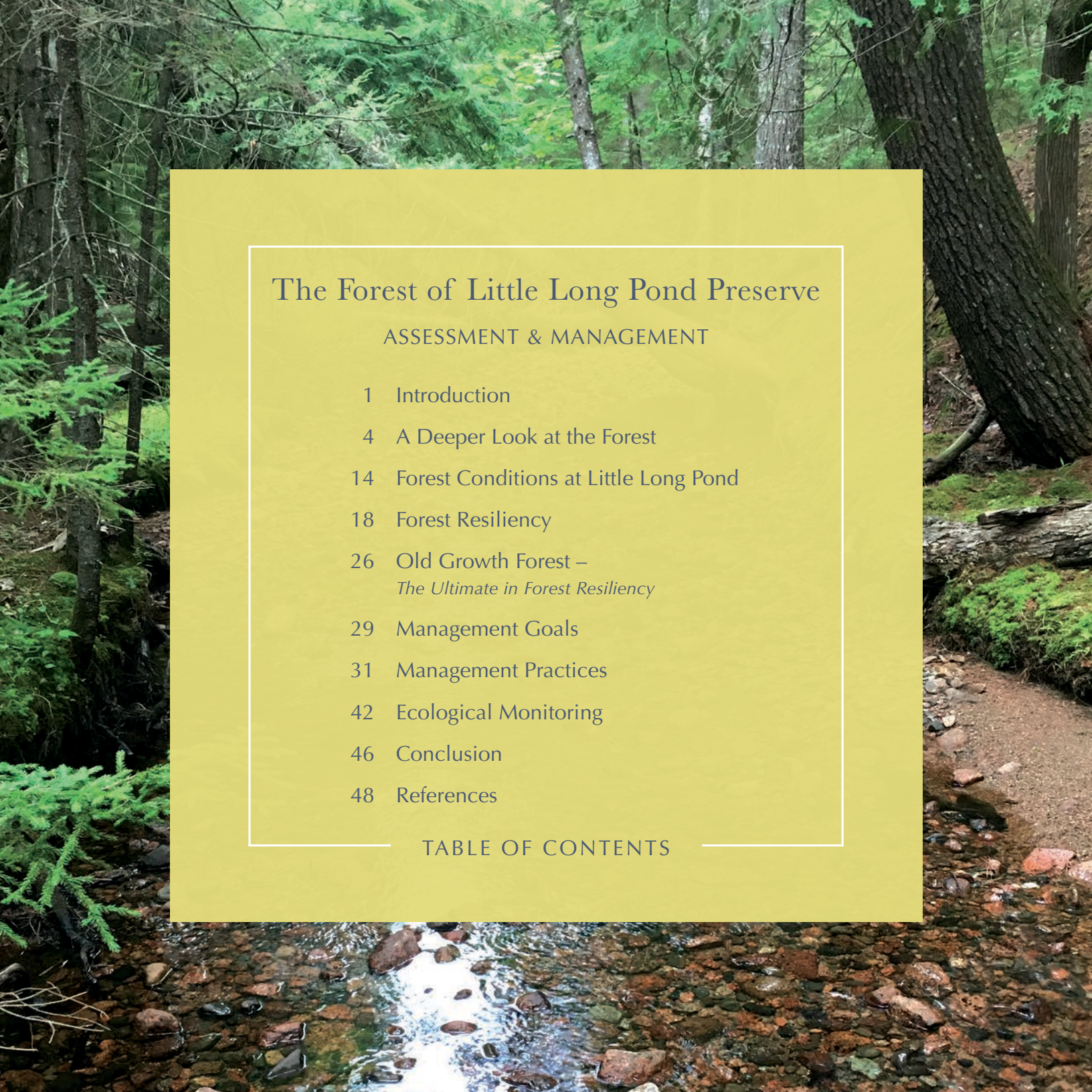
THE FOREST OF LITTLE LONG POND PRESERVE

Assessment & Management

Condensed Version

December 2021

LAND & GARDEN
PRESERVE



The Forest of Little Long Pond Preserve

ASSESSMENT & MANAGEMENT

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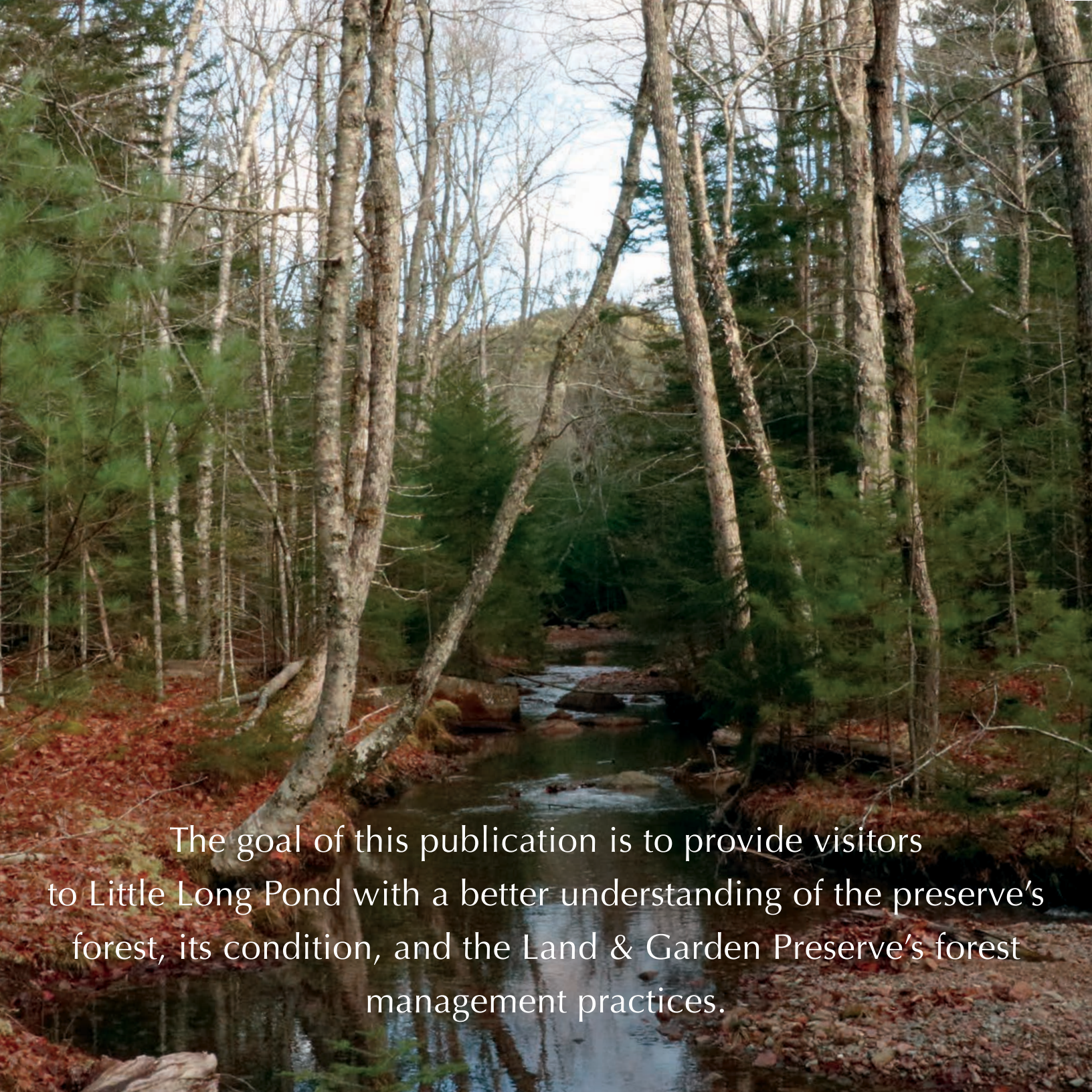
Like much of Maine and the rest of New England, the Little Long Pond preserve is primarily covered by forests that have regrown from extensive 18th and 19th century timber harvests and clearing for agriculture. Vast forests are the natural vegetation cover and basic life-support system of our region; they clean water, produce air, store carbon, build soil, recycle nutrients, and provide habitat for tens of thousands of plant and animal species. While forests are intrinsically resilient, they currently face many serious stressors including invasive plants and insects, climate change, fragmentation, deer over browse, and more that can impact their health. Some of these stressors are already active at the forests of Little Long Pond and Land & Garden Preserve staff are addressing them through active management.

