaropes, phalaropes everywhere. *Bird Observer* 21: 98–99.

Frederiksen, M., R.W. Furness, and S. Wanless. 2007. Regional variation in the role of bottom-up and top-down processes in controlling Sandeel abundance in the North Sea. *Marine Ecology Progress Series* 300: 201–211.

Frederiksen, M., M.P. Harris, F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. *Global Change Biology* 10: 1214–1221.

French, T.W. 2002. Summary of Leach's Storm-Petrel nesting on Penikese Island, MA and a report of probable nesting on Nomans Land Island. *Bird Observer* 30: 182–187.

Friesen, V.L., D.W. Anderson, T.E. Steeves, H. Jones, and E.A. Schreiber. 2002. Molecular support for species status of the Nazca Booby (*Sula granti*). *Auk* 119: 820–826.

Friesen, V.L., T.M. Burg, and K.D. McCoy. 2007b. Mechanisms of population differentiation in seabirds. *Molecular Ecology* 16: 1765–1785.

Friesen, V.L., A.L. Smith, E. Gómez-Díaz, M. Bolton, R.W. Furness, J. González-Solís, and L. Monteiro. 2007a. Sympatric speciation by allochrony in a seabird. *Proceedings of the National Academy of Sciences of the USA* 104: 18589–18594.

Fritz, M. 2008. New Jersey's first Royal Tern breeding colony. *New Jersey Birds* 34: 22–28.

Furness, R.W. 1987. *The Skuas*. Calton, UK: T & A D Poyser. 363 pp.

Furness, R.W. 2002. Management implications of interactions between fisheries and sandeel dependent seabirds and seals in the North Sea. *ICES Marine Sciences* 59: 261–269.

Furness, R.W., and N. Ratcliffe. 2004a. Arctic Skua *Stercorarius parasiticus*. Pages 160–172 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Furness, R.W., and N. Ratcliffe. 2004b. Great Skua *Stercorarius skua*. Pages 173–186 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Fussell, J.O., III, and Allen-Grimes, A. 1980. Bird sightings associated with hurricane David. *Chat* 44: 89–100.

Galbraith, H., R. Jones, R. Park, J. Clough, S. Herrod-Julius, B. Harrington, and G. Page. 2002. Global climate change and sea level rise: potential losses of intertidal habitat for shorebirds. *Waterbirds* 25: 173–183.

Gales, R. 1998. Albatross populations: status and threats. Pages 20–45 in *Albatross Biology and Conservation* (Robertson, G., and R. Gales, eds). Chipping Norton, NSW, Australia: Surrey Beatty and Sons. 300 pp.

Gallo, S. 2006. Notes on the 2005 Maine Audubon loon count. *Loon News* (Maine Audubon Society: [http://www.maineaudubon.org]

Garthe S., C.J. Camphuysen, and R.W. Furness. 1996. Amounts of discards by commercial fisheries and their significance as food for seabirds in the North Sea. *Marine Ecology Progress Series* 136: 1–11.

Garthe S., U. Walter, M.L. Tasker, P.H. Becker, G. Chapdelaine, and R.W. Furness. 1999. Evaluation of the role of discards in supporting bird populations and their effects on the species composition of seabirds in the North Sea. *ICES Cooperative Research Report* 232: 29–41.

Gaston, A.J., and J.M. Hipfner. 2000. Thick-billed Murre (*Uria lomvia*). No. 497 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Gaston, A.J., and I.L. Jones. 1998. *The Auks*. Oxford: Oxford University Press. 349 pp.

Gilchrist, H.G. 2001. Glaucous Gull (*Larus hyperboreus*). No. 573 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Gilchrist, H. G., and M. L. Mallory. 2005. Declines in abundance and distribution of the Ivory Gull (*Pagophila eburnea*) in Arctic Canada. *Biological Conservation* 121: 303–309.

Gilg, O., H. Strøm, A. Aebischer, M. V. Gavrilo, A. E. Volkov, C. Miljeteig, and B. Sabard. 2010. Post-breeding movements of northeast Atlantic Ivory Gull (*Pagophila eburnea*) populations. *Journal of Avian Biology* 41: 532–542.

Gillett, W.H., J.R. Hayward Jr., and J.F. Stout. 1975. Effects of human activity on egg and chick mortality in a Glaucous-winged Gull colony. *Condor* 77: 492–495.

Giraud, J.P. 1844. *The Birds of Long Island*. New York: Wiley & Putnam. 297 pp.

Gjerdrum, C., A.M.J. Vallée, C.C. St. Clair, D.F. Bertram, J.L. Ryder, and G.S. Blackburn. 2003. Tufted Puffin reproduction reveals ocean climate variability. *Proceedings of the National Academy of Sciences of the USA* 100: 9377–9382.

Gochfeld, M. 1973. Effect of artefact pollution on the viability of seabird colonies on Long Island, New York. *Environmental Pollution* 4: 1–6.

Gochfeld, M., and J. Burger. 1994. Black Skimmer (*Rynchops niger*). No. 108 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Gochfeld, M., J. Burger, A. Haynes-Sutton, R. van Halewyn, and J.E. Saliva. 1994. Successful approaches to seabird protection in the West Indies. Pages 186–209 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Gochfeld, M., J. Burger, and I.C.T. Nisbet. 1998. Roseate Tern (*Sterna dougallii*). No. 370 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Godfrey, P.J., S.P. Leatherman, and P.A. Buckley. 1980. ORVs and barrier beach degradation. *Parks* 5(2): 5–11.

Godfrey, W E. 1979. *The Birds of Canada*. Ottawa: National Museum of Natural Sciences. 428 pp.

Gómez-Díaz, E., and J. Gonzáles-Solís. 2006. Geographic assignment of seabirds to their origin: combining morphologic, genetic and biogeochemical analyses. *Ecological Applications* 17: 1494–1498.

Gómez-Díaz, E., J. Gonzáles-Solís, M.A. Peinado, and R.D.M. Page. 2006. Phylogeography of the *Calonectris* shearwaters using molecular and morphometric data. *Molecular Phylogenetics and Evolution* 41: 322–332.

GOMSWG (Gulf of Maine Seabird Working Group). 1984–2009. *Annual Reports and Minutes of Meetings*. Bremen, ME: National Audubon Society.

González-Solís, J., J.P. Croxall, D. Oro, and X. Ruíz. 2007. Trans-equatorial migration and mixing in the wintering areas of a pelagic seabird. *Frontiers in Ecology and the Environment* 5: 297–301.

Good, T.P. 1998. Great Black-backed Gull (*Larus marinus*). No. 330 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Goodale, M.W. 2001. *Herring Gulls' Use of Lobster Bait during the Breeding Season in Penobscot Bay, Maine*. M.S. thesis. College of the Atlantic, Bar Harbor, ME. 66 pp.

Gore, J.A., and M.J. Kinnison. 1991. Hatching success in roof and ground colonies of Least Terns. *Condor* 93: 759–762.

Goudie, R.I., S. Brault, B. Conant, A.V. Kondratyev, M.R. Petersen, and K. Vermeer. 1994. The status of sea ducks in the North Pacific rim: towards their conservation and management. *Transactions of the North American Wildlife and Natural Resources Conference* 59: 27–49.

Goudie, R.I., G.J. Robertson, and A. Reed. 2000. Common Eider (*Somateria mollissima*). No. 546 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Griscom, L., and D. Snyder. 1955. *The Birds of Massachusetts*. Salem, MA: Peabody Museum. 295 pp.

Grose, P.L., and J.S. Mattison (eds.). 1977. *The* Argo Merchant *Oil Spill: A Preliminary Scientific Report*. Boulder, CO: US Department of Commerce, National Oceanic and Atmospheric Administration. 133 + 212 pp.

Gross, A.O. 1951. The Herring Gull-cormorant control project. *Proceedings of the Xth International Ornithological Congress*: 532–536.

Guilford, T., J. Meade, J. Willis, R. A. Phillips, D. Boyle, S. Roberts, M. Collett, R. Freeman, and C. M. Perrins. 2009. Migration and stopover in a small pelagic seabird, the Manx Shearwater *Puffinus puffinus*: insights from machine learning. *Proceedings of the Royal Society of London* B 276: 1215–1223.

Guinet, C., O. Chastel, M. Koudil, J. Durbec, and P. Jouventin. 1998. Effects of warm sea-surface temperature anomalies on the Blue Petrel at the Kerguelen Islands. *Proceedings of the Royal Society of London* B 265: 1001–1006.

Hagemeijer, W.J.M., and M.J. Blair. 1997. *The EBBC Atlas of European Breeding Birds: Their Distribution and Abundance.* London: T & A D Poyser. 933 pp.

van Halewyn, R., and R.L. Norton. 1984. The status and conservation of seabirds in the Caribbean. Pages 169–222 in *Status and Conservation of the World's Seabirds* (Croxall, J.P., P.G.H. Evans, and R.W. Schreiber, eds.). ICBP Technical Publication 2. Cambridge, UK: International Council for Bird Preservation. 778 pp.

Haney, J.C. 1983. Previously unrecorded and hypothetical species of seabirds on the continental shelf of Georgia. *Oriole* 48: 21–32.

Haney, J.C. 1985a. Aggregations of Cory's Shearwaters (*Calonectris diomedea*) at Gulf Stream fronts. *Wilson Bulletin* 97: 191–200.

Haney, J.C. 1985b. Wintering phalaropes off the southeastern United States: application of remote sensing imagery to seabird habitat analysis at oceanic fronts. *Journal of Field Ornithology* 56: 321–333.

Haney, J.C. 1985c. Band-rumped Storm-Petrel occurrences in relation to upwelling off the coast of the southeastern United States. *Wilson Bulletin* 97: 543–547.

Haney, J.C. 1986a. Remote sensing of seabird environments. *American Birds* 40: 396–400.

Haney, J.C. 1986b. Records of seabirds from South Carolina offshore waters. *Chat* 50: 44–46.

Haney, J.C. 1987. Aspects of the pelagic ecology and behavior of the Black-capped Petrel (*Pterodroma hasitata*). *Wilson Bulletin* 99: 153–168.

Haney, J.C. 1990. Winter habitat of Common Loons on the continental shelf of the southeastern United States. *Wilson Bulletin* 102: 253–263.

Haney, J.C., P. Brisse, D.R. Jacobson, M.W. Oberle, and J.M. Paget. 1993. An observation of Fea's Petrel (*Pterodroma feae*) off the southeastern United States, with comments on the taxonomy and conservation of the soft-plumaged and related petrels in the Atlantic Ocean. *Brimleyana* 18: 115–124.

Haney, J.C., D.S. Lee, and R.D. Morris. 1999. Bridled Tern (*Sterna anaethetus*). No. 468 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Haney, J.C., and P.A. McGillivary. 1985. Midshelf fronts in the South Atlantic Bight and their influence on seabird distribution and seasonal abundance. *Biological Oceanography* 3: 401–430.

Hanson, J. 2005. New Jersey Bird Records Committee List of Accepted Records of Rare Birds in New Jersey through 2004. *Records of New Jersey Birds, Supplement* 31(2): 1–32.

Harlow, R.A., Jr. 1995. Ram Island—recovery in progress. *Bird Observer* 23: 333–338.

Harris, M.P. 2004. Atlantic Puffin *Fratercula arctica*. Pages 392–406 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Harris, M.P., and S. Wanless. 2004. Common Guillemot *Uria aalge*. Pages 350–363 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Harrison, P. 1983. *Seabirds: An Identification Guide*. Boston: Houghton Mifflin. 448 pp.

Hata, D.N. 2006. *Incidental Captures of Seabirds in the U.S. Atlantic Pelagic Longline Fishery, 1986–2005*. Unpublished Report, NOAA Fisheries Service, Southeast Fisheries Science Center, Protected Resources and Biodiversity Division. Miami, FL: National Oceanographic and Atmospheric Administration. 23 pp.

Hatch, J.J. 1970. Predation and piracy by gulls at a ternery in Maine. *Auk* 87: 244–254.

Hatch, J.J. 1984. Rapid increase of Double-crested Cormorants nesting in southern New England. *American Birds* 38: 984–988.

Hatch, J.J. 1995. Changing populations of Double-crested Cormorants. *Colonial Waterbirds* 18, *Special Publication* 1: 11–24.

Hatch, J.J. 2002. Arctic Tern (*Sterna paradisaea*). No. 707 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 40 pp.

Hatch, J.J., K.M. Brown, G.G. Hogan, and R.D. Morris. 2000. Great Cormorant (*Phalacrocorax carbo*). No. 553 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Hatch, S.A., and D.N. Nettleship. 1998. Northern Fulmar (*Fulmarus glacialis*). No. 361 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Hatch, J.J., and D.V. Weseloh. 1999. Double-crested Cormorant (*Phalacrocorax auritus*). No. 441 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 36 pp.

Haymes, G.T., and H. Blokpoel. 1978. Seasonal distribution and site tenacity of the Great Lakes Common Tern. *Bird-Banding* 41: 97–106.

