Global Loss of Wetlands

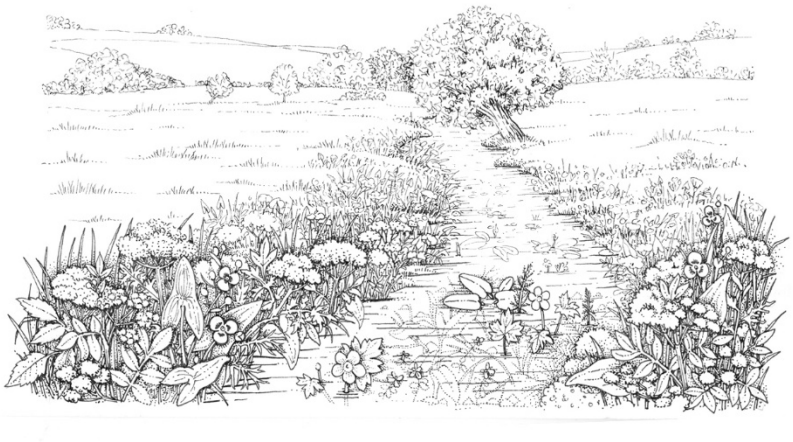
AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

1 Global Loss of Wetlands:

Wetlands stabilize climate, clean water, and support biodiversity. Despite the growing recognition of their value, globally, wetland degradation and loss continue. Scientists estimate that between 54% and 57% of natural wetlands have been lost since the Industrial Revolution. These losses have accelerated by more than three hundred percent over the last century. The deterioration of wetlands around the world is widespread and became worse between 2011 and 2017. The Ramsar Convention, a global treaty to stem the loss and degradation of wetlands, was established 50 years ago, and is currently agreed upon by 171 countries. Yet wetlands degradation and loss continue around the world including in the U.S.



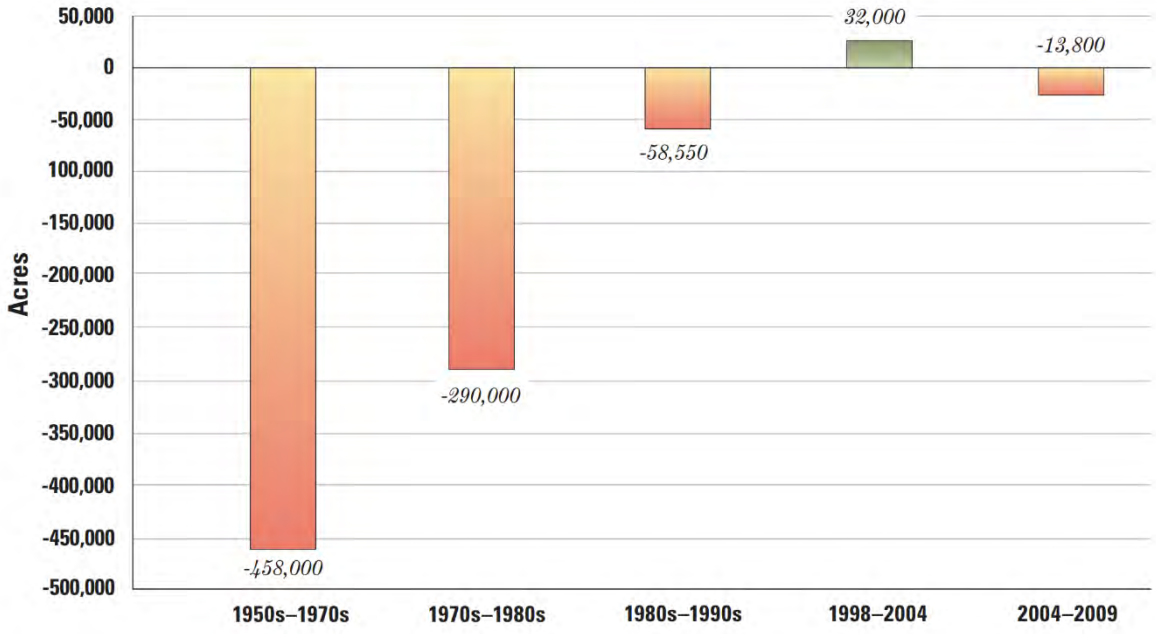


Figure 19. Average annual net loss and gain estimates for the conterminous United States, 1954 to 2009. Estimates of error are not graphically represented. Sources: Frayer et al. 1983; Dahl and Johnson 1991; Dahl 2000; 2006; and this study.

Wetland Conditions Nationally and Locally

AUDIO DESCRIPTION

VIRTUAL TOUR

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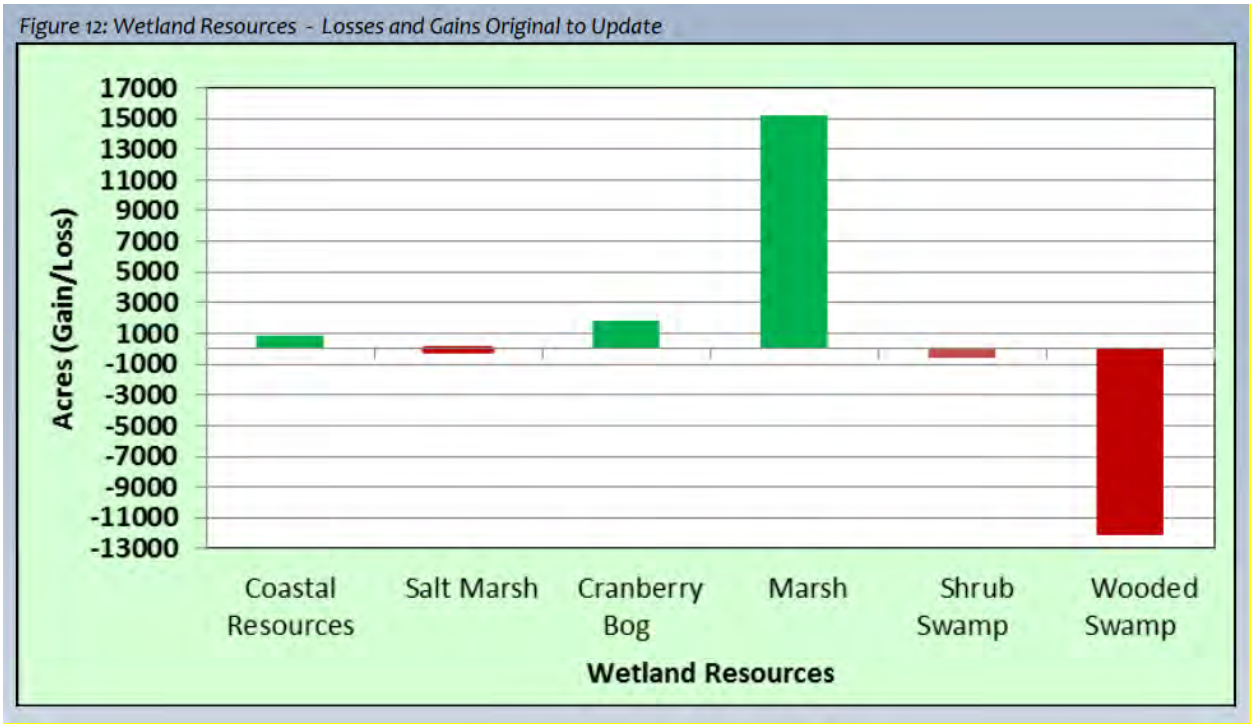
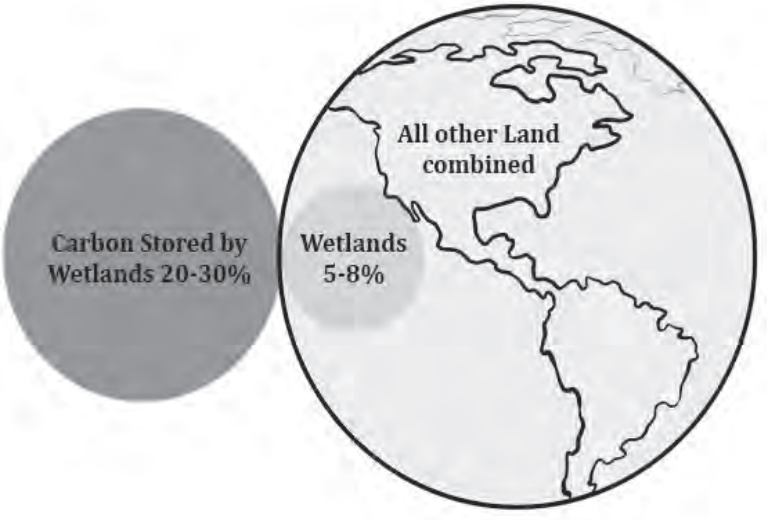
2 Wetland Conditions Nationally and Locally:

In 2011, the EPA assessed the condition of wetlands in the U.S. and found that across the nation 48% of the wetland area is in good condition, 20% is in fair condition and the remaining 32% are in poor condition. In Massachusetts only 52% of wetlands were estimated to be in good condition.

