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A Patterned Land

The control and management of nature

Rapid Ecological Assessments: Essential Tools for Land Management and Protection, and Responding to Climate Change

In my letter in the last issue of *Sanctuary* (Fall/Winter 2013-2014), I wrote about the evolution in the way that conservation scientists establish goals for preserving biological diversity. I described the change from what I called the *species scale* to the *ecosystem* (or *landscape*) *scale*. Here at Mass Audubon, we continue to strive to obtain the most current, well-informed, and practical tools to guide us as we manage our existing sanctuaries and take action to protect new conservation lands across Massachusetts. We do this with a particular sense of urgency in our time because we need to anticipate the complex and potentially destructive impacts of climate change on our state.

One absolutely critical way that Mass Audubon is improving its ecological management capacity has been underway for the past seven years—namely, the completion of what are called Rapid Ecological Assessments on the 97 properties that Mass Audubon owns in the Commonwealth. This is the first time in our 118-year history that we have an ecological management plan for every one of our properties.

Rapid Ecological Assessments, or REAs, directly advance our mission by increasing the understanding of our lands and motivating active land management for habitat improvement. Regional scientists, sanctuary directors, and property staff integrate priority recommendations into work plans and together seek the resources necessary to complete these projects. With a central database of all 700 plus management recommendations, we can identify patterns and generate reports in response to inquiries and funding opportunities. Completion of the REAs also means that we have now met a critical minimum requirement for land trust accreditation.

Now, no sooner than the REAs have been completed, we are already taking steps to revise them, together with our sanctuary land protection plans, through the prism of climate change. We are working to identify habitats that are particularly vulnerable to climate change and to develop management actions that will maintain and build resilience in these habitats, with the goal of helping them adapt to the aspects of climate change that are now inevitable. We



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are then adding these practical recommendations to the REAs.

We are also determining what currently unprotected resilient landscapes need to be brought into conservation status. These added layers of information make our REAs even more useful as Mass Audubon formulates comprehensive strategies to address climate change. And, as if this weren't enough, we are also making the practical management and conservation recommendations in our REAs available to landowners, municipal governments, and land trusts across the state through our education and advocacy programs and with direct technical assistance through our Ecological Extension Service.

This is a highly instructive capsule example of how Mass Audubon mobilizes the three strategies—science-based land protection/management, education, and advocacy—to advance our mission of protecting the nature of Massachusetts for wildlife and people.

Henry Tepper, President

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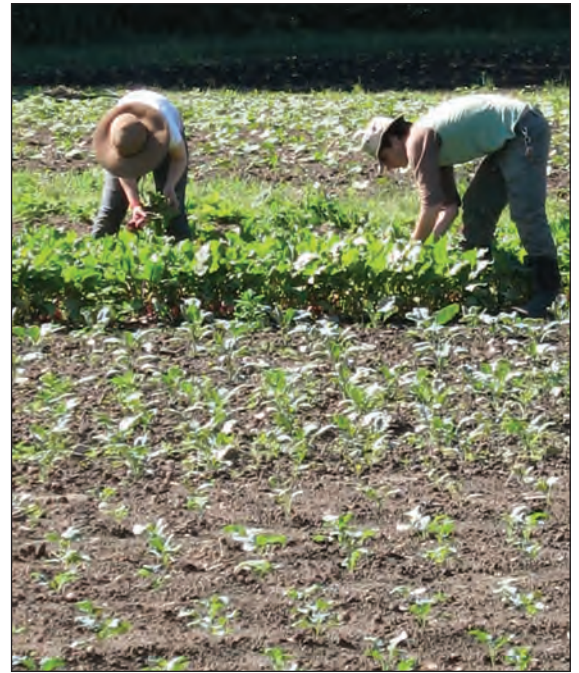
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Founded in 1896 by two inspirational women who were committed to the protection of birds, Mass Audubon has grown to become a powerful force for conservation in New England. Today we are respected for our sound science, successful advocacy, and innovative approaches to connecting people and nature. Each year, our statewide network of wildlife sanctuaries welcomes nearly half a million visitors of all ages, abilities, and backgrounds and serves as the base for our work. To support these important efforts, call 800-AUDUBON (800-283-8266) or visit www.massaudubon.org.

The Earth as Vernal Pool

On a warming afternoon around the beginning of March last spring, I heard the first calls from a population of wood frogs that collect in a series of vernal pools on the northwest side of my property. Their ducklike quacking, along with the appearance of mourning cloak butterflies, and the spearing heads of skunk cabbage in the local swamps, is a reliable indication of the advent of true spring. But the last few years have been uncertain. Dry spells have become more common, even in spring, and for whatever reason the pools have been drying out earlier than usual, threatening the year's crop of frogs. Last spring was the worst of these years.

The season started well enough: the snows melted, the ice went out of the pools, and the wood frogs arrived on schedule and began calling. By April, I could see the little clouds of jellied eggs floating freely or attached to submerged twigs and branches. But around mid-April, the rains ceased and we entered into a dry spell, coupled with some strange unseasonably high temperatures. The pond edges began to shrink. The heat and drought continued into May, and soon enough it looked like the pools would dry out even before the eggs hatched.

I'm not sure of the legality, or even the wisdom, of what followed, but I set out on a campaign to rescue at least a segment of the population. I have three different ornamental pools in my garden, two of them heavily vegetated and deep enough to maintain cool waters. So little by little I began collecting eggs from the vernal pools and moving them to my own pools. I had help in this from a willing five year old, and three or four times a week we would carry a net and buckets to the vernal pools, scoop up a mass of eggs, and carry them back to the garden.

Our rescue operation continued all through May. And all the while, the heat and the drought wore on, and the pools diminished day by day, foot by foot, leaving a surround of wet vegetation.

Nonetheless, at some point during that month some of the eggs hatched; I could see the little tadpoles in the



Wood frog

© BARRY VAN DUSEN

deeper water. The boy and I would wait and watch for wriggling ripples in the still waters and then scoop them out with the nets and carry the tadpoles back to the garden pools.

As the vernal pools dried, this rescue operation began to take on a bit of a desperate maneuver. By early June, with still no significant rain, the center of the pools was no more than a mud puddle teeming with wriggling tadpoles. And beyond these last refuges, in the drying leaves, we could find multitudes of those unfortunates that did not survive. We began going out every morning, bringing in more and more survivors. Finally, as far

as we could tell, there were no more struggling tadpoles in the now-dried-out pools.

Meanwhile the ones we had rescued thrived. Slowly over the month of June and early July the tadpoles grew legs. We checked their progress by netting them to watch the growth of their legs and the slow shrinking of their tails. Happily, as the season progressed, there seemed to be fewer and fewer in the pools—presumably a good sign. They were making their way out into the wide world.

Then, late in the summer, along with the usual adults that seem to appear at the end of the growing season each year, I began spotting tiny wood frogs, more than usual.

I see a metaphor in all this. Without our intervention that season's crop of local frogs would not have thrived, thereby decreasing, however slightly, the number of wood frogs in the world. The adults that originally laid the eggs will probably return to their native ponds this year, and the year after. But in an increasingly warming planet, and with the associated vagaries of bizarre weather, who knows how long that population would last? So our efforts, for the time being, were justified.

But in a sense, the world is a vernal pool. The climate is warming, habitats are disappearing worldwide, populations of wild things are shrinking, and there are no god-like giants roaming the earth to scoop us up and carry us off to a better more sustainable planet.

JHM

One for All and All for One on Brown Hill

Management on a small scale at Wachusett Meadow Wildlife Sanctuary

by Joe Choiniere

On Labor Day weekend in 1985, I hiked the half mile to the summit of Brown Hill and stood in absolute disbelief. What had been a shrubby landscape with a view obstructed by saplings was now a panoramic overview of the two square miles of Wachusett Meadow Wildlife Sanctuary. The vista surrounded the hill on all sides, with farther views to sister hills Wachusett, Little Wachusett, Asnebumskit, and even the great Monadnock itself, 25 miles distant in New Hampshire. The silos at the Stimson Farm, the vast red maple swamp below, and even cars in the sanctuary parking lot all seemed close enough to touch.

I knew the source of this rather sudden change; still it was the impact that was unexpected. This rather abrupt opening up of the twenty-acre hilltop had been no accident, natural or otherwise. A summer youth corps from Fitchburg had cleared the summit in just over seven weeks. Carried out during the breeding season with little regard for nesting birds, and with a goal of maintaining the view for visitors, it would not be the model for future hilltop management efforts. In fact, it was the last time the entire hilltop was cleared in a single season, although the hill has been managed as a wildlife sanctuary for the 30 years following, and essentially for the almost six decades since the sanctuary was established in 1956.

Brown Hill is a big place, one where big management might logically prevail, but the record demonstrates that it is low-key, small, and often unintended management that has made the hill what it is.

Expectedly, the trees grew back. Adventitious buds lie hidden within the woody basal stems of most hardwood tree species; freed from their hormone-controlled dormancy by the removal of the tree's top, and nourished by the root system of their "parent" tree, these buds can sprout and grow quickly, often as much as ten feet in a single year. It's a truism every land manager learns—cut one hardwood tree down and fifteen may grow back. Red maple, gray birch, red oak, black cherry, white ash, and shagbark hickory all grew back, overtopping the shrub canopy of highbush and lowbush blueberry, wild raisin, huckleberry, meadowsweet, and pasture juniper in just two years.

Brown Hill is no drumlin with deep soils developed over glacial till. It's a resistant monadnock, an isolated rocky hill with much exposed bedrock, part of the geologic unit named the Fitchburg pluton—basically a rocky base of volcanic origin. In this case it's a variety of granite known as tonalite that was spread as hot magma perhaps 390 million years ago. The bedrock's



Darthea Crocker on Brown Hill, 1918

resistance to erosion and weathering, and the relatively short amount of time since the last glacier covered the hill and gouged deep scratches that are still visible today near the hill summit, has resulted in little soil covering the curved slabs of broken rock. It is perhaps amazing that trees can grow at all, but the tough bedrock is riddled with cracks both horizontal and vertical, allowing vegetation to take hold and then, over the eons, produce soil by the breakdown of leaves.

Photos of the Brown Hill summit in the early 1900s show an almost completely clear summit, not to mention mostly open fields flowing southward to the sanctuary office on Goodnow Road—a most remarkable view. The Crocker family, the sanctuary donors, accessioned part of the summit in the purchase of a piece of land known in 1928 as Brown's Pasture, which further speaks to longtime open habitat on the hill. Sheep were grazed all over the hill, even in mid-slope groves. Large trees, mostly shagbark hickories and a few white oaks, also grew around the hill, and even a few on the summit, providing shade as well as "mast"—nuts and acorns valuable for fattening up livestock—for the sheep and swine. Tree cores taken from the few solid hickories dated them as late 1790s. Perhaps the summit burned accidentally or even purposely, encouraging growth of lowbush blueberry and huckleberry.

By 2004, twenty years of hand-cutting efforts conducted intermittently on a haphazard schedule had kept



Brown Hill in the mid-20th century

only small portions of the hill cleared. By that time I was uncomfortable with full-scale cutting and clearing in summer during bird nesting season, and the months of September and October were often too busy for the hill project. So it was time to reconsider the hill and its management.

Our first concern was: Why clear the summit in the first place? Our initial rationales were aesthetic, not ecological. The view from the hill is spectacular and popular with visitors, and was a feature that could not be left to forest succession, we thought. Could our aesthetic objective be married with an ecological one? We turned to birds for ideas on how to manage the summit.

The rufous-sided towhee, now renamed the eastern towhee, was a common bird across the entire landscape of the sanctuary in the mid-1960s when the Forbush Bird Club census of breeding birds at Wachusett was initiated by Fran McMenemy (he would coordinate the annual second Sunday in June event for the next forty-five years). The bird records obtained constitute one of the most complete documentations of breeding birds on a wildlife sanctuary over time, now spanning 50 years. While the most commonly counted bird was often the red-eyed vireo or ovenbird, towhees reigned during the first few years of the count, with numbers as

high as 94. By 2002, however, as sanctuary old fields and early successional forests matured, towhees dwindled, holding out in a few places including Brown Hill, where clearing was at least partially maintained. Another bird, the prairie warbler, was also more common in the first two decades of the sanctuary but faded to two pairs on Brown Hill and disappeared entirely as the hill grew.

