Atlantic Flyway Shorebird Initiative

A Business Plan

February 2015

Cover photo: Sanderlings. James Dendrick
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Lesser Yellowlegs.
Andrew Reding

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American Oystercatcher.
James Dedrick

PLAN DEVELOPMENT

The Atlantic Flyway Shorebird Business Plan is the culmination of a three-year effort involving multiple partners along the entire Atlantic Flyway, from Alaska to Argentina. Spearheaded by the U.S. Fish and Wildlife Service (USFWS) as a regional effort to address declines in shorebirds, the initiative grew to embrace full life cycle conservation, which is described in a document entitled, The Atlantic Flyway Shorebird Business Strategy (Winn et al. 2013). Using results from the adaptive planning framework Open Standards for the Practice of Conservation (Conservation Measures Partnership 2013), the partners further refined the 2013 report to produce the Atlantic Flyway Shorebird Initiative: A Business Plan. The business plan represents the full suite of strategies and actions needed to conserve 15 Atlantic Flyway shorebirds, and will also benefit many other species occupying the same habitats.

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Sanderlings.
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EXECUTIVE SUMMARY

LIVING ON THE EDGE

Recognizing the decline of migratory shorebird populations throughout the Atlantic Flyway, a USFWS-led partnership of government agencies, conservation organizations, academics, and shorebird experts developed this ambitious business plan to reverse these population trends and build a foundation to safeguard the phenomena of migration. Together, the actions outlined in this document should sustain shorebird populations throughout the hemisphere.

Often weighing less than a cell phone, shorebirds travel thousands of miles each year between the barren tundra of the Arctic and the wind-swept beaches of Tierra del Fuego in the southern hemisphere. The majority of temperate, boreal, and Arctic shorebirds breeding in Alaska and Canada (60 of the 77 North American species) spend their non-breeding period in South American or Caribbean countries. Annual round-trip migration usually requires a sequence of flights between two or more stopover sites that connect breeding and non-breeding habitats.

Protecting all stopover links along the migratory pathway is a critical component of shorebird conservation. The degradation of just one site can have a profound and catastrophic impact on a species. In Delaware Bay, for example, a major staging area, the collapse of horseshoe crabs has led to dramatic declines in Red Knot, which feed on the crab eggs. To add to the urgency, many shorebird species have been severely impacted by the changes humans have made to their wetland, grassland, and beach habitats; few shorebirds have increased in the last several decades and the majority of species have declined.

Implementing full life cycle conservation across large geographic and cultural landscapes requires long-term vision and commitment to a sustained effort over many years. The flyway approach described herein provides a road map for a coordinated effort involving multiple organizations working together across political boundaries to effectively conserve Atlantic Flyway shorebirds.

MAJOR THREATS

During migration, shorebirds face a multitude of challenges: (1) finding sufficient food to fuel them over long distances; (2) avoiding predators; (3) competing for limited habitat; (4) adapting to a changing climate; and (5) evading sport and subsistence hunters.

Among the many threats faced by Atlantic Flyway shorebirds, four primary anthropogenic threats were identified as key mortality sources: (1) habitat loss and change; (2) human disturbance; (3) hunting; and (4) predation. Threats to shorebird habitats have been further refined to address specific problems with residential and commercial development, coastal engineering, incompatible management, and invasive plants and invertebrates. Because of shorebirds' affinity for coastlines, the potential impacts of climate change ranked very high as a stressor. In addition, for some species and populations, basic information is lacking on critical habitats, population size and trends, priority sites, and resource needs; in these instances, and as part of the overall threat reduction strategies, investments in filling knowledge gaps will be required to allow the implementation of effective management actions.

SELECTING FOCAL SPECIES AND GEOGRAPHIES

Fifteen shorebird Focal Species were selected to represent a wide array of regional ecologies and habitats, and to serve as representatives for other species that share similar conservation needs. Focusing on a small group of shorebird species makes conservation planning and evaluation more efficient and simplifies implementation. Focal Species include taxa that are of high conservation concern, represent important habitat suites in the flyway, or have existing conservation plans.

To focus conservation efforts in the most important places for shorebirds, the initiative was designed to highlight areas where shorebirds concentrate or where conservation actions can have the greatest impact. Partners organized the initiative at three overlapping spatial scales. Focal Sites, the smallest scale, are either migratory stopover areas that met the population thresholds to qualify as Western Hemisphere Shorebird Reserve Network (WHSRN) sites or areas known to be important breeding or wintering habitats. Then Focal Areas were established by grouping together Focal Sites that shared species or conservation issues. Finally, Focal Geographies, the largest scale, were developed by combining Focal Areas into broad regions sharing similar species or threats. The initiative covers seven Focal Geographies: (1) Arctic regions of Alaska and Canada; (2) boreal regions of Alaska and Canada; (3) the Canadian Maritimes and the Northeast U.S. coast; (4) the mid-Atlantic and Southeast U.S. coast; (5) the Caribbean; (6) northern South America; and (7) southern South America..

"Like the resource it seeks to protect, wildlife conservation must be dynamic, changing as conditions change, seeking always to become more effective."

Rachel Carson

CONSERVATION OUTCOMES

Within the plan, the Atlantic Flyway 10-year goals and associated outcomes are expressed at three levels: (1) the entire initiative; (2) for each species; and (3) by conservation strategy. The overall, cumulative goal of the Atlantic Flyway Business Plan is to increase focal shorebird populations 10 to 15 percent by 2025; some individual projects have the potential to increase local shorebird abundance by even higher levels in response to proven management actions. To achieve this ambitious goal, five strategies were identified to address the four major threats and the knowledge gaps identified above: (1) protect habitat; (2) minimize predation; (3) reduce human disturbance; (4) reduce hunting; and (5) fill knowledge gaps. For each strategy, one or more actions are outlined with corresponding SMART objectives (Specific, Measured, Achievable, Results-oriented, and Time-fixed). Partners further developed activities under each strategy and prioritized them into Tier I, II, and III actions; only Tier 1 and II actions are presented in the implementation plan in Chapter F.

IMPLEMENTING THE PLAN

The successful implementation of the Atlantic Flyway Business Plan will depend on the partnership's capacity to: (1) monitor change across a broad landscape; (2) work within legal frameworks established to promote flyway conservation (e.g., treaties, conventions); and (3) coordinate implementation across large geographies and multiple institutions. Successful implementation of the Atlantic Flyway Business Plan will require the formal establishment of a hemispheric oversight body to provide strategic and operational coordination. The current ad-hoc steering committee provides a foundation for such a body.

MONITORING AND EVALUATING SUCCESS

The ultimate measure of the success of this plan is an increase in the population sizes of the 15 Focal Species. However, the same globe-spanning ranges that leave shorebirds vulnerable to anthropogenic threats also make them difficult to monitor. Thus, population sizes and trends are known with certainty for only a handful of species. Recognizing the challenges of monitoring these species on a hemispheric scale, three distinct levels of monitoring resolution were recommended: (1) effectiveness monitoring, which yields immediate results and allows managers to adapt quickly in response to unexpected outcomes; (2) index monitoring, which allows us to demonstrate that species are responding

to our actions as expected; and (3) population monitoring, which provides the big picture of our success at restoring populations.

RISKS AND RESOURCING

Seven principal risks to the Atlantic Flyway Business Plan were assessed, and, where applicable, strategies to avoid or mitigate these risks were identified and incorporated into the plan. This business plan is built on the assumption that adequate funds can be raised over a 10-year period and effectively investing these funds will result in a 10 to 15 percent increase in the 15 Atlantic Flyway shorebird Focal Species populations. To achieve this goal, the partnership will be challenged to raise an estimated $90 million to manage and protect critical habitat ($37.490m), minimize predation impacts ($10.940m), reduce human disturbance ($30.565m), reduce hunting pressure ($3.450m), and fill knowledge gaps ($7.935m). The successful implementation of the business plan thus will require a collaborative effort to secure funding among federal and state governments, multilateral and bilateral agencies, foundations, and not-for-profit conservation organizations.

LOOKING AHEAD

The business plan responds to an urgent need to halt declines and restore Atlantic Flyway shorebird populations. In the process of developing the business plan, the partnership recognized the urgent need to expand partner participation to the Caribbean and Atlantic Flyway regions of South America. As part of ongoing efforts to implement elements of the business plan, partners will be making a concerted effort to fill in knowledge gaps by engaging more fully with key stakeholders in Latin America and the Caribbean. As such, this business plan should be considered the first version of a living document that will be updated as part of an iterative process leading to a more comprehensive Atlantic Flyway Shorebird Initiative (AFSI) in the coming years.

Tiera Del Fuego.
Creative Commons

Piping Plover survey, Turks and Caicos.
Craig Watson

CONSERVATION NEED

BACKGROUND

Migratory birds—both inter- and intra-continental migrants—link people, countries, and cultures, and offer an extraordinary opportunity for international collaboration on shared development and conservation issues. Many migratory bird populations are sharply declining, and there is increasing evidence that these declines are linked to large-scale environmental issues.

Each year shorebirds use habitats across a vast geography, undertaking some of the longest migrations of any animals on earth. They are also one of the bird groups undergoing the steepest declines. Recent data suggest that several Atlantic Flyway shorebird species have experienced dramatic declines of between 50 and 90 percent within the last three decades (Andres et al. 2012). The Canadian and U.S. Shorebird Conservation plans have identified that 50 percent of shorebird species or subspecies regularly occurring in Canada and the United States are either highly imperiled or species of high concern. Eight populations of shorebirds are listed, or have been considered for listing, as threatened or endangered in the United States; one species is likely extinct. Eighteen species of shorebirds are on the State of North American Birds 2016 Watch List (NABCI 2016), and 22 populations are on the 2008 U.S. Fish and Wildlife Service Birds of Conservation Concern list (USFWS 2008).

In general, shorebird populations are relatively small and hence vulnerable to anthropogenic and environmental impacts. For example, of the 74 distinct shorebird populations occurring regularly in North America, 30 percent include populations with fewer than 25,000 individuals, and only nine populations exceed one million individuals (Andres et al. 2012). In terms of breeding biology, shorebirds

The life history of shorebirds is a chronicle of life on the edge of survival.

Charles Duncan, former Director, WHSRN

typically have high annual adult survival rates, moderate to high parental investment in offspring care, and low reproductive rates. The breeding range for Atlantic Flyway species includes temperate and tropical coastal to Arctic tundra habitats; environmental conditions in these breeding habitats can be highly variable.

The majority of temperate, boreal, and Arctic breeding shorebird species (60 species) spend the non-breeding period ("winter") in South American or Caribbean countries. Movement or migration between breeding and non-breeding habitats usually requires a sequence of flights between two or more stopover (feeding) sites that connect the breeding and non-breeding habitats. Arrival and departure from stopover areas is carefully timed to coincide with maximum food abundance, allowing individuals to refuel before continuing their migration. Protecting these critical stopovers and staging sites is a key component of shorebird conservation.

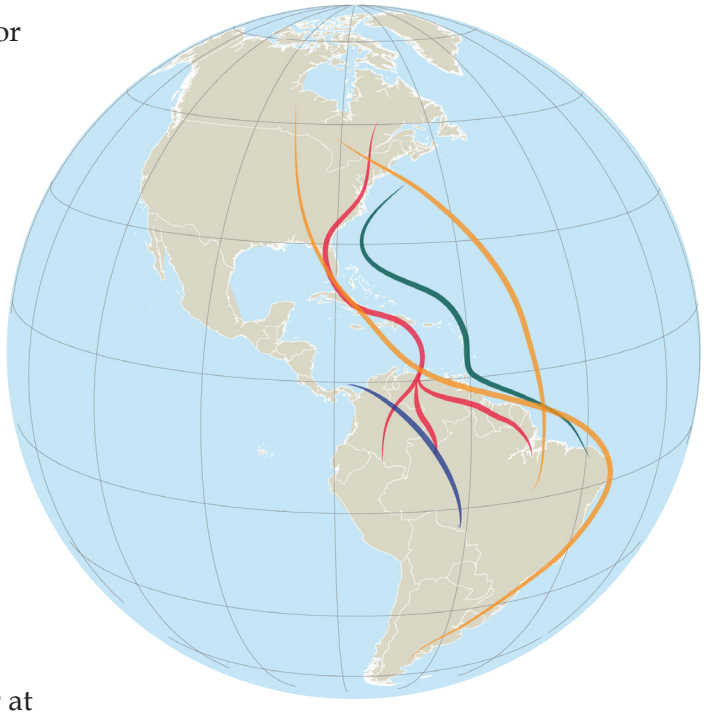
Consequently, the combination of nesting habitat preference (variable Arctic and coastal environments), life history strategies (low

reproductive output, long distance migration), and demography (small populations) results in high potential vulnerability to a suite of threats across multiple landscapes during the annual cycle and, more inclusively, throughout the lifespan of an individual. Shorebirds have co-evolved to respond to natural threats such as predators, severe weather, and periodic local food depletion events. However, human-induced threats such as habitat destruction, recreational disturbance, artificially inflated predator populations, unregulated hunting, and pollution are relatively new and can wreak havoc on shorebird populations. These threats, which produce additive stress and mortality, can lead to population decline; human activity has also altered natural sources of mortality, producing additional strain on shorebirds. For example, habitat loss at stopover locations can result in higher densities of birds, thus increasing natural predation risk and/or success for predators such as Peregrine Falcons.

Historically, almost every shorebird species using the Atlantic Flyway was at one time hunted for its commercial value or for unregulated sport. By the 1930s, many species were in serious decline and several, including the American Golden-Plover and Buff-breasted Sandpiper, came perilously close to extinction. Further, it wasn't just the migrants that were in peril; locally breeding coastal species like American Oystercatcher and Willet were also greatly reduced. Although some populations have recovered from "market-hunting-era" declines, recent sharp declines precipitated by an ever-expanding set of anthropogenic threats have raised once again the extinction risk for some species. Addressing this suite of threats requires a range-wide, full life cycle or flyway approach to conservation.

A FLYWAY APPROACH

The total geographic area used by a population, species, or group of species throughout its annual cycle is termed a flyway (Kirby et al. 2008). Boere and Stroud (2006) provided a more detailed definition of a flyway: "… the entire range of a migratory bird species (or groups of related species or distinct populations of a single species) through which it moves on an annual basis from the breeding grounds to non-breeding areas, including intermediate resting and feeding places as well as the area within which the birds migrate." Within the Americas, four major flyways are generally recognized for North American breeding migrants: the Atlantic, Mississippi, Central, and Pacific Flyways.



Effective conservation of migratory birds requires action beyond any one set of political borders. Within the Atlantic Flyway, many shorebird species breed in the Canadian Arctic tundra and boreal forest and winter along the eastern shores of South America, stopping over at a number of critical migratory sites in between, particularly along the east coasts of the U.S. and Canada. Atlantic Flyway shorebirds are exposed to a diverse set of human-induced threats across this network of sites. While the nature and severity of these threats may vary, each site plays a critical role in shorebird survival. Therefore, effective shorebird conservation requires a wide-ranging approach to identify and ameliorate threats that shorebirds face at multiple locations throughout the flyway. Such an approach requires the coordination of research, conservation, and management efforts of many groups across many political boundaries and the consolidation of resources to undertake efficient conservation activities. Only with such a collaborative flyway-scale approach[1] can we reverse the serious declines happening in many of Atlantic Flyway shorebird populations.

[1] The experts responsible for the development of this plan were not evenly distributed across the flyway. Thus, some activities may be underrepresented for certain geographies, particularly within Latin America. In these cases, every attempt has been made to lay the groundwork for future improvement, expansion, and cross-boundary coordination.

FOCAL SPECIES: SHOREBIRDS MOST IN NEED

Fifteen shorebird Focal Species were selected to represent a wide array of regional ecologies, and serve as representatives for other Atlantic Flyway shorebird species that share similar conservation needs, making planning and implementation more efficient. Focal Species include taxa that: (1) are highly imperiled or of high concern; (2) represent important habitat suites in the flyway; or (3) have existing conservation plans. The Focal Species concept will guide recovery and management efforts in the Atlantic Flyway to maintain diversity and populations.

Sanderling.
Jim Fenton

Focal Species selected by Atlantic Flyway Shorebird Initiative Working Group

Focal Species	USSCP Status[2]	Estimated Population[3]	Population Estimate Confidence	Population Trend (30-year)	Rationale notes
American Oystercatcher	High Concern	11,284	95% = 10,700–11,300	↑	Existing NFWF Business Plan; temperate and tropical beach nesting
Semipalmated Sandpiper	High Concern	810,000	Moderate	↓↓	Significant recent declines noted in staging locations and some wintering locations; hunted in South America
Red Knot	Highly Imperiled	42,000	High	↓↓	Precipitous decline; long-distance migrant
Whimbrel	High Concern	40,000	Low	↓	Salt marsh obligate species; measured declines; hunted in Caribbean
Wilson's Plover	High Concern	8,600	Moderate	↓	High priority temperate and tropical beach nesting species
Marbled Godwit	High Concern	2,000	Moderate	UNK	Small flyway population; grassland/prairie nesting species
Piping Plover	Highly Imperiled	3,600	High	↑	Threatened, high priority temperate beach nesting species; Piping Plover Recovery Plan
Purple Sandpiper	High Concern	15,000	Moderate	↓	Small population; Northeast wintering species; unique rocky shoreline species
Red-necked Phalarope	High Concern	2,500,000	Low	↓↓	Unique life history; lack of knowledge reflected in phalarope conservation needs
Ruddy Turnstone	High Concern	180,000	Moderate	↓↓	Declining species
Sanderling	High Concern	300,000	Low	↓	Dispersed migrant; broad wintering distribution
Snowy Plover	Highly Imperiled	1,040	95% = 883–1,222	↓	High priority temperate and tropical beach nesting species; FL and Caribbean
American Golden Plover	High Concern	500,000	95% = 294,200 – 705,800	↓↑	Representative of grassland migrant and wintering species; Caribbean hunting pressure
Greater Yellowlegs	High Concern	137,000	Low	↑	Boreal nester; hunted in Caribbean and South America
Lesser Yellowlegs	High Concern	660,000	Low	↓↓	Boreal nester; Birds of Conservation Concern list; hunted in Caribbean / and South America

[2] US Shorebird Plan

[3] Data (counts, certainty, and trends) are from Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. "Population estimates of North American shorebirds, 2012." Wader Study Group Bulletin 119: 178–194

KEY THREATS TO SHOREBIRDS

Overall, shorebirds face numerous threats across multiple geographies and political landscapes during their annual life cycle. To slow or reverse shorebird population declines, four primary anthropogenic threats have been identified as key mortality sources for Atlantic Flyway shorebirds. These are habitat loss and change, human disturbance, hunting, and predation. Threats to shorebird habitats have been further refined to address specific problems with:

1. residential and commercial development;
2. coastal engineering;
3. incompatible management; and
4. invasive plants and invertebrates.