INTRODUCTION

The Land & Garden Preserve recently completed *The Forest of Little Long Pond - Assessment and Management*, which is used by the Land & Garden Preserve staff to document their understanding and management of the forest. This condensed version acts as a summary companion to that report and is intended to provide the public with a shortened version of the same information. This document only addresses Little Long Pond's forest; future documents will address the remaining ecosystems such as the pond and the meadows. This document does not include management of the Land & Garden Preserve's natural lands at Hunters Cliff.

INTRODUCTION

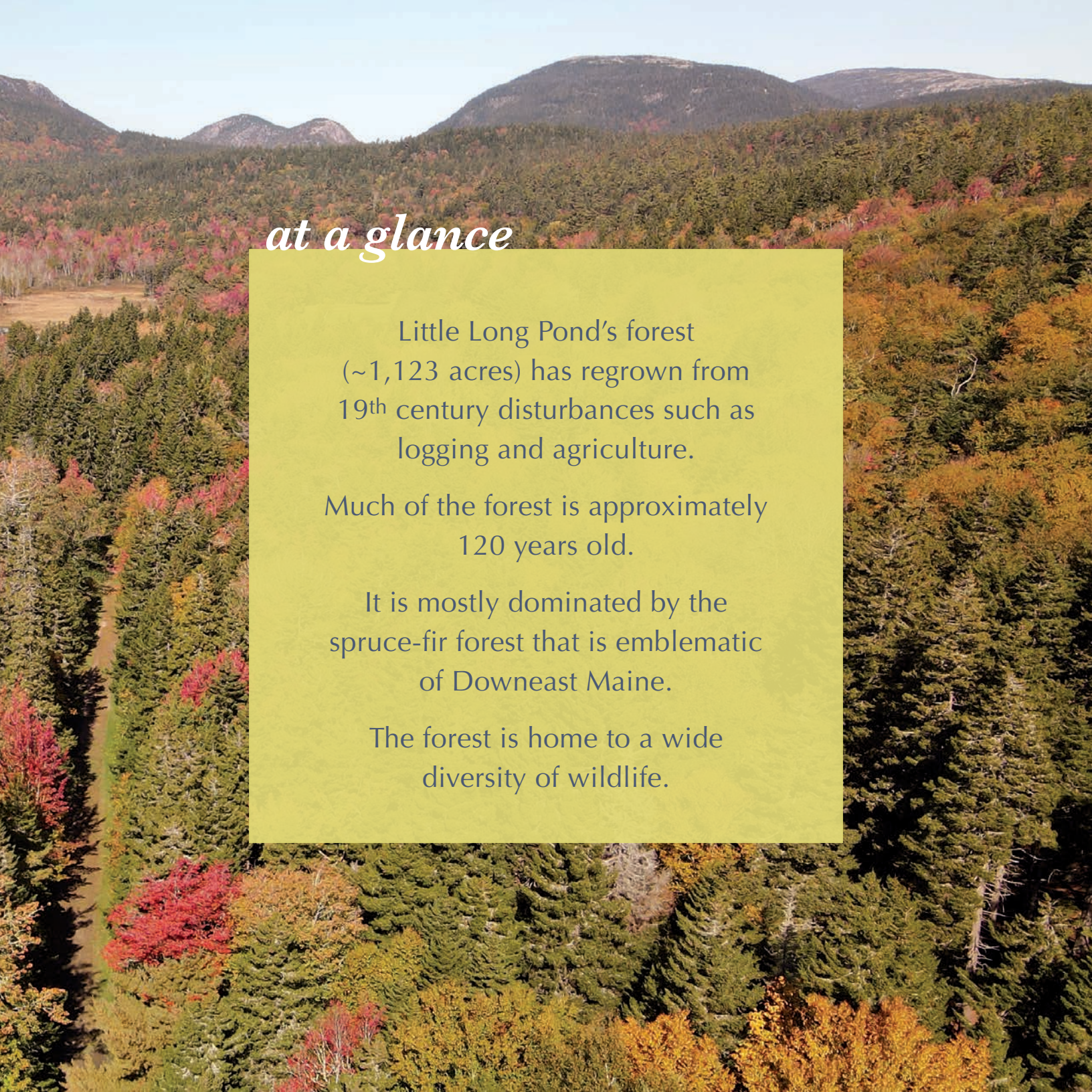


The goal of this publication is to provide visitors to Little Long Pond with a better understanding of the preserve's forest, its condition, and the Land & Garden Preserve's forest management practices.

A DEEPER LOOK AT THE FOREST

Left: Bobcat captured on a game camera at Little Long Pond.

Right: American marten captured on a game camera at Little Long Pond.



at a glance

Little Long Pond's forest (~1,123 acres) has regrown from 19th century disturbances such as logging and agriculture.

