Mass Audubon
Protecting the Nature of Massachusetts

Sustaining People and Nature in a Rapidly Changing Climate

Presented to the Board of Directors for adoption, June 10, 2010

I. Introduction

More than 110 years ago, Mass Audubon was founded by Boston women who successfully advocated for laws to end the slaughter of birds in the name of fashion. Over the years, our mission has broadened to protect all wildlife and their habitats, as we have remained true to our organizational values. We have a passion for nature and a commitment to inspire people to act to protect nature for people and for wildlife.

Accomplishing our mission has focused on addressing the threats of habitat loss and fragmentation, but the growing impacts of a rapidly warming climate caused by the emission of greenhouse gases from fossil fuel use and deforestation[1] threaten to exacerbate the impacts of habitat loss and disrupt natural processes upon which humans and wildlife depend. We continue to be inspired by our founders who demonstrated the power of collective action. The response to climate change must be a similarly cooperative effort on a global scale.

Responding to the effects of climate change on people and wildlife will redefine responsible environmental stewardship as we combine traditional resource protection efforts with those efforts that reduce CO_2 emissions, such as in the siting and expansion of low-emission renewable-energy facilities.[2] The actions that respond to climate change –including improvements in energy conservation and efficiency, and changes in the patterns of development –will make our communities and economy more sustainable and will protect wildlife habitat.

In this document, we outline the anticipated effects of climate change on the nature of Massachusetts and describe Mass Audubon's major climate change initiatives for the next five years. Given the enormous scope of the problem, we know that the impacts of even the most aggressive organizational response will be insufficient. We will use our unique strengths in science-based advocacy and environmental education, along with a large and dedicated membership, to work with our conservation partners and catalyze collective action leading to a cleaner energy future and the needed reduction in greenhouse gas emissions.

II. The Problem

Current CO_2 concentrations are higher than they have been at any previous time in the past 650,000 years. As CO_2 concentrations have increased rapidly and substantially since the mid-19th century, average global temperatures have risen; summer temperatures have increased by 2^{o} F and winter temperature increases have been twice that level.[3] This upward trend is expected to become even more pronounced toward the end of the 21st century. For the northeastern US, the most recent climate models predict that by 2100 winters will be 6-10^{o} F warmer, and summers will be 5-11^{o} F warmer than they are now.[4]

Current models for the northeastern US also predict that more winter precipitation will fall as rain rather than snow. With less snow and warmer winters, the extent of winter snow cover in New England will be considerably reduced compared with its present extent, with implications for New England's annual hydrologic cycle. The pattern of precipitation is also predicted to become more erratic, with more intense storm events that cause flooding and erosion interspersed with frequent summer droughts. Many rivers and streams in Massachusetts are already stressed by low flows in the summer, and the anticipated increase in heat and drought will boost water demand and withdrawals, exacerbating the stress on aquatic life in rivers, resulting in more frequent fish kills and a loss of other aquatic life.[5]

The warming of New England's oceans will also continue, with predicted changes in sea surface temperature ranging from a 5-8^{o}F (2-6^{o} C)[6] increase by 2100.[7] Predicted sea level rise of up to two feet, or higher, combined with expected increases in intensities of coastal storms will accentuate coastal erosion along the New England coast. Analyses of the Massachusetts coastline indicate that Cape Cod and the Islands will be particularly vulnerable to these effects. If this sea-level rise occurs, endangered coastal waterbirds and vulnerable salt marsh species could lose a large proportion of their habitat.

Native ecosystems have already responded to the warming of the earth.[8] Northward range extensions in Europe and North America of birds, amphibians, butterflies, dragonflies, marine fish, and plants attributed to climate change through the last 50 years have been well documented in the scientific literature. In our temperate region, phenological changes (i.e., changes in the timing of yearly events related to climate), have been reported, including nesting times of birds, occurrence of amphibian breeding, and flowering times.[9] Of particular concern is the disruption of species interactions (e.g., pollination, prey availability during nesting) that may become out of synchronization resulting from species-specific differences in response to climate change.[10] Additionally, climate changes in other regions of the world threaten elements of Massachusetts' natural heritage. For example, in Arctic regions where warming has been particularly pronounced[11] , temperature increases could disrupt the nesting of vast numbers of Arctic birds, many of which spend significant time in Massachusetts during spring and fall migrations or during winter months.[12]

We anticipate that ecological changes will become more pronounced as warming intensifies during the 21st century. Some scenarios project that the ranges of communities and species with northern affinities will continue to contract until they no longer occur in Massachusetts. For example, spruce-fir forests, which occur only on a few isolated mountaintops in Massachusetts, will disappear from the Commonwealth. The northern hardwood forest – dominated by sugar maple, American beech, and yellow birch and covering much of central and western Massachusetts – will also disappear.

