Chapter 4

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Gray catbird

Environmental Consequences

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Introduction

This chapter analyzes and discusses the potential environmental effects on the resources outlined in Chapter 3—Affected Environment. Environmental effects include those that are direct, indirect, and cumulative. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.

Alternative B, if approved, is generally believed to have indirect effects since the majority of lands are not expected to be protected immediately. Cumulative impacts are effects on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects are discussed in a separate section following the analysis of alternatives A and B.

Potential effects or impacts, either positive (beneficial) or negative (adverse), to resources resulting from the implementation of the two alternatives were identified and placed into one of the following listed categories, when possible:

- None—no effects expected.
- Minimal—impacts are not expected to be measurable, or are too small to cause any discernible degradation to the environment.
- Minor—impacts would be measurable, but not substantial, because the impacted system is capable of absorbing the change.
- Moderate—effects would be measureable, but could be reduced through appropriate conservation measures.
- Major—impacts would be measurable and individually or cumulatively significant; an Environmental Impact Statement would be required to analyze these impacts.

Impact significance is defined in terms of intensity, the type, quality, and sensitivity of the resource involved, the location of a proposed projects, the duration of its effect (short-term or long-term), and other consideration of context. It is not a value judgment, as some actions can be beneficial for one species and adverse for another, or have a positive impact on visitor use but a negative impact on migratory birds.

We recognize that we cannot fully address all the potential impacts involved with the alternatives through this planning process. Inevitably, some future management decisions may require more detailed analysis before an action can be implemented. For specific projects evaluated in the future, NEPA documents will be prepared that address and fully analyze the potential adverse and beneficial impacts. Most likely, these NEPA documents will be prepared by Service staff at the national wildlife refuge nearest to the acquisition parcel. Our goal is to develop and implement all future plans to minimize adverse impacts while maximizing the long-term benefits to each resource. Each additional NEPA analysis will include compliance with Federal laws and mandates including the ESA, the National Historic Preservation Act, and the Coastal Zone Management Act, as appropriate. Although not a comprehensive list, we recognize that further analysis would be required for the following projects associated with Refuge System lands:

- Habitat Management Plans (HMPs)
- Hunt Plans by respective state

- Fishing Management Plans
- Fire Management Plan (following HMP completion).
- Visitor Services Plan
- Integrated Pest Management Plan

Impact Analysis and Relationship to Scale

We have organized this section by major resource heading. Under each heading we discuss the impacts of each alternative. We generally discuss the impacts to the physical and socioeconomic environment on the AOI scale and the impacts to the biological environment on the RAFA scale (see Table 22 below). This aligns with how we discuss the same resources in Chapter 2—Affected Environment.

Each section addresses the projected types of impacts, both adverse and beneficial, potentially resulting from proposed actions in the different alternatives. We also describe, when possible, how impacts differ across alternatives. In doing so, impacts can more clearly be compared and evaluated. Lastly, concluding summary statements about impacts are provided for each section analyzed.

Table 22: Context for Impact Analysis

Resource Impacted	Resource Aspect	Area of Interest	Refuge Acquisition Focus Areas
Physical	Geomorphology	✔	
	Hydrology and water quality	✔	
	Soils	✔	
	Climate	✔	
	Air quality	✔	
Socioeconomic	Local tax revenues	✔	
	Local property values	✔	
	Refuge personnel salary spending	✔	
	Refuge visitor spending	✔	
	Cultural Resources and Historic Preservation	✔	✔
Biological	Vegetation and habitat types		✔
	Birds		✔
	Mammals		✔
	Federal-listed species and other species of concern		✔

Effects on Cultural Resources and Historic Preservation

New England cottontail released on Patience Island in Rhode Island

Tom Barnes/USFWS

Impacts that would not vary by Alternative

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and Section 14 of the Archaeological Resources Protection Act require the Service to evaluate the effects of any of its actions on cultural resources (e.g., historic, architectural, and archaeological) that are listed or eligible for listing in the National Register of Historic Places (NRHP). In accordance with these regulations, the Service has coordinated the review of this proposal with all six states that are affected by this proposal. The body of Federal historic preservation laws has grown dramatically since the enactment of the Antiquities Act of 1906. Several themes recur in these laws, their promulgating regulations, and more recent executive orders. They include: (1) Each agency is to systematically inventory the historic properties on its holdings and to scientifically assess each property's eligibility for the NRHP; (2) Federal agencies are to consider the impacts to cultural resources during the agencies' management activities and seek to avoid or mitigate adverse impacts; (3) the protection of cultural resources from looting and vandalism are to be accomplished through a mix of informed management, law enforcement efforts, and public education; and (4) the increasing role of consultation with groups, such as Native American Tribes, in addressing how a project or management activity may impact specific archaeological sites and landscapes deemed important to those groups. The Service, like other Federal agencies, is legally mandated to inventory, assess, and protect cultural resources located on those lands that the agency owns, manages, or controls. The Service's cultural resource policy is delineated in 614 FW 1-5 and 126 FW 1-3.

Activities outlined in each alternative have some potential to adversely impact cultural resources, either by direct disturbance during a variety of habitat management projects (e.g., mowing), minor construction (e.g., interpretative sign installation), public use activities (e.g., hiking), and administration and operations activities (e.g., parking lot and road construction). These actions may directly or indirectly expose cultural and historic artifacts. The presence of cultural resources including historic properties would not prevent a Federal undertaking or project, but any undertaking would be subject to the above-mentioned laws and regulations.

Refuge staff would provide the Regional Office archaeologist a formal description and location of all projects, activities, routine maintenance, and operations that could disturb the ground or structures, details on requests for appropriate and compatible uses, and the options being considered. The archaeologist would analyze these undertakings for their potential to affect historic properties and enter into consultation with the State Historic Preservation Officer (SHPO) and other parties as appropriate. As necessary, Service staff would notify the public and local government officials. The Service would protect all known gravesites. Any collection of materials for tribal ceremonial purposes would be conducted under a special use permit.

Impacts of Alternative A

Alternative A would have an adverse impact on the protection of historical and archaeological resources in the AOI. Without additional protection, cultural resources, whether listed or not, tend to be vulnerable to development, disturbance, take, and vandalism. Absent the establishment of Great Thicket NWR, fewer lands would be managed by the Service and its partners, which have a clear responsibility for protection of cultural resources. Landowners and developers have no similar legal responsibilities, unless one of their activities requires a Federal permit (e.g., U.S. Army Corps of Engineers 404 Permit,

or a Service Incidental Take Permit) or state permit. If permits are required, landowners or developers would have to comply with either Section 106 of the NHPA or state regulations regarding cultural resources prior to the issuance of any permit. In these cases, archaeological and historical investigations, if deemed necessary by the Federal agency, the state agencies, and the tribes, would be limited to the project area in question. The activity could proceed provided that the landowner or developer has taken steps to avoid, minimize, or mitigate adverse impacts to historic properties identified within the specific project area. Because of population growth, increased urbanization, and changing land use patterns projected for the region, a number of historical properties would likely be adversely impacted under the no action alternative. These impacts are expected to be moderate.

Impacts of Alternative B
Moderate beneficial impacts to cultural resources would be anticipated from the implementation of alternative B. Federal acquisition in any of the RAFAs would help increase the preservation of any archaeological and historic sites on otherwise unprotected lands. The Service, like other Federal agencies, has several legally mandated responsibilities that include development of a cultural resource management plan, compliance with Section 106 of the NHPA prior to any undertaking that possesses the potential to impact historic properties, archaeological inventory of its lands and subsequent National Register eligibility testing, research-directed testing or excavation, site protection, and interpretation. Critical to these efforts are the SHPOs, federally recognized Native American Tribes, and a number of interested parties, such as nearby universities, adjacent landowners, and state resource agencies. Protection of historic properties would be enhanced by incorporating concepts of site stewardship and ownership, where appropriate, into public use materials and interpretive panels. This effort would be further enhanced by providing advanced archaeological resource protection training to refuge law enforcement personnel.

Minimal adverse impacts to cultural resources could be anticipated under alternative B. There could be some risk that where refuge lands are open to the public, visitors may inadvertently or intentionally damage or disturb cultural resource sites; however, we would employ all means available to protect archaeological sites, historic structures, cemeteries, and historic landscapes through scientific investigations, public education, partnerships with tribal, state, and local governments, and law enforcement efforts.

Effects on the Physical Environment

Effects on Geomorphology

Impacts of Alternatives A and B
Alternatives A and B would have no impacts on geomorphology.

Effects on Hydrology and Water Quality

Impacts of Alternative A
Under alternative A, it is reasonable to assume that some of the 15,000 acres proposed for Federal acquisition in alternative B would be developed in the absence of additional land protection by the Service. Studies have shown that adverse impacts to streams can occur with as little as 10 percent impervious cover (Schueler 1994). Impervious land cover is defined as the sum of roads, parking lots, sidewalks, rooftops, and other impermeable surfaces. Adverse impacts of impervious surfaces can include shaping stream beds, decreased water quality, increased stream warming, and a decrease in stream biodiversity.

Impervious land cover can result in decreased infiltration of stormwater and increased runoff. This in turn can lead to more frequent flooding, causing widening and undercutting of stream banks. Channel instability leads to the loss of habitat structures, such as pool and riffle features, and overhead cover. These adverse impacts can be seen with approximately 10 to 15 percent impervious cover (Booth and Reinelt 1993).

Pollutants accumulate on impervious surfaces from atmospheric depositions, vehicles, and other sources. Storms can quickly wash these pollutants into the nearest stream. These adverse impacts can be reduced by installation of retention ponds or other infiltration systems.

As noted by Schueler (1994), "Impervious surfaces both absorb and reflect heat. During the summer months, impervious areas can have local air and ground temperatures that are 10 to 12 degrees warmer than the fields and forests that they replace. In addition, the trees that could have provided shade to offset the effects of solar radiation are absent."

Stream channel instability, increased pollutants, and stream warming lead to a general decrease in aquatic system biodiversity. Aquatic diversity and health is a strong environmental indicator of overall watershed quality (Schueler 1994). Decreases in the diversity of fish, aquatic insects, wetland plants, and amphibians are all manifestations of increases in impervious surfaces of 10 percent or greater.