With regard to loss of wetlands, the picture is brighter in Massachusetts due to local, state and federal wetland protection regulations. Here in Massachusetts, the total area of freshwater wetlands increased by 4,188 acres and coastal wetlands increased by 737 acres. Increases include marshes and cranberry bogs, but wooded swamps lost ground and were most likely to be lost to residential development. Most of the coastal wetland gains were for beaches and tidal flats whereas salt marshes were still being lost faster than they can be restored.





Wetlands in the Carbon Cycle

AUDIO DESCRIPTION

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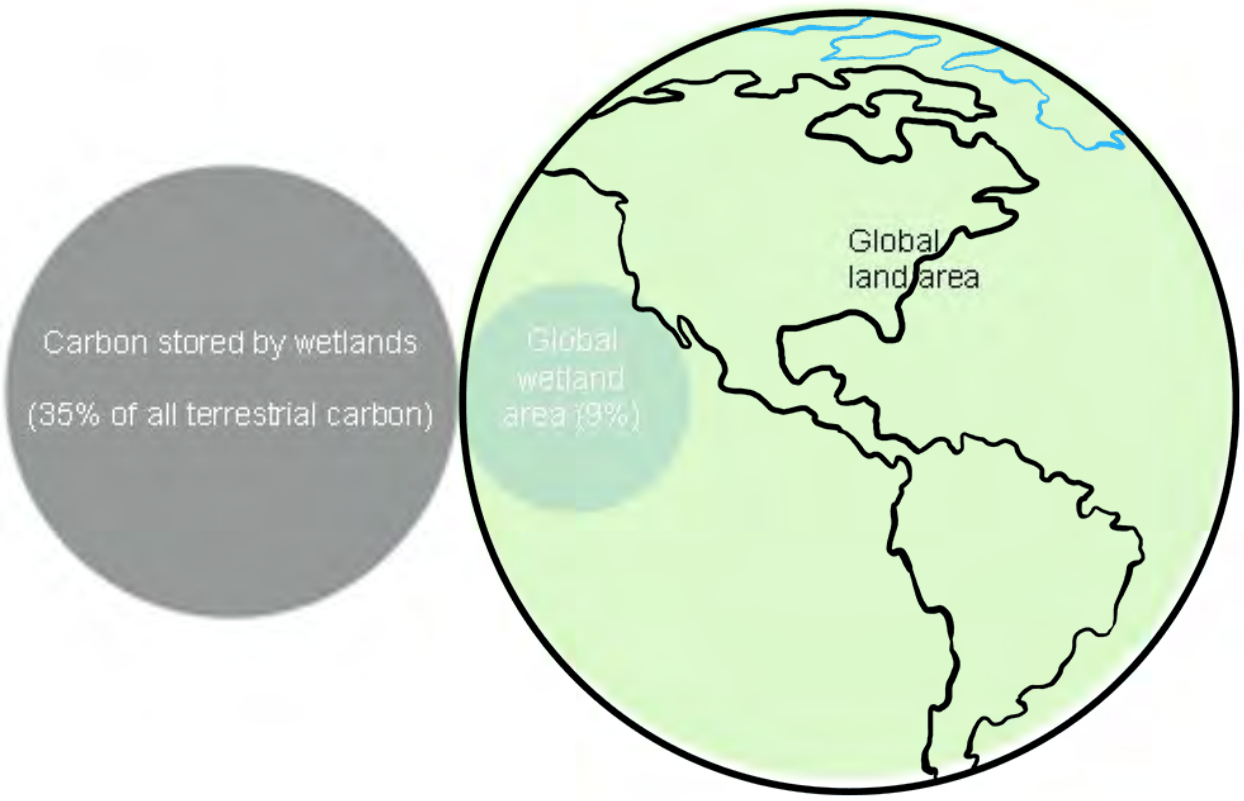
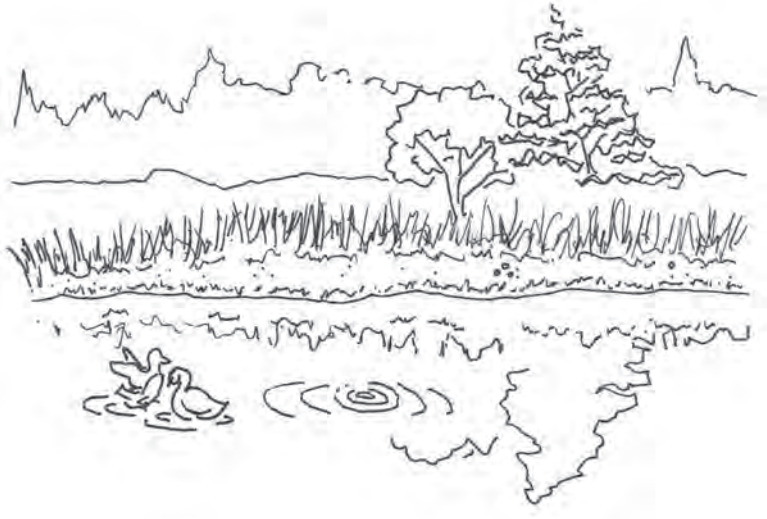
3 Wetlands in the Global Carbon Cycle

In addition to their cooling effects and role in the atmospheric water cycle, wetlands play a big role in storing carbon, thereby reducing global warming and stabilizing the climate. Although wetlands occupy only 5% - 8% of the earth's land surface, they store approximately 20% - 30% of the world's soil carbon. Carbon sequestration refers to the process whereby atmospheric carbon is converted into plant material and temporarily stored, and then the portion that does not return to the atmosphere when the plant decomposes becomes soil organic matter for long term storage. Wetlands accumulate more carbon than uplands because decomposition happens more slowly in low oxygen wetland soils.





Our Impacts to Wetland Carbon Sequestration

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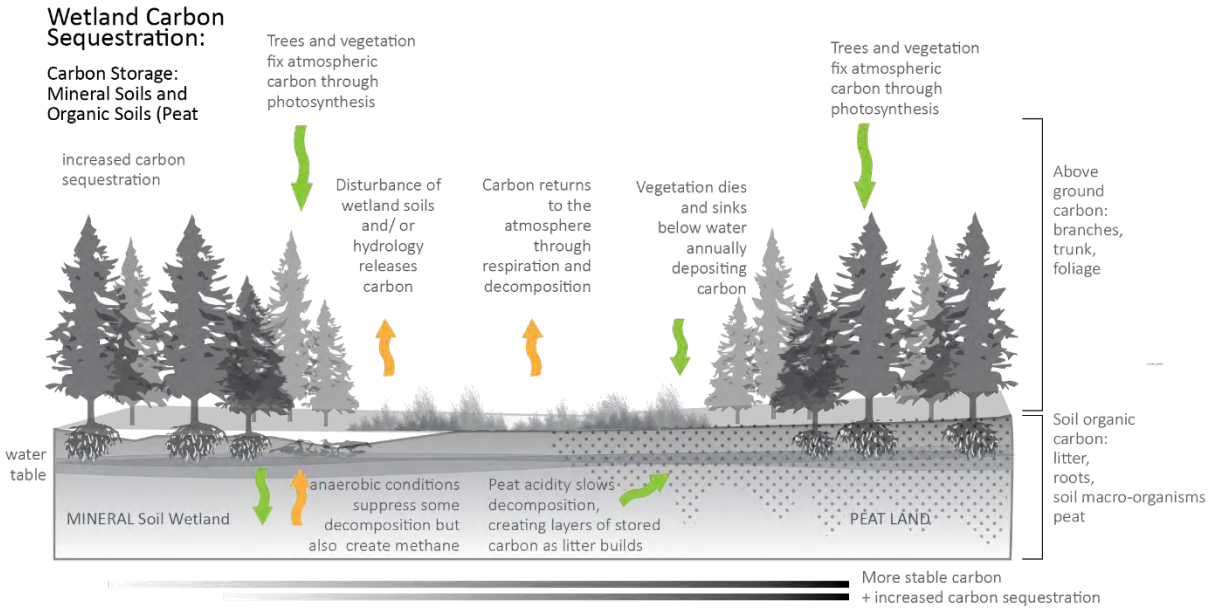
4 Impacts to Wetland Carbon Function

