Northeast Watersheds Business Plan

National Fish and Wildlife Foundation

March 2023 – March 2033

Purpose of a Business Plan

The purpose of a NFWF business plan is to provide a concise multi-year blueprint of the strategies and resources required to achieve the desired conservation outcomes by the end of the plan. This plan incorporates the views of federal, state, academic, and organizational experts consulted during its development and is intended to complement existing efforts in the larger conservation community.

NFWF implements these strategies to generate a measurable conservation impact in a landscape, and NFWF uses progress towards species goals as a measure that healthy, functioning habitat has been restored and that threats can be managed. Although the landscape-scale conservation need is typically greater than the investment from a single business plan, NFWF monitors species response to interventions within the business plan's focal areas to demonstrate that the conservation strategies *can* move the needle on its goals, thus building the case for larger investments in the strategies.

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About NFWF

Chartered by Congress in 1984, the National Fish and Wildlife Foundation (NFWF) protects and restores the nation's fish, wildlife, plants and habitats. Working with federal, corporate, foundation and individual partners, NFWF has funded more than 6,000 organizations and generated a total conservation impact of $7.4 billion. Learn more at www.nfwf.org.

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Conservation Need

The Northeast Watersheds landscape includes a varied complex of habitats ranging from the forests of the Green Mountains of Vermont to the marshes and dunes of Long Island Sound to the rocky shores of the Gulf of Maine. Beaches, dunes, bays, rivers and estuaries provide feeding, breeding, nesting and nursery areas for over 100 species of finfish and dozens of species of shorebird. Coldwater streams in New England boast the most expansive and resilient populations of eastern brook trout, and the rivers of Maine support the only remaining wild populations of endangered Atlantic salmon in the U.S.

The region is one of the most densely forested in the U.S. Much of the land that was cleared in the 19th and early 20th century has since been returned to forest. These forests range from oak to maple to spruce and are home to some of the greatest diversity of nesting songbirds in the country, as well as to turtles, fishers, moose, and other wildlife.

Fish and wildlife share these habitats with tens of millions of people. Human development on the landscape has two distinct characters — the northern inlands are significantly forested and dotted with smaller cities and towns, while the southern and coastal regions are more densely populated, supporting sprawling metropolitan areas such as New York and Boston, as well as agriculture, commercial and recreational fishing, transportation and other infrastructure. Human activities including road, rail and dam construction, forest clearing, agriculture, and the development of urban/suburban areas, have all contributed to the loss and fragmentation of habitat, sedimentation and degradation of water quality, declines in populations of native fish and wildlife, and deterioration in ecosystem functions such as flood and storm protection, water filtration, which in turn restricts and deteriorates recreational opportunities.

This business plan addresses the threats to species and ecosystem function in coastal habitats, stream and riparian habitats, and upland forests and grasslands.

Coastal Habitats

With more than 8,700 miles of tidal shoreline, the Northeast's beaches and dunes provide important habitat for beach-dependent wildlife, including crustaceans, shorebirds and sea turtles, while the adjacent marshes provide nursery, foraging and refuge habitat for commercial and recreational fish, birds and other wildlife. The coastal habitats buffer wildlife and human communities from storm surges, flooding, and erosion, all of which are intensifying with climate change.

Shorebirds. Along the Atlantic flyway, migratory shorebirds encounter a host of threats. Shorebirds, like the **American oystercatcher**[1], have evolved to respond to natural threats, including predators, severe weather and periodic local food depletion events. However, human-induced threats, such as habitat destruction, human disturbance of nesting and foraging habitat, artificially inflated predator populations, and pollution are relatively new and negatively impact shorebird populations. These threats, which produce additive stress and mortality, can lead to population decline.

[1] Bold text indicates the first mention of a focal species or species group in this business plan.

Salt Marsh. Salt marshes are among the world's most productive ecosystems, supporting significant biodiversity, benefiting water quality, buffering coastal communities from storms, and sequestering carbon (Barbier et al. 2011; Friess et al. 2020). However, centuries of human alterations that have filled, ditched, and modified salt marshes have led to decades of decline, with an estimated loss of 80,000 acres of coastal wetlands each year in the U.S. (Dahl 2011). Throughout the Northeast, extensive modifications of coastal wetlands have altered natural hydrological processes and limited opportunities for landward marsh migration, lowering salt marsh resilience to threats from sea level rise (Roman et al. 2017; Watson et al. 2017; Besterman et al. 2022).

As salt marsh habitat is lost, salt marsh-dependent species are increasingly vulnerable. **Saltmarsh sparrows** are tidal marsh obligates that breed exclusively in high marsh habitat[2] from Virginia to Maine. Species experts predict saltmarsh sparrows will decline to critically low levels if sufficient high-quality habitat is not maintained to support successful breeding, projecting the population could collapse to 10,000 birds by 2030 (Hartley & Weldon 2020).

Table 1. Coastal habitat focal species

Species	Habitat Needs	Conservation Status
American oystercatcher *Haematopus palliatus*	Nest on barrier beaches and islands and shell rakes in salt marshes along the Atlantic coast; diet is predominantly shellfish and invertebrates.	Special Concern status in CT; Species of Greatest Conservation Need (SGCN) in ME, MA, RI, CT and NY.
Saltmarsh sparrow *Ammodramus caudacutus*	Nest in high marsh, forage in low marsh. Endemic to salt marshes from Virginia to Maine and winter along the southern Atlantic coast.	Endangered Species Act (ESA) status under review; Special Concern status in CT; SGCN in ME, NH, MA, RI, CT and NY.

Stream and Riparian Habitats

In the Northeast, cold headwater streams feed lakes, wetlands and coastal estuaries that are vital and diverse habitats supporting a wide array of fish and wildlife. The quality and connectivity of these aquatic systems is critical for supporting coldwater species like **eastern brook trout**, as well as anadromous fish such as **Atlantic salmon** and **river herring** that use these waters to spawn. The adjacent floodplains further provide a mosaic of streamside forests that are important wildlife corridors and provide habitat for species like the **wood turtle**, while also filtering polluted runoff, shading waters, and buffering communities from floodwaters.

Eastern Brook Trout. Eastern brook trout persist in only the coldest and cleanest waters and are excellent indicators of good water quality and overall watershed health. The Eastern Brook Trout Joint Venture (EBTJV 2018) estimates that only 8% of watersheds that historically supported eastern brook trout in the eastern U.S. can be classified as "intact" (i.e., at least 50% of the catchments in a HUC 12 watershed have wild trout present). Fragmentation from dams and impassable culverts has resulted in isolated populations that are more vulnerable to disturbance events (e.g., floods, drought) and demographic and genetic bottlenecks. Poor habitat quality and lack of riparian habitat also pose threats.

[2] This plan defines high marsh as "portions of the salt marsh platform that are above the mean high-water level, are irregularly flooded, and form a transition zone between the low marsh platform and upland areas, regardless of vegetative community structure" (Hartley & Weldon 2020).

Atlantic Salmon. Atlantic salmon are anadromous fish and the only native salmonid of the genus *Salmo* in North America. Atlantic salmon were once wide-ranging and abundant in the Northeast, but habitat degradation and fragmentation, overharvesting and pollution, have pushed it to the brink of extirpation from the U.S. The natural anadromous population now can only be found in small numbers in Maine, and it is listed as endangered under the Endangered Species Act (ESA). Atlantic salmon are an integral part of Northeast riverine ecosystems, not only playing a role in the local food web but also introducing marine derived nutrients, increasing primary productivity of the habitat.

River Herring. River herring is the collective term for two closely related alosine species, alewife and blueback herring. River herring are anadromous fish native to rivers and coastal waters of the Northeast. Typically, river herring spawn in lakes and ponds but may also utilize large and small streams with a wide array of substrates. River herring, like the Atlantic salmon, serve as vectors transporting marine-derived nutrients to inland aquatic ecosystems. River herring are a culturally and economically important fishery resource, as it is caught commercially, recreationally, and used as bait in some states. River herring have decreased in abundance across much of their range in recent decades (ASMFC 2017). For example, river herring run counts in the main stem of the Connecticut river (Holyoke dam fishway) dropped from over 600,000 fish in the 1980s to less than 600 fish in 2014. Dams (and other stream barriers) are particularly problematic as they obstruct access to freshwater habitats important to river herring's lifecycle.

Wood Turtle. The wood turtle is a semi-aquatic, freshwater species that ranges from Virginia to Nova Scotia and west to the Great Lakes. It is associated with slow-moving streams containing a sandy or gravelly bottom with instream coarse wood debris that it uses for overwintering and mating, and adjacent upland areas including vegetated riverbanks, agricultural fields and early successional habitats are used for nesting and foraging. Wood turtles are a long-lived species (perhaps living 70 years or more) and often do not reach sexual maturity until their late teens (Jones et al. 2018). Wood turtle life history makes their populations particularly vulnerable to anthropogenic threats like habitat loss through development, mortality or injury from agricultural machinery and cars, and illegal poaching (Jones et al. 2018). They are currently under review for listing under the ESA.

Table 2. Stream and riparian habitat focal species

Species	Habitat Needs	Conservation Status
Eastern brook trout *Salvelinus fontinalis*	Occupies cold headwater streams, with swift flowing, clean, well-oxygenated water with a gravel streambed and resting areas in pools and along undercut banks, under fallen trees and rock ledges.	Species of Greatest Conservation Need (SGCN) in ME, NH, VT, MA, RI, CT and NY.
Atlantic salmon *Salmo salar*	Anadromous fish that migrate from the ocean up their natal rivers and streams to spawn. Require well-oxygenated, cold flowing water and gravel substrate for spawning.	Endangered since 2000; SGCN in ME, NH, VT, MA, RI, CT and NY.
River herring (blueback and alewife) *Alosa aestivalis* *Alosa pseudoharengus*	Needs well-oxygenated and good quality freshwater spawning and rearing habitats such as lakes, ponds, or slow-flowing tributaries with soft substrates and detritus.	SGCN in NH, MA, RI, CT and NY. Blueback are SGCN in VT.
Wood turtle *Glyptemys insculpta*	Lives on both land and water along meandering mid-sized streams and surrounding fields and forests.	ESA status under review; SGCN in NH, MA, CT, NY, ME, VT and RI.

Upland Forests and Grasslands

Forests. During the timber boom of the late 19th and early 20th centuries, much of the region's vast forests were cleared. Today, large areas have been reforested, including 75% of New England. Still at risk of development, these forests also have an even-age distribution, lacking the structural diversity to support birds and other wildlife populations that rely on a more complex forest system.

Neotropical migrant bird species are at risk from loss of habitat caused by fragmentation, incompatible land practices and/or forest management. Since 1970, an estimated 3 billion birds have been lost from continental North America, equivalent to a loss of approximately 29% of the total bird abundance present in 1970 (Rosenberg et al. 2019). Losses were across multiple breeding biomes with the eastern forest region suffering a nearly 30% decline in overall bird abundance. In the eastern region, the decline of habitat specialists including **golden-winged warbler** (60% decline) and wood thrush (59% decline) are symptomatic of habitat loss and fragmentation.