Might we manage the hill for both the view and the resultant shrubland, and use the towhee and prairie warbler as mascots? In 2003, Natural Resources Conservation Service Office Director Ron Thompson was likely aware of Brown Hill's plight when he encouraged me to apply for a WHIP grant to maintain and recreate shrubland. WHIP, the Wildlife Habitat Incentive Program, a federally funded USDA program, provided grant funding to clear the summit. We devised an eight-year project to completely clear the hill, hand-cutting one-eighth of the summit, a 2.5-acre wedge annually, hand-cut late in the year to avoid disturbance of breeding birds and other wildlife.

Although many WHIP projects involved one-time broad-scale cutting of complete areas to transform shrubland, our proposal devised a gradual change over the eight-year period. I think perhaps my remembrance of that complete cut of 1984—necessary but drastic—

affected my ideas at the time.

And so the summit clearing and view returned, gradually. Volunteers returned to the summit, hand-cutting in the hilltop's colorful fall scenery. Likewise returned the birds: towhees are back, and at least two singing prairie warbler males each summer. The chromatic up-scale song of the prairie warbler contrasts with the folksy *drink-your-tea* of the towhee.

Moose have returned to the sanctuary and frequent the hill's sprout woods. The stereotypical view of a moose chest deep in a pond feeding on water plants is only a part of its life history. In colder months moose move to uplands and browse, finding arboreal sprouts to their liking. In 2006, I noticed the first moose browse on sprouts from the 2004 cuts, not an anticipated situation because moose had only repopulated our area recently.

Moose! Imagine considering their effects when designing the Brown Hill project. And we needed their help. Although not considered at the time, the summer cutting by the youth corps produced fewer and weaker sprouts since much of the energy was high in the twigs and leaves in summer. October cutting, although less stressful to summer-nesting birds, was probably the worst time for cutting since it increased sprout vigor. The regrowth was spectacular compared with the 1985 cutting, and was especially noticed by those who had struggled with handsaws and loppers the previous years, cutting 1- to 2-inch in diameter hardwood sprouts more than head high. The moose could hold down sprouting, keeping the growth from our first and second years from catching up with us to enable us to finish on our eighth year.

The view came back and with it the blueberries, two great reasons to hike the hill in July. The fairly ancient highbush blueberries awoke in the newfound open sunlight and produced, along with the lesser noticed huckleberries. The real difference between huckleberries and blueberries at least in our area is the lower crop size. Blueberry seeds range throughout the fruit mass while huckleberry seeds are in neat partitions of ten per fruit.

Other natural treasures grace Brown Hill. Its lichens are diverse and include a broad range of the reindeer lichens, *Cladina*, including a few not seen elsewhere on the sanctuary. Three-toothed cinquefoil, a plant remarkable mostly for its deep scarlet leaves in the fall, has persisted on the hill but requires hand removal of encroaching lowbush blueberry and other plants to survive. Interestingly, in contrast to other rare alpine cinquefoils that are damaged by trampling, it thrives where people walk. It is "county rare," found primarily on Brown Hill's sister monadnocks Wachusett and Little Wachusett. Anywhere unusual plants grow can likewise spawn unusual plant-dependent insects. The huckleberry sphinx moth is one



© JOE CHOINIERE

Sprouting woods on Brown Hill

of four moths, caught on the summit with night light traps, that are reasonably rare.

Whenever I spend an hour to pull the blueberry sprouts around the cinquefoil, often in June when they sport their tiny white rose-like blooms, I am tempted to wonder whether such small-scale management as our work on Brown Hill means very much, or whether it even qualifies as management. And I hear and read that areas of small size are unimportant in the scheme of management; it seems we need areas that support hundreds of pairs of prairie warblers and towhees. Some even describe small areas as sinks where detrimental things occur that don't help wildlife populations.

I cannot be influenced by this thinking as I imagine a world where hundreds of Brown Hills exist and hundreds of groups of people like our sanctuary staff and volunteers labor to keep their local space viable. Management can be small and local. Ultimately, it involves being aware of what you have—knowing the importance or rarity of species and understanding them as part of a larger system.

Joe Choiniere is property manager at Wachusett Meadow and Broad Meadow Brook wildlife sanctuaries.

A Light in the Forest

The Northeast is now the most forested region in the United States.

Should we leave the forests alone or actively manage them?

by Thomas Conuel

When David Foster, director of Harvard Forest, takes his daily walk around some of the 3,200 acres of land that comprise Harvard Forest in Petersham and Phillipston, he encounters unique habitat and fragile sites as well as a forest that is, with some exceptions, actively managed for research, ecology, and education with the goal of exploring the interactions of humans with the land. One of the exceptions to the managed forest that Foster experiences is a modest section left untouched—part of Harvard Forest’s Wildlands & Woodlands, based upon the concept that not all land and forests in New England need to be controlled and molded by humans.

Wildlands, under the Harvard Forest plan, are reservations with little or no human interference; woodlands, by contrast, are forest tracts that are actively managed. Both can and should exist across New England, according to Foster who envisions a future encompassing long tracts of connected forest habitats, some in a wild state, stretching across the New England landscape.

Under his plan, woodlands would dominate, managed mainly through timber harvesting, while producing clean water, wood products, carbon sequestration, wildlife habitat, biodiversity, recreation, and aesthetics. Wildlands, covering around 10 percent of the designated forest, would offer parcels of woods “exempt from direct human manipulation” shaped by the environment and natural processes including wind, ice, and wildlife.

New England is the most heavily forested region in the continental United States, a surprising fact given the great tracks of forest in the Pacific Northwest, but true if you go state by state. Maine, New Hampshire, and Vermont are all heavily forested. Washington and Oregon, though heavily forested in many parts, are also

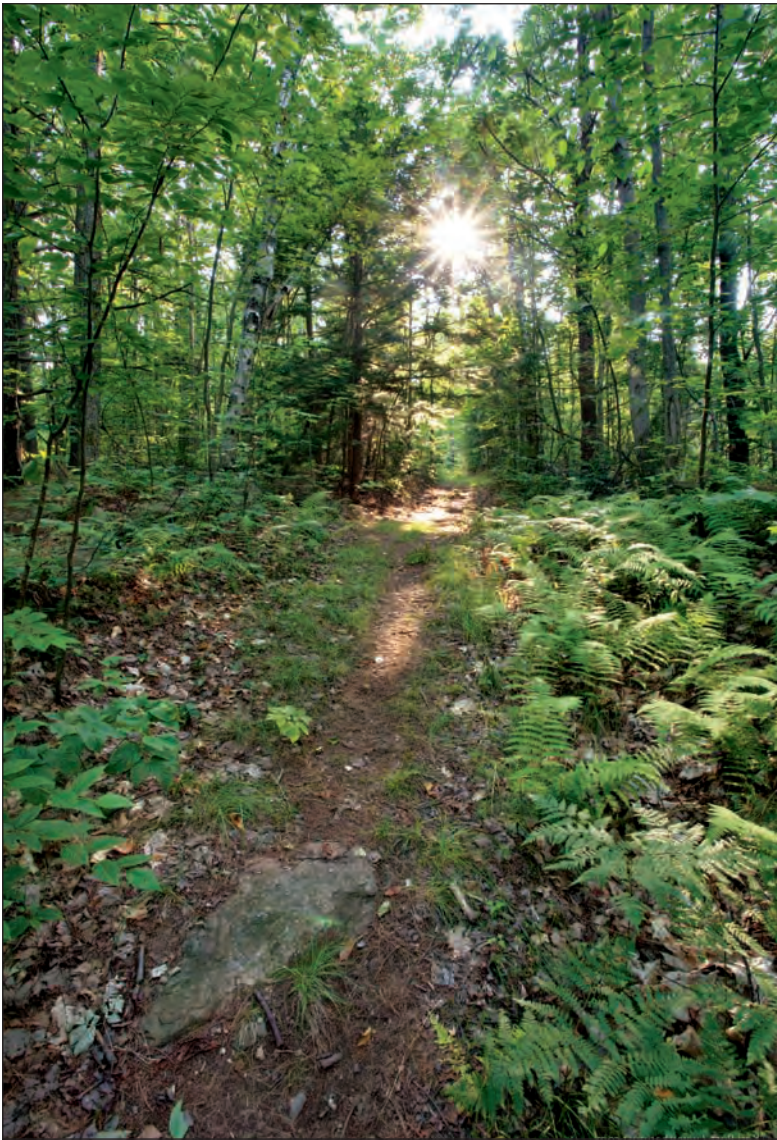
covered with great stretches of arid treeless land.

The New England forest, with signature spruce and fir to the north and mixed hardwoods with oak and maple to the south, has been cut, burned, and managed since before the Pilgrims arrived in 1620. Native Americans, starting at least 3,000 years ago, cleared the forest to



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Pristine old growth in Mohawk Trail State Forest, Savoy



*Trail through land owned and managed by
the New England Forestry Foundation*

create farm plots and to improve hunting. Like the rivers of New England, the forests of the region stand as portraits that show the etching on a landscape shaped by the artisans of agriculture, industry, and colonial settlement. By 1830 and on to 1880, farms, fields, meadows, and orchards dominated the landscape of New England with the woods in full retreat. That changed in the latter part of the 19th century with the coming of the industrial revolution and the abandonment of many farms, with the fields reverting to successional forest.

The forests of Massachusetts, which were expanding through most of the 20th century, are now shrinking, threatened by the usual toxic mix of sprawl and development. But New England is still a landscape of trees.

Forest clearing in the decades leading up to the Civil War, and later, logging, fires, hurricanes, disease, pests, and now climate change, have all reshaped the forests of New England. Colonial farming and agricultural clearing, a heroic and justly praised endeavor, split the

new lands (and later the unfathomable frontier to the west) into manageable segments while clearing the forests and creating farm fields. We live with that legacy today. Change trundles on in the New England woods, where work done by forestry researchers (Jonathan Thompson, Dunbar Carpenter, Charles Cogbill, and David Foster) from centuries-old land survey records show a stark portrait of changes in the land from the forests before the first settlers to our present-day mix of suburban tree belts and deep forests.

"Maples have exploded across the Northeast," the report notes, "their numbers increasing by more than 20 percent in most towns. Other tree types have declined sharply, with beeches, oaks, and chestnuts showing the most pronounced loss." Maples, rapidly growing successional species, are pushing out the slow-growing oaks in the New England woods and have been doing so for some time.

The control of nature when it comes to forests is simple yet daunting: you can manage a site or you can leave it alone.

Whit Beals of the New England Forestry Foundation (NEFF) says, "There are all kinds of forestry being practiced across New England—good, bad, and no forestry at all. Our job is to help people understand what they have on their land." As a pioneer in forest management, the NEFF has been managing its forest sites for some 70 years; it cuts and clears away some trees and some brush, and battles invasive species and then sells the trees it cuts.

Mass Audubon has also been managing its forest holdings to a limited degree. Staff members Jeff Collins and Stuart Watson at Mass Audubon work with landowners and local land trusts to spread the word that good forestry management is beneficial in numerous ways and can help support a variety of wildlife including specific bird species.

Mass Audubon takes a slightly more hands-off approach than the NEFF—it cuts only to improve the woods and never to sell timber. "We go site by site," says Jeff Collins, director of Ecological Management. "We don't have a blanket policy. But we do manage for certain problems, invasive species especially." New and exotic invasive plants are always a headache for land managers. For example, Pleasant Valley in Lenox faces a new invasion, in this case hardy kiwi, a fast-growing invasive vine.