Changes in type or function of wetland can mean a loss of ecosystem services, reduced air-cooling, carbon sequestration or habitat loss. Although loss of wetlands to development requires wetland replication in Massachusetts, human-constructed wetlands often do not provide the full suite of ecosystem services provided by undisturbed natural wetlands, and often, particularly with freshwater wetlands, do not replicate the carbon sequestration and storage functions for tens, hundreds or even thousands of years later



How Wetlands Protect Us

AUDIO DESCRIPTION

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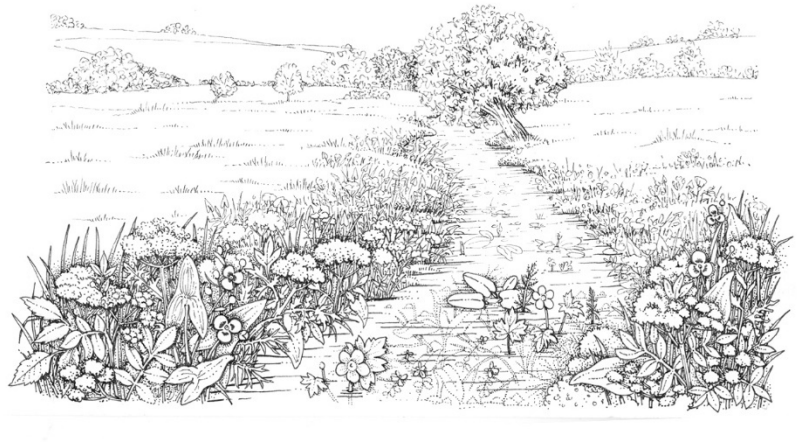
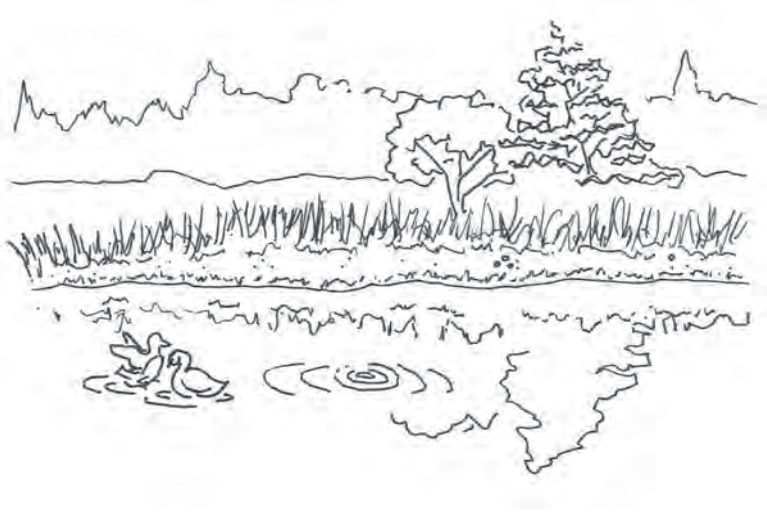
6 Climate Resilience Provided by Wetlands/ Protection from Flooding, Drought and Storm Damage

Wetlands also play a disproportionate role in providing climate resilience ecosystem services for human communities. These include flood control, storm damage prevention, cooling, improving water quality and water supply, fish, shellfish, and wildlife habitat, biodiversity, and both local and regional habitat/ecosystem connectivity.

Wetlands absorb and store flood waters during storm and peak flow events, reducing flood and storm damage. Over time, they release these waters gradually, and during drought, high heat, and low flow times, these releases support base flow in streams and provide water supplies for humans and biodiversity. Functioning like a sponge, wetlands even out the highs and lows of the water cycle and protect communities and ecosystems from the increasing frequency and severity of flooding, drought and storm damage.





Wetlands and Water Quality

AUDIO DESCRIPTION

VIRTUAL TOUR

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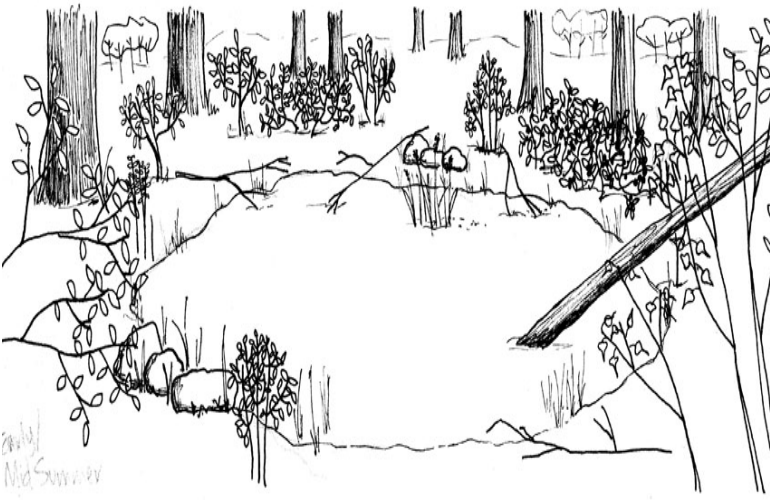
7 Water Quality:

Water quality can deteriorate during flooding events because water flows into upland areas, picking up pollutants and toxins that ordinarily are beyond the reach of flowing water. Unfortunately, water quality also tends to deteriorate during periods of low flow and drought, as the contaminants that are already in the water become more concentrated. Wetland soils and vegetation, acting as landscape-level kidneys, trap, filter, transform and bind nutrients (such as nitrogen), pollutants and sediment, such that water leaving a wetland is cleaner than water entering a wetland.

Vegetation in wetlands shades streams and rivers, thus helping to maintain cooler water temperatures which then support higher oxygen levels in the water. The cooler temperatures and higher oxygen levels help support cold water fisheries and avoid algal blooms and other temperature-related water quality issues. Thus wetlands, absorbing and filtering flood waters and supporting low flow water supply, and shading waterways and water bodies, help protect water quality as we experience more hydrologic extremes and temperature increases that cause increases in flooding, low flow/drought and high heat days.