Hays, H., P. Lima, L. Monteiro, J. DiCostanzo, G. Cormons, I.C.T. Nisbet, J.E. Saliva, J.A. Spendelow, J. Burger, J. Pierce, and M. Gochfeld. 1999. A nonbreeding concentration of Roseate and Common Terns in Bahia, Brazil. *Journal of Field Ornithology* 70: 455–464.

Hazevoet, C.J. 1994. Status and conservation of seabirds in the Cape Verde Islands. Pages 279–285 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger, and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Hazevoet, C.J. 1995. *The Birds of the Cape Verde Islands: An Annotated Check-list.* BOU Check-list No. 13. Dorchester: British Ornithologists' Union. 192 pp.

Hébert, P.N. 1989. Decline of the Kent Island, New Brunswick, Herring Gull, *Larus argentatus*, colony. *Canadian Field-Naturalist* 103: 396–397.

Heidrich, P., J. Amengual, and M. Wink. 1998. Phylogenetic relationships in Mediterranean and North Atlantic shearwaters (Aves: Procellaridae) based on nucleotide sequences of mtDNA. *Biochemical Systematics and Ecology* 26: 145–170.

Hémery, G., and C. Jouanin. 1988. Statut et origine géographique des populations de Petrel culblanc (*Oceanodroma leucorhoa*) présentes dans le Golfe de Gascogne. *Alauda* 56: 238–245.

Heubeck, M. 2004. Black-legged Kittiwake *Rissa tridactyla*. Pages 277–290 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Hill, N.P. 1965. *The Birds of Cape Cod, Massachusetts*. New York: William Morrow. 364 pp.

Hoffman, M.L., and P. Davis. 1999. *Second Report of the Maryland/DC Rarities Committee*. Baltimore: Maryland Ornithological Society. 15 pp.

Holt, D., J.P. Lortie, B.J. Nikula, and R.C. Humphrey. 1986. First record of Black-headed Gulls breeding in the United States. *American Birds* 40: 204–206.

Hoopes, E.H., P.M. Cavanagh, C.R. Griffin, and J.T. Finn. 1994. *Synthesis of Information on Marine and Coastal Birds of the Atlantic Coast: Abundance, Distribution, and Potential Risks from Oil Activities. Vols. 1–4.* Unpublished report to US Department of the Interior, Minerals Management Service. Amherst: Massachusetts Cooperative Fish and Wildlife Research Unit. 683 pp.

Houde, P. 1977. Gull-tern interactions on Hicks Island, 1975. *Proceedings of the Linnaean Society of New York* 43: 58–64.

Howell, S.N.G., and J. Dunn. 2007. *A Reference Guide to Gulls of the Americas*. Boston: Houghton Mifflin Company. 516 pp.

Howell, S.N.G, J.B. Patteson, K. Sutherland, and D.T. Shoch. 2010. Occurrence and identification of the Band-rumped Storm-Petrel (*Oceanodroma castro*) complex off North Carolina. *North American Birds* 64: 196–207.

Huettmann, F., A.W. Diamond, B. Dalzell, and K. MacIntosh. 2005. Winter distribution, ecology and movements of Razorbills *Alca torda* and other auks in the outer Bay of Fundy, Eastern Canada. *Marine Ornithology* 33: 161–171.

Hunt, G.L. 1972. Influence of food distribution and human disturbance on the reproductive success of Herring Gulls. *Ecology* 53: 1051–1061.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. *Southeast United States Regional Waterbird Conservation Plan*. Unpublished report, Patuxent Wildlife Research Center. 134 pp. [http://www.pwrc.usgs.gov]

Huntington C.E., R.G. Butler, and R.A. Mauck. 1996. Leach's Storm-Petrel (*Oceanodroma leucorhoa*). No. 233 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Hurrell, J.W., and R.R. Dickson. 2004. Climate variability over the North Atlantic. Pages 15–32 in *Marine Ecosystems and Climate Variation*. (Stenseth, N.C., G. Ottersen, J.W. Hurrell, and A. Belgrano, eds.). Oxford: Oxford University Press. 241 pp.

Hurrell, J.W., Y. Kushnir, G. Ottersen, and M. Visbeck (eds.). 2003. *The North Atlantic Oscillation: Climatic Significance and Environmental Impact*. Geophysical Monograph 134. Washington, DC: American Geophysical Union. 287 pp.

Hutchinson, A.E. 1979. Estimating numbers of colonial nesting seabirds: a comparison of techniques. *Proceedings of the Colonial Waterbird Group* 3: 235–244.

Imber, M.J. 2004. Kermadec Petrels (*Pterodroma neglecta*) at Ilha da Trindade, South Atlantic Ocean and in the North Atlantic. *Notornis* 51: 33–40.

IPCC (Intergovernmental Panel on Climate Change). 2007. IPCC Fourth Assessment Report. Working Group I Report: "The Physical Science Basis". Intergovernmental Panel on Climate Change. [http://www.ipcc.ch]

Irons, D.B., T. Anker-Nilssen, A.J. Gaston, G.V. Byrd, K. Falk, G. Gilchrist, M. Hario, M.H. Jernquist, Y.V. Krasnov, A. Mosbech, B. Olsen, A. Peterson, J.B. Reid, G.J. Robertson, H. Strøm, and K.D. Wohl. 2008. Fluctuations in circumpolar seabird populations linked to climate oscillations. *Global Change Biology* 14: 1455–1463.

Jedrey, E.L., R.J. Harris, and E.A. Ray. 2010. Citizens of the world: the Canada to Cape Cod connection. *Bird Observer* 38: 146–150.

Jodice, P.G., T.M. Murphy, F.J. Sanders, and L.M. Ferguson. 2007. Longterm trends in nest counts of colonial nesting seabirds in South Carolina, USA. *Waterbirds* 30: 40–51.

Johnson, C.M., and W.B. Krohn. 2001. The importance of survey timing in monitoring breeding seabird numbers. *Waterbirds* 24: 22–33.

Kadlec, J.A., and W.H. Drury. 1968. Structure of the New England Herring Gull population. *Ecology* 49: 644–676.

Kampp, K., D.N. Nettleship, and P.G.H. Evans. 1994. Thick-billed Murres of Greenland: status and prospects. Pages 133–154 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger, and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Kaufman, K. 1994. Changing seasons: 1993–1994 winter season. *Field Notes* 48: 172–175.

Kehoe, F.P. 1994. A New Brunswick Black-legged Kittiwake, *Rissa tridactyla*, colony. *Canadian Field-Naturalist* 108: 375–376.

Kehoe, F.P., and A.W. Diamond. 2001. Increase and expansion of the New Brunswick breeding population of Black-legged Kittiwakes, *Rissa tridactyla*. *Canadian Field-Naturalist* 115: 349–350.

Kenow, K.P., D. Adams, N. Schoch, D.C. Evers, W. Hanson, D. Yates, L. Savoy, T.J. Fox, A. Major, R. Kratt, and J. Ozard. 2009. Migration patterns and wintering range of Common Loons breeding in the northeastern United States. *Waterbirds* 32: 234–247.

Kenow, K.P., M.W. Meyer, D.C. Evers, D.C. Douglas, and J. Hines. 2002. Use of satellite telemetry to identify Common Loon migration routes, staging areas and wintering range. *Waterbirds* 25: 449–458.

Kilpatrick, A.M., A.A. Chmura, D.W. Gibbons, R.C. Fleischer, P.P. Marra, and P. Daszak. 2006. Predicting the global spread of H5N1 influenza. *Proceedings of the National Academy of Sciences of the USA* 103: 19368–19373.

King, W.B. 1984. Accidental mortality of seabirds in gillnets in the North Pacific. Pages 709–715 in *Marine Birds: Their Feeding Ecology and Commercial Fisheries Relationships* (Nettleship, D.N., G.A. Sanger, and P.F. Springer, eds.). Ottawa: Canadian Wildlife Service. 220 pp.

Kirkham, I.R. 1986. *Comparative Foraging and Breeding Habits of Arctic and Common Terns*. Ph.D. dissertation. Dalhousie University, Halifax, NS. 257 pp.

Korschgen, C. 1979. *Coastal Waterbird Colonies: Maine*. U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS–79/09. 83 pp.

Kress, S. 1982. The return of the Atlantic Puffin to Eastern Egg Rock, Maine. *Living Bird Quarterly* 1: 11–14.

Kress, S. 1983. The use of decoys, sound recordings, and gull control for re-establishing a tern colony in Maine. *Colonial Waterbirds* 6: 185–196.

Kress, S.W. 1997. Using animal behavior for conservation: case studies in seabird restoration from the Maine coast, USA. *Journal of the Yamashina Institute of Ornithology* 29: 1–26.

Kress, S., and C.S. Hall. 2004. *Tern Management Handbook—Coastal Northeastern United States and Atlantic Canada*. Hadley, MA: US Fish and Wildlife Service. 195 pp.

Kress, S. W., and D.N. Nettleship. 1988. Re-establishing the Atlantic Puffin (*Fratercula arctica*) at a former breeding site in the Gulf of Maine. *Journal of Field Ornithology* 59: 161–170.

Kress, S., E. Weinstein, and I.C.T. Nisbet. 1983. The status of tern populations in northeastern United States and adjacent Canada. *Colonial Waterbirds* 6: 84–106.

Krohn, W.B., R.B. Allen, J.R. Moring, and A.E. Hutchinson. 1995. Double-crested Cormorants in New England: population and management histories. *Colonial Waterbirds* 18, *Special Publication* 1: 99–109.

Krohn, W.B., P.O. Corr, and A.E. Hutchinson. 1992. *Status of the American Eider with Special Reference to Northern New England*. Fish and Wildlife Research Report 12. Washington, DC: US Fish and Wildlife Service. 12 pp.

Kury, C.R., and M. Gochfeld. 1975. Human interference and gull predation in cormorant colonies. *Biological Conservation* 8: 23–24.

Kushlan, J.A., M.J. Steinkamp, K. Parsons, and 20 others. 2002. *North American Waterbird Conservation Plan, Version 1*. Washington, DC: Waterbird Conservation for the Americas. 78 pp.

Lambert, K. 1973. The migration of Sabine's Gull, *Xema sabini*, in the northwest Atlantic. *Canadian Field-Naturalist* 87: 57–60.

L'Arrivée, L., and H. Blokpoel. 1988. Seasonal distribution and site fidelity in Great Lakes Caspian Terns. *Colonial Waterbirds* 11: 202–214.

Le Grand, G., K. Emmerson, and A. Martin. 1984. The status and conservation of seabirds in the Macaronesian Islands. Pages 337–391 in *Status and Conservation of the World's Seabirds* (Croxall, J.P., P.G.H. Evans, and R.W. Schreiber, eds.). ICBP Technical Publication 2. Cambridge, UK: International Council for Bird Preservation. 778 pp.

Lebreton, J.-D., J.E. Hines, R. Pradel, J.D. Nichols, and J.A. Spendelow. 2003. Estimation by capture-recapture of recruitment and dispersal over several sites. *Oikos* 101: 253–264.

Lee, D.E., N. Nur, and W.J. Sydeman. 2007. Climate and demography of the planktivorous Cassin's Auklet *Ptychoramphus aleuticus* off northern California: implications for climate change. *Journal of Animal Ecology* 76: 337–347.

Lee, D.S. 1984. Petrels and storm-petrels in North Carolina waters. *American Birds* 38: 151–163.

Lee, D.S. 1986. Seasonal distribution of marine birds in North Carolina waters, 1975–1986. *American Birds* 40: 409–412.

Lee, D.S. 1987a. December records of seabirds off North Carolina. *Wilson Bulletin* 99: 116–121.

Lee, D.S. 1987b. First record of Wilson's Storm-Petrels on a Christmas Bird Count. *American Birds* 41: 1331–1333.

Lee, D.S. 1989. Jaegers and skuas in the western North Atlantic: some historical misconceptions. *American Birds* 43: 18–20.

Lee, D.S. 1995. The pelagic ecology of Manx Shearwaters, *Puffinus puffinus*, off the southeastern United States of America. *Marine Ornithology* 23: 107–119.

Lee, D.S. 2000a. Color morph bias and conservation concerns for a tropical *Pterodroma*. *Chat* 64: 15–20.

Lee, D.S. 2000b. Status and conservation priorities for Black-capped Petrels in the West Indies. Pages 11–18 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Lee, D.S. 2000c. Status and conservation priorities for Audubon's Shearwaters. Pages 25–30 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Lee, D.S. 2007. *Species Profiles of Eastern North Atlantic Seabirds*. Unpublished draft report to NOAA Fisheries Service, Southeast Fisheries Science Center, Miami, FL. 65 pp.

Lee, D.S. 2009. Review of Bradley and Norton (2009). *Waterbirds* 32: 604–606.

Lee, D.S., and J. Booth. 1979. Seasonal distribution of offshore and pelagic birds in North Carolina waters. *American Birds* 33: 715–721.