Mass Audubon, emulating a management program in Vermont, is striving to create forestry-for-birds woodland sites that encourage and shelter threatened or declining species. The pilot project plans to sculpt parts of a designated forest into improved habitats for a dozen species: American woodcock, black-throated blue warbler, black-throated green warbler, blue-headed vireo, Canada warbler, chestnut-sided warbler, eastern wood-pewee, scarlet tanager, veery, white-throated sparrow, wood thrush, and yellow-bellied sapsucker.



Forester Dave Kent oversees a timber harvest on New England Forestry Foundation land.

The scarlet tanager's preferred habitat is interior deciduous forests. To manage a forest beneficial to the scarlet tanager, you maximize forest interior and promote understory growth. The yellow-bellied sapsucker, declining in New England, prefers mixed coniferous and deciduous woodlands. Managing for it requires retaining deadwood and leaving birch, beech, and aspen for cavity-nesting habitat.

Yet another example: Migratory songbirds will eat invasive species such as buckthorn, autumn olive, barberry, and honeysuckle berries when they are fueling up for the fall migration, though the berries of most invasive plants are not nutritious. So forestry for birds calls for removing those invasive species and allowing the return of native vegetation.

Mass Audubon's program trains consulting foresters on best practices for integrating timber management on parcels of 20 acres or more to create songbird habitat, and offers private landowners forest bird habitat assessments to help them understand their land and the needs of birds on the land. While birds are an important component of Mass Audubon's conservation efforts in forests and elsewhere, our powerful and timely mission of protecting the nature of Massachusetts for wildlife and people extends our scope to a full range of species that include reptiles and amphibians, mammals, and insects.

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Managing the land is sometimes a nebulous concept—on occasion trotted out by “the bad guys” to justify cutting and selling a forest off to the highest bidder. But management also includes maintaining roads and trails, timber harvesting, and controlling pests, wildlife, or invasive plants, and defending and often salvaging woods damaged by wind and fire.

Forest management has its detractors. One example is the woods surrounding Quabbin Reservoir in central-western Massachusetts, the water supply for Boston and some 44 cities and towns in the metropolitan Boston area. Trees are cut regularly as part of a state management plan that seeks to preserve the health of the 55,000 acres that circle the reservoir through forest management, though many, including David Foster, challenge that concept.

Foster and others take issue with the notion that forest management at Quabbin, sometimes called “creating structural diversity,” enhances forest resilience, and that the Quabbin forestry program is actually necessary to prevent future problems. The need for a high-quality source of water for

the Boston metropolitan area led to creation of Quabbin Reservoir in the 1930s, but according to Foster there is no science behind the claim that active forest management will help keep the waters of Quabbin clean and pristine.

“If they are going to harvest timber at Quabbin, they should just say that is what they are doing,” says Foster. Proponents of managing the Quabbin woods point out that forestry programs at Quabbin are low impact and along with timber, recreation, and wildlife an acceptable part of the mix at Quabbin.

By contrast, for many years the former head forester, Bruce Spencer, worked to remove red pines from the forest. By actively managing the

forest, by cutting down the red pine, a non-native species planted in the early days of Quabbin that created a dark biological desert under the trees, Spencer returned parts of the forest to the open fields that once dominated the area—a management strategy that worked well.

Whit Beals of the New England Forestry Foundation works closely with local land trusts to evaluate lands and then follows a 10-year management plan. “Good forest management has to look ahead as to what the next forest will be like, say in 50 years,” he says. “Nature is the real manager.”

Thomas Conuel is a field editor for Sanctuary magazine.

The Paradise for Deer

*The return of the forest and the increase in suburban yards
have created an Eden for the white-tailed deer.*

by Jack Thorndike

Almost everyone loves deer. Gentle and graceful, white-tails browse their way through the eastern woodland forests. Dwelling mainly in shadows under the tree canopy, emerging into the open at dawn or dusk, they radiate placid serenity, evoking a preindustrial time when North America was a timeless Eden. And why not? Today's New England hardwood forest may be fragmented by roads and housing developments, but the overall landscape is a paradise for deer.

But this wasn't always so. New England's deer population declined steadily starting in the 1600s as hunters decimated the herds and, clearing forests for farms, eliminated areas where the deer could hide. In the late 1880s newly formed wildlife management agencies halted the population decline, and the deer numbers stabilized for a few decades before they rose precipitously in the 1970s to today's level. In the absence of predators such as gray wolves and mountain lions and with many towns restricting hunting, the deer are now thriving in the fragmented suburbanized eastern woodland habitat.

But even as they flourish in New England's "artificial" habitat, their excessive population is wreaking havoc on bird and plant species, and the entire ecosystem.

Like any browsing ungulates, deer feed constantly. Mature bucks eat between four and ten pounds of forage each day while does eat slightly less. From late spring through summer, they eat mainly leaves, grasses, forbs, and twigs, and in fall they consume mostly acorns, nuts, and seeds. The lean times for deer are late summer when herbaceous nonwoody plants are browsed down and, of course, winter.

"Deer are not random eaters," notes William McShea of the Smithsonian's National Zoo Conservation & Research Center. "They are not vacuum cleaners that walk through the forest and eat everything they encounter. They go looking for things." And for most of the year they find what they are looking for. But during the



Young buck

lean seasons—late summer and winter—food scarcity leads to a decrease in the deer population, at least in a fully functioning ecosystem. It's an unsympathetic yet efficient arrangement for populations remaining stable naturally, but it is being sabotaged in New England's 21st-century forest where suburbs and small farms are integral parts of the habitat.

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Deer that live in or near the suburbs can supplement their forest-plant diet with ornamental shrubs, grass, and flowers. They are sustained not only by plantings but also by bird feeders, and some people even feed the deer directly. This artificial food source, rather than reducing overbrowsing of native forest plants, actually makes it worse by increasing the deer population.

"You've maintained that higher deer density through [the lean] part of the year so it impacts the forest in other parts of the year," says McShea. And since artificial food sources in suburban neighborhoods allow more deer to survive the lean times, there are more deer to browse when the forest plants are plentiful—but they don't stay plentiful for long. The inevitable outcome is that eastern woodland forests are becoming a different kind of forest as the ground- and shrub-level vegetation disappears.

Some of the bird species most threatened by deer overbrowsing are the eastern towhee, brown thrasher, and whip-poor-will. The deer take out the understory so birds have less substrate to nest on, and they're more exposed to predators and don't have access to insects, which are their main food source during the breeding season. Eight low- or ground-nesting species in our forests or early-successional landscapes are scored as "conservation action urgent" in Mass Audubon's *State of the Birds 2013*.

In addition to eliminating safe nesting sites for ground- and shrub-nesting species, deer overbrowsing eliminates the leaves where insects perch, and where many bird species hunt for them. "Ovenbirds, worm-eating warblers, and others eat insects off of the leaves," adds McShea. "And when the deer clean that out, then you're not going to get as many birds."

Deer overbrowsing impacts bird species that dwell in deep forests much more than species that thrive on the edges. Furthermore, the forest dwellers are already challenged by forest fragmentation. "The studies we did show that when you have a high density of deer you get more woodpeckers, more cardinals, and more nuthatches," says McShea, adding that these species thrive at the forest's edge while the birds of the forest interior are at risk.

Along with reducing cover and nesting sites, deer overpopulation contributes to the spread of invasive plants by overbrowsing native plants while ignoring the invasive weeds. "A lot of invasives have browse-deterrent compounds, or they're thorny," says



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Deer herd in field

Jeff Collins, Mass Audubon's director of Ecological Management. "So deer will preferentially browse native understory species."

Deer researcher Tim Nuttle of Civil & Environmental Consultants, Inc. describes how deer help spread invasive plants by carrying the seeds on their coats. However, he adds, "while [the seeds of] forest understory plants may also be dispersed when deer eat their fruit, the deer are not just eating the fruits, they're eating whole plants, such as trillium." McShea describes how deer's decimation of native plants works in lockstep with the spread of invasives to diminish an ecosystem's complexity and vigor as "the forest floor becomes dominated by ferns or grasses or invasive plants."

Jeff Collins describes plant surveys going back 40 years at Mass Audubon's Broadmoor and Ipswich River wildlife sanctuaries to illustrate the effects of deer overpopulation. "If you walk around Broadmoor, you don't see a completely decimated shrub layer, so to look at it you might not say this is really being damaged by deer." But he adds, "There are a lot of herbaceous forest species that are no longer present." It is even worse at Ipswich River where deer overbrowsing is more extensive and the damage more obvious. "It's a parklike setting of tall trees but with nothing growing on the forest floor," says Collins. "You can see right through the understory of the forest and that's not natural."

And even if deer populations could magically be reduced to sustainable levels, how long would it take



Doe with triplets

for the forest to recover its ecological vigor? Since deer damage many parts of the forest ecosystem, the recovery timeline is equally complex.

Tim Nuttle went back to plots in the Allegheny National Forest that in the 1980s had been experimentally subjected to deer overpopulation similar to that of present-day New England. The original experiment resulted in a decimated forest understory and reduced biodiversity. Then in 2010 Nuttle found that damage to forest plant communities was still clearly visible.

"This was 20 years after they took the fences down and legacy effects were still evident in the understory vegetation plants," Nuttle notes. The lingering effects of deer overpopulation that he documented include a lower diversity of flowering plants and a decrease in an abundance of most herbaceous plants. In many places the forest floor was carpeted with ferns, to the exclusion of other species. That blanket of ferns "creates havens for small mammals where they can just run around under those fern covers and eat all the seeds of native plants. They're in no danger of being predated by hawks or owls," Nuttle says. He found these conditions persisting for decades after the deer population reached sustainable levels. "People think that after you remove the cause of the problem then the problem goes away," he adds. "But you've set up the situation so that the conditions persist long after you reduce the deer population."

While the forest health remains compromised decades after deer have damaged it, the centuries-long view may

look even bleaker. "In the shrub layer there are the saplings and seedlings of the next generation of canopy trees," Collins says. Living under the canopy, those saplings are chronically deprived of light but will shoot up and become full-size trees when the canopy opens resulting from a blowdown or mature trees dying of disease. But in a forest where deer have killed the young trees by browsing off all their leaves, the canopy species will not regenerate, leading to instability in our forest ecosystems. "In coming decades, Collins adds, "the forest won't be prepared for regeneration. And once you add in climate change you're just tugging away at the threads of the forest."

So what's to be done about the deer? We might hope that natural regulation will eventually kick in and that deer numbers will fall without human intervention. But nature's original tool of population control—mainly gray wolves—are

long gone, and coyotes, the wolves' scrappy cousin, are not up to the job of culling the white-tail herd. "State agencies say that we've got coyotes and they will eat deer," notes Collins, but they generally only eat deer carcasses or fawns. And nature's other main population regulator—starvation—is easily dodged when deer can visit the salad bar of vegetation that homeowners and farmers provide.

More subtly, forest fragmentation helps browsers eat more because low-level leafy plants are abundant at the edges of forest tracts, less so in the interior. Also forest edges help deer by offering hiding places right next to artificial food sources like bird feeders, ornamental plantings, or farm fields. "Artificial landscapes create a lot of food for the deer, and if there's any threat they can just go into the forest," notes Collins.

When you consider how much edge habitat and human-generated food boosts deer populations, it becomes clear that our white-tails live in an Eden that people have made for them.

Reducing the deer herd of eastern Massachusetts significantly would be a huge undertaking, but it won't happen by itself. "In my view you shouldn't say 'let nature take its course,'" says McShea. "We have made this overpopulation of deer and we should deal with it."

Jack Thorndike is a freelance journalist who writes about the cultural and ecosystem implications of climate change. His blog is: keenforgreen.com/blogs/jack-thorndike.

Habitat Rebirth

Wetland restoration projects across the state are also helping fish and amphibians.

by Gayle Goddard-Taylor

From the viewing platform overlooking Stony Brook salt marsh in Brewster, waves of rushes and sedges spread across the floodplain in a muted russet, yellow, and green panorama that has long inspired artists. This marsh is on a journey back in time, transforming into what it was more than a century ago. The ill-advised cranberry bog that it became in modern times is now gone. Herring have returned in significant numbers to spawn in its waters, and tiny mummichogs, a staple fish for countless marsh denizens, drift in large schools.