Wetlands and Microclimate Conditions

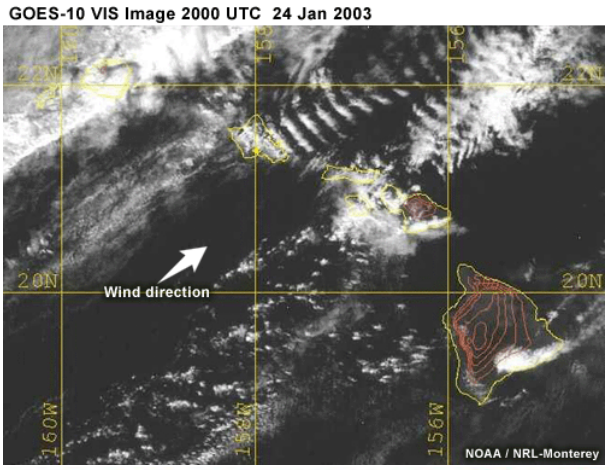
AUDIO DESCRIPTION

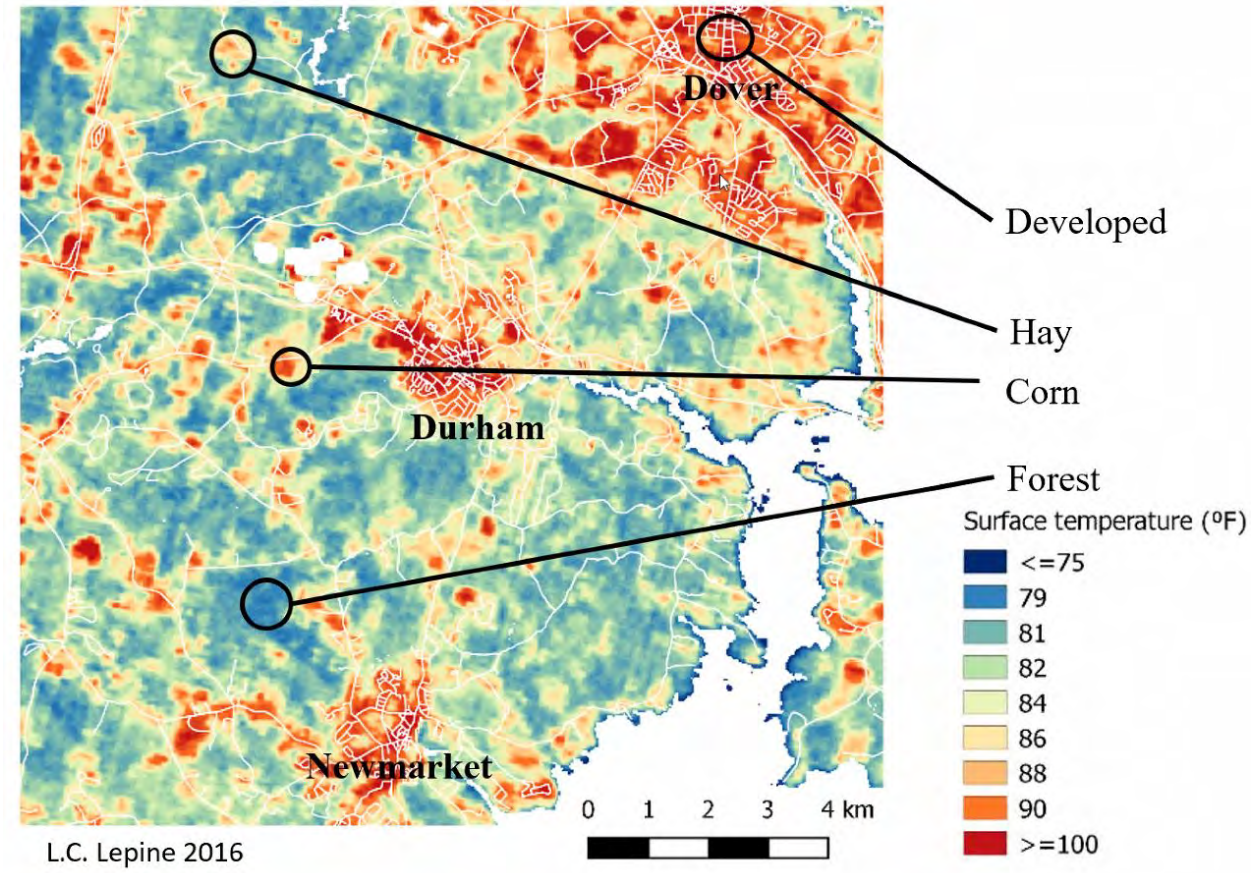
VIRTUAL TOUR

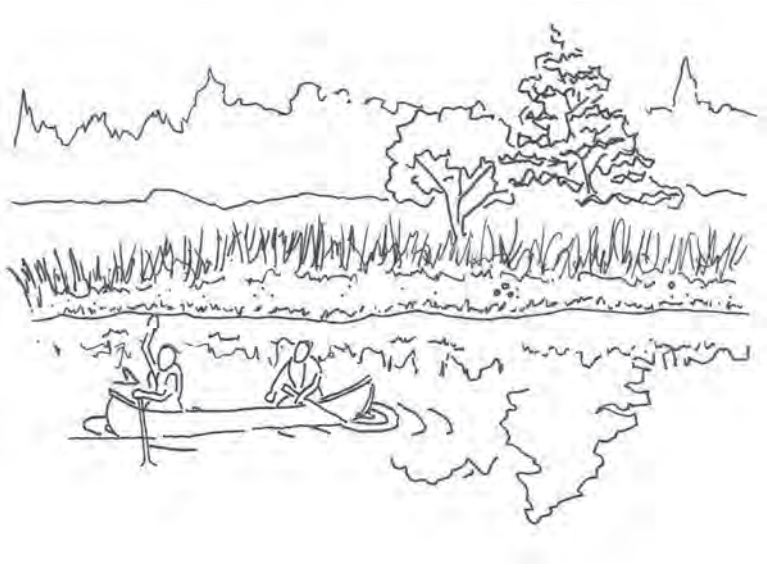
https://climateresilient.wixsite.com/applecountry

8 Localized Cooling, Maintaining Microclimate Conditions:

Wetlands and water bodies provide localized cooling on the landscape, as do forested lands. This localized cooling benefits humans, fish and wildlife, allowing all species to respond to high heat and drought events with greater resilience. Landscapes that have a high density of wetlands (wetland mosaics) are more climate-resilient than those that don't because wetland mosaics create temperature and humidity gradients on the landscape. The local differences create opportunities for species to migrate in response to changes in temperature or other threats.







Public Access To Ecological Resources

AUDIO DESCRIPTION

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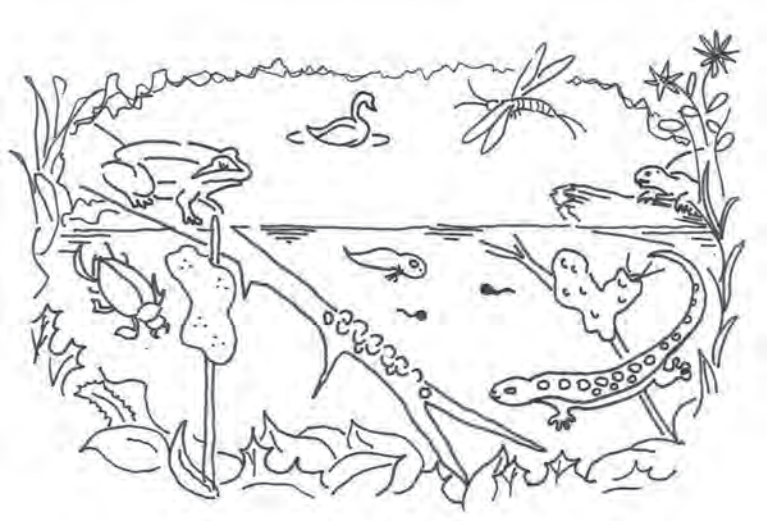
https://climateresilient.wixsite.com/applecountry

9 PUBLIC ACCESS TO ECOLOGICAL RESOURCES:

Cooler natural environments on publicly owned lands, such as conservation land and state and federal parks, particularly those that offer shade, provide local low cost recreational, educational and spiritual opportunities for citizens from all economic backgrounds. The COVID19 pandemic has demonstrated the importance of locally available, publicly accessible outdoor spaces for supporting public mental and physical health. During high heat events, access to these cooler environments can be particularly important for residents who do not have home air conditioning, thus helping to address environmental justice issues.



Wildlife Habitat, Biodiversity, and Landscape Connectivity

AUDIO DESCRIPTION

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10 Wildlife Habitat/Biodiversity – Landscape Connectivity:

In addition to providing local temperature and humidity gradients and opportunities for local movements, wetlands, particularly riparian wetlands, can support landscape scale ecological connectivity that allows species to migrate regionally in response to climate changes. Landscape level ecosystem connectivity supports climate resilience by allowing biological and non-biological components of ecosystems to flow across habitats and ecosystems. This includes flow of water, food, materials, and of genetic material, individual organisms, and populations. Organisms may require different habitat types during different life stages, and greater ecological connectivity allows a wider range of species and populations to access the necessary habitats.