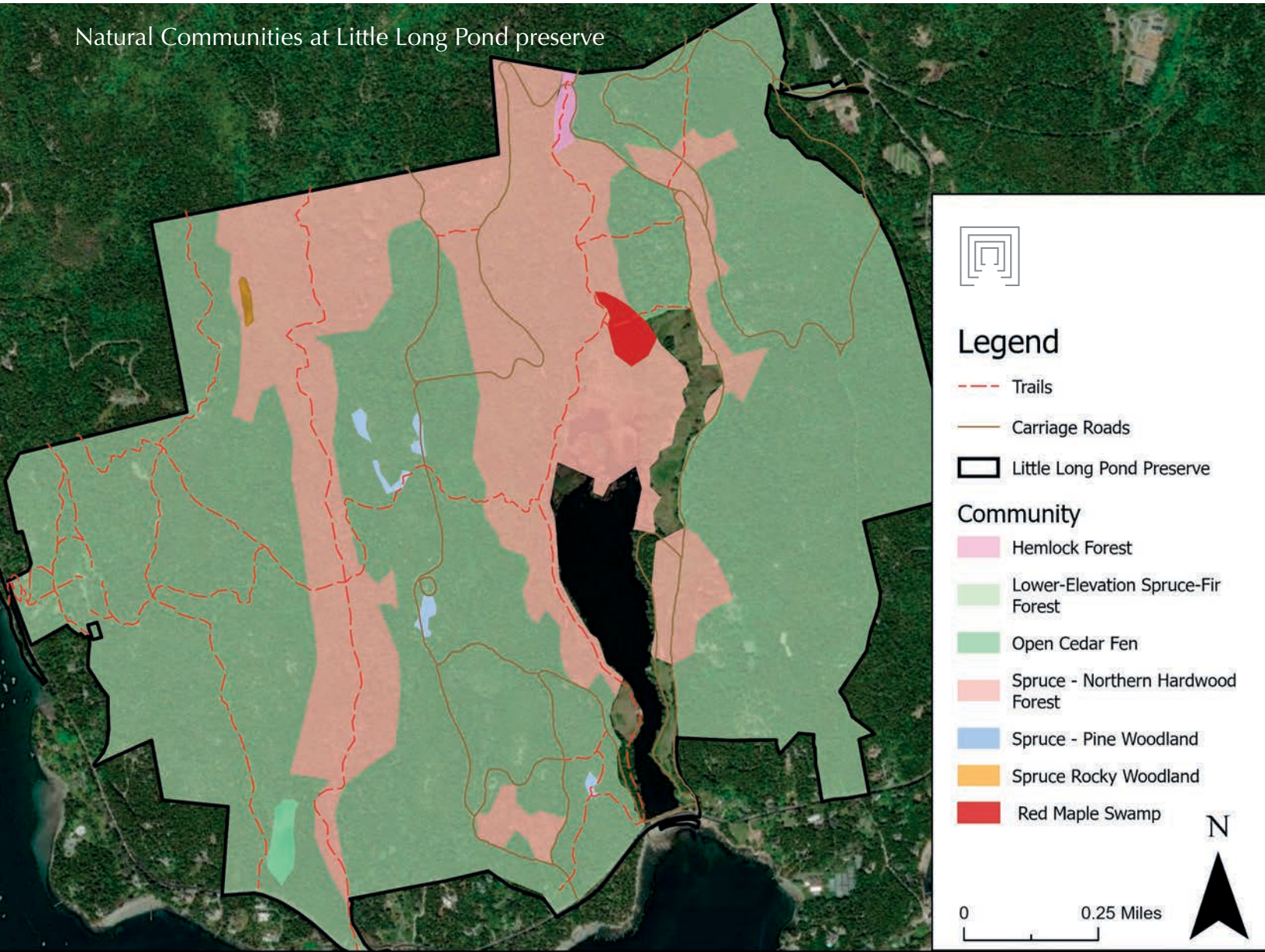
Much of the forest is approximately 120 years old.

It is mostly dominated by the spruce-fir forest that is emblematic of Downeast Maine.

The forest is home to a wide diversity of wildlife.

A NATURAL COMMUNITY is an assemblage of interacting plants and animals and their common environment found recurring across the landscape, in which the effects of human intervention are minimal.

(Gawler & Cutko, 2010)



MARITIME SPRUCE-FIR FOREST / LOWER-ELEVATION SPRUCE-FIR FOREST

These two Spruce-Fir Forest types are very similar to one another and are dominated by red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*) (more white spruce in the Maritime forest). Also present are white pine (*Pinus strobus*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and white cedar (*Thuja occidentalis*) sprinkled throughout in varying amounts, with occasional red oak (*Quercus rubra*), white ash (Fraxinus americana), and eastern hemlock (*Tsuga canadensis*).

These are the characteristic forests of Acadia National Park and Downeast Maine. Their understories are generally sparse and are comprised mostly of regenerating spruce and other canopy trees. The forest floor ranges from bare conifer litter to extensive moss mats to dense ericaceous (heath family plants) swaths depending on overstory conditions. The herb layer is not particularly diverse and generally consists of spotty occurrences of bunchberry (*Chamaepericlymenum canadense*), Canada mayflower (*Maianthemum canadense*), and star flower (*Lysimachia borealis*). These two natural communities are presented here as one unit because they mix at Little Long Pond on a small scale and therefore require more work to map their respective distributions.

The most common forest type at Little Long Pond Preserve.

SPRUCE-NORTHERN HARDWOOD FOREST

The primary exception to the extensive spruce-fir forest is the *Spruce-Northern Hardwood Forest* found on locally enriched soil such as, 1) along mid-lower slopes, 2) stream corridors, and 3) where recent human intervention (agriculture, carriage road management, and species preference) has resulted in hardwood selection. In the *Spruce-Northern Hardwood Forest* the hardwoods present in the *Maritime Spruce-Fir Forest/ Lower-elevation Spruce-Fir Forest* are dominant or co-dominant in the canopy with the softwoods.

Many birch, maple and ash trees along the Harbor Brook.