The **New England cottontail** (NEC), which is the only rabbit species native to New England and eastern New York, is a habitat specialist that has experienced steep declines and is estimated to have disappeared from approximately 86% of its former range (Litvaitis et al. 2006). This decline is likely due to loss and fragmentation of preferred habitats and the expansion of the invasive eastern cottontail which can competitively displace NEC where they co-occur (Cheeseman et al. 2018). Additionally, previous methods used to create early successional habitat may have inadvertently promoted further eastern cottontail invasion, resulting in updated management guidance to facilitate NEC colonization of newly created habitat. New England cottontail depend on dense areas of persistent shrubland or "thicket" habitat that are common in early and mid-successional systems (Litvaitis 2003). They rely on these thickets to forage, reproduce, find protection from the elements, and evade predators.

Patches of young forest habitat were once common in this region due to natural and anthropogenic disturbances like logging, fire and flooding. Additionally, after abandonment of farmland throughout the 20th century, fallow fields have transitioned to young forests and shrublands providing patchwork of suitable habitat. Loss of these disturbance regimes in combination with development, land use change and natural senescence of young habitat into mature forests resulted in a significant decline in shrubland habitats. Early successional systems are also vulnerable to exotic plant invasion, further degrading the ability of these systems to support robust populations of habitat specialists like golden-winged warbler and New England cottontail.

Grasslands. More than 70% of all grassland bird species are in decline. Loss of breeding birds in grasslands exceeds that for all other breeding biomes with a cumulative loss of more than 700 million birds across 31 species or more than 53% of the abundance (Rosenberg et al. 2019). Habitat loss and declines in nesting habitat quality are key factors contributing to the decline of grassland nesting birds and include conversion of grassland habitat to other uses, succession of grassland to forest, and the intensification of agricultural practices on remaining grasslands (Sutti et al. 2017). In the northeastern United States, grassland birds are found primarily on formerly forested land that has been cleared for agriculture and are most abundant on hay fields and pastures (Chakrabarti et al. 2019). Nearly all patches are found on private land (Ciuzio et al. 2013). Incompatible harvesting practices, especially for the dairy industry that requires nutrient rich hay, has resulted in diminished annual reproductive success rates leading to population declines. Species like the **bobolink** eastern meadowlark, and Savannah sparrow are showing annual declines of 3.6%, 3.8%, and 2.6% per year, respectively (Sauer et al. 2017).

Table 3. Upland forest and grassland focal species

Species	Habitat Needs	Conservation Status
Golden-winged warbler *Vermivora chrysoptera*	Breeding pairs require a complex young-forest or old field structure consisting of shrubby young forest interspersed with herbaceous areas of grasses and forbs and widely spaced overstory trees for singing perches. Habitat typically borders mature forest.	ESA status under review; State Endangered in MA & CT; Special Concern in NY; SGCN in NH and VT.
New England cottontail *Sylvilagus transitionalis*	Require interlinked patches of dense, woody understory that occur in shrub thickets and young forests. Large patches of suitable habitat (>25 acres) promote population resilience.	State Endangered in ME & NH; Special Concern in NY; SGCN in VT, MA, RI and CT.
Bobolink *Dolichonyx oryzivorus*	Nest in native grasslands and agricultural pasture mixed with forbs. Large fields >10 acres are preferred as pairs tend to nest away from "edges".	Special Concern in CT; SGCN in ME, VT, RI, CT and NY.

Background

NFWF has had a significant presence in the region since 2005, with two regionally focused annual grant programs: the Long Island Sound Futures Fund (LISFF), which launched in 2005 and awards $5–10M per year, and the New England Forests and Rivers Fund (NEFRF), which launched in 2015 and awards $1–2M per year. NFWF's national programs also invest heavily in this region, including Five Star and Urban Waters and the National Coastal Resilience Fund.

This business plan will build on the success of three past NFWF business plans — the river herring, eastern brook trout and early successional forest initiatives — which closed while demonstrating best practices and showing impact at a small scale. The Northeast Watersheds Business Plan is designed to take that success to the landscape scale. It also will drill down on shorebird priorities detailed in the Atlantic Flyway Shorebird Business Plan, which identifies Long Island Sound as a focal area providing critical habitat for American oystercatcher.

Current Conservation Context

Conservation need is aligned with partner opportunity. NFWF is well-positioned to leverage federal, state and NGO-driven conservation efforts in the region including:

- The Long Island Sound Study (LISS) is a partnership among state and federal agencies, non-profits, academics and other stakeholders that has been working to restore water quality and coastal habitats in the Sound since 1985. The LISS updated their management plan in 2015 and it has recently seen a dramatic increase in federal appropriations to the Environmental Protection Agency (EPA). With this new funding, the LISS has expanded their area of interest beyond the coastal states of Connecticut and New York to include the upper basin states of Massachusetts, Vermont and New Hampshire. EPA and the LISS are NFWF's primary partners in funding and delivering the Long Island Sound Futures Fund.

- Through the North Atlantic Aquatic Connectivity Collaborative, states in the Northeast have pioneered systematic aquatic connectivity assessment and prioritization. Using consistent protocols, federal, state and nonprofit partners have assessed and prioritized barrier removal, including dams and culverts. Through this business plan, NFWF is able to leverage a pipeline of projects this work has generated. New funding through the Infrastructure Investment and Jobs Act is further accelerating this important work.
- The Eastern Brook Trout Joint Venture (EBTJV) is one of the 19 National Fish Habitat Partnerships, launched in 2005 to halt the decline of eastern brook trout through a public-private partnership that advances science and supports locally-driven efforts throughout the species' range and this business plan is informed by the EBTJV's ongoing efforts to assess and prioritize brook trout populations for conservation.
- The Atlantic Coast Joint Venture (ACJV) is one of 22 Migratory Bird Joint Ventures, which are cooperative regional partnerships spearheaded by the U.S. Fish and Wildlife Service to conserve target bird populations. The ACJV specifically is focused on tidal marsh birds, and this business plan will help support implementation of ACJV priorities for saltmarsh sparrow conservation.
- Several Working Lands for Wildlife (WLFW) initiatives have been established in the northeast. These initiatives represent collaborations between the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and the USFWS to target conservation on agricultural and forest lands that enhance wildlife habitat for key species. This business plan specifically leverages WLFW initiatives for golden-winged warbler and northeast turtles.
- Through our partnership with the National Oceanic and Atmospheric Administration (NOAA), the National Coastal Resilience Fund is driving unprecedented investments in resilient communities throughout the U.S., including in this landscape. With huge population centers vulnerable to coastal storms, and in response to Hurricane Sandy in 2012, this region has developed considerable interest and expertise in bolstering natural systems to better protect human and wildlife communities from flooding, saltwater inundation, and erosion.

Through the efforts above, and others like them, conservation practitioners in this region have developed technical capacity and community support to protect and restore the region's vital natural resources. NFWF's business planning leverages and brings focus to these efforts, in order to achieve measurable outcomes and optimize synergistic benefits through more strategic investments.

Conservation Outcomes

The vision of this business plan is **to sustain and improve the quality and connectivity of coastal, stream and riparian habitats, and upland forest and grasslands to benefit native fish, birds, and other wildlife.** For coastal habitat, focal species are American oystercatcher and saltmarsh sparrow. For stream and riparian habitat, the species include eastern brook trout, Atlantic salmon, river herring and wood turtle. For upland forests and grasslands, the focal species are golden-winged warbler, New England cottontail and bobolink.

Coastal Habitats

This plan includes two focal species as indicators of ecosystem health within coastal habitats. Business plan goals for these species are listed in Table 4 and focal areas are shown in Figure 1.

American Oystercatcher. This business plan will leverage the lessons learned through implementation of the NFWF-led American oystercatcher conservation initiative, which over a ten-year period (2008-18): (a) reversed a population decline, (b) more than doubled the average reproductive success (from 0.2 to 0.5 chicks per pair), and (c) ultimately increased the Atlantic coast population by 23%. Investments will focus on actions to improve reproductive success including habitat restoration, human disturbance reduction and predator management at sites in southern New England and Long Island with concentrations of nesting pairs.

Saltmarsh Sparrow. The business plan aims to build a stable population of saltmarsh sparrow by increasing density within priority salt marshes across the Northeast. Long-term goals for the conservation community are to stabilize and increase the population to 25,000 birds by providing 80,000 acres of high marsh habitat throughout the breeding range by 2070 (Hartley & Weldon 2020). Restoring high quality, functional salt marsh habitat will benefit saltmarsh sparrow and other salt marsh-dependent species, will sequester carbon, and will provide resilience benefits to coastal communities facing increasing flood-related threats. The plan seeks to restore at least 5,000 of those acres of salt marsh habitat within priority patches as identified by the Atlantic Coast Joint Venture and partners[3], which aligns with the short-term habitat targets in the Northeast needed to help stabilize the population and reverse rapid annual decline rates (Hartley & Weldon 2020).

Table 4. Coastal habitats: Focal species goals

Focal Species	10-yr Business Plan Goals
American Oystercatcher	Increase reproductive success to 0.55 chicks fledged per pair at managed sites throughout New England.
Saltmarsh Sparrow	Maintain or increase density (individuals/acre) at restored patches (density is highly variable - see Appendix A for baseline density estimates for focal salt marshes in the Northeast).

[3] Saltmarsh Restoration Priorities for Saltmarsh Sparrow: https://experience.arcgis.com/experience/0a580f98787f4250bff871892d266d64