An assessment of the overall threat ratings throughout the flyway highlights habitat loss and change as the primary stressor on shorebird Focal Species along the Atlantic Flyway.

Climate change and sea level rise could ultimately be the single largest threat to shorebird populations globally. We are beginning to see effects on higher latitude species as well as rising sea levels, which affect temperate and tropical habitats. Implementing policies and regulations to reduce carbon output and other mitigating factors fall outside of the scope of this plan; therefore, we have not developed actions that would address climate change directly. However, as we implement this plan over the next ten years, the authors intend to recommend more specific actions related to understanding the overall effects of climate change on shorebirds in the Atlantic Flyway, and will focus on improving the resiliency of both habitats and populations to the likely increases in threats from climate change.

In addition, for some species and populations, basic information is lacking on critical habitats, population size and trends, priority sites , and resource needs. In these instances, and as part of the overall threat reduction strategies, investments in knowledge gaps will be required to allow for the implementation of effective management actions.

Although there may be multiple stressors for shorebirds, the layout of the plan is focused on mitigating the known threats described below, measuring the response, and then allowing for development of additional strategies to respond to emerging threats or needs.

Habitat Loss and Change

Habitat loss and change was identified as the greatest threat to Atlantic Flyway shorebirds in several Focal Regions. This threat was further subdivided into the following sub-categories and is further described below:

- Residential and Commercial Development
- Coastal Engineering
- Incompatible Natural Resource Management
- Invasive Species

Residential and Commercial Development

Habitats important for shorebirds, including beaches, mud flats, sand flats, emergent marshes, impounded wetlands, mangroves, and saline ponds and lagoons, are increasingly threatened by many types of human development. Coastal areas are rapidly being lost to commercial developments, including hotels, resorts, marinas, cruise ship ports, shopping malls, and golf courses. Industrial development, such as cargo shipping ports and power plants, is also a major threat. Sand mining, coastal engineering (e.g., armoring, dredging, etc.), and residential development are also adversely impacting habitats for shorebirds. Finally, various forms of pollution often associated with development—including dumping, agricultural runoff, sedimentation, solid waste, mercury, and oil spills—are severely damaging and limiting the availability of high quality habitat for breeding and migratory shorebirds.

In the Caribbean, a vast number of small and large wetlands and mangroves, and thousands of kilometers of shoreline, provide critical habitat for migrating and wintering shorebirds. Key factors contributing to the loss

and degradation of important habitats here are high levels of unemployment and poverty and low levels of public awareness of the importance and value of healthy and functioning coastal ecosystems for birds and human societies. Decision makers are under heavy pressure to provide jobs for their constituents and to grow their local economies. Tourism is the primary economic driver for most of the islands, and the mass tourism model of cruises and resorts prevails, with development concentrating on the coast. While some areas have been afforded protected area status, this does not guarantee that a site will actually be spared from development (Sorenson 2008, Jamaica Environment Trust 2014). For example, a number of vitally important protected coastal areas in the region have been developed in recent years.

In the United States, more than half of the nation's population lives along the coast. As in other parts of the flyway, coastal watersheds serve as nurseries for important commercial and recreational fish and are vital to many threatened and endangered species (EPA 2006). They also provide coastal communities with natural protection from the most damaging effects of hurricanes and storm surges (Costanza et al. 2008). In the eastern United States, coastal habitats are rapidly being lost to development. Population densities in coastal counties are five times greater than in non-coastal counties, driving the construction of roads, homes, and businesses, which in turn has accelerated wetland losses to unprecedented levels. In northern South America, and especially in the Guianas, the majority of the population—and residential and commercial development—is concentrated in a narrow coastal strip. Along the "southern Riviera" of Uruguay and Argentina, sprawling urban areas adjacent to productive coastal wetlands are impacting the integrity of several critical staging areas for larger shorebird species, most notably Red Knot, Hudsonian Godwit, and Stilt Sandpiper. Wetland conservation is often more challenging in coastal areas where high land values reduce protection and restoration opportunities, and environmental factors, such as storms and large expanses of soft sediment, hamper restoration and enhancement efforts.

While further loss of some coastal and wetland habitat to development is inevitable, a concerted effort is needed to identify remaining key wetland sites for shorebirds and ensure that these habitats are protected and properly managed. Endorsement of these sites as having values critical to the region's future, for example, by

Residential Sprawl. USFWS

contributing to local economies through sustainable livelihoods, can ensure that they are not lost to development. Best management practices (BMPs) for sustaining shorebird populations (including for wetland restoration and enhancement) should be implemented on sites that have been or are being developed. This can be done by encouraging partnerships among developers and local governments, communities, land trusts, and other NGOs, using incentives such as promotion of ecotourism opportunities and habitat grants.

Coastal Engineering

Coastal engineering practices designed to stabilize naturally dynamic coastal systems have a huge impact on species that have evolved to require such habitats. Practices such as sand mining, beach replenishment, dredging, and the widespread construction on beaches and islands of "hardened" structures (e.g., jetties, groins, seawalls, etc.) have taken a toll on coastal birds. Coastal inlets are some of the most important habitats for shorebirds (Harrington 2008). Fifty-four percent of inlets in the southeastern United States have been stabilized, channelized, hardened, or otherwise altered (Rice 2012). In the mid-Atlantic and northeastern U.S., it's likely the coasts are even more heavily converted, but the analysis of those regions has not yet been completed. Ninety percent of inlets on the Atlantic Coast of Florida currently have some form of sediment retaining structure. These practices limit or prevent sand movement, which in turn changes the natural dynamics of beach accretion and erosion, altering and often destroying important nesting, foraging, roosting, and loafing habitat for coastal birds. Outside the United States, the same trend can be seen: as development increases, countries harden their shorelines to mitigate sea level rise and lose natural barriers like mangroves and coral reefs.

Coastal engineering activities currently permitted under existing regulatory processes, such as adding beach sand during a "renourishment" project, frequently destroy habitats used by shorebirds. Such activities can also destroy or degrade habitat by negatively affecting food resources found in the sediments of near-shore sand source sites. Current permitting structures in the U.S. and Caribbean do not address cumulative impacts. While smaller individual coastal engineering projects may not impact shorebirds at the population level, the cumulative effect of many projects at the regional or flyway scale undoubtedly does.

The strategies outlined in this section have been developed to reverse the trend of coastal habitat loss from coastal engineering projects—which many believe has driven some shorebird species to the brink—and create opportunities to repair and rebuild the vital marine and estuarine landscapes that support populations of Atlantic Flyway shorebirds.

Incompatible Natural Resource Management

Historically among natural resource agencies, the conservation and management of shorebirds has been a relatively low priority compared to the management of waterfowl and other game birds. Consequently, management of unrelated species, either for consumption (e.g., fisheries) or conservation, has often led to conflicts that have had direct and significant detrimental effects on shorebird population viability.

For example, harvest of horseshoe crabs in the mid-Atlantic, and specifically in Delaware Bay, has contributed to the dramatic decline in shorebird populations using this site during spring migration staging periods (Baker et al. 2004, Niles et al. 2007). Eggs produced by spawning horseshoe crabs are a critical food resource for shorebirds staging in Delaware Bay during northbound migration (Atkinson et al. 2007, Haramis et al. 2007). Reduction in horseshoe crab egg availability has caused a marked reduction in the ability of staging shorebirds to gain weight in preparation for the last leg of migration to the breeding grounds (Atkinson et al. 2007, Mizrahi et al. 2012). Additionally, energy reserves accumulated during the Delaware Bay staging period are likely used to sustain birds after arriving on the breeding grounds and prior to snowmelt, when food resources are scarce (Morrison and Hobson 2004).

Importantly, large proportions of species' populations (e.g., Red Knot, Semipalmated Sandpiper, Ruddy Turnstone, Sanderling) in the Atlantic Flyway use Delaware Bay during this period (Myers 1983, Senner and Howe 1984, Niles et al. 2007). Marked and significant declines of up to 80 percent in shorebird populations that pass through Delaware Bay in spring have been documented since the mid-1990s, when unsustainable harvesting of horseshoe crabs began (Niles et al. 2007, Morrison et al. 2012).

In South America, a rapidly growing shrimp farming industry along the northern coast threatens migratory shorebirds on their wintering grounds. Mangrove habitats are being converted to managed wetlands (e.g., impoundments) to grow shrimp, which results in habitat loss that adversely affects shorebirds (Rovai et al. 2012).

Additionally, shorebirds may be exposed to contaminants used in shrimp grow-out ponds designed to eliminate pathogens, metabolites, and predators, reduce organic matter, and increase pH. Disposal of excess feed can also have adverse effects on wetlands in close proximity to shrimp farms. Importantly, the northern coast of South America is the main wintering region for several shorebird species, such as Black-bellied Plover, Ruddy Turnstone, Semipalmated Sandpiper, Short-billed Dowitcher, Willet, and Whimbrel. Historically, this region has supported significant proportions of these species' populations during non-breeding periods (Morrison and Ross 1989). Recent aerial surveys (Morrison and Mizrahi, unpublished data) of the northeast coast of Brazil suggest that this region also supports large numbers of wintering Red Knot.

Similarly, activities designed and executed to benefit the conservation of other species have often been incompatible with shorebird conservation and thus detrimental to shorebird populations. For example, management actions to bolster dwindling Peregrine Falcon populations in the early 1970s included the establishment of breeding populations in the coastal regions of the mid-Atlantic. This was accomplished by erecting towers in tidal marshes that were used first to "hack" young falcons and then as nesting platforms by adult birds. These now "resident" Peregrine Falcon populations prey upon shorebirds at stopover and staging areas throughout the mid-Atlantic region during both north- and southbound migration periods.

Water level management at impoundments that benefits waterfowl and the emergent vegetation they feed upon can conflict with the needs of migrating shorebirds. In recent years, multi-species management that includes shorebird requirements has improved. However, more needs to be done across federal, state, and privately owned managed wetlands to incorporate requirements of shorebirds that breed in temperate and tropical regions, as well shorebirds that migrate through or winter in these same regions.

Invasive Species

Along the entire Atlantic Flyway, non-native animals and plants are establishing populations where they have not existed before. Many of these species have arrived as stowaways from their native lands and waters. Some invasive species have the potential to negatively impact shorebird habitat. Some impacts to shorebirds are easily recognizable, such as direct habitat loss to encroaching non-native vines and trees, while other impacts may be less obvious but equally detrimental, such as marine crabs introduced from Asia destroying populations of native clams used by shorebirds.

Early successional invasive plants pose a considerable threat to shorebird staging and nesting areas throughout their range. Plant species are considered invasive when they become established in a new environment, then proliferate and spread in ways that are destructive to native ecosystems, human health, and, ultimately, human welfare. In some areas, especially in the southern United States and throughout the Caribbean, invasive species are reducing critical beach and wetland habitat for breeding, migrating and, wintering shorebirds.

The primary invasive plants of concern are Australian pine (Casurina equisetifolia), white inkberry (Scaevola taccada), and beach vitex (Vitex rotundifolia), all salt-tolerant species that compete with native beach plants. Originally introduced for erosion control, wind breaks, and ornamental hedges, these invasive species have quickly spread to occupy thousands of acres of coastal shorebird habitat, from New Jersey to southern Florida and throughout the Caribbean (Austin 1978, Morton 1980). In addition, Australian pines are prone to uprooting during storms; this can create barriers on beaches similar to a sea wall, increasing erosion and reducing the potential available roosting habitat. Inkberry and Australian pine also provide refuge for shorebird predators, increasing the risk of predation for roosting and feeding shorebirds.

Concern for the impact of invasive species on natural species has grown in recent years, as outlined by the International Union for the Conservation of Nature's Global Invasive Species Program. Several countries in the region, including the United States, Canada, and the Bahamas have developed national policies and programs to address the threat posed by invasive species. Opportunities to support invasive management programs for shorebird habitat should align with these national initiatives.

Specific invasive management programs have been supported in several coastal Atlantic states of the United States (e.g., Florida and Georgia) and have met with a certain degree of success. There is an opportunity to learn from these programs to help inform and strengthen invasive management efforts throughout the region, including the development of BMPs. Implementation of invasive management efforts in critical shorebird habitat should be undertaken in areas that are most impacted by invasive plant species and where there is support and capacity to sustain BMPs.

Predation

Native and introduced predator populations may grow artificially large in association with high numbers of people along coastal areas. Overabundant predators associated with humans—such as raccoons, foxes, coyotes, crows, gulls, rats, and feral cats and dogs—prey on shorebird eggs, chicks, and adults in great numbers, and can have major impacts on shorebird reproductive success and the viability of breeding populations. Human development in prime shorebird nesting habitat forces shorebirds to nest in less desirable areas with more predators, further increasing predation risks. In some areas, predation is one of the primary threats facing shorebird Focal Species, as in the case of the Piping Plover and American Oystercatcher (Boettcher et al. 2007, Denmon et al. 2013).


Red fox. Rylee Isitt

Chasing birds can cause birds to "flush", interrupting their ability to rest and feed.
Florida Fish & Wildlife

Human Disturbance

Human disturbance has been defined as "any activity that changes the contemporaneous behavior or physiology of one or more individuals" (Nisbet 2000). Whether intentional or unintentional, human disturbance can have a significant negative impact on shorebirds and is recognized in shorebird conservation and recovery plans, as well as many published studies (Brown et al. 2001, USFWS 1996, USFWS 2009, Niles et al. 2010, Colwell 2010). The human disturbance threat is significant due to its potential demographic effect on shorebirds. Specifically, human disturbance reduces fitness expressed as lower reproductive rates and potentially as compromised ability to add weight due to exclusion from or interrupted access to food or resting locations. At extremes, human disturbance results in habitat that is unavailable to shorebirds.

Causes of human disturbance include but are not limited to:

1. active and passive recreation activities;
2. off-road/highway vehicles;
3. dogs;
4. fireworks;
5. beach raking; and
6. monitoring for other species (e.g.,. sea turtles).

The threat to shorebirds can vary from temporary displacement or exclusion from suitable habitat to nest loss and direct mortality of chicks and adults.

Hunting Pressure

Shorebird hunting has a long history in the Caribbean region, where it was originally practiced by English, French, and Dutch colonists, and in other parts of the Atlantic Flyway hunting of shorebirds by indigenous peoples has an even longer history. While the extent of modern hunting pressure on shorebirds within the Atlantic Flyway is incompletely known, annual harvest is emerging as a potential population-level constraint for some species. Current information indicates that considerable hunting pressure exists at least in Barbados, Guadeloupe, Martinique, Suriname, French Guiana, and Brazil (Andres 2011). Recent analysis of data from Barbados shows an annual gun harvest of 12,200 to 34,570 shorebirds (Reed 2012). Guadeloupe has 3,000 licensed hunters and Martinique 1,400 licensed hunters. In Suriname, a preliminary survey conducted from 2006 to 2009 revealed that a wide variety of protected waterbirds were killed and sold illegally each year, among which were at least "several tens of thousands" of shorebirds (Ottema and Spaans 2008). Across the region, unsustainable and unregulated hunting has the potential to limit positive growth of shorebird populations.

Snowy Plover.
Lynn Schmid

CONSERVATION LANDSCAPE

SCIENCE AND CONSERVATION CAPACITY

The successful implementation of the Atlantic Flyway Business Plan will depend on the partnership's capacity to: (1) monitor change across a broad landscape; (2) work within legal frameworks established to promote flyway conservation (e.g., treaties, conventions); and (3) coordinate implementation across large geographies and multiple institutions. The following provides an overview and assessment of the conservation capacity in the region.

Science and Monitoring Capacity

Management of shorebird populations is the jurisdiction of federal, state, and provincial governments in the United States, Canada, and in most countries along the Atlantic Flyway. In the United States and Canada, shorebird conservation is guided by a National Shorebird Plan, first published in 2001, and a 2012 Implementation Strategy for the Plan. These documents provide an excellent scientific framework for national shorebird conservation; however, partners lack the resources necessary to carry forward the ambitious agendas presented in these plans. Similar shorebird plans exist in Colombia and Brazil, and are managed by responsible federal government agencies.

Survey and monitoring efforts provide information critical to successfully carry out shorebird conservation. Important monitoring initiatives are helping to increase understanding of shorebird demographics. The longest running of these is the International Shorebird Survey (ISS), which promotes a standardized methodology for gathering information on shorebirds and the habitats they use. The ISS is the longest running effort to monitor shorebirds in the Americas. Chronically under-resourced, the ISS relies on volunteer effort. Both the Neotropical Waterbird Census and the more recent Caribbean Waterbird Census provide a regional mechanism to carry out shorebird monitoring along the Atlantic coast of South America and throughout the Caribbean, respectively.

The Program for Regional Shorebird Monitoring (PRISM) was designed to: (1) address concerns about shorebird population declines; (2) estimate and monitor trends in population size; (3) monitor shorebirds at stopover locations; (4) determine distribution, abundance, and habitats used throughout the year, and (5) assist local managers in meeting shorebird conservation goals.

The goal of the Arctic Shorebird Demographics Network (ASDN) is to conduct demographic analyses for several target species that will help determine

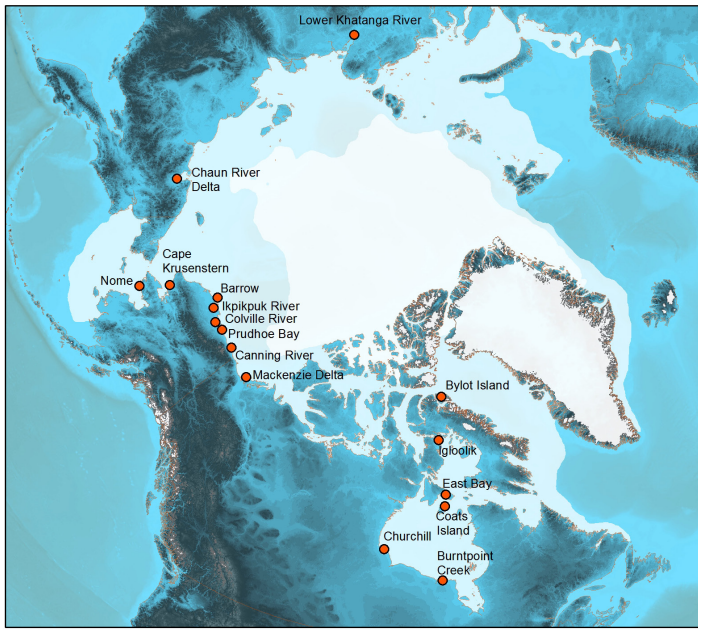


Figure 2: Arctic PRISM monitoring sites.
Map credit J.F. Lamarre

the factors limiting their populations. The ASDN measures demographic rates such as adult survival and productivity, as well as other demographic parameters at various life history stages.

