



Photo by Robert F. Bukaty

Only seventeen feet above high tide, Eastern Egg Rock is vulnerable to the rising ocean levels.

## PUFFINS, TERNS, AND GLOBAL WARMING

by Stephen W. Kress

Puffins at Maine coast islands continue to thrive, as demonstrated by increasing populations and high nesting success. But researchers elsewhere are finding troubled times for puffins and other seabirds. While there are many subtle effects that a rapid shift in climate can have on seabirds, rising ocean levels and changes in food supplies are two immediate threats.

### Rising Ocean Levels

Water from melting ice in Greenland, the Arctic, and Antarctica are contributing to rising ocean levels. Recent estimates from the Intergovernmental Panel on Climate Change predicts in its 4<sup>th</sup> (2007) assessment an increase in sea level of between seven and 24 inches by 2100.<sup>1</sup> These effects will vary greatly along the Atlantic Coast with the most severe effects in the Mid-Atlantic and Southeastern states due to the gentle slope of the land.<sup>2</sup> Since the year 1800, sea levels in the Gulf of Maine have risen about one foot, and most of this has happened in the 20<sup>th</sup> century—a rate unprecedented in the previous 1,000 years, and consistent with warming of the northern hemisphere.<sup>3</sup> To assess the impact rising water has on Maine, the Natural Resources Council of Maine in collaboration with the Geographic Information Systems Department at Colby College and University of Maine's Climate Change Institute determined that, given a three-foot rise in water, 242 key coastal wildlife habitats in Maine would be flooded. The report also identified 20 high risk cities and towns that would lose 20 to 30% of their land.<sup>4</sup>

A sea level rise of 3 ft would result in disaster for Maine seabirds, as most nest on low-lying islands. Eastern Egg Rock, for example, is only 17 ft above the average high tide. The most immediate threat from rising ocean levels is the compounded effect of high tides and storm surges, which will become more common with warming seas.<sup>5</sup> For example, on April 16, 2007, storm waves measuring 31.5 ft were recorded on the Maine Coast. Combined with a high tide of over 13 ft (the 7<sup>th</sup> highest tide recorded since the early 1900s), it is no surprise that the storm washed over most of Eastern Egg Rock. If the storm had occurred a month later, it would have flooded most puffin-nesting burrows. Ironically, the timing of the storm actually improved tern nesting habitat, by eroding accumulating invasive grasses and exposing the underlying beds of gravel—ideal tern-nesting habitat. Some terns even nested atop heaps of vegetation and marine debris dumped by the storm into the interior of the island.



Photo by Scott Hall. Inset photo by Robert F. Bukaty

Common Terns thrived at Eastern Egg Rock this year in the wake of an extreme April storm and high tide that washed over the island, depositing heaps of dead vegetation and marine debris, where many nested. Marine storms can create or destroy seabird nesting habitat—depending on the time of the year.



Atlantic saury (*Scomberesox saurus*), a fish usually found further south, became an excellent food source for Maine's puffins and terns last summer.

### Changes in Fish Stocks

Even small increases in water temperature are significant as they diminish plankton populations, which in turn affect entire marine ecosystems. Melting arctic ice will likely balance some of the global warming effect on Maine coastal waters, but data from NOAA's Climate Diagnostic Center reveals an average water temperature increase of 1.1°F. over the past 147 years in the Gulf of

Maine.<sup>6</sup> Likewise, changes in ocean currents and salinity can also negatively affect the plankton and fish species available to foraging seabirds. These changes can also affect the size and timing of the arrival of fish that are fed to seabird chicks. Puffins and terns are especially sensitive to these changes and researchers worldwide are beginning to see troubling effects.

Some of the changes brought about by climate change are complex and difficult to predict. Surprisingly, others may have at least short term benefit for seabirds. For example, Atlantic saury (*Scomberesox saurus*) has recently been identified in the diet of Maine puffins and terns. Typically found in the warmer waters south of Cape Cod, its presence in the Gulf of Maine indicates warmer waters. Its appearance the past two years in southern and mid-coast Maine has helped supplement the meals of puffins and terns. However, more often, climate change brings trouble to seabird food supplies. Especially when combined with overfishing and marine pollution, climate change can have disastrous effects on the growth and survival of seabird chicks.