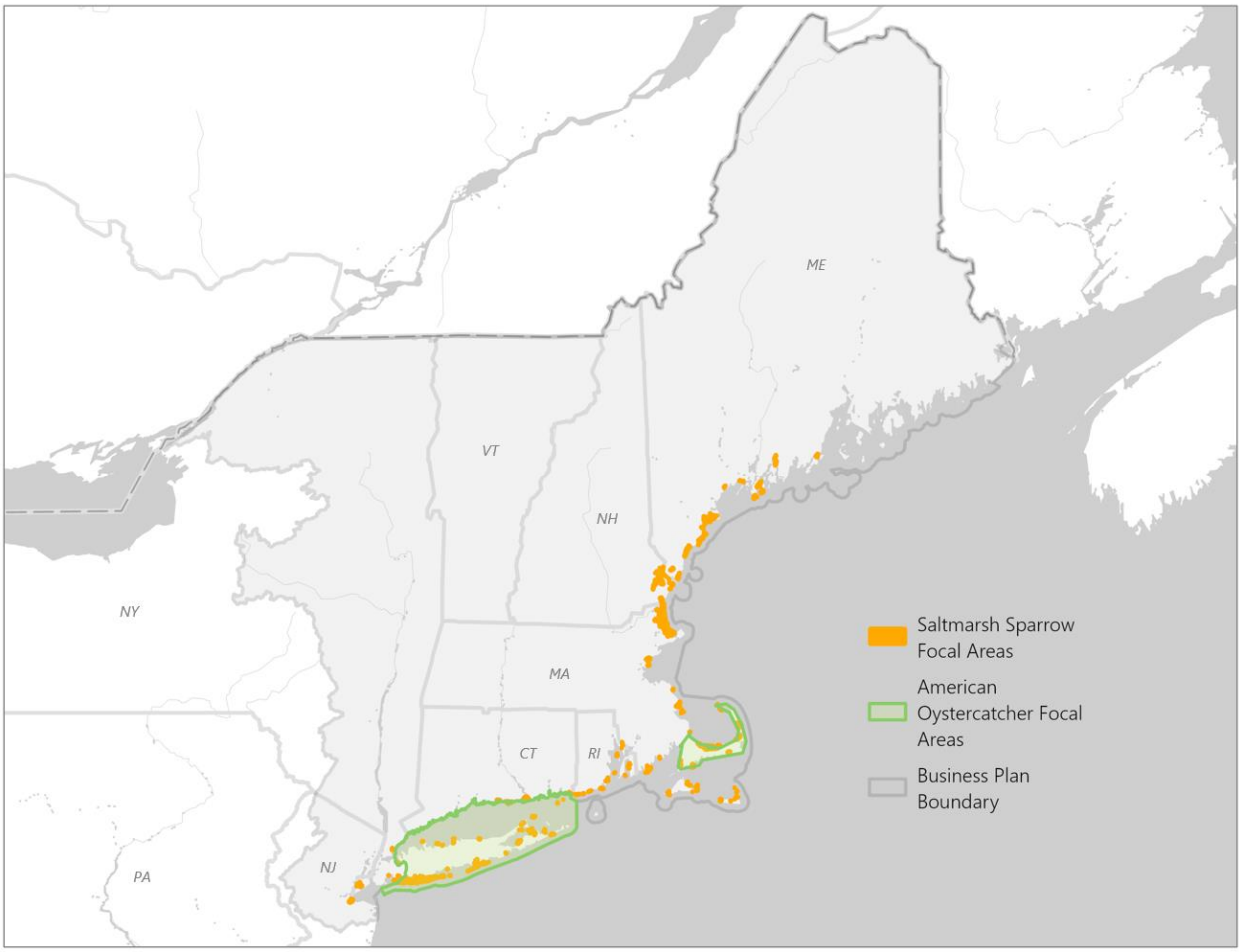

Figure 1. Map of coastal habitat priority areas for focal species. An interactive digital map of this business plan is available at: [Northeast Watersheds Business Plan map].

Stream and Riparian Habitats

This plan includes four focal species as indicators of ecosystem health within stream and riparian habitats. Business plan goals for these species are listed in Table 5 and focal areas are shown in Figure 2.

Eastern Brook Trout. NFWF aims to improve eastern brook trout relative abundance in eight priority patches and maintain brook trout populations in other high value patches within watersheds that will serve as focal areas for the species. These focal areas include the Saranac River Watershed of eastern New York and select watersheds associated with the Connecticut and Housatonic rivers. Within these focal areas, NFWF will invest in habitat improvements – such as riparian restoration, aquatic organism passage (AOP) improvements, or in-stream restoration – to high quality eastern brook trout "patches." These patches are subwatersheds that the Eastern Brook Trout Joint Venture (EBTJV) and Trout Unlimited (TU)[4] have previously identified as priorities on the basis of their habitat quality and their connectivity to other subwatersheds that provide habitat for eastern brook trout. At the time of writing, the EBTJV and TU are updating these priorities, and NFWF's targeted patches and watersheds may adjust as a result.

[4] https://www.tu.org/science/conservation-planning-and-assessment/conservation-portfolio/

River Herring. The plan will increase river herring adult spawning runs by enhancing aquatic connectivity in focal rivers throughout the Northeast. Barriers to fish migration prevent river herring from reaching high quality habitat and hinder population growth. By removing barriers to fish passage, annual spawning runs are expected to increase as access to spawning habitat is restored (Hare et al. 2021). The plan prioritizes fish passage improvement projects in eight focal rivers including: the St. Croix (Skutik), Baskahegan, Narraguagus, Megunticook, and Sabattus rivers in Maine; and the Farmington, Eightmile, and Mattabesset tributaries of the Connecticut River in Connecticut. Site assessment, planning, and fish passage improvements will also be considered within 12 additional prospective rivers.[5,6]

Atlantic Salmon. NFWF aims to improve occupancy of Atlantic salmon by increasing aquatic connectivity and restoring instream habitats within focal rivers in Gulf of Maine Distinct Population Segment (GOM DPS). NFWF will follow the recommendations of the GOM DPS recovery plan (USFWS & NMFS 2018), which emphasizes that access to suitable spawning and rearing habitats is crucial to the survival and recovery of Atlantic salmon. In the GOM DPS, the geographic scale of these suitable habitats is estimated and reported as "habitat units", in which 1 habitat unit equals to 100 m^2 of suitable spawning/rearing habitat (USFWS & NMFS 2018). Accordingly, this plan will prioritize fish passage improvement, instream restoration (i.e., large wood additions), and species monitoring in the following focal rivers within GOM DPS: Narraguagus, Piscataquis, Sabattus, and Mattawamkeag/ Baskahegan. Restoration planning and implementation projects will also be considered in an additional prospective river, the Kennebec watershed.

Wood Turtle. This plan will promote wood turtle population viability by maintaining adult abundance and securing or establishing nesting habitat. Generation times for turtles can be >45 years, so conserving reproductively active individuals is critical for long-term persistence. Viability analyses have shown that the removal of even a few breeding individuals annually can significantly increase the risk of losing entire populations (Compton 1999; Jones et al. 2018). Wood turtles are at increased risk of mortality in the absence of riparian buffers primarily from heightened exposure to agricultural machinery. NFWF will support riparian buffer restoration and implementation of BMPs on agricultural lands that are compatible with wood turtle ecology such as delayed mowing, sickle-bar mowers, off-season burning and year-round grazing. These practices will benefit turtle survival and allow females to use upland nest sites safely. These strategies will also function to protect nesting habitat every ~500 meters within project sites which correlates with the average home range size of an adult female (Jones et al. 2015).

Table 5. Stream and riparian habitats: Focal species goals

Focal Species	10-yr Business Plan Goals
Eastern Brook Trout	1) Increase in eastern brook trout relative abundance in eight persistent or stronghold patch types and 2) maintain relative abundance by improving habitat in four additional persistent or stronghold patches.
River Herring	Increase river herring adult runs in focal rivers in the Northeast by at least four times the baseline levels.

[5] Priority will be given to barriers that if rectified, are expected to also result in flood-risk reduction for human communities.
[6] Prospective rivers include the Union, Kennebec, and Presumpscot rivers in ME; Oyster and Lamprey rivers in NH; Merrimack and Mystic rivers in MA; Naugatuck, Housatonic, Tenmile, and Shepaug rivers in CT; and the Bronx-East River in NY.

Focal Species	10-yr Business Plan Goals
Atlantic Salmon	Increase occupancy of Atlantic Salmon in at least ten restoration sites, by improving more than 1,000 units of suitable spawning/rearing habitats in focal rivers within Gulf of Maine Distinct Population Segment (DPS).
Wood Turtle	1) Maintain adult abundance at sites managed for wood turtles and 2) secure nesting habitat every 500 meters of stream in managed sites.

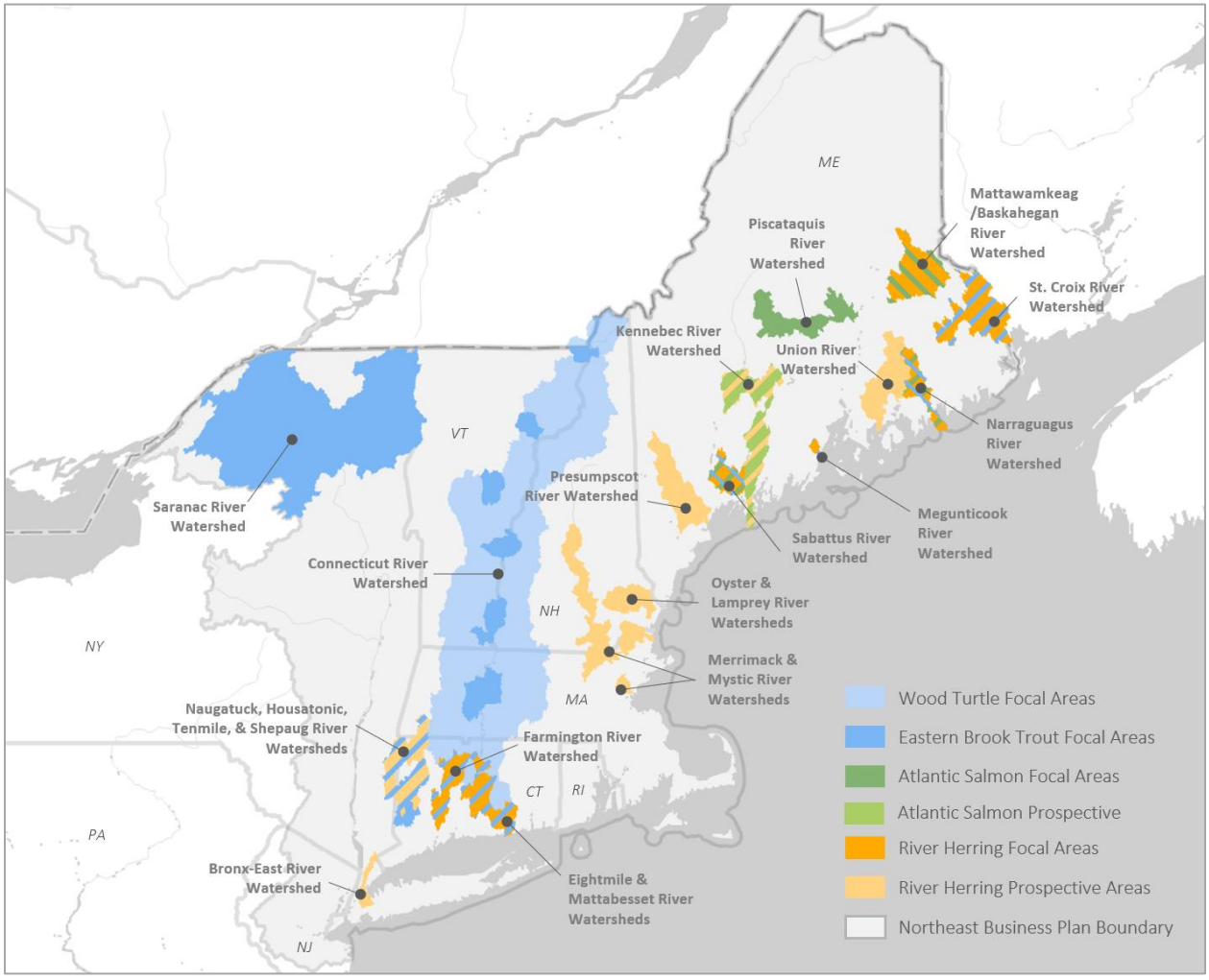

Figure 2. Map of stream and riparian habitat priority areas for focal species. An interactive digital map of this business plan is available at: [Northeast Watersheds Business Plan map].