Impacts of Climate Change on Wetlands

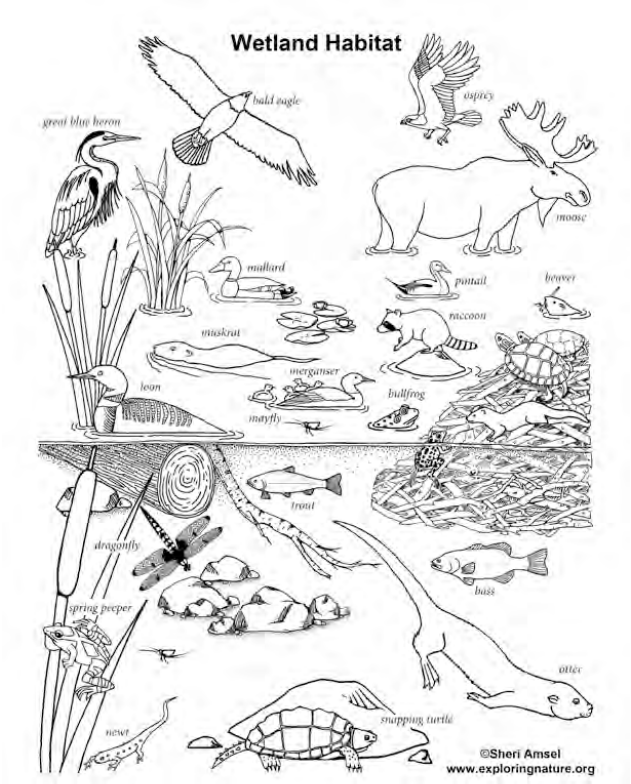
AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

11 Impacts of Climate Change on Wetlands:

Vegetated wetlands exist at the interface between fully aquatic and fully upland ecosystems, with relatively narrow elevation ranges, making them particularly vulnerable to changes in water level. Wetlands often exist in low-lying areas, and thus receive both local climate-related impacts and those that accumulate from areas further up in the watershed like floodwater. In Massachusetts, we are experiencing an increase in heavy precipitation events resulting in more frequent and severe flooding (most often during winter and spring seasons), as well as increased incidence of drought and high heat (most often during summer and fall seasons).



Wetland Buffer Zones

AUDIO DESCRIPTION

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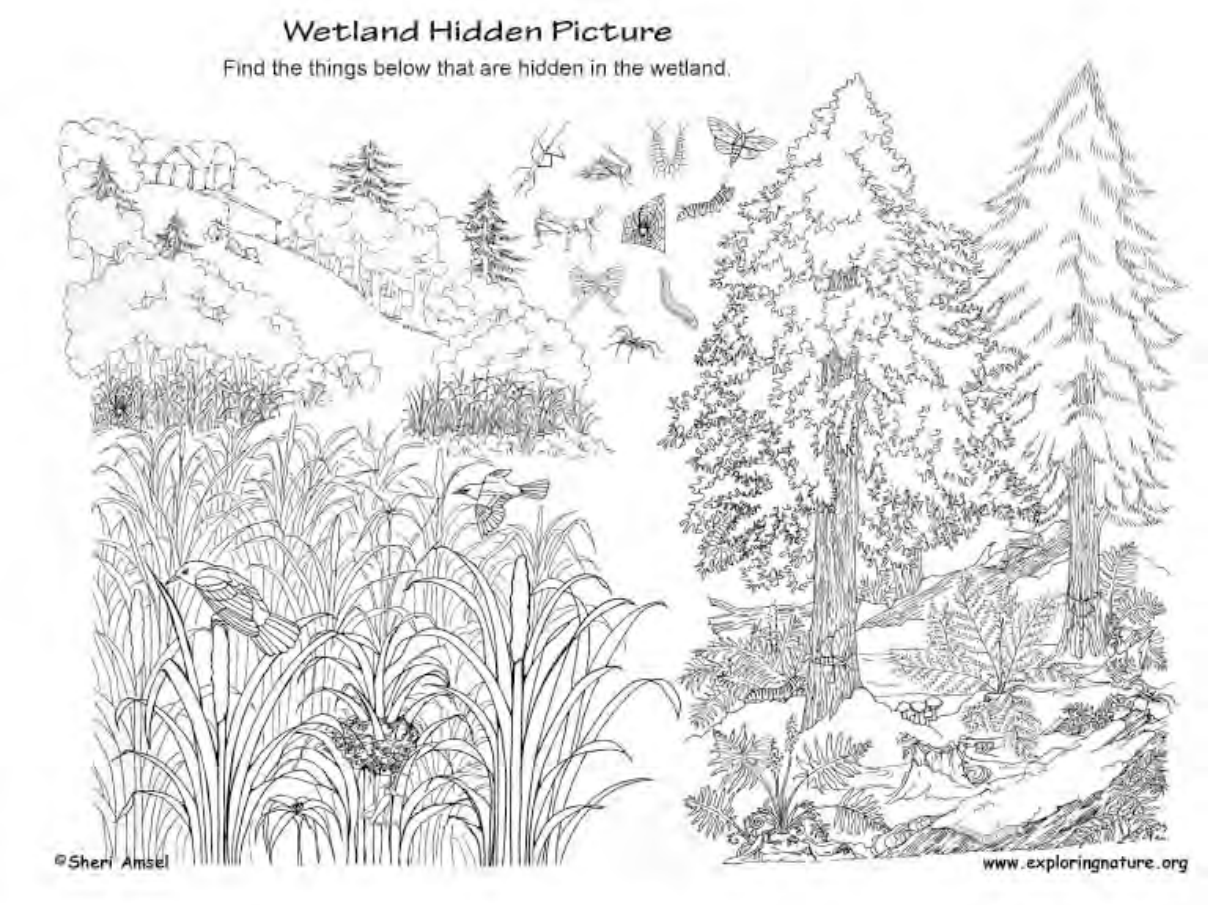
https://climateresilient.wixsite.com/applecountry

12 Buffer Zones:

Buffer zones are the vegetated areas surrounding wetlands, streams, rivers, ponds and lakes. When groundwater and surface water levels increase for sustained periods and/or recur with greater duration and/or frequency, soil biogeochemistry and vegetative species may shift, leading to the expansion of the wetland. That is why it is essential to protect these buffer zones. Without naturally vegetated buffer zones, wetland expansion may be limited by development. This can lead to habitat loss or flooding of areas further downstream. During drought, groundwater levels drop which can lead to die-off of wetland vegetation and replacement with upland species. Protection of the buffer zone is important so that wetland that converts to upland during a dry period can reclaim the converted area when wetter conditions return.