“Our primary focus here was to restore the natural processes while getting rid of the stressors,” says Jeremy Bell, restoration specialist for the Division of Ecological Restoration of the Massachusetts Department of Fish & Game for nine years (now working on wetlands restoration for The Nature Conservancy in Maine).

The natural process that was impeded at Stony Brook was simply the tide. The stressor was a tiny culvert beneath Route 6A that constricted the normal tidal flow. Once a great run for herring and eels, Stony Brook gushed through the three-foot pipe, discouraging the migrants from swimming upstream. The constant layering of sand on the marsh surface by cranberry growers smothered native marsh plants. Invasives such as common reed formed spreading clumps. When the state teamed with governmental and private groups to replace the pipe with an 18-foot-wide culvert, the results were immediate. Where Stony Brook and Paine’s Creek now meet, the tide advances broadly, restoring natural flows and water quality, once again inviting creatures to swim upstream.

Across the country, habitats that were previously filled, drained, or poisoned to accommodate the desire for agricultural or developable land are returning. Long-buried streams are seeing daylight again, dams are being removed to restore wet meadows and historic fish runs, and vernal pools are resurfacing. Wetlands restoration has been on a remarkable journey since federal wetlands legislation was initially passed in the



© JEREMY BELL

Joe-Pye weed along the banks of the Eel River

1940s, eventually followed by the Clean Water Act of 1972. While simply protecting wetlands has required continual monitoring and legislative tweaking over the years, restoration has demanded both the will and the wherewithal to tackle such projects.

Wetlands Ecologist/Wildlife Biologist Tom Biebighauser has been resurrecting lost wetlands—forested swamps, emergent marshes, rivers, streams, and springs—since 1982. In all, he has left his mark in twenty-one states and the Canadian provinces, with more than 1,500 completed projects. Working initially for governmental agencies, he later launched a consulting business that focuses on wetlands restoration. He has been witness to the progress made legislatively as well as the slow recognition by government and the public that such ecosystems are the cauldrons in which life is brewed. But, he admits, much of what was lost can never be regained.

“There was so much draining and filling in the 1800s, and the 1900s before the Clean Water Act, that we could spend our lives restoring wetlands and still never replace what used to exist,” says Biebighauser. “The destruction of wetlands hasn’t stopped either, but I believe the Massachusetts Wetlands Protection Act has slowed it greatly.”

While wetlands regulations require those who would destroy wetlands to replicate them elsewhere, replacement marshes, streams, and vernal pools haven’t always been successful. In fact, says Biebighauser, more than half have failed, though in recent years increased understanding of how these ecosystems work and concurrent advances in technology have changed that.

“When I drive around Massachusetts, I often see the ghosts of drained wetlands on former farmland but no one is farming them now,” he says. “The trees grow up but the buried drains [installed by farmers long ago] are still working. There are restoration opportunities everywhere in the state.”

The past three springs, Biebighauser has led hands-on wetlands restoration workshops for more than 100 professionals at Mass Audubon’s Long Pasture Wildlife Sanctuary in Barnstable and Ashumet Holly Wildlife Sanctuary in East Falmouth. The 2011 and 2012 workshops resulted in creation of two new vernal pools in the uplands of Ashumet. During the 2013 workshop, more pools emerged on the landscape at Long Pasture when workshop participants again pitched in to put into practice some of Biebighauser’s new techniques. The central goal is to provide habitat for wetland-dependent species including the rarest frog in Massachusetts, the eastern spadefoot toad, which is known to burrow at Sandy Neck Barrier Beach in Barnstable.

For the participants, it meant valuable hands-on learning; for the sanctuaries, it meant vast opportunities not only to restore ecological benefits that wetlands provide but also to conduct Mass Audubon’s work toward its mission through restoration, education, and advocacy on behalf of spadefoot toads.

The impetus for the Long Pasture project began with aerial images that showed long striations—or mounds of earth called “lands”—in the old pasture at the sanctuary. These striations were evidence that wetlands once there had been buried by farmers to gain more tillable land. Metal probes sunk into the mounds gave added proof of the underlying groundwater. A plan was hatched by Biebighauser, Long Pasture Director Ian Ives, and Bryan Windmiller of Grassroots Wildlife Conservation in Concord to restore these erstwhile pools.

At the outset, the partners determined which pools would require a groundwater approach and which could be viable using a surface water technique. The pool depths would be shallow—from 9 to 15 inches—with a goal of providing a range of depths to attract a variety of pond dwellers and also to ensure that the pools would be ephemeral. Just how ephemeral would only be revealed as the months unspooled.



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*Beaver dam and wetland at
Waseeka Wildlife Sanctuary, Hopkinton*

For the surface-water pools, an excavator took advantage of naturally occurring clay to remove soil to the mineral layer, then create and compact an underground barrier on all but the lowest side. The dam prevented much of the water from seeping out of the wetlands. The shallow depth of the basin allowed just enough water loss over time to provide an environment favorable to the toads but less so for its predators. The groundwater technique involved digging down just deep enough to expose the groundwater table near the surface. Ashumet Holly’s pools require a buried liner to hold water in because the wetlands were built in sandy uplands far from the water table.

The tiny spadefoot tadpoles have adapted to the vagaries of water level and temperature by being able to develop into little toads in as short a time as two weeks in warm weather. In colder temperatures, it may take six weeks to metamorphose. It benefits spadefoots for pools to empty before other species that eat tadpoles can complete their development. In a citizen science project, spadefoot tadpoles are given to schools where they’re headstarted by students who raise them, provide project data, and learn firsthand about tadpole life history. Once the polliwogs metamorphose, the toads are released in the newly created vernal pools at Ashumet Holly Wildlife Sanctuary.

More than 9,000 headstarted toads were released

at Ashumet Holly's new pools in the springs of 2011, 2012, and 2013, and paid field technicians, volunteers, and students began the task of watching and waiting. Each day "pitfall" traps, buckets installed at surface level within drift fencing that surrounds the pool, were inspected and tree-mounted recorders checked for frog calls. Some 20 headstarted toads—and one wild spadefoot toad—were trapped and counted to date. The low counts are not surprising: the odds of a spadefoot celebrating its first birthday are less than 1 in 1,000. That's why their survival strategy has been lots of eggs, an elastic development schedule, and a long life. We expect the numbers trapped will increase over the course of the project as more toads are released and headstarted toads return to breed.

The discovery of the sole wild spadefoot at Ashumet reveals "that there truly are a few wild individuals remaining there, but clearly not enough to maintain the population," according to Ives. Other results were also worth extolling. Within a year of establishing the first pools, monitors documented the presence of 15 species of invertebrates and 8 species of amphibians. Another plus was the discovery of spotted salamanders breeding in the pools within one year of their establishment. "We saw a huge amount of biodiversity move in within just a short time," says Ives.

An Atlantic white cedar swamp, buried deep beneath a cranberry bog, was the inspiration for a wet meadow restoration undertaken in Plymouth by town, state, and federal agencies with help from environmental groups. The Eel River winds through what had formerly been an Atlantic white cedar swamp. More than a century ago, the watercourse was moved to the edge of the meadow to allow cranberries to be grown across some 40 acres. Nearby "borrow pits," sources of glacially deposited sands, provided material to spread over the bog surface each year to stimulate the growth of runners to more densely cover the area. In 2006, the Division of Ecological Restoration began prowling the site, now owned by the town of Plymouth, to find clues as to the soils, hydrology, and vegetation prior to cranberry growing.

"We found twenty-foot peat deposits so we knew this was a wetland 10,000 years ago," says Jeremy Bell. "Our biggest find was evidence in the peat of Atlantic white cedar. Site conditions were ideal for it. That's when we decided to shoot big for habitat."

Removing all of that sand would have been wildly cost prohibitive so when the project began in 2009, work centered on, again, removing the stressors—in this case a dam and a dysfunctional culvert—and raising the water table in the meadow. The latter task was accomplished with fabric-encapsulated grade controls called "lifts"—think speed bumps—just below the surface of the water in the channels. The lifts slowed the flow just enough to allow water to spread across the floodplain and create a meandering stream. Upstream, crews planted 17,000 Atlantic white cedar saplings, fast but fussy growers that were hand-collected from existing cedar

swamps. Among the project's costliest investments was a high fence to protect the saplings from foraging deer.

Across the road, work included partly deconstructing the Sawmill Dam, an effort that required "de-watering" the impoundment with a bypass pipe and removing 8 feet of built-up sediment. The goal was to allow increased stream flow and to encourage the passage of fish and maybe one day the eels for which the river was named.

"Eels could get up here now," says Bell. "I don't believe anyone has found an eel upstream since the deconstruction of the dam but I believe they're there. That might be wishful thinking."

Through these wetlands projects, some common threads can be detected. New ideas and approaches to making restoration successful is one thread. Innovative technologies is another. And vision, both from those developing new methodologies and those who support and monitor the finished products, is an essential piece. Furthermore, optimism must be added to that list.

There's a good bit of pride in bringing back something that was lost. Looking over the Eel River from the bridge, the view is one of a complex ecology that is well on the road to recovery. Jeremy Bell muses that the waters below will likely support trout in the future. "Of all the projects I've done," he says, "I'm most proud of this one."

Gayle Goddard-Taylor is a field editor for Sanctuary magazine.

Advocating for Wetlands Restoration

A key element of Mass Audubon's participation in wetlands restoration throughout the Commonwealth has been our focus on the need to expand and accelerate restoration of both coastal and inland wetlands. Based on our experience undertaking a variety of wetland restoration projects, we have found existing regulations to be overly complex and restrictive, impairing and slowing down the approval process and often adding significantly to the costs. The need to accelerate wetlands restoration is becoming even more urgent because these resources provide critical buffering against increasingly intense storms associated with climate change.

There are many opportunities to improve and coordinate permitting procedures. Mass Audubon experts continue to be invited advisors to state agencies as we advocate for regulatory reforms that will expedite the approval of ecological restoration projects including dam removal, tidal flow restoration, and stream daylighting, among others.

The Sea and Survival

Fisheries management is critical to both marine ecology and human societies.

by Robert Buchsbaum



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Eastern rig dragger, 1920s

Human beings have had a grim track record for managing wild animals that have been harvested commercially for food or for other purposes. Vast flocks of birds, such as shorebirds and passenger pigeons, were decimated, sometimes to the point of extinction by market hunters. Herds of bison numbering in the millions were reduced to several hundred largely by sport hunters. We currently are killing elephants for their ivory, rhinos for their horns, and tigers for traditional medicines at a level that their populations are threatened. Formerly considered an inexhaustible resource, marine fish have been harvested to the point that there have been severe declines in a number of species as well as altered marine ecosystems.

When the European settlers first arrived in New England, they were astounded by the abundance of fish in the rivers, harbors, bays, and offshore waters. In the seventeenth century, explorer Bartholomew Gosnold reported that cod were so abundant around his ship that they vexed his crew. It didn't take long after European settlement and exploitation of these resources for those numbers to begin to fall. When catches declined in the harbors and bays near the coast, you could always venture farther offshore. Traveling a greater distance from home port made it a more dangerous enterprise, but at least the groundfish (cod, haddock, and flounder, the mainstay of New England fisheries) were still there.

A big change occurred around 1900. Fishing shift-

ed from being primarily a community-based artisanal venture to an increasingly industrialized enterprise. Trawlers powered by steam replaced long-lining schooners, and the introduction of the otter trawl made it easier to catch more fish and exploit new areas and habitats. By 1930 fisheries scientists and some in the industry worried that the capacity of the fishing fleet was too large to sustain the resource. Haddock catches were declining and the fish that were being caught were smaller and smaller, an obvious indication of overfishing.