Upland Forests and Grasslands


Golden-winged warbler

This plan includes a focus on forest health as well as three focal species to serve as indicators of ecosystem health within upland forests and grasslands. Business plan goals for these species are listed in Table 6 and focal areas are shown in Figure 3.

Golden-winged Warbler. This plan will support habitat management to ensure persistence (occupancy) of golden-winged warbler (GWWA) in patches managed across the landscape. Hybridization between GWWA and blue-winged warblers (BWWA) is well-studied (Gill 2009; Confer et al. 2020). Hybrids have been increasing as BWWA have expanded into GWWA's range (Gill 2009). In the regions of overlap, BWWA have replaced GWWA in numerous patches resulting in a contraction of the distribution of GWWA and population declines (Sauer et al. 2017; Roth et al. 2019). Thus, because hybridization with BWWA is likely contributing to current declines of GWWA, understanding the impacts of changing climate on the GWWA/BWWA hybrid landscape (Crawford et al. 2016) is important for management. A recent analysis suggests that GWWA and BWWA distributions are projected to substantially change under future climate scenarios (Hightower et al. 2023). Projected future distributions suggest a reduction in overlap between these species underscoring the importance of managing for GWWA at the landscape level within current NY/VT focal area to ensure long-term persistence.

New England Cottontail. This plan aims to increase abundance of NEC in managed sites throughout multiple focal areas in Maine, New Hampshire, Massachusetts, Connecticut and New York by increasing the size and number of suitable habitat patches. The accomplishments of this plan will contribute to the range-wide goal of 27,000 acres of restored habitat to support 13,500 rabbits (Fuller & Tur 2012). Larger patches have been associated with higher rates of survival and recruitment and short distances between patches are critical to facilitate dispersal of NEC and discourage eastern cottontail colonization and expansion (Villafuerte et al. 1997; Cheeseman et al. 2021). Some populations will require translocations of individuals to assist in colonizing newly created patches. This plan will support technical assistance, implementation of forest management and translocations of NEC to promote population growth and persistence.

Bobolink. The overall aim of investments through this business plan is to increase bobolink and other grassland bird reproduction (fledglings per female) in three focal areas: the Champlain Basin in Vermont, the Connecticut River Valley (VT, NH, and MA), and in central Maine. This will be achieved through expanding outreach, targeting high value grasslands, simplifying enrollment and providing incentive payments to producers to delay mowing in hayfields, providing grassland bird habitat and thus allowing bobolink to successfully fledge young.

Forest Health. NFWF will enhance forest health in the Northeast by investing in actions that improve age and structural diversity, a strategy that mirrors NFWF's work in other landscapes. A suite of best management practice guidelines has been developed for forest birds and other wildlife, and further, capacity exists to provide technical assistance towards expanding habitat delivery (increased age and structural diversity) aligned to improving forest health. The plan supports a forest health goal (expressed as acres planned and acres implemented) following dynamic forest restoration block (DFRB) guidance from central Appalachia and Delaware river business plans (15% young forest, 50% mature forest, and

35% late successional forest/old growth). To assess changes in the bird community NFWF will explore use of eBird data for developing trend and abundance information for eastern forest birds aligned to regions where forest management is occurring. Forest management blocks in the Northeast will include public land, private land or a mix of public/private lands.

Table 6. Upland forest and grasslands: Focal species goals

Focal Species	10-yr Business Plan Goals
Golden-winged Warbler	Maintain or increase golden-winged warbler occupancy in managed patches to a minimum 25% of all detections (relative to blue-winged warblers and hybrids detected at each site).
New England Cottontail	Increase population abundance by 40% in areas being managed for New England cottontails.
Bobolink	Increase the number of fledglings to 2.8 per nesting female in managed grasslands.
Forest Health	Improve forest stand age and structure on 100,000 acres through planning and implementation of dynamic forest restoration blocks (15% young forest, 50% mature forest, and 35% late successional forest/old growth).

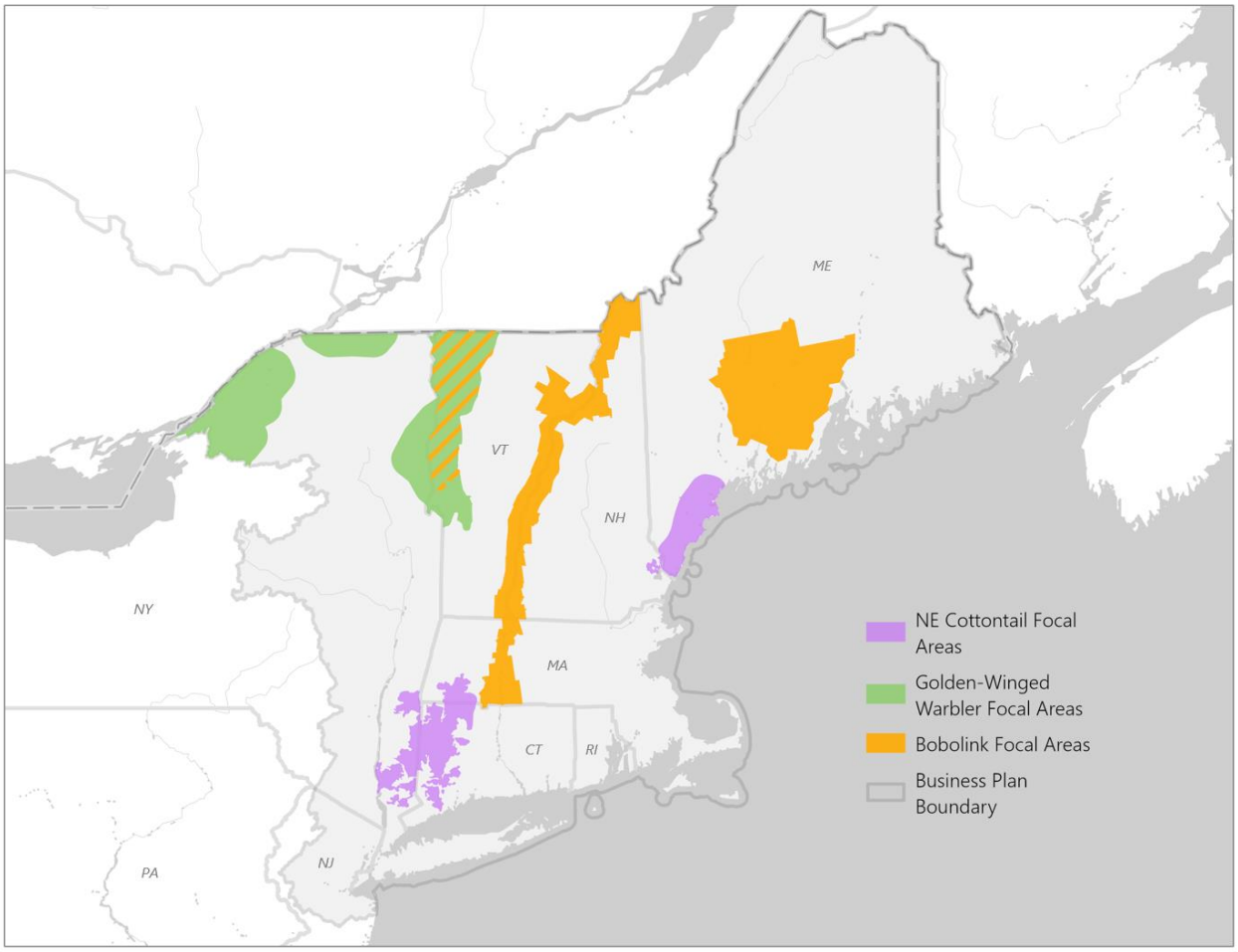

Figure 3. Map of forest and grassland priority areas for focal species. An interactive digital map of this business plan is available at: [Northeast Watersheds Business Plan map].

Implementation Plan

NFWF will fund projects implementing the following strategies to support the overarching goal of sustaining and improving coastal, stream, wetland, upland forest and grassland habitats to benefit fish, birds and other wildlife. The results chains depict the collective strategies that are anticipated to contribute to the identified coastal habitat conservation outcomes (Figure 4) and aquatic and upland habitat conservation outcomes (Figure 5).

Strategy 1: Protect and restore priority marsh habitat

The business plan aims to build a stable population of saltmarsh sparrow by increasing density within priority salt marshes across the Northeast, providing high quality breeding habitat and increasing nest productivity over time. Priority patches for restoration will follow *priority* and *honorable mention* marshes identified by the Atlantic Coast Joint Venture (ACJV) and partners[7]. In addition, NFWF will favor those marshes proximate to dense human community assets where restoration activities can provide co-benefits for saltmarsh sparrow nest productivity and flood-risk reduction to human communities. Following restoration of a priority patch, we will support monitoring for increases in saltmarsh sparrow occupancy and density over time.

1.1 Improve and increase high quality salt marsh habitat. Restore native vegetation and hydrologic function to priority salt marsh complexes, and where appropriate create microhabitats to support saltmarsh sparrow nesting sites.

- 1.1.1 Remediate tidal marsh ditching and create runnel systems that allow storm surge to rise and fall
- 1.1.2 Conduct thin layer placement of sediment on tidal marsh that has subsided and/or developed pond holes
- 1.1.3 Remove tidal restrictions (e.g., culverts, berms) to restore natural sedimentation and hydrology
- 1.1.4 Restore native vegetation

1.2 Protect priority salt marsh habitat. Reduce the loss and fragmentation of salt marsh habitat from erosion and sea level rise.

- 1.2.1 Install living shorelines and oyster reefs to reduce marsh loss and fragmentation
- 1.2.2 Conserve and restore freshwater wetlands, coastal forests and agricultural lands adjacent to large salt marsh systems to provide a transition zone and facilitate marsh migration.

[7] Saltmarsh Restoration Priorities for Saltmarsh Sparrow: https://experience.arcgis.com/experience/0a580f98787f4250bff871892d266d64

Strategy 2: Restore and improve management of beach and dune habitat

American oystercatchers, like migratory shorebirds in general, are exposed to a diverse set of human-induced threats across the network of sites used annually for breeding, roosting, feeding and staging. While the nature and severity of the threats varies, each site plays a critical role in shorebird survival. Therefore, effective shorebird conservation requires a wide-ranging approach to identify and ameliorate threats that shorebirds face at multiple locations across a flyway. Such an approach must coordinate research, conservation, and management efforts of diverse groups across political boundaries and consolidate resources to undertake effective conservation activities.

2.1 Restore beach and dune habitat

2.2 Engage communities in preventing disturbance and preventing refuse that attracts predators (e.g., raccoons, skunks, gulls)

2.3 Reduce human disturbance and predation

- 2.3.1 Implement practices to reduce disturbance (e.g., dune fencing, signage)
- 2.3.2 Implement practices to reduce predation (e.g., refuse management) at priority nesting sites

Strategy 3: Restore aquatic connectivity

The strategy addresses barriers to fish movement in the region's rivers and streams caused by derelict and/or under-utilized dams as well as under-sized and/or failing culverts at road-stream crossings. These barriers fragment habitat isolating resident fish populations and cutting off anadromous fish from their spawning habitat.