Individual species conservation plans exist for 21 shorebird species in the Americas, providing important life history information and a road map for each species' conservation. The implementation of these plans largely depends on their integration into broader conservation initiatives such as incorporating the Wilson's Plover Conservation Plan into Gulf-funded beach nesting bird conservation efforts.

There is no lack of science and technical expertise on shorebirds. The governments of both the United States and Canada, under the North American Treaty Act, have invested in science capacity. However, the tools and instruments by which shorebirds are monitored are underfunded and need to be coordinated and streamlined throughout the Atlantic Flyway. Building on the ISS and ensuring full integration with both the Caribbean Waterbird Census and the Neotropical Waterbird Census could provide an effective monitoring platform for Atlantic Flyway shorebirds.

Conventions, Legal Frameworks and Initiatives

National, regional, and international legal and policy instruments have been developed to support the conservation of shorebirds and their habitat throughout the Americas. These instruments range from specific federal threatened-species legislation to multilateral environmental agreements. Key pieces of regional legislation, policy directives, agreements, and initiatives relevant to the conservation of shorebirds in the Americas include the following:

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, otherwise known as the Ramsar Convention, is an intergovernmental treaty that provides a framework for national action and international cooperation regarding the conservation and wise use of wetlands and their resources. Contracting Parties to the convention, which include almost all countries within the Atlantic Flyway, commit to ensuring the effective management and protection of wetlands of international importance and cooperating internationally on transboundary wetlands, shared wetland systems, and shared species.

The Americas Flyways Framework adopted in November 2014, under the auspices of the Bonn Convention on Migratory Species (CMS) by the governments of Argentina, Brazil, and several Caribbean nations (and observed by the U.S. and Canada) offers a structure for cooperation on migratory birds throughout the Western Hemisphere. The framework strives to promote a coordinated effort along flyways to conserve migratory birds. As such, it offers a tool for engaging governments along the flyway in the implementation of the Atlantic Flyway Business Plan.

The North American Migratory Bird Treaty of 1916, between Canada and the United States, enacted into U.S. federal law in 1918, is a convention for the

Arctic banding. Manomet

protection of migratory birds. The statute makes it unlawful to pursue, hunt, take, capture, kill, or sell migratory birds listed therein.

Founded in 1985, the Western Hemisphere Shorebird Reserve Network is the longest serving migratory bird conservation initiative in the Americas. Focused on the conservation of critical sites for shorebirds, WHSRN (pronounced "wizern") has increased awareness of critical shorebird sites and the need for their protection, as well as forged an effective network of governments, NGOs, and academic institutions working at over 90 sites in the United States, Canada, Mexico, the Caribbean, and Central and South America. The potential exists for WHSRN to play a pivotal role as an implementation arm of the Atlantic Flyway Shorebird Initiative

The Important Bird Areas (IBAs) program coordinated by BirdLife International is a site-based conservation initiative implemented by BirdLife partners in countries throughout the Atlantic Flyway. The aim of this program is to safeguard these globally important areas for birds. One of the criteria used to identify IBAs is whether the site supports a significant percentage of a species' biogeographic population. That includes many shorebird staging areas.

Coordination

As summarized in 5.1, there are numerous national, regional, and hemispheric initiatives aimed at conserving shorebirds and their habitat. Actively fostering greater coordination among these initiatives will greatly enhance the effectiveness of the actions proposed in the business plan.

Surprisingly, information regarding shorebird conservation is being rapidly disseminated through the various active networks stretching across the Western Hemisphere. However, it is clear that a lack of resources is severely hampering efforts to use this information to inform and set in motion conservation actions designed to address some of the very real threats experienced by shorebirds along their entire migratory routes.

Effective full life cycle conservation of shorebirds will depend on establishing an oversight body to:

Figure 3: Ninety-seven sites are formally designated to the Western Hemisphere Shorebird Reserve Network. Sites must fulfill biological and management criteria to be accepted. A majority of the hemispherically important sites (supporting more than 500,000 shorebirds during migration) are found along the Atlantic Flyway: Delaware Bay (United States), James Bay and Bay of Fundy (Canada), and Biggi Pan, Coppename, and Wia Wia (Suriname).

(1) provide strategic and operational oversight; (2) coordinate partners to ensure that objectives are being met efficiently; (3) track successes so actions can be evaluated and revised; (4) communicate broadly to multiple constituencies; and (5) help raise the profile of the business plan and secure the resources to achieve its overarching goal of increasing populations of shorebird Focal Species, and, by extension, many other shorebird and wildlife species that occupy similar habitats. The current ad-hoc steering committee, led by the USFWS, provides a foundation for such a body.

Greater Yellowlegs.
Gary Yancech

CONSERVATION OUTCOMES

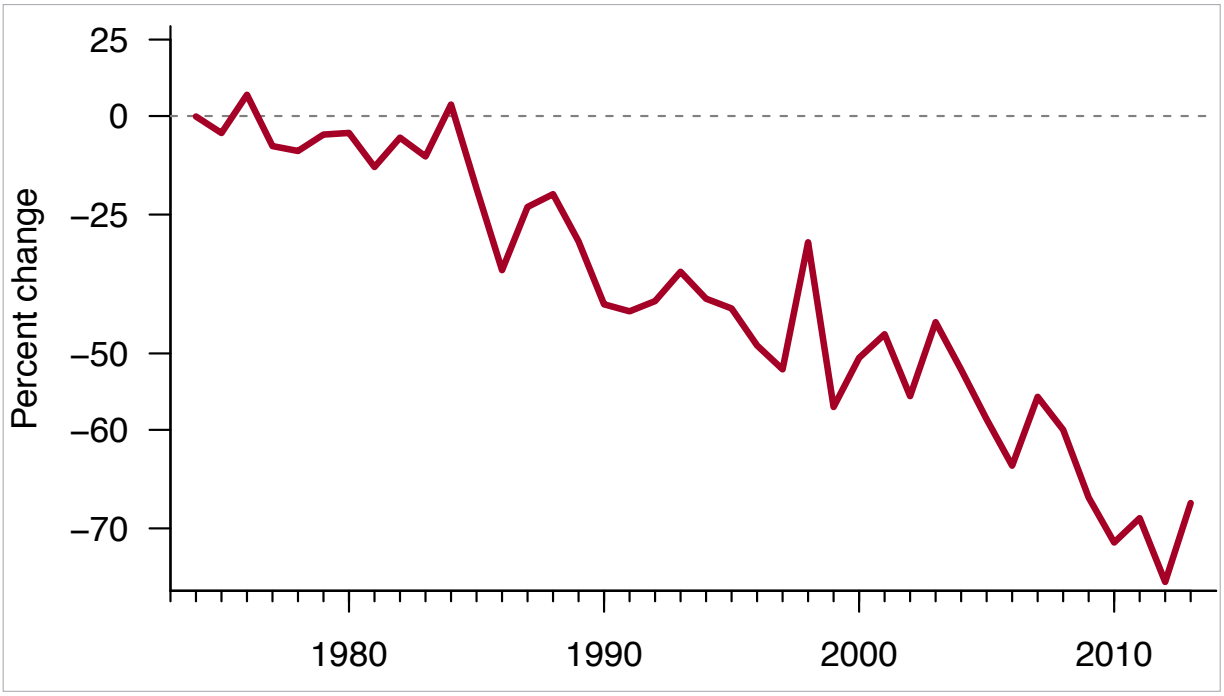
BACKGROUND

The Atlantic Flyway's 10-year goals and associated outcomes will be expressed at three levels: (1) for the entire flyway initiative; (2) for the 15 Focal Species; and (3) for four main conservation strategies. Species-level goals and outcomes are in development for populations with accurate data; for species whose population estimates have low confidence, progress toward the initiative goal will be assessed through monitoring species counts at index sites (see Evaluation and Monitoring section). Strategy goals and outcomes address the four primary anthropogenic threats identified as key sources of shorebird mortality.

INITIATIVE GOAL

The goal of the Atlantic Flyway Business Plan is to increase population levels of shorebird Focal Species within the flyway by 10 to 15 percent over a 10-year period.

Note: This is a level that expert contributors believe can be met by implementing the conservation actions herein. The individual projects have the potential to increase local shorebird abundance by even higher levels in response to proven management actions. Baseline population estimates are from 2015.



Indicators of the population status of shorebirds. Indicators represent the average estimated population status of shorebird species relative to their status in 1973 (the baseyear). Data come from the International Shorebird Survey, the Atlantic Canada Shorebird Survey and the Ontario Shorebird Survey. Adam Smith, Senior, Canadian Wildlife Service

SPECIES GOALS AND OUTCOMES

Projected short-term outcomes and long-term goals for Atlantic Flyway shorebird Focal Species:

Focal Species	Short-term outcomes (3 to 5 years)	Species goals (10 years)
American Oystercatcher *Haematopus palliatus*	• Predation pressure reduced • Number of protected nesting beaches increased by 10% • Number of chicks produced per pair increased in the U.S.	• Population level increased by 30% by 2019 • Reproductive success of 0.5 chicks per pair maintained for U.S. breeding populations
Semipalmated Sandpiper *Calidris pusilla*	• 10 critical staging sites protected in northeastern U.S. • Human disturbance reduced in Bay of Fundy • Population estimate refined through monitoring effort	• Overall population level stabilized and then increased by a minimum of 5%
Red Knot (rufa spp) *Calidris canutus*	• 10 km of beach in Delaware Bay restored • Human disturbance reduced along critical staging beaches in Georgia	• Population level increased by 10 to 15%
Whimbrel *Numenius phaeopus*	• Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Wilson's Plover *Charadrius wilsonia*	• Predation pressure reduced • Number of protected nesting beaches increased • Number of chicks produced per pair increased	• Population level increased by 10 to 15%
Marbled Godwit *Limosa fedoa*	• Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Piping Plover *Charadrius melodus*	• Breeding success increased at nesting sites • Number of new protected sites increased by 10% • Total breeding habitat increased by 500 acres	• Population level increased by 10 to 15%
Purple Sandpiper *Calidris maritima*	• Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Red-necked Phalarope *Phalaropus lobatus*	• Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Ruddy Turnstone *Arenaria interpres*	• Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Sanderling *Calidris alba*	• Population estimate refined through monitoring effort	• Population levels maintained
Snowy Plover *Charadrius nivosus*	• Predation pressure reduced • Number of protected nesting beaches increased • Number of chicks produced per pair increased	• U.S. breeding population level increased by 10 to 15%
American Golden Plover *Pluvialis fulva*	• Hunting pressure reduced • Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Greater Yellowlegs *Tringa melanoleuca*	• Hunting pressure in the Caribbean and the Guianas reduced • Population estimate refined through monitoring effort	• Population level increased by 10 to 15%
Lesser Yellowlegs *Tringa flavipes*	• Hunting pressure in the Caribbean and the Guianas reduced by 50% • Population estimate refined through monitoring effort	• Declines reversed in various monitoring efforts • Population outcomes tbd

STRATEGY GOALS AND OUTCOMES

Long-term goals and outcomes to be achieved by 2025, for conservation strategies and associated Focal Species in the Atlantic Flyway Shorebird Initiative:

Strategies	Goals	Outcomes	Focal Species most impacted
1. Manage and protect critical habitat.			
a. Commercial and residential development	Reduce the loss of shorebird habitat to development.	• Number of acres of shorebird habitat maintained at or increased 10% from 2014 levels • Shorebird use increased by 10% at targeted sites	All species
b. Coastal engineering	Reverse trends in wet and dry sand habitats for shorebirds along the Atlantic Coast that were lost due to incompatible coastal engineering practices.	• 20,000 acres of high quality, intertidal (wet sand) habitats restored • 3,000 acres of supratidal (dry sand) habitat restored	All species
c. Incompatible natural resource management	Ameliorate the adverse effects of these activities and build consensus for strategies that balance shorebird conservation needs with objectives of stakeholders engaged in profit-driven natural resource use.	• BMPs and model projects developed that meet the needs of multiple species and diverse stakeholders, and contribute to overall shorebird conservation objectives • Effects of incompatible management reduced at 50% of critical shorebird sites throughout the Atlantic Flyway	All species
d. Invasive plants	Reduce the impact of invasive species through targeted management and eradication programs and prevent the introduction of new exotic species at key sites throughout the Atlantic Flyway.	• Impacts of invasive species reduced at 10 priority (locations specified) shorebird sites.	All species
2. Minimize predation impacts.			
	Reduce the number of nests, chicks, and adults lost annually to predators.[5]	• Predation pressure reduced at approximately 180 priority breeding sites	American Oystercatcher, Piping Plover, Snowy Plover, Wilson's Plover
3. Reduce human disturbance.			
	Reduce human disturbance events at managed sites, resulting in increased fledging success and annual survival sufficient to recover declining populations.	• Human disturbance events reduced by 90% on all actively managed sites	All except for Red-necked Phalarope
4. Reduce hunting pressure.			
	Achieve a sustainable harvest of shorebirds where hunting is legal and decrease illegal hunting of shorebirds in the Caribbean islands and northern South American countries.	• Hunting pressure reduced 20%	American Golden Plover, Lesser and Greater Yellowlegs, Red Knot, Ruddy Turnstone, Semipalmated Sandpiper, Whimbrel

[5] Target reduction goals will vary by species and location. Specific targets will be developed as part of the Best Management Practices

Delaware Bay.
Bob Mical

SELECTION OF FOCAL AREAS

FOCAL GEOGRAPHIES

Focal Geographies listed in this business plan were identified by overlaying available distribution data for Focal Species with priority sites in the Atlantic Flyway. Focal Geographies cover the entire flyway and share broad habitat features and conservation issues. They also align with, but are not entirely identical to the eco-zones (e.g. Arctic, temperate, etc.) used in the threat ratings. The eco-zones corresponding to each Focal Geography are highlighted in parentheses.

Eastern Arctic and Subarctic (Arctic)

This region extends from the northwestern border of Alaska (68.85N, 166.14W), encompassing the entire Alaskan Coastal Plain north of the Brooks Range, across the entirety of the Canadian Arctic to the north on Ellesmere Island (82.70N, 64.43W), and to the south and east to the tip of Labrador (52.17N, 55.70W). The southern border of the Arctic and Sub-Arctic Focal Geography includes James and Hudson Bays, with a line that captures the Hudson Bay Lowlands back to the north and west to encompass all of the Mackenzie River Delta and tie into the Alaskan North Slope again. The Arctic and Subarctic Focal Geography encompasses the "Arctic" eco-zone used in the threat rating. The southern border of this zone includes the complex transitional area between the treeless open tundra and the boreal forest. This Focal Area is seasonally restricted to shorebirds, supporting open tundra and forested wetland nesting habitats for many North American shorebird species, including most of those on the Focal Species list. Other than nesting, there are important staging areas within this region for shorebirds moving north to nesting territories, and post-nesting stopover sites for birds needing to refuel before long southward flights to wintering habitats.

Figure 4: Focal geographies cover the entire flyway and share broad habitat features and conservation issues. Seven distinct geographies are defined in the Atlantic Flyway Shorebird Business Plan.

The Focal Species dependent on this area include American Golden Plover, Greater Yellowlegs, Lesser Yellowlegs, Purple Sandpiper, Red Knot, Semipalmated Sandpiper, Sanderling, Red-necked Phalarope, Ruddy Turnstone, Whimbrel, and Marbled Godwit.

The main threats to shorebirds in this Focal Geography include commercial and industrial development, illegal and unsustainable hunting, and predation of eggs and chicks by native and alien species.

Boreal

Much of Canada and Alaska is covered by boreal forest, but for the purposes of this document we are including just the most eastern swath of this eco-zone holding the strongest biological ties to the Atlantic Flyway. Our Focal Geography area lies just south of the sub-Arctic, between the southeastern edge of Hudson Bay on its western end (58.63N, 95.68W), and continues east to the coast of Labrador (52.23N, 56.05W). The southern border (46.53N, 81.09W) includes those lands just above the Great Lakes, and sits above the Maritime Canada and Northeastern U.S. Focal Geography to the east. The boreal forest is dominated by spruce and other conifers, frequently growing in very dense stands. The shorebirds that rely on this eco-zone use a variety of open habitats, primarily the wetland openings within the forest, such as bogs, shallow ponds, and the marshlands associated with river plains. As the forest thins to the north, more tundra-like conditions prevail, creating a mosaic of thin forests and expansive openings (taiga) that provide nesting and stopover habitat for additional species. Many Arctic nesting species use specific locations within this eco-zone for staging during both northbound and southbound migrations. The most significant of these staging sites is the southern coast of James Bay, supporting millions of shorebirds annually.

The shorebird Focal Species associated with the boreal Focal Geography for nesting include Lesser and Greater Yellowlegs, Semipalmated Sandpiper, Marbled Godwit, and Whimbrel on this geography's northern open edge.

The primary threats to shorebirds in the boreal Focal Geography stem from large-scale commercial development's adverse impacts on the biological integrity of critical staging areas. The commercial endeavors of greatest potential negative influence include hydro-power, mining, and petroleum extraction. Direct mortality from hunting within this Focal Geography occurs, particularly along the eastern coastal edge of this area in Quebec, but the extent and significance of this hunting is yet to be fully understood. Hunting of boreal nesting shorebirds as they migrate through or winter in the Caribbean and along the north coast of South America has come to light in recent years and may be a significant threat to Atlantic Flyway populations of some species.

Maritime Canada and Northeastern United States (Temperate)

This Focal Geography includes coastal eastern Canada and the coastal northeastern United States, starting with Newfoundland (49.26N, 53.53W), the Gulf of the St. Lawrence, and the Canadian Maritimes, extending down through New England and coastal New York to the (40.50N, 74.26W) border between New York and New Jersey.