Lee, D.S., and J.C. Haney. 1996. Manx Shearwater (*Puffinus puffinus*). No. 257 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Lee, D.S., and M. Walsh-McGehee. 1998. White-tailed Tropicbird (*Phaethon lepturus*). No. 353 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

LeGrand, H.E. Jr., K.E. Camburn, S. Cooper, R.J. Davis, E.V. Dean, W.K. Forsythe, and R.L. Tyndall. 2004. 2003 annual report of the North Carolina Bird Records Committee. *Chat* 68: 1–5.

Lensink, C.J. 1984. The status and conservation of seabirds in Alaska. Pages 13–27 in *Status and Conservation of the World's Seabirds* (Croxall, J.P., P.G.H. Evans, and R.W. Schreiber, eds.). Cambridge, UK: International Council for Bird Preservation. 778 pp.

Levine, B. (ed.). 1998. *Bull's Birds of New York State*. Ithaca, NY: Comstock Publishing Associates. 622 pp.

Lindsay, K., B. Horwith, and E.A. Schreiber. 2000. Status of the Magnificent Frigatebird in the Caribbean. Pages 25–30 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Link, J S., and L.P. Garrison. 2002. Trophic ecology of Atlantic Cod *Gadus morhua* on the northeast US continental shelf. *Marine Ecology Progress Series* 227: 109–123.

Livezey, B.C. 1995. Phylogeny and evolutionary ecology of modern seaducks (Anatidae: Mergini). *Condor* 92: 233–255.

Lock, A.R. 1988. Recent increases in the breeding population of Ring-billed Gulls *Larus delawarensis* in Atlantic Canada. *Canadian Field-Naturalist* 102: 627–633.

Lohr, S., and D. Ryan. 2002. Least Tern colony at Shaw Air Force base, South Carolina. *Chat* 66: 23–25.

López Suárez, P., N. Varo Cruz, C.J. Hazevoet, and L.F. López Juaro. 2005. Restricted nesting habitat and reproductive failure of Magnificent Frigatebirds *Fregata magnificens* in the Cape Verde Islands. *Atlantic Seabirds* 7: 10–12.

Lowther, P.E., A.W. Diamond, S.W. Kress, G.J. Robertson, and K. Russell. 2002. Atlantic Puffin (*Fratercula arctica*). No. 709 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Ludwig, J.P. 1979. Present status of the Caspian Tern population of the Great Lakes. *Michigan Academician* 12: 69–77.

MacKinnon, C.M., and A.D. Smith. 1985. *A Summary of Historical Information on the Seabirds of Machias Seal Island*. Unpublished report. Sackville, NB: Canadian Wildlife Service. 35 pp.

Madeiros, J. 2009. The Bermuda islands. Pages 7–14 in *An Inventory of Breeding Seabirds of the Caribbean* (Bradley, P.E., and R.L. Norton, eds.). Gainesville: University of Florida Press. 353 pp.

Madeiros, J. 2012. *Cahow Recovery Program: 2010–2011 Breeding Season Report*. Hamilton: Bermuda Government Department of Public Works.

Malling Olsen, K., and H. Larsson. 1995. *Terns of Europe and North America*. Princeton: Princeton University Press. 176 pp.

Mallory, M. L., I.J. Stenhouse, G. Gilchrist, G. Robertson, J.C. Haney, and S.D. Macdonald. 2008. Ivory Gull (*Pagophila eburnea*). No. 175 in *The Birds of North America online* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

MANEM Waterbird Working Group. 2006. *Waterbird Conservation Plan for the Mid-Atlantic/New England/Maritimes Region: 2006–2010*. 44 pp. [http://www.waterbirdconservation.org]

Manuwal, D.A. 1978. Effect of man on marine birds: a review. Pages 140–160 in *Wildlife and People* (Kirkpatrick, C.M., ed.). Purdue: Purdue University Press. 191 pp.

Marchant, S., and P.J. Higgins (eds.). 1990. *Handbook of Australian, New Zealand and Antarctic Birds. Vol. 1: Ratites to Petrels*. Melbourne: Oxford University Press. 1400 pp.

Mawhinney, K., A.W. Diamond, P. Kehoe, and N. Benjamin. 1999. Status and productivity of Common Eiders in relation to Great Black-backed Gulls and Herring Gulls in the southern Bay of Fundy and northern Gulf of Maine. *Waterbirds* 22: 253–262.

Maybank, B. 1997. Atlantic Provinces region, 1997 spring season. *Field Notes* 51: 838–839.

McAlpine, D.F., N.R. Garrity, N. Benjamin, A.W. Diamond, L.C. Hughes, M.C. Sollows, D.M. Johnson, and M. Sheppard. 2005. Ring-billed Gulls (*Larus delawarensis*) nesting on Manawagonish Island, New Brunswick: continuing expansion of the seabird community in the Bay of Fundy. *Northeastern Naturalist* 12: 263–266.

McCollough, M., C. Todd, B. Swartz, P. deMaynadier, and H. Givens. 2003. Bald Eagle. Pages 60–61 in *Maine's Endangered and Threatened Wildlife*. Augusta: Maine Department of Inland Fisheries and Wildlife. 117 pp.

McGowan, A.F. 1969. Common Terns, *Sterna hirundo*, nesting on roof in Pompano Beach. *Florida Naturalist* 42: 172.

McIntyre, J.W., and J.F. Barr. 1997. Common Loon (*Gavia immer*). No. 313 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Academy of Natural Sciences and Washington, DC: The American Ornithologists' Union. Birds of North America, Inc. 32 pp.

McNair, D.B. 2000a. The status of Magnificent Frigatebirds in the interior of Florida: the influence of storms. *North American Birds* 54: 11–15.

McNair, D.B. 2000b. Assessment of occurrences of Magnificent Frigatebirds in northwest Florida: the influence of weather and roosts. *North American Birds* 54: 339–344.

McNair, D.B., and W. Post. 1993. *Supplement to Status and Distribution of South Carolina Birds*. Charleston Museum Ornithological Contribution No. 8. Charleston: Charleston Museum. 23 pp.

McNicholl, M.K., P.E. Lowther, and J.A. Hall. 2001. Forster's Tern (*Sterna forsteri*). No. 595 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Mendall, H.L. 1936. The home-life and economic status of the Double-crested Cormorant *Phalacrocorax auritus auritus* (Lesson). *University of Maine Studies* 38: 1–150.

Mercier, F., and D.E. Gaskin. 1985. Feeding ecology of migrating Red-necked Phalaropes (*Phalaropus lobatus*) in the Quoddy region, New Brunswick, Canada. *Canadian Journal of Zoology* 63: 1062–1067.

Merne, O., and P.I. Mitchell. 2004. Razorbill *Alca torda*. Pages 364–376 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Meyer, T.L., R.A. Cooper, and R.W. Langton. 1979. Relative abundance, behavior and food habits of the American sandlance, *Ammodytes americanus*, from the Gulf of Maine. *Fisheries Bulletin* 77: 243–253.

Mills, E.L. 1969. Hurricane 'Gladys' and its ornithological effect on the Maritime Provinces. *Nova Scotia Bird Society Newsletter* 11: 6–16.

Milton, G., and P. Austin-Smith. 1983. Changes in the abundance and distribution of Double-crested (*Phalacrocorax auritus*) and Great (*P. carbo*) Cormorants in Nova Scotia. *Colonial Waterbirds* 6: 130–138.

Minsky, D. 1980. Preventing fox predation at a Least Tern colony with an electric fence. *Journal of Field Ornithology* 51: 180–181.

Mitchell, P.I. 2004a. Leach's Storm-petrel *Oceanodroma leucorhoa*. Pages 101–114 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Mitchell, P.I. 2004b. Black Guillemot *Cepphus grylle*. Pages 377–391 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Mittelhauser, G.H. 2000. *The Winter Ecology of Harlequin Ducks in Coastal Maine*. M.S. thesis. University of Maine, Orono. 131 pp.

Mittelhauser, G.H. 2008. Harlequin Ducks in the eastern United States. *Waterbirds* 31, *Special Publication* 2: 58–66.

Mittelhauser, G.H., J.B. Drury, and P.O. Corr. 2002. Harlequin Ducks (*Histrionicus histrionicus*) in Maine, 1950–1999. *Northeastern Naturalist* 9: 163–182.

Molina, K.C., and R.M. Erwin. 2006. The distribution and conservation status of the Gull-billed Tern (*Gelochelidon nilotica*) in North America. *Waterbirds* 29: 271–295.

Molina, K.C., R.M. Erwin, E. Palacios, E. Mellink, and N.W.H. Seto. 2010. *Status Review and Conservation Recommendations for the Gull-billed Tern* (Gelochelidon nilotica) *in North America*. US Fish and Wildlife Service Biological Technical Publication BTP–R1013–2010. Washington, DC: US Fish and Wildlife Service. 70 pp.

Møller, A.P., E. Flensted-Jensen, and W. Mardal. 2006. Rapidly advancing laying date in a seabird and the changing advantage of early reproduction. *Journal of Animal Ecology* 75: 657–665.

Møller, A.P., E. Flensted-Jensen, and W. Mardal. 2009. Adjustment of the annual cycle to climate change in a long-lived migratory bird species. *Current Zoology* 55: 92–101.

Montevecchi, W.A. 2002. Interactions between fisheries and seabirds. Pages 527–558 in *Biology of Marine Birds* (Schreiber, E.A., and J. Burger, eds.). Boca Raton, FL.: CRC Press. 722 pp.

Montevecchi, W.A., D.K. Cairns, A.E. Burger, J. Elliott, and J. Wells. 1987. The current status of the Black-headed Gull in Labrador. *American Birds* 41: 197–201.

Montevecchi, W.A., and R.A. Myers. 1997. Centurial and decadal oceanographic influences on changes in northern gannet populations and diets in the north-west Atlantic: implications for climate change. *ICES Journal of Marine Science* 54: 608–614.

Montevecchi, W.A., and I.J. Stenhouse. 2002. Dovekie (*Alle alle*). No. 701 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Morris, R.D., D.V. Weseloh, L.R. Wires, C. Pekarik, F.J. Cuthbert, and D.J. Moore. 2011. Population trends of Ring-billed Gulls breeding on the North American Great Lakes, 1976 to 2009. *Waterbirds* 34: 20 –212.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2000a. *Estimates of Shorebird Populations in North America*. Canadian Wildlife Service Occasional Paper 104. Ottawa: Canadian Wildlife Service. 64 pp.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2000b. Population estimates of Nearctic shorebirds. *Waterbirds* 23: 337–352.

Moser, M.L., and D.S. Lee. 1992. A fourteen-year survey of plastic ingestion by western North Atlantic seabirds. *Colonial Waterbirds* 15: 83–94.

Moskoff, W., and L.R. Bevier. 2002. Mew Gull (*Larus canus*). No. 687 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Mowbray, T.B. 2002. Northern Gannet (*Morus bassanus*). No. 693 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Muller, S.A., I.M. Mazzocchi, and K. Loconti-Lee. 1992. *Black Tern* (Chlidonias niger) *Investigations in New York State, 1990 and 1991*. Watertown: New York State Department of Environmental Conservation. 18 pp.

Murphy, R.C. 1936. *Oceanic Birds of South America. Vol. 1*. New York: MacMillan Co. and American Museum of Natural History. 640 pp.

Murphy, R.C., and W. Vogt. 1933. The Dovekie influx of 1932. *Auk* 50: 325–349.

Muzzafar, S. bin, R.C. Ydenberg, and I.L. Jones. 2006. Avian influenza: an ecological and evolutionary perspective for waterbird scientists. *Waterbirds* 29: 243–257.

National Research Council. 1991. *The Adequacy of Environmental Information for Outer Continental Shelf Oil and Gas Decisions: Georges Bank*. Washington, DC: National Academy Press. 86 pp.

Nelson, B. 1978. *The Sulidae: Gannets and Boobies*. Aberdeen: University of Aberdeen Press. 1012 pp.

Nettleship, D.N. 1972. Breeding success of the Common Puffin *Fratercula arctica* L. in different habitats on Great Island, Newfoundland. *Ecological Monographs* 47: 239–268.

Nettleship, D.N., J. Burger, and M. Gochfeld (eds.). 1994. *Seabirds on Islands: Threats, Case Studies and Action Plans*. BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Nettleship, D.N., and G. Chapdelaine. 1988. Population size and status of the Northern Gannet *Sula bassanus* in North America, 1984. *Journal of Field Ornithology* 59: 120–127.

Nettleship, D.N., G.A. Sanger, and P.F. Springer (eds.). 1984. *Marine Birds: Their Feeding Ecology and Commercial Fisheries Relationships*. Ottawa: Canadian Wildlife Service. 220 pp.

New Jersey Audubon. 2006. Avalon Seawatch. [http://www.njaudubon.org]

Newton, I., and B. Little. 2009. Assessment of wind-farm and other bird casualties from carcasses found on a Northumbrian beach over an 11-year period. *Bird Study* 36: 158–167.