The next major change in New England fisheries occurred in the 1960s when foreign trawlers began visiting our coast. They initially targeted herring, and when the herring were depleted they set their sights on groundfish. Alarmed by the rapid decline in fisheries in New England and elsewhere, the US Congress passed the Magnuson Fishery Conservation and Management Act of 1976, which created the 200-mile Exclusive Economic Zone and eliminated foreign fleets.

Unfortunately, rather than seizing this opportunity to institute sustainable fishing practices, the US itself began overfishing. Financial incentives provided by the government encouraged more citizens to get into the fishing industry and enabled fishermen to replace old boats and gear with modern equipment that could catch fish more efficiently. In response to industry pressure, the New England Fisheries Management Council (NEFMC), which is responsible for managing



© JAMES A. MITCHELL

Western rig dragger

New England fisheries, failed to set actual hard quotas for the number of fish that could be landed. Instead, they relied on increasing the mesh size of nets, a measure that proved wholly inadequate to prevent further declines.

By the early 1990s, haddock and flounder populations were at record low numbers in management areas under the jurisdiction of the NEFMC. Atlantic cod, the mainstay of the New England fishing industry for hundreds of years, was in serious decline. The Conservation Law Foundation, joined by Mass Audubon, led a successful lawsuit against the NEFMC and the National Marine Fisheries Service (NMFS). The settlement required that overfishing be ended and depleted stocks be rebuilt.

The successful 1991 lawsuit has put fisheries management in New England on a more conservation-oriented track. The Magnuson-Stevens Fishery Conservation and Management Act of 1996 contributed to this effort by requiring that population targets and recovery deadlines be set for all fish classified as overfished. Still the road has been bumpy.

A variety of management systems are available to achieve recovery goals. Efforts to reduce fishing capacity include limiting the number of days fishing boats can fish and limiting entry into the industry. Area closures and constraints on gear types in certain habitats are used to provide a refuge for the fish, to protect underwater habitats, and to limit bycatch (the incidental catch of undersized fish or species that are not targeted). Putting observers on fishing boats and requiring mandatory reporting of catches assist scientists in making population projections. Although not popular in New England, many fisheries throughout the world have hard quotas that require a fish-

ery to be closed once a certain number of fish are caught.

Catch shares is another increasingly popular management system worldwide and has been instituted recently in New England. In this system, the total allowable catch is determined by scientists based on stock assessments and then allocated among people who have traditionally fished in that fishery. Each fisherman gets a percentage of the allowable catch to harvest whenever that individual sees fit. Catch sharing creates incentives to stop overfishing, protect habitat, and use selective gear to reduce bycatch. It also allows fishermen to time their fishing when market conditions and weather are favorable.

In New England, a catch share program for groundfish was instituted for hook-and-line fishermen in 2004 and soon after adopted by gillnetters. Recognizing that the system of limiting the number of days fisherman can fish has failed to stop overfishing, catch share became the primary management system for all groundfish in 2009. Each sector is given a percentage of the catch to distribute among its participants.

Opponents of catch share programs in New England say that they privatize what should be a public resource. Since shares can be leased or sold, they worry that a few large companies will eventually buy out the small, independent fishermen who have traditionally been the mainstay of fishing communities, resulting in a loss of jobs. Basing the allocations on past history excludes new people from getting into the industry while potentially rewarding fishermen who contributed to overfishing in the past. To address that latter concern some catch share programs have a cap on the number of shares that can be owned.

Although there have clearly been some successes, the



Fishing in summer seas

jury is still out on whether catch share programs have had the expected ecological and economic benefits. An analysis of over 11,000 fisheries across the globe reported in the journal *Science* in 2008 concluded that catch shares could halt and reverse the global trend toward collapsing fisheries. However, a more recent study of 15 programs in the United States reported mixed results. In New England, participants in the catch share program for groundfish seemed to be doing better economically than those who opted out.

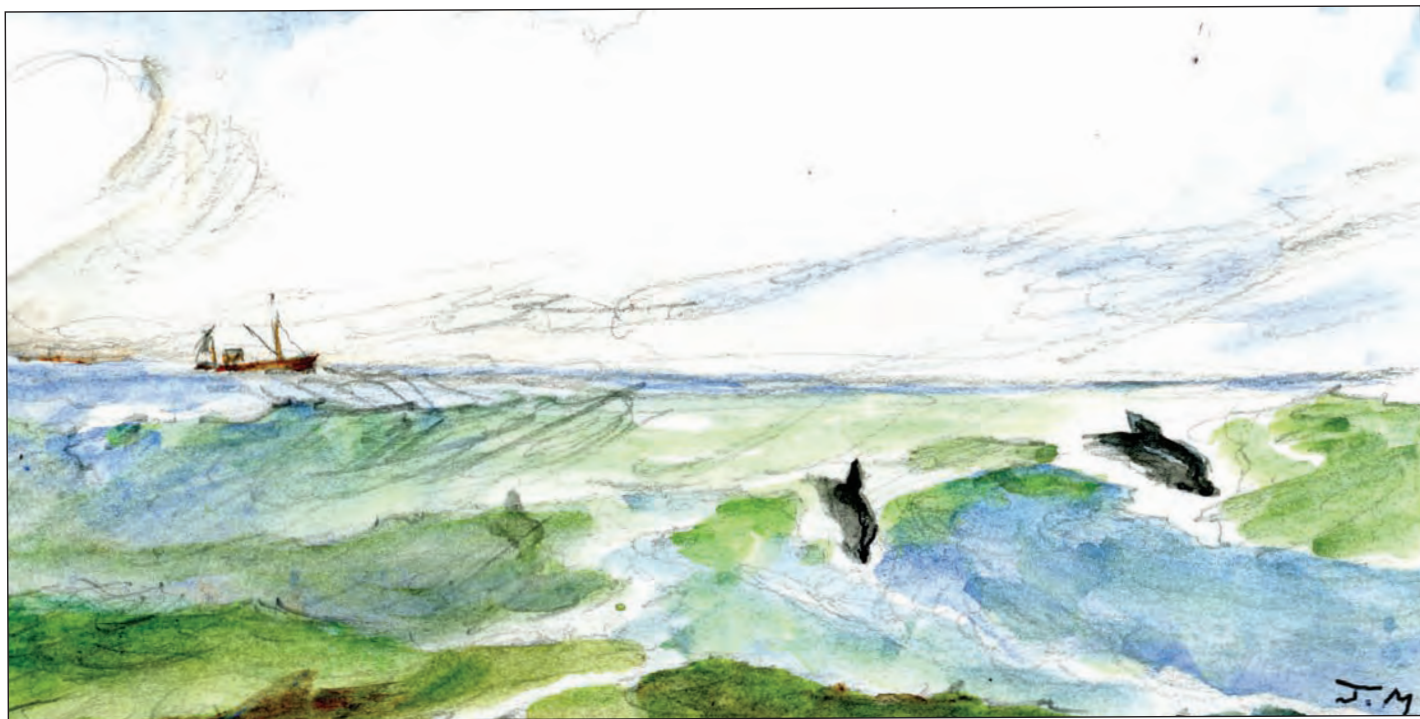
The story of New England fisheries over the past 20 years includes some good news. Sea scallops have gone from record low numbers in the early 1990s to near record highs now. Area closures, larger mesh sizes, and restrictions on fishing days have allowed juveniles to grow up to adulthood before being harvested. Sea scallops are under a rotational management scheme; areas where scallops are concentrated alternate between being open to harvesting and closed to protect young scallops. From an economic perspective, scallops are New England's most valuable fishery, so overall income from New England fisheries is higher than ever.

Another great success story is striped bass. This species winters in estuaries of the mid-Atlantic region and migrates to New England during the summer to feed. Extremely low numbers in the 1980s were attributed to overfishing and pollution of their freshwater spawning areas. Strict catch limits supported strongly by both recreational and commercial interests combined with pollution remediation led to the complete recovery of this species by 1995. Happily, today many anglers throughout Massachusetts have the opportunity to catch striped bass.

Haddock, which have the ability to reproduce very rapidly (up to 3 million eggs per female), have recovered well. They are no longer classified as overfished on Georges Bank where their numbers have exceeded their recovery target. Between 1995, when the fish were at a record low, and 2005, the haddock catch increased ninefold. The story of flounder, which includes several species, is mixed. Some species and stocks (a discrete segment of a population inhabiting a specific region) show recovery, and others are still in serious trouble.

Atlantic Cod have not recovered as fast as hoped, and the fishing on all New England stocks is still very limited. Like haddock, cod females can produce a large number of eggs (3 to 9 million) so their reproductive potential under optimum conditions is high. The slow recovery suggests that more severe restrictions in fishing pressure on cod are warranted and perhaps that something else has been going on in their environment.

The experience of our neighbor to the north with cod highlights the tragic and disruptive human side of waiting too long to implement management measures. Canada instituted a moratorium on almost all cod fishing along the coasts of Newfoundland and Labrador in 1992 in response to very low numbers. It was thought that the cod decline could be part of a natural cycle, thus recovery would eventually occur if fishing pressure was reduced. Unfortunately, the cod have still not recovered to anything near their former abundance, and the moratorium is still in place for much of the region. The social and political consequences have been tremendous. Forty thousand people were put out of work, thus changing life forever in towns across the region.



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Breaking sea with dolphins

A consequence of the decline of cod in Newfoundland and New England may be what ecologists call a regime change. As formerly abundant, large, voracious predators, cod played a major role in structuring the northwest Atlantic marine food web. In the absence of cod, dogfish and skates are much more common now than before the decline of cod. They may be suppressing the recovery of cod by feeding on its juvenile stages. Bob Steneck of the University of Maine has suggested that the loss of cod, which prey on juvenile lobsters and crabs, has led to an ecosystem more dominated by these crustaceans. Off Newfoundland there is now a fishery for snow crabs and shrimp.

Climate change may be having an impact on cod and other fish, although it is difficult to distinguish any impact of climate change from the much stronger impact of overfishing. Cod thrive in cooler bottom waters, particularly for spawning and in juvenile stages. The temperature of bottom waters in southern New England and Georges Bank is already close to the threshold for optimum larval survival (47 degrees Fahrenheit), and climate models indicate that this temperature will likely be exceeded over the next 50 to 100 years.

Questions about the accuracy of the science have been raised by those in the fishing industry and their political supporters when scientists indicate that further cuts in fishing effort are needed to meet recovery targets. Sampling and modeling fish populations are complex and not easily understood even by scientists who do not work in that particular discipline.

Nonetheless, the veracity of the stock assessments is ensured by a rigorous peer review process that

includes scientists from academia as well as government. Outcomes are presented in terms of statistical probabilities that indicate the likelihood of a range of outcomes. It is easy to understand why someone faced with paying off a loan for a fishing boat or a mortgage on a house would be tempted to lobby for the most optimistic forecast even if the probability is extremely low.

Another issue raised about the science is that it does not adequately address natural variability; however, modeling looking at both fishing effort and the impacts of natural variations on the survival of larval fish still show that fishing is by far the major driver of fish populations in exploited species.

As this article indicates, fisheries management in New England is controversial, but the controversy has little to do with biology. The ecology of fisheries management is simple according to Andrew Rosenberg, former Northeast regional director of the National Marine Fisheries Service. "We know what to do and it is straightforward. If you stop overfishing, the fish will eventually come back." The challenge of managing our fisheries resources in a sustainable manner is almost entirely one of social science—managing people, addressing economic issues, thinking long-term, and creating political will to take action.

The stakes are high. Fishing is the major human impact on our ocean ecosystems, yet it is the livelihood for a significant number of people and is part of our regional identity. We need to get this right.

Robert Buchsbaum is Mass Audubon's conservation scientist in the Southeast and Islands Region.