Overall, the adverse impacts on hydrology and water quality in the AOI are expected to constitute a moderate impact under the no action alternative.

Impacts of Alternative B
This alternative is expected to result in beneficial impacts to the hydrology and water quantity of the area. Approximately 15,000 acres of proposed refuge lands would eventually be protected from the construction of extensive drainage ditches, roads, and large areas of impervious surfaces associated with development that would otherwise alter the hydrology. Furthermore, the Service would restore the hydrology where needed, which would be beneficial to refuge lands and areas outside of the refuge.

Under alternative B, there could be some adverse impacts to hydrology and water quantity resulting from some potential construction projects on the proposed refuge. Infrastructure such as visitor and office facilities, paved areas, and landscaped areas would alter, to some degree, the local hydrology and amount of water available to downstream areas. Specific site plans for public use building(s) and refuge offices have not yet been developed (where possible, existing structure would be evaluated to determine if they could serve refuge needs), so the amounts of impervious surfaces are unknown at this time. However, impervious surfaces, such as roads, sidewalks, and buildings, reduce the area available for rainwater to percolate into the soil. This generally has two direct consequences when it rains: there is less water available for recharging the local surficial aquifer, while at the same time the amount of runoff that flows into low-lying area increases. Low impact development methods and best management practices would be used to minimize these effects. Storm-water wetlands and retention ponds, rain gardens, and rooftop rainwater harvesting, for example, would help mitigate many of the water quantity impacts associated with impervious surfaces. Best Management Practices would be employed to minimize impacts from refuge-associated development. Although additional environmental studies would likely be conducted in association with any future construction, it is not believed that there would be significant impacts to the hydrology or water quantity resulting from the proposed refuge. Overall, the negative effects on hydrology and water quantity are believed to be minimal under this alternative.

Effects on Soils

Impacts of Alternative A
In unprotected areas, soils would continue to be lost and degraded, leading to adverse impacts such as erosion and sedimentation as a result of various land use practices including road building and the construction of buildings, parking lots, and other infrastructure needed to support expanding human settlements. Natural soil formation processes would no longer occur in areas covered by impervious surfaces (e.g., roads, parking lots, buildings). Soil compaction is also expected at sites where construction occurs. Some soil compaction could result from managing shrublands (e.g., mowing) but these impacts would be temporary in nature and, therefore, would have short-term adverse impacts compared with the long-term adverse impacts of converting lands to developed areas.

In alternative A, soils would continue to be degraded by various contaminants resulting from the application of agricultural chemicals and run-off from roads and urban areas. Additionally, there would be no opportunity for the Service to protect or restore roads, trails, or other existing sites within RAFAs, thus soil impacts from development or unmanaged use of those lands would continue and likely would increase over the long term. However, adverse impacts to soils in the absence of a refuge would be minor, because the total area that could theoretically be protected under this proposal is relatively small compared to the entire AOI.

Impacts of Alternative B
Under this alternative, there would be a minor benefit to soils on the proposed refuge. Within the refuge, this resource would largely be protected from disturbance and degradation associated with development, agriculture, mining, etc., as discussed above in alternative A.

There is a potential for adverse impacts to soils from the shrubland management tools we intend to use to help maintain, enhance, or create shrubland and young forest habitat. These tools are described in detail in appendix A: Conceptual Management Plan and include replanting with native species, prescribed burning, haying/mowing, mechanical cutting, and applying herbicides and biological control agents. In general, we will use best management practices in all activities that might affect soils to ensure that we maintain soil productivity. Site conditions, including soil composition, condition, and hydrology, will be the ultimate determinant of the management technique for any particular site. We will make every attempt to manage specific sites consistent with their recognized potential.

Prescribed fire can elevate surface temperatures; mineralize detritus, litter, and standing dead material; volatilize some nutrients and organic matter; alter the water-holding capacity of soil; and alter its populations of micro- and macro-fauna (Barbour et al. 1999). Fire usually elevates soil pH because of cation release; that effect is particularly evident in acidic soils. Fire may enhance soil microbial nitrogen fixation, due to the mineralization of nutrients and elevated pH levels in soils (Barbour et al. 1999). Fire usually reduces fungi, but increase soil bacteria. It may remove soil and litter pathogens. Fire often destroys nitrifying bacteria. Legumes and other nitrogen-fixing plants often must recover nitrogen losses due to volatilization, as the recovery of nitrifying bacteria is slow (Barbour et al. 1999). To minimize impacts, we would conduct all prescribed burns under a strict prescription and in optimal weather conditions to minimize concerns about smoke and the risk of wildfire. We would maintain all fires within their prescriptions to minimize the degradation of resources, although impacts could occur in small areas.

Haying, mowing, and other mechanical methods affect soils by rutting and compaction and, depending on the soil conditions and vegetation ground cover, by

Suzanne Paton/USFWS

Habitat restoration at Avalonia Land Conservancy in Connecticut

removing soil-protective vegetation. To minimize these impacts we would avoid using tracked equipment when possible. We would not conduct these operations when the soil is saturated.

We would follow an approved Pesticide Use Plan when utilizing herbicides and other biological control agents to minimize adverse impacts to the soil and other microbial and biotic organisms.

Within the proposed refuge, some soils would be disturbed due to the construction of one or more potential buildings, parking lots, and other infrastructure needed to support refuge visitors and operations. Natural soil-formation processes would no longer occur in areas covered by impervious surfaces (e.g., roads, parking lots, buildings). Soil compaction is also expected at sites where construction occurs. Best management practices would be used to minimize these impacts. Additional environmental analyses would be conducted in association with any substantial (e.g., roads, parking lots, buildings) construction projects, per Service policy.

Although the exact acreage needed for any new refuge infrastructure is unknown at this point, it is believed it would be a small percentage of the total refuge area. The impacts to soils resulting from alternative B are expected to be minimal.

Effects on Climate, Including Effects Related to Climate Change

Impacts of Alternative A

Under this alternative, fewer areas in the AOI are expected to remain or become carbon sinks (i.e., areas that absorb carbon instead of releasing it), so positive impacts with regard to climate change are not anticipated.

There may, however, be some minimal adverse impacts associated with climate change under this alternative. Vegetation, alive or dead, is an important carbon stock, and ecosystems in the United States contain approximately 66,600 million tons of carbon (Heath and Smith 2004). The carbon density (the amount of carbon stored per unit of land area) of any given tract of land is highly variable, as it is directly correlated to the amount of biomass in an ecosystem or plant community.

Besides vegetation, the total carbon in an ecosystem also includes the organic component of soil, which can be substantial, depending on the vegetation cover type and other factors (Bruce et al. 1999).

When land is permanently cleared of vegetation, carbon dioxide that was stored in plant material and soil is released relatively quickly into the atmosphere through such processes as decomposition, burning, and soil oxidation. Additionally, without vegetation, the ability of the land to sequester or store carbon is reduced to minimal levels. The exact extent of unprotected natural lands that would eventually be converted to agricultural or urban use in alternative A is unknown. However, even in the unlikely event that an area equaling the proposed refuge (15,000 acres) were cleared of all vegetation, it would represent only a fraction of the over 9 billion tons of global carbon entering the atmosphere annually.

Impacts of Alternative B

Under Alternative B, there would be some assurances that the approximately 15,000 acres of proposed refuge lands would remain vegetated and therefore would continue to act as carbon sinks, resulting in a positive impact with regard to climate change. Therefore, it is believed that these proposed refuge lands would provide a net reduction in greenhouse gases, even with potential anthropogenic sources (see discussion below) of these gases taken into account. Still, due to the comparatively small size of the proposed refuge, beneficial impacts to climate change would likely be minimal compared to the volume of Earth's atmosphere.

Under alternative B, refuge operations and facilities, public visitation, and habitat management would contribute greenhouse gases to the atmosphere, thus resulting in some adverse impacts. The amount of carbon that would potentially be released through refuge operations (e.g., combustion engines, electrical equipment use) was not estimated for the draft or final LPP/EA. However, the proposed refuge would aim to minimize its carbon emissions. As the Refuge System works to implement many of the strategies for achieving Service wide carbon neutrality by 2020 (USFWS 2010), refuge energy use is expected to decline. These actions would include use of hybrid vehicles, building energy efficient facilities, video-conferencing (to reduce travel-related energy use), and green purchasing. These strategies, combined with those of other Service offices and the Federal Government in general, would likely result in a beneficial reduction in the rate of greenhouse gas emissions nationally.

Refuge visitation would be associated with a number of vehicles on the refuge. The low rate of speed necessitated would minimize emissions. In addition, the number of vehicles on the refuge at any given time would not be expected to create a significant impact to greenhouse gas emissions.

Prescribed burning would be a valuable habitat management tool within several habitats of the proposed refuge. The primary gases released during prescribed fire include CO_2, carbon monoxide (CO), and water vapor, with other gases present in trace amounts (EPA 2012). Most of these are greenhouse gases. However, it has been shown that prescribed fires can decrease the risk of wildfires, which typically release greater amounts of greenhouse gases (National Science Foundation 2010).

Overall, the amount of greenhouse gases contributed to the atmosphere as a result of refuge-related administrative, public use, and management activities is expected to be minimal.

Effects on Air Quality

Impacts of Alternative A
Under alternative A, potential impacts to air quality would depend on the fate of lands that otherwise may have been protected by the Service. If these lands remain vegetated and undeveloped, they may continue to contribute positive air quality benefits by absorbing carbon dioxide and emitting oxygen. If lands are developed, the degree of adverse impact on air quality would depend on the type and density of development. Industrial or dense residential development using traditional energy sources may increase carbon and other contaminants in the atmosphere above current levels, which would be detrimental to air quality. Use of solar or other non-emitting energy would reduce these potential adverse impacts. Overall, impacts to air quality under this alternative are likely to be minimal.

Impacts of Alternative B
With the establishment of the proposed refuge, potential sources of air pollution resulting from urbanization, agricultural operations, industry, etc., would be eliminated on 15,000 acres. This benefit is expected to be minimal, given that the proposed refuge would cover a relatively small percentage of the total AOI.