### **A FEW EXAMPLES:**

- **Machias Seal Island, New Brunswick, Canada:**

Since 2001, the diet of Atlantic Puffins at the largest Gulf of Maine puffin colony has switched from finger-sized to larval herring (less than an inch) and shrimp—both inferior foods that also contributed to the abandonment of the largest colony of Arctic and Common Terns in the Gulf of Maine. More than 3,100 pairs of Arctic and Common Terns abandoned the island in 2006—a pattern that continued in 2007. The relationship to global warming is so far unclear.

- **North-East Atlantic:**

In early October, lead seabird scientists from Greenland, Iceland, the Faeroe Islands, Denmark, Sweden, and Norway issued a joint news release concerning Atlantic Puffin, Arctic Tern, Northern Fulmar, Black-legged Kittiwake, and Common Murre. They reported that large-scale, climate-related ecological changes have disrupted the food web of marine birds in Nordic waters. Over recent years, a decreasing number of birds have shown up in the colonies, and local populations are in trouble as few chicks are being raised.

- **Iceland:**

Aevar Petersen, Chief Scientist of the Icelandic Institute of Natural History, reports that this was the third consecutive year of widespread nesting failure for many Icelandic seabirds. Some species on Iceland's western coast have suffered longer. Here, ocean temperatures have increased by 3.6 °F in the past two decades, and this coincides with the absence of sand lance (*Ammodytes spp.*) In their place are less nutritious fish—some of which the seabirds can't swallow. Arctic Terns, Atlantic Puffins, Black-legged Kittiwake, and Shag are hardest hit because of their dependence on sand lance. The well-being of puffins in Iceland is especially important as 3-4 million pairs nest here.

- **Røst Island, Norway:**

Puffins here typically feed on small herring, but the fish are scarce when the puffins most need them. Scientists are finding that cold water plankton are moving north, followed by herring that once fed the puffins.<sup>7</sup> Herring have now moved beyond the feeding range of puffins, resulting in the death of most nestlings. A study has found that the timing of puffin breeding is being influenced by climate change and food may not be available when needed by the puffin chicks.<sup>8</sup>

- **Shetland Islands, United Kingdom:**

Arctic Terns, Common Murres, and Atlantic Puffins have experienced chronic breeding failure and wide-spread starvation of chicks because of the absence of sand lance, their primary food.<sup>9</sup> Food shortages are compounded at many Scottish Islands by the increased growth of tree mallow (*Lavatera arborea*), a Mediterranean native. Because of global warming, this plant has rapidly overgrown puffin nesting habitat.<sup>10</sup>

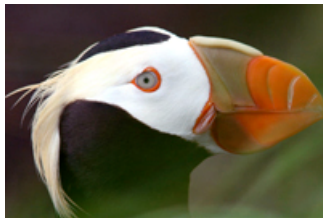


Photo by Ryan Kingsbery

**Tufted Puffins at British Columbia's Triangle Island have poor nesting success in years when the water is warmest.**

- **Triangle Island, British Columbia:**

Changes in ocean currents attributed to global warming have affected seabirds at many locations along the Pacific Coast in recent years, but the effect is especially well documented at Triangle Island, which hosts the largest colony of Tufted Puffins in Canada. In years when the waters are warmest, puffin chicks exhibit drastically reduced growth rates and fledging success. Prolonged increases in ocean temperature could make the island unsuitable as a breeding site.<sup>11</sup>

### Measuring the Effects of Global Warming on Maine Seabirds

To measure the effects of global warming on seabirds, interns from Audubon's Seabird Restoration Program measure sea surface temperatures three times daily at each of our seven island field stations. These measurements, along with studies of the diets and growth of puffins and terns, are providing long-term measures of the health of the Gulf of Maine. As seen by the examples above, puffins and other seabirds are among the most sensitive indicators of problems in the marine food chain.



Photo by Stephen W. Kress  
Spencer Galen collects sea water at Seal Island NWR to measure sea surface temperature.