Beyond Organic at Drumlin Farm

Mass Audubon's most popular destination is its wildlife-friendly sustainable farm.

by Ann Prince

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Boyce Field at Drumlin Farm Wildlife Sanctuary

Each year over 120,000 visitors, as well as schoolchildren and campers, come to Drumlin Farm, many to admire the animals and view the agricultural operation firsthand. Simply strolling through and observing the pleasant picture of a small diversified farm with chickens, pigs, cows, goats, and sheep, as well as a greenhouse, demonstration garden, and cropland, is educational and a wonderful way to get outdoors during any season. But the inner workings of the farm far surpass any first impression anyone might have.

Guiding principles at Drumlin Farm include sustainable growing practices and management for native wildlife including declining bird species. The farm-nature connection is a time-honored element of small farms that in the present day can be both challenging and rewarding. Many factors come into play and the labor-intensive management required demands considerable perseverance and innovation.

Key growing practices enhance productivity while incorporating environmentally sound methods. "Crop rotation is a major factor in our approach," says Crops Manager Matt Celona. "We keep the fields on a sev-

en-year rotation, two years of rest and five years of growing. And we plant red clover as a cover crop to enrich the soil."

Allowing fields to lay fallow in alternating years and green manuring with clover are accompanied by use of only organic matter as fertilizer. The farm animals provide Drumlin Farm's own compost—both straw bedding and animal waste are utilized. In addition, the soil is maintained so that it can be airy and light. "The disc harrow cuts and wiggles the soil without flipping it over," says Celona. "Any method that breaks up the ground without turning it over is preferable, and harrowing also helps beneficial insects such as praying mantises, ladybugs, lacewings, and spiders." Protecting the

soil, often a neglected and undervalued resource, demonstrates its importance—just one way that Drumlin Farm educates by example.

The organic material added to the clay-rich soil at Drumlin Farm helps to keep the fields from drying out since no irrigation is employed. "Not irrigating avoids an energy-intensive farming practice," explains Celona. "This protects natural resources when we don't run the tractor to water the acreage—we're not using water and we're not consuming fossil fuels." Fortunately, the water table is high so keeping the soil loose allows the water to come to the surface, not only sustaining the plants but also the amphibians and birds that frequent the farm fields. "We're sharing the space with all kinds of wildlife," Celona points out. The cropland harbors frogs, salamanders, and toads, representing just one class of creatures that thrive thanks to Mass Audubon's consideration for the interplay between farmland management and wildlife conservation. The blue-spotted salamander, a species afforded special concern status in Massachusetts, is one of the amphibians of note.

Domestic animals are an important piece of the man-



Drumlin Farm's beautiful and healthful Swiss chard

agement puzzle. More than 20 acres of cropland are used to cultivate hay, which feeds the farm menagerie through the winter. All farm animals are raised humanely—they are free roaming, free of hormones, and they graze on rotation so they can truly go where the grass is greener. Once they finish feeding in one location, they are moved to the next. The sheep are often shifted from one section of meadow to another on the drumlin, and this year they even spent time feeding in the field in front of Gordon Hall, Mass Audubon's main headquarters building. The chickens are relocated intermittently as well, in a portable hen house called the eggmobile.

For the farmers, dealing with pests large and small is an ongoing challenge that requires ingenuity, patience, and hard work. Since Drumlin Farm growers never use any chemical pesticides, alternative strategies are the only way to control insects and mammals that damage and consume the crops. For instance, an organically approved bacterial solution is used that affects the digestive system of targeted insects but does not persist in the environment. In addition, destructive flea beetles are deterred by row cover, lightweight cloth that is fastened down to keep them away.

While the usual garden thieves such as groundhogs and rabbits help themselves to gourmet salad mix and other choice selections, white-tailed deer are the biggest aggravation. Their population numbers in Massachusetts are now excessively high. Not only do they overbrowse

native plants but they venture onto the farm fields to enjoy delicacies such as beet, turnip, and carrot greens, and chard, spinach, and lettuce. "Liquid fence" containing garlic oil and rotten eggs deters the deer and the smaller mammalian crop raiders, as do local coyotes that prey on the deer and other wild mammals on the farm.

Fortunately, there are many other native species that live in harmony with agriculture, especially when practices employed encourage and nurture wildlife, including many bird species that grace the farmland. The bird list for Drumlin Farm Wildlife Sanctuary is long and diverse and includes a good number that are likely declining or strongly declining, according to Mass Audubon's *State of the Birds 2013*. The com-

mon nighthawk, Nashville warbler, and olive-sided flycatcher are some of the declining birds that occur at the farm. Fifteen acres of cropland, 19 acres of hayfields, and edge habitat between the forestland and farmland attract shorebirds, songbirds, and raptors.

Killdeer, shorebirds that are generally seen in places other than beaches, are known for their tendency to nest on flat rooftops and school playgrounds—as well as between the rows of cropland under active cultivation. The pairs on the fields at Drumlin Farm have often dug their depressions in the dirt for egg laying even before plowing has occurred so our bird-friendly protocol is to mark the nests and then plow and plant around them. Typically, each ground nest contains four eggs. Throughout the summer the killdeer are monitored and their breeding success is recorded. In the spring, Matt Celona observed at least five killdeer nests, and two later in the summer. Several other shorebirds that have visited the cropland while passing through include the buff-breasted sandpiper, American woodcock, and lesser yellowlegs.

According to Drumlin Farm Volunteer Coordinator Pam Sowizral, a multitude of avian species have been sighted in Boyce Field and adjacent field edges. Migrant songbirds that stop through include vesper, Lincoln's, field, swamp, white-crowned, and fox sparrows, as well blackpolls and flocks of American pipits. Raptors, always welcome because they hunt for small mammals and thus protect the crops, are the American kestrel, merlin, northern harrier, osprey, and Cooper's,



A killdeer in recently harrowed cropland

red-shouldered, and sharp-shinned hawks. Similarly advantageous are species that nest on the property and consume insects in the fields such as indigo buntings, song sparrows, and eastern kingbirds.

Bobolinks and savannah sparrows are grassland nesters that use the fields. In 2012 staff and volunteers began to survey these ground-nesting species so as not to hay where they are breeding until after the young have fledged. In the past couple of years, 16 to 30 bobolinks have been present, showing a preference for the cattle pasture.

An immensely successful and visible project at Drumlin Farm is the nest box program. During nesting season, people walking by boxes along the trails by farm fields looking for bluebirds are guaranteed to see what they're looking for. "Currently, there are 38 boxes in thirteen locations on the sanctuary," says Sowizral. "A majority are placed in groups of three at 21-foot intervals and are erected for bluebirds and tree swallows, as well as housing chickadees and house wrens some years." In 2013, 71 bluebirds and 26 tree swallows fledged at the farm. Volunteer Fred Costanza and 22 additional volunteers are integral to the program. In a seven-year period, a grand total of 425 eastern bluebirds have fledged at Drumlin Farm.

The federal Wildlife Habitat Incentive Program (WHIP) has funded a special project enabling staff and volunteers to transform the south side of the drumlin, previously overgrown with invasives such as autumn olive and multiflora rose, to a vibrant meadow of native forbs and grasses. Now that section offers the best birdwatching of anyplace at Drumlin Farm. As well as

drawing fall passerines, the restored habitat serves as a feeding oasis for Baltimore orioles, blue-winged warblers, and indigo buntings. Not to mention, wild turkeys forage there with their young, rose-breasted grosbeaks and ruby-throated hummingbirds are fairly common, and during the fall pine siskins and purple finches stop through on migration, just to name a few.

The crossroads of sustainable farming and wildlife preservation would not be possible without the unfailing commitment and hard work of Crops Manager Matt Celona, Livestock Manager Caroline Malone, an army of determined volunteers, schoolchildren and campers eager to help, and the farm apprentices whose labor is invaluable and who receive supplemental compensation in the form of knowledge that they gain on the job. When the apprentices move on, they help to expand an ecologically sound system of farming that is continually spreading through New England and other regions of the country.

Of course, a market for the produce is also essential. People who buy Drumlin Farm Community Supported Agriculture (CSA) shares support the farm while receiving weekly allotments of produce topped off with herbs and flowers. Of the 150 summer shares last season, 110 were picked up weekly at the farm and 40 were delivered to CSA members in the city. In addition, a farm stand at the entrance provides fresh vegetables for visitors, and freshly harvested produce is also delivered to local restaurants.

Drumlin Farm is living proof that getting back to the earth is reemerging and more essential than ever. Not only is Drumlin Farm serving as a model for stewardship of the planet through its innovative agriculture and ecological management, but it's providing flavorful healthful food for the community and remaining profitable so that the conservation can continue.

Ann Prince is associate editor of Sanctuary.

Our Neighbor Members Can Join in Through Community Supported Agriculture (CSA)

Become a CSA shareholder to help fund wildlife conservation and sustainable agriculture at Drumlin Farm while benefiting from the delicious produce grown here. From June through mid-October (20 weeks) shareholders enjoy enough freshly harvested fruits and vegetables to feed a family of four. To sign up call 781-259-2200 or check our website www.massaudubon.org/drumlincsa

The Case for Ecological Management

by Chris Leahy

What we save now is all we'll ever save. We are standing on the west coast of Easter Island. It is our third stop on a three-week ecotour around the world by charter jet: Amazon Basin, Galapagos Archipelago, Easter Island, Great Barrier Reef, etc. The morning is crystalline; the Pacific is attempting to show all possible variations of the color blue; a group of the famous statues makes a nice focal point in the middle distance. Viewed with innocent eyes, the landscape is pleasantly rugged—volcanic cones covered in bronzy tufted grasses—vaguely reminiscent of romantic barrens like the Scottish highlands or the Patagonian steppe.

I have just cast a light but perceptible pall by explaining to the group that when the first people—Polynesian colonists—arrived here only 1,500 years ago, the place was covered in lush subtropical forest. Presumably it contained a unique fauna of birds and insects, perhaps even a lizard or two—presumably because all of it was gone hundreds of years before anyone interested in cataloguing such details of the biodiversity of the island had gotten there. Aside from the rock and, I suppose, the lichens, every bit of the present visible landscape was imported relatively recently by people.

We don't know how many native land bird species there once were—some parrot bones have been identified from excavated middens—but there are now only five species. You can guess what two of them are—both are also common in Boston: house sparrow and pigeon. The other three are the chimango caracara, a small scavenger of temperate South America, imported with the ornithologically naïve expectation that it would help get rid of another fellow immigrant, the rat; the Chilean tinamou brought from Chile (which now governs the island) to provide some upland game to shoot; and an unprepossessing songbird of the Chilean mainland, the common diuca finch, which seems to be sharing the available passerine habitat amicably with the house sparrows.

"Well, won't it all come back eventually if we just let nature takes its course?"—an amiable and intelligent self-described outdoorsman from the Chicago area asked.

I explained that most of the species in question are extinct and that even if someone were to attempt to reconstruct a plausible Easter Island biota using surviving species from similar islands, the land had been altered so profoundly that it was doubtful that the "old" species would "take." A unique form of Pacific subtropical forest had been replaced by a kind of moonscape



A common diuca finch, the most abundant introduced bird species on Easter Island

© ALVARO JARAMILLO

made up of hardy pantropical colonists. Nature had no inherent mandate or ability to restore the previous ecosystem. I went on to hint, smiling through the gathering gloom and doom, that what happened to Easter Island could happen—was happening—elsewhere.

The Chicago man's question comes up often when I talk to people—including conservation-minded people—about the need to actively manage protected lands to effectively conserve a full spectrum of native species. In addition to, "Can't we just let nature take its course?," I hear, "Who gives us the right to play God?" The basic hands-off argument is that we are the ones who are screwing things up, and if we would just leave the land alone all-knowing Mother Nature would work in her mysterious ways to make things the way they ought to be.

This is valid enough up to a point. If no one had ever landed on Easter Island it would—barring a volcanic eruption—be something akin to a tropical paradise today rather than a grossly depauperate grass-covered rock. There are also natural communities closer to home for which something near to a hands-off approach is appropriate. One example: a large (50,000+ acres) ecologically diverse forest reserve that is free in perpetuity

simply to be a forest, without any thought of deriving useful products or offering recreational opportunities for anything involving wheels or treads, or, for that matter, even horse hooves. There would, of course, have to be energetic management of invasive species, and eventually we would probably decide to extinguish a fire, but with these exceptions the human role would be to study and love the place.