Under alternative B, refuge operations and facilities, public visitation, and habitat management would contribute some pollutants to the atmosphere, thus adversely affecting air quality. Some air pollutants would be released through refuge operations (e.g., combustion engines, electrical equipment use). However, the proposed refuge would aim to minimize its emissions from vehicles as well as the indirect emissions associated with electrical energy use. As mentioned above, the Refuge System is working to implement strategies for achieving Service wide carbon neutrality by 2020. These strategies, combined with those of other Service offices and the Federal Government in general, would likely result in a beneficial reduction of air pollutants.

Refuge visitation would be associated with a number of vehicles on the refuge. The low rate of speed necessitated would minimize emissions of air pollutants. In addition, the number of vehicles on the refuge at any given time would not be expected to create a significant impact to air quality.

Prescribed burning would be a valuable habitat management tool within several habitats of the proposed refuge. As mentioned above, prescribed burning releases several air pollutants, including CO and particulate matter. The proposed refuge would work with its partners to reduce smoke-related issues in adjacent areas resulting from prescription fires. The risk of wildfires would be minimized through a fire management program. One positive consequence of prescribed fire is the reduction in the frequency and intensity of wildfires, which tend to release larger amounts of air pollutants (National Science Foundation 2010). Overall, the adverse impacts to air quality associated with this alternative are expected to be minimal.

Effects on the Socio-Economic Environment

Impacts of Alternative A
Under alternative A (no new refuge), it is difficult to determine what the overall effects would be on local tax revenues. Generally, the area is experiencing population growth, but there are more localized areas where this is not the case. These trends could change over time. Similarly, with no new refuge, there would be no impacts to property values.

Since there would be no new refuge lands, there would also be no economic impacts associated with wildlife-dependent recreation such as hunting, fishing, and wildlife observation and wildlife photography.

Impacts of Alternative B
Much of the information presented in this section was taken from an economic analysis completed by the USGS for the Silvio O. Conte National Fish and Wildlife Refuge CCP. In general, the consequences of refuge land acquisition in this proposal are similar to those predicted within the Connecticut River Watershed.

Local tax revenues
In alternative B, the Service is considering expanding the Refuge System's total acreage under ownership through additional fee and easement acquisitions. As noted by USGS:

These transactions are typically in the form of a one-time payment. A transaction of this type and shift in private to public land ownership can have an assortment of economic impacts. Some examples include effects to the local tax base and adjoining revenues, the amount of municipal services required, spillover property value impacts, and various dynamics with development in the region. The effect of fee acquisitions on local government revenue is complex and speculative. Many variables are at play, often requiring time to unfold. While there may be some upfront reductions in local tax revenues, reduced dependence on municipal services could more than counter these losses. Other unknowns, such as relocation and spending decisions, and property enhancement effects, will ultimately determine the extent of the economic and fiscal impacts within the region. While these relationships are identified and discussed, estimating these impacts quantitatively requires a large degree of speculation and is beyond the scope of this analysis.

Bobcat

Gary Kramer/USFWS

The sale of interest in land (fee and easement) will provide the original landowner with additional revenue following the sale. The landowner might go on to spend some percentage of the funds from their equity in the property in the regional economy, including new real estate investment in the local area. This spending activity can directly impact local industries such as construction and various service sectors, with additional indirect impacts to follow suit. Contrarily, these types of economic impacts could be relinquished if former landowners emigrate outside the region. There is also the possibility of removing a production practice on the land parcel, such as farming or forestry, which could have negative economic consequences. These, too, could be negated by the expenditures required for habitat restoration and stewardship fronted by the Service once acquired. As indicated, there are many dynamic relationships at play that ultimately determine net economic impacts to the local and regional economies.

There are also many dynamic variables at play when considering effects to local tax revenues. Property taxes constitute the largest source of local governments' own revenue (Urban Institute and Brookings Institution 2008). Lands acquired by the Service would be exempt from local property taxation. However, under provisions of the RRS Act, local townships and/or counties receive an annual payment for lands that have been purchased by full fee simple acquisition by the Service. Payments are based on the greatest of 25 percent of net receipts[1], 75 cents per acre, or 0.75 percent of the market value[2] of lands acquired by the

[1] Revenues are derived from the sale or disposition of products (e.g., timber and gravel), privileges (e.g., right-of-way and haying/grazing permits), and/or leases for public accommodations or facilities (e.g., oil and gas exploration and development) providing economic activities incidental to, and not in conflict with, refuge purposes.

[2] Updated appraisals of refuges are to be completed every 5 years to determine the market value.

Service. The exact amount of the annual payment depends on congressional appropriations, which has tended to be less than the amount to fully fund the authorized level of payments, and has been progressively declining. In fiscal year (FY) 2014, actual RRS payments were 23.7 percent of authorized levels.

Lands acquired by the Service through fee acquisition would lose their development potential in perpetuity. While this could affect local property tax and income tax revenues, conserved and protected land requires fewer municipal services. New and existing residential developments require local governments to provide services such as fire protection, police services and schools, and to construct new infrastructure such as roads, waste treatment facilities, and water and electrical delivery systems. Providing such services can be very expensive for municipalities in rural settings with a relatively low tax base. A majority of studies conducting community services analysis have concluded land in residential use requires more service expenditures (paid by the municipality) than it generates in tax revenues. Additionally, these studies have typically found land classified as open space to provide a net gain in local revenues. Table 34 below highlights the revenue-to-expenditure findings from service studies done for 11 towns in New Hampshire. A revenue-to-expenditure ratio of 1:1.30 translates to the town receiving $1 in revenue for every $1.30 it has to spend on that land use. Or in other words, for every $10,000 in property tax and other revenues the town receives from that land use, it spends $13,000 in providing services to it.

Table 23: Revenue-to-Expenditure Ratios by Land Use in New Hampshire Communities Studied

New Hampshire Community	Residential Land Use (including farm houses)	Commercial & Industrial	Working & Open Land	Source
Brentwood	1:1.17	1:0.24	1:0.83	Brentwood Open Space Task Force 2002
Deerfield	1:1.15	1:0.22	1:0.35	Auger 1994
Dover	1:1.15	1:0.63	1:0.94	Kingsley et al. 1993
Exeter	1:1.07	1:0.40	1:0.82	Niebling 1997
Fremont	1:1.04	1:0.94	1:0.36	Auger 1994
Groton	1:1.01	1:0.12	1:0.88	New Hampshire Wildlife Federation 2001
Hookset	1:1.16	1:0.43	1:0.55	Innovative Natural Resource Solutions 2008
Lyme	1:1.05	1:0.28	1:0.23	Pickard 2000
Milton	1:1.30	1:0.35	1:0.72	Innovative Natural Resource Solutions 2005
Mont Vernon	1:1.03	1:0.04	1:0.08	Innovative Natural Resource Solutions 2002
Stratham	1:1.15	1:0.19	1:0.40	Auger 1994

Source: American Farmland Trust 2010

King and Anderson (2004) examined the marginal property tax effects of conservation easements—representing a similar loss of development rights, but without any county payments—in 29 Vermont towns. Their analysis found conservation easements do slightly raise marginal property tax rates in the short run (2 to 3 years after conservation), as the overall tax base is lessened and bares

more of the tax burden. However, in the long run (6 to 8 years after conservation) they found conservation easements to be tax-neutral or even tax-suppressing as nearby property values increased.

As noted earlier, there is also the chance for land acquisition to spur development in other areas within the region as private landowners relocate and new residents are attracted by the publically conserved natural landscape and the almost guaranteed opportunities for compatible outdoor recreation. It is well documented that open space carries positive values to local residents and communities, as well as passers-by (McConnell and Walls 2005). This is evidenced by the success of open space preservation ballot initiatives at the local, county, and state levels. Banzhaf et al. (2006) point out that between 1997 and 2004, over 75 percent of the more than 1,100 referenda on open space conservation that appeared on ballots across the U.S. passed, most by a wide margin. Accessibility to outdoor trails and park usage can be prime attractions to new homebuyers (National Park Service 1995). It is also well documented that open space and protected natural areas can increase surrounding property values; that is properties in the vicinity of parks and preserved open space can have higher property values than those not in the vicinity (see McConnell and Walls 2005, for a comprehensive review). In essence, the real estate market is quantifying the demand and desirability of land that is nested within or adjacent to a conservation mosaic. For example, an analysis of properties surrounding multiple parks in Worcester, Massachusetts, revealed, on average, a house located 20 feet from a park sold for $6,445 (converted to 2012 dollars) more than a similar house located 2,000 feet away (More et al., 1982). Another study that was conducted in the early 1990s in Maryland showed that preserving a significant amount of forest land accounted for anywhere from 4 to 10 percent of the value of houses within 1 mile of the site, in three different counties (Curtis 1993; Crompton 2001).

Under this alternative (establishment of a new refuge), it is difficult to determine what the overall effects will be on local tax revenues. Generally, the area is experiencing population growth, but there are more localized areas where this is not the case. These trends could change over time. At this point in time, we are unable to predict (if the proposal were to be authorized) where and when refuge lands would be purchased within the RAFAs.

Effect on Local Property Values

The reciprocating value of open space on property values will vary depending on landscape characteristics and location attributes (e.g., distance to the conserved area) (Kroeger 2008). Permanence of the open space is also an influencing factor. Typically, open space that is permanently protected (such as refuge lands) will generate a higher enhancement value of local properties than land that has the potential for future development. A study done by Goeghegan (Goeghegan et al. 2003) in a suburban county in Maryland shows that permanently protected open space generates a property enhancement value of over three times that of developable open space. Irwin (2002) conducted a similar analysis (in context and location) and found that protected open space increases residential property values by between 0.6 percent and 1.9 percent more in absolute terms than developable open space. As noted, location and demographic factors in the region can influence the relative level of property enhancement value. For instance, open space may generate larger amenity premiums for property in a more urbanized area and where median incomes are higher (see Netusil et al., 2000); that is not to say there is not the chance for property values to increase substantially in rural areas as well (see Phillips 2000; Crompton 2001; Vrooman 1978; Thorsnes 2002).