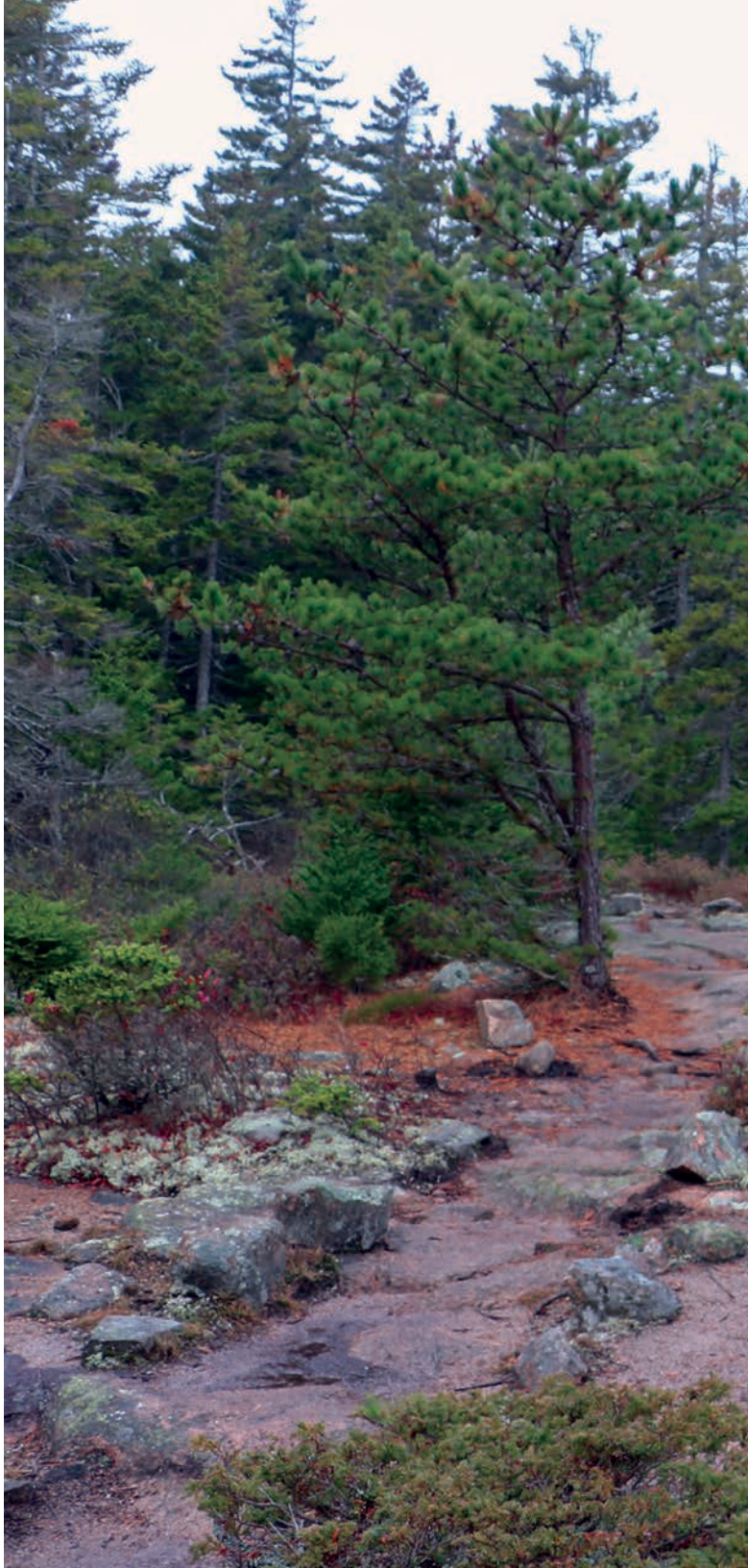
HEMLOCK FOREST

The Hemlock Forest is situated in a steep ravine near the Cobblestone Bridge where cold water from the Jordan Stream keeps the ravine cool and moist during the summer. Here, hemlock is dominant/co-dominant alongside spruce, fir, and the hardwoods (ash, birch, maple). We assume that these hemlocks will be killed by the invasive hemlock woolly adelgid (*Adelges tsugae*) that is currently present and spreading in Maine. Red spruce is common in the understory of the *The Hemlock Forest* and we predict that it will become more dominant tree in the ravine as the hemlock decline.

Hemlock forest by the cobblestone bridge.

SPRUCE-PINE WOODLAND

The *Spruce-Pine Woodland* is an open canopy community (25%-70% closure) occurring in small patches over bedrock where the soil is very thin. The dominant trees are red spruce and white pine and there is a well-developed understory of blueberry (*Vaccinium ssp.*), black huckleberry (*Gaylussacia baccata*), and sheep laurel (*Kalmia angustifolia*). The best example of the *Spruce-Pine Woodland* is on the Friends Trail where an obvious change is visible because of the open canopy and the characteristic exposed bedrock.



Spruce-Pine Woodland as seen from the Friends Path.

RED MAPLE SWAMP

This community is found in a broad basin near the intersection of the Jordan Stream and Little Long Pond, where seasonal flooding and beaver have created a diverse wetland habitat of ephemeral and perennial rivulets and hummock topography. Red maple is dominant, northern white cedar, red spruce are codominant, and white ash, yellow birch, and green ash are present. The forest canopy ranges from semi-open to closed. Visitors on the 'Jordan Stream, Southern Spur' trail walk through this community.

As show here, small channels run through the red maple swamp.

SPRUCE ROCKY WOODLAND

This open canopy community (<50% canopy cover) is found over a steep talus slope on the eastern side of Eliot Mountain. Although small (~2 acres) this community clearly stands out from the surrounding forest. Red spruce, yellow birch, and red maple are the dominant trees, but the tree cover is very sparse and patchy due to the rocky substrate. Here, open slopes of huge boulders are covered in rock tripe lichen (*Umbilicaria ssp.*), marginal wood fern (*Dryopteris marginalis*), and polypody fern (*Polypodium sp.*). Maneuvering through this natural community is difficult and risky due to the slope and rocky terrain.

Spruce Rocky Woodland.

OPEN CEDAR FEN

The Open Cedar Fen is an open canopy woodland community (20%-60% canopy closure) that occurs in a peatland setting directly north of Route 3 and directly to the east of the Eliot Mt. Trail. The dominant tree is northern white cedar and red maple, larch (*Larix laricina*), and red spruce are also present. The shrub layer is comprised of many heath family plants such as lowbush blueberry, leatherleaf (*Chamaedaphne calyculata*), sheep laurel, and sweetgale (*Myrica gale*). The herb layer is diverse and contains cinnamon fern (*Omundastrum cinnamomeum*), royal fern (*Osmunda regalis*), bog aster (*Oclemana nemoralis*), bog goldenrod (*Solidago uliginosa*), rose pogonia (*Pogonia ophioglossoides*), cotton sedge (*Eriophorum sp.*), and three-way sedge (*Dulichium arundinaceum*), which are all embedded in a sea of sphagnum mosses (*Sphagnum ssp.*).

There are dozens of standing dead trees (mostly cedar) in the *Open Cedar Fen* that possibly succumbed to a relatively quick change (increase or decrease) in water level. The fen's water exits through a narrow outlet at its southern end that could have easily been dammed by beaver, which may have flooded and killed the cedar trees. Alternatively, the cedar may have died because of a rapid and sustained drop in water level. Aerial photos show that the fen's eastern channel was not always present, and we take this to mean that it was likely dug by humans who presumably wanted to lower the fen's water level, which may have killed the cedar. Regardless of what killed the cedar, many dozens of regenerating cedar indicate that the fen will become more forested in the future. It may be necessary to reclassify this natural community in the future as the peatland becomes less open.

Dead cedar trees indicate a large change in the recent past.

FOREST CONDITIONS AT LITTLE LONG POND

Destructive factors such as invasive species, forest pests, fragmentation, and deer overabundance that are common in many eastern US forests **have not yet significantly impacted the forests of Mount Desert Island and the Little Long Pond preserve**. Some stressors, such as emerald ash borer (Agrilus planipennis; EAB) will likely come to decimate local ash populations on MDI over the next decade.

Little Long Pond preserve's adjacency to Acadia National Park (ANP) is meaningful because ecologically speaking 'bigger is better.' The two landholdings flow together to create an even bigger natural landscape that allows larger-scale natural processes to function as well as for plants and animals to move unobstructed. Such large, undeveloped, and unlogged blocks of mature forest are uncommon in the Northeast and act as reservoirs for biodiversity now and under future climatic conditions.

National Park scientists have scored ANP's forest condition as 'good' (possible scores: Good, Caution, Significant Concern) based on data collected between 2006 and 2013 (Miller, Mitchell, Curtin, & Wheeler, 2014). Assessments of the ANP forest cannot be strictly applied to the LLP forest but they serve as a reasonable proxy because of the similarity among the two forests. Considering the findings at ANP and our own preliminary studies we currently consider Little Long Pond's forests to be in good condition.

EVEN-AGED vs. UNEVEN-AGED FOREST STANDS

The next time you are in the forest try to guess the relative ages of the trees. Which trees are oldest? Which are youngest? Did they all start growing at the same time? Foresters use the terms 'even-aged' and 'uneven-aged' to describe the ages of trees in a forest stand (a stand is just a group of trees). Even-aged stands are formed when a group of trees is established at the same time, usually after a disturbance such as a storm, insect outbreak, timber harvest, and farm abandonment. Approximately half of the stands at Little Long Pond preserve are even-aged and virtually all of these are comprised of softwoods. You can see from the following photographs that the ages (assumed by size) of these even-aged stands vary, which means they resulted from disturbances that took place at different times.

There is very little structural complexity in this young, even-aged forest stand.

Even-aged stands are sometimes desirable in a forestry context, but they generally lack a very important component of a healthy forest: structural complexity, or the *spatial and physical heterogeneity of physical objects* in the forest. Structurally complex stands have variously sized trees, varied tree spatial arrangements, standing snags, downed logs, canopy openings, younger trees at various stages of regeneration, and bumpy ground topography. Even-aged stands are generally comprised of similarly sized trees and lack virtually all these characteristics. An increase in structural complexity is desirable because it allows for increased habitats, microhabitats, microclimates (all equate to biodiversity) and future generations of trees.