3.1 Build local, state and regional capacity to design road-stream crossings that allow for fish passage and flood risk reduction

3.2 Accelerate the design and permitting of right-sized road-stream crossings

3.3 Implement culvert replacement projects, especially by leveraging federal infrastructure and other funding

3.4 Remove derelict or under-utilized dams that are barriers to fish movement

Strategy 4: Restore the quality of stream and riparian habitat

Polluted runoff from developed and agricultural lands and the alteration of upland and riparian areas degrade water quality and habitat complexity that threaten brook trout and wood turtles. Addressing these impairments through riparian buffer restoration, best management practices to reduce runoff, and improvements to in-stream habitat will bolster healthy populations, while also expanding available habitat.

4.1 Protect and restore riparian buffers

- 4.1.1 Engage landowners in restoring wetlands and riparian buffers on their lands
- 4.1.2 Provide technical and financial assistance to restore wetlands, especially leveraging Farm Bill funding
- 4.1.3 Provide technical and financial assistance to reforest riparian buffers, especially leveraging Farm Bill funding

4.2 Reduce polluted runoff and erosion

- 4.2.1 Engage agricultural, urban/suburban and municipal landowners
- 4.2.2 Provide technical and financial assistance to implement agricultural conservation practices, especially leveraging Farm Bill funding
- 4.2.3 Provide technical and financial assistance to implement green stormwater infrastructure practices

4.3 Improve the complexity of in-stream habitat through large wood additions

- 4.3.1 Engage public and private landowners
- 4.3.2 Implement projects to increase large wood in rivers and streams

Strategy 5: Improve Age-Class and Structural Diversity of Forests

This strategy will support forest management to enhance diversity and improve forest health. A growing consensus suggests that habitat in the Northeast is generally abundant for mature forest species, and the primary need is to increase the proportion of young forest (<15 years; early successional habitat) and late successional or old growth (>150 yrs) age classes across the landscape.

5.1 Accelerate forest management planning that balances age-class and structural diversity

- 5.1.1 Engage public and private landowners
- 5.1.2 Conduct forest planning at the forest block scale[8]

5.2 Create early successional forest habitat for New England cottontail

- 5.2.1 Engage public and private landowners
- 5.2.2 Implement NEC management practices, especially by leveraging Farm Bill funding
- 5.2.3 Translocate New England cottontail to newly created habitat

5.3 Create early successional forest habitat for golden-winged warbler

- 5.3.1 Conduct landowner outreach targeting old fields, shrublands and adjacent forest
- 5.3.2 Provide technical and financial assistance to implement forest practices, especially leveraging Farm Bill funding

Strategy 6: Increase Grassland Habitat

The business plan aims to improve management of grasslands in New England through an incentive payment program for individual producers to delay cutting of grass on managed acres during the peak breeding period for grasslands birds. The goal is to enroll a minimum of 1,500 acres of high-quality grassland habitat in VT, MA, NH or ME annually. NFWF support for incentive payments in the Northeast will increase bobolink reproduction and benefit several additional declining grassland bird species.

6.1 Conduct landowner outreach

6.2 Provide technical and financial assistance to increase adoption of BMPs for mowing and hay harvest

[8] For the purposes of this plan, forest blocks are contiguous forest patches >5,000 acres in size.

Strategy 7: Monitor Species Response

Monitoring data for each of the nine focal species will be collected to measure and track species response to implementation strategies. Data will be collected using consistent, cost-effective protocols. Site-based monitoring data will be supplemented with population response modeling to improve the understanding of landscape-wide impacts of the conservation strategies implemented.

7.1 Leverage existing, ongoing monitoring conducted by other agencies, academics and nonprofits

7.2 Embed monitoring in grantee implementation projects

7.3 Conduct third-party species response monitoring as needed

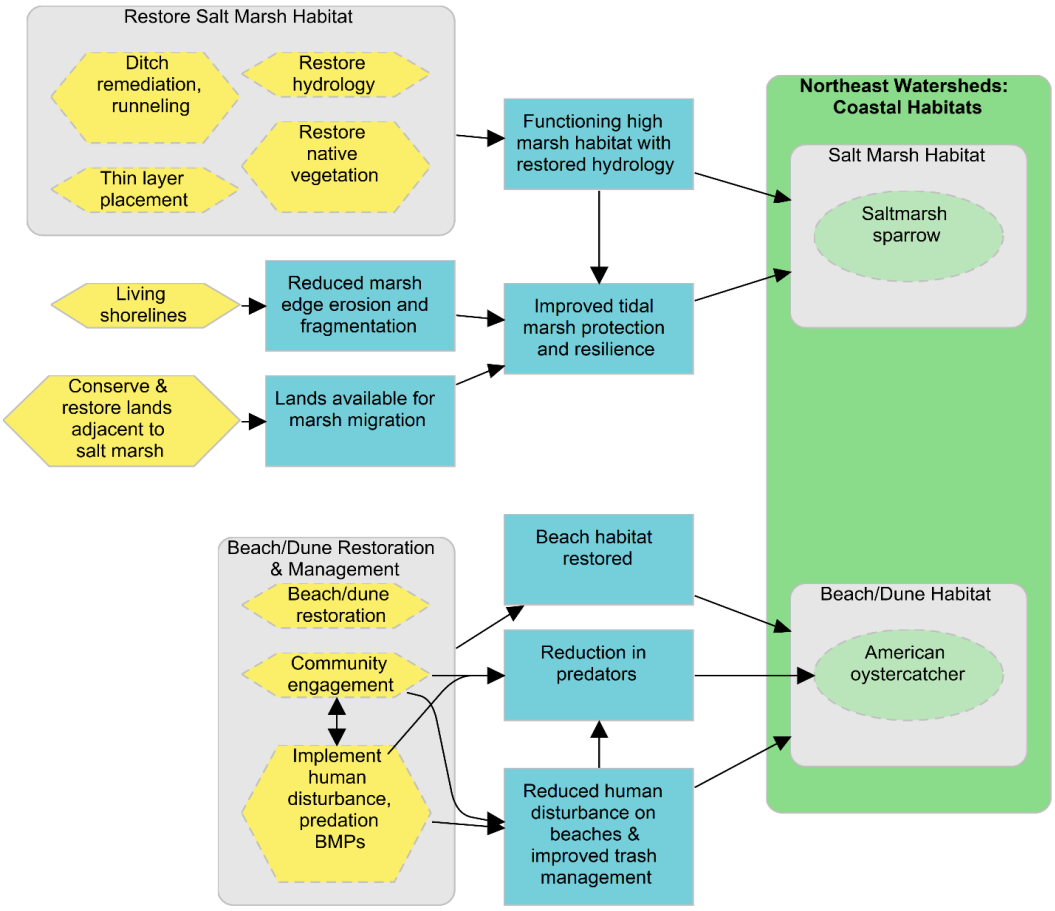

Figure 4. Results chain depicting the relationship of coastal habitat strategies (yellow hexagons) to the intermediate results (blue boxes) and ultimately to the focal species (green ovals).

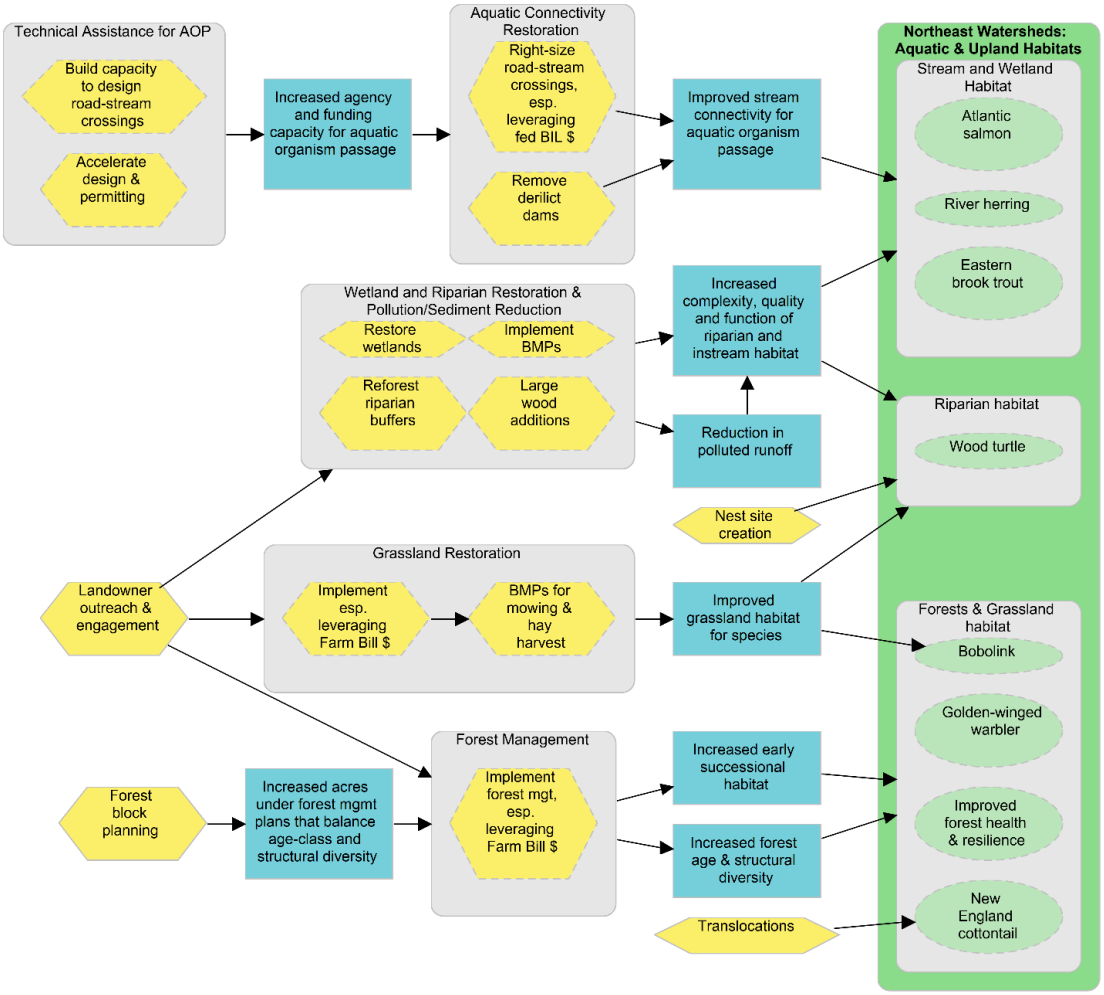

Figure 5. Results chain depicting the relationship of aquatic and upland strategies (yellow hexagons) to the intermediate results (blue boxes) and ultimately to the focal species (green ovals).

Risk Assessment

Risk is an uncertain event or condition which, if it occurs, could negatively affect a plan's outcomes. NFWF assessed seven risk categories to determine the extent to which they could impede progress towards the strategies and goals for the Northeast Watersheds Business Plan during the next 10 years. Table 7 lists the primary risks to success and the strategies that NFWF will implement to minimize or avoid those risks, where possible.