Furthermore, protected open space is a public good that generates many benefits for local residents, communities, and governments. Protected open space can

protect values associated with biodiversity and wildlife abundance, maintain aesthetic beauty, and protect traditional, social, and culturally significant features of landscapes and livelihoods (Holdren and Ehrlich 1974; Ehrlich and Ehrlich 1992; Daily 1997; Millennium Ecosystem Assessment, MEA 2005). Ecosystem services, such as water purification, oxygen production, pollination, and waste breakdown, are also maintained for local residents through protected open space (MEA 2005). Some of these services provided by the landscape can reduce the need for certain municipal services (ex. expanding or building new waste treatment facilities). A primary public benefit of Service acquisitions is enhanced and preserved wildlife habitat. As development stressors increase over time, many key off-refuge habitat areas may become less available due to conversion to non-wildlife habitat uses. Unlike goods derived from natural resources that are traded in a traditional market setting, many of the benefits from land conservation, such as ecosystem services and intrinsic worth, can be difficult to quantify and value monetarily. We do not attempt to provide estimates of non-market values for this assessment; however, they can be significant in some cases.

Under this alternative (establishment of a new refuge), it is difficult to determine what the overall effects will be on local property values. Generally, the area is experiencing population growth, but there are more localized areas where this is not the case. These trends could change over time. At this point in time, we are unable to predict (if the proposal were to be authorized) where and when refuge lands would be purchased within the RAFAs.

Refuge Personnel Salary Spending
Refuge employees reside and spend their salaries on daily living expenses in communities within each sub-region, thereby generating impacts within the local economy. Household consumption expenditures consist of payments by individuals and households to industries for goods and services used for personal consumption. Salary expenditures made by refuge personnel contribute to the local economic impacts associated with the refuge.

Under alternative B, however, refuge lands will likely be managed by the nearest already-existing national wildlife refuge. While some staff may be added to these refuges to help manage additional lands, the impact of refuge personnel salary spending is likely to be minimal.

Refuge Visitor Spending
Spending associated with recreational visits to national wildlife refuges generates significant economic activity. The Service report Banking on Nature: The Economic Benefits of National Wildlife Refuge Visitation to Local Communities, estimated the impact of national wildlife refuges on their local economies (Carver and Caudill 2007). According to the report, more than 34.8 million visits were made to national wildlife refuges in FY 2006 which generated $1.7 billion of sales in regional economies. Accounting for both the direct and secondary effects, spending by national wildlife visitors generated nearly 27,000 jobs, and over $542.8 million in employment income. Approximately 82 percent of total expenditures were from non-consumptive activities, 12 percent from fishing, and 6 percent from hunting (Carver and Caudill 2007).

Under this alternative it is difficult to determine which lands would be open for public visitation because we do not yet know which specific lands we will acquire. Therefore, we are unable to predict the impact of alternative B on refuge visitor spending at this time.

Effects on the Biological Environment

Effects on Vegetation and Habitat Types

Impacts of Alternative A
Under the No Action alternative, benefits to this resource are not expected. Given past actions and land use trends, it is anticipated that human population growth, development, and other land use changes would continue. Within the AOI, native habitats and natural systems would continue to be converted to developed lands and other uses, resulting in continued loss of natural vegetation and further fragmenting existing habitat. It is likely that the amount of early successional habitat would continue to decline as very little management for shrublands and young forest would occur. Overall, alternative A is expected to result in moderate adverse impacts to habitat types.

Impacts of Alternative B
Under our proposed action, up to 15,000 acres of land would be conserved and managed for shrubland habitat. It will likely take many years before that amount of land is included in the refuge through acquisition or conservation easement. Overall impacts to vegetation would be positive as land that is protected would not be developed for residential or commercial uses. The amount of each specific type of habitat would change as some of the land is converted to shrubland from other habitat types. As described in Chapter 3—Affected Environment, the current rate of decrease in available shrublands is greater than that of other habitats. Therefore, we conclude that the overall effect on habitats would be minor and positive. In addition, there would be a temporary loss of vegetation as existing habitats are cut or burned, but this habitat management would not result in a complete loss of vegetation and species associated with early successional forest and shrubland habitats would quickly replace vegetation loss.

Invasive species management would be applied to areas owned in fee or easement, where appropriate. The native vegetation within these areas would likely benefit from the control of invasive plants that tend to dominate areas and inhibit native plant growth.

Some management activities, including invasive species control, would have short-term adverse impacts on vegetation, such as removal of plants, herbicide use, trampling, and other potential damage to plant structure. These short-term negative impacts would be minor and would be offset by providing long-term benefits to the diversity and health of the refuge's native plant community.

With the use of prescribed burns or mechanical means of thinning vegetation, there would be a reduction in certain tree species that would either be removed through thinning or that would burn because of the lack of fire tolerance. Any species associated with that vegetation would likely decline. Additional impacts to vegetation would occur within the areas designated as fire breaks where vegetation is removed and maintained for the prevention of wildfires and for the use during prescribed burning efforts. These adverse impacts are expected to be short-term and minor.

Effects on Birds

Impacts of Alternative A
Under the "no action" alternative, there would be an overall loss of habitat, especially shrubland and early successional, which would continue to decrease at a greater pace than other habitat types. Less breeding habitat availability would reduce the number of breeding pairs of birds within the areas of habitat loss. It is not known if those displaced birds would find other breeding sites. The

composition of bird species would change in conjunction with any habitat changes. Overall, alternative A is expected to have a moderate adverse impact on birds.

Impacts of Alternative B

The proposed acreage targets in alternative B for shrubland habitat management are expected to provide an estimated 12,000 additional acres of potentially suitable habitat for shrubland birds. This estimated acreage is based on the assumption that 80 percent of the 15,000 acres targeted for fee or easement acquisition under alternative B would be managed and maintained as shrubland habitat of suitable quality for breeding shrubland birds. These additional acres of managed shrubland habitat would make moderately beneficial contributions (i.e., thousands of additional birds for each species) to supporting populations of priority migratory bird species beyond what is currently supported by existing shrubland habitat within the RAFAs (see the *Birds* section in the Affected Environment chapter for description of current conditions).

Bill Thompson

Field sparrow

For selected shrubland-dependent birds identified as priorities in BCR 30 and/or as representative species for shrubland habitats within the southern New England region, we have estimated the total amount of potentially suitable habitat that would be created and maintained within the RAFAs under alternative B and the associated number of breeding birds supported by the newly created habitat. We also compare these habitat and population estimates with the habitat and population objectives that have been identified for each species in BCR 30, as reported in the BCR 30 Bird Conservation Plan (ACJV 2014), the Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004) in conjunction with the Partners in Flight Population Estimates Database (PIF 2013), or the American Woodcock Conservation Plan (WMI 2008).

We estimate that the proposed combined target acres for shrubland habitat management within the RAFAs could potentially meet 35 percent of the BCR 30 breeding population objective for willow flycatcher as well as greater than 5 percent of the BCR 30 population objective for four other species: blue-winged warbler, prairie warbler, chestnut-sided warbler, and field sparrow. Estimated total number of breeding birds potentially supported by the additional acres of managed habitat in the RAFAs ranges from 2,800 to 8,375 for these species. For the other species evaluated, the estimated total number of breeding birds potentially supported by managed habitat in the Focus Areas ranges from 440 for American woodcock to 7,475 for eastern towhee. While these total numbers

represent less than 5 percent of the BCR 30 population objectives for these two species, the results still indicate the large number of additional total birds that could be supported by the targeted acres of habitat management within the RAFAs.

Table 24: Current and Proposed Breeding Bird and Habitat Estimates for all RAFAs Combined

Context:

Current suitable habitat for shrubland-dependent birds in all RAFAs combined = 21,120 acres.

Area of additional suitable habitat for shrubland-dependent birds in all RAFAs combined under Alternative B = 12,000 acres.

Total acres of suitable habitat (12,000) under Alternative B may overlap with some of the existing 21,120 acres of existing suitable habitat. However, because our estimate of existing suitable habitat includes protected and unprotected lands, we believe that any overlap would be absorbed by the loss of existing suitable habitat not already protected. Estimates for additional breeding birds would follow the same trend.

Species	% of BCR 30 habitat objective based on 21,120 acres	Current # of breeding birds (% of BCR 30 population objective)	Estimated % of BCR 30 habitat objective under Alternative B based on 12,000 acres	Estimated # of breeding birds under Alternative B (% of BCR 30 population objective)
Blue-winged warbler	7.8%	6,380 (10.6%)	4.0%	3,240 (5.4%)
Prairie warbler	10.1%	12,480 (13.4%)	5.2%	6,335 (6.8%)
Brown thrasher	17.1%	3,950 (7.2%)	8.7%	2,005 (3.6%)
Eastern towhee	2.0%	14,720 (3.2%)	1.0%	7,475 (1.6%)
Chestnut-sided warbler	14.9%	16,460 (16.5%)	7.6%	8,375 (8.4%)
Field sparrow	14.8%	5,510 (3.3%)	1.7%	2,800 (5.6%)
Willow flycatcher	53.3%	13,900 (69.5%)	47.2%	7,075 (35.4%)
Gray catbird	1.5%	13,400 (1.7%)	0.8%	6,830 (0.9%)
American woodcock	0.01%	772 (0.01%)	0.01%	440 (0.01%)

In addition to assuming that 80 percent of proposed refuge lands would be managed and maintained as shrubland habitat, we also assumed that the proportion of upland and wetland shrub habitats in the acquired acres would be the same as the proportion currently existing within the RAFAs, which is approximately 80 percent upland and 20 percent wetland. Estimates of additional birds supported under alternative B were derived by applying published breeding density estimates for each species (see Emlen 1977, Inman et al. 2002, Chandler et al. 2009, King et al. 2009a, King et al. 2009b, Schlossberg et al. 2010) to these estimated acres of additional suitable upland and wetland shrub habitat types to be managed within the RAFAs.