Canada's Maritime Provinces and the northeastern United States encompass part of the temperate eco-zone used in the threat rating. Vegetation in this area includes boreal and temperate forests, freshwater marshes and coastal salt marshes, tidal river deltas, coastal shrub-scrub, un-vegetated rocky coasts, open beaches, and grass-covered dunes. This area of the Atlantic Flyway is important to beach-nesting Focal Species including American Oystercatchers, and is particularly critical to Piping Plovers, supporting the majority of nesting effort for the Atlantic Flyway population of this species. The region is one of the most heavily human-dominated areas of the entire Atlantic Flyway, with a long history of coastal landscape manipulation, land alteration, and wetland destruction. The region remains an important staging and fly-through zone for shorebirds during southbound migration.

Arctic and boreal nesting species, including Red Knot, Semipalmated Sandpiper, Whimbrel, Red-necked Phalarope, and American Golden Plover, begin to arrive as early as late June before continuing south out over the Atlantic or along the coast. At least two shorebird Focal Species winter in this area in important numbers: Sanderling and, most significantly, Purple Sandpiper. The rocky coasts of eastern coastal Canada and Maine support most of the Purple Sandpiper wintering population.

The human-dominated landscape of the northeastern United States presents many threats to shorebirds in this Focal Geography. Threats to shorebirds in Maritime Canada and the northeastern United States include commercial, industrial, and residential development; incompatible coastal engineering; human disturbance; pollution; predation of eggs, chicks, and adults from elevated numbers of native, non-native, and domestic predators; incompatible management practices; and unregulated intertidal aquaculture practices.

Mid-Atlantic and Southeastern United States (Temperate)

This Focal Geography extends from the northeastern tip of New Jersey (40.48N, 74.00W) all the way down the Atlantic Coast to the tip of the Florida Keys (24.57N, 82.13W), then up the Gulf Coast of Florida to the border with Alabama (30.28N, 87.52W). This region is a heavily human-dominated coastal landscape, but it offers critical habitats for shorebirds year-round. The most important ecosystems are the outer coastal strands of beaches, inlets, tidal flats, and salt marshes. Providing and maintaining quality nesting, migration stopover, and wintering sites in the southeastern United States is extremely important for the population health and stability of Atlantic Flyway shorebird populations. This Focal Geography includes the important spring staging sites of Delaware Bay and the unparalleled Virginia-to-Georgia complex of barrier islands and salt marshes.

All states in the region are important to shorebirds. Virginia supports the highest nesting density of American Oystercatchers in the Flyway, and hosts significant numbers of Red Knots and other Arctic-nesting shorebirds before their final push north for nesting. Whimbrels use the extensive salt marshes of coastal Virginia as well as North Carolina, South Carolina, and Georgia as critical staging and fattening areas during a six-week period in April and May before departure for Arctic nesting. Georgia has the only known post-nesting staging site for Red Knots on the U.S. Atlantic Coast, with recent estimates reaching into the tens of thousands of Red Knots staging there to molt and fatten on Coquina clams (Donax variabilis) and other invertebrates. This Focal Geography supports nesting populations of all three of the small plovers on the Focal Species list—Piping, Wilson's, and Snowy—as well as essential stopover and wintering sites for Piping Plovers from the Atlantic Coast and Great Lakes populations and wintering sites for the Great Plains population. North Carolina supports significant populations of migrating and wintering Sanderling, as well as other Arctic and boreal nesting shorebirds. South Carolina, Georgia, and the Florida Gulf Coast support significant wintering populations of American Oystercatcher, especially South Carolina and the Cedar Key area of the upper Florida Gulf Coast.

Threats in this region are similar to those of the Northeast, with the additional need for protective management in coastal barrier habitats, especially in the most southern states where the season for recreation extends to the entire year. Noteworthy threats in the area include incompatible coastal engineering; commercial, industrial, and residential development; human disturbance; pollution; predation of eggs, chicks, and adults from elevated numbers of native, non-native, and domestic predators; incompatible management practices (e.g., sea turtle conservation patrols, and others); and invasive exotic marine invertebrates that threaten access to and availability of intertidal food resources.

Caribbean (Tropical)

This Focal Geography covers the islands of the insular Caribbean, including the Bahamas, Greater Antilles (Cuba, Hispaniola, Jamaica, and Puerto Rico), the Virgin Islands, Cayman Islands, Lesser Antilles, Trinidad and Tobago, and the islands off the coast of Venezuela, from approximately 27.38N, 79.00W to 10.00N, 61.88W.

Trunk Bay, Virgin Islands
Keith Watson

The Caribbean holds a number of habitats important to shorebirds, including extensive sand banks and intertidal flats (especially in the Bahamas, the Turks and Caicos, and Cuba), sheltered bays and saline lagoons, mangrove forests, sandy beaches, freshwater wetlands (the largest being the Ciénega de Zapata in Cuba, with extensive flooded palm savanna), rice fields, and managed shooting swamps (in Barbados).

The Caribbean encompasses part of the Tropical eco-zone used in the threat rating. It provides important staging and wintering habitat for Focal Species, including Whimbrel, both Yellowlegs species, Ruddy Turnstone, Red Knot, Semipalmated Sandpiper, and additional species such as Short-billed Dowitcher. Of particular note is the Caribbean's importance for wintering Piping Plover, especially Joulter Cays in the Bahamas. Wetlands in the Lesser Antilles, and in particular the managed shooting swamps in Barbados, provide important refuges for migrating shorebirds, such as American Golden Plover, during adverse weather conditions. This Focal Geography also supports small numbers of beach nesting shorebirds, including resident populations of American Oystercatcher, Snowy Plover, and Wilson's Plover.

Threats to shorebirds in the Caribbean include commercial, industrial, and residential development; incompatible coastal engineering; human disturbance; pollution; predation of eggs, chicks, and adults from elevated numbers of native, non-native, and domestic predators; and incompatible management practices. A particularly significant threat in this geography is unsustainable harvesting.

Northern South America (Tropical)

This Focal Geography covers the area from the Uraba Gulf in Colombia (8.63N, 77.37W), where the Isthmus of Panama joins South America, along the Caribbean coast to the northeastern tip of Brazil, at Natal in Rio Grande do Norte State (5.77S, 35.20W). The coastline east from the isthmus is dominated by mangrove forests interspersed with estuaries, coastal lagoons and sandy beaches, with nearshore lagoons a more prominent feature in central Venezuela. Key areas for shorebirds include the Magdalena River delta and adjacent Ciénaga Grande (an extensive complex of lagoons bordered by mangroves and wetlands) in Colombia, and the Maracaibo Basin and Venezuela Gulf (with extensive wetland, mangrove, and sandy beach habitats), and the Orinoco River delta in Venezuela. Inland lies the Llanos, an extensive area of grassy savanna subject to seasonal inundation.

The Guianas (Guyana, Suriname, and French Guiana) and Amapa State, Brazil, represent one of the most important staging and wintering areas for shorebirds in South America. Here the coastline consists of extensive mudflats, sand ridges, brackish and freshwater swamps, coastal marshes, and mangrove forests. The mouth of the Amazon River is essentially a freshwater environment, with sand flats backed by palm forests and open swamps. East of the Amazon, the coastline is highly indented, with large areas of intertidal flats lined with mangrove forests alternating with sandy headlands. This is another key staging and wintering area for shorebirds and includes the Reentrâncias Maranhenses State Protected Area. From here to Natal the coastline is primarily sandy ridges and dunes alternating with occasional estuaries.

Northern South America encompasses part of the Tropical eco-zone used in the threat rating. It represents the most important wintering area in South America for Focal Species such as Whimbrel, Greater and Lesser Yellowlegs, Ruddy Turnstone, and Semipalmated Sandpiper, in addition to Black-bellied Plover, Short-billed Dowitcher, and Willet. Reentrâncias Maranhenses is an important wintering area for Red Knot, which also stage in French Guiana. This Focal Geography also supports small numbers of beach nesting shorebirds, including resident populations of American Oystercatcher, Snowy Plover, and Wilson's Plover.

Threats to shorebirds in Northern South America include commercial, industrial, residential, and agricultural development; incompatible coastal engineering; human disturbance; pollution; predation of eggs, chicks, and adults from elevated numbers of native, non-native, and domestic predators; and incompatible management practices. A particularly significant threat in this geography is illegal and unsustainable harvesting.

Eastern South America (Austral)

This Focal Geography covers the area from the Natal, at the northeastern tip of Brazil (5.77S, 35.20W) south to Tierra de Fuego (Argentina, Chile) at the extreme southern tip of South America (56.00S, 69.00W). From Natal south the coastline is a mix of low cliffs and sandy beaches, with some barrier beaches, and mangrove forests in embayments and estuaries. Further south, the coastline of Rio Grande do Sul (Brazil) forms one of the longest uninterrupted beaches in the world, with a number of major lagoons behind the coast that continue into

Rio de la Plata, Argentina and Uruguay. Creative Commons

Uruguay. Coastal lagoons, such as Lagoa de Peixe (Brazil) and Laguna de Rocha (Uruguay), provide important wintering and staging habitat for shorebirds. Inland, the Pampas grasslands of southern Brazil, Uruguay, southern Paraguay, and north-central Argentina are an important wintering area for grassland-dependent shorebirds.

The coastline from the Rio de la Plata Estuary to Tierra de Fuego includes a wide variety of habitats, with deltas and estuaries, sandy coasts with dunes, cliffs, pebble beaches, and rocky platforms (the latter primarily in Patagonia). Important areas for shorebirds include the extensive marshes and mudflats of the Bahía Samborombón, the intertidal flats and salt marshes of Bahía Blanca, the embayment at San Antonio Oeste, and the Río Gallegos Estuary. Tierra del Fuego holds vast intertidal mudflats at Bahía San Sebastián (Argentina) and Bahía Lomas (Chile).

Eastern South America encompasses part of the Tropical eco-zone and all of the Austral eco-zone used in the threat rating. The mudflats of Tierra del Fuego and southern Argentina provide critical wintering and staging habitat for Red Knot, in addition to Hudsonian Godwit and White-rumped Sandpiper. The coastal lagoons, wetlands, and associated grasslands of southern Brazil to northern Argentina provide important wintering habitat for American Golden Plover and both species of Yellowlegs, in addition to Buff-breasted and Pectoral Sandpipers, while the beaches of Rio Grande do Sul state hold the most significant population of Sanderling wintering in eastern South America. This Focal Geography also supports important populations of beach nesting shorebirds, including resident populations Wilson's Plover (northern Brazil only) and American Oystercatcher, and South American endemic species such as Magellanic and Blackish Oystercatchers, Two-banded Plover, Rufous-chested Dotterel, and Magellanic Plover.

Threats to shorebirds in eastern South America include commercial, industrial, and residential development; incompatible coastal engineering; human disturbance; pollution; predation of eggs, chicks and adults from elevated numbers of native, non-native, and domestic predators; and incompatible management practices.

Piping Plover and chick.
Jim Fenton

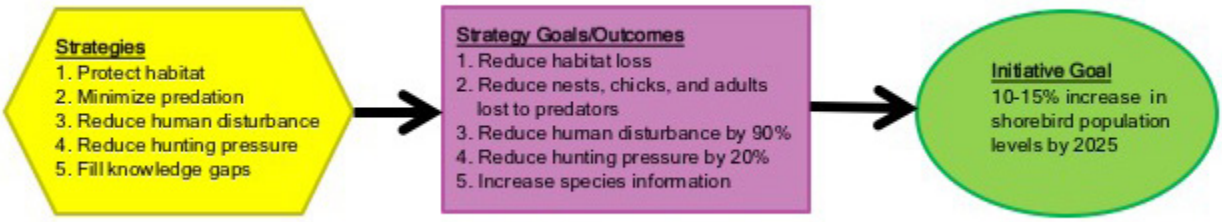
IMPLEMENTATION PLAN

BACKGROUND

The implementation section of the business plan addresses the most serious human-induced threats affecting shorebird species and their habitats along the Atlantic Flyway. For each strategy, one or more actions are outlined with corresponding SMART (specific, measurable, achievable, relevant, time-oriented)objectives. Together, the implementation of the strategies, actions, and objectives will lead to achieving the goal of increasing shorebird population levels by 10 to 15 percent over the next decade. Activities were further prioritized into Tier I, II and III. Only Tier 1 and II actions are presented in the implementation plan.

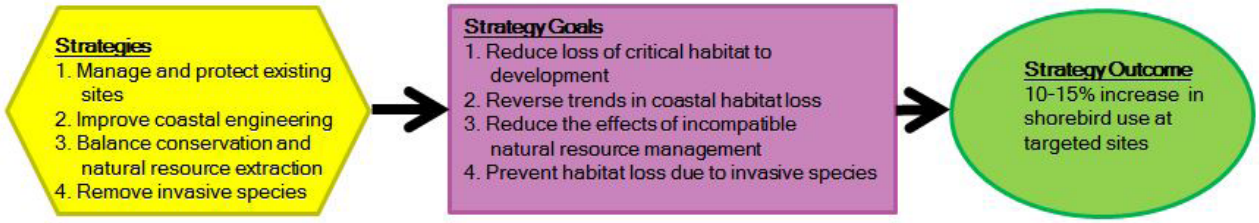
STRATEGIES FOR IMPLEMENTATION

Five strategies for implementation are outlined in the "Conservation Outcomes" section. These are: (1) Manage and protect critical habitat, which is comprised by four sub-strategies; (2) Minimize predation impacts; (3) Reduce human disturbance; (4) Reduce hunting pressure; and (5) Fill knowledge gaps. Each strategy has associated actions and objectives. The implementation of these strategies will lead to a 10 to 15 percent increase in shorebird Focal Species population levels.



Manage and Protect Critical Habitat

To manage and protect habitat, four sub-strategies address the threats of commercial and residential development, coastal engineering practices, incompatible natural resource management, and invasive species. Multiple actions and objectives were identified to reduce these threats and achieve associated goals and outcomes for each sub-strategy.



Commercial and Residential Development

While further loss of some coastal and wetland habitat to development is inevitable, a concerted effort is needed to identify remaining key wetland sites for shorebirds and ensure that these habitats are protected and properly managed. Endorsement of these sites as having value critical to the region's future (as National Wildlife Refuges, WHSRN or Ramsar sites, etc.) and contributing to local economies through sustainable livelihoods can ensure that they are not lost to development. Best management practices for sustaining shorebird populations, including for wetland restoration and enhancement, should be carried out on sites that have been or are being developed, by encouraging partnerships among developers and local governments, communities, land trusts, and other non-governmental organizations, and using incentives such as promotion of ecotourism opportunities, providing technical assistance, and habitat conservation grants.

The long-term goals of this key strategy are to reduce the loss of critical shorebird habitat to development so that by 2025 the following outcomes are achieved: (1) the number of acres of shorebird habitat is maintained at or increased 10 percent from 2014 levels and (2) shorebird use is increased by 10 percent at managed sites targeted for action. Four key actions are identified to prevent the further loss and degradation of shorebird habitats from development, with a focus on Maritime Canada; the Northeast, Mid-Atlantic, and Southeast United States; the Caribbean; and Southern South America:

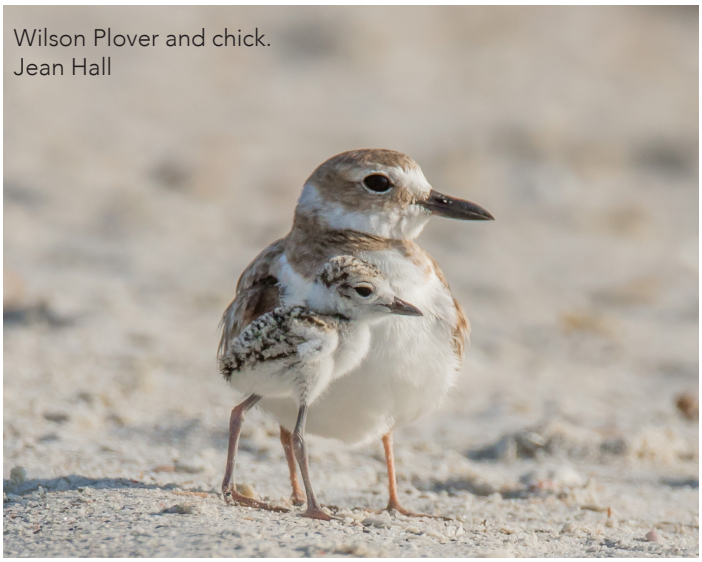
Action 1: Increase the management, enhancement, restoration, and protection of existing shorebird sites.

Many areas currently protected for shorebird conservation are under threat from development or are degraded, while other sites remain unprotected. This strategy aims to assess capacity to protect, restore, and enhance habitats that support shorebirds; provide scientific and economic justification for why a site should be protected; and work with local governments and communities to garner or strengthen protection and implement BMPs. This will result in:

1. the establishment of new protected areas;
2. strengthening of protections at existing sites; and
3. enhancing habitats through management and restoration.

Key sites that are privately owned will be targeted for purchase or easements, and landowners will be educated on BMPs to minimize impacts of development (e.g., protecting beach roosting sites). Sites will be assessed and nominated for recognition based on global/regional significance (e.g., WHSRN, IBA, Ramsar).

Objective: By 2025, protect, restore, enhance, or improve management on 50,000 acres of priority habitat to benefit shorebirds.



Wilson Plover and chick.
Jean Hall

Action 2: Build capacity and promote sustainable livelihoods at important shorebird sites.

Bird and nature tourism is an alternative use of natural areas that heightens awareness of birds and biodiversity and provides income to local communities, thereby demonstrating the sustainable economic value of the area (Eubanks et al. 2004, Driscoll et al. 2011). Key sites will be targeted for building local capacity, including:

1. interpretive planning and infrastructure enhancements (e.g., boardwalks, viewing platforms, interpretive and directional signage);
2. development of birding/nature tours;
3. guide training; and
4. partnering with local businesses to support the effort.

Promotion of sites for education, low impact recreation (e.g., birding, photography, fishing, and kayaking) and citizen science monitoring will also be emphasized. Engaging local communities, site managers, and tourism and environmental ministries (or their equivalents) to foster sustainable economic development that is compatible with shorebird conservation will be critical to the success

of this strategy. Helping stakeholders manage sites sustainably and attract travelers to these areas has the potential to bring attention and funding to the communities adjacent to these important sites (Powell and Ham 2008, USFWS 2011). This strategy will build on recent efforts to develop bird tourism and alternative sustainable livelihoods (Eubanks 2013, Robertson and Sorenson 2013).

Objective: By 2025, facilitate and promote sustainable nature-based economic opportunities that benefit local communities at 30 priority sites.