These northward range shifts are of serious concern because not all species will be able to shift their range at a rate that tracks the projected rate of warming. Plants that are not dispersed widely by wind or birds, as well as animal species with limited dispersal ability that cannot cross barriers like roads and development (e.g., turtles, cold water fish, and many other small terrestrial and aquatic animals) may not be able to reach these new habitats and may therefore suffer local or more widespread extirpation.[13]

We also do not know what will replace vulnerable terrestrial and aquatic communities. The communities that replace forests destroyed by these stresses are not likely to resemble native habitats found south of New England. Unpredictable combinations of plants and animals may survive and colonize various locations. Non-native invasive plants and animals that are already stressing our natural

communities often thrive in disturbed areas and may outcompete native plants, even those adapted to the new conditions.[14] Invasive plants tend to not support the food, shelter, and breeding requirements of many native birds and other animals as well as native plant species.[15]

Pest organisms and plant diseases are expected to show similar northward range expansions. For example, the hemlock woolly adelgid, which has devastated eastern hemlock throughout much of the eastern United States, is predicted to continue its northern expansion under current warming scenarios to eventually encompass all of New England with major, negative ecological consequences.[16]

Marine life in New England will continue to show the effects of warmer temperatures, rising sea levels, and the measurable increase in ocean acidity resulting from absorption of increasing atmospheric CO_2. Water temperatures off the Massachusetts coast are already near the maximum for survival of juvenile Atlantic cod and American lobster, two of our signature marine species that are likely to be eliminated from the southern parts of their current range.[17] Salt marshes may not be able to keep up with the accelerated rate of sea level rise and would then begin to degrade. These marshes serve as key nursery habitats for many of our marine fish and invertebrate species, and support some unique species of birds, invertebrates, and plants. The example of salt marshes shows how the effects of climate change on one type of ecological community will have wide-ranging and hard-to-predict impacts on other communities. Rising levels of dissolved CO_2, as carbonic acid, is lowering the pH of ocean water in a process called "ocean acidification," which is interfering with the shells and skeletons of marine organisms with potentially dire consequences for pH-sensitive coral reefs and shellfish.[18]

The disruptive effects of climate change will have substantial impacts on the human environment. Transmission of diseases, such as the mosquito-borne West Nile virus, are likely to become more prevalent in response to predicted increases in temperature and the pattern of drought alternating with intense rainfall and flooding.[19] Illness and death caused by extreme heat and heat waves are likely to increase, and air-quality standards will become more difficult to meet as temperatures increase. For example, ground-level ozone concentrations are correlated with temperature and would increase under scenarios of increasing temperature exacerbating respiratory disease, such as asthma, and decreasing lung function. Children, the poor, and the elderly will be most vulnerable to these climate-related health effects.[20] In addition, our water supplies are likely to be stressed from increased evaporation related to warmer temperatures and smaller winter snowpacks. Unless updated, stormwater systems and road culverts will be overwhelmed more often and neighborhoods will be flooded by more frequent, intense storms. Extensive tracts of coastline are already threatened by inundation and erosion resulting from sea-level rise. The economic effects of climate disruption will be felt in tourist, agricultural, and winter recreation industries.

III. Significance of Climate Change to Mass Audubon's mission

Mass Audubon's mission is to protect the nature of Massachusetts for people and wildlife, and it is imperative that we respond to the challenge posed by a rapidly changing climate if we are to be successful in accomplishing our mission. We conclude that climate change related to an unprecedented increase in the amount of CO_2 emitted to the atmosphere from the burning of fossil fuels is occurring and is a serious threat to our earth's ecosystems and the nature of Massachusetts. The rapidity at which climate change is presently occurring threatens to disrupt many components of the natural and human communities of Massachusetts. Because of the complexity of ecosystems, no one can predict with certainty what the future suite of organisms inhabiting Massachusetts will be under a rapidly changing

climate, but, based on fossil evidence, periods of rapid climate change in the past have been marked by destabilization of ecosystems and much loss of biodiversity.[21]

The protection of birds and their habitats remains a primary focus of our conservation mission, and there is ample evidence that the ranges of birds and the timing of nesting and migrations have been shifting in response to the past century of climate change. Sea-level rise threatens to undo our successes over the past 25 years in protecting endangered coastal birds, including terns, plovers, and saltmarsh sparrows. The disruption of plant communities in response to warming will have large impacts on forest breeding species. As much as 75% of eastern forest birds dependent on a single habitat type are vulnerable to the impacts of climate change, and Massachusetts breeding birds that migrate to the Caribbean may experience reduced overwinter survival as high-elevation habitats dry out.[22]