In addition to contributions to breeding bird populations, the proposed target acres of managed shrubland habitat would also provide additional critical habitat during migration for many species of birds that breed in the Northeast region and eastern Canada. Shrublands are considered to be some of the most important stopover habitat for migrant landbirds because they provide quality food resources in the form of fruits and berries that are not as abundant in other habitats during the fall migration. The dense vegetation of shrublands also provides high quality cover for resting and recovery by birds that have completed

migratory flights. Southern New England is also thought to be an important stopover location for American woodcock (Wildlife Management Institute 2008) that breed in northern New England and eastern Canada. An analysis of Next Generation Weather Radar (NEXRAD) data (Buler and Dawson 2012, 2014) has identified the southern New England coastal area as one of the areas in the Northeast region that supports the highest density of migrating birds during the fall migration and most of the RAFAs overlap with at least some areas of high or moderate densities of migrating birds (see Figure 1 in the "Birds" section of Chapter 3 - Affected Environment). While it is difficult to quantify the benefit to migrating birds of managing and maintaining additional shrubland within the RAFAs, we assume that providing thousands of additional acres of shrubland habitat would have moderately beneficial impacts for migratory birds stopping over in southern New England during migration, particularly in areas that already support moderate to high densities of migrating birds. We anticipate that the additional shrubland habitat would result in increased body condition and ultimately increased survival for birds using these habitats as stopover sites.

Effects on Mammals

This section considers impacts to those mammals associated with shrublands to varying degrees, except for the NEC, which is discussed later in the section entitled, "Federal Listed Species and other Species of Concern."

Impacts of Alternative A
Under this alternative, there would be no designation of the 10 proposed RAFAs, and the Service would not be authorized to acquire additional lands and conservation easements across the six-state partnership area, to be managed as part of the Refuge System. The Service's Partners for Fish and Wildlife program could still provide assistance to private landowners and partners, but there would be no additional refuge land acquisition and no related certainty of long-term management and maintenance. It is likely that there would be some continuation of conversion of wildlife habitat to either residential or commercial development over time. This fragmentation and reduction of available habitat would have minor, but long term adverse and cumulative effects to the overall population levels of mammal species in the areas of habitat loss.

Shrublands and young forest throughout the six-state partnership area would continue to be subject to existing regulations, pressures, land use trends, and current management to maintain shrubland conditions for the cottontail and shrubland-dependant birds. No additional contributions to the accomplishment of partnership shrubland goals and objectives are expected beyond existing partnership commitments. We expect there would be an overall continuation of the loss of early successional, shrubland and young forest habitat. One uncertainty that would continue to exist is whether the rangewide effort can enlist and manage enough private land to create an effective habitat network.

Impacts of Alternative B
Proposed acquisition targets within RAFAs under this alternative would allow us to protect, restore, and maintain an additional 12,000 acres of shrubland and young forest habitat, beyond the current capacity of the existing rangewide partnership effort. As explained above in the "Birds" section, the 12,000 acres within RAFAs is derived from the assumption that the Service would likely conduct shrubland management on approximately 80 percent of each parcel acquired in fee or easement, since many parcels contain a mix of habitat types. The majority of these lands would be managed to benefit the numerous wildlife species that depend on these habitats, including those mammal species discussed earlier in chapter 3 that demonstrate some preference for young forests, shrublands, or old-field habitats.

Available parcels of land that contain, are adjacent to, or are in close proximity to known populations of NEC would receive high priority, as would lands that allow us opportunities to contribute to multiple overlapping Strategic Growth priorities of the Refuge System. The approach of applying pre-approved acreage targets within the larger strategically placed RAFAs would allow us the flexibility to help state land management teams react to willing-seller opportunities, and secure key parcels with respect to important core/source NEC populations. Acquiring tracts in close proximity to partners would allow the Service and partners to pool management resources, and provide greater certainty that shrublands would continue to be managed over the long-term. The high degree of certainty of long-term management provided by Service acquisition would help to ensure that the partnership is able to maintain a network of shrubland habitats across the landscape with suitable connectivity and patch size to maintain all shrubland-dependent species.

Management for early successional and shrubland habitats would occur through mechanical means such as cutting and mowing, and through the use of prescribed fire (see Appendix A: Conceptual Management Plan for more detail on habitat management techniques for shrubland and young forest habitats). Mammals that prefer more open canopy conditions that allow for a dense understory layer would benefit from the prescribed fire regime and thinning measures. A variety of mammals would benefit from additional foraging, nesting, or cover habitat, including both obligate and opportunistic inhabitants noted earlier in chapter 3 that demonstrate a preference for young forests, shrublands, or old-field habitats. Examples mentioned earlier include the bobcat, black bear, little brown bat, white-tailed deer, white-footed and deer mice, red and grey fox, raccoon, opossum, striped skunk, and semi-aquatic species like the beaver and mink.

In addition, the network of partner-protected lands that alternative B would allow the Service to contribute to is intended to promote the development of habitat corridors and facilitate landscape connectivity, thus enabling the movement and migration of shrubland wildlife necessary for long-term population viability and resiliency in the face of changing climate. We expect alternative B to result in overall positive impacts on mammals dependent upon shrubland habitats, including obligate, part-time and opportunistic users.

Any prescribed burning on the refuge may benefit bat species but could cause some harm to their habitat if precautions are not taken. Prescribed burning can have short-term detrimental effects on bats by eliminating some snags and stumps used for roosting (Taylor 2006). Roosting bats may also be killed under intense fire conditions. Juveniles and adults that depend on torpor, a diurnal hibernation-like state, may be especially at risk because of the time it takes for them to arouse from torpor (i.e., time it takes them to fly) (Dickinson et al. 2010). Neonatal bats that cannot fly and are too heavy for the mother to carry may be at greater risk from smoke than adults and juveniles (USFWS 2007b). This impact would most likely be minimal because prescribed burns are likely not to occur during the height of summer when neonatal bats are still in their roost (Dickinson et al. 2009).

Other mechanical means for managing shrubland habitats include tree cutting, which also has the potential to impact bat habitat. For these and any other management techniques that could potentially impact bats, we would consult with the Ecological Services Field Office nearest to the project area to determine if there are any bat maternity roost trees or hibernacula before we burn or remove trees. For example, our entire project area is located within the range of the northern long-eared bat, which was listed as threatened under the ESA in an interim 4(d) rule, published in the Federal Register on April 2, 2015. However,

forest management practices are exempt from the final listing as long as they include the following measures:

- Activity occurs more than 0.25 miles (0.4 km) from a known, occupied hibernacula.
- Activity avoids cutting or destroying known, occupied roost trees during the pup season (June 1 to July 31).
- Activity avoids clearcuts (and similar harvest methods, e.g., seed tree, shelterwood, and coppice) within 0.25 miles (0.4 km) of known, occupied roost trees during the pup season (June 1 to July 31).

By consulting with our Ecological Services colleagues and following best management practices when appropriate, we would ensure minimal adverse impacts to bats under this alternative.

Effects on Federal-Listed Species and other Species of Concern

Bog Turtle

Impacts of Alternative A
Under this alternative, there would be no designation of the proposed Upper Housatonic RAFA, and the Service would not be authorized to acquire lands and conservation easements in southeastern New York and western Connecticut to be managed as part of the Refuge System. The Service's Partners for Fish and Wildlife program could still provide assistance to private landowners and partners, but there would be no additional refuge land acquisition and resulting certainty of long-term management and maintenance.

Bog turtles had suffered a 50 percent decline in range and numbers in the 20 years leading up to the issuance of the Bog Turtle Recovery Plan (recovery plan) (USFWS 2001). One of the most significant threats to the survival of this species is outright loss and alteration of its habitat, as well as the ecological systems that sustain these habitats. The shallow wetlands inhabited by bog turtles have been easily drained. Conversely, farm ponds, reservoirs, and other impoundments have been created by inundating the shallow, open wet meadows and fens required for bog turtle survival. Although light grazing may be beneficial in controlling succession, intensive pasturing can be detrimental.

Bog turtle

USFWS

The recovery plan acknowledges that existing protected areas for bog turtles have generally been relatively small and, although encompassing the turtle's primary habitat, leave the drainage basin largely unprotected. Some of the most persistent and widespread problems associated with maintaining bog turtle habitat are succession of open meadows to wooded swamps, drainage,

and flooding of habitats through diversion or damming of feeder streams, pollution, nutrient enrichment, and the establishment of alien plants. Without the possibility of additional Service acquisition, bog turtle sites in this area would continue to be subject to existing regulations, pressures, land use trends, and lack of specific management to maintain open wetland conditions for the turtle. No additional contributions to the accomplishment of recovery plan goals and objectives are expected, leading to minor adverse impacts to the bog turtle.

Impacts of Alternative B
The bog turtle's range in New York is concentrated primarily in the southeastern corner of the State, and generally restricted to extreme western Connecticut in Fairfield and Litchfield counties (USFWS 2001). These turtles inhabit sub-climax seral wetland stages and are dependent on riparian systems that are unfragmented and sufficiently dynamic to allow the continual creation of meadows and open habitat to compensate for the closing-over of habitats caused by ecological succession. Succession of many wetlands from open-canopy fens to closed-canopy red maple swamps may account for the turtle's irregular and shrinking distribution.

The recovery plan recommends protection of additional turtle sites through purchase, conservation easements and voluntary agreements, by agencies and organizations dedicated to the species' conservation, to achieve long-term protection. This includes protection of upland buffers surrounding turtle wetlands, and the groundwater recharge areas supporting those wetlands. Like shrubland habitats, these sites would likely require management to ensure their suitability for turtles. The recovery plan acknowledges bog turtle habitat as an intermediate stage of succession, requiring management of succession and invasive plants, and also recommends implementation of measures to minimize collection of turtles. Active management and maintenance is generally required to replace the natural processes (e.g., flooding by beaver, fire, grazing by wildlife) that have been lost and to control exotic plants, in order to restore or maintain suitability for the turtles.