Objective: Complete economic analyses for pilot projects to demonstrate financial success and number of acres protected.

Action 3: Develop outreach campaigns to build a constituency supporting conservation of shorebird habitats.

To reverse the present trends, it is essential that local communities and decision makers have an understanding of the many functions of coastal wetlands. Education programs and social media marketing campaigns targeting specific stakeholders around locally or regionally important sites will be designed to raise awareness about ecosystem services provided by coastal wetlands and will underscore the link between ecosystem resilience and thriving local economies (Costanza et al. 1997, UNEP 2006, Raffaele and Wiley 2014). The effectiveness of such campaigns for bringing about positive changes in attitudes and behaviors is well known (e.g., Butler 1995, Dettman and Pease 1999, Sorenson et al. 2004, Chawla and Cushing 2007). Funding will cover the costs of outreach materials, workshops, and community engagement initiatives (e.g., social marketing campaigns, radio and television programs, and print and social media).

Objective: By 2025, develop and implement targeted community engagement initiatives for 15 priority shorebird sites. Success will be evaluated using a number of metrics including: (1) the number of stakeholders petitioning for new protected lands and better management; (2) the number of businesses developing "shorebird-friendly" policies, and (3) the number of private landowners requesting information on protecting, restoring, and enhancing their lands for shorebirds.

Elementary school children help the Audubon Alliance for Coastal Waterbirds by making signs to encourage beachgoers to respect nesting areas along the coast of Connecticut. Photo by Scott Kruitbosch, RTPI

Action 4: Develop Best Management Practices for shorebird habitat management and protection.
This strategy aims to secure long-term protection for shorebird habitats through effective commercial and residential development legislation that will require the use of BMPs and institute a mandatory regional planning process for protecting shorebird habitat in coastal areas. Regulations should include avoidance, reduction, and mitigation of impacts of development projects on shorebird habitat. This information will be disseminated to local planning boards and developers.

Objective: By 2019, develop BMPs to guide management and protection of shorebird habitats; implement BMPs at up to 50 percent of priority shorebird sites.

Objective: By 2025, at least 25 percent of jurisdictions responsible for shorebird sites incorporate BMPs into local legislation and enforcement policies.

Coastal Engineering

The goal of this strategy is to reverse trends in wet and dry sand habitats lost due to incompatible engineering practices, which have greatly reduced or eliminated vital coastal environments for shorebirds dependent upon beaches and marshes. The strategy has three main approaches: (1) develop regionally applicable BMPs to be adopted by government managers of the U.S., Canadian, and Caribbean shorelines; (2) work with government bodies to establish regulatory and policy changes conducive to shorebird habitat protection; and (3) pursue opportunities to restore and re-establish shorebird habitats lost to incompatible engineering practices at priority sites in the temperate geographic region. Resulting conservation outcomes include the restoration of at least 20,000 acres of high quality, intertidal (wet sand) shorebird habitats and 3,000 acres of supratidal (dry sand) habitats by 2025, at priority sites in the temperate geographic region. Four key actions are identified to prevent the further loss and degradation of shorebird habitats from coastal development with a focus on Maritime Canada; the Northeast, Mid- Atlantic, and Southeast U.S.; the Caribbean; and Northern South America:

Action 1: Develop Best Management Practices for coastal projects.
BMPs for coastal engineering projects are non-existent, largely ignored, or inconsistent among and within political jurisdictions. Moreover, species-specific BMPs occasionally conflict with one another, resulting in the net loss of important habitat for one or more species. There is a pressing need to develop consistent BMPs for, and in partnership with, state and federal management agencies that protect shorebird habitats on local, regional, and flyway scales. At the same time, BMPs that have been developed for other species (e.g., sea turtles) require a careful review to ensure they do not contribute to the loss of shorebird habitat.

The purpose of this activity is to develop BMPs based on the best available science, design monitoring efforts that measure the effectiveness of the BMPs, and encourage the implementation of BMPs throughout the flyway. This strategy will have tremendous impact on the condition of coastal shorebird habitats on the U.S. Atlantic coast and will benefit all designated Focal Species in this plan. The U.S. state wildlife agencies, working through the Coastal Zone Management Act, will have a major role in contributing to the success of this strategy in restoring shorebird populations. U.S. federal agencies involved with coastal engineering projects (e.g., U.S. Army Corps of Engineers (USACE), Bureau of Ocean Energy Management, and USFWS) will likely have significant interest in participating in this effort as a hedge to avoid U.S. Endangered Species Act involvement due to continued shorebird declines and additional species listings. Outreach through state media venues will be instrumental in garnering public support for BMP adoption. This strategy is somewhat dependent on an additional strategy promoting compliance and enforcement.

Objective: Develop and encourage the development and implementation of BMPs that avoid direct, indirect, and cumulative impacts to shorebird breeding, migrating, and wintering habitats resulting from coastal engineering projects.

Objective: With a no-net-loss policy agreement, apply BMPs to a minimum of 60 percent of the engineering projects carried out by the North Atlantic District, South Atlantic District, and Caribbean Region of the USACE.

Action 2: Enact regulatory and policy reform.

Enacting effective legislation that will require the use of BMPs and take into account actual environmental costs and benefits of coastal engineering projects will help curtail destructive and expensive projects in vulnerable coastal habitats and minimize the construction and impacts of beachfront buildings, roads, etc.

Objective: In collaboration with the coastal state and federal agencies, secure long-term protection for shorebird habitats through effective coastal engineering legislation that requires the use of BMPs and institutes a mandatory regional planning process for protecting shorebird habitat in coastal areas.

Objective: By 2025, at least 10 of 17 states (60 percent) in the U.S. Atlantic Flyway adopt regulations and policies in coastal sediment management that include BMPs and no-net-loss terminology for intertidal and supratidal shorebird habitat.

Repairing and Restoring Rockaway Beach. USACE NY

Action 3: Conserve and restore critical habitat, sediment deposition, and inlet function.

It can be argued that there has been no greater negative impact to coastal-dependent birds than the destruction of beach, inlet, and intertidal shoal habitats from coastal engineering projects over the last century, especially on the U.S. Atlantic Coast. At the same time, there is an unprecedented opportunity to work effectively with the agencies responsible for coastal engineering to restore some important habitats so they can again become vital to Atlantic Coast shorebird populations. Navigation channel deepening, river channel straightening, near-shore dredging for beach replenishment, dam building, and causeway or dike construction have all limited or eliminated the flow and eventual deposition of upland sediments into coastal areas that in turn become critical intertidal and supratidal habitats for shorebirds. Working with coastal geologists, project planners can identify historically engineered coastal areas that no longer serve their original purpose. Identifying these local opportunities for reestablishing sediment flow to promote accretion of beaches and shoals will be important to rebuilding vital shorebird habitats and contribute to flyway level goals. These restoration projects may come in the form of developing recycling standards for maintenance dredging materials that under current standards are removed from the sand-sharing system; deconstruction of unwarranted or unused dams, jetties, and dikes; or returning coastal rivers to original sinuous meanders. Close collaboration with state agencies and other non-government organizations will be important to the success of this project. This project dovetails well with other national conservation initiatives, including dam, dike and culvert removal, and will involve working closely with the BMP project in Action 1 above.

Objective: Restore the function of coastal processes that maintain and create critical habitat for shorebirds in the Atlantic Flyway by working within at least 10 states (or 60 percent of the U.S. Atlantic Flyway coastline), 50 percent of the USACE Caribbean Islands Region, and opportunistically throughout the Caribbean island nations.

Objective: Coastal habitat projects increase shorebird use of historical and new priority sites by a minimum of 15 percent on average.

Action 4: Prioritize inlets and deltas for restoration and protection.
Use expert opinion, remote sensing, WHSRN and IBA designations, as well as other conservation programs to prioritize coastal sites used currently or historically by shorebird Focal Species during breeding, migration, and wintering. It is important to focus on engaging local authorities in applying engineering BMPs and/or undertaking potential restoration activities at the sites with the greatest shorebird values. Implementation of this key strategy will be most effective at the state level and most efficient with a combination of funding to state wildlife managers and non-governmental organizations working on coastal conservation issues. Estimated budget costs reflect the use of Geographic Information System (GIS) expertise for site mapping, with partial funding for a shorebird habitat specialist as project coordinator and partial funding to ensure local non-governmental organization or government agency engagement.

Objective: By 2025, assess all Focal Geographies throughout the temperate and tropical regions of the Atlantic Flyway for historical, current, and potential future shorebird use and importance. Build a portfolio of sites assessing overall value, vulnerability, and potential for improvement of function as viable shorebird habitat.

Incompatible Natural Resource Management

Incompatible management issues must be addressed collectively as part of a comprehensive strategy to ensure the long-term viability of shorebird populations in the Atlantic Flyway. The long-term goal is to ameliorate the adverse effects of these activities and build consensus for strategies that balance shorebird conservation needs with objectives of stakeholders engaged in profit-driven natural resource extraction (e.g., fisheries) and the conservation needs of other species. Specific conservation outcomes include: (1) by 2025, guidance documents and model projects are developed that meet the needs of multiple species and diverse stakeholders, and contribute to overall shorebird conservation objectives, and (2) by 2025, the effects of incompatible management are reduced at 50 percent of the critical shorebird sites throughout the Atlantic Flyway affected by natural resource management conflicts.

The initial focus should be on priority sites designated in the WHSRN, under the Ramsar Convention, as IBAs, or governmentally protected areas used by shorebirds in temperate and tropical regions throughout the annual cycle. Five key actions are identified to prevent further loss and degradation of shorebird habitats from incompatible natural resource management, with a focus on the Mid-Atlantic and Southeast United States and Northern South America:

Action 1: Form a flyway-wide working group to pursue multi-species management that averts conflicts.
Interaction among federal, state, and private land managers is essential for the development of comprehensive, multi-species strategies to address management that conflicts with shorebird conservation goals. A critical first step involves convening initial meetings in North America, the Caribbean Basin, and South America to assess the scale and scope of incompatible management across the flyway. Once established, the flyway-wide working group will determine the activities and financial resources necessary to address incompatible natural resource management issues at key temperate and tropical sites. Although incompatible natural resource management threats exhibit commonalities across geographic domains, engaging a geographically and topically diverse group of experts ensures that differences between temperate and tropical regions and during different parts of the annual cycle are addressed.

Objective: By 2016, convene initial meetings in North America, the Caribbean Basin, and South America to assess the scale and scope of incompatible management practices across the flyway.

Sanderlings in the WHSRN site at the Bay of Fundy, Canada.
Dennis Jarvis

Action 2: Develop public/private partnerships that address conflicts between shorebird conservation needs and wildlife resource extraction objectives.
Situations that involve competing conservation and economic needs require non-traditional partnerships to produce compromises, achieve conflict resolution, and realize multiple objectives. However, roadmaps for successful formulation of these kinds of partnerships are few. Completion of this objective will provide successful examples of how to resolve conflicts caused by incompatible management of natural resources. Importantly, outcomes from these projects will help refine best practices for resolving management conflicts and achieving benefits for competing conservation objectives.

Objective: By 2025, develop, implement, and complete 10 pilot projects throughout the flyway to inform future implementation projects. Pilot project outcomes include conflict resolution strategies, which are used to develop work plans for future projects aimed at ameliorating the adverse effects of incompatible natural resource management on shorebirds.

Objective: By 2025, implement 10 projects using conflict resolution strategies developed through pilot projects. Projects reduce the adverse effects of incompatible natural resource management on shorebirds at the site level (e.g., aquatic species harvest or cultivation, impoundment management, non-game species management), while realizing economic or conservation objectives.

Action 3: Develop guidance documents that assist site and natural resource managers in resolving conflicts identified by the flyway-wide working group.
Characterizing existing and potential management conflicts across the flyway, especially at key sites, is a necessary first step to reducing them. Sites will likely have different combinations and magnitudes of incompatible management issues involving fisheries, aquaculture, and management for other wildlife species. The assessment will identify commonalities and synthesize patterns of management conflict across sites, and generate a shared approach to mitigating conflicts that explicitly considers solutions that balance management goals for shorebird populations with the goals of other resource users.

Objective: By 2020, develop a guidance document informed by expertise from the flyway-wide working group and lessons learned from pilot public/private partnership and implementation projects. The guidance document includes, but is not limited to: (1) guidelines to be used when forming partnerships with managers and resource users to mitigate the impacts of their activities on shorebirds; (2) guidelines for Environmental Impact Assessments of aquaculture development projects so that they address/mitigate potential impacts to shorebirds; (3) recommendations to regulatory agencies regarding aquaculture exclusion areas; (4) impoundment management practices that benefit shorebirds; and (5) methods of conflict resolution for non-game species management.

Action 4: Improve education and outreach about incompatible natural resource management.
Targeted education and outreach is critical to changing perspectives about incompatible management. Gaining widespread support for public/private partnerships to achieve multiple management goals will require engaging key audiences, such as fishing communities, community and business leaders, consumers, and the conservation community. One expected outcome is greater willingness by these entities to enter into non-traditional partnerships to achieve sustainable resource use while addressing shorebird conservation issues. Another important outcome is consumer support for fishery and aquaculture products resulting from these kinds of projects.

Objective: Design a social marketing campaign that guides consumers toward fishery and aquaculture products that result from balanced management via public/private partnerships.

Action 5: Strengthen legislation and policies regarding incompatible management.
Develop policies, laws, and regulations addressing fisheries management and aquaculture development that are integral to ameliorating the adverse effects of these activities on shorebird populations. Products from the flyway-wide incompatible management assessment and working group, such as the aforementioned guidance documents, and from the outcomes of public/private partnership projects can be used to underpin new policies and regulations.

Objective: By 2020, obtain one positive policy change regarding an incompatible management issue.

Removing invasive species is critical for shorebird protection. USACE Buffalo

Invasive Species

The long-term goals of this strategy are to: (1) prevent the introduction of new invasive species into the waters and lands of the Atlantic Flyway, and (2) reduce the impact of invasive species on select, critical shorebird habitat through targeted management and eradication programs when applicable. The conservation outcome is reduced impacts of invasive species at 10 priority shorebird sites by 2025. Three key actions are identified to prevent the further loss and degradation of shorebird habitats from invasive species with a focus on the Mid-Atlantic and Southeast United States, and the Caribbean:

Action 1: Develop measures to prevent invasive species introductions.

Engage with public and private organizations working to prevent the introduction of invasive species. Work with port authorities, the U.S. Coast Guard, USFWS, National Oceanic and Atmospheric Administration, and others to develop or encourage strategies that block additional introductions of harmful invasive marine and terrestrial species.

Objective: By 2020, develop a cooperative initiative with relevant agencies to inform and implement a program to minimize the introduction of invasive species detrimental to shorebird survival.

Action 2: Develop an awareness campaign to empower local stakeholders to participate in invasive species prevention and management efforts at priority shorebird sites.

Engaging landowners and managers of critical shorebird sites in developing and implementing invasive species management practices is fundamental to successful invasive control. Also key to the process is the participation of policy makers, government agencies, land managers, private resort owners, leaders of NGOs, and community groups. Steps for project development and implementation include site assessments, identifying and engaging key local stakeholder groups, securing funding for project implementation, local training on BMP techniques, and undertaking stewardship and monitoring practices.

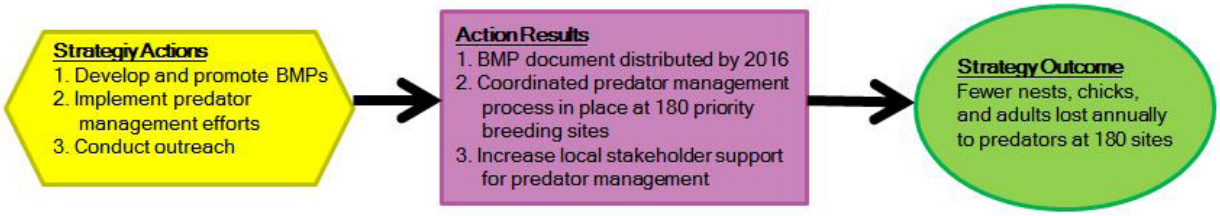
Objective: By 2018, develop site-specific invasive species control and removal strategies for ten priority sites/areas. By 2025, implement strategies to enhance priority shorebird habitats at these sites.

Action 3: Build local science and management capacity in the Caribbean.

For the Caribbean specifically, there is a need to build the capacity of both public and private local land managers to identify and remove invasive plants, and to restore sites impacted by invasive plants. Training will be provided throughout the region, but will be more targeted as resources become available for on-the-ground conservation action at priority sites.

Objective: By 2018, increase the number of staff in the Caribbean by five who have knowledge and skills to sustain invasive plant eradication projects.

Minimize Predation Impacts



In areas with high predation pressures, predator management strategies must be improved and coordinated with other management efforts to maximize effectiveness and efficiency. Expansion of education and outreach efforts is also needed to garner critical public support that will ensure that management can be successfully carried out without opposition. A successful conservation strategy not only requires resources for supporting predator management efforts at important nesting locations, but reliable techniques for measuring management success.

The long-term goal of this key strategy is to reduce the number of nests, chicks, and adults lost annually to predators[6] with the conservation outcome of reduced predation pressure at approximately 180 priority breeding sites for American Oystercatcher and Snowy, Wilson's, and Piping Plovers. Initially, this strategy focuses on temperate breeding shorebirds, for which more site-specific information is currently available, with subsequent expansion to tropical (and sub-tropical) nesting species. Three actions are identified to address predation with a focus on Maritime Canada; the Northeast, Mid-Atlantic, and Southeast United States; and the Caribbean:

Action 1: Develop and promote best practices for predator monitoring and management.
Streamlined guidance can greatly assist managers in making decisions about how, when, and where to initiate predator management efforts, evaluate success, and adapt management strategies. Creation of a BMP guidance document includes developing: (1) tools to help managers determine when management is necessary; (2) recommendations for assessment, evaluation, and improvement of predator management practices; and (3) "shorebird-safe" guidelines that discuss potentially conflicting management goals (e.g., Peregrine Falcon nest platforms and perching structures).

Objective: Evaluate the effectiveness of existing predation management practices, work to better understand predator ecology and improve management methods, and where appropriate implement updated cost effective and efficient techniques that minimize risks to non-target predators.

Objective: By 2016, develop, disseminate, and promote a BMP document that will facilitate effective and efficient predator management at scale.