Structurally complex stands support higher amounts of plant and animal biodiversity and are generally more resilient to ecological stressors such as drought, invasive plants, insect outbreak, storms, etc. All stands (including even-aged stands) slowly develop greater complexity over time through natural processes. In the Northeast structural complexity is developed through decades of frequent, yet small-scale disturbances, specifically windstorms. The mechanics are quite simple: as windstorms topple trees new patches of light can penetrate the canopy and favor the growth of new trees.

The trees are densely packed and competition for light is high in this even-aged forest stand. Trees that cannot compete die and fall over, eventually leading to the recruitment of new trees.

FOREST RESILIENCY

Ecosystems naturally change over time but the problems facing the planet today stem from the ***rate of change***, which humans have accelerated. The Land & Garden Preserve recognizes that the goal of forest management is not to maintain the ecosystem *exactly* as it currently exists. Tree species and ecosystem processes may change; however, it is important that forest ecosystems persist *as forests* in the face of climate change and anthropogenic stresses because of their overall biological richness and importance. We must accept their unpredictable futures while striving to support their basic life-supporting properties (Messier, et al., 2019).

FOREST RESILENCY

Forest resiliency can be defined as the ability of a forest to absorb disturbance and reorganize under change to maintain similar functioning and structure (Scheffer, 2009). All ecosystems naturally have resiliency and considering global climate change and other anthropogenic stressors scientists and natural resource managers have increasingly recognized the importance resiliency may play in sustaining life on the planet by cleaning water, producing soil, providing plant and wildlife habitat, buffering flood and drought events, storing carbon, and providing recreation and meaningful spaces for humans. **Of particular interest to Land & Garden Preserve is the ability to *maximize* and *support* Little Long Pond's forest resiliency.**

Following are ecosystem properties and factors that can support forest resiliency and some information about their status and trajectory at Little Long Pond preserve.

TREE REGENERATION

In the absence of tree regeneration, a forest will experience significant change and/or a transition to non-forest. Seedlings and saplings must overcome intense pressures such as drought, herbivory, nutrient deprivation, and competition to become fully established. Tree regeneration is currently not an issue at Little Long Pond but can be seriously impacted by an overabundant deer herd.

TREE / SPECIES DIVERSITY

Greater diversity of tree species confers resiliency to the forest because disturbances generally affect species differentially. For example, an insect outbreak will usually only impact a small number of species and leave others unscathed. The spruce-fir forest naturally has low tree diversity, which may make it inherently less resilient.

TREE ADAPTEDNESS

It is impossible to predict exactly how or where a tree species range will shift in response to climate change, but it is widely accepted that changes are likely to occur. The table on the next page shows tree species and predictions of how competitive they will be in the future.

[TABLE 1] Predicted Change in Suitable Habitat

The following table provides tree species and predictions of how competitive they will be in the future. The values following each species name indicate whether species-suitable habitats will increase (+), decrease (−), or stay the same (●) under projected climate change.

Northern New England (Ecological subsections M211A, B, C, and D, and M211E and J)		
Tree Species	Low Emissions (PCM B1)	High Emissions (GFDL A1FI)
Balsam Fir	−	−
Black Spruce	−	−
Northern White Cedar	−	−
Paper Birch	−	−
Red Spruce	−	−
Tamarack	−	−
White Spruce	−	−
American Beech	●	−
Quaking Aspen	●	−
Sugar Maple	●	−
Yellow Birch	●	−
Bear/Scrub Oak	●	●
Bigtooth Aspen	●	●
Eastern White Pine	●	●
Red Maple	●	●
American Basswood	●	+
Bitternut Hickory	●	+
Black Cherry	●	+
Pitch Pine	+	●
Black Birch	+	+
Black Oak	+	+
Chestnut Oak	+	+
Northern Red Oak	+	+
Shagbark Hickory	+	+
White Oak	+	+
Threatened by Current Forest Health Issues (Do not target)		
Black Ash	−	−
Eastern Hemlock	●	●
White Ash	●	●

Southern New England (Ecological subsection M221A)		
Tree Species	Low Emissions (PCM B1)	High Emissions (GFDL A1FI)
Balsam Fir	−	−
Black Spruce	−	−
Eastern White Pine	−	−
Northern White Cedar	−	−
Paper Birch	−	−
Quaking Aspen	−	−
Red Spruce	−	−
White Spruce	−	−
Tamarack	−	●
American Beech	●	−
Northern Red Oak	●	−
Red Maple	●	−
Yellow Birch	●	−
Bear/Scrub Oak	●	●
Black Cherry	●	●
Sugar Maple	●	●
Bigtooth Aspen	+	●
Pitch Pine	+	●
American Basswood	●	+
Bitternut Hickory	+	+
Black Oak	+	+
Chestnut Oak	+	+
Shagbark Hickory	+	+
White Oak	+	+
Threatened by Current Forest Health Issues (Do not target)		
Black Ash	−	−
Eastern Hemlock	●	●
White Ash	●	●

Projected change in suitable habitat in the year 2100 based on Tree Atlas projections for a given ecological subsection. Prasad, A. M., L. R. Iverson, S. Matthews, M. Peters. 2007–ongoing. A Climate Change Atlas for 134 Forest Tree Species of the Eastern United States [database]. www.nrs.fs.fed.us/atlas/tree, Northern Research Station, USDA Forest Service, Delaware, Ohio.

Tree species and predictions for future competitiveness

from: *Increasing Forest Resiliency for an Uncertain Future*, by Paul Catanzaro, Anthony D'Amato, and Emily Silver Huff

Mount Desert Island falls within the Northern New England group, where, under a low emission scenario, many of our common tree species (balsam fir, black spruce, northern white cedar, paper birch, red spruce, tamarack, and white spruce) are predicted to lose some competitiveness while trees uncommon to or not currently on MDI such as black birch (*Betula lenta*), black oak (*Quercus velutina*), chestnut oak (*Quercus montana*), red oak, shagbark hickory (*Carya ovata*), and white oak (*Quercus alba*) will gain some competitiveness. It is important to take these predictions with a grain of salt and understand their true meaning. The table on the preceding page should not be taken as a prediction of which species will be replaced by other species. Instead, this research is saying that based on region-wide climate variables (primarily temperature and moisture) the predicted climate in northern New England will be one that we more often associate with black birch, oaks, and hickory than with boreal forest species.

One thing to consider while digesting this prediction is that the climate at Little Long Pond is heavily influenced by the Gulf of Maine and that region-wide, climate-based models may not be able to discern and reflect these coastal effects. It may be that over the next 100 years interior Maine sees a change in vegetation that is different than that in coastal Maine. At the same time, it is important to remember that Mount Desert Island sits just outside of the natural range of many of the oak and hickory species and a small shift in climate variables may be all that is needed to shift the competition in their favor. Similarly, some hardwood species such as ironwood (*Ostrya virginiana*), cherry (*Prunus* ssp.), sugar maple (*Acer saccharum*), and musclewood (*Carpinus caroliniana*) are currently present at low levels on MDI. These species may become more common under a changing climate.

The best way to ensure that well adapted trees are present at Little Long Pond is to manage for overall tree diversity.

The best way to ensure that well adapted trees are present at Little Long Pond is to manage for overall tree diversity and to not invest in tree species that have bleak futures such as hemlock and ash that will likely experience local extirpations due to invasive insects.