The overall objective of the recovery program is to protect and maintain the northern population of this species and its habitat, enabling the eventual removal of the species from the Federal List of Endangered and Threatened Wildlife and Plants. Actions specified in the recovery plan include the management of turtle populations at extant sites, maintenance of turtle habitat to ensure its continuing suitability, and reintroduction of turtles into areas where they have been extirpated or removed. Other recommended recovery actions that become possible with acquisition of turtle sites include the control of invasive plant species, restoration of hydrology to altered sites where ditching and draining have occurred, and reconnection of fragmented habitats.

The recovery plan specifies that long range protection be secured for at least 185 populations distributed among five recovery units (USFWS 2001). For the Hudson/Housatonic Recovery Unit, it specifies the protection of 40 viable bog turtle populations and sufficient habitat to ensure the sustainability of these populations, including at least 10 populations in each of the following subunits: the Wallkill River watershed, the Hudson River watershed, and the Housatonic River watershed, which includes our project area. Under alternative B of this proposal, suitable wet portions of acquired parcels and easements would be managed to maintain and restore open meadow or fen conditions for bog turtles, particularly in the vicinity of existing populations, and where potential exists to improve

connectivity between populations. These sites would be co-managed along with adjacent shrublands for migratory birds and the cottontail. While it is not possible to predict with certainty where acquisition opportunities will arise over time, this land protection plan would contribute to bog turtle population goals for the Housatonic River sub-unit, thus resulting in moderate beneficial impacts to the bog turtle overall.

Northern Red-Bellied Cooter (Plymouth Red-bellied Turtle)

Impacts of Alternative A

Under this alternative, there would be no designation of the proposed Plymouth RAFA. The Service would not be authorized to acquire lands or conservation easements in southeastern Massachusetts beyond existing refuge boundaries. The Service's Partners for Fish and Wildlife program could still provide assistance to private landowners and partners, but there would be no additional Service acquisition and associated certainty of long-term habitat maintenance. The 209-acre Massasoit NWR, established in 1983 to help support the northern red-bellied cooter (cooter), is located within this RAFA. The refuge has acquired all lands contained within its current approved boundary. We would continue to manage existing Service lands within the Massasoit NWR, with no additional Service contribution to land acquisition in this area.

Many factors have contributed to the current endangered status of the cooter. Its small population size and restricted range are foremost among factors limiting its long-term viability. Other factors include adverse modification of water quality, due to events such as siltation from land clearing adjacent to ponds; pollution and excess nutrients in ponds; pollution of groundwater or reduction in the water levels of ponds from groundwater pumping; and draining or filling of wetlands adjacent to occupied ponds and shoreline modifications such as filling, dredging for beaches, dikes, and real estate development. The Plymouth County area, particularly along pond shores, has undergone rapid residential and commercial development in recent times. Closure of the forest canopy plays a significant role in diminishing habitat suitability for cooters. Historically, the pine barren habitat was burned often. Today, the area has been largely protected from fire and most remaining undeveloped areas near ponds are now closed-canopy pine forest, resulting in a scarcity of nesting habitat with adequate sunlight for nesting (USFWS 1994).

Habitat alteration as a result of agricultural development and practices may affect the status of the cooter population. It is unknown to what extent cooters have been affected by the growth of the cranberry industry in Plymouth County. Cranberry bog acreage increased greatly during the last century, and the industry owns and manages more than 14,000 acres in Massachusetts (Cranberry Growers Association 2014). Many of the reservoirs and upland watershed areas managed by the industry provide habitat for cooters. Some of these areas have become increasingly important, as surrounding habitat is lost to residential development or becomes over-shaded through forest succession. Overall, the cranberry industry in Plymouth County has been supportive of recovery efforts, and individual growers are important partners in the program. Due to changing markets and socioeconomic pressures, a potential decrease in acreage owned by these growers could pose new threats of development and disturbance to cooters.

To increase survival and recruitment by reducing predation rates, the MDFW, in partnership with the Service, began a headstarting program (i.e., raising wild hatchlings in captivity for nine months) in 1985 that continues today. This is the longest and most intensive freshwater turtle headstarting program in existence. Since 1985, over 3,500 wild-born individuals have been headstarted and released at 28 sites, including two large river systems and 13 new ponds, three of which

have been wholly or partially protected by the Massasoit NWR. Anecdotal observations and some preliminary field work suggest that the headstarting program has provided a significant contribution to the recovery of the species, but the increase in population numbers and landscape occupancy has not been quantified.

Without the possibility of additional Service acquisition, cooters in southeastern Massachusetts would continue to be subject to existing regulations, pressures, land use trends, and lack of specific management to maintain quality habitat. No additional contributions to the accomplishment of recovery plan goals and objectives are expected under alternative A, leading to minor adverse impacts to the cooter.

Impacts of Alternative B
The Service already has a presence within the Plymouth RAFA, for the purpose of contributing to cooter recovery efforts. The turtle was placed on the Federal endangered species list in 1980, and the original recovery plan was completed in 1981. Since the 1994 plan revision, a recent 5-year review assessed its status and objectives towards delisting. The review indicates progress in population growth, with an estimated 400 to 600 breeding-age individuals occurring in more than 20 ponds, but also documents the need for continued listing (USFWS 2007a). Threats still include restricted range, habitat alteration including closed canopies at nesting sites, collection and disturbance by people, and high mortality due to nest failure and predation on hatchlings (USFWS 1994, 2007a). The proposed Plymouth RAFA includes the 3,269-acre area designated as critical habitat (USFWS 1994). The species will be considered for delisting when populations collectively include greater than or equal to 1,000 breeding-age individuals among 20 self-sustaining populations.

The Massasoit NWR was established in 1983 with the purchase of the 183-acre main parcel, Crooked Pond, and shoreline of Gunner's Exchange Pond, ". . . to conserve the federally endangered northern red-bellied cooter, as well as other wildlife and plant species" 16 U.S.C. § 1534 (ESA of 1973). Additional parcels were purchased in 2002 (Island Pond) and 2006 (Hoyt's Pond). The Service remains committed to assisting with recovery plan goals, and expanded land protection authority in this area would allow additional effort towards recovery tasks, including protecting occupied and potential habitat, improving habitat at ponds with known populations by clearing nesting sites and providing basking sites, and helping to locate and protect nests at ponds with major populations.

Under alternative B, the Service would work closely with other Federal and state agencies, as well as local land trusts, universities, and other non-government organizations (NGOs) to coordinate land protection activities as opportunities arise. The Service would be authorized to contribute additional land protection through management agreements with partners and private landowners, purchase of conservation easements, and fee acquisition for key parcels. Parcels that are located along pond shorelines or that could help ensure connectivity between ponds would be a high priority. , and management of pine barren and pitch pine-oak habitat in this area is expected to provide overlapping species benefits for shrubland birds, rare moths and butterflies, bats, and possibly the NEC.

The 5-year review assessed known ponds and critical habitat based on surveys and previous headstart release efforts. Of the 22 to 25 ponds identified with populations, only four are protected through conservation. Ninety percent of the pond habitat that may support cooter populations is in private ownership, with only 10 percent protected through permanent conservation. As much as 50 percent is contained within the privately owned Federal Furnace Pond, and

the MDFW has a long standing relationship with the landowner of that pond for cooter management.

Management activities in alternative B would have moderate beneficial impacts on the cooter population. Closure of the forest canopy plays a significant role in diminishing habitat suitability. Historically, the pine barren habitat that makes up most of Plymouth County was frequently burned, causing a mosaic of pitch pine-scrub oak barrens with frequent openings. Today, the area has largely been protected from fire and most of the undeveloped areas are closed-canopy pine forests. These forests surround the ponds that, with adequate sunlight, could provide needed nesting habitat. Mechanical and prescribed burning measures would have a positive impact by creating openings that cooters need for nesting. Collaboration with the State and other partners across the Plymouth RAFA would increase the potential opportunity for genetic variation within the species by helping to ensure contiguous habitats and connectivity for cooter populations (USFWS 2007a).

New England Cottontail

Impacts of Alternative A

Under this alternative, there would be no designation of the 10 proposed RAFAs, and the Service would not be authorized to acquire additional lands and conservation easements across the six-state partnership area, to be managed as part of the Refuge System. The Service's Partners for Fish and Wildlife program could still provide assistance to private landowners and partners, but there would be no additional refuge land acquisition and related certainty of long-term management and maintenance.

Meagan Raecy/USFWS

Young New England cottontail released into transition pen at Ninigret National Wildlife Refuge

Limited regulatory mechanisms exist to directly prevent the destruction or modification of wildlife habitat. Today, habitat impacts occur mainly on private lands. Existing zoning ordinances appear to provide inadequate protection of NEC habitat, since much habitat destruction and modification has already occurred under zoning ordinances designed to regulate development. The destruction of NEC habitat could be lessened by possibly persuading conservation commissions or other municipal permitting authorities to more actively limit development of habitats used by NEC.

Regulatory activity under state endangered species laws has preserved habitat for NEC on utility rights-of-way, protected habitat patches through deed restrictions and voluntary easements, and secured mitigation funding to help restore habitat. Rangewide, the NEC benefits from state and Federal regulatory mechanisms protecting other wildlife that share their habitats, including migratory birds, the bog turtle, and the eastern box turtle; these species' ranges substantially overlap that of NEC in southern New England. Both state and Federal agencies currently have authority to manage land that is suitable for NEC, which could collectively and substantially lessen the threat to the population from continued habitat modification and fragmentation. However, all these efforts are already occurring to the extent possible with the rangewide partnership effort, which has requested and supports the proposed Refuge System contribution.

Under the no-action alternative, shrublands and young forest throughout the six-state partnership area would continue to be subject to existing regulations, pressures, land use trends, and current management to maintain shrubland conditions for the cottontail and shrubland-dependant birds. No additional contributions to the accomplishment of NEC Conservation Strategy goals and objectives are expected beyond existing partnership commitments. We expect there would be an overall continuation of the loss of early successional, shrubland and young forest habitat. One uncertainty that would continue to exist is whether the rangewide effort can enlist and manage enough private land to create an effective habitat network. Overall, we expect moderate adverse impacts to the NEC population under alternative A.