Action 2: Implement and coordinate predator management efforts. Implementing effective predator management at priority shorebird breeding sites requires coordination and "on-the-ground" effort.
Populations of several shorebird species are vulnerable to the impacts of predation during the breeding season. Necessary steps include: (1) the review and evaluation of current permit requirements and management strategies; (2) implementation of BMPs (see prior strategy) for predator monitoring and management; and (3) evaluation of predator monitoring and management techniques. A companion goal of the above process is to adapt management to maximize efficiency and increase success of efforts to reduce impacts on priority populations.

Objective: Develop a coordinated process for organizations to implement predator management at a network of approximately 180 priority breeding sites.


Red fox are a key predator to shorebirds. Rylee Isitt

[6]Target reduction goals will vary by species and location. Specific targets will be developed as part of the BMPs.

Action 3: Outreach campaign for predator management support.

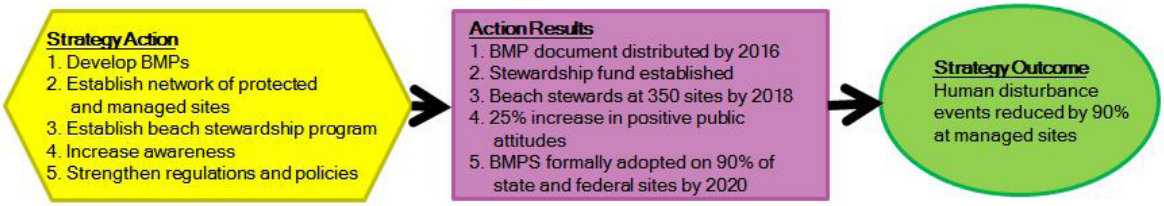
Public support is crucial to ensure that predator management can be successfully carried out. To achieve this outcome, it is important to build local stakeholder support for actions to reduce the predator load, influence funding streams, and guide local policy. Outreach efforts will be directed toward raising public awareness of the impacts that predators have on coastal wildlife, and communicating to local governments and stakeholders that shorebirds can benefit from proper waste management practices. Measures of success will include the percent of a community involved in or supporting conservation efforts and the levels of local funding for improved waste and predator management.

It's important for stakeholders to understand that a simple thing like properly disposing of waste can have a huge impact on shorebirds. Geoffrey Meyer-van Voorthuijsen

Objective: Implement outreach efforts in 75 percent of communities adjacent to or near priority shorebird breeding sites.

Objective: Develop and implement a scoring system to track improvements in waste management practices that reduce resources supporting predator populations.

Reduce Human Disturbance



The goal of this strategy is to reduce human disturbance events at managed sites resulting in increased fledging success and annual survival sufficient to recover declining populations by 2025, with the outcome of human disturbance events reduced by at least 90 percent on all actively managed sites. Five actions are identified to address human disturbance with a focus on Maritime Canada and the Northeast, Mid-Atlantic, and Southeast United States:

Action 1: Develop Best Management Practices.

Compile and, as needed, develop guidelines for controlling human disturbances following recommendations from the latest and best available science. The guidelines should include proper symbolic fencing, other barriers to disturbance, signage, buffer distances, seasonality, monitoring, personnel, training, outreach materials, and other guidelines for protecting shorebirds. The presence of personnel at sites with symbolic fencing or other barriers, along with local outreach, is essential to successfully preventing disturbances, but is not a substitute for symbolic fencing.

Objective: By 2016, develop, publish, and distribute BMPs for controlling human disturbance of breeding, migrating, and wintering shorebirds, with endorsement by the Atlantic Flyway Shorebird Group.

Action 2: Establish a network of sites protected and appropriately managed to reduce disturbances.
Use diverse conservation tools (e.g., acquisitions, easements, long-term agreements, etc.) to increase the number of priority shorebird sites that are protected and managed appropriately to reduce human disturbance threats to shorebirds. Ensure that sites protected by local, state, federal, or non-governmental conservation organizations are managed to reduce human disturbance following BMPs developed through Action 1.

Objective: Establish a "stewardship" fund for the protection and restoration of habitat on private lands within priority shorebird sites managed to reduce disturbances.

Action 3: Establish beach stewardship programs.
Establish beach stewardship programs focused on protecting shorebirds from human disturbances and other threats at key sites. Beach stewards would be properly trained to assist professional staff in a broad range of activities that include: (1) reducing human disturbances; (2) increasing public awareness through education and outreach programs focused on reducing threats to coastal birds at specific sites; and (3) maintaining consistent oversight of protected areas to discourage disturbance to shorebirds. Such programs, led by Audubon staff, have been successful in protecting shorebirds from disturbance and building community support for shorebird conservation.

Objective: By 2018, reduce threats from human disturbance at 350 sites through active stewardship by 3,000 beach stewards.

Action 4: Increase awareness of the conservation needs of shorebirds.
A contributing factor to human disturbance is a general lack of awareness of the threats facing shorebirds, their needs, and the impacts of disturbance. With increased awareness of shorebirds as imperiled wildlife and knowledge of their habitat and energetic needs, beachgoers and coastal residents will have the option to adopt a new set of cultural expectations when visiting coastal areas that are important for shorebirds, though increased awareness does not replace the need for establishing symbolic fencing or other barriers to human disturbance. Awareness programs will be implemented at the appropriate scale to be most effective and will employ social marketing strategies aimed at changing public attitudes and behaviors. Authentic, local engagement by an informed public has the potential to collectively protect thousands of miles of shoreline.

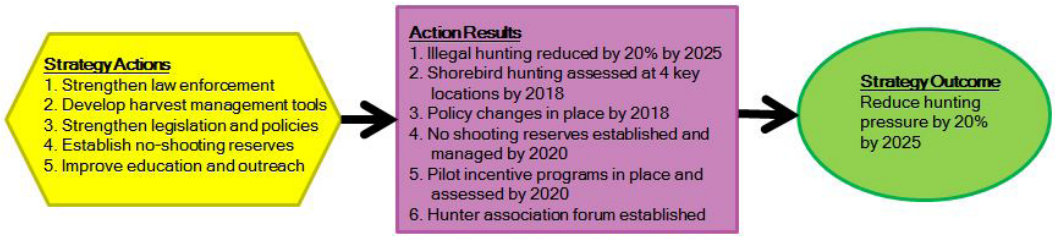
Objective: Within three years of implementing a social marketing campaign, improve public attitudes toward shorebird protection by 25 percent.

Bird steward installs chick crossing signs. Bob Clark

Action 5: Strengthen conservation regulations and policies.
Regulations and land-use policies for public conservation lands are sometimes inadequate to address threats to shorebirds from human disturbances. Often such regulations or policies, if they do exist, overlook non-breeding shorebirds. A model regulation or policy that follows BMPs will be developed for public conservation lands. At the same time, a model mitigation plan will be developed that includes protection of shorebirds from human disturbances at shorebird sites impacted by projects requiring a federal permit.

Objective: By 2020, BMPs for reducing human disturbance threats are formally adopted as management policy on at least 90 percent of state and federal conservation lands, and are required to be implemented for all mitigation projects associated with federal permits that impact shorebirds or shorebird habitats.

Reduce Hunting Pressure



The long-term conservation goal is to achieve a sustainable harvest of shorebirds, where hunting is legal, and to decrease the illegal hunting of shorebirds in the Caribbean islands and northern South American countries. The conservation outcome is a 20 percent reduction in hunting pressure by 2025. The ability of shorebird populations to sustain harvest mortality varies in relation to their life histories. Potential sustainable harvest levels will be evaluated by species-specific analyses funded in 2015. Obtaining a sustainable harvest will contribute to reversing the precipitous declines of Atlantic Flyway shorebird populations. Six key actions are identified to address hunting pressure on shorebirds in the Caribbean and northern South America:

Action 1: Strengthen law enforcement.
Providing sufficient resources for salaries, equipment, travel, capacity, and training is needed to effectively enforce existing laws and policies. Increased capacity for law enforcement, coupled with hunter education, will deter the desire to illegally hunt. The initial focus should be on priority sites, designated by the WHSRN, under the Ramsar Convention, as IBAs, or as governmentally protected areas.

Objective: By 2025, reduce illegal hunting 20 percent, with an initial focus on the Caribbean, Suriname, and French Guiana.

Action 2: Develop harvest management tools.
Some efforts are underway to assess shorebird harvest, hunting pressure, and hunter dimensions, but a more comprehensive understanding is needed. Gathering information on site-specific harvest parameters is a critical first step to determine if other strategies should be implemented, such as strengthening law enforcement or hunting policies,.

Objective: By 2018, conduct assessments in four countries/departments (French Guiana, Suriname, Barbados, and Guadeloupe and associated French Territories) where hunting is known to occur and information is lacking.

Action 3: Strengthen legislation and policies.
Propagation of new laws and regulations is critical for achieving a sustainable harvest where hunting is legal, such as Guadeloupe, Martinique, and French Guiana. Information provided through harvest and hunter assessments can be used to adjust policies concerning the number of licensed hunters, daily and seasonal bag limits, and season timing and duration. The hunting of shorebirds of conservation concern can also be restricted or eliminated through legislation.

Objective: By 2018, obtain one positive policy change in each jurisdiction.

Action 4: Establish and maintain no-shooting reserves.
Providing shooting-free reserves in areas where shorebird hunting occurs is a viable strategy to reduce mortality. This can be accomplished by purchasing and restoring defunct shooting swamps on Barbados and private wetlands on other islands or by establishing no-shooting reserves on public lands. Beyond fee-title acquisitions, easements, or designations, there is a critical need to support the long-term maintenance of these reserves.

Objective: By 2020, establish one new non-shooting reserve and adequately manage three existing no-shooting reserves for shorebirds.

Action 5: Develop and assess incentives to not hunt.

Hunter assessments will also provide information to develop potential incentive programs to reduce hunting by promoting economic alternatives. For example, former hunters could be employed as biological monitors or, where hunting is legal, as local hunting guides and/or monitors to support hunting information programs by 2020.

Objectives: By 2020, assess pilot initiatives that provide incentives to reduce shorebird hunting at priority sites in Barbados and the French territories.

Objective: By 2020, develop and implement a hunting guide and monitoring scheme in Guadeloupe and a biological monitoring scheme in Suriname.

Action 6: Improve education and communication.

Education and outreach are crucial for convincing hunters and other stakeholders that a sustainable harvest is in their best long-term interest. Informational brochures on the status of Red Knot have been produced and distributed to every licensed hunter on Guadeloupe, and will be used as a model for hunter outreach in other locations. As a result of this program, hunters on Guadeloupe agreed to a moratorium on Red Knot hunting.

Objective: By 2018, build a hunter association forum to discuss management of the shorebird harvest at regional scales, which can be modeled on the Flyway Councils used to manage game birds in the United States. The initial focus will be increased coordination and information exchange among the French-speaking focal territories, provinces, and departments.

Ruddy Turnstone.
barloventomagico

Fill Knowledge Gaps

Information on shorebird vitals (e.g., population size, reproductive success, adult survivorship) is essential to: (1) understand how shorebirds are responding (or not) to conservation investments; (2) measure progress against outcomes; and (3) adaptively manage. Efforts to gather, collate, and analyze information on species populations as well as the status and prioritization of important shorebird sites are major priorities in the early phase of the Atlantic Flyway Shorebird Initiative. This includes strengthening and expanding existing monitoring and assessment programs to generate additional information.

Action 1: Refine baseline population estimates for shorebird Focal Species.

Current knowledge is insufficient to determine with confidence population estimates for many shorebird Focal Species. Without baseline information on population size and trends, it is difficult to prioritize conservation actions and measure impacts. Priority will be given to strengthening existing shorebird census initiatives, including coastal shorebirds surveys in the Arctic (e.g., the James and Hudson's Bay staging areas), along the eastern U.S. seaboard (e.g., Red Knot and American Oystercatcher), in northern South America (e.g., Semipalmated Sandpiper), and through the Caribbean and South American Waterbird Census initiatives (all species). In addition, species-specific surveys (e.g., Piping Plover) will be undertaken.

Objective: By 2020, obtain and use population size and/or trends for Focal Species to inform conservation efforts throughout the Atlantic Flyway.

Action 2: Identify and prioritize critical shorebird sites across the Atlantic Flyway.

Information on priority sites for shorebirds exists (e.g., the ISS database, IBAs, e-Bird) and is being managed by various independent organizations. This material will be pooled so that users can access up-to-date information on priority sites throughout the Atlantic Flyway, including extensive information from WHSRN site assessments. Such an inventory would also provide information on threats to sites from development (e.g., type, intensity, impact), predation (e.g., species, rates, impact), human disturbance (e.g., type, impact), and hunting (e.g., species impacted, pressure, intensity). Information gaps will be identified and efforts focused to gather relevant data. The Critical Sites Network Tool employed by the African Eurasian Flyway project should be assessed as a potential model for managing site-based information.

Objectives: By 2015, compile, map and rank known priority sites for conservation action; by 2020, identify, map, and assess 25 new priority sites for shorebirds. Develop a guidance document that identifies and prioritizes the major shorebird sites in the mid-Atlantic U.S by 2015; in the southeast U.S., northeast U.S., and Atlantic Canada by 2016; and in the Caribbean and South America by 2020.

Objective: Identify priority shorebird sites impacted by invasive species with a focus on temperate and tropical regions by 2016.

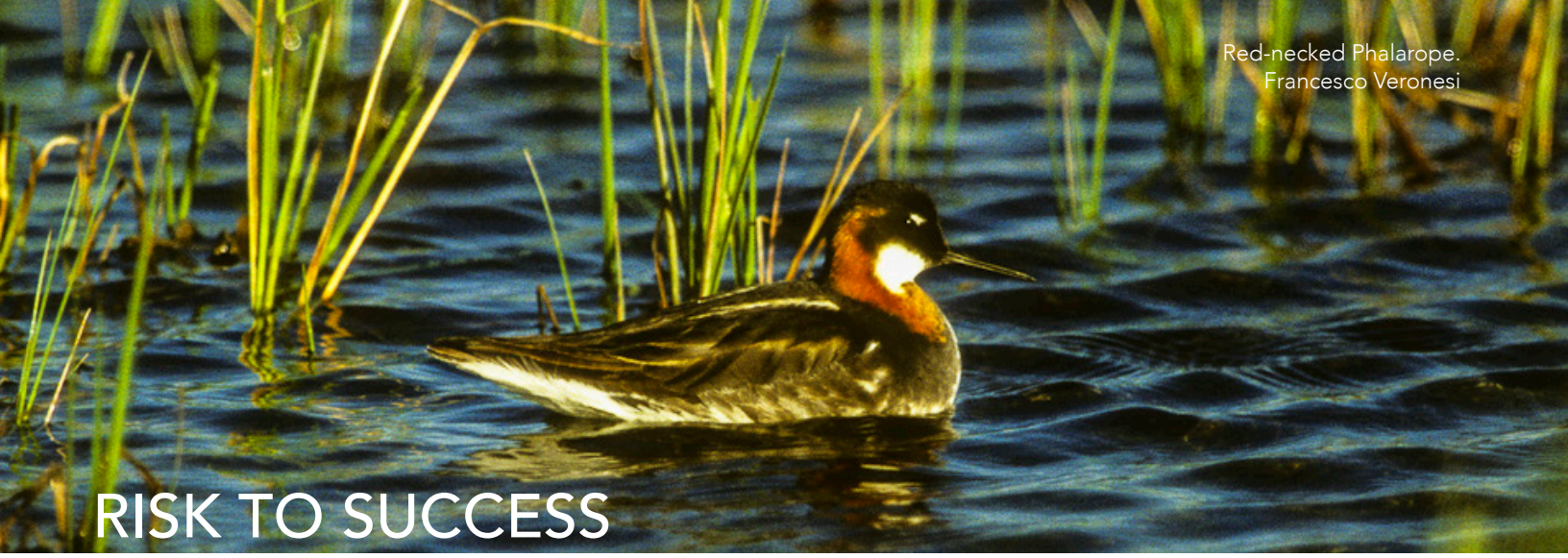
Objective: Assess and prioritize known priority shorebird sites threatened by human disturbance by 2015.

Action 3: Establish a flyway approach to monitoring populations of shorebird Focal Species.

The International Shorebird Survey is the longest running shorebird monitoring effort of its kind in the Americas. The Caribbean Waterbird Census has begun to identify important sites for focal shorebirds, including important areas that were previously unknown; however, regional coverage is still incomplete (Sorenson and Gerbracht 2014). The ongoing Neotropical Waterbird Census in South America is an important monitoring initiative that is systematically collating data on shorebirds, but it suffers from chronic under-funding. An overarching, flyway-level monitoring initiative is needed and will be created by applying PRISM's standard approach for monitoring shorebirds.

Objective: By 2017, establish a unified monitoring protocol to measure changes in shorebird populations along the Atlantic Flyway.

Semipalmated Sandpiper.
Fyn Kynd



Red-necked Phalarope.
Francesco Veronesi

RISK TO SUCCESS

BACKGROUND

Risks are uncertain events or conditions that, if they occur, can have a negative effect on implementation of initiative strategies or achievement of outcomes. The principal risks to the Atlantic Flyway Business Plan are outlined below and, where applicable, strategies to avoid or mitigate these risks have been identified and incorporated into the plan.

RISKS TO SUCCESS

Regulatory Risks

The ability to adequately protect shorebirds from threats, such as human disturbance or development, often requires conservation-oriented policies, including both incentives and regulations on public and privately held lands. However, policies and regulations affecting shorebirds vary greatly across the numerous countries and jurisdictions within the scope of the Atlantic Flyway Business Plan, which can lead to inconsistent management. In many instances, current regulatory systems favor economic benefits, such as those resulting from coastal development and engineering projects, regardless of their impacts on shorebirds and shorebird habitats. Even on lands under public ownership, diverse pressures can lead to management policies that undervalue shorebirds and their habitats. Although policy and regulatory changes will be challenging, the risks can be mitigated in part by successfully developing and encouraging the widespread adoption of BMPs for shorebird conservation.

Even where similar regulations exist, the level of enforcement can differ. This risk will be addressed through increasing enforcement capacity, as is described under the strategy to reduce illegal harvesting of shorebirds. Lastly, affecting change within a regulatory or policy context, such as establishing protected areas, has a long time lag from conception to completion. Therefore, intermediate outcomes will be used to gauge interim progress. Although the timeline for regulatory and policy improvements can be long, the benefits to conservation and resource protection are also long lasting and significant to shorebird population stability. In addition, as new shorebird species are proposed and potentially listed under the U.S. Endangered Species Act, regulations will require greater incorporation of shorebird needs into development and coastal engineering projects.