NFWF also considers how these risks might affect the long-term sustainability of the outcomes achieved (i.e., up to 10 years after closure of the plan). For example, funding for monitoring can be particularly challenging to raise and environmental risks will likely intensify and impact coastal restoration sites. To support long-term sustainability, NFWF engages in the following best practices:

- **RFP:** Any Request for Proposals for the business plan will include language notifying applicants that projects should anticipate post-implementation monitoring by future NFWF grantees or contractors. The RFPs will also list long-term sustainability in the evaluation criteria section.

- **Outreach:** NFWF will support conservation projects that engage directly with landowners and local communities to build sustained support for implementation and maintenance.
- **Building Technical Capacity:** NFWF will support staff positions at grantee organizations and agencies, as appropriate, to increase technical capacity by supporting training for foresters and aquatic organism passage practitioners.
- **Long-term Maintenance and Monitoring:** NFWF will leverage, where possible, monitoring capacity at state agencies where long-term monitoring is required as a condition of receiving targeted state funding for a project.

Table 7. Business plan risk assessment summary

RISK CATEGORY	RATING	RISK DESCRIPTION	MITIGATING STRATEGIES
Economic Risks	Low	Risk that budget is insufficient to achieve goals because costs of materials continue to increase substantially.	Business plan goals developed with cost buffer in mind.
Environ-mental Risks	Moderate	Climate and ecological threats could pose a risk, including sea level rise, increased drought or flooding, invasive Eastern cottontail, and golden-winged warblers hybridizing with blue-winged warblers.	Business plan strategies are meant to increase species resilience to environmental and climate factors and to limit competition from and hybridization with other species.
Financial Risks	Low	Funding for monitoring more challenging to raise. Risk that funding for addressing all strategies at certain species priority sites will not be available.	Monitoring funding will be embedded into grants where possible. Multiple species priority sites have been identified as options to achieve goals.
Institutional Risks	Low	Risk of limited staff capacity in NGOs and agencies to implement conservation activities and monitoring, particularly due to tight job market. Lack of foresters trained in management for different age classes.	Plan could help fund positions and leverage Farm Bill technical assistance money. NFWF will fund train-the-trainer for forest managers.
Regulatory Risks	Low	Anticipated species listing decisions may impact landowner willingness to engage in conservation actions. Permitting challenges could delay marsh restoration and dam removals.	Plan includes landowner outreach strategies. NFWF approach of separating design/ permitting grants from implementation and encouraging applicants to work early with permitting agencies helps ensure a project is shovel ready before receiving restoration funding.
Scientific Risks	Moderate	Scientific uncertainty exists surrounding future climate impacts, parts of species life cycle (e.g., marine) and threats (e.g., strategies to reduce invasion of Eastern cottontail).	Business plan invests in monitoring to learn and adapt to observed habitat and species response.
Social Risks	Low	Lack of community or landowner support could limit ability to implement conservation actions (e.g., dam removal, hay cutting BMPs). Poaching remains a threat to wood turtles.	Plan embeds outreach to landowners and managers and is flexible re: sites within the broad geography where work can be conducted. NFWF requires evidence of landowner support in applications. Plan maintains privacy of wood turtle spatial data.

Monitoring & Evaluating Performance

Performance of the Northeast Watersheds Business Plan will be assessed at both project and program scales. At the project scale, **individual grants** will be required to track relevant strategy and habitat metrics from Table 8 to demonstrate progress on project activities and to report out on them in their interim and final programmatic reports.

Table 8. Business plan metrics from individual grants

Strategy	Outcome	Metrics	Baseline (2023)	Goal (2033)
Coastal Habitats				
Strategy 1: Protect and restore priority marsh habitat	Improve marsh habitat for coastal communities and wildlife, including salt marsh sparrow	Acres of salt marsh with project design and permitting completed	0	7,500
		Acres of salt marsh restored	0	5,000
Strategy 2: Restore and manage beach and dune habitat	Improve American oystercatcher nesting success	Acres of beach habitat restored	0	1,000
		# of sites with human disturbance and predator management BMPs	0	5
Stream and Riparian Habitats				
Strategy 3: Restore aquatic connectivity	Replace barriers to fish passage for brook trout, river herring, and/or Atlantic salmon	# of barriers assessed and/or with design plan	0	30
		# of barriers rectified	0	40
		Stream miles opened	0	2,000
		Acres of lake/pond habitat opened	0	80,000
Strategy 4: Restore the quality of stream and wetland habitat	Restore wetlands riparian buffers for eastern brook trout and wood turtle	Miles with riparian restoration with a minimum width of 35 feet	0	970
		Acres of riparian restoration	0	4,200
	Reduce polluted runoff and erosion	Acres of agricultural BMPs	0	1,000
		Acres of green stormwater infrastructure	0	100
	Instream restoration for eastern brook trout and Atlantic salmon	Miles of instream restoration (with large woody additions)	0	50
Upland Forests and Grasslands				
Strategy 5: Improve age-class and structural diversity of forests	Plan & implement management for early successional habitat in GWWA and NEC focal areas	Acres planned	0	100,000
		Acres under improved management (ESF)	0	2,400
	Increase NEC abundance at managed sites via translocations	# of individuals translocated	0	50
Strategy 6: Increase native grassland habitat	Restoration and implementation of incentive payment BMPs to benefit nesting bobolink	Acres of grassland under improved management (annually)	0	1,500
Monitoring				
Strategy 7: Monitor species response	Monitor response of the 9 focal species	# of monitoring programs	0	9

At the program scale, **species outcomes** from Table 9 will be monitored through targeted grants to key monitoring partners (e.g., Saltmarsh Habitat and Avian Research Program, American Oystercatcher Working Group), existing external data sources, and/or aggregated data from relevant grant projects, as appropriate. Priorities for targeted monitoring grants will be included in annual RFPs under this plan.

Table 9. Business plan metrics for species outcomes

Species	Outcome	Metrics	Baseline (2023)	Goal (2033)
Coastal Habitats				
American Oystercatcher	Increase reproductive success	# of chicks fledged per pair	0.5	0.55
Saltmarsh Sparrow	Maintain or increase salt marsh sparrow density	# individuals/acre	Varies by site[9]	≥ baseline
Stream and Riparian Habitats				
Eastern Brook Trout	Increase relative abundance in 8 patches	# of patches with increased brook trout	0	8
	Improve habitat to maintain populations.	# of EBT patches improved	0	4
Atlantic Salmon	Improve occupancy by enhancing aquatic connectivity and habitat quality in focal rivers in Gulf of Maine DPS	# of salmon habitat units opened	0	5,000
		# of salmon habitat units restored	0	1,000
		Presence of redds/smolt in restored sites	0	10
River Herring	Increase runs in focal rivers by 4x the baseline levels by improving aquatic connectivity	# of fish/adult river herring in LIS watersheds	2,500	10,000
		# of fish/adult river herring in New England Watersheds	1,000,000	4,000,000
Wood Turtle	Maintain adult abundance at managed sites and secure nesting habitat	# of nesting sites secured	0	400
		# of adults at managed sites	Varies by site	Maintain
Upland Forests and Grasslands				
Golden-winged Warbler	Maintain nesting populations in WLFW VT and NY focal areas	% occupancy of GWWA in managed patches (relative to all *Vermivora* detected)	Varies by site	25%
New England Cottontail	Increase abundance at managed sites through habitat improvements	% population increase	Varies by site[9]	40%
Bobolink	Increase Bobolink reproductive success	Number of females per 10 acres	Varies by site	4
		Number of fledglings per nesting female	0	2.8
Forest Health	Enhance forest health by creating age-class & structural diversity in managed forest blocks	% of forest in the various age classes in managed forest blocks	Varies by site	ESF: 15% Mature: 50% LSF: 35%

[9] See Appendix A for data on site-specific baselines.

Budget

The following budget shows the estimated costs to implement the business plan activities (Table 10). NFWF will have to raise funds to meet these costs; therefore, this budget reflects NFWF's anticipated engagement over the business plan period of performance and is *not* an annual or even cumulative commitment by NFWF to invest. This budget assumes that current activities funded by others will, at a minimum, continue.

Table 10. Business plan budget

Business Plan Strategy	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	TOTAL
Strategy 1. Protect and restore salt marsh											
1.1 Improve salt marsh	$1M	$1M	$1.5M	$1.5M	$1.25M	$1.25M	$1.25M	$1.25M	$1M	$1M	**$12M**
1.2 Protect salt marsh	$1M	$1M	$1.5M	$1.5M	$1.25M	$1.25M	$1.25M	$1.25M	$1M	$1M	**$12M**
Strategy 2. Restore and improve management of beach and dune habitat											
2.1 Restore beaches, dunes	$825k	$825k	$825k	$825k	$550k	$550k	$550k	$550k	$500k	$500k	**$6.5M**
2.2 Engage communities	$225k	$225k	$225k	$225k	$150k	$150k	$150k	$150k	$150k	$100k	**$1.75M**
2.3 Reduce human disturbance & predation	$450k	$450k	$450k	$450k	$350k	$350k	$350k	$300k	$300k	$300k	**$3.75M**
Strategy 3. Restore aquatic connectivity											
3.1 Build capacity	$300k	$300k	$300k	$300k	$300k	$0k	$0k	$0k	$0k	$0k	**$1.5M**
3.2 Design/permitting	$500k	$0k	$500k	$0k	$500k	$0k	$0k	$0k	$0k	$0k	**$1.5M**
3.3 Culvert replacements	$200k	$200k	$500k	$700k	$700k	$700k	$500k	$500k	$500k	$500k	**$5M**
3.4 Remove derelict dams	$0M	$1M	$1.7M	$2M	$0M	$0.3M	$1M	$1M	$1M	$1M	**$9M**
Strategy 4. Restore the quality of stream and riparian habitat											
4.1 Riparian buffers	$2.85M	$2.85M	$2.85M	$2.85M	$2.3M	$2.3M	$2.2M	$2.2M	$2.2M	$2.2M	**$24.8M**
4.2 Reduce polluted runoff & erosion	$2M	$2M	$2M	$2M	$1.5M	$1.5M	$1M	$1M	$1M	$1M	**$15M**
4.3 Large wood additions	$200k	$200k	$200k	$200k	$200k	$200k	$200k	$200k	$200k	$200k	**$2M**
Strategy 5. Improve age-class and structural diversity of forests											
5.1 Forest block planning	$100k	$0k	$100k	$0k	$100k	$0k	$100k	$0k	$100k	$0k	**$0.5M**
5.2 Forest mgmt for NEC	$200k	$0k	$200k	$0k	$200k	$0k	$200k	$0k	$200k	$0k	**$1M**
5.3 Forest mgmt for GWWA	$0k	$200k	$0k	$200k	$0k	$200k	$0k	$200k	$0k	$200k	**$1M**
Strategy 6. Increase native grassland habitat											
6.1 Landowner outreach	$200k	$0k	$200k	$0k	$200k	$0k	$200k	$0k	$200k	$0k	**$1M**
6.2 Grassland BMPs	$0k	$200k	$0k	$200k	$0k	$200k	$0k	$200k	$0k	$200k	**$1M**
Strategy 7. Species response monitoring											
7.1 Leverage external monitoring	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
7.2 Monitoring embedded in implementation grants	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
7.3 Third-party monitoring	$100k	$200k	$200k	$200k	$200k	$200k	$200k	$200k	$200k	$200k	**$1.9M**
TOTAL BUDGET	**$10.2M**	**$10.7M**	**$13.3M**	**$13.2M**	**$9.8M**	**$9.2M**	**$9.2M**	**$9M**	**$8.6M**	**$8.4M**	**$101.2M**

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Appendix A. Species Goals and Monitoring

Additional detail on the business plan's focal species site-based goals and/or monitoring approach is provided below. In addition, NFWF may conduct an internal assessment or commission a third-party evaluation at a future stage of the business plan to determine outcomes and adaptively manage. In some cases, these course corrections may warrant increased investment; however, it is also possible that NFWF would reduce or eliminate support if periodic evaluation indicates that further investments are unlikely to achieve intended outcomes.