A frequent problem with the let-mother-do-it approach, however, is that we often want to apply it after we've already made a big mess. We import purple loosestrife to feed our honeybees; the loosestrife takes over our wetlands and wreaks havoc with our native marsh birds. Having dumped the contents of Pandora's box into the marsh, can we then just say, "Let nature take its course?" In this case we have set the course by introducing an invasive plant and nature, in the form of purple loosestrife, will pursue its genetic destiny at the expense of bitterns and rails and moorhens. That purple loosestrife runs amok in our wetlands while remaining tastefully sparse in its native Eurasia is not "unnatural," but that is cold comfort to those of us who haven't heard a bittern call in Massachusetts for over a decade.

Another problem with laissez-faire conservation is that many habitats—harboring perhaps a third of all of our native species in Massachusetts—are transitional by nature. Mother Nature, let us recall, is less a gentle permissive mom, and more an irascible goddess hurling thunderbolts and bringing down floods, droughts, and locust plagues on her little gardens of biodiversity. In fact, it is not in spite of but because of such natural catastrophes that thousands of species have evolved to inhabit so-called "successional" communities.

Huckleberries, fritillaries, prairie warblers, and meadow voles, for example, don't just survive fires and other

natural traumas; they depend upon them to maintain their existence and way of life. Not so long ago, before fire trucks and vacation homes, the weather created transitional habitats pretty much constantly and on a grand scale. A truly natural landscape anywhere in the world is not a sheltered place where nothing ever happens, but something like the opposite: a mosaic of overlapping cataclysms and the biota's spectacularly diverse response to them.

We can no longer depend on wildfires to stimulate broom crowberry reproduction or create grasshopper sparrow habitat wherever lightning happens to strike. Our only alternative is to protect large tracts of transitional habitats—with their full complement of characteristic species—and then make sure that they remain transitional by burning them or mowing them or letting the sheep graze on to them periodically.

Before the middle of the century—perhaps much sooner—we will probably have protected all of the most critical habitats that we are going to in Massachusetts, and relinquished what's left to be carved up by the developers. The main thrust of conservation will then shift from acquiring habitat and calling it conservation land to managing specific habitats with an unforgiving and numerically verifiable goal of conserving all possible elements of the Commonwealth's native biodiversity: the barrier beaches with their piping plovers and eastern spadefoots; the airport grasslands with their upland sandpipers and Harris's checkerspot; the calcareous fens with their rare sedges and orchids...

Isn't this like playing God? Yes it is. Which is why we must take it seriously.

Chris Leahy holds the Gerard A. Bertrand Chair of Natural History and Field Ornithology at Mass Audubon.



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Restoring the Waters

by Karen Heymann

Wilderness is not a luxury but a necessity of the human spirit, and as vital to our lives as water and good bread.

— Edward Abbey

Along streams and rivers in Massachusetts, current restoration projects of unimpeded flows are replenishing free-flowing cold water and restoring the health of local populations of many species of fish and wildlife. Mass Audubon's Canoe Meadows Wildlife Sanctuary is a case in point. Local and state partners worked together there to remove the Sackett Brook dam on Pittsfield's Mill River.

Mass Audubon has also supported the partnership of other nonprofit groups and state and federal agencies that are bringing about the Mill River Restoration, which includes removal of three dams on this tributary to the Taunton River, the longest undammed coastal river in New England. This project is restoring access for herring and other fish into Lake Sabbatia while improving habitat for many native species of wildlife. Restoration of the river's floodplain and natural flows will also promote the overall health of the river, making it more resilient to the impacts of climate change while reducing flood hazards in the city of Taunton.

The Bay State's coastline would also benefit from such an approach—restoring coastal wetlands and vegetated buffer areas that are our first line of defense against coastal storms and flooding while providing critical habitat for vulnerable populations of coastal birds and aquatic species.

The traditional approach to protecting the built environment has been to reinforce developed shorelines with structures such as seawalls, the effectiveness of which has long been debated. In some cases, "gray" or "hard" infrastructure such as seawalls makes sense—for example, safeguarding critical facilities like wastewater treatment plants and utilities along the coast to protect highly vulnerable assets for which failure or relocation are not options. Seawalls may be needed to secure vulnerable urban areas where restoration and relocation are not feasible options.

However, armoring the coastline interrupts natural sediment movement and often actually accelerates the rate of erosion in adjoining areas. Over the last decade more accepted approaches include conservation and restoration of marshes, seagrass beds, beaches, banks, dunes, and oyster reefs. These are resilient and powerful tools provided by nature, unmatched in their capability to absorb floodwater and buffer damaging winds and waves. Mass Audubon has long advocated for conserving wetlands and limiting development in vulnerable coastal areas.

A 2009 statewide study, the Massachusetts Coastal Infrastructure Inventory and Assessment Project of public infrastructure along the state's 1,730 miles of coastline, found that almost 80 percent of coastal structures have outlasted their 50-year lifespan. While most coastal protection structures are presently in stable condition, costs of repairs over the next twenty years are estimated at over \$600 million.

In January of 2013, Governor Patrick signed into law An Act Further Regulating Dam Safety, Repair and Removal, which facilitates repair or removal of unsafe dams and coastal infrastructure in the Commonwealth. This law provides a new source of funding for dam and seawall repair or removal, and also presents an enormous opportunity to consider how to best adapt our coastline to a changing climate and projected sea-level rise. Over the last century, population growth has resulted in dense residential and commercial development along our coastline, and today nearly 85 percent of the state's population lives within 50 miles of the coast.

Currently, many towns and cities along the Atlantic coast are coming to grips with projected sea-level rise, which could inundate many coastal areas. Restoring portions of our natural coastline would be a smart use of tax dollars, resulting in a more secure, better prepared Commonwealth.

At Mass Audubon's Wellfleet Bay Wildlife Sanctuary on Cape Cod, a project to restore oyster reef habitat is underway. Oyster reefs not only serve as buffers to protect coastal communities from wind and wave action; they also enhance water quality and support the local economy, providing an excellent return on investment. A 2005 study by the Multihazard Mitigation Council (Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities) showed that every one dollar invested in the mitigation of storm-surge effects in coastal communities saves the American taxpayer four dollars in losses from natural hazards.

We can increase the Commonwealth's ability to live with climate change by considering ecological restoration as an alternative to repairing or replacing expensive hard infrastructure such as dams and seawalls. Expanding our options for enhancing coastal resiliency will not only protect the environment, it will also save the lives of residents and first responders, protect vital lifesaving infrastructure and power sources during winter storm events, and address an expensive long-term problem with a cost-effective, long-term solution.

Karen Heymann is Mass Audubon's Legislative Director.

Poetry

Edited by Susan Richmond



© KEVIN FLEMING

Twin fawns

Crepuscular

by Joanne DeSimone Reynolds

A fawn dusk falls –

what woods there are,
wake; my car
a capsule
prey to onyx hooves
arcng, darting away;
one onyx eye a dense
planet; beams & tines,
strange, navigational.

Low beams
nose the road, wend
toward the rail bed,
fallow, narrowing;
the bucking rump
flagging white; flight
of bony wings;
a streetlight a globe

blinds a dim world.

Joanne DeSimone Reynolds lives in Scituate, Massachusetts. Her chapbook Comes a Blossom was published by Main Street Rag in January 2014.

The Leapers (*Salmo salar*)

by Gary Metras

For days impatience had loomed
in the class room as eggs lay
in the chiller. Then it happened,
in a blink, a tank full of dark,
squiggling lines that he watched
consume their yolk sacs until today.
Held delicately with both hands,
the child counts the dozen
salmon fry in the paper cup.
There are a few more fry
than the child has years.
When we walk to the brook's edge,
he places a palm over the cup.
He knows these fish are the leapers
and will not risk even one
jumping to the dry forest floor.
We find the spot on the brook
where we already measured
the water's speed, depth, coldness.
His shoe's toes kiss the water
as he half-submerges the cup
and each fry wiggles its inch
into the flow and vanishes.
In sleep we will see them, large,
long, and strong, leaping
falling water.

Gary Metras is a retired educator from western Massachusetts who fly fishes the local rivers as often as possible. He is the past president of the Pioneer Valley Chapter of Trout Unlimited, a cold water conservation group.

Sonny Days in the Community Gardens

by Ann Prince

The Clark Cooper Community Gardens at Mass Audubon's Boston Nature Center (BNC) is a gathering place for young and old alike—a hub in the heart of Boston where a love for growing vegetables and flowers is shared and celebrated. Last summer, the community lost an enduring gardener (and one of the BNC's founders and a Sanctuary Committee member), Alden “Sonny” Washington, who died at 80 on June 9, 2013, just as the growing season was really getting underway.

A certified master gardener, Sonny imparted his knowledge of organic gardening especially to local youth and also to his friends in neighboring plots who grew everything from spinach to sweet peas, garlic to gladiolas. His illimitable legacy lives on for all those he helped, as well as countless fond memories of him recollected by his garden companions and fellow Sanctuary Committee members.

Dollie Taylor remembers when Sonny moved back to his hometown of Boston from New Hampshire after retiring in 1992 from Digital Equipment Company where he was senior manufacturing engineer. “He immediately got involved, arriving with his truck and his rototiller,” says Dollie. “He was hardworking and a Jack-of-all-trades. From the first time he stepped foot in the garden he helped everyone.”

Sonny grew his assortment of familiar and somewhat exotic vegetables with no chemical fertilizers or pesticides and with all-natural enhancements to the soil. He cultivated kale and other greens such as callaloo, a Caribbean



Sonny Washington surveys the garden plots.

leafy vegetable, as well as peppers, tomatoes, and asparagus, which he started from seeds rather than using the shortcut by planting roots.

Among the plots, his own little domain was in a unique location near a singular tree that stood in the middle of the patchwork of individual gardens. Underneath the tree, he kept a toolbox full of gardening implements and pen and paper so he could work on his layout of plants or write grants to obtain supplies such as wheelbarrows and chippers for the community gardens, and to fund the all persons accessible raised beds as well as youth programming.

Gardening was not his only passion; he was also a musician. Sonny read biographies of jazz legends, played piccolo, and amassed a collection of 2,000 albums. “Sonny’s garden was near mine,” says Liza Green. “One of my favorite memories is he’d be listening to the most alive jazz while he worked—planting, weeding, and cultivating. He was a consum-

mate organic gardener, a seed saver, and he was always devising his own methods for dealing with pests.”

Since 2007, Sonny volunteered his time with the Boston Youth Fund. Inspired by young people’s enthusiasm and willingness to learn, he would teach them organic gardening skills and how to use the tools and equipment. As director of Educational Programs for Teens, he developed the Urban GrassRoots Gardening Program. “Sonny was so interested in giving back to children and helping them to understand how food is grown,” says Patricia Odom. “Kids could relate to him; he was patient, engaging—everyone just loved him.”

Every spring Sonny would come to the gardens with sweet potatoes he had started indoors over the winter and other seeds and plants he couldn’t wait to get into the ground. “He was always ready for a healthy, fresh garden season,” his friends remember. When Sonny’s fellow gardeners return, they will remember his patience, dedication, and cheerful life-affirming presence.

“We are thankful for Sonny’s service and leadership,” says Julie Brandlen, Boston Nature Center’s Anne and Peter Brooke Director, “and his friendship through all these years.”

Ann Prince is associate editor of Sanctuary.

© LIZA GREEN

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Sonny holds a ready-to-plant sweet potato he started indoors.

SCHOOL VACATION WEEK PROGRAMS

BOSTON NATURE CENTER

Mattapan, 617-983-8500

April Vacation Week

April 21-25—8:30 a.m.-5:30 p.m.