Financial Risks

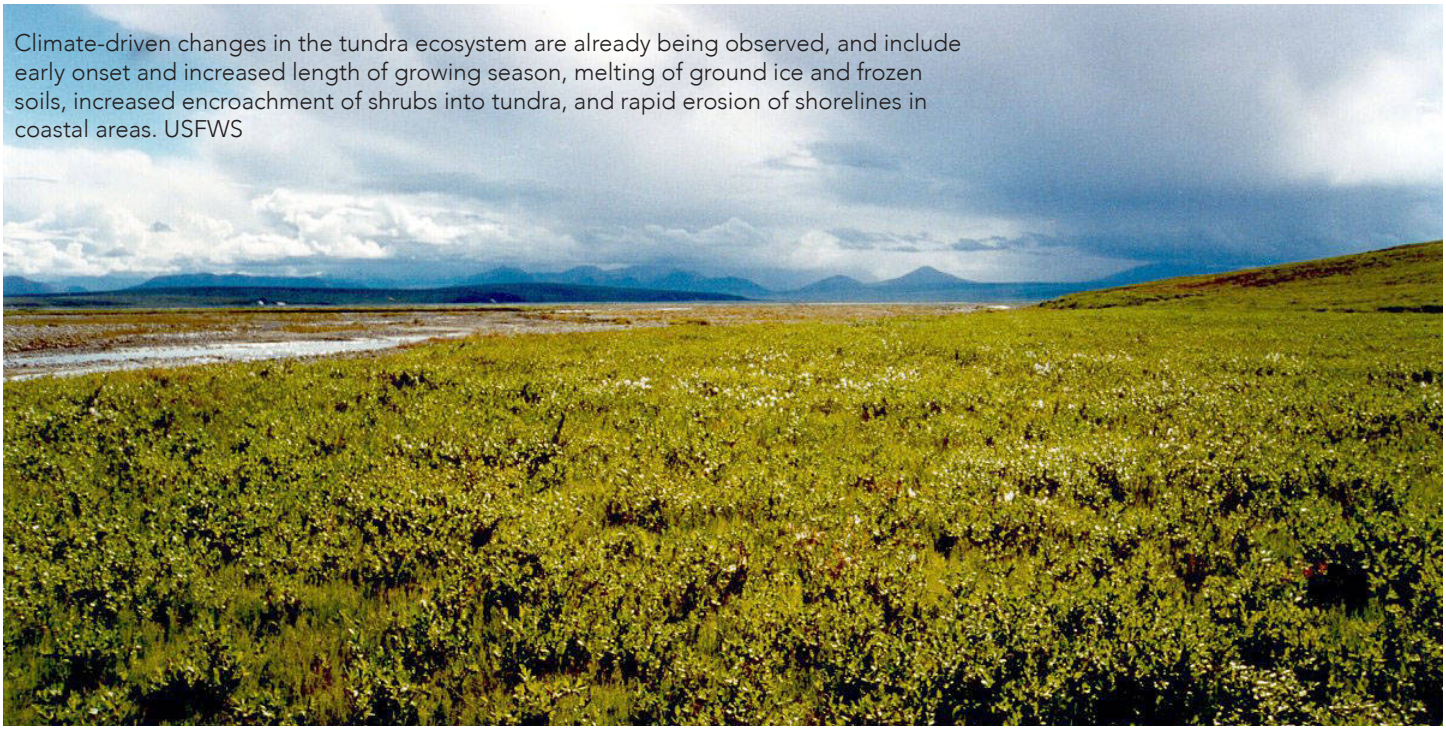
Many threat-reduction strategies, such as reducing human disturbance in habitats used by nesting and migratory shorebirds and controlling predators, require ongoing management and monitoring. A long-term funding stream will be needed to finance these recurring management activities and to ensure the sustainability of achievements. In addition, the cost of certain threat-reduction activities, such as those in coastal engineering projects, is high. However, developing and incorporating BMPs into standard operations (e.g., using internal USACE programs such as “Engineering with Nature” and the current federal mandate of seeking “best use” of dredge materials) will alleviate this risk.

This Business Plan is literally a shorebird "roadmap for recovery" along the Atlantic Flyway, which allows potential funders to choose priority projects and outcomes; however, funding to fully implement the plan at a flyway-scale will require substantial involvement and commitment from a broad partnership. Lack of funding, particularly in the Caribbean and South America where capacity is very low, is a serious risk. Generating new funding in this environment will be challenging, yet there are several organizations that have already made substantial investments in strategic planning on a flyway-scale and thus can be used as leverage to find new partners. For example, National Audubon has committed to a flyway approach and has already shown considerable commitment to shorebird conservation in the Bahamas. The USFWS manages key National Wildlife Refuges along the Atlantic that are important for shorebirds as stopover sites, including some that benefitted from Hurricane Sandy restoration funds. States and provinces also manage grant programs (e.g., state wildlife grants) that can be targeted to the Business Plan. To be successful in achieving population outcomes and project objectives, a coordinated approach to development will be necessary to generate new corporate, foundation, and NGO partnerships for supporting the flyway approach to shorebird conservation and this Business Plan.

Environmental Risks

As summarized in a recent publication (Galbraith et al. 2014), global climate change is an anthropogenic stressor that could adversely affect shorebird populations across species' ranges, particularly those that breed and/or winter at high latitudes where climatic change is expected to be most severe (Parry et al. 2007). For instance, in the Arctic, the trophic mismatch of insect emergence and shorebird chick hatch induced by global climate change could have significant consequences on shorebird reproduction. The consequences of global climate change will likely accelerate the reduction in quantity and quality of grassland, wetland, beach, and tundra habitats used by shorebirds throughout their annual cycle. Climate change impacts, such as sea level rise, can reduce the likelihood of long-term success in conserving key shorebird habitats. It is clear that coastal ecosystems where natural conditions are maintained by management practices are more resilient to increases in storm surge than more urbanized coastal settings.

Although climate change is not being directly addressed in the activities outlined in this plan, targeted monitoring programs and predictive modeling will be used to better understand how the changing climate will affect shorebird populations and habitats. This information will be incorporated into efforts to prioritize the most critical and viable sites that, in addition to having the greatest impact on shorebirds, are also expected to be more resilient to the effects of climate change and thus are more likely to be sustainable over the long term.



Climate-driven changes in the tundra ecosystem are already being observed, and include early onset and increased length of growing season, melting of ground ice and frozen soils, increased encroachment of shrubs into tundra, and rapid erosion of shorelines in coastal areas. USFWS

Another key environmental risk is the continuing introduction of invasive species that have the potential to alter or destroy wetland ecosystems and the food webs that support shorebirds. Furthermore, once established as successfully reproducing species, invasives can frequently be impossible to eradicate. Continued vigilance by communities, governments, and/or NGOs will be required for invasive control efforts to be sustainable over the long term.

Scientific Risks

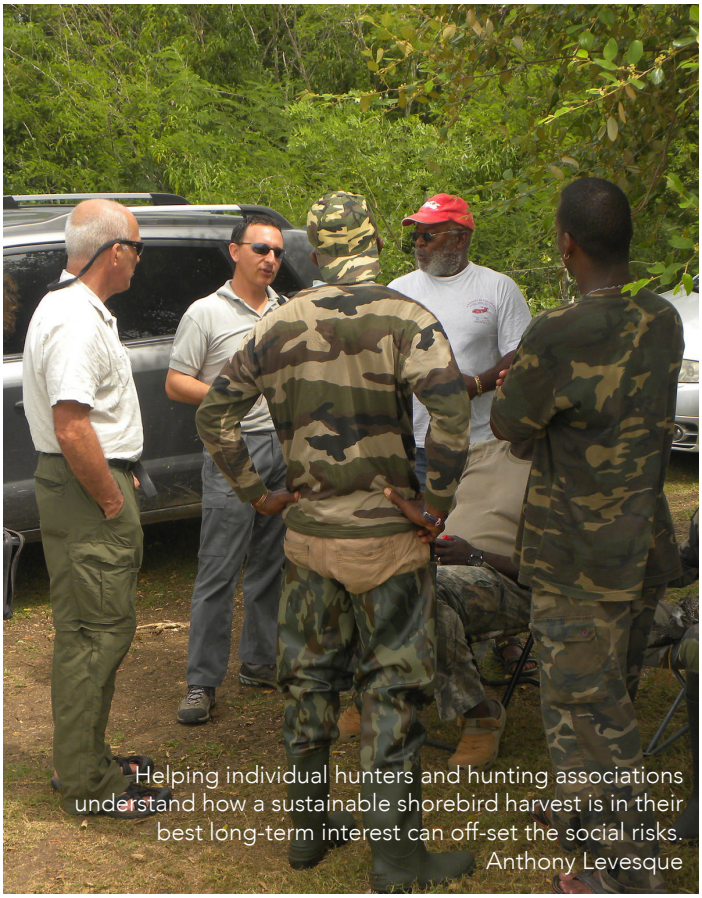
Precise predictions of how populations will increase as a result of the activities described within this plan are difficult to estimate due to the interactive effects of different threats and a lack of total population estimates for some shorebird species. Some of the activities identified in this plan (e.g., evaluation of predator control projects) are directed toward increasing our knowledge of the most effective management tools and practices for shorebird conservation. Both effectiveness and population monitoring efforts will be undertaken to measure progress toward achieving the plan's interim objectives and long-term goals. This monitoring will provide critical information for adaptive management, thus minimizing the risk of continuing to invest in ineffective or inefficient conservation activities.

Economic Risks

Economic incentives to develop coastal property and protect properties using coastal engineering techniques far outweigh the perceived economic benefits of protecting or maintaining coastal habitats for shorebirds. Economics can also affect support for incorporating shorebird conservation needs into existing or future for-profit ventures, such as fisheries, aquaculture, or mariculture. This risk will be minimized by focusing on public-private partnerships that have minimal impacts on operational costs to these industries. If the cost of bringing "shorebird safe" products to market results in higher prices, consumers might be less likely to purchase them. With an effective outreach campaign, however, many consumers may be willing to pay a marginally higher price for "shorebird safe" products.

Social Risks

Support from the local public is critical for successful implementation of many of the plan's strategies. For instance, public opposition to lethal methods of predator control is well documented and can impede achievement of goals. Beach communities and property owners sometimes implement measures to harden shorelines and mine shoals for sand in an attempt to reduce beach erosion and replenish shorelines, which is detrimental to shorebirds. In addition, many Caribbean inhabitants perceive invasive plants, like the Australian pine, as quick growing hedges that create windbreaks for properties. The long-term success of strategies to reduce these types of threats requires local support, starting when projects are being planned and implemented and continuing into ongoing stewardship of the site. To reduce the risk from local opposition that hinders successful implementation of conservation activities, this plan includes education and outreach activities as part of the various threat-reduction strategies. For example, the strategy to reduce the threat of unsustainable levels of harvesting relies on helping individual hunters and hunting associations understand how a sustainable shorebird harvest is in their best long-term interest. These education and outreach activities are geared toward encouraging the local public and decision-makers to see the value of protecting shorebirds and their habitats and to become engaged in stewardship activities that will benefit their communities.



Helping individual hunters and hunting associations understand how a sustainable shorebird harvest is in their best long-term interest can off-set the social risks.
Anthony Levesque

Marbled Godwit.
Loren Chipman

Institutional Risks

Many natural-resource management and regulatory agencies currently focus much of their attention on game species without giving sufficient consideration to potential adverse impacts on non-game species. Strategies to minimize this risk include engaging game managers in a flyway-wide working group and disseminating key resources, such as BMPs, to support a greater emphasis on multi-species management. Game species also have extensive annual surveys and adequate management budgets to ensure healthy populations to hunt, while shorebirds and other non-game species are in need of standardized surveys and sufficient budgets to ensure their conservation. The growing focus on "stressor management" (through the analysis of impacts associated with human land use) has the potential to help address this lack of resources for non-game conservation through the application of mitigation and offset measures resulting from the permitted take of migratory species.

In addition, insufficient institutional capacity can pose a risk to effective implementation of shorebird conservation strategies, particularly in the Caribbean and South America, where institutional funding is lacking. This risk will be minimized by providing funding for institutional capacity-building, training, and coordination. Although staff turnover in government agencies and NGOs is inevitable and can erode the capacity created, it also highlights the need to ensure that established conservation community members are adequately engaged in key processes and decisions, and help provide mentoring to new community members. Furthermore, the recent development through the Convention on Migratory Species of the Americas Flyways Framework, an overarching framework for the conservation of migratory birds in the Western Hemisphere, provides a mechanism through which governments and other stakeholders within the Atlantic Flyway can develop joint strategies and collaborate to address institutional capacity and other needs for the effective conservation of shorebirds at the flyway scale.

Workshop participants in Lagoa do Peixe National Park.
Brad Winn

MONITORING & EVALUATING PERFORMANCE

BACKGROUND

Prioritization of conservation actions is of paramount importance so that investments are targeted where they are most urgently needed and where they can yield the greatest benefits. However, prioritizing relative conservation needs and tracking the benefits of action require monitoring, and dollars spent monitoring compete with the same dollars available to undertake direct conservation action.

This business plan strikes a balance by advocating efficient use of existing monitoring programs and targeted investment only in those programs necessary to prioritize action or to determine when actions have been successful. In this way, investment in monitoring can in fact lead to a net gain in efficiency by ensuring that action is directed only where it is needed, and ceased when the goals have been achieved.

Monitoring Strategies[7]

The ultimate measure of success of this plan is an increase in the population sizes of the Focal Species. However, the same globe-spanning ranges that leave shorebirds vulnerable to anthropogenic threats also make them difficult to monitor. Population size and trends are known with certainty for only a handful of species (Andres et al. 2012). Recognizing the challenges of monitoring these species on a hemispheric scale, we propose monitoring at three distinct levels of resolution: Effectiveness Monitoring, Index Monitoring, and Population Monitoring.

Effectiveness Monitoring

Effectiveness monitoring yields immediate results, and allows managers to adapt quickly in response to unexpected outcomes. For example, decisions can be made quickly on the basis of return on investment. In the short-term, monitoring should demonstrate that conservation action achieved the intended outcome. Metrics of success are directly tied to the action and could include measures such as habitat acres conserved or miles of beach restored.

Two of the most widely used tools are the WHSRN Site Assessment Tool and the IBA monitoring framework. Both assign scores to variables for status, threats, and conservation responses at sites. They also include measures of the effectiveness of the responses, and allow for scores to be rolled up across networks, to provide indicative values for the variables at individual sites and across sites that can then be monitored over time. Projects and tools such as these will provide the short-term feedback necessary to measure progress toward achieving the interim objectives of the activities outlined in this plan. The full suite of objectives and associated monitoring will provide guidance about the overall effectiveness of this effort in the short term.

Index Monitoring

Index monitoring provides early indications of population response, justifying continued investment in what's working or a shift away from what's not, and has proven to be useful for understanding direction of change in populations (Bart et al. 2007). The conservation actions suggested in this plan are designed on the basis of our collective understanding of the Focal Species and ecosystems, and index monitoring allows us to demonstrate that species are responding to our actions as expected. An early example of this is the effort to reduce hunting pressure on populations of specific Focal Species that occur on certain Caribbean islands where hunting occurs. Information gathered is helping to inform management decisions at specific hunting swamps on Barbados.

[7]Refer to Appendix C for a table summarizing the objectives and metrics for measuring progress on the Atlantic Flyway Shorebird initiative.

Bird surveys in Turks and Caicos.
Craig Watson

In the medium-term, monitoring should demonstrate that conservation actions yield improvements in parameters expected to correlate with population status. These indices might include shorebird abundance and residence time at important sites, or demographic parameters such as adult survival or number of young fledged. These programs should be designed to collect data on population status at different stages of the species' life cycles so that we do not miss an important threat that could be affecting the overall population size. Existing programs can collectively address this need but will require increased support to make improvements in effectiveness and accuracy.

Large-scale programs such as the ISS, the Atlantic Canada Shorebird Survey, and the Ontario Shorebird Survey make use of volunteers to provide cost-effective annual indices of population status, but suffer from some problematic biases that can be addressed through improvements in design. Aerial surveys in South America have provided important information about population trends for some Focal Species. Other programs such as the Neotropical Waterbird Census or the Caribbean Waterbird Census are in a period of growth, and opportunities exist to support the programs and empower them to achieve objectives of this plan.

Population Monitoring

Population monitoring is critical for understanding the size of the current population (Andres et al. 2012) and, even more importantly, provides the big picture of our success at restoring populations. Actions occur at a local scale and local success can be monitored effectively through indices. However, combining these indices can be challenging when actions address different life-history stages or affect different fractions of the population. Large-scale population monitoring (Bart et al. 2005) provides the integrated signal that demonstrates the flyway-scale conservation successes sought by this plan. Tracking progress toward this goal requires long-term and large-scale monitoring. Existing large-scale monitoring programs provide a valuable starting point but do not yet provide the level of detail required for successful implementation of this plan, so strategic improvements in these programs are needed. Fortunately, there are several important existing programs to monitor shorebirds that achieve these goals or offer valuable starting points:

Program for Regional and International Shorebird Monitoring (PRISM) surveys provide unbiased estimates of population status at fixed intervals. The Arctic Shorebird Demographics Network (ASDN) provides critical information about what limits population sizes of Arctic breeding shorebirds. Fieldwork was completed in 2014; however, additional support is needed for model building and analysis. The International Piping Plover census and the recent American Oystercatcher census are examples of ongoing population size monitoring efforts that are designed to determine the status of single shorebird species of particular conservation concern. They are comprehensive survey efforts conducted every five years, tracking abundance and distribution across a species range.

American Golden Plover,
Dominic Sherony

FUNDING NEEDS

RESOURCING NEEDS

The business plan is built on an assumption that adequate funds can be raised over a 10-year period and effectively invested in activities that result in a 10 to 15 percent increase in populations of the 15 Focal Atlantic Flyway shorebird species. To achieve this goal, the AFSI partnership will be challenged to raise an estimated $90 million.

BUDGET	
Period - 10 years	USD
1. Manage and protect critical habitat (a) Commercial and residential development	21,410,000
1. Manage and protect critical habitat (b) Incompatible coastal engineering	4,700,000
1. Manage and protect critical habitat (c) Incompatible natural resource management	8,060,000
1. Manage and protect critical habitat (d) Invasive species management	3,320,000
2. Minimize predation impacts	10,940,000
3. Reduce human disturbance	30,565,00
4. Reduce hunting pressure	3,450,000
5. Fill knowledge gaps	7,935,000
TOTAL	90,380,000

Note: a detailed budget is included in Appendix D.