American Oystercatcher

The goal for American oystercatcher (AMOY), to increase reproductive success to 0.55 chicks per pair per year, mirrors the oystercatcher goal in NFWF's Atlantic Flyway Shorebird Business Plan. Oystercatcher projects supported through this business plan, thus, will also support the flyway plan. Oystercatcher monitoring is coordinated by the American Oystercatcher Working Group facilitated by scientists at Manomet Center for Conservation Sciences. Range-wide implementation of standardized reproductive success monitoring allows for a comprehensive evaluation of the efficacy of conservation interventions on AMOY breeding success. This business plan will support human disturbance reduction, predator management, and habitat restoration actions to improve AMOY reproductive success.

Saltmarsh Sparrow

The business plan aims to restore 5,000 acres of priority salt marsh habitat across the Northeast by 2033. The Atlantic Coast Joint Venture (ACJV), in consultation with states and other partners, have identified high priority and honorable mention marshes where restoration or protection activities will support saltmarsh sparrows. Regionwide breeding surveys were completed from 2011 to 2012 and were used to develop Bayesian network models to estimate patch-scale saltmarsh sparrow density (Wiest et al. 2016 & 2019). The ACJV estimates the saltmarsh sparrow population is currently declining at a rate of 9% per year. To develop patch-level density estimates for this business plan (Table 11), the 2011/12 data were multiplied by a 9% annual decline rate to develop projected 2022 baseline estimates for the business plan. As patches are restored through implementation of business plan strategies, patch-level monitoring will allow NFWF to track saltmarsh sparrow response to restoration and relative to the projected 2022 baseline estimates.

Restoration activities occurring within focal saltmarsh sparrow patches[11] will be monitored to detect patch-level changes in occupancy and density over time. Prior to and following restoration activities, sites will be monitored using the standardized Saltmarsh Habitat and Avian Research Program (SHARP 2023) protocols to determine the presence of saltmarsh sparrows within a patch and if present, to estimate density through point count surveys. Where possible, rapid demographic surveys will also be used to estimate breeding success by counting the number of females within restored patches. In addition to monitoring birds, vegetation, marsh elevation, unvegetated-vegetated marsh ratio, and other biotic and abiotic metrics will also be gathered. Data from ongoing 2021/2022 range wide surveys will be used to update density estimates as needed once available.

[11] Saltmarsh Restoration Priorities for Saltmarsh Sparrow including priority and honorable mention marshes as defined by the Atlantic Coast Joint Venture: https://experience.arcgis.com/experience/0a580f98787f4250bff871892d266d64

Eastern Brook Trout

The business plan aims to improve the patch status (e.g., from persistent to stronghold) of eight high quality patches. A full suite of restoration activities is necessary to achieve a patch status change. The hypothesis is that patch improvement will result in increased relative abundance. Preliminary identified patches to be considered are in Table 12. The plan will utilize an adaptive management approach where patches can be removed or added to the list upon new information (e.g., a new patch assessment).

Relative abundance will be monitored within the eight high value patches in focal areas. The monitoring and sampling will be designed at the appropriate scale to measure a difference in relative abundance across each patch. Relative abundance measures can include catch per unit effort (CPUE) or biomass. Traditional and standard fisheries sampling methodologies will be deployed for the measurement of this goal. Standards include, but are not limited to, fishing gear, proper distance upstream/downstream from restoration sites within a patch, environmental data, and effort data. Pre- and post- restoration grantee monitoring that meets the standard monitoring scheme will be used when possible. Grantee monitoring will be complemented by NFWF contractor monitoring where needed.

Atlantic Salmon

The development of goals for Atlantic salmon in this business plan is adapted from the Atlantic Salmon Recovery Plan and in consultation with federal and state agencies and other experts from organizations working on salmon restoration in the Northeast region.

Monitoring will be completed pre- and post- restoration within focal rivers, most importantly on large woody debris treatment sites. Detection of reproductive and rearing activities (redds, parrs and/or smolts) will be determined by visual counts and/or electrofishing. In some cases, other fish sampling techniques may be considered (e.g., eDNA, sonar).

River Herring

The business plan aims to increase the number of returning river herring spawners by removing dams/barriers that impede migration. Allowing river herring to freely migrate and access spawning and rearing habitats is crucial for population sustainability and expansion (Hare et al. 2021). Thus, dam removal and improved aquatic connectivity is critical to river herring restoration. Focal rivers for this business plan were chosen based on modeled river herring production potential from literature, historical and on-going monitoring data, and current prioritization plans by state agencies and other organizations (e.g., NAACC, TNC's Aquatic Barrier Prioritization Tool). The projected population goal of four times the 2022 baselines was estimated using historical run count data, examples of real-time average rates of run count increases after dam removal observed in the region (i.e., Penobscot and Sebasticook rivers) and the life cycle of river herring. While all severe barriers obstruct aquatic connectivity, priority for removal will be given to downstream barriers on focal rivers.

Dam/barrier removal activities within the focal areas will be monitored to determine changes in fish run counts. Existing fish sampling techniques (e.g., video counters) will be used for monitoring run counts. Annual run counts will be established in those rivers without existing monitoring.

Wood Turtle

The business plan aims to maintain the number of breeding adults at managed sites primarily through establishing riparian buffers. The majority of wood turtle movements occur within 300m of the streams edge (Jones et al. 2018), so the main objective of this strategy is to move agricultural machinery (a major source of injury and mortality) away from their primary movement area. These strategies will also secure or establish safe nesting areas along streams for females within the average home range size (~500m) to improve recruitment. The target number of nest sites was developed using the miles of riparian buffer expected to be established through this plan and the average width of a riparian buffer project.

Project sites will occur where demographic surveys have recently been conducted or will collect population data (adult abundance, nesting sites) to establish baseline estimates prior to interventions. Population data will be collected using established protocols (Wood Turtle Population Assessment Protocol). Securing nest sites can be assessed immediately post-intervention; however, maintenance of the adult population should be assessed 3-5 years post-implementation to establish success of conservation actions. Grantee monitoring will be complemented by NFWF contractor monitoring where needed.

New England Cottontail

This business plan aims to increase New England cottontail (NEC) abundance through a comprehensive strategy including habitat improvement and translocation where needed. Recent studies suggest that NEC inhabit lower-quality habitat when co-occurring with eastern cottontails. There are complex interactions between vegetative cover, invasive species, canopy density and presence of eastern cottontails that require a more nuanced approach to habitat management in the context of the surrounding landscape. NFWF will fund projects that help to align habitat quality with NEC habitat selection to improve vital rates and ultimately grow the population. NFWF will support translocation of individuals where necessary to supplement existing populations to increase density, dispersal, and ultimate expansion of populations. Patch-scale density is variable across their range, but this plan strives to achieve a minimum of 0.5 NEC per acre which is a conservative approximation of the average winter density in occupied patches (Fuller & Tur 2012).

Range-wide surveys conducted annually throughout the current distribution of NEC help to assess changes in occupancy through time and impact of management activities on occupancy status. While these data can inform overall trends and patch colonization/extinction, abundance surveys are needed to adequately assess growth of a population at NFWF investment sites through time. Projects will use robust approaches for estimating abundance like that described by Kristensen and Kovach (2018). NEC population response to habitat management may take several years, so grantee monitoring will be complemented by NFWF contractor monitoring where needed.

Golden-Winged Warbler

This plan will support habitat management for breeding golden-winged warbler (GWWA) in managed patches across the landscape. Hybridization between GWWA and blue-winged warblers (BWWA) is increasing as BWWA has expanded into the GWWA range. A recent analysis suggests that GWWA and BWWA distributions are projected to change under future climate scenarios, thus underscoring the importance of managing for GWWA at the landscape level within current NY/VT focal areas to ensure persistence. Patch-level occupancy rates for GWWA will be generated from one or more monitoring approaches:

1) Point counts (twice annually during the breeding period) conducted in managed patches with playback to confirm species from visual detection is the primary method. However, if multiple points need to be sampled annually, a subset of sampling locations can use autonomous recording units (ARUs) which cover approximately 10 acres to collect detection data, followed by playback and visual surveys in the same or following year to confirm species ratios.

2) Patch-level occupancy data generated from eBird data collected and reported following explicit protocols (see: http://content.ebird.org/vt/news/golden-blue-winged-warbler-potpourri-how-to-submit-to-ebird/) that are shared with the birding community each spring.

Bobolink

Perlut et al. (2006) demonstrated that nesting bobolinks had no reproductive success on hay fields cut early in the nesting season (before June 11 and at subsequent five-week intervals), 1.8 young/female in fields that were rotationally grazed, 2.2 young/female in fields cut in late June/July, and 2.8 young/female in fields first cut in August. Building on this, Ag Allies and the Bobolink Project, a joint effort of several regional Audubon societies, provide incentive payments for ecosystem services that encourages producers to delay harvest to allow for successful breeding of grassland birds (Perlut et al. 2011; Sutti et al. 2017; Chakrabarti et al. 2019).

Both Ag Allies and the Bobolink Project provide at least two options for producers, the first is to delay haying until August 1st, the second allows for an early season harvest of high nutrition hay by May 31st and a delay of the second cut by 65 days allowing time for bobolinks to renest and fledge young, which yields a similar number of young/female to fields first cut in August (Perlut et al. 2011). The business plan will enroll a minimum of 1,500 acres of high-quality grassland habitat in VT, MA, NH or ME annually in programs that incentivize delayed mowing through payments. Monitoring for bobolink will follow methods outlined in Perlut et al. (2007) and Chakrabarti et al. (2019) to produce estimates of the number of female bobolinks using managed fields and the number of fledglings produced per female.