For children ages 5-14

BROAD MEADOW BROOK

Worcester, 508-753-6087

April Vacation Week

April 21-25—9 a.m.-3 p.m.

BROADMOOR

South Natick, 508-655-2296

April Vacation Week

April 22-25—8:30 a.m.-4:30 p.m.

For children in grades K-5

CONNECTICUT RIVER VALLEY

Easthampton, 413-584-3009

April Vacation Week

April 22-25—9 a.m.-3 p.m.

DRUMLIN FARM

Lincoln, 781-259-2206

March Vacation Single Day Programs

March 25-27

For children ages 4-grade 6

April Vacation Week

April 21-25

For children ages 4-grade 8; single and 4-day programs available

HABITAT

Belmont, 617-489-5050

April Vacation Week

On the Brink: April 22—9 a.m.-3:30 p.m.

Animal Allies: April 23—9 a.m.-3:30 p.m.

Pollination Party: April 24—9 a.m.-3:30 p.m.

Sensational Spring Pools:

April 25—9 a.m.-3:30 p.m.

For children in grades K-3

To Habitat and Beyond!

April 22-25—9 a.m.-3:30 p.m.

For children in grades 4-6

IPSWICH RIVER

Topsfield, 978-887-9264

April Vacation Week

April 22-25—9 a.m.-3 p.m.

Children in grades K-5 may sign up for individual days, or for all 4 days at a discounted rate

MOOSE HILL

Sharon, 781-784-5691

April Vacation Days

Ocean Life: April 21, 22, 23, 24, 25—9 a.m.-4 p.m.

Extended day options available

SOUTH SHORE

Marshfield, 781-837-9400

April Vacation Week Activities

April 21-25

For children ages 5-11

WACHUSETT MEADOW

Princeton, 978-464-2712

April Vacation Days

April 22-25—9 a.m.-3 p.m.

For children ages 5-11

WELLFLEET BAY

South Wellfleet, 508-349-2615

April Vacation Adventures

April 21-25

Family Programs

BERKSHIRE SANCTUARIES

Lenox, 413-637-0320

Bird Banding Demonstrations

April 5—10 a.m.-noon

Evening at the Beaver Ponds

April 23—6:30-8 p.m.

May 14—7-8:30 p.m.

Spring Stampede Salamander Search

April 25—6-7:30 p.m.

Wildflowers and Spring Changes

May 11—10 a.m.-noon

BOSTON NATURE CENTER

Mattapan, 617-983-8500

Wake Up Seeds!

March 23—2-3:30 p.m.

BROAD MEADOW BROOK

Worcester, 508-753-6087

Peregrine Falcons,

Flying High in Worcester

April 23—7-9 p.m.

BROADMOOR

South Natick, 508-655-2296

Wild about Reptiles

April 6—1-2:30 p.m.

CONNECTICUT RIVER VALLEY

Easthampton, 413-584-3009

Big Night

March 29—5:30-8:30 p.m.

Field and Turtle Day

May 24—10 a.m.-1 p.m.

DRUMLIN FARM

Lincoln, 781-259-2206

Bread and Bunnies

March 21—3:30-5 p.m.

Woolapalooza

March 29—10 a.m.-4 p.m.

FELIX NECK

Edgartown, 508-627-4850

Wild Edibles Power Point

Presentation with Russ Cohen

May 24—7-9 p.m.

Wild Edibles Ramble at

Felix Neck with Russ Cohen

May 25—1-4 p.m.

IPSWICH RIVER

Topsfield, 978-887-9264

It's Big Night!

April 5—6-8 p.m.

For families with children

4 years and older

Audubon Nature Festival

June 1—10 a.m.-4 p.m.

For all ages

JOPPA FLATS

Newburyport, 978-462-9998

After School Wednesdays at Joppa

March 26—3:45-5:15 p.m.

April 2—3:45-5:15 p.m.

April 9—3:45 p.m. to 5:15 p.m.

WACHUSETT MEADOW

Princeton, 978-464-2712

Sheep Shearing Open House

April 5—1-4 p.m.

Rain date: April 6—1-4 p.m.

WELLFLEET BAY

South Wellfleet, 508-349-2615

Sharkfest

May 24-25

Birding Programs

BERKSHIRE SANCTUARIES

Lenox, 413-637-0320

Bird Walks at Canoe Meadows

April 11, 18, 25—8-10 a.m.

May 2, 9, 16, 23, 30—7-9 a.m.

BOSTON NATURE CENTER

Mattapan, 617-983-8500

Spring Bird Walks

April 18, 29—7-9 a.m.

May 6, 9, 13, 23—7-9 a.m.

BROAD MEADOW BROOK

Worcester, 508-753-6087

Friday-Morning Birds

Every Friday from

April 4-June 13—7-9:30 a.m.

Warbler Madness at Mount Auburn

May 10, 18—7 a.m.-noon

Spring Migration in

Weekend Field Trips

May-June—7-8:30 p.m.

BROADMOOR

South Natick, 508-655-2296

Pancake Breakfast and Bird Walks

May 11—7, 8, 9 and 10 a.m.

CONNECTICUT RIVER VALLEY

Easthampton, 413-584-3009

Great Blue Herons and Bald Eagles

April 12—3-6 p.m.

Bird Sounds, Songs, and Calls

April 9—7-9 p.m.

DRUMLIN FARM

Lincoln, 781-259-2206

Kinglet Birders

March 2—1:30-3 p.m.

For children ages 4-6 accompanied by an adult

FELIX NECK

Edgartown, 508-627-4850

Big Moon Owl Prowl

April 11—7-8:30 p.m.

IPSWICH RIVER

Topsfield, 978-887-9264

The State of Massachusetts Birds

April 4—7-8:30 p.m.

Birdwatcher's Getaway

for the Day Series

May 2, 23—7 a.m.-3 p.m.

Spring Migrants at

Mount Auburn Cemetery

May 9—5:50-11:30 a.m.

Evening Paddle for Rails

May 7—6-8 p.m.

JOPPA FLATS

Newburyport, 978-462-9998

Wednesday-Morning Birding

Every Wednesday from March 30-June 30—9:30 a.m.-12:30 p.m.

SOUTH SHORE

Marshfield, 781-837-9400

Warblers of Mount Auburn

May 13—6 a.m.-noon

WACHUSETT MEADOW

Princeton, 978-464-2712

Bird-a-thon Birds and Breakfast

May 17—7:30-10:30 a.m.

WELLFLEET BAY

South Wellfleet, 508-349-2615

Birding Cape Cod

Friday mornings from 9 a.m.-noon

Call the individual sanctuaries for more information, fees, and to register.

For a full listing of Mass Audubon programs and events, visit our online catalog at www.massaudubon.org/programs.

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US TOURS

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For more information, contact Berkshire Sanctuaries, 413-637-0320

Southern Arizona—Owls, Hummers, Hawks, and More:

April 28-May 4
For more information, contact Drumlin Farm, 781-259-2200

Birding Big Bend and West

Texas: April 29-May 6,
with Bill Gette and David Larson
For more information, contact Joppa Flats, 978-462-9998

Birding the North Woods and Connecticut Lakes:

June 2014, with David Clapp and Sue MacCallum

For more information, contact South Shore Sanctuaries, 781-837-9400

Sketching & Naturalizing on Monhegan Island: June 12-14

For more information, contact Ipswich River, 978-887-9264

Northern California—Yosemite, Point Reyes, and the Farallon Islands: June 29-July 6

For more information, contact Drumlin Farm, 781-259-2200

Puffins and Peatlands: July 10-13, with Sue MacCallum and Carol Decker

Cosponsored by Ipswich River & South Shore Sanctuaries
For more information, contact Ipswich River, 978-887-9264, or South Shore Sanctuaries, 781-837-9400

Women's White Mountain Adventure: July 31-August 2

For more information, contact Ipswich River, 978-887-9264



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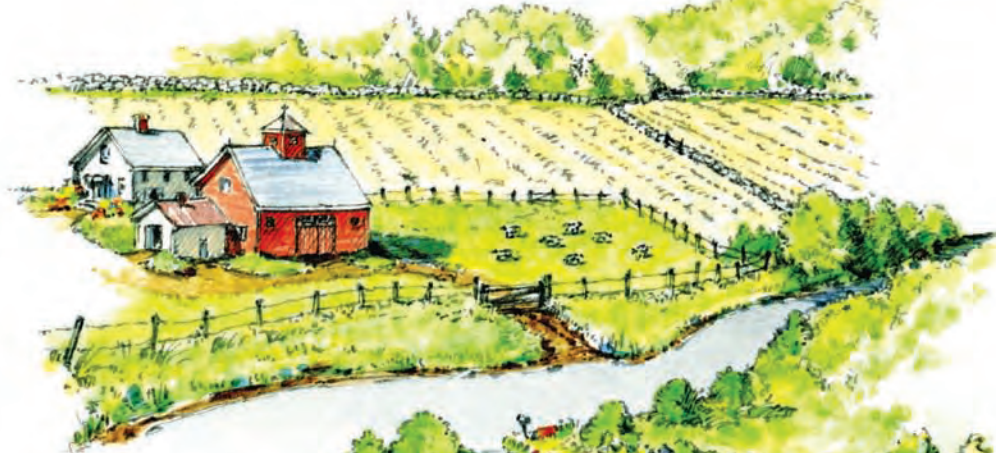
A Biodiverse Landscape

Illustrated by Gordon Morrison

Ecologists generally agree that a patchwork of various habitats over a landscape offers the greatest opportunity for a variety of species.

Wooded Hills and Deep Forests:

Many species of mammals and also woodland birds, such as the wood thrush and veery, require extensive forest interiors for nesting sites.



Fields and Scrublands:

Large open fields offer nesting sites for grassland birds. These, combined with farmland, scrublands, hedgerows, and forest edges, create excellent habitat for a wide variety of birds and small mammals.

Swamps and Marshes: Treed red maple swamps offer critical habitat for amphibians, as well as wood ducks and herons. Open, treeless marshes are critical for turtle species and waterbirds and marsh nesters such as the marsh wren and rails, herons and bitterns.





Outdoor Almanac Spring 2014



© GORDON MORRISON

March 2014

**March 16** Full Moon. The Fish Moon**March 20** Vernal equinox, first day of spring.
Days and nights are equal length.**March 23** Listen for the trill of song sparrows.**March 26** Phoebes and fox sparrows arrive
about this time.

April 2014

April 3 Listen for spring peepers.**April 6** Field sparrows return.**April 10** Tree swallows return.**April 15** Full moon.
The Flower Moon.**April 20** Listen for the trill of toads from near-
by swamps and marshes.**April 25** Look for white shadbush blossoms in
woodlands.**April 29** Brown thrashers, towhees, house
wrens, barn swallows, and chimney swifts
return.

May 2014

May 8 Watch for trout lilies, columbine,
trillium, and other woodland wildflowers
before the trees leaf out.**May 10** Spring azure butterflies appear at
forest edges and in gardens.**May 14** Full moon. The Planting Moon.**May 18** Height of spring warbler migration;
listen for the dawn chorus and watch the
treetops and shrubbery at sunrise and sunset.**May 21** Painted turtles and snapping turtles
move onto land to lay their eggs.**May 26** Scarlet tanagers and rose-breasted
grosbeaks return.**May 28** Dogwoods bloom.

June 2014

June 6 Listen for the green frog chorus from
freshwater marshes and ponds.**June 11** Field wildflowers begin to bloom
about this date.**June 13** Full moon. The Strawberry Moon.**June 16** Sulphur butterflies emerge; fireflies
appear in grassy areas.**June 21** Summer solstice, longest day of the
year.**June 23** Watch for bats in the evening sky.**June 27** Gray treefrogs begin singing; bullfrog
chorus can be heard at night at nearby ponds.**June 30** Check your garden for robber flies,
which hover in midair then zip off.

July 2014

July 4 Daylilies bloom along roadsides.**July 10** Watch for monarch butterflies on
milkweed blooms.

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