### Seeking Higher Ground

The same methods developed to restore seabirds to new nesting islands can also help seabirds move to higher ground as ocean levels rise. This may mean selecting islands with higher elevations for future restoration sites, or encouraging seabirds to move away from the edges of islands to higher ground. The creation of suitable nesting habitat combined with social attraction—the use of seabird decoys and sound recordings to lure birds to safe sites—has great promise for this purpose. Several projects are already underway to move tern nesting colonies away from the dangers of flooding shorelines.



Photo by Robert F. Bukaty

Arctic Terns thrived this year at Eastern Egg Rock in the wake of an extreme April storm and high tide that washed over most of the island, exposing ideal nesting habitat. If the storm had occurred a month later, it would have been a disaster for the nesting birds.

### Making a Difference

Climates have changed in the past, but never as fast as now. Our success at slowing global warming will depend on meaningful actions by governments and our personal choices. This is not just about the quality of life for seabirds and our grandchildren—it is about our own future. Electing caring legislators and making more sustainable energy conservation choices at home and work are excellent places to start.

Here are some links to specific things that you can do to make a difference:

- **Elect leaders that care** about global warming: <http://www.stepitup2007.org>
- Conduct a **home energy audit**: <http://www.hes.lbl.gov>
- **Buy or rent cleaner cars**: <http://www.evrental.com>
- **Measure your carbon footprint** at the Center for Alternative Technology: <http://www.cat.org.uk>
- **Inform teachers** about available energy education materials: <http://www.eia.doe.gov/kids>
- **Learn more about global warming and find solutions**: <http://www.audubon.org/globalWarming/index.php>; <http://www.climatecrisis.net>; <http://www.earthday.net>; and <http://www.npr.org/climateconnections>
- **Stay informed** by reading **Audubon** magazine

## Footnotes

<sup>1</sup> [http://www.ipcc-wg1/Report/AR4WG1\\_Print\\_SPM.pdf](http://www.ipcc-wg1/Report/AR4WG1_Print_SPM.pdf)

<sup>2</sup> <http://www.pubs.usgs.gov/fs/fs76-00/fs076-00.pdf>

<sup>3</sup> W. Roland Gehrels, Daniel F. Belknap, Stuart Black, and Rewi M. Newnham  
**Rapid sea-level rise in the Gulf of Maine, USA, since AD 1800**

The Holocene, May 2002; 12: 383 - 389.

<http://www.hol.sagepub.com/cgi/content/abstract/12/4/383>

[http://www.cleanair-coolplanet.org/information/pdf/Indicators\\_poster.pdf](http://www.cleanair-coolplanet.org/information/pdf/Indicators_poster.pdf)

<sup>4</sup> [http://www.nrcm.org/sea\\_level\\_rise.asp](http://www.nrcm.org/sea_level_rise.asp)

<sup>5</sup> [http://www.ucusa.org/global\\_warming/science/hurricanes-and-climate-change.html](http://www.ucusa.org/global_warming/science/hurricanes-and-climate-change.html)

<sup>6</sup> [http://www.cleanair-coolplanet.org/information/pdf/Indicators\\_poster.pdf](http://www.cleanair-coolplanet.org/information/pdf/Indicators_poster.pdf)

<sup>7</sup> Joël M. Durant, Tycho Anker-Nilssen, Dag Ø. Hjernmann, Nils Chr. Stenseth (2004)

Regime shifts in the breeding of an Atlantic puffin population

Ecology Letters 7 (5), 388–394.

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<http://www.blackwell-synergy.com/doi/abs/10.1111/j.1461-0248.2004.00588.x?cookieSet=1&journalCode=ele>

<sup>8</sup> <http://www.ch4.org.uk/article.php/Will+Puffins+Disappear%3F>

<sup>9</sup> [http://www.news.bbc.co.uk/2/hi/uk\\_news/scotland/3931465.stm](http://www.news.bbc.co.uk/2/hi/uk_news/scotland/3931465.stm)

<sup>10</sup> <http://www.guardian.co.uk/science/2005/dec/18/biodiversity.conservationsandendangeredspecies>

<sup>11</sup> Proc Natl Acad Sci USA. 2003 Aug 5;100(16):9377-82. Epub 2003 Jul 18.

<http://www.pnas.org/cgi/content/abstract/100/16/9377>



*Photo by Robert F. Bukaty*  
**Charlie Governali banding terns at Eastern Egg Rock.**