STRUCTURAL COMPLEXITY

As described above, structural complexity can be thought of as spatial heterogeneity and occurs as stands develop over time to form various structural layers (overstory, understory, etc.) of patchy and irregular vegetation patterns. Structural complexity strengthens a forest's resiliency because the diversity of microclimates and micro habitats are differentially affected by disturbance, which increases the chances of intact habitat persisting once the disturbance has passed. For example, a nor'easter may topple all spruce trees of a certain size on a hillside but do nothing to the smaller trees growing in the understory, which then come to inherit the site. Many forest stands at Little Long Pond are even-aged and are still developing ideal structural complexity.

Trees of various ages and sizes and dead trees lying on the forest floor demonstrate structural complexity.

INVASIVE SPECIES

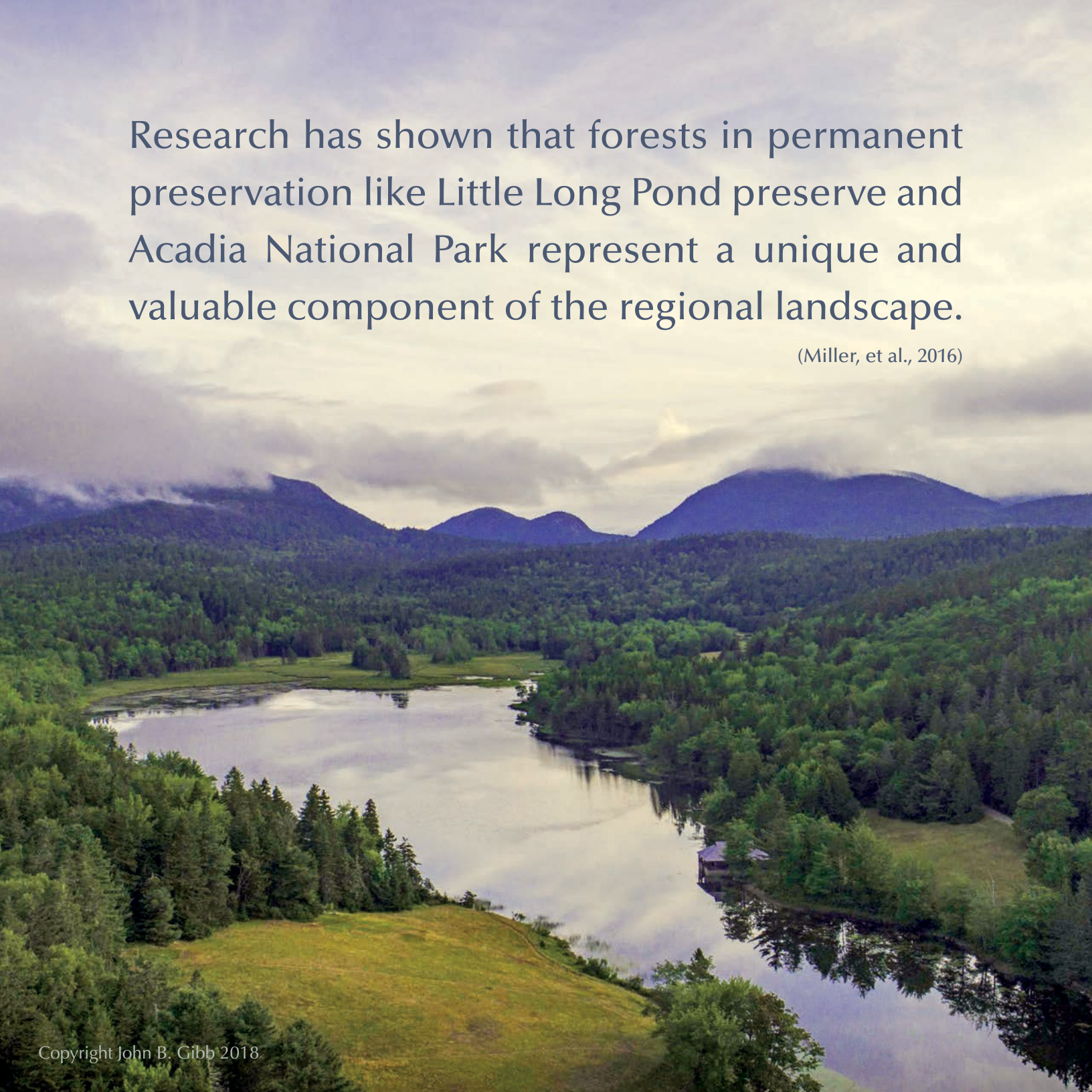
Invasive species can undermine forest resiliency by killing and/or replacing native species and altering forest structure. Invasive plants are currently minimal at Little Long Pond preserve but invasive insects are poised to create significant change in the coming years/decades. Emerald Ash Borer and Hemlock Woolly Adelgid (HWA) are two exotic invasive insects that generally end up killing their host. Millions of trees have already succumbed to these two insects in the US, which are currently (December 2020) established in Maine in Aroostook, Cumberland, and York counties (EAB) and Cumberland, Knox, Lincoln, Sagadahoc, and York counties (HWA). The Red Pine Scale (*Matsucoccus resinosae*), another exotic invasive insect, is already established on Mount Desert Island and responsible for killing our native red pine trees. The Little Long Pond forest will have less diversity and less resiliency once these pests eliminate their host species from the landscape.

HABITAT CONNECTEDNESS

The edges of habitats can be vulnerable to invasive plants. Although the overall shape of the natural lands at Little Long Pond resembles a circle, where edge is minimized, past owners have created many miles of internal edges by building the carriage road system, vistas, meadows, parking lots, and other structures. Land & Garden Preserve staff has observed invasive plants growing along these external and internal edges. These edges may also fragment 'interior' habitat that is shrinking in Maine and important to sensitive wildlife.

OLD GROWTH FOREST

THE ULTIMATE IN FOREST RESILIENCY


Research has shown that forests in permanent preservation like Little Long Pond preserve and Acadia National Park represent a unique and valuable component of the regional landscape.
(Miller, et al., 2016)
Copyright John B. Gibb 2018

When people hear the words 'old growth' they usually think of the redwood trees of the Pacific Northwest, but we now know that the eastern United States was once home to its own type of old growth forest. It is important to recognize that old growth forests look and function differently across the landscape, from the Pacific Northwest to the US Southeast to the Canadian boreal forest.

Scientists have found that eastern old growth forests differ in meaningful ways from second growth and even mature forests including carbon storage, resilience, biodiversity, and interactions with streams.

> **This leads to a *functional* definition of old growth forests: 'ecosystems that are dominated by old trees and have unique characteristics of stand structure (size, ages, spacing of trees), and species composition (including all forms of life), dead wood, and ecosystem function'** (Lapin, 2005).
>
> **Older forest habitat is currently very rare in the Northeast; Lorimer and White (2003) estimate that 70-89% of pre-settlement northern hardwood forests were old-growth (uneven-aged, >150 years old), whereas they occupy less than 0.5% of the region today** (Davis M. B., 1996).

Virtually all the land that has been legally conserved in the Northeast (state and national parks, state and national forests, wildlife reserves, historic sites, lands protected by land trusts) is second growth or younger, having been at one or many points in history cleared for agriculture and/or timber harvest. Maine is carpeted by vast forests, but it is important to remember that most are 'working forests' (aka logged) and are generally diminished in terms of ecosystem services and are unable to develop structural complexity and old age characteristics. Research has shown that forests in permanent preservation like Little Long Pond preserve and Acadia National Park represent a unique and valuable component of the regional landscape. (Miller, et al., 2016)

MANAGEMENT GOALS

The Land & Garden Preserve is currently managing the forest of Little Long Pond preserve with two principal goals in mind.