Newton, S.F. 2004. Roseate Tern *Sterna dougallii*. Pages 302–314 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Newton, S.F., K. Thompson, and P.I. Mitchell. 2004. Manx Shearwater *Puffinus puffinus*. Pages 63–80 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Nicholls, R.J., and A. Cazenave. 2010. Sea-level rise and its impact on coastal zones. *Science* 328: 1517–1520.

Nikula, B. 1993. Black-headed Gull. *Birding* 25: 55–60.

Nisbet, I.C.T. 1971a. The Laughing Gull in the Northeast. *American Birds* 25: 677–683.

Nisbet, I.C.T. 1971b. Laughing Gull colonies in the Northeast. *Massachusetts Audubon* 55: 2–10.

Nisbet, I.C.T. 1973. Terns in Massachusetts: present numbers and historical changes. *Bird-Banding* 44: 27–55.

Nisbet, I.C.T. 1978a. Dependence of fledging success on egg-size, parental performance and egg-composition among Common and Roseate Terns (*Sterna hirundo* and *S. dougallii*). *Ibis* 120: 207–215.

Nisbet, I.C.T. 1978b. Recent changes in gull populations in the western North Atlantic. *Ibis* 120: 129–130.

Nisbet, I.C.T. 1980a. *Status and Trends of the Roseate Tern* Sterna dougallii *in North America and the Caribbean*. Unpublished Report. Newton Corner, MA: US Fish and Wildlife Service. viii + 125 pp.

Nisbet, I.C.T. 1980b. Effects of toxic pollutants on productivity in colonial waterbirds. *Transactions of the Linnaean Society of New York* 11: 103–114.

Nisbet, I.C.T. 1981. *Biological Characteristics of the Roseate Tern* Sterna dougallii. Unpublished Report. Newton Corner, MA: US Fish and Wildlife Service. xi + 136 pp.

Nisbet, I.C.T. 1984a. Migration and winter quarters of North American Roseate Terns as shown by banding recoveries. *Journal of Field Ornithology* 55: 1–17.

Nisbet, I.C.T. 1984b. Paralytic shellfish poisoning: effects on breeding terns. *Condor* 85: 338–345.

Nisbet, I.C.T. 1989. The Roseate Tern. Pages 478–497 in *Audubon Wildlife Report 1989/1990* (Chandler, W.J., ed.). New York: National Audubon Society. 585 pp.

Nisbet, I.C.T. 1992. Predation by a Peregrine Falcon on Common and Roseate Terns at Bird Island. *Bird Observer* 20: 137–139.

Nisbet, I.C.T. 1994. Effects of pollution on marine birds. Pages 8–25 in *Seabirds on Islands: Threats, Case Studies and Action Plans* (Nettleship, D., J. Burger, and M. Gochfeld, eds.). BirdLife Conservation Series 1. Cambridge, UK: BirdLife International. 318 pp.

Nisbet, I.C.T. 2000. Disturbance, habituation and management of waterbird colonies. *Waterbirds* 23: 313–322.

Nisbet, I.C.T. 2001. Reliability of aerial photography for detecting population trends in gulls. *Waterbirds* 24: 457–460.

Nisbet, I.C.T. 2002a. Common Tern (*Sterna hirundo*). No. 618 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 40 pp.

Nisbet, I.C.T. 2002b. Hybrid terns cryptically resembling Forster's Terns nesting in Massachusetts. *Bird Observer* 30: 161–171.

Nisbet, I.C.T., and N. Ratcliffe. 2008. Comparative demographics of tropical and temperate Roseate Terns. *Waterbirds* 31: 346–356.

Nisbet, I.C.T., and L.M. Reynolds. 1984. Organochlorine residues in Common Terns and associated estuarine organisms, Massachusetts, USA, 1971–1981. *Marine Environmental Research* 11: 33–66.

Nisbet, I.C.T., and J.A. Spendelow. 1999. Contribution of research to conservation and management of the Roseate Tern: review of a twelve-year project. *Waterbirds* 22: 239–252.

Nisbet, I.C.T., and M.J. Welton. 1984. Seasonal variation in breeding success of Common Terns: consequences of predation. *Condor* 86: 53–60.

NOAA (National Oceanic and Atmospheric Administration). 2005. *Bouchard Barge No. 120 Oil Spill, Buzzards Bay, Massachusetts: Pre-assessment Data Report*. Washington, DC: National Oceanic and Atmospheric Administration: 208 pp.

Northeast Fisheries Science Center. 1993. Atlantic Herring coastal stock complex assessment. Pages 60–74 in *Report of the 16th Northeast Regional Stock Assessment Workshop (16th SAW)*. Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. Woods Hole: NOAA/National Marine Fisheries Service. 272 pp.

Northeast Roseate Tern Recovery Team. 1998. *Roseate Tern Recovery Plan, Northeast Population: First Update*. Hadley, MA: US Fish and Wildlife Service. 75 pp.

Norton, R.L. 1984. Cayenne × Sandwich Terns nesting in Virgin Islands. *Journal of Field Ornithology* 55: 243–246.

Norton, R.L., A. White, and A. Dobson. 2004. West Indies and Bermuda region, 2003–2004 winter season. *North American Birds* 58: 293–295.

Novak, P.G. 1992. Black Tern *Chlidonias niger*. Pages 149–162 in *Migratory Nongame Birds of Management Concern in the Northeast* (Schneider, K.J., and D.M. Pence, eds.). Newton Corner, MA: US Fish and Wildlife Service. 400 pp.

NYSDEC (New York State Department of Environmental Conservation). 1992–2009. *Long Island Colonial Waterbird and Piping Plover Survey. Annual Reports*. Stony Brook, NY: New York State Department of Environmental Conservation.

O'Donnell, C., and J. Fjeldså. 1997. *Grebes: Status Survey and Conservation Action Plan*. Gland, Switzerland, and Cambridge, UK: IUCN/SSC Grebe Specialist Group, International Union for Conservation of Nature. 32 pp.

Office of Migratory Bird Management. 1993. *Status of Sea Ducks in Eastern North America*. Unpublished report. Laurel, MD: US Fish and Wildlife Service. 28 pp.

Onley, D., and P. Scofield. 2007. *Albatrosses, Petrels and Shearwaters of the World*. Princeton: Princeton University Press. 240 pp.

Overholtz, W.J., and K.D. Friedland. 2002. Recovery of the Gulf of Maine–Georges Bank Atlantic Herring (*Clupea harengus*) complex: perspectives based on bottom trawl survey data. *Fisheries Bulletin* 100: 593–608.

Overholtz, W.J., S.A. Murawski, and K.L. Foster. 1991. Impact of predatory fish, marine mammals and seabirds on the pelagic fish ecosystem of the northeastern USA. *ICES Marine Science Symposium* 193: 198–208.

Palka, D., and M. Warden. 2007. *Seabirds Observed Interacting with Fishing Gear in the Northwest Atlantic through July 2006*. Unpublished Report prepared for Bycatch Breakout Group, Atlantic Marine Bird Conservation Cooperative Workshop, Shepherdstown, West Virginia, 29 January–1 February 2007. 11 pp.

Palmer, R.S. 1949. *Maine Birds*. Bulletin of the Museum of Comparative Zoology 102. Cambridge: Harvard College. 656 pp.

Palmer, R.S. (ed.). 1962. *Handbook of North American Birds. Vol. I. Loons through Flamingos*. New Haven: Yale University Press. 567 pp.

Palmer, R.S. (ed.). 1976. *Handbook of North American Birds. Vol. 3. Waterfowl (concluded)*. New Haven: Yale University Press. 560 pp.

Parnell, J.F., D.G. Ainley, H. Blokpoel, B. Cain, T.W. Custer, J.L. Dusi, S. Kress, J.A. Kushlan, W.E. Southern, L.E. Stenzel, and B.C. Thompson. 1988. Colonial waterbird management in North America. *Colonial Waterbirds* 11: 129–169.

Parnell, J.F., R.M. Erwin, and K.C. Molina. 1995. Gull-billed Tern (*Sterna nilotica*). No. 140 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 20 pp.

Parnell, J.F., W. Golder, and T.M. Henson. 1995. *Atlas of Colonial Waterbirds in North Carolina Estuaries*. North Carolina Sea Grant Program Publication UNC–SG–95–02. Wilmington: University of North Carolina.

Parnell, J.F., W. Golder, M.A. Shields, T.L. Quay, and T.M. Henson. 1997. Changes in populations of colonial waterbirds in coastal North Carolina, 1990–1995. *Colonial Waterbirds* 20: 458–469.

Parnell, J.F., R.N. Needham, R.F. Soots, Jr., J O. Fussel, III, D.A. McCrimmon, Jr., R.D. Bjork, and M.A. Shields. 1986. Use of dredged-material deposition sites by birds in coastal North Carolina, USA. *Colonial Waterbirds* 9: 210–217.

Parnell, J.F., M.A. Shields, and D. Frierson. 1984. Hatching success of Brown Pelican eggs after contamination with oil. *Colonial Waterbirds* 7: 22–24.

Parnell, J.F., and R.F. Soots. 1978. The use of dredge islands by wading birds. Pages 105–111 in *Wading Birds* (Sprunt, A., J.C. Ogden, and S. Winckler, eds.). Research Report No. 7. New York: National Audubon Society. 381 pp.

Paton, P., K. Winiarski, C. Trocki, and S. McWilliams. 2010. *Spatial Distribution, Abundance, and Flight Ecology of Birds in Nearshore and Offshore Waters of Rhode Island*. Interim Technical Report for the Rhode Island Ocean Special Area Management Plan 2010. Unpublished report. Kingstown: Department of Natural Resources Sciences, University of Rhode Island. 304 pp.

Patteson, J.P., and E.S. Brinkley. 2004. A petrel primer: the gadflies of North Carolina. *Birding* 36: 586–596.

Pearson, T.G., C.S. Brimley, and H.H. Brimley. 1942. *Birds of North Carolina*. Raleigh: North Carolina State Museum of Natural History. 434 pp.

Perry, M.C., F. Ferrigno, and F.H. Settle. 1979. Rehabilitation of birds oiled on two mid-Atlantic estuaries. *Proceedings of the 32nd Annual Conference, Southeastern Association of Fish & Wildlife Agencies*: 318–325.

Peterjohn, B.G. 1989. *The Birds of Ohio*. Columbus: Ohio Department of Natural Resources. 637 pp.

Peterjohn, B.G. 2001. *The Birds of Ohio*. Wooster, OH: Wooster Book Co. 637 pp.

Petersen, W.R., and W.R. Meservey (eds.). 2004. *Massachusetts Breeding Bird Atlas*. Lincoln: Massachusetts Audubon Society. 441 pp.

Phillips, J.H. 1963. The pelagic distribution of the Sooty Shearwater, *Procellaria grisea*. *Ibis* 105: 340–353.

Pierotti, R.J., and T.P. Good. 1994. Herring Gull (*Larus argentatus*). No. 124 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Pitman, R.L., and J.R. Jehl. 1998. Geographic variation and reassessment of species limits in the "Masked" Boobies of the eastern Pacific Ocean. *Wilson Bulletin* 110: 155–170.

Podolsky, R.H. 1989. The Razorbill in the Gulf of Maine. *American Birds* 43: 14–16.

Portnoy, J.W., R.M. Erwin, and T.W. Custer. 1981. *Atlas of Gull and Tern Colonies: North Carolina to Key West, Florida (Including Pelicans, Cormorants and Skimmers)*. FWS/OBS–80–05. Washington, DC: US Fish and Wildlife Service, Office of Biological Services. 126 pp.

Post, P.W. 1967. Manx, Audubon's, and Little Shearwaters in the northwestern North Atlantic. *Bird-Banding* 38: 278–305.

Post, P.W., and S.A. Gauthreaux, Jr. 1989. *Status and Distribution of South Carolina Birds*. Contributions of the Charleston Museum XVIII. Charleston: Charleston Museum. 83 pp.

Post, P.W., and R.H. Lewis. 1995. The Lesser Black-backed Gull in the Americas: occurrence and subspecific identity. *Birding* 27: 282–290, 371–381.

Post, W. 2004. First South Carolina specimens of the Masked Booby (*Sula dactylatra*). *Chat* 68: 39–43.

Post, W., D. Corkern, and I. Pitts, Jr. 2004. A recent South Carolina specimen of the Brown Noddy (*Anous stolidus*), and a review of the species' regional status. *Chat* 68: 161–166.

Post, W., D.M. Forsythe, R.R. Scott, and P. Worthington. 1998. Red-billed Tropicbird salvaged in South Carolina: first specimen for state. *Chat* 62: 155–157.

Powers, K.D. 1983. *Pelagic Distributions of Marine Birds off the Northeastern United States*. NOAA Technical Memorandum NMFS–F/NEC–27. Woods Hole: US Department of Commerce, National Oceanographic and Atmospheric Administration. 201 pp.