Climate and Species Changes

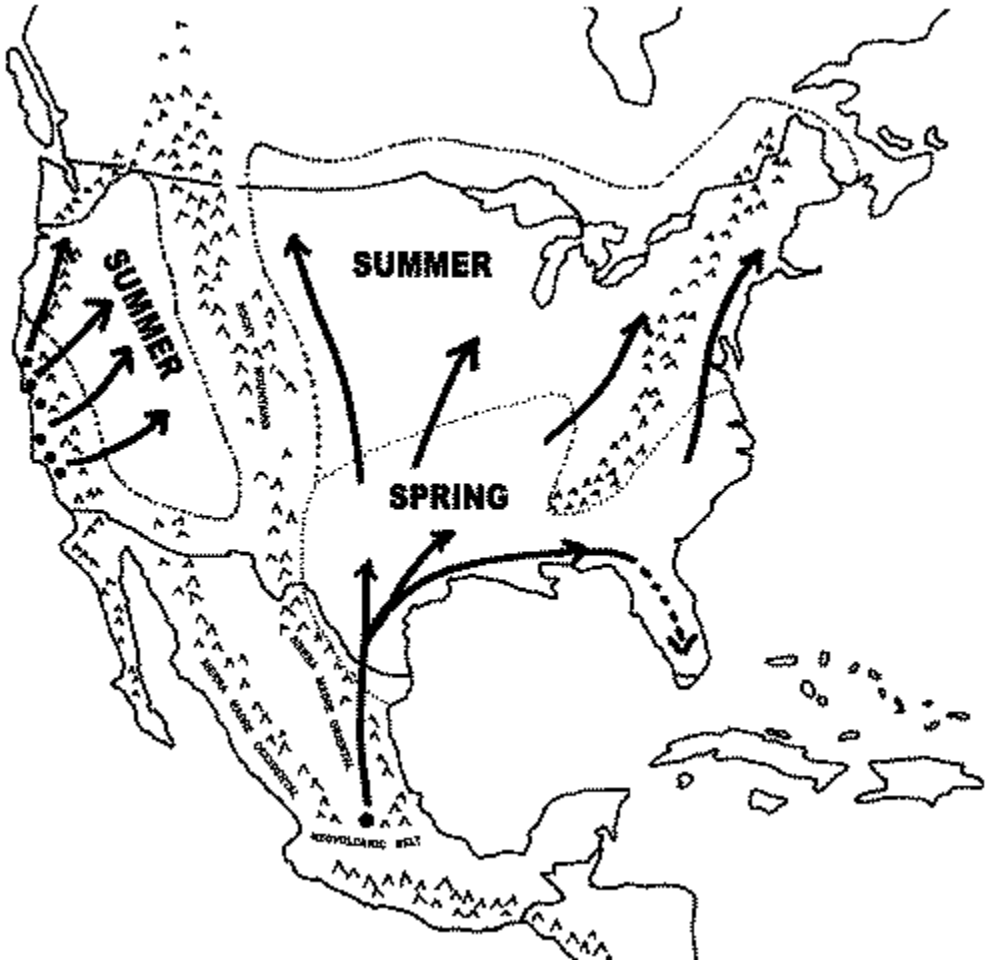
AUDIO DESCRIPTION

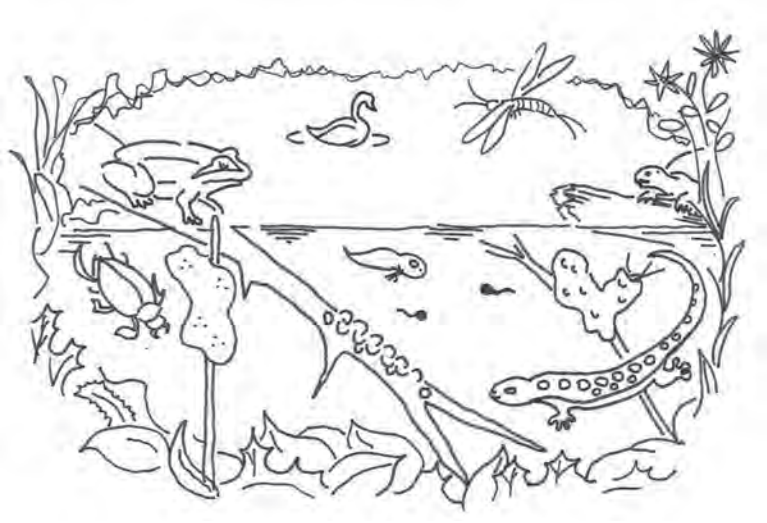
VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

13 Species Changes:

As the climate shifts, species and species communities change. Southern species are moving northward, and opportunistic adaptable invasive species are more common. Warming temperatures allow more pests and diseases to move northward where natural defenses are not in place. Severe storms may impact ecosystem structure, which may take a long time to recover, or may not recover, after the storm is over. Relationships between species may become disrupted, such as flowering being timed with warming temperatures during the spring, whereas pollinators time their arrival based on changes in daylight. Native Massachusetts species are increasingly stressed by these climate-related pressures in combination with other existing stressors such as loss of habitat to development, pollution, and water table changes. If combined, these could lead to ecological shifts or ecosystem failures.





Vernal Pools

AUDIO DESCRIPTION

VIRTUAL TOUR

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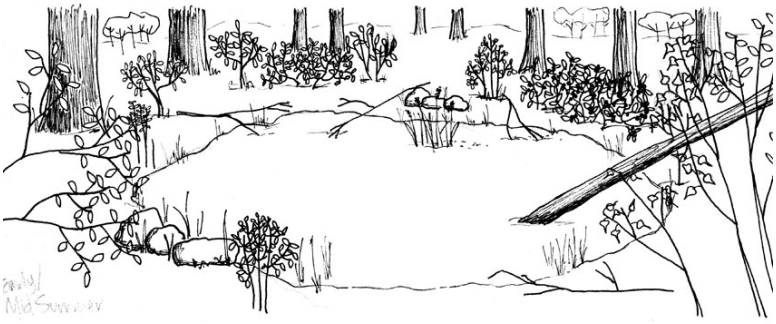
14 Vernal Pools

Vernal pools are small, forest ponds that tend to dry out in summer. But, for a period of time in the beginning of the growing season each year, they are aquatic ecosystems where a number of species have evolved to exploit these productive, though temporary, habitats. Vernal pools are essential habitat for at least some portion of the life cycle of many species including salamanders and wood frogs. Amphibians prefer vernal pools as these don't support fish, which would devour their eggs and young.

Beyond the most characteristic frogs, toads, and salamanders of vernal pools, there is a complex ecosystem composed of hundreds of species who depend on vernal pools. The ecological reach of vernal pools extends well beyond the boundary of a given pool. At the landscape scale, there is an important interchange between the vernal pool community and its surroundings. We call these metapopulation dynamics. Vernal pools are important breeding ground for insects and amphibians that feed reptiles, mammals, and birds throughout the connected landscape. Without these the predators that function as the immune system of the forest would dwindle, making room for aggressive pests.



Identifying and Managing Vernal Pools

AUDIO DESCRIPTION

VIRTUAL TOUR

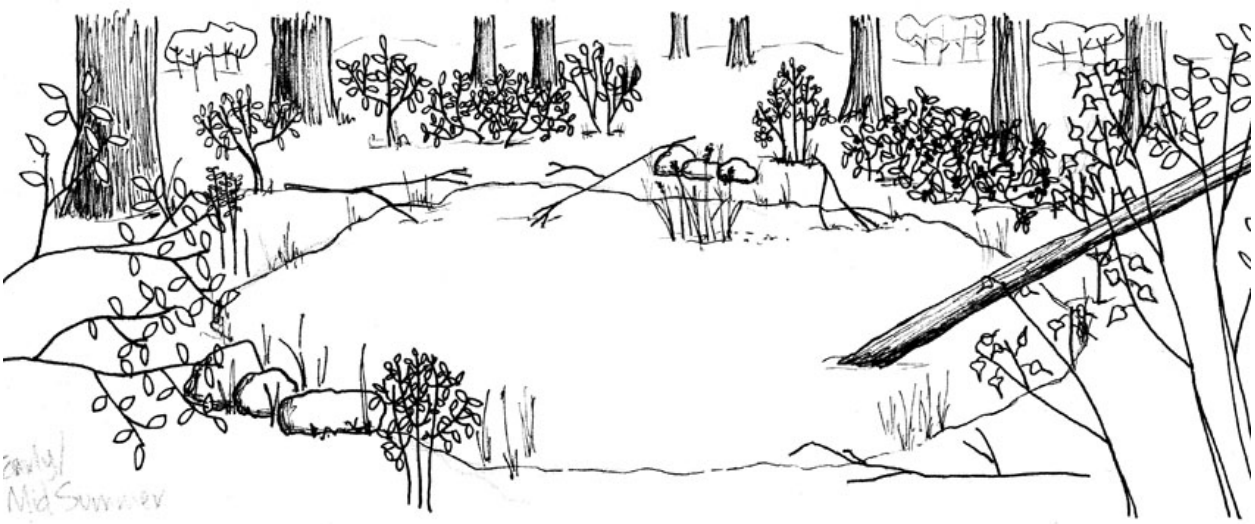
https://climateresilient.wixsite.com/applecountry