Impacts of Alternative B
While this proposal is intended to help reverse the decline of an entire suite of species, one of its most important individual purposes is to contribute to accomplishing NEC Conservation Strategy goals for the cottontail. Proposed acquisition targets within RAFAs under this alternative would allow us to protect or restore, and provide long-term maintenance for, an additional 12,000 acres of shrubland and young forest habitat, beyond the current capacity of the existing rangewide partnership described in alternative A. The 12,000 additional acres within RAFAs is derived from the assumption that it is not reasonable to expect 100 percent of lands or easements acquired by the Service would be managed as shrubland, but that 80 percent of the 15,000 acres proposed in alternative B reflects a strong management commitment by the Service. The majority of these lands would be co-managed as shrubland habitat for both NEC and migratory birds.

Available parcels of land that contain or are in close proximity to known populations of NEC would receive high priority, as would lands that allow us opportunities to contribute to multiple overlapping Strategic Growth priorities of the Refuge System. The approach of applying pre-approved acreage targets within the larger strategically placed RAFAs would allow us the flexibility to help state land management teams react to willing-seller opportunities, and secure key parcels with respect to important core/source NEC populations. Acquiring tracts in close proximity to partners would allow the Service and partners to pool management resources, and provide greater certainty that shrublands would continue to be managed over the long-term. The high degree of certainty of long-term management provided by Service acquisition was identified as an extremely important contribution to the successful implementation of the NEC Conservation Strategy, and was taken into consideration when the Service decided not to list the rabbit under the ESA in 2015.

The locations of RAFAs and acquisition target acreages represent the Service's contribution to accomplishing NEC Conservation Strategy habitat and population goals. The strategy established a landscape design and conservation goals based on principles of population viability and biogeography that would: (1) keep or return NEC to most of its historic range; (2) protect existing populations by ensuring that enough individuals are present to overcome environmental and genetic uncertainty; and (3) provide multiple populations to guard against unexpected events such as disease outbreaks. It outlines goals to be reached by year 2030 that the NEC Technical Committee believes will best ensure long-term conservation of NEC. Consideration was given to rangewide goals developed by the Service, individual state goals, and sub-goals for NEC focus areas within each state.

To conserve NEC, the Service had set a regional habitat restoration goal of 27,000 acres to support 13,500 rabbits (see Table 25). The NEC Technical Committee delineated 47 focus areas for NEC conservation, each having 11 or

more habitat patches, with a combined capacity to support 80 metapopulations of NEC. The rangewide partners plan to manage 31 focus areas between 2012 and 2020, with a target level of 35,987 acres of habitat, including 15,595 on private land, 1,290 on municipal land, 18,555 on state land (to include 10,475 acres managed through controlled burning), 525 on Federal land, and 25 acres on Native American Tribal land.

Table 25: NEC Conservation Strategy-Recovery Goals

Goal Level	Habitat (acres)	Population
USFWS Range wide Goals	27,000	13,500
Connecticut	19,000	9,500
Massachusetts	6,800	4,500
Maine	3,640	1,150
New Hampshire	2,000	1,000
New York	10,000	5,000
Rhode Island	1,000	500
Total All State Goals	42,440	21,650
Total All Focus Area Sub-Goals	51,665	28,100

The proposed 12,000 additional acres of managed shrubland habitat are expected to make measurable contributions towards NEC Conservation Strategy and State Land Management Team habitat and population goals for the rabbit, beyond numbers currently supported by existing habitat under alternative A. Strategic placement of acquisition efforts is expected to help improve and maintain critical landscape connectivity between patches of habitat containing NEC, important to population viability. Additional securement of lands through Service acquisition is expected to increase the long-term certainty of management and success in key locations, as opposed to the uncertainty of other approaches such as short-term private land enrollments. Overall, alternative B is expected to have moderate beneficial impacts on the NEC population.

Monarch Butterfly and Other Pollinators

Impacts of Alternative A

The Service's Northeast Region is taking a cross-programmatic approach and identifying ways to work with diverse partners to restore and enhance monarch habitat on Federal and non-Federal lands. Under alternative A these efforts would continue. Projects include work on refuge lands, state, county, and municipal lands, NGO properties, utility right of ways (ROWs), schools, private lands, and others. In addition to habitat and restoration projects underway for 2015, additional potential opportunities to work with other Federal, state, private, and NGO landowners have been identified to incorporate monarch habitat considerations into ongoing management. These opportunities are still being explored and may not result in new habitat in 2015, but we are committed to exploring the folowing ideas to increase habitat in the future:

- We will continue to identify refuge lands that currently allow farming but will likely be discontinuing the practice in the next few years. There are about 1,000 acres on eight different refuges, and some of these acres may provide opportunity for monarch habitat restoration.

- On Service-owned lands we will develop and implement Best Management Practices (BMPs) where mowing and prescribed fire are commonly used management tools to benefit monarch butterflies and other pollinator species.

Monarch butterfly

Bill Thompson

Service programs will continue to identify and engage potential land management partners to develop BMPs applicable to non-refuge lands, including improved mowing, invasive species control, and burning practices. We will incorporate nectar producing plants and milkweed in habitat restoration and enhancement projects wherever appropriate in wetland, stream, riparian, early successional, and upland habitat projects.

The Service's Ecological Services program expects to continue to work with USDA's Natural Resources Conservation Service (e.g., Conservation Stewardship Program, Environmental Quality Incentives Program, Working Lands for Wildlife) at the state level to assess, plan, and implement cooperative conservation practices, including incorporating milkweed and nectar-producing species, that provide direct benefits to pollinators and monarchs.

Cooperative conservation practices include:
- Incorporating prescribed fire management
- Incorporating mowing and haying
- Seed collection, propagation, seeding, and planting
- Invasive plant management
- Establishing pollinator gardens of various sizes
- Management of ROWs and other frequently mowed habitats such as roadsides
- Management practices for wetland mitigation sites to include pollinator friendly plants

Impacts of Alternative B
The recent Service Monarch Butterfly Conservation Framework (Framework) identifies a strategy based on the principles of SHC, which relies on public-private partnerships to address habitat, engagement, and science needs to help restore monarch butterfly populations. The Service intends to work to protect, restore, and enhance monarchs and their habitats through landscape conservation on both public and private lands across North America. The Framework identifies a population objective of 300 million monarchs by 2024 and an intent to restore and enhance 150,000 acres of habitat in FY15 through Service programs and lands.

The Northeast Region's Regional Monarch Conservation Action Plans for 2014 include "exploring potential overlap of habitat use and management practices for monarch butterflies, grassland birds, and shrubland birds/New England

cottontail." There are already identified opportunities for alterations in grassland habitat management on Service lands to benefit monarch butterflies. Alternative B offers a great deal of opportunity to contribute to monarch and pollinator habitat goals, given the 15,000-acre acquisition target and our intention to restore, manage, and maintain 12,000 acres of potential early successional/ shrubland habitat over time on these lands and easements. One example would include the acquisition of fee or easement rights for former farmland parcels, where complementary management would be a matter of timing and rotation of mowing regimes to maintain juxtaposed shrubland and open lands. We intend to make every effort to incorporate pollinator and monarch habitat management on acquired lands and easements as part of alternative B.

Other Species

Impacts of Alternative A
As native and natural habitats continue to decline in quality and spatial extent, and as habitat patches become more fragmented, the animal species that use these habitats would decline in numbers or fitness. Under the alternative A, there would be few additional benefits to native fish or wildlife populations with the possible exception of those species that can tolerate or thrive in urbanized, agricultural, or otherwise altered environments. Examples of such species include deer (*Odocoileus virginianus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), blue jay (*Cyanotta cristata*), mocking bird (*Mimus polyglottos*), and various fish species that can live in low-quality waters.

As native and natural habitats continue to decline in quality and spatial extent, and as habitat patches become more fragmented, the animal species that use these habitats would decline in numbers or fitness. The No Action alternative would exacerbate this decline in the area's unique flora and fauna. Nuisance species that prefer forest edges would increase, such as the brown-headed cowbird (*Molothrus ater*), raccoon, fox (*Vulpes vulpes*), and opossum (*Didelphis virginiana*). These species are predators on other wildlife and increases in their populations would cause further disruption of native ecosystems. Nonnative aquatic species would also likely increase. Depending on the rarity of the native species affected that are likely to occur in the RAFAs, this impact is expected to be moderate.

Impacts of Alternative B
If alternative B is implemented, the rate of loss of shrubland habitat would be slowed slightly. This relative increase in shrubland habitat, as compared to alternative A, would benefit shrubland-dependent species. This increase in available habitat would allow shrubland-dependent species to achieve higher levels of fitness, which could lead to higher reproductive rates and slightly greater abundance. Since these species are highly represented in SWAPs as species of greatest conservation need, this alternative would have a minor beneficial impact on the overall positive health of the RAFAs.

Edge species and species dependent on late successional forest would have slightly less available habitat as early successional habitats are maintained or late successional habitats are converted to shrublands or early successional forests. However, this is not anticipated to have any impact on those species that use late successional forests, since overall the amount of available late successional habitat would decrease only slightly.

Cumulative Impacts

According to the Council on Environmental Quality regulations on implementing NEPA (40 CFR 1508.7), a cumulative impact is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes the other actions. Cumulative

impacts can result from individually minor but collectively significant actions taking place over time.

This cumulative impacts assessment includes the actions of other agencies or organizations, if they are interrelated and influence the same environment. Thus, this analysis considers the interaction of activities at the RAFAs with other actions occurring over a larger spatial and temporal frame of reference. Specific to this analysis we considered the continued residential and commercial development of undeveloped lands, state wildlife agency and NGO acquisition of lands for conservation, Service acquisition and management of shrublands associated with existing national wildlife refuges within and adjacent to the RAFAs, and the continuation of climate change effects. We have considered these actions in the context of implementing Service actions over the next 30 years.

We have identified those resources that could be cumulatively affected by the combination of actions described to implement this land protection plan, along with the other activities described in this section. It is likely that there could be a cumulative impact to habitat and vegetation, wildlife species, and socio-economics.