Powers, K.D., and R.G.B. Brown. 1987. Seabirds. Pages 372–384 in *Georges Bank* (Backus, R.H., and D.W. Bourne, eds.). Cambridge, MA: MIT Press. 593 pp.

Powers, K.D., and J. Cherry. 1983. Loon migrations off the coast of the northeastern United States. *Wilson Bulletin* 95: 125–132.

Powers, K.D., G.L. Pittman, and S.J. Fitch. 1980. *Distribution of Marine Birds on the Mid- and North-Atlantic US Outer Continental Shelf*. Technical Progress Report to US Department of Energy, Office of Health and Environmental Research. Manomet, MA: Manomet Bird Observatory. 165 pp.

Powers, K.D., and W.T. Rumage. 1978. Effect of the *Argo Merchant* oil spill on bird populations off the New England coast, 15 Dec. 1976–Jan. 1977. Pages 142–148 in *In the Wake of the* Argo Merchant: *Proceedings of a Symposium Held January 11–13, 1978*. Narragansett: Center for Management Studies, University of Rhode Island. 181 pp.

Powers, K.D., and J.A. Van Os. 1979. A concentration of Greater Shearwaters in the western North Atlantic. *American Birds* 33: 253.

Pranty, B. 1997. Field observations. *Florida Field Naturalist* 25: 26–31.

Ratcliffe, N. 2004a. Common Tern *Sterna hirundo*. Pages 315–327 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Ratcliffe, N. 2004b. Arctic Tern *Sterna paradisaea*. Pages 302–314 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Ratcliffe, N. 2004c. Sandwich Tern *Sterna sandvicensis*. Pages 291–301 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Ratcliffe, N., I.C.T. Nisbet, and S. Newton. 2004. Roseate Tern *Sterna dougallii*. *BWP Update* 6: 77–90.

Reed, A., and A.J. Erskine. 1986. Populations of the Common Eider in eastern North America: their size and status. *Canadian Wildlife Service Report Series* 47: 156–175.

Reid, J.B. 2004. Great Black-backed Gull *Larus marinus*. Pages 263–276 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Rice, J.C. 1992. Multispecies interactions in marine ecosystems: current approaches and implications for study of seabird populations. Pages 586–601 in *Wildlife 2001: Populations* (McCullough, D.R, and R.H. Barrett, eds.). London: Elsevier Science Publishers. 1163 pp.

Riepe, D. 1994. A Forster's Tern colony at Jamaica Bay, New York City. *Kingbird* 44: 10–13.

Rimmer, D.W., and R.D. Deblinger. 1992. Use of fencing to limit terrestrial predator movements into Least Tern colonies. *Colonial Waterbirds* 15: 226–229.

Robb, M., K. Mullarney, and The Sound Approach. 2008. *Petrels Night and Day: A Sound Approach Guide*. Poole, UK: The Sound Approach. 300 pp.

Robert, M., G.H. Mittelhauser, B. John, G. Fitzgerald, and P. Lamothe. 2008. New insights on Harlequin Duck population structure in eastern North America as revealed by satellite telemetry. *Waterbirds* 31, *Special Publication* 2: 159–172.

Robertson, C.J., and G.B. Nunn. 1998. Towards a new taxonomy for albatrosses. Pages 13–19 in *Albatross Biology and Conservation* (Robertson, G., and R. Gales, eds.). Chipping Norton, NSW, Australia: Surrey Beatty and Sons. 300 pp.

Robertson, G.J. 2002. Current status of the Manx Shearwater (*Puffinus puffinus*) colony on Middle Lawn Island, Newfoundland. *Northeastern Naturalist* 9: 317–324.

Robertson, G.J., and R.I. Goudie. 1999. Harlequin Duck (*Histrionicus histrionicus*). No. 466 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Robertson, G.J., and J.-P.L. Savard. 2002. Long-tailed Duck (*Clangula hyemalis*). No. 651 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Robertson, G.J., P.W. Thomas, J.-P.L. Savard, and K.A. Hobson (eds.). 2008. Harlequin Ducks in the northwest Atlantic. *Waterbirds* 31, *Special Publication* 2: 1–203.

Robertson, W.B., Jr. 1969. Transatlantic migration of juvenile Sooty Terns. *Nature* 223: 632–634.

Rock, P. 2002. Lesser Black-backed Gull *Larus fuscus*. Pages 365–368 in *The Migration Atlas: Movements of the Birds of Britain and Ireland* (Wernham, C., M. Toms, J. Marchant, J. Clark, G. Siriwardena, and S. Baillie, eds.). London: T & A D Poyser. 884 pp.

Rodgers, J.A., Jr., and J. Burger. 1981. Concluding remarks: symposium on human disturbance and colonial waterbirds. *Colonial Waterbirds* 4: 69–70.

Rodway, M.S., W.A. Montevecchi, and J.W. Chardine. 1996. Effects of investigator disturbance on breeding success of Atlantic Puffins (*Fratercula arctica*). *Biological Conservation* 76: 311–319.

Roemmich, D. 1992. Ocean warming and sea level rise along the southwest U.S. coast. *Science* 257: 373–375.

Ronconi, R.A., and S.N.P. Wong. 2003. Estimates of changes in seabird numbers in the Grand Manan archipelago, New Brunswick, Canada. *Waterbirds* 26: 462–472.

Root, T.L. 1988. *Atlas of Wintering North American Birds: An Analysis of Christmas Bird Count Data*. Chicago: University of Chicago Press. 312 pp.

Rowlett, R.A. 1980. *Observations of Marine Birds and Mammals in the Northern Chesapeake Bight*. FWS/OBS–80/04. Slidell, LA: US Fish and Wildlife Service, National Coastal Ecosystems Team. 87 pp.

Rubega, M.A., D. Schamel, and D.M. Tracy. 2000. Red-necked Phalarope (*Phalaropus lobatus*). No. 538 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Ruckdeschel, C.A., C.R. Shoop, and G.W. Sciple. 1994. A mass stranding of Leach's Storm-Petrel in Georgia and Florida. *Florida Scientist* 57: 48–49.

Runde, D.E. 1991. *Trends in Wading Bird Nesting Populations in Florida, 1976–78 and 1986–89*. Final Performance Report. Tallahassee, FL: Nongame Wildlife Section, Florida Game and Fresh Water Fish Commission. 90 pp.

Russell, R.W. 2002. Pacific Loon (*Gavia pacifica*) and Arctic Loon (*Gavia arctica*). No. 657 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 40 pp.

Ryder, J.P. 1993. Ring-billed Gull. No. 33 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Safina, C., and J. Burger. 1983. Effects of human disturbance on reproductive success in the Black Skimmer. *Condor* 85: 164–171.

Safina, C., D. Witting, and K. Smith. 1989. Viability of salt marshes as nesting habitat for Common Terns in New York. *Condor* 91: 571–584.

Saliva, J.E. 2000a. Conservation priorities for Sooty Terns in the West Indies. Pages 103–108 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Saliva, J.E. 2000b. Roseate Tern conservation in the West Indies. Pages 87–95 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Sandvik, H., K.E. Erikstad, R.T. Barrett, and N.G. Yoccoz. 2005. The effect of climate on adult survival in five species of North Atlantic seabirds. *Journal of Animal Ecology* 74: 817–831.

Sangster, G., J.M. Collinson, A.G. Knox, D.T Parkin, and L. Svensson. 2007. Taxonomic recommendations for British birds: Fourth report. *Ibis* 149: 853–857.

Savard, J.-P.L., B. Allen, D. McCauley, G.R. Milton, and S. Gililand. 2005. Abundance and distribution of the Common Eider in Eastern North America during the molting season. Second North American Sea Duck Conference, Annapolis, MD, Nov 7–11, 2005 (Abstract).

Savard, J.-P.L., D. Bordage, and A. Reed. 1998. Surf Scoter (*Melanitta perspicillata*). No. 363 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Savard, J.-P.L., M. Robert, and S. Brodeur. 2008. Harlequin Ducks in Quebec. *Waterbirds* 31, *Special Publication* 2:19–31.

Schauffler, R. 1998. *An Estimate of the Number of Breeding Herring Gulls and Great Black-backed Gulls on the Coast of Maine and a Comparison of the Methods Used to Count Them*. M.S. thesis. University of Massachusetts, Amherst. 57 pp.

Schick, S. 1890. Birds found breeding on Seven Mile Beach, New Jersey. *Auk* 8: 326–390.

Schneider, D.C., D.C. Duffy, A.D. MacCall, and D.W. Anderson. 1992. Seabird-fisheries interactions: evaluation with dimensionless ratios. Pages 602–615 in *Wildlife 2001: Populations* (McCullough, D.R, and R.H. Barrett, eds.). London: Elsevier Science Publishers. 1163 pp.

Schreiber, E.A. 2000a. Action plan for conservation of West Indies seabirds. Pages 182–191 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Schreiber, E.A. 2000b. Boobies in the West Indies: their status and conservation. Pages 46–57 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Schreiber, E.A. 2002. Climate and weather effects on seabirds. Pages 179–215 in *Biology of Marine Birds* (Schreiber, E.A., and J. Burger, eds.). Boca Raton, FL: CRC Press. 722 pp.

Schreiber, E.A., and J. Burger. 2002. Seabirds in the marine environment. Pages 1–15 in *Biology of Marine Birds* (Schreiber, E.A., and J. Burger, eds.). Boca Raton, FL: CRC Press. 722 pp.

Schreiber, E.A., C.J. Feare, B.A. Harrington, B.G. Murray Jr., W.B. Robertson Jr., M.J. Robertson, and G.E. Woolfenden. 2002. Sooty Tern (*Sterna fuscata*). No. 665 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Schreiber, E.A., and D. S. Lee (eds.). 2000. *Status and Conservation of West Indian Seabirds*. Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Schreiber, E.A., and R.L. Norton. 2002. Brown Booby (*Sula leucogaster*). No. 649 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Schreiber, E.A., and R.W. Schreiber. 1978. *Colonial Bird Use and Plant Succession on Dredged Material Islands in Florida. Vol. 1: Sea and Wading Bird Colonies*. Dredged Material Program Technical Report D–78–14. Vicksburg, MS: US Army Corps of Engineers Waterways Experiment Station. 126 pp.

Schreiber, R.W. 1975. Bad days for the Brown Pelican. *National Geographic* 147: 111–123.

Sea Duck Joint Venture Management Board. 2008. *Sea Duck Joint Venture Strategic Plan: 2008–2012*. Anchorage: US Fish and Wildlife Service, and Sackville, NB: Canadian Wildlife Service. 95 pp.

Sellers, R.M. 2004. Great Cormorant *Phalacrocorax carbo*. Pages 128–145 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Shealer, D. 1999. Sandwich Tern (*Sterna sandvicensis*). No. 405 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Shealer, D. 2002. Foraging behavior and food of seabirds. Pages 137–178 in *Biology of Marine Birds* (Schreiber, E.A., and J. Burger, eds.). Boca Raton, FL: CRC Press. 722 pp.

Sherman, K., C. Jones, L. Sullivan, W. Smith, P. Berrien, and L. Ejsymont. 1981. Congruent shifts in sand eel abundance in western and eastern North Atlantic ecosystems. *Nature* 291: 486–489.

Sherony, D.F., B.M. Ewald, and S. Kelling. 2000. Inland fall migration of Red-throated Loons. *Journal of Field Ornithology* 71: 310–320.

Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*). No. 609 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 36 pp.

Sindermann, C.J. 1979. *Status of Northwest Atlantic Herring Stocks of Concern to the United States*. Northeast Fisheries Center Technical Series Report 23. Highlands, NJ: National Marine Fisheries Service. 449 pp.

Slotterback, J.W. 2002. Band-rumped Storm-Petrel (*Oceanodroma castro*). No. 673 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Smith, A.L., L. Monteiro, O. Hasegawa, and V.L. Friesen. 2007. Global phylogeography of the Band-rumped Storm-Petrel (*Oceanodroma castro*; Procellariiformes: Hydrobatidae). *Molecular Phylogenetics and Evolution* 43: 755–773.

Smith, H.T., and E.M. Alvear. 1997. Recent breeding records of the Gull-billed Tern in Florida: status undetermined? *Florida Naturalist* 70: 22–23.

Snell, R.R. 2002. Iceland Gull (*Larus glaucoides*) and Thayer's Gull (*Larus thayeri*). No. 699 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 36 pp.

Soczek, M.L. 2006. *An Analysis of Seabird Bycatch in New England Commercial Fisheries*. M.S. thesis. Antioch University, Lebanon, NH. 75 pp.

Soots, R.F. Jr., and J.F. Parnell. 1975. *Ecological Succession of Breeding Birds in Relation to Plant Succession on Dredge Islands in North Carolina*. University of South Carolina Sea Grant Publication UNC–SG–75–27. Columbia: University of South Carolina. 91 pp.