GOAL: ECOLOGICAL HEALTH

Approximately 90% of the forest – corresponding to the area where visitors tend not to be (off the carriage road or trails) – is managed primarily for its ecological health and its trajectory toward a mature forest with old-growth characteristics. Specifically, forest management activities here will aim to increase and sustain structural complexity, species diversity, and pools of coarse woody debris, which are supported by the current, mostly hands-off approach to forest management.

GOAL: VISITOR EXPERIENCE

The remaining 10% of the forest is managed primarily for visitor experience in areas where visitors tend to concentrate, such as along the carriage road system, trail system, at the boathouse, and water access areas. Here, forest management activities aim to mitigate hazard trees, highlight unique forest features along the carriage roads (rock outcrops, specimen trees, etc.), facilitate carriage road maintenance, and provide select historic views and vistas.

MANAGEMENT PRACTICES

MANAGEMENT PRACTICES

To achieve our goal of managing Little Long Pond's forest for eventual old growth conditions we will let natural processes unfold and minimize human intervention on most of the natural lands. Below are examples of management practices aligned with our old growth forest and visitor-based goals.

MANAGEMENT PRACTICE:
RETAIN STANDING & DOWNED DEADWOOD

Standing dead trees (snags) are critical for dozens of wildlife species as foraging, nesting, shelter, and/or denning sites (see table below). Likewise, fallen trees are also very important to the forest and act as denning sites to mammals, nurse logs for trees, habitat for a variety of moss species, foraging sites for birds, as well as a carbon source for future soil. Retaining both snags and fallen trees where possible is critical for forest health. In general, larger diameter snags and fallen logs are more valuable to wildlife than smaller diameter so it is especially important to retain large diameter features where they occur. Snags along the carriage roads are removed if they pose a threat to human safety. Trees that naturally fall in the forest are generally left unless they are hazardous or have fallen on or too close to a structure (building, carriage road, etc.). Anecdotally, we hear that people generally like the aesthetic of very old, decomposing snags and fallen logs because as the dead wood ages it takes on a unique look (i.e., covered in moss, full of woodpecker holes, etc.).

Cavity-Nesting Birds'[1] (40 species) and Cavity-Using Mammals'[2] (13 species) use of cavities in New England.

Species Common name	Food	Nest	Perch
BIRDS			
Wood duck	X	X	X
Common goldeneye		X	
Barrow's goldeneye		X	
Bufflehead		X	
Hooded merganser		X	X
Common merganser		X	X
Turkey vulture		X	X
Black vulture		X	X
Merlin		X	X
American kestrel		X	X
Barn owl		X	X
Screech owl		X	X
Hawk owl		X	X
Barred owl		X	X
Boreal owl		X	X
Saw-whet owl		X	X
Chimney swift		X	
Common flicker	X	X	X
Pileated woodpecker	X	X	X
Red bellied woodpecker	X	X	X
Red headed woodpecker	X	X	X
Yellow-bellied sapsucker	X	X	
Hairy woodpecker	X	X	X
Downy woodpecker	X	X	X
Black-backed woodpecker	X	X	
Three toed woodpecker	X	X	

Species Common name	Food	Nest	Perch
BIRDS Continued			
Great crested flycatcher		X	X
Tree swallow		X	
Purple martin		X	X
Black-capped chickadee		X	
Boreal chickadee		X	
Tufted titmouse		X	
White-breasted nuthatch		X	
Red-breasted nuthatch		X	
Brown creeper		X	
House wren		X	
Winter wren		X	
Carolina wren		X	
Eastern bluebird		X	X

Species Common name	Den/Shelter
Mammals	
Racoon	X
Northern flying squirrel	X
Southern flying squirrel	X
Fisher	X
American marten	X
Mink	X
Grey fox	X
Porcupine	X
Red squirrel	X
Grey squirrel	X
White footed mouse	X
Eastern chipmunk	X
Silver-haired bat	X

1. Source: Cavity - Nesting Birds of North American Forests, Agriculture Handbook 551, November 1977, Forest Service, U.S. Department of Agriculture (full citation in reference section)
2. Source: New England Wildlife, 2001, DeGraaf and Yamasaki (full citation in reference section)

MANAGEMENT PRACTICE:
MANAGE INVASIVE PLANTS

Most of the plants in the forest are either native or naturalized; invasive plants make up a small percentage of the flora. Currently present are buckthorn, Asiatic bittersweet, Japanese barberry, Norway maple, and Japanese knotweed. Populations of these plants at LLP are generally small and linked to past land disturbance. They have only secured a foothold in a few places within the forest and long-term eradication of most populations is foreseeable in the next 5-10 years. Major management progress has already taken place on some populations, most notably buckthorn in the Open Cedar Fen, at Thuya Garden, along the shores of Little Long Pond, and along the Little Harbor Brook. Management of bittersweet is ongoing along the shores of LLP.

The Land & Trails staff carries out a robust invasive plant monitoring and management program that relies on mapping (GIS), annual field work (~4 weeks), and collaboration with community partners (ANP and Lake Stewards of Maine, among others) for its success. The staff keeps annual reports that map and summarize that year's invasive plant management work, which can be consulted for the most updated information. Introduction of new invasive plants (i.e., stilt grass, *Microstegium vimineum*) are likely to occur and are monitored.

MANAGEMENT PRACTICE:
MANAGE TREES ALONG THE CARRIAGE ROAD CORRIDOR

Prior to the lands around Little Long Pond coming under the management of the Land & Garden Preserve, the forest was regularly "cleaned" along a thin strip adjacent to the carriage roads. Sticks were manually collected and downed logs and fallen trees were removed by machine. The Land & Garden Preserve has discontinued this practice in the interest of greater forest health. We have observed that in the absence of routine tree culling, the edges of the carriage roads grow thick with young spruce that generally interfere with road drainage and encroach upon the road surface. Therefore, Land & Garden Preserve needs to manage vegetation along the carriage roads to keep the roads passable and the drainage ditches functional. This vegetation management gives us a great opportunity to shape the look and feel of the roadside trees in a variety of ways to support the visitor experience. This management is usually directly adjacent to the carriage road and may extend ~10'-30' into the forest. For example, in areas of impressive rock outcrops we curate a setting that highlights the stone by thinning and pruning trees that otherwise would block it (see photo below). On the outcrop itself we tastefully retain significant trees (large trees, trees with interesting architecture, etc.) and important plant textures (lichens, mosses, small trees, etc.) that juxtapose the stone's hardness.

Trees were pruned and small trees and branches removed to highlight the bedrock and create a curated setting along the carriage road.

Another example of carriage road vegetation management is highlighting mature trees with impressive stature. This straightforward practice usually requires us to remove smaller and competing trees that are adjacent to very large trees, with the goal of maximizing their visibility and growing space. The north-running carriage road that begins at the Bracy Cove entrance has an approximately quarter mile stretch of towering hardwood trees (mostly yellow birch and red maple) on either side of the carriage road that come together to form a tunnel under which visitors walk. This unique feature – situated just north of the boathouse – is one of the true gems of the carriage roads. Here, we have brought additional attention to some trees by culling their neighbors and have begun selecting for the next generation of large hardwood trees.

We are also taking advantage of storm blow downs along this stretch of carriage road to select a desired tree from the resulting regenerating saplings. The next generation of large hardwood trees needs to be well established, have a robust and well-formed crown, and have adequate growing space or the opportunity for us to create adequate growing space. This constellation of ideal factors is not common, but they do emerge every so often.