IV. Mass Audubon's Response

Our response to climate change is moving forward on two fronts. We are working with our environmental partners and government officials for climate change mitigation – reducing greenhouse gas emissions that are driving climate change in order to keep the impacts of climate change within manageable limits. And, we are safeguarding natural communities by increasing protection and restoration measures that enhance the resilience of these communities to the disruptive effects of climate change that are unavoidable. Mitigation is especially urgent because we need to keep the effects of climate change and resulting ecosystem responses to an adaptable level. Therefore, mitigation will be a primary focus of our response.

Mitigation

We are committed to a series of actions that will measurably reduce fossil fuel use through the conservation and more efficient use of energy and by increasing the production of energy from renewable sources, and we will vigorously support state efforts to reduce greenhouse gas emissions.

The Massachusetts Global Warming Solutions Act (GWSA) sets a near term statewide CO_2 emissions reduction target of 10-25% by2020 (all percentages refer to the 1990 baseline) and a longer term target of 80% by 2050. Existing and planned energy efficiency and renewable energy production policies are projected to lead to emission reductions of approximately 18% from 1990 levels by 2020.[23] **Mass Audubon is committed to a series of actions that collectively will expand and extend these policies and related actions to help the Commonwealth achieve an additional 10% reduction beyond this estimate for a total of a 28% emissions reduction by 2020**.[24] Our actions are intended to complement those of our partners and contribute to meeting more ambitious emissions-reduction targets on a faster timeline. Our actions include:

- **Implementing energy reduction and efficiency measures that will reduce the organization's carbon footprint by 50% by 2014.** Mass Audubon, through energy conservation and efficiency measures and the purchase and production of renewable energy, already has reduced its carbon footprint by more than 40% over 2003 levels, the first year we began monitoring our energy consumption (www.massaudubon.org/renewableenergy). Because we generally do not support the purchase of offsets[25] to achieve emissions targets, we will continue efforts to reduce energy

consumption in our vehicle use and heating and cooling of our extensive facility portfolio. Our facilities account for approximately 70% of our footprint.

- **Advocating for Federal policy initiatives that implement a national framework for greenhouse gas reductions.** Our experience in reducing our footprint has convinced us that the deeper emissions cuts necessary to reach this goal will not be possible without a national climate change policy. Mass Audubon will, therefore, work with our national partners and the Massachusetts Congressional delegation to implement such a policy.

- **Engaging and educating our membership in energy conservation and efficiency efforts** directed toward a reduction of member household carbon footprint by an average of 25% by 2020. Mass Audubon, as the largest conservation organization in New England, has more than 100,000 members, and if our members have average carbon footprints, these actions will reduce CO_2 emissions by 1.8 million tons of CO_2, or 1.7% of the statewide total.[26] Our actions include: working in partnership with energy service companies to provide incentives to our members to substantially reduce their energy use and enlisting our statewide sanctuary network to amplify these initiatives by integrating climate change and sustainability themes into our sanctuary programs.

- **Promoting local and regional land use planning and zoning to reduce sprawl.** Sprawl reduction will result in less loss and fragmentation of habitat; reduced transportation-related energy consumption; and reduced impacts on water resources while also sustaining the substantial carbon storage ability of natural landscapes.

- **Working with state officials and conservation partners to develop environmentally responsible siting guidelines for wind energy development on land and offshore** to protect wildlife resources and to ensure that biomass facilities and other renewable energy projects result in real reductions in greenhouse gas emissions. We continue to lead efforts to develop siting guidelines for wind energy development in Massachusetts and the nation (www.massaudubon.org/wind).

- **Advocating for protection of existing Massachusetts forests that are offsetting 10-15% of Massachusetts' current carbon dioxide emissions,** and working with our conservation partners in Belize to protect carbon storing tropical forests.

<u>Resource Protection</u>

Our actions for climate change adaptation will focus on providing future viable habitats for biodiversity and providing connections between protected areas to enable species ranges to respond to changing climates. We are working closely with our partner land conservation organizations, and are founding members of the Massachusetts Climate Change and Wildlife Alliance. Because species do not recognize political boundaries, we will continue to work with partners beyond the borders of the Commonwealth. Our actions include:

- **Developing strategies that will protect diverse and healthy Massachusetts ecosystems** by 1) focusing protection efforts on those physiographic regions of the Commonwealth that contain

the highest and most complete representation of the Commonwealth's biological diversity; 2) promoting creation of large forest reserves connected at the landscape level by well-managed private and publicly owned woodlands; 3) strengthening our wildlife sanctuary cores by protecting linkage corridors that increase connectivity and focusing coastal land acquisition to buffer effects of sea-level rise on salt marshes and barrier beaches; and 4) promoting management of Mass Audubon sanctuary lands that balances protection of species with the carbon storage abilities of forests.