Southern, W.E. 1974. Seasonal distribution of Great Lakes region Ring-billed Gulls. *Jack-Pine Warbler* 52: 154–179.

Southern, W.E. 1980. Comparative distribution and orientation of North American gulls. Pages 449–498 in *Behavior of Marine Animals. Vol. 4: Marine Birds* (Burger, J., B.L. Olla, and H.E. Winn, eds.). New York: Plenum Press. 515 pp.

Spear, K.A., S.H. Schweitzer, R. Goodloe, and D.C. Harris. 2007. Effects of management strategies on the reproductive success of Least Terns on dredge spoil in Georgia. *Southeastern Naturalist* 6: 27–34.

Spendelow, J.A., J.E. Hines, J.D. Nichols, I.C.T. Nisbet, G. Cormons, H. Hays, J.J. Hatch, and C.S. Mostello. 2008. Temporal variation in adult survival rates of Roseate Terns during periods of increasing and declining populations. *Waterbirds* 31: 309–319.

Spendelow, J.A., J.D. Nichols, I.C.T. Nisbet, H. Hays, G.D. Cormons, J. Burger, C. Safina, J.E. Hines, and M. Gochfeld. 1995. Estimating annual adult survival and movement rates within a metapopulation of Roseate Terns. *Ecology* 76: 2415–2428.

Spendelow, J.A., and S.R. Patton. 1988. *National Atlas of Coastal Waterbird Colonies in the Contiguous United States: 1976–82*. US Fish and Wildlife Service Biological Report 88 (5). Washington, DC: US Fish and Wildlife Service. 326 pp.

Squires, W. A. 1952. *The Birds of New Brunswick*. New Brunswick Museum Monograph Series No. 4. St. John: New Brunswick Museum. 165 pp.

Stanton, P.B. 1977. Eider Duck transplantation experiments on Penikese Island. *Transactions of the Northeast Fish and Wildlife Conference* 34: 65–70.

Stedman, S.J. 2000. Horned Grebe (*Podiceps auritus*). No. 505 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Stenhouse, I., and W.A. Montevecchi. 1996. Winter distribution and wrecks of Little Auks (*Alle a. alle*) in the northwest Atlantic. *Sula* 10: 219–228.

Stenhouse, I., and W.A. Montevecchi. 1999. Increasing and expanding populations of Northern Fulmars in Atlantic Canada. *Colonial Waterbirds* 22: 382–391.

Stenseth, N.C., G. Ottersen, J.W. Hurrell, and A. Belgrano. 2004. *Marine Ecosystems and Climate Variation*. Oxford: Oxford University Press. 252 pp.

Stevenson, H.M., and B.H. Anderson. 1994. *The Birdlife of Florida*. Gainesville: University Press of Florida. 892 pp.

Stone, W. 1937. *Bird Studies at Old Cape May. Vol. 1*. Philadelphia: Delaware Valley Ornithological Club. 941 pp.

Storer, R.W., and G.L. Nuechterlein. 1992. Western and Clark's Grebes (*Aechmophorus occidentalis* and *A. clarkii*). No. 26 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Storey, A.E. 1987a. Adaptations for marsh nesting in Common and Forster's Terns. *Canadian Journal of Zoology* 65: 1417–1420.

Storey, A.E. 1987b. Characteristics of successful nest sites for marsh-nesting Common Terns. *Canadian Journal of Zoology* 65: 1411–1416.

Storey, A.E., and J. Lien. 1985. Development of the first North American colony of Manx Shearwaters. *Auk* 102: 395–396.

Stout, B.E., and G.L. Nuechterlein. 1999. Red-necked Grebe (*Podiceps grisegena*). No. 465 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Suydam, R.S. 2000. King Eider (*Somateria spectabilis*). No. 491 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Tasker, M.L. 2004. Northern Fulmar *Fulmarus glacialis*. Pages 49–62 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Tasker, M.L., K. Camphuysen, J. Cooper, S. Garthe, M. Leopold, W.A. Montevecchi, and S. Baber. 2000. The impacts of fisheries on marine birds. *ICES Journal of Marine Science* 57: 531–547.

Tate, J., Jr., and D.J. Tate. 1982. The blue list for 1982. *American Birds* 36: 126–135.

Thomas, P.W. 2008. Harlequin Ducks in Newfoundland. *Waterbirds* 31, *Special Publication* 2: 44–49.

Thompson, B.C., J.A. Jackson, J. Burger, L.A. Hill, E.M. Kirsch, and J.L. Atwood. 1997. Least Tern (*Sterna antillarum*). No. 290 in *The Birds of North America* (Poole A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Thompson, K.R. 2002. Manx Shearwater *Puffinus puffinus*. Pages 120–123 in *The Migration Atlas: Movements of the Birds of Britain and Ireland* (Wernham. C., M. Toms, J. Marchant, J. Clark, G. Siriwardena, and S. Baillie, eds.). London: T & A D Poyser. 884 pp.

Thompson, P.M., and J.C. Ollason. 2001. Lagged effects of ocean climate change on Fulmar population dynamics. *Nature* 413: 417–420.

Titman, R.D. 1999. Red-breasted Merganser (*Mergus serrator*). No. 443 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Tracy, D.M., D. Schamel, and J. Dale. 2002. Red Phalarope (*Phalaropus fulicarius*). No. 698 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 32 pp.

Trimm, N.A, Jr. 2004. *Behavioral Ecology of Audubon's Shearwaters at San Salvador, Bahamas*. Ph.D. dissertation. Loma Linda University, Loma Linda, CA. 161 pp.

Trull, P., S. Hecker, M.A. Watson, and I.C.T. Nisbet. 1999. Staging of Roseate Terns in the post-breeding period around Cape Cod, Massachusetts, USA. *Atlantic Seabirds* 1: 145–158.

Tuck, L.M. 1968. Laughing Gulls *Larus atricilla* and Black Skimmers *Rhynchops nigra* brought to Newfoundland by hurricane. *Bird-Banding* 39: 200–208.

Tufts, R.W. 1986. *Birds of Nova Scotia, 3rd edn*. Halifax, NS: Nova Scotia Museum of Natural History. 481 pp.

US Army Corps of Engineers. 2004. Appendix 5.7–M in *Cape Wind Energy Project: Draft Environmental Impact Statement*. USACE NAE–2004–338–1. Waltham, MA: U S Army Corps of Engineers, New England District. 3842 pp.

US Fish and Wildlife Service. 1989. *Roseate Tern Recovery Plan: Northeastern Population*. Newton Corner, MA: US Fish and Wildlife Service. 78 pp.

US Fish and Wildlife Service. 1993. *Status of Sea Ducks in Eastern North America*. Laurel, MD: US Fish and Wildlife Service, Office of Migratory Bird Management. 28 pp.

US Fish and Wildlife Service. 2004. *Biological Opinion and Emergency Consultation*. Letter to US Coast Guard, October 20, 2004. Concord, NH: US Fish and Wildlife Service. 43 pp.

Van Velzen, W.T., and R.D. Benedict. 1972a. Recoveries of Royal Terns banded in Virginia. Part I. The Caribbean. *Raven* 43: 39–41.

Van Velzen, W.T., and R.D. Benedict. 1972b. Recoveries of Royal Terns banded in Virginia. Part II. Central and South America. *Ring* 75: 38–40.

Veit, R.R. 1978. Some observations of South Polar Skuas (*Catharacta maccormickii*) on Georges Bank. *American Birds* 32: 300–302.

Veit, R.R. 1985. Long-tailed Jaegers wintering along the Falkland Current. *American Birds* 39: 873–878.

Veit, R.R. 2005. Yellow-nosed Albatross at Tuckernuck Island, Massachusetts. *Bird Observer* 33: 284–288.

Veit, R.R., and P.A. Guris. 2009. Recent increases in alcid abundance in the New York Bight and New England waters. *New Jersey Birds* 34: 83–87.

Veit, R.R., J.A. McGowan, D.G. Ainley, T.R. Wahl, and P. Pyle. 1997. Apex predator declines ninety percent in association with changing oceanic climate. *Global Change Biology* 3: 23–28.

Veit, R.R., and W.A. Montevecchi. 2006. The influences of global climate change on marine birds. *Acta Zoologica Sinica* 52 *(Supplement)*: 165–168.

Veit, R.R., and W.R. Petersen. 1993. *Birds of Massachusetts*. Lincoln: Massachusetts Audubon Society. 514 pp.

Veit, R.R, P. Pyle, and J.A. McGowan. 1996. Ocean warming and long-term change in pelagic bird abundance within the California Current system. *Marine Ecology Progress Series* 139: 11–18.

Via, J., and D.C. Duffy. 1992. Gull-billed Tern *Sterna nilotica*. Pages 135–148 in *Migratory Nongame Birds of Management Concern in the Northeast* (Schneider, K.J., and D.M. Pence, eds.). Newton Corner, MA: US Fish and Wildlife Service. 400 pp.

Vickery, P.D. 1978. Northeastern maritime region, 1977 fall migration. *American Birds* 32: 174–180.

Vickery, P.D. 1988. Distribution and population status of Harlequin Ducks (*Histrionicus histrionicus*) wintering in eastern North America. *Wilson Bulletin* 100: 119–126.

Votier, S.C., M. Kennedy, S. Bearhop, R.G. Newell, K. Griffiths, H. Whitaker, M.S. Ritz, and R.W. Furness. 2007. Supplementary DNA evidence fails to confirm presence of Brown Skuas *Stercorarius antarctica* in Europe: a retraction of Votier et al. (2004). *Ibis* 149: 619–621.

Wallace, R.D., and R. Wigh. 2007. Pelagic birds of the southern South Atlantic Bight. *North American Birds* 61: 198–207.

Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. *Birds of New Jersey*. Bernardsville: New Jersey Audubon Society. 704 pp.

Walsh-McGehee, M. W. 2000. Status and conservation priorities for White-tailed Tropicbirds and Red-tailed Tropicbirds in the West Indies. Pages 31–38 in *Status and Conservation of West Indian Seabirds* (Schreiber, E.A., and D.S. Lee, eds.). Ruston, LA: Society of Caribbean Ornithology, Special Publication No. 1. 225 pp.

Wanless, S., M. Frederiksen, F. Daunt, B.E. Scott, and M.P. Harris. 2007. Black-legged Kittiwakes as indicators of environmental change in the North Sea: evidence from long-term studies. *Progress in Oceanography* 72: 30–38.

Wanless, S., M. Frederiksen, J. Walton, and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. *Ibis* 151: 274–285.

Wanless, S., and M.P. Harris. 2002. Northern Gannet *Morus bassanus*. Pages 130–132 in *The Migration Atlas: Movements of the Birds of Britain and Ireland* (Wernham. C., M. Toms, J. Marchant, J. Clark, G. Siriwardena, and S. Baillie, eds.). London: T & A D Poyser. 884 pp.

Wanless, S., and M.P. Harris. 2004. Northern Gannet *Morus bassanus*. Pages 115–127 in *Seabird Populations of Britain and Ireland* (Mitchell, P.I., S.F. Newton, N. Ratcliffe, and T.E. Dunn, eds.). London: T & A D Poyser. 511 pp.

Washburn, B.E., R.A. Dolbeer, and G.E. Bernhardt. 2006. *Laughing Gull Nest Population in Jamaica Bay, New York, 1992–2006*. Unpublished Report, US Department of Agriculture, Wildlife Services. 27 pp.

Watson, G.E. III, D.S. Lee, and E.S. Backus. 1986. The status and subspecific identity of White-faced Storm-Petrels in the western North Atlantic. *American Birds* 40: 401–408.

Watts, B.D. 2004. *Status and Distribution of Colonial Waterbirds in Coastal Virginia: 2003 Breeding Season*. CCBTR–04–06. Williamsburg, VA: Center for Conservation Biology, College of William and Mary. 25 pp.

Watts, B.D., and D.S. Bradshaw. 1998. Population expansion by Double-crested Cormorants in Virginia. *Raven* 67: 75–78.

Watts, B.D., and M.A. Byrd. 1998. Status and distribution of colonial waterbirds in coastal Virginia. *Raven* 76: 20–32.

Webster, P.J., G.J. Holland, J.A. Curry, and H.-R. Chang. 2005. Changes in tropical cyclone number, duration and intensity in a warming environment. *Science* 309: 1844–1846.

Weimerskirch, H. 2004. Diseases threaten Southern Ocean albatrosses. *Polar Biology* 27: 374–379.

Wetherbee, D.K., R.P. Coppinger, and R.E. Walsh. 1972. *Time Lapse Ecology: Muskeget Island, Nantucket, Massachusetts*. New York: MSS Publishing Co. 122 pp.

Wetlands International. 2006. *Waterbird Population Estimates, 4th edn*. (Delaney, S., and D. Scott, eds.). Wageningen, The Netherlands: Wetlands International. 239 pp.

White, C.M., N.J. Clum, T.J. Cade, and G.M. Hunt. 2002. Peregrine Falcon (*Falco peregrinus*). No. 660 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 48 pp.