Air Quality

Projected land/habitat acquisitions and restoration of native shrublands and young forest should generate beneficial impacts to air quality locally. While both alternatives would facilitate continued and increased land protection ability, alternative B would have the most beneficial impact with an additional 15,000 acres of protected lands. These beneficial habitat impacts would derive from the refuge's capacity to continue to filter out many air pollutants harmful to humans, wildlife, and the environment. In some cases the Service would set back succession on refuge lands by, for example, brush hogging or thinning trees, to create better habitat for shrubland-dependent species. These management activities could have adverse impacts on air quality as these areas would no longer have the capacity to absorb as much carbon. However, these types of land management activities would be staggered throughout the RAFAs over a period of 30 or more years, resulting in only short-term, minor impacts.

With our partners, we would continue to contribute to improving air quality through cooperative land conservation and management of shrublands. Protecting valuable fish and wildlife habitat from development and maintaining it in natural shrubland vegetation assures these areas would continue to filter out many air pollutants that, incrementally, may be harmful to humans and the environment.

Some short-term, local and immediate deterioration in air quality would be expected from air emissions of motor vehicles associated with public use and heavy equipment associated with land management activities. These incremental sources of emissions potentially do contribute to a degradation of air quality of the local and regional environment, but such contributions are extremely minor and of very short duration. Future refuge lands are generally not expected to be a recreation destination where visitors are drawn from distant places. Most visitors would already be in the area or would be passing through the area on vacation and would seek out the refuge for a day trip. Therefore, the presence of the refuge alone would only account for a small percentage of vehicle emissions generated in the AOI and even in the individual RAFAs.

Hydrology and Water Quality

Under both alternatives, habitat protection and restoration would result in cumulative benefits to hydrology and water quality. The Service and its partners would protect and maintain lands in their natural vegetated state, thus preventing these lands from being converted to impervious surfaces. Furthermore, the Service would restore lands containing unnecessary buildings

and structures (e.g., removing impermeable surfaces), other disturbed sites, and unused roads and trails on acquired and protected lands. Protecting, managing, and restoring shrubland habitats that currently exist and that may be acquired in the future would improve the health of local watercourses and aquatic resources, resulting in greater diversity and functionality of refuge habitats and watersheds in general.

Both alternatives also include some level of management to maintain early successional habitat. Both limited habitat restoration and passive natural succession would result in improvements in water quality in terms of chemistry, reduced sediment, and mitigation of any contaminated run-off from off-refuge sources. Collectively and over time, those actions would improve the ability of Service lands to process nutrients and store carbon and contribute to other state watershed regulation standards and initiatives that are designed to maintain and improve local water quality within the RAFAs.

There would be a very slight potential for herbicide dispersal into wetlands and streams, but not to any measurable or chronic proportion that could add to local or regional cumulative adverse impacts. Based on the relatively short half-life and the limited acreage likely to require treatment, it is not expected that any discernible effects would occur to these water resources as a result of herbicide treatments.

BMPs and erosion and sediment control measures would be used on building, road, trail, and other recreation infrastructure construction sites to ensure any impacts on hydrology and water quality are minimized. Management actions would also be adaptive to address climate change cumulative impacts on the physical environment.

In addition, when the conservation actions by the Service are combined with actions by state wildlife managers, non-profit organizations, private landowners, and local communities, there would be considerable cumulative progress in stemming and mitigating the urbanization and development changes that can directly and indirectly impair good water quality and productive habitats within the AOI.

Soils

In both alternatives, permanent protection of watershed soils in areas potentially to be acquired and managed by the Service would result in beneficial impacts to overall soil conservation in the AOI.

As with many areas nationwide, the greatest cumulative impact on soils is from land development. With the cessation of development, watershed soils on lands managed by the refuge should improve in natural fertility and productivity. Logically, more soil benefits are to be gained with alternative B since it proposes expanded land/habitat protection. Both alternatives would employ best management practices to minimize impacts to soils.

Positive consequences and beneficial cumulative impacts of managing soils in native vegetation for the long term include increasing capacity for carbon sequestration from the environment. Biological CO_2 sequestration can be enhanced in managing natural habitats that increase the natural absorption of atmospheric carbon in soils. The long-term cumulative potential is limited to how the land is used and managed, and the refuge would maintain and, where possible, enhance the ability of Service-owned lands to sequester carbon.

There would be some potential adverse cumulative impacts to refuge soils from shrubland management. However, in both alternatives, these types of land management activities would be staggered throughout the AOI over a period

Old field habitat suitable for New England cottontail at Libby River Farm, Scarborough, Maine

Kelly Boland/USFWS

of 30 or more years. Therefore, even when added to other past, present, and reasonably foreseeable future actions, these impacts would result in only short-term, minor impacts.

We would minimize any potential for adverse cumulative impacts by continuing to use best management practices when setting back succession in shrubland habitats. Habitat management tools used for setting back succession include mowing, brush-hogging or prescribed burning. Under both alternatives, we expect to reclaim problem areas dominated by invasive species and restore them to native plant communities, which should improve nutrient recycling, restore native soil biota and soil fertility, and return soils to natural productivity regimes.

Climate Change

There would be no significant cumulative adverse effects to biological resources under any of the alternatives because the changes in habitat components that we would manage for directly or expect to realize through natural succession would on balance be beneficial.

DOI Secretarial Order 3226 states that "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making. This order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making." Additionally, it calls for the incorporation of climate change considerations into long-term planning documents, such as LPPs.

The Wildlife Society published an informative technical review report in 2004 titled Global Climate Change and Wildlife in North America (Inkley et al. 2004). It interprets results and details from publications such as the Intergovernmental Panel on Climate Change reports (1996 to 2002) and describes the potential

impacts and implications on wildlife and habitats. It mentions that projecting the impacts of climate change is hugely complex because it is important to predict changing precipitation and temperature patterns, their rate of change, and the exacerbated effects of other stressors on the ecosystems. Those stressors include loss of wildlife habitat to urban sprawl and other developed land uses, pollution, ozone depletion, exotic species, disease, and other factors. Projections over the next 100 years indicate major impacts such as extensive warming in most areas, changing patterns of precipitation, and significant acceleration of sea level rise. According to the Wildlife Society report, "…other likely components of ongoing climate change include changes in season lengths, decreasing range of nighttime versus daytime temperatures, declining snowpack, and increasing frequency and intensity of severe weather events" (Inkley et al. 2004). The Wildlife Society report details known and possible influences on habitat and wildlife, including changes in primary productivity, changes in plant chemical and nutrient composition, changes in seasonality, sea level rise, snow, permafrost, and sea ice decline, increased invasive species, pests and pathogens, and impacts on major vertebrate groups.

The effects of climate change on populations and range distributions of wildlife are expected to be species specific and highly variable, with some effects considered negative and others considered positive. Generally, the prediction in North America is that the ranges of habitats and wildlife will generally move upwards in elevation and northward as temperature rises. Species with small or isolated populations and low genetic variability will be least likely to withstand impacts of climate change. Species with broader habitat ranges, wider niches, and greater genetic diversity should fare better or may even benefit. This will vary depending on specific local conditions, changing precipitation patterns, and the particular response of individual species to the different components of climate change (Inkley et al. 2004). The report notes that developing precise predictions for local areas is not possible due to the scale and accuracy of current climate models, which is further confounded by the lack of information concerning species-level responses to ecosystem changes, their interactions with other species, and the impacts from other stressors in the environment. In other words, only imprecise generalizations can be made about the implications of our refuge management on regional climate change.

Our evaluation of the proposed action concludes that the activities that may contribute negligibly, but incrementally, to stressors regionally affecting climate change: our prescribed burning program, our use of vehicles and equipment to manage habitat and administer the refuge, and visitor use of motorized vehicles. We discuss the direct and indirect impacts of those activities elsewhere in this chapter. We also discuss measures to minimize the impacts of both. For example, with regard to prescribed burning, we would follow detailed burn plans operating only under conditions that minimize air quality concerns. In addition, many climate change experts advocate prescribed burning to manage the risk of catastrophic fires (Inkley et al. 2004). Federal mandates require all Federal agencies to reduce petroleum fuel use by 2 percent annually based upon 2005 fuel use, having a goal of reducing petroleum fuel use by 30 percent. More than any other factor, this mandate will drive fleet management practices through 2020, and the refuge would attempt to replace older, inefficient vehicles, with more fuel efficient models. With regard to our equipment and facilities, we are trying to reduce our carbon footprint wherever possible by using alternative energy sources and energy-saving appliances, and using recycled or recyclable materials, along with reduced travel and other conservation measures. In our professional judgment, neither alternative would exacerbate climate change in the AOI or in any of the RAFAs, and some might incrementally prevent or slow local impacts.

Biological Resources

In general, native habitat protection and varying levels of management (including both active and "passive" management) would have cumulative beneficial impacts on the biological environment, even and especially when considered within the context of past, present, and future actions of other agencies and organizations. We expect to increase select species populations in targeted situations (e.g., New England cottontail, blue-winged warbler) through habitat protection and active management (e.g., silviculture operations). Native habitat protection and management cumulatively benefits the biological environment by increasing and enhancing healthy soil biota, restoring, and enhancing native plant resources, potentially increasing resident wildlife populations of mammals, fish, reptiles, and amphibians, and enhancing invertebrate populations such as dragonflies and pollinators. Cumulative beneficial impacts on adjacent protected lands would also accrue from reducing habitat fragmentation across the watershed landscape through refuge land protection activities.

There would be no cumulative adverse effects to biological resources under either of the alternatives because the changes in habitat components that we would manage for directly or expect to realize through natural succession would on balance be beneficial.

USFWS

Indiana bat

Proposed habitat enhancement and restoration activities (e.g., tree thinning) under alternative B would limit any potential adverse cumulative impacts effects on the biological environment by careful employment of best management practices, as noted earlier. Occasionally, mowing or brush hogging could result in the loss of some small mammal, reptiles, or other species. However, even when combined with management activities of our partners, these losses are short-term and minor. When managing habitats that are used by federally listed species (e.g., bog turtle, Plymouth red-bellied turtle) we would follow recovery plan guidelines.