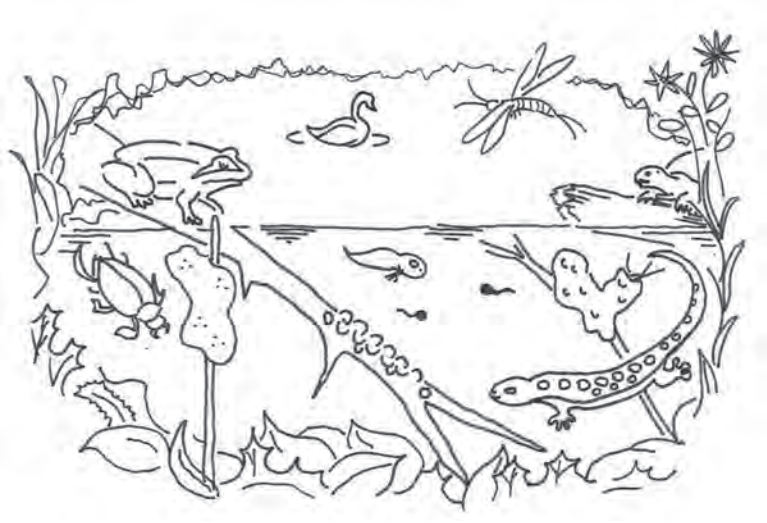
15 Identifying and Managing Vernal Pools

Since 1988, Massachusetts has maintained a program, managed by the Division of Fisheries & Wildlife's (MassWildlife) Natural Heritage and Endangered Species Program (NHESP), who certify vernal pools. Certified Vernal Pools can receive protection under federal, state, and local wetlands protection regulations. In 2001, MassWildlife completed a state-wide aerial photo interpretation survey of potential vernal pools which identified over 30,000 potential vernal pools.

In Apple Country, 345 potential vernal pools have been identified and 105 have been certified. Not every vernal pool is accounted for in these two datasets, and there may be many more pools than indicated by the numbers presented above. If you suspect you have found a vernal pool, you can make a report to the Massachusetts Natural Heritage and Endangered Species Program by visiting this website: https://www.mass.gov/how-to/report-rare-species-vernal-pool-observations

The presence, absence, and movement of water controls vernal pool functions. Formation of vernal pools relies primarily on groundwater from below, soil type, snow melt, and rain. Evapotranspiration and surrounding land uses have a significant effect on how long a vernal pool will contain water, and thus, on whether or not breeding amphibians will be successful.





Vernal Pool Climate Vulnerability and Resilience

AUDIO DESCRIPTION

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16 Vernal Pool Climate Vulnerability and Resilience

The amount of time that vernal pools are wet will decline under future climate projections. Larger pools are more likely to continue to function. Protecting, expanding, and making sure these larger pools are present in aggregate across the community will be essential to preserving our balance of species.

Amphibians are vulnerable to drying and to short-term changes in the timing and intensity of rain events, which can alter water levels in vernal pools. The overall ecological functioning of vernal pool systems will be negatively impacted by these impacts to amphibians, which also can lead to changes in species composition. The arrival of southern species and tropical diseases all may have potentially significant effects on vernal pool ecosystems.

Because of these vulnerabilities, we need to prioritize the protection of bigger, more climate-resilient, vernal pools and look for opportunities to enhance vernal pool resilience by protecting hydrology and ensuring that the vernal pool buffer zone is protected, forest cover is maintained, and invasive species are controlled.

Snag Tree Homes

AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

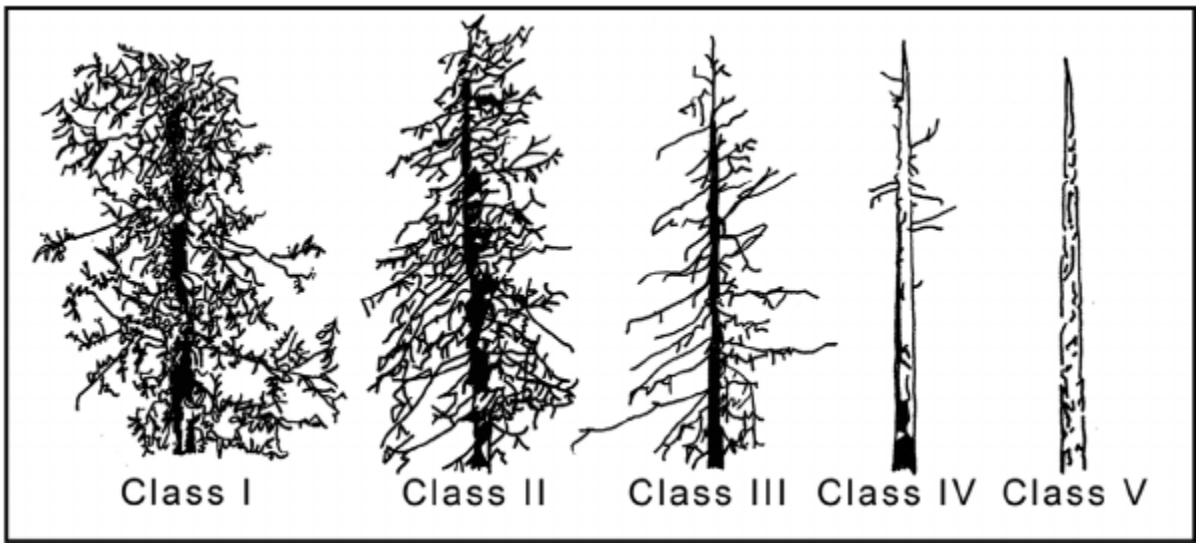
Habitat features

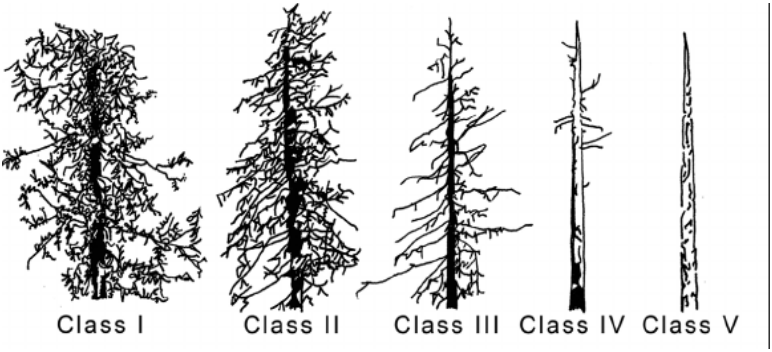
17 Snag Tree Homes

Trees have an active after-life. We call these snags. Snags are home to many native pollinators such as wild honeybees, tiny mason bees, and giant carpenter bees, as well as bats, birds and others. Look for tiny holes. These are often started by beetles. If the hole is long and deep it is a perfect home for tiny mason bees, who line it with mud and lay their eggs with a little packet of pollen and nectar for their young. Some crops, like blueberries, rely on these tiny wild bees for pollination as honeybees aren't the right shape for the job.

18 Snag Tree and Life Cycle

It's a common misconception that rotting wood hosts wood eaters that threaten trees and property. Maintaining a stable supply of food for predators maintains a healthy forest immune system and mitigates volatility such as when gypsy moth populations explode. To create a snag tree, cut just the tops of dead and dying trees that may be a hazard, thus retaining the snag trunk and log as habitat.