White, T.P., R.R. Veit, and M.C. Perry. 2009. Feeding ecology of Long-tailed Ducks *Clangula hyemalis* wintering on the Nantucket Shoals. *Waterbirds* 32: 293–299.

Wiese, F.K., and G.J. Robertson. 2004. Assessing seabird mortality from chronic oil discharges at sea. *Journal of Wildlife Management* 68: 627–638.

Wiese, F.K., G.J. Robertson, and A.J. Gaston. 2004. Impacts of chronic marine oil pollution and the murre hunt in Newfoundland on Thick-billed Murre *Uria lomvia* populations in the eastern Canadian Arctic. *Biological Conservation* 116: 205–216.

Wiley, R.H., and D.S. Lee. 1998. Long-tailed Jaeger (*Stercorarius longicaudus*). No. 365 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Wiley, R.H., and D.S. Lee. 1999. Parasitic Jaeger (*Stercorarius parasiticus*). No. 445 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Wiley, R.H., and D.S. Lee. 2000. Pomarine Jaeger (*Stercorarius pomarinus*). No. 483 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 24 pp.

Wilkinson, P.M. 1997. Survey and census of colonial nesting seabirds in South Carolina. *Chat* 61: 233–259.

Wilkinson, P.M., and C. Marsh. 1988. First verified record for Forster's Terns nesting in South Carolina. *Chat* 52: 15.

Wilkinson, P.M., S.A. Nesbitt, and J.F. Parnell. 1994. Recent history and status of the eastern Brown Pelican. *Wildlife Society Bulletin* 22: 420–430.

Williams, B., R.A. Beck, B. Akers, and J.W. Via. 1990. Longitudinal surveys of the beach nesting and colonial waterbirds of the Virginia barrier islands. *Virginia Journal of Science* 41: 381–388.

Williams, B., R.A. Beck, B. Akers, and J.W. Via. 2005. The 30th annual beach-nesting and colonial waterbirds survey of the Virginia barrier islands–2004. *Raven* 76: 14–18.

Wingate, D.B. 1964. Discovery of breeding Black-capped Petrels on Hispaniola. *Auk* 81: 147–159.

Wingate, D.B. 1977. Excluding competitors from Bermuda Petrel nesting burrows. Pages 93–102 in *Endangered Birds: Management Techniques for Preserving Threatened Species* (Temple, S.A., ed.). Madison: University of Wisconsin Press. 466 pp.

Wink, M., D. Heidrich, and P. Ristow. 1993. Genetic evidence for speciation of the Manx Shearwater *Puffinus puffinus* and Mediterranean Shearwater *P. yelkouan*. *Vogelwelt* 114: 226–232.

Winkler, D.W. 1996. California Gull (*Larus californicus*). No. 259 in *The Birds of North America* (Poole, A., and F. Gill, eds.). Philadelphia: The Birds of North America, Inc. 28 pp.

Wires, L.R., and F.J. Cuthbert. 2006. Historic populations of the Double-crested Cormorant (*Phalacrocorax auritus*): implications for conservation and management in the 21st century. *Waterbirds* 29: 9–37.

Work, T.M., A.M. Beale, L. Fritz, M.A. Quilliam, M. Silver, K. Buck, and J.L.C. Wright. 1993. Domoic acid intoxication of Brown Pelicans and cormorants in Santa Cruz, California. Pages 643–649 in *Toxic Phytoplankton Blooms in the Sea* (Smayda, T.J., and Y. Shimuzu, eds.). Amsterdam: Elsevier Science Publishers. 892 pp.

Zino, F., B. Heredia, and M.J. Biscotto. 1996. Action plan for Fea's Petrel (*Pterodroma feae*). Pages 25–31 in *Globally Threatened Birds in Europe: Action Plans* (Heredia, B., L. Rose, and M. Painter, eds.). Strasbourg: Council of Europe and BirdLife International. 408 pp.

APPENDIX 1

Scientific names of species referred to in the text, tables, or appendices.

Mammals	
Red Fox	*Vulpes vulpes*
Coyote	*Canis latrans*
Raccoon	*Procyon lotor*
American Mink	*Mustela vison*
Birds	
Brant	*Branta bernicla*
Steller's Eider	*Polysticta stelleri*
King Eider	*Somateria spectabilis*
Common Eider	*Somateria mollissima*
Harlequin Duck	*Histrionicus histrionicus*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta deglandi*
Black Scoter	*Melanitta americana*
Common Scoter	*Melanitta nigra*
Long-tailed Duck (=Oldsquaw)	*Clangula hyemalis*
Red-breasted Merganser	*Mergus serrator*
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Arctic Loon	*Gavia arctica*
Common Loon	*Gavia immer*
Yellow-billed Loon	*Gavia adamsii*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
Eared Grebe	*Podiceps nigricollis*
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchus*
Indian Yellow-nosed Albatross	*Thalassarche carteri*
Black-browed Albatross	*Thalassarche melanophris*
Northern Fulmar	*Fulmarus glacialis*
Cape Petrel	*Daption capense*
Trindade Petrel	*Pterodroma [arminjoniana] arminjoniana*
Herald Petrel	*Pterodroma [arminjoniana] heraldica*
Mottled Petrel	*Pterodroma inexpectata*
Cahow (=Bermuda Petrel)	*Pterodroma cahow*
Fea's Petrel	*Pterodroma feae*
Black-capped Petrel	*Pterodroma hasitata*
Bulwer's Petrel	*Bulweria bulwerii*
White-chinned Petrel	*Procellaria aequinoctialis*

Cory's Shearwater	*Calonectris diomedea*
Cape Verde Shearwater	*Calonectris edwardsii*
Great Shearwater	*Puffinus gravis*
Buller's Shearwater	*Puffinus bulleri*
Sooty Shearwater	*Puffinus griseus*
Short-tailed Shearwater	*Puffinus tenuirostris*
Manx Shearwater	*Puffinus puffinus*
Audubon's Shearwater	*Puffinus lherminieri*
Newell's Shearwater	*Puffinus newelli*
Townsend's Shearwater	*Puffinus auricularis*
Little [Macaronesian] Shearwater	*Puffinus baroli*
Wilson's Storm-Petrel	*Oceanites oceanicus*
White-faced Storm-Petrel	*Pelagodroma marina*
European Storm-Petrel	*Hydrobates pelagicus*
Black-bellied Storm-Petrel	*Fregetta tropica*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*
Swinhoe's Storm-Petrel	*Oceanodroma monorhis*
Band-rumped Storm-Petrel	*Oceanodroma castro* [sensu lato]
White-tailed Tropicbird	*Phaethon lepturus*
Red-billed Tropicbird	*Phaethon aethereus*
Masked Booby	*Sula dactylatra*
Nazca Booby	*Sula granti*
Brown Booby	*Sula leucogaster*
Red-footed Booby	*Sula sula*
Northern Gannet	*Morus bassanus*
Brown Pelican	*Pelecanus occidentalis*
Neotropic Cormorant	*Phalacrocorax brasilianus*
Great Cormorant	*Phalacrocorax carbo*
Double-crested Cormorant	*Phalacrocorax auritus*
Magnificent Frigatebird	*Fregata magnificens*
Lesser Frigatebird	*Fregata ariel*
Bald Eagle	*Haliaeetus leucocephalus*
Peregrine Falcon	*Falco peregrinus*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicaria*
Black-legged Kittiwake	*Rissa tridactyla*
Ivory Gull	*Pagophila eburnea*
Sabine's Gull	*Xema sabini*
Bonaparte's Gull	*Chroiocephalus philadelphia*
Black-headed Gull	*Chroiocephalus ridibundus*
Little Gull	*Hydrocoloeus minutus*
Ross's Gull	*Rhodostethia rosea*
Laughing Gull	*Leucophaeus atricilla*
Franklin's Gull	*Leucophaeus pipixcan*
Black-tailed Gull	*Larus crassirostris*
Heermann's Gull	*Larus heermanni*
Common [Mew] Gull	*Larus [canus] canus*
Mew Gull	*Larus [canus] brachyrhynchus*
Kamchatka [Mew] Gull	*Larus [canus] kamtschatschensis*
Ring-billed Gull	*Larus delawarensis*

Western Gull	*Larus occidentalis*
California Gull	*Larus californicus*
[American] Herring Gull	*Larus [argentatus] smithsonianus*
[European] Herring Gull	*Larus [argentatus] argentatus*
Vega Gull	*Larus vegae*
Yellow-legged Gull	*Larus michahellis*
Thayer's Gull	*Larus thayeri*
Iceland Gull	*Larus glaucoides*
Lesser Black-backed Gull	*Larus fuscus*
Slaty-backed Gull	*Larus schistisagus*
Glaucous-winged Gull	*Larus glaucescens*
Glaucous Gull	*Larus hyperboreus*
Great Black-backed Gull	*Larus marinus*
Kelp Gull	*Larus dominicanus*
Brown Noddy	*Anous stolidus*
Black Noddy	*Anous minutus*
Sooty Tern	*Onychoprion fuscatus*
Bridled Tern	*Onychoprion anaethetus*
Least Tern	*Sternula antillarum*
Large-billed Tern	*Phaetusa simplex*
Gull-billed Tern	*Gelochelidon nilotica*
Caspian Tern	*Hydroprogne caspia*
Black Tern	*Chlidonias niger*
White-winged Tern	*Chlidonias leucopterus*
Whiskered Tern	*Chlidonias hybrida*
Roseate Tern	*Sterna dougallii*
Common Tern	*Sterna hirundo*
Arctic Tern	*Sterna paradisaea*
Forster's Tern	*Sterna forsteri*
Royal Tern	*Thalasseus maximus*
[Cabot's] Sandwich Tern	*Thalasseus [sandvicensis] acuflavidus*
[Cayenne] Sandwich Tern	*Thalasseus [sandvicensis] eurygnatha*
Elegant Tern	*Thalasseus elegans*
Black Skimmer	*Rynchops niger*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Great Skua	*Catharacta skua*
South Polar Skua	*Catharacta maccormickii*
Brown Skua	*Catharacta antarctica*
Dovekie	*Alle alle*
Common Murre	*Uria aalge*
Thick-billed Murre	*Uria lomvia*
Razorbill	*Alca torda*
Black Guillemot	*Cepphus grylle*
Atlantic Puffin	*Fratercula arctica*
Long-billed Murrelet	*Brachyramphus perdix*
Ancient Murrelet	*Synthliboramphus antiquus*
Cassin's Auklet	*Ptycoramphus aleuticus*
Crested Auklet	*Aethia cristatella*

Tufted Puffin	*Fratercula cirrhata*
Great Horned Owl	*Bubo virginianus*

Fishes

Atlantic Cod	*Gadus morhua*
Haddock	*Melanogrammus aeglefinus*
Atlantic Mackerel	*Scomber scombrus*
Atlantic Herring	*Clupea harengus*
Menhaden	*Brevoortia tyrannus*
American Sand Lance	*Ammodytes americanus*

APPENDIX 2

Gazetteer of locations referred to in the text.

Location	State/Province	Latitude	Longitude	Map
Albemarle Sound	North Carolina	36°05' N	75°57' W	3
Avalon Seawatch	New Jersey	39°06' N	74°43' W	3
Bahamas		22°–27° N	71°–79° W	1
Baie de Chaleur	New Brunswick/Quebec	47°59' N	65°43' W	1
Baltimore	Maryland	39°18' N	76°38' W	3
Barnegat Inlet	New Jersey	39°46' N	74°06' W	3
Bay of Fundy	New Brunswick/Nova Scotia	45° N	66° W	2
Bermuda		32° N	65° W	1
Biscayne Bay	Florida	25°34' N	80°14' W	4
Boston Harbor	Massachusetts	42°19' N	70°58' W	2
Buzzards Bay	Massachusetts	41°34' N	70°46' W	3
Cape Ann	Massachusetts	42°39' N	70°36' W	2
Cape Canaveral	Florida	28°27' N	80°32' W	4
Cape Cod	Massachusetts	41°41' N	70°15' W	2,3
Cape Cod Bay	Massachusetts	41°40' N	70°40' W	2
Cape Fear	North Carolina	33°51' N	77°58' W	4
Cape Hatteras	North Carolina	35°14' N	75°32' W	3,4
Cape May	New Jersey	38°56' N	74°57' W	3
Cape Sable Island	Nova Scotia	43°28' N	65°37' W	2
Chesapeake Bay	Maryland	37°45' N	76°09' W	3
Elizabeth Islands	Massachusetts	41°27' N	70°48' W	3
Fisher's Island	New York	41°16' N	72°00' W	3
Georges Bank		41°14' N	67°26' W	2
Gloucester	Massachusetts	42°37' N	70°39' W	2
Grand Manan Archipelago	New Brunswick	44°42' N	66°49' W	2
Great Duck Island	Maine	44°09' N	68°15' W	2
Gulf of Maine		43° N	68° W	2
Hereford Inlet	New Jersey	39°01' N	74°47' W	3
Hudson Canyon	New York/New Jersey	39°30' N	72°17' W	3
Isles of Shoals	Maine/New Hampshire	42°59' N	70°37' W	2
Jamaica Bay	New York	40°36' N	73°50' W	3
JF Kennedy International Airport	New York	40°38' N	72°17' W	3
Kent Island	New Brunswick	44°32' N	67°05' W	2
Little Duck Island	Maine	44°10' N	68°15' W	2
Long Island	New York	40°48' N	73°14' W	3
Long Island Sound	New York	41°05' N	72°56' W	3
Lubec	Maine	44°51' N	66°59' W	2
Machias Seal Island	New Brunswick	44°30' N	67°06' W	2
Manawagonish Island	New Brunswick	45°12' N	66°07' W	2
Manomet Point	Massachusetts	41°55' N	70°33' W	2
Martha's Vineyard	Massachusetts	41°24' N	70°35' W	3