Table 11. Saltmarsh Sparrow Density Estimates within Priority Marshes				
Patch Name	**ACJV Category[1]**	**Patch Size** *(acres)*	**2011/2012 Density[2]** *(birds/acre)*	**Projected 2022 Baseline Density[3]** *(birds/acre)*
Connecticut Marshes				
Hammock River Marsh Complex	Priority	309	0.096	0.037
Ragged Rock Marsh	Priority	324	0.000	0.000
Barn Island	Priority	312	0.047	0.018
East River Marsh Complex	Priority	809	0.026	0.010
Great Island Marsh Complex	Priority	746	0.325	0.127
Hammonassett Marsh Complex	Priority	679	0.361	0.141
Massachusetts Marshes				
Allens Pond	Priority	268	0.000	0.000
Barnstable Complex	Priority	5,380	0.200	0.078
Belle Isle Marsh	Priority	156	0.000	0.000
Great Marsh	Priority	16,152	0.202	0.079
Rumney Marsh	Priority	959	0.009	0.003
Skaket and First Encounter Marshes	Priority	796	0.136	0.053
Wellfleet Marshes	Priority	1,013	0.788	0.307
Waqouit Bay	Priority	254	0.000	0.000
Little River	Honorable Mention	187	0.000	0.000
Slocum River / Peters Creek	Honorable Mention	195	0.000	0.000
Duxbury	Honorable Mention	1,331	0.324	0.126
Ellisville Marsh Complex	Honorable Mention	64	0.186	0.072
Hatches Harbor	Honorable Mention	107	0.199	0.078
Kent Street	Honorable Mention	101	0.015	0.006
West End Marshes	Honorable Mention	238	0.195	0.076
Cape Pogue Bay / Pocha Pond	Honorable Mention	211	0.026	0.010
Coys Brook / Herring River / Harwich	Honorable Mention	342	0.202	0.079
Folgers Marsh and UMASS field station	Honorable Mention	27	0.202	0.079
Great Point Lagoon	Honorable Mention	13	0.605	0.235
Great Sippewissett	Honorable Mention	186	0.202	0.079

Table 11. Saltmarsh Sparrow Density Estimates within Priority Marshes				
Patch Name	**ACJV Category[1]**	**Patch Size** *(acres)*	**2011/2012 Density[2]** *(birds/acre)*	**Projected 2022 Baseline Density[3]** *(birds/acre)*
Massachusetts Marshes *(continued)*				
Hither Creek	Honorable Mention	77	0.375	0.146
Sengekontacket	Honorable Mention	140	0.000	0.000
The Glades	Honorable Mention	136	0.202	0.079
Katama Bay	Honorable Mention	6	0.202	0.079
Little Bay	Honorable Mention	no data	0.202	0.079
Polpis Harbor Marsh Complex	Honorable Mention	116	0.202	0.079
Menemsha Pond	Honorable Mention	68	0.026	0.010
The Creeks	Honorable Mention	44	0.202	0.079
Eel Point	Honorable Mention	37	0.563	0.219
Maine Marshes				
Scarborough Marsh	Priority	2,605	0.000	0.000
Webhannet	Priority	934	0.200	0.078
Cousins	Priority	125	0.087	0.034
Gamble Marsh	Priority	53	0.000	0.000
Kennebec/Swett	Priority	582	0.017	0.007
Middle Bay	Priority	46	0.009	0.004
Popham	Priority	608	0.168	0.066
Reid State Park	Priority	457	0.081	0.032
Sherman Marsh	Priority	364	0.003	0.001
Weskeag	Priority	310	0.050	0.020
Goose Rocks	Priority	439	0.000	0.000
Goosefare Brook	Priority	162	0.128	0.050
Granite Point	Priority	213	0.114	0.044
Little River, Wells	Priority	212	0.201	0.078
Ogunquit	Priority	298	0.000	0.000
Spurwink River	Priority	434	0.136	0.053
York River	Priority	254	0.185	0.072

Table 11. Saltmarsh Sparrow Density Estimates within Priority Marshes				
Patch Name	**ACJV Category[1]**	**Patch Size** *(acres)*	**2011/2012 Density[2]** *(birds/acre)*	**Projected 2022 Baseline Density[3]** *(birds/acre)*
Maine Marshes *(continued)*				
Dyer Marsh	Honorable Mention	206	0.149	0.058
Biddeford Pool	Honorable Mention	135	0.114	0.044
Kennebunkport Conservation Trust	Honorable Mention	23	0.000	0.000
Kittery	Honorable Mention	310	0.064	0.025
York Harbor	Honorable Mention	24	0.096	0.038
New Hampshire Marshes				
Dover and Durham	Priority	254	0.000	0.000
Greenland and Newington	Priority	247	0.000	0.000
Piscataqua	Priority	229	0.000	0.000
Rye	Priority	180	0.000	0.000
Seabrook-Hamptons Estuary	Priority	940	0.153	0.060
Squamscott and Lamprey River	Priority	578	0.000	0.000
New Jersey Marshes				
Cheesequake	Honorable Mention	1,180	0.101	0.039
New York Marshes				
Southwest Long Island	Priority	947	0.146	0.057
Hempstead - Alder	-	-	*0.503*	*0.196*
Hempstead - Cinder	-	-	*0.346*	*0.135*
Hempstead - High Meadows	-	-	*0.414*	*0.161*
Hempstead - Laurence	-	-	*0.000*	*0.000*
Hempstead - Smith	-	-	*0.341*	*0.133*
Hempstead - Green Sedge	-	-	*0.202*	*0.079*
Hempstead - Oceanside Marine Nature Study Area	-	-	*0.202*	*0.079*
Babylon	-	-	*0.496*	*0.193*
Babylon - Gilgo	-	-	*0.026*	*0.010*
Babylon - Thatch Island	-	-	*1.114*	*0.434*

Table 11. Saltmarsh Sparrow Density Estimates within Priority Marshes				
Patch Name	**ACJV Category[1]**	**Patch Size** *(acres)*	**2011/2012 Density[2]** *(birds/acre)*	**Projected 2022 Baseline Density[3]** *(birds/acre)*
New York Marshes *(continued)*				
Babylon - Elder	-	-	*1.114*	*0.434*
Babylon - Captree	-	-	*0.087*	*0.034*
Accabonac Harbor	Priority	269	0.202	0.079
Cedar Beach (including Cedar Beach Creek)	Priority	25	0.202	0.079
East Fire Island	Priority	903	0.284	0.110
Fire Island National Seashore Wilderness Area	-	-	*0.484*	*0.188*
Suffolk County / Smith Point / Great Gun	-	-	*0.025*	*0.010*
West Neck Creek Marshes	Priority	294	0.026	0.010
Mastic Beach (including William Floyd Estate/Fire Island NS, Smith Point)	Priority	278	0.202	0.079
Napeague	Priority	279	0.202	0.079
Pipes Cove	Priority	56	0.145	0.057
Wertheim NWR and Fireplace Neck Tidal Wetlands Area	Priority	758	0.050	0.019
Long Beach Bay Marshes (including Broad Meadow/Narrow River)	Priority	210	0.124	0.048
Caumsett State Historic Park	Priority	107	0.108	0.042
Crab Meadows	Priority	267	0.026	0.010
Sunken Meadows	Priority	83	0.202	0.079
Wading River	Priority	175	0.202	0.079
North Haven (including East Side North Haven, Fresh Pond, Genet Creek)	Priority	98	0.202	0.079
Idlewild Park	Honorable Mention	570	0.122	0.047
JoCo	-	-	*0.005*	*0.002*
Spring Creek	-	-	*0.139*	*0.054*
Fishers Island	Honorable Mention	42	0.607	0.236
Cassidy Preserve (including Paul Stoutenburgh Preserve)	Honorable Mention	29	0.170	0.066
Conscience Point	Honorable Mention	72	0.202	0.079
Corey Creek	Honorable Mention	23	0.202	0.079
Northwest Habor	Honorable Mention	225	0.202	0.079
Seatuck National Wildlife Refuge	Honorable Mention	81	0.201	0.078

Table 11. Saltmarsh Sparrow Density Estimates within Priority Marshes				
Patch Name	**ACJV Category[1]**	**Patch Size** *(acres)*	**2011/2012 Density[2]** *(birds/acre)*	**Projected 2022 Baseline Density[3]** *(birds/acre)*
New York Marshes *(continued)*				
Pine Neck Sanctuary Marshes	Honorable Mention	34	0.026	0.010
William T. Davis	Honorable Mention	529	0.202	0.079
Pelham Bay Park	Honorable Mention	176	0.202	0.079
West Meadow	Honorable Mention	94	0.202	0.079
Alley Pond Park	Honorable Mention	54	0.202	0.079
Flax Pond	Honorable Mention	67	0.005	0.002
Mashomack Preserve	Honorable Mention	73	0.202	0.079
Rhode Island Marshes				
Belcher's Cove and Palmer River	Priority	126	0.202	0.079
Narrow River	Priority	205	0.248	0.096
South Shore Management Area (Galilee Outer)	Priority	25	0.202	0.079
South Shore Management Area (Galilee Inner)	Priority	113	0.202	0.079
Jacobs Point	Priority	41	0.026	0.010
Marsh Meadows	Priority	68	0.213	0.083
Quonochontaug	Priority	98	0.070	0.027
Sachuest	Priority	50	0.443	0.172
Seapowet Marsh Management Area	Priority	187	0.723	0.282
Succotash Marsh Management Area	Priority	99	0.202	0.079
Winnapaug	Priority	171	0.202	0.079
Prudence Island 'Coggeshall & Sheep Pen'- Narraganset Bay NERR	Priority	78	0.409	0.159
Prudence Island 'Providence Point' - Narraganset Bay NERR	Priority	15	0.245	0.096
East Beach State Park (Ninigret)	Priority	138	0.119	0.046
Fogland	Honorable Mention	94	0.723	0.282

[1] ACJV (Atlantic Coast Joint Venture) categorizes marshes into priority and honorable mentions (see https://experience.arcgis.com/experience/0a580f98787f4250bff871892d266d64)
[2] Density estimates based on Wiest et al. (2019).
[3] Projected 2022 density estimates apply a 9% annual decline rate to 2011/2012 density estimates. As data from ongoing 2021/2022 rangewide surveys become available density estimates will be updated as needed.

Table 12. Preliminary high-value patches identified to improve eastern brook trout status and increase relative abundance.

Focal Watershed	Trout Unlimited Patch ID(s)	State	# of high value patches
Saranac River	4280	NY	1
Tenmile River	3543, 4265	NY, CT	2
Mattabesset River	8079	NY	1
Passumpsic River	563, 730, 822	VT	3
Still River-Housatonic River	8310	NY, CT	1

Appendix B. Carbon Co-Benefits

Although NFWF business plans are aimed at achieving habitat and species goals, NFWF is committed to understanding the broader impacts of these investments in conservation. Specifically, NFWF has begun measuring other environmental and social co-benefits from business plan investments, including carbon benefits.

NFWF estimates the activities funded through the life of this business plan will yield a 30-year carbon benefit, either sequestered (i.e., removed from the atmosphere) or through avoided emissions, of between 571,000 to 857,000 metric tons CO_2 equivalent. NFWF produced this estimate using open-source datasets, various scientific reports, and IPCC guidelines. NFWF estimates the carbon benefit not to claim any formal carbon credits, but rather to demonstrate the co-benefits that accrue from our business plan's conservation investments for fish, wildlife, and habitats.