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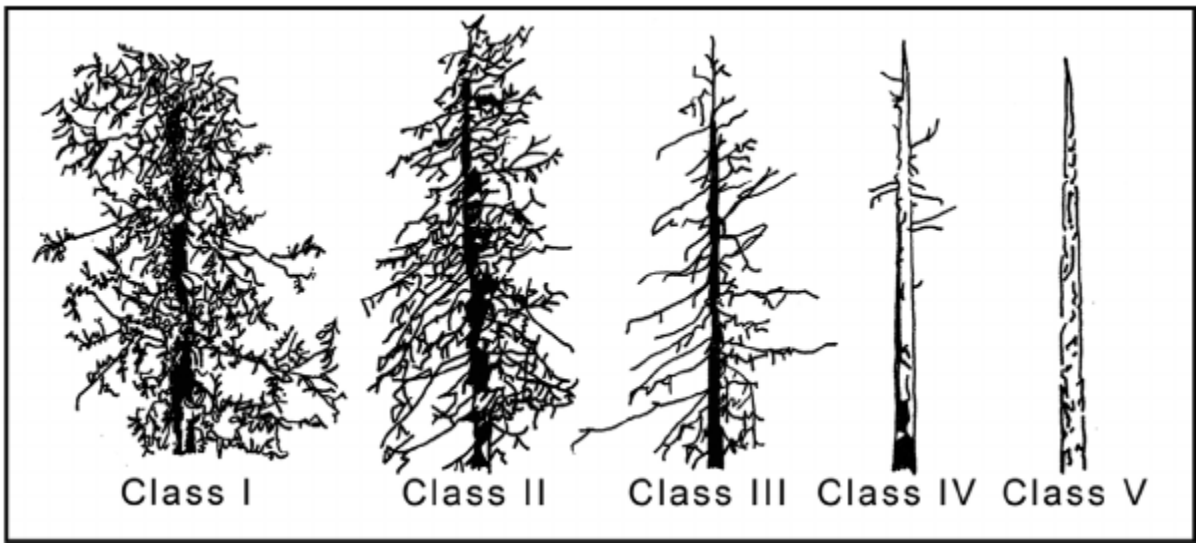


Nurse logs

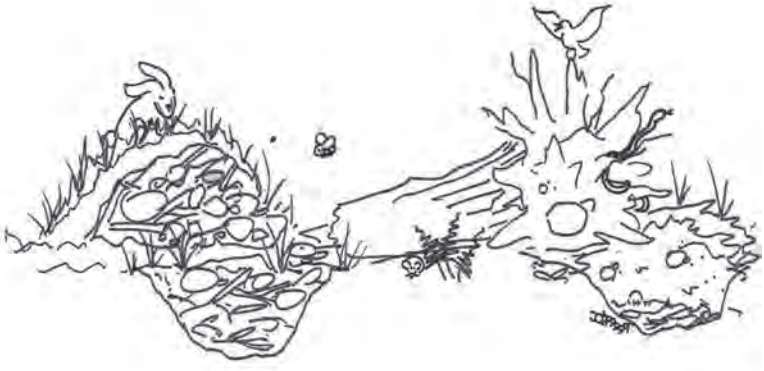
AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

20 Ground Logs: A Ground level Investment

Tidy managed forests may look healthy, but cleanliness means an incomplete biome. The cycle of death and decay is as important in the forest as it is in all living systems. When it is missing, the forest becomes unstable. Ground logs, sometimes referred to as nurse logs, are home to native bees, moths, soil building macroinvertebrates, and host to saprophytes, fungi and beneficial microbes that make the forest soils whole and vibrant. Often mosses, lichen, and small plants will grow on them, sometimes including tree seedlings that ultimately join the forest canopy.



The Root Wad and the Hibernacula

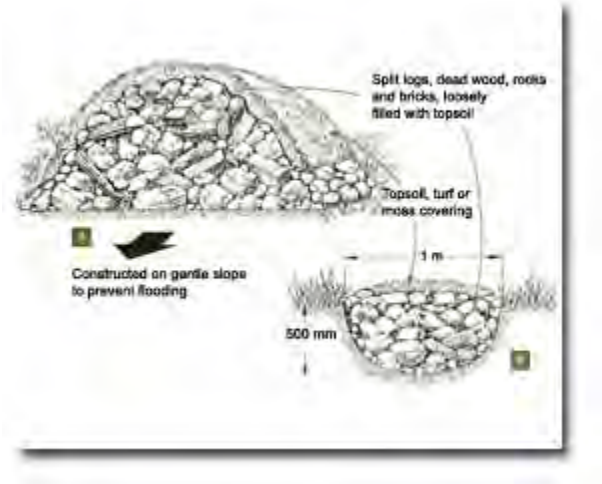
AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

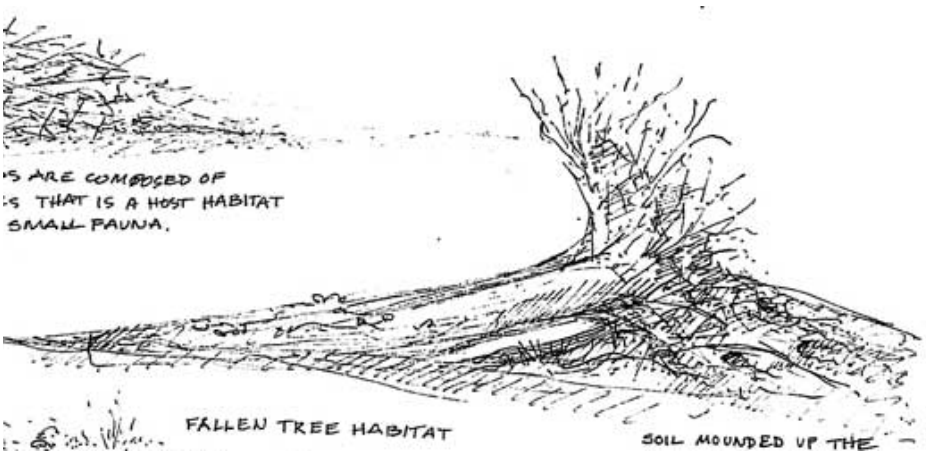
21 Landform: The Earthen Hibernacula

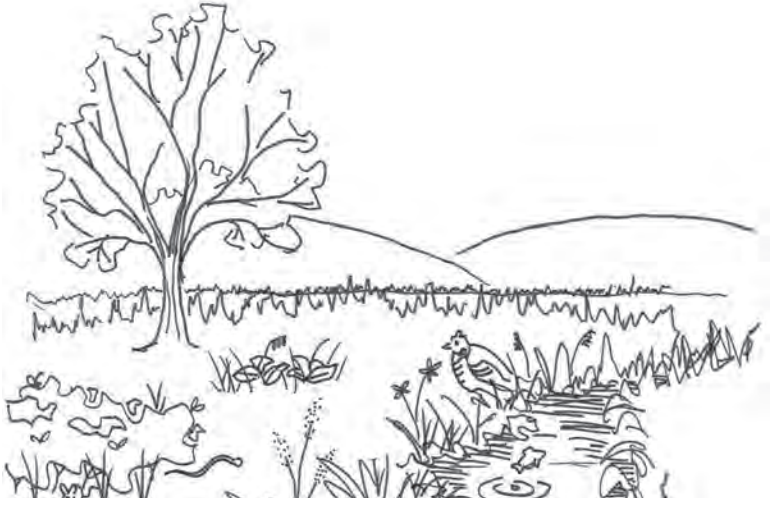
These sculptural mounds are built of woody debris and stone. These mimic the large root-wads of fallen old growth trees that in falling, would create a forest canopy opening for flowering nectar plants, as well as a home for pollinators and habitat for complimentary species. By adding these to our yards, our cleared driveways and walks become an opportunity to mimic nature and support these important natural processes, instead of paying to dispose of these materials off site. Why sculpt them? So you will notice them, of course.



22 The Root Wad:

These sculptural mounds mimic the function of fallen mother trees. They provide nesting for ground bees but are also the preferred home of the white-footed deer mouse. Why house the mice? They avoid human contact, instead, collecting food and running home to a hibernacula to eat. These good friends eat gypsy moth eggs, thereby limiting population explosions of harmful pests. Also, they are territorial, driving off the house mice, who prefer human buildings and who eat and excrete where they find food, such as in your kitchen or on cafeteria tables. We choose the right allies - it's a matter of leverage.





The Cultural Savannah
Sharing our Habitat

AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

24 Pollinator Savannah.

Savannahs are meadows with sparse trees and were once a common biome, resulting from disturbances like floods and fires. They are a breeding and foraging ground for many birds, pollinators and related species. As we dam and channelize rivers, block beavers, and prevent fires, this highly bioactive landscape is almost regionally extinct. Only through managed landscapes can we bring them back.

Pollinator savannahs provide a striking structural and habitat value to our commercial orchards, parks, even roadways. Its time to recognize our place as a force for habitat creation and make sure the elements we include have high habitat value.