- **Supporting sustainable water management initiatives and programs.** These programs include Low Impact Development and riverine restoration projects such as dam removals and culvert upgrades that improve stream connectivity and enable fish and other aquatic life to move around the landscape in response to heat, drying, and other stresses.

- **Building the capacity of the Commonwealth to respond to climate change** by enlisting the public in documenting changes in flora and fauna in response to climate change, and increasing knowledge and interpreting the response of the nature of Massachusetts to climate change.

By launching new programs and refining existing programs, Mass Audubon will contribute to the reduction in greenhouse gas emissions necessary to avoid the most serious effects of global climate change while protecting natural resources at risk from projected climate change. To sustain and build on these initiatives, we will redouble our efforts to build stronger connections with people and nature. As our founders did in 1896 when faced with an issue that reached far beyond the bounds of the state, we will direct our resources as best we can to addressing this challenge and protecting the nature of Massachusetts.

VOTED: That the Board of Directors of the Massachusetts Audubon Society adopts the Policy on Sustaining People and Nature in a Rapidly Changing Climate dated June 2, 2010.

21 July 2010
Date

Jonathan Panek
Chairman of the Board of Directors

[1] IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, US, 996 pp.

[2] The restriction of the definition of renewable energy to include low emissions of greenhouse gases is important because there is considerable debate underway to determine what energy sources qualify for renewable energy credits. For example, there is growing evidence suggesting that burning wood harvested from forests in the near-term releases much more carbon than is absorbed by growing forests (for example, see Searchinger, T. et al. 2009. Fixing a critical climate accounting error. Science 326: 527-528. This observation is significant because the most

critical reductions in greenhouse gas emissions need to occur in the next 5-10 years. Thus, renewable energy should have immediate impact on greenhouse gas emissions.

[3] Hayhoe, K., C.P. Wake, T.G. Huntington, L. Luo, M.D. Schwartz, J. Sheffield, E. Wood, B. Anderson, J. Bradbury, A. DeGaetano, T.J. Troy, and D. Wolfe. 2007: Past and future changes in climate and hydrological indicators in the U.S. Northeast. Climate Dynamics 28(4): 381-407.

[4] For recent reviews, see Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, and D.J. Wuebbles. 2007. *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions*. *Synthesis Report of the Northeast Climate Impacts Assessment (NECIA).* Cambridge, MA: Union of Concerned Scientists (UCS); and Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). 2009. Global Climate Change Impacts in the United States. Cambridge University Press, 2009, 196 pp.

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Abundant examples exist including: Root, T.L., J.T. Price, K.R. Hall, S.H. Schneider, C. Rosenzweig, and J.A. Pounds. 2003. Fingerprints of global warming on wild animals and plants. Nature 421: 57-60; Parmesan, C. and G. Yohe. 2003, A globally coherent fingerprint of climate change impacts across natural systems. Nature 421: 37-42.

[9] See for example, Miller-Rushing, A.J., and R.B. Primack. 2008. Global warming and flowering times in Thoreau's Concord: A community perspective. Ecology 89: 332-341; Crick, H.Q.P., C. Dudley, D.E. Glue and D.L. Thomson. 1997. UK birds are laying their eggs earlier. Nature 388:526; LaRoe, E.T., and D.H. Rusch. 1996. Changes in nesting behavior of Arctic geese, *in* E.T. LaRoe, G.S Farris, C.E. Puckett, P.D. Doran, and M.J. Mac (eds.). *Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems*. U.S. Department of the Interior, National Biological Service, Washington, DC; T. Kusano and M. Inoue. 2008. Long-term trends toward earlier breeding of Japanese amphibians. J. Herpetology 42(4): 608-614; and Clean Air-Cool Planet. 2005. Indicators of Climate Change in the Northeast, 40 pp

[10] See for example Both, C., and M. Visser. 2001. Adjustment to climate change is constrained by arrival date in a long-distance migrant bird. Nature 411: 296-298.