Location	State/Province	Latitude	Longitude	Map
Matinicus Rock	Maine	43°47' N	68°15' W	2
Metinic Island	Maine	43°53' N	69°08' W	2
Montauk Point	New York	41°04' N	71°52' W	3
Mount Desert Rock	Maine	43°59' N	68°10' W	2
Muskeget Island	Massachusetts	41°20' N	70°18' W	3
Nag's Head	North Carolina	35°57' N	75°37' W	3
Nantucket Island	Massachusetts	41°17' N	70°04' W	2,3
Nantucket Shoals	Massachusetts	41°04' N	69°51' W	2,3
Nantucket Sound	Massachusetts	41°28' N	70°17' W	3
Narragansett Bay	Rhode Island	41°33' N	71°24' W	3
New Bedford	Massachusetts	41°38' N	70°56' W	3
Noman's Land	Massachusetts	41°15' N	70°49' W	3
Norfolk	Virginia	36°56' N	76°17' W	3
Northeast Channel	New England	42°09' N	65°53' W	2
Outer Banks	North Carolina	35°23' N	75°30' W	3,4
Pamlico Sound	North Carolina	35°23' N	75°51' W	3,4
Passamaquoddy Bay	Maine	45°04' N	66°59' W	2
Penikese Island	Massachusetts	41°27' N	70°55' W	3
Plum Island	Massachusetts	42°46' N	70°47' W	2
Point Lepreau	New Brunswick	45°03' N	66°28' W	2
Pompano Beach	Florida	26°14' N	80°05' W	4
Portland	Maine	43°40' N	70°15' W	2
South Beach	Massachusetts	41°36' N	69°58' W	2
South Wolf Island	New Brunswick	44°57' N	66°44' W	2
Stellwagen Bank	Massachusetts	42°20' N	70°17' W	2
Vero Beach	Florida	27°38' N	80°23' W	3
Whitehorse Island	New Brunswick	44°35' N	66°46' W	2
Yellow Murre Ledge	New Brunswick	44°31' N	66°47' W	2

APPENDIX 3

List of vagrant species recorded in eastern United States/Bay of Fundy waters. The species included in this table have been recorded at least once in eastern US waters, but appear to be recorded less frequently than once per year (≤30 total records). The list is of course changing continuously, as some species increase in frequency, others decrease, and others are recorded for the first time. It is not our intention to provide an exhaustive listing (though we believe we have mentioned all species that have occurred), and indeed an exhaustive listing is almost certainly not possible due to differing standards for acceptance of records at both continent-wide (AOU, American Birding Association, *North American Birds*) and state (record committees, state bird books) scales. Instead, our goal is to provide a guide to the relative frequency with which each of these species occurs in our area. We have compiled records that have been accepted by at least one of the reviewing authorities cited above: we have not attempted to review the records ourselves or to make independent judgments on their validity.

Species	**Season**	**Approx. No. of Records**	**Years**	**Locations**
Steller's Eider	Dec, Mar	2	1926, 1977	Maine, Massachusetts
Yellow-billed Loon	Dec–Apr	6	1930–2004	Maine–Georgia
Clark's Grebe	Jan–Mar	3	2003–05	Maine–North Carolina
Black-browed Albatross	Jan–Dec	11+	1970–2010	Maine–Virginia
Cape Petrel	Jun	1	1873	Maine
Mottled Petrel	Apr	1	1880	New York
White-chinned Petrel	Oct	2	1996, 2010	North Carolina, Maine
Cape Verde Shearwater	Aug	2	2004	North Carolina, Maryland
Buller's Shearwater	Oct	1	1984	New Jersey
Little Shearwater	Aug	1	2007	Massachusetts
Short-tailed Shearwater	Jan	1	1998	Virginia
Bulwer's Petrel	Jun–Sep	10	1969–2006	Massachusetts–Florida
European Storm-Petrel	May–Jun	12	2003–10	North Carolina
Black-bellied Storm-Petrel	May–Jun	6	2004–10	North Carolina
Swinhoe's Storm-Petrel	Jun, Aug	4	1998, 2008	North Carolina
Red-footed Booby	Apr-Nov	3	1986–2007	South Carolina–Florida
Neotropic Cormorant	Aug	1	2005	Maryland
Lesser Frigatebird	Jul	1	1960	Maine
Black-tailed Gull	Jan–Dec	15	1984-2008	Massachusetts–Virginia
Mew Gull	Oct–Dec	3	1980–2010	Massachusetts–Virginia
Heermann's Gull	Aug	2	2002–03	Virginia
Kamchatka [Mew] Gull	Jan–Feb	2	2006, 2009	Rhode Island, Massachusetts
Kelp Gull	Jan–Dec	1	1999–2004	Maryland
Glaucous-winged Gull	Jan	1	2009	New Hampshire
Western Gull	Feb	1	2006	New York
European Herring Gull	Nov–Apr	3	1980–2006	Massachusetts, Florida

Species	Season	Approx. No. of Records	Years	Locations
Yellow-legged Gull	Sep– Mar	10	1990–2002	Massachusetts–Virginia
Slaty-backed Gull	Nov–Feb	10	1992–2008	New Hampshire–North Carolina
Ross's Gull	Nov–May	20	1974–2010	Massachusetts–Maryland
Cayenne Tern	May–Sep	8	1970–2007	New York, North Carolina
Black Noddy	Sep	1	2006	Virginia
Elegant Tern	Jun–Sep	3	1985–2002	Massachusetts–Virginia
Whiskered Tern	Jul–Aug	3	1993–98	New Jersey/Delaware, Bahamas
White-winged Tern	May–Nov	20	1954–2008	New Brunswick-Georgia
Large-billed Tern	May	1	1988	New Jersey
Long-billed Murrelet	Sep–Mar	15	1982–2007	Massachusetts–Florida
Ancient Murrelet	Nov–Feb	5	1992–99	Massachusetts–Pennsylvania
Crested Auklet	winter	1	1884–85	Massachusetts
Tufted Puffin	winter	1	1831–32	Maine

NUTTALL ORNITHOLOGICAL MONOGRAPHS

OUT OF PRINT:

Lanyon, Wesley E. 1957. *The Comparative Biology of Meadowlarks* (Sturnella) *in Wisconsin.* Nuttall Ornithological Monographs No. 1. 66 pp. + 31 plates.

Meyerriecks, Andrew J. 1960. *Comparative Breeding Behavior of Four Species of North American Herons.* Nuttall Ornithological Monographs No. 2. 158 pp. + 15 plates.

Zusi, Richard L. 1962. *Structural Adaptations of the Head and Neck in the Black Skimmer* Rynchops nigra *(Linnaeus).* Nuttall Ornithological Monographs No. 3. 101 pp. + 5 tables, 44 figures.

Lunk, William A. 1962. *The Rough-winged Swallow* Stelgidopteryx ruficollis *(Vieillot): A Study Based on Its Breeding Biology in Michigan.* Nuttall Ornithological Monographs No. 4. 159 pp. + 19 figures, 3 plates.

Kale, Herbert W. 1965. *Ecology and Bioenergetics of the Long-billed Marsh Wren* Telmatodytes palustris griseus *(Brewster) in Georgia Salt Marshes.* Nuttall Ornithological Monographs No. 5. 142 pp. + 61 tables, 22 figures.

Smith, W. John. 1966. *Communications and Relationships in the Genus* Tyrannus. Nuttall Ornithological Monographs No. 6. 250 pp. + 3 tables, 51 figures.

Skutch, Alexander F. 1967. *Life Histories of Central American Highland Birds*. Nuttall Ornithological Monographs No. 7. 213 pp. + 1 table, 6 figures.

Kepler, Cameron B. 1969. *Breeding Biology of the Blue-faced Booby* Sula dactylatra personata *on Green Island, Kure Atoll.* Nuttall Ornithological Monographs No. 8. 97 pp. + 42 tables, 32 figures.

Mayr, Ernst, and Lester L. Short. 1970. *Species Taxa of North American Birds: A Contribution to Comparative Systematics.* Nuttall Ornithological Monographs No. 9. 127 pp. + 8 tables.

Skutch, Alexander F. 1972. *Studies of Tropical American Birds.* Nuttall Ornithological Monographs No. 10. 228 pp. + 2 tables, 15 figures.

Smith, Susan T. 1972. *Communication and Other Social Behavior in* Parus carolinensis. Nuttall Ornithological Monographs No. 11. 125 pp. + 6 tables, 22 figures.

OUT OF PRINT:

Diamond, Jared M. 1972. *Avifauna of the Eastern Highlands of New Guinea.* Nuttall Ornithological Monographs No. 12. 438 pp. + 19 tables, 42 figures. 4 maps.

Wattel, Jan. 1973. *Geographical Differentiation in the Genus* Accipiter. Nuttall Ornithological Monographs No. 13. 231 pp. + 21 figures, 27 maps.

Haffer, Jürgen. 1974. *Avian Speciation in Tropical South America, with a Systematic Survey of the Toucans (Ramphastidae) and Jacamars (Galbulidae).* Nuttall Ornithological Monographs No. 14. 390 pp. + 31 tables, 22 figures.

OUT OF PRINT:

Paynter, Raymond A. (ed.). 1974. *Avian Energetics.* Nuttall Ornithological Monographs No. 15. 334 pp. + 48 tables, 57 figures.

Kepler, Angela K. 1977. *Comparative Study of Todies, with Emphasis on the Puerto Rican Tody* Todus mexicanus. Nuttall Ornithological Monographs No. 16. 206 pp. + 37 tables, 67 figures, 7 maps.

Stegmann, Boris C. 1978. *Relationships of the Superorders Alectromorphae and Charadriomorphae (Aves): A Comparative Study of the Avian Hand.* Nuttall Ornithological Monographs No. 17. 119 pp. + 37 figures.

Moynihan, Martin. 1979. *Geographical Variation in Social Behavior and in Adaptations to Competition among Andean Birds.* Nuttall Ornithological Monographs No. 18. 162 pp. + frontispiece.

Skutch, Alexander F. 1981. *New Studies of Tropical American Birds.* Nuttall Ornithological Monographs No. 19. 281 pp. + 7 tables, 11 figures.

Kilham, Lawrence. 1983. *Life History Studies of Woodpeckers of Eastern North America.* Nuttall Ornithological Monographs No. 20. 240 pp. + frontispiece, 58 figures.

Montevecchi, William A., and Leslie M. Tuck. 1987. *Newfoundland Birds: Exploitation, Study, Conservation.* Nuttall Ornithological Monographs No. 21. 273 pp. + frontispiece, 23 tables, 40 figures.

Houde, Peter. 1988. *Paleognathous Birds from the Early Tertiary of the Northern Hemisphere.* Nuttall Ornithological Monographs No. 22. 149 pp. + 27 tables, 41 figures.

Baumel, Julian J. (ed.). 1993. *Handbook of Avian Anatomy, 2nd edn.* Nuttall Ornithological Monographs No. 23. 779 pp. + 2 tables, 191 figures.

Roca, Roberto Luis. 1994. *Oilbirds of Venezuela: Ecology and Conservation.* Nuttall Ornithological Monographs No. 24. 84 pp. + frontispiece, 13 tables, 26 figures.

Paynter, Raymond A. 1995. *Nearctic Passerine Migrants in South America.* Nuttall Ornithological Monographs No. 25. 126 pp. + 3 tables, 71 figures.

Mees, G.F. 1996. *Geographical Variation in Birds of Java.* Nuttall Ornithological Monographs No. 26. 119 pp. + 123 tables, 25 figures.

Tyrberg, Tommy. 1998. *Pleistocene Birds of the Palearctic: A Catalogue.* Nuttall Ornithological Monographs No. 27. 720 pp. + 3 tables, 59 figures.

Marshall, Joe T. 2001. *The Gray-cheeked Thrush,* Catharus minimus, *and Its New England Subspecies, Bicknell's Thrush,* Catharus minimus bicknelli. Nuttall Ornithological Monographs No. 28. 135 pp. + 2 tables, 2 plates, 5 maps, 6 figures, 2 photographs.