Another general example of vegetation management along the carriage roads is promoting tree diversity. Uncommon tree species such as oak, shadbush (Amalanchier spp.), cedar, sugar maple, and to a lesser extent yellow birch, red maple, and striped maple are sometimes selected when they are growing among a dense clump of spruce and fir trees. Spruce and fir trees are the most common and abundant species on Mount Desert Island and generally do not need any additional favoring. By selecting the less common species we are promoting tree diversity (bolstering forest resiliency), as well as creating a visually heterogeneous – and more stimulating – environment to walk through.

Large trees on either side of the carriage road form a tunnel. Competing trees (mostly spruce and fir) are periodically removed from this area to provide more growing space to the large, selected trees.

MANAGEMENT PRACTICE:
MAINTAIN VISTAS

When the carriage road system on MDI was built the forest was recovering from large-scale timber harvest and its trees were short. Therefore, many places along the carriage road system offered wonderful views of the surrounding landscape. Many of these views have since been blocked by regrowing forests and the experience of using the carriage road has changed. We currently maintain two vistas along the carriage road and one vista from Eliot Mountain. Maintaining a vista requires managing the vegetation (usually felling trees) to allow for unobstructed views of a chosen landscape. Vistas are usually popular among visitors and represent a great opportunity to orient them and connect them with their surroundings.

Maintaining open vistas in an otherwise closed forest has ecological consequences that need to be better understood. Generally, we know that vistas introduce additional edges to the forest, which is where invasive plants are likely to become established. For example, Lands & Trails staff found a thriving population of invasive buckthorn in a vista at the Thuya Garden. Also, this type of interior forest edge allows wind to penetrate a forest, which leads to additional drying in the summer (increased drought stress) and wind stress during storms. There are currently no plans to create any additional vistas.

This vista from the carriage road overlooks the meadow and Little Long Pond.

MANAGEMENT PRACTICE:
BUILD SUSTAINABLE TRAILS

Little Long Pond's trail system is ten miles long and accesses every major part of the natural lands. Many trails were laid out and blazed many decades ago and are insufficient in accommodating the current volume of visitor traffic. In 2020 Lands & Trails staff measured the number of visitors at LLP's three most popular entrances (Bracy Cove, Upper Lot, Little Harbor Brook) to find that we received 65,000 human visits and 36,000 dog visits (Gibson, 2020). Lands & Trails staff has been repairing and maintaining trails for approximately six years and is in the process (2021-2022) of a large trail restoration project on the David & Neva Trail and Jordan Stream Trail as these are the trails with some of the highest visitor use.

To accommodate our current visitor volume the trails must be built out of hard material (stone and/or packed mineral soil) which requires that the soft material (organic soil and surface roots) be removed. The trail corridor is considered a 'sacrifice zone' because trail building and trail maintaining sometimes have a detrimental impact on the nearby trees. For example, a tree will die if enough of its roots are cut or trees sometimes need to be removed because of proximity to the trail. Sacrificing a narrow corridor through the woods and building a trail with hard materials is generally seen as a less destructive option than keeping an underperforming trail system. The less-intensively built trail will result in an ambiguous, erodible treadway that leads to social trails, trail widening, trail creep and, in the long run, more impact to the surrounding forest. Lands & Trails staff construct 'sustainable' trails in a manner consistent with industry best management practices for storm water management, erosion, and trail longevity.

ECOLOGICAL MONITORING

The Land & Garden Preserve does not currently allocate much resource to monitoring changes in the forest because the Northeast Temperate Network (National Park Service) has a robust monitoring and science program in Acadia National Park that we can use as a proxy for LLP's forest. The following are exceptions:

CANOPY GAPS

The Land & Garden Preserve has begun mapping its known forest canopy gaps for the purpose of surveying for invasive species. Invasive plants generally find a competitive advantage in disturbed sites with high light conditions, such as canopy gaps. Keeping track of and monitoring these canopy gaps is a proactive way to prevent invasive plants from getting established. Secondarily, by focusing on woody saplings, canopy gaps can also give us a look at new forest recruits and, therefore, stand development.

BROWNTAIL MOTH

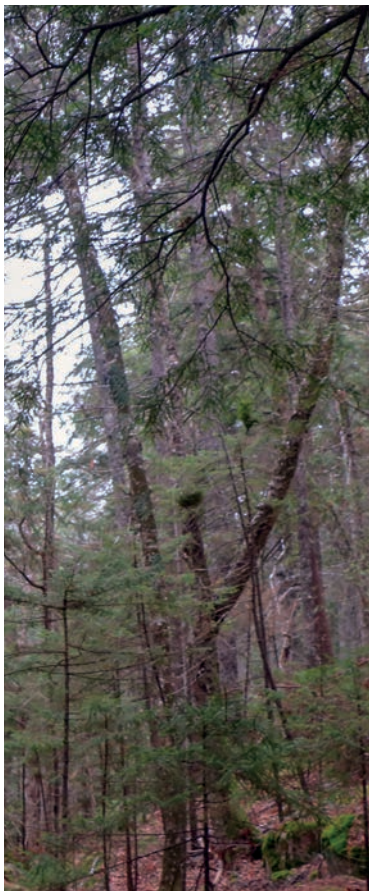
Browntail moth (*Euproctis chrysorrhea*), is an invasive insect found along the coast of Maine and Cape Cod. The browntail moth caterpillar — active April to late June — has tiny poisonous hairs that cause dermatitis like poison ivy via direct human contact with the caterpillar or indirect from contact with airborne hairs. Most affected people develop a localized rash that will last a few hours up to several days. The caterpillars feed on the foliage of hardwood trees and shrubs including oak, shadbush, apple (*Malus* sp.), cherry, beach plum (*Prunus maritimus*), and rugosa rose (*Rosa rugosa*). Browntail moths were observed in multiple locations in Seal Harbor in 2020 and 2021 and resulted in rashes on multiple individuals. Because this moth has the potential to impact the visitor experience at Little Long Pond, the Land & Garden Preserve monitors for and manages the caterpillar where possible.

Current monitoring and management methods focus on searching for the moth's webs in the winter and early spring, and manually removing and destroying confirmed occurrences. The webs are constructed of white silk and are tightly attached to the tree. Webs in fruit trees (i.e., crabapple at Little Long Pond) will be low to the ground and can be removed easily by staff whereas webs in mature oak trees may need to be removed by contracted professionals. The State of Maine is currently doing a good job of tracking and mapping known occurrences of browntail moth and providing web-based resources on identification and removal to individuals and municipalities.

NATURAL RESOURCE INVENTORY

The Land & Garden Preserve launched a natural resource inventory in 2020 that will initially focus on Little Long Pond preserve's vascular plants. This inventory will inform management decisions and act as a baseline against which we can compare future inventories. This type of high-resolution dataset is rare and invaluable. The Maine Natural History Observatory has been contracted to conduct the initial survey, which will be stored in a searchable database as well as in a spatial database for use in Arc GIS. As part of the inventory plants specimen are collected and stored in College of the Atlantic's herbarium.

CONCLUSION



The forest of Little Long Pond preserve is currently healthy but is likely to experience stress induced by climate change and invasive species (plants and insects). The forest is resilient, and the Land & Garden Preserve aims to bolster this resilience through managing for old growth forest characteristics where possible. We allow approximately 90% of the forest to undergo natural processes while maintaining the remaining 10% in a way that is safe and enjoyable for visitors.

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