[11] CCSP, 2009: Past Climate Variability and Change in the Arctic and at High Latitudes. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [Alley R.B., J. Brigham-Grette, G. H. Miller, L. Polyak, and J.W.C. White. U.S. Geological Survey, Department of the Interior, Washington D.C., USA; and see http://www.giss.nasa.gov/research/news/20100121/ and associated graphics.

[12] Nantucket Sound, for example, is home to hundreds of thousands of waterfowl including common eiders, black scoters, and long-tailed ducks. These species breed in the high Arctic and their nesting grounds are at risk due to greater warming recorded in the Arctic. See Veit, R.R., and W.R. Petersen. 1993. Birds of Massachusetts, Massachusetts Audubon Society, 514 pp.

[13] See for example, Thomas, C.D., et al. 2004. Extinction risk from climate change. *Nature* **427**: 145-148.

[14] Hellmann, J.J., J.E. Byers, B.G. Bierwagen, and J.S. Dukes, 2008. Five potential consequences of climate change for invasive species. Conservation Biology 22(3):534-543.

[15] Schmidt, K.A., and C.J. Whelan, 1999. Effects of exotic *Lonicera* and *Rhamnus* on songbird nest predation. Conservation Biology 13(6):1502-1506.

[16] Paradis, A., J. Elkington, K. Hayhoe, and J. Buonaccorsi, 2008. Role of winter temperature and climate change on the survival and future range expansion of the hemlock woolly adelgid (*Adelges tsugae*) in eastern North America. Mitigation and Adaptation Strategies for Global Change. 13: 541-545.

[17] Fogarty M., L. Incze, R. Wahle, D. Mountain, A. Robinson, A. Pershing, K. Hayhoe, A. Richards, and J. Manning. 2007. Potential climate change impacts on marine resources of the Northeastern United States. NECIA Technical Series http://www.northeastclimateimpacts.org/pdf/miti/fogarty_et_al.pdf, 33 pp.

[18] See Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean. http://www.nap.edu/catalog/12904.html

[19] Multiple references on this topic include: Epstein, P.R. and C. DeFilippo. 2001. West Nile virus and drought. Global Change & Human Health 2(2): 2-5; Shaman, J, J.F. Day, and M. Steiglitz. 2005. Drought-induced amplification and epidemic transmission of West Nile virus in southern Florida. Journal Medical Entomology 42(2): 134-141; and Soverow, J.E., G. A. Wellenius, D.N. Fisman, M.A. Mittleman. 2009. Infectious disease in a warming world: how weather influenced West Nile Virus in the United States (2001-2005). Environ. Health Perspect. 117(7): 1049-1052. Most scientific publications, including the IPPC AR4 (cited previously) are careful not to overstate the effects of climate change on the incidence of vector-borne diseases, such as malaria and West Nile virus, because occurrence of these diseases is the result of many factors, and in some regions conditions for disease transmission will decrease. For a recent review, see Lafferty, K. D. 2009a. The ecology of climate change and infectious diseases. Ecology 90(4): 888–900.

[20] Karl, T. R., J. M. Melillo, and T. C. Peterson (eds.), p. 87.

[21] Erwin, D.H. 2006. *Extinction: How Life on Earth Nearly Ended 250 Million Years Ago*. Princeton Univ. Press.

[22] North American Bird Conservation Initiative, U.S. Committee, 2010. The State of the Birds 2010 Report on Climate Change, United States of America. U.S. Department of the Interior: Washington, DC.

[23] http://www.mass.gov/dep/air/climate/draftcip.pdf

[24] Global Warming Solutions Act – the stated goal is an emissions reduction of 10-25% by 2020. Our actions will help the Commonwealth achieve its maximum target.

[25] Carbon offsets in climate change discussions are technically financial instruments that have one party paying for another party to reduce its carbon emissions, which the latter would otherwise not reduce. The paying party uses this reduction to "offset" its own emissions. Offsets are controversial often because of concerns about "additionality" and "leakage." Additionality refers to whether the offsetting project relies on the sale of the offset, i.e., would the project have happened without the funding? Leakage refers to the concern that the offsetting project could lead to increased emissions outside the project's scope, e.g., protecting land from deforestation does not result in the equivalent deforestation in another area. There are other considerations as well, and all of these considerations taken together have led us to question the validity of most carbon offsets available on today's market. In the evaluation of strategies for reducing our own footprint, adopting a goal of becoming carbon neutral is not feasible in the short-term without offset purchases, and we have concluded that such offset purchases are unlikely to lead to real reductions in carbon emissions.

[26] To derive this estimate our assumptions included 60,000 member households; 60,000 pounds of carbon dioxide per year average; statewide 1990 baseline = 94 million metric tons.