Over the duration of the business plan, the bulk of resources required to achieve a 10 to 15 percent increase in shorebird Focal Species will be invested to: (1) manage and protect critical habitat; (2) reduce human disturbance; and (3) minimize predation. Combined, these three strategies represent more than 65 percent of the total budget. In the short-term, resources will be required to fill in critical information gaps needed to inform investments in each of these three major threat-reduction strategies (e.g., assess the status of priority shorebird sites, estimate population trends, determine reproductive success of beach nesting species).

FUNDING OPPORTUNITIES

The successful implementation of the business plan will require a collaborative effort to secure funding from the following sources:

Federal and state governments – Governments in North America provide substantial funding for shorebird research and conservation. The U.S. government's Neotropical Migratory Bird Conservation Act (NMBCA) is an important source of funding for migratory bird conservation (for example, in 2014, $3.6 million was appropriated by the U.S. government). Some of these funds have been allocated to conserve important staging and wintering sites along the Atlantic Flyway in Latin America and the Caribbean. Securing a 3:1 match requirement, as required by the NMBCA, is a challenge for Latin American and Caribbean organizations. Domestically, the USFWS directs substantial support to the management of priority shorebird sites along the U.S. Atlantic seaboard. Regional offices of the USFWS provide additional funds for surveys, research, and monitoring efforts. The U.S. Forest Service and the State Department are additional sources of funding for work in Latin America and the Caribbean.

The Canadian Wildlife Service provides resources for research and monitoring as well as funds to support shorebird sites designated as National Wildlife Areas. Latin American and Caribbean governments, through their support for protected areas and biodiversity conventions, are another important source of national resources, a majority of which support protected areas important for staging shorebirds (e.g., Bigi Pan, Wia Wia, and Coppename in Suriname; Lago do Peixe and Reentrancias Maranhenses in Brazil; Lagunas de Rocha in Uruguay; and Samboronbon in Argentina).

Multilateral and bilateral agencies – The Inter-American Development Bank and the Global Environment Facility provide resources and skills to institutions in developing countries. Both have supported shorebird conservation work in South America through in-country programs (e.g., Southern Cone Grasslands Alliance).

Foundations – Several foundations provide support for migratory bird conservation in the Americas. In the United States, National Fish and Wildlife Foundation (NFWF) provides appropriated federal dollars and other public and private funds to the American Oystercatcher business plan and will continue to provide funds to support the Atlantic Flyway Shorebird Initiative. Other family and company foundations, including Bobolink, Levy, MacArthur, Mitsubishi, Shell, BP, and Conoco Phillips, are important sources of funding in the United States, Latin America, and the Caribbean.

Individuals – Over the years, individual donors have made important contributions to various aspects of migratory bird conservation. These individuals are largely associated with the conservation community in the U.S. and Europe. Efforts to engage these individuals through existing networks will be crucial, especially through established conservation organizations such as National Audubon Society, Ducks Unlimited, National Wildlife Federation, Wildlife Conservation Society, World Wildlife Fund, International Union for Conservation of Nature, and others.

American Oystercatcher and chick.
Walker Golder

Feeding shorebirds.
From the book Life on Delaware Bay Jan van der Kam

LITERATURE CITED

Andres, B.A. 2011. *Shorebird hunting workshop summary and supplemental information*. Unpublished report, Fourth Western Hemisphere Shorebird Group Meeting, U. S. Fish and Wildlife Service, Lakewood, CO, USA.

Andres, B.A., J. Johnson, S. Brown, and R. Lanctot. 2012. "Shorebirds breed in unusually high densities in the Teshekpuk Lake Special Area, Alaska." *Arctic* 66(4): 411-420.

Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. "Population estimates of North American shorebirds, 2012." *Wader Study Group Bulletin* 119: 178–194.

Atkinson, P.W., A.J. Baker, K.A. Bennett, N.A. Clark, J.A. Clark, K.B. Cole, A. Dekinga, A. Dey, S. Gillings, P.M. Gonzalez, K. Kalasz, C.D.T. Minton, J. Newton, L.J. Niles, T. Piersma, R.A. Robinson, and H.J. Sitters. 2007. "Rates of mass gain and energy deposition in Red Knot on their final spring staging site is both time- and condition-dependent." *Journal of Applied Ecology* 44:885-895.

Austin, D.F. 1978. "Exotic Plants and Their Effects in Southeastern Florida." *Environmental Conservation* 5(1): 25-34.

Baker, A.J., P.M. González, T. Piersma, L.J. Niles, Inês de Lima Serrano do Nascimento, P.W. Atkinson, N.A. Clark, C.D.T. Minton, M. Peck and G. Aarts. 2004. "Rapid population decline in Red Knots: fitness consequences of decreased refueling rates and late arrival in Delaware Bay." *Proceedings of the Royal Society B* 271:875–882.

Bart, J., B. Andres, S. Brown, G. Donaldson, B. Harrington, V. Johnston, S. Jones, R.I.G. Morrison, and S.K. Skagen. 2005. "The Program for Regional and International Shorebird Monitoring (PRISM)." In: Ralph, C.J. and T.D. Rich, (eds.). *Bird conservation implementation and integration in the Americas: Proceedings of the Third International Partners in Flight conference,* Volume 2, March 20-24, 2002, Asilomar, California. Gen. Tech. Rpt. PSW-GTR-191. Albany, CA: U.S. Forest Service, Pacific Southwest Research Station. p. 893-901.

Bart, J., S. Brown, B. Harrington, and R. I. G. Morrison. 2007. "Survey Trends of North American Shorebirds: Population declines or shifting distributions?" *Journal of Avian Biology,* 38(1): 73-82.

Boettcher, R., T. Penn, R.R. Cross, K.T. Terwilliger, and R.A. Beck. 2007. "An overview of the status and distribution of piping plovers in Virginia." *Waterbirds* 30 (special publication 1):138-151.

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. *The U.S. Shorebird Conservation Plan, 2nd Ed.* Manomet Center for Conservation Sciences, Manomet, MA.

Butler, P. J. 1995. "Marketing the conservation message: Using parrots to promote protection and pride in the Caribbean." Pages 87-102 in S. K. Jacobson, editor. *Conserving Wildlife: International Education and Communication Approaches.* Columbia University Press, New York.

Chawla, L., and D. F. Cushing. 2007. "Education for strategic environmental behavior." *Environmental Education Research* 13:437-452.

Colwell, M.A. 2010. *Shorebird ecology, conservation, and management*. University of California Press, Berkley, CA 329 pp.

Conservation Measures Partnership 2013. *Open Standards for the Practice of Conservation. Version 3.0* cmp-openstandards.org

Costanza, R., O. Pérez-Maqueo, M. Luisa Martinez. P. Sutton, S.J. Anderson, and K. Mulder. 2008. "The Value of Coastal Wetlands for Hurricane Protection." *Ambio* 37: 241-248.

Costanza, R.R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van der Belt. 1997. "The value of the world's ecosystem services and natural capital." *Nature* 387: 253-260.

D.F. Austin. 1978). "Exotic Plants and Their Effects in Southeastern Florida." *Environmental Conservation*, 5, pp 25-34. doi:10.1017/S0376892900005233.

Denmon, P., B.D. Watts, and F. M. Smith. 2013. "Investigating American Oystercatcher (Haematopus palliatus) nest failure on Fisherman Island National Wildlife Refuge." *Waterbirds* 36:156-165.

Dettmann-Easler, D. and J. L. Pease. 1999. "Evaluating the effectiveness of residential environmental education programs in fostering positive attitudes toward wildlife." *The Journal of Environmental Education* 31:33-39.

Driscoll, L., C Hunt, M. Honey, D. Durham. 2011. *The Importance of Ecotourism as a Development and Conservation Tool in the Osa Peninsula, Costa Rica.* Center for Responsible Travel (CREST). 69 pp. <responsibletravel.org/resources/documents/reports/Tinker_Final_Report_MASTER.pdf>

EPA. 2006. *Economic Benefits of Wetlands*. <water.epa.gov/type/wetlands/outreach/upload/EconomicBenefits.pdf>

Eubanks, T. 2013. "The Caribbean Birding Trail: An Interpretive Plan for Seven Key Biodiversity Areas in Grenada, Dominican Republic and Jamaica." *BirdsCaribbean,* Arlington, VA. 90 pp.

Eubanks, T. L., J.R. Stoll, and R.B. Ditton. 2004. "Understanding the Diversity of Eight Birder Characteristics, Motivations, Expenditures and Net Benefits." *Journal of Ecotourism,* 3(3), 151-172.

Estelle, V. and E.D. Grosholz. 2012 "Experimental test of the effects of a non-native invasive species on a wintering shorebird." *Conservation Biology* 26(3):472-81

Florida Fish and Wildlife Conservation Commission: Weed Alert, Australian Pine (casuarina species) <myfwc.com/media/226456/InvasivePlants_AustralianPine.pdf>

Galbraith H., D.W. DesRochers, S. Brown, and J.M. Reed (2014) "Predicting Vulnerabilities of North American Shorebirds to Climate Change." *PLoS ONE* 9(9): e108899. doi:10.1371/journal.pone.0108899

Hapke, C.J., E.A. Himmelstoss, M. Kratzmann, J.H. List, and E.R. Thieler. 2010. *National assessment of shoreline change; historical shoreline change along the New England and Mid-Atlantic coasts.* U.S. Geological Survey Open-File Report 2010-1118, 57 pp.

Haramis, G.M., W. A. Link, P.C. Osenton, D.B. Carter, R.G. Weber, N. A. Clark, M.A. Teese, and D. S. Mizrahi. 2007. "Stable isotope and pen feeding studies confirm the value of horseshoe crab (Limulus polyphemus) eggs to spring migrant shorebirds in Delaware Bay." *Journal of Avian Biology* 38 (3):367-376.

Harrington, B.R. 2008. *Coastal inlets as strategic habitat for shorebirds in the southeastern United States.* DOER Technical Notes Collection. ERDC TN – DOER - E25. Vicksburg, Mississippi: U.S. Army Engineer Research and Development Center.

Jamaica Environment Trust. 2014. Save Goat Islands: Take a Stand for our Islands. Ongoing campaign to save the Portland Bight Protected Area, Jamaica, from a proposed transshipment port and logistics hub. <savegoatislands.org/>

Jones, T and Mundkur, T. (compilers) 2010. *A review of CMS and non-CMS existing administrative/management instruments for migratory birds globally.* Prepared on behalf of the CMS Working Group on Flyways. United Nations Environment Programme Convention on Migratory Species of Wild Animals, Bonn, Germany.

Lott, C.A., C.S. Ewell, Jr., and K.L. Volansky. 2009. *Habitat associations of shoreline-dependent birds in barrier island ecosystems during fall migration in Lee County, Florida.* Dredging Operations and Environmental Research Program Publication ERDC/EL TR 09 - 14. Engineer Research and Development Center, U.S. Army Corps of Engineers, Washington, D.C. 110p.

Mizrahi, D.S., K.A. Peters, and P.A. Hodgetts. 2012. "Energetic condition of Semipalmated and Least Sandpipers during northbound migration stopover periods in Delaware Bay." *Waterbirds* 34: 135-145.

Morrison, R.I.G. and K.A. Hobson. 2004. "Use of body stores in shorebirds after arrival on high-Arctic breeding grounds." *Auk* 121:333-344.

Morrison, R.I.G. and R.K. Ross. 1989. *Atlas of Nearctic shorebirds on the coast of South America.* Canadian Wildlife Service Special Publication, Ottawa.

Morrison, R.I.G., D.S Mizrahi, R.K. Ross, O.H. Ottema, N. de Pracontal, and A. Narine. 2012. "Dramatic declines of Semipalmated Sandpipers on their major wintering areas in the Guianas, Northern South America." *Waterbirds* 34:120-134.

Morton, J.F. 1980. "The Australian Pine or Beefwood (*Casuarina equisetifolia L*), An Invasive "Weed" Tree in Florida." *Proceedings of the Florida State Horticultural Society* 93:87-95.

Morton, R. A., and T.L. Miller. 2005. *National assessment of shoreline change: Part 2: Historical shoreline changes and associated coastal land loss along the U.S. Southeast Atlantic Coast*. U.S. Geological Survey Open-file Report 2005-1401.

Myers, J. P. 1983. "Conservation of migrating shorebirds: Staging areas, geographic bottlenecks and regional movements." *American Birds* 37:23-24.

National Oceanic and Atmospheric Administration. "Coastal wetlands in eastern U.S. disappearing." *Science Daily,* 20 February 2009. <www.sciencedaily.com/releases/2009/02/090219141134.htm>.

Niles, L., H. Sitters, A. Dey, and Red Knot Status Assessment Group. 2010. *Red Knot Conservation Plan for the Western Hemisphere (Calidris canutus),* Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Niles, L.J., J.P. Sitters, A.D. Dey, A.J. Baker, R.I.G. Morrison, D. Hernandez, K.E. Clark, B.A. Harrington, M.K. Peck. P.M. Gonzalez, K.A. Bennett, K. Kalasz, P.W. Atkinson, N. A. Clark, and C.D.T. Minton. 2007. *Status of the Red Knot* (Calidris canutus rufa) *in the Western Hemisphere.* US Fish and Wildlife Service, New Jersey, USA.

Nisbet, I, C. T. 2000. "Disturbance, habituation, and management of waterbird colonies." *Waterbirds* 23: 312–322.

North American Bird Conservation Initiative. 2016. *The State of North America's Birds 2016*. Environment and Climate Change Canada: Ottawa, Ontario. 8 pages.

Ottema, O.H., and A. L. Spaans. 2008. "Challenges and advances in shorebird conservation on the Guianas, with a focus on Suriname." *Ornithologia Neotropical* 19(Supplement): 339-346.

Parry ML, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson, editors. 2007. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA.

Powell, R.B. and S.H. Ham. 2008. "Can Ecotourism Interpretation Really Lead to Pro-Conservation Knowledge, Attitudes and Behaviour? Evidence from the Galapagos Islands." *Journal of Sustainable Tourism* 16: 467-489.

Raffaele, H.A. and J. Wiley. 2014. *Wildlife of the Caribbean.* Princeton University Press. 304 pp.

Reed, E. T. 2012. *Evaluation of the Barbados shorebird harvest between 1988 and 2010.* Unpublished report, Canadian Wildlife Service, Barbados Wildfowlers Association, and BirdLife International, Canadian Wildlife Service, Gatineau, Québec, Canada.

Rice, T.M. 2012. "Inventory of Habitat Modifications to Tidal Inlets in the Coastal Migration and Wintering Range of the Piping Plover (Charadrius melodus)." Appendix 1B in *Draft Comprehensive Conservation Strategy for the Piping Plover (Charadrius melodus) Coastal Migration and Wintering Range,* U.S. Fish and Wildlife Service. 35pp.

Robertson, H. and L.G. Sorenson. 2013. "Caribbean Birding Trail: Draft Operational Plan." *BirdsCaribbean,* Arlington, VA. 24 pp.

Rovai, A.S., E.J. Soriano-Sierra, P.R Pagliosa. et al. 2012. "Secondary succession impairment in restored mangroves." *Wetlands Ecology and Management* 20: 447.

Senner, S.E. and M.A. Howe. 1984. "Conservation of Nearctic shorebirds." 1084. Pages 379-421, in *Behavior of Marine Animals,* Vol. 6, Shorebirds, Breeding behavior and populations (J. Burger and B. Olla, Eds.). Plenum Press, New York, USA.

Smith, C.G., S.J. Culver, S.R. Riggs, D. Ames, D.R. Corbett, and D. Mallinson. 2008. "Geospatial analysis of barrier island width of two segments of the Outer Banks, North Carolina, USA: Anthropogenic curtailment of natural self-sustaining processes." *Journal of Coastal Research* 24(1):70 - 83.

Smith, R.L. 2010. *Invasive alien plant species of the Bahamas and biodiversity management: a practicum report*. Miami University, Oxford, Ohio, USA. <ufdcimages.uflib.ufl.edu/AA/00/00/46/18/00001/Smith_Ross_L.pdf>

Sorenson, L.G. and G. Gerbracht. 2014. Building Capacity for Waterbird and Wetland Conservation: The Caribbean Waterbird Census (CWC) - 2014 Report.

Sorenson, L.G. 2008. *Participatory Planning Workshop for the Restoration of Ashton Lagoon: Workshop Proceedings and Final Report*. The Society for the Conservation and Study of Caribbean Birds and Sustainable Grenadines Project. 99 pp..

Sorenson, L.G., P.E. Bradley, and A. Haynes-Sutton. 2004. "The West Indian Whistling-Duck and Wetlands Conservation Project: A Model for Species and Wetlands Conservation and Education." *Journal of Caribbean Ornithology* 17: 72-80.

U.S. Fish and Wildlife Service. 1996. *Piping Plover* (Charadrius melodus), *Atlantic Coast Population, revised recovery plan.* Hadley, Massachusetts. 258 pp.

U.S. Fish and Wildlife Service. 2008. *Birds of Conservation Concern 2008*. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp.

U.S. Fish and Wildlife Service. 2009. *Piping Plover* (Charadrius melodus), *5-year review: summary and evaluation.* Hadley, Massachusetts. 206 pp.

U.S. Fish and Wildlife Service. *2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation.* Washington, D.C. 162 pp.

United Nations Environment Programme. 2006. *Marine and Coastal Ecosystems and Human Well-being: A synthesis report based on the findings of the Millennium Ecosystem Assessment.* UNEP. 76 pp.

U.S. Shorebird Conservation Plan Council. 2012. *Strategy for Implementing the U.S. Shorebird Conservation Plan* (2012–2016). www.shorebirdplan.org/wp-content/uploads/2013/03/USSCPStrategicPlanJul2012.pdf Wheeler, G. S., G. S. Taylor, J. F. Gaskin, and M. F. Purcell 2011. "Ecology and Management of Sheoak (Casuarina spp.), an Invader of Coastal Florida, U.S.A." *Journal of Coastal Research:* Volume 27, Issue 3: pp. 485 – 492.

Winn, B, C, Spiegel, D. Reynolds, and S. Johnston. 2013. *The Atlantic Flyway Shorebird Business Strategy: A Call to Action, Phase* manometcenter.pairserver.com/sites/default/files/publications_and_tools/AtlanticFlywayShorebirdBusinessStrategy.pdf

Marbled Godwit.
Jim Fenton

I believe I can fly!
Wilson's Plover chick. Mark Vance

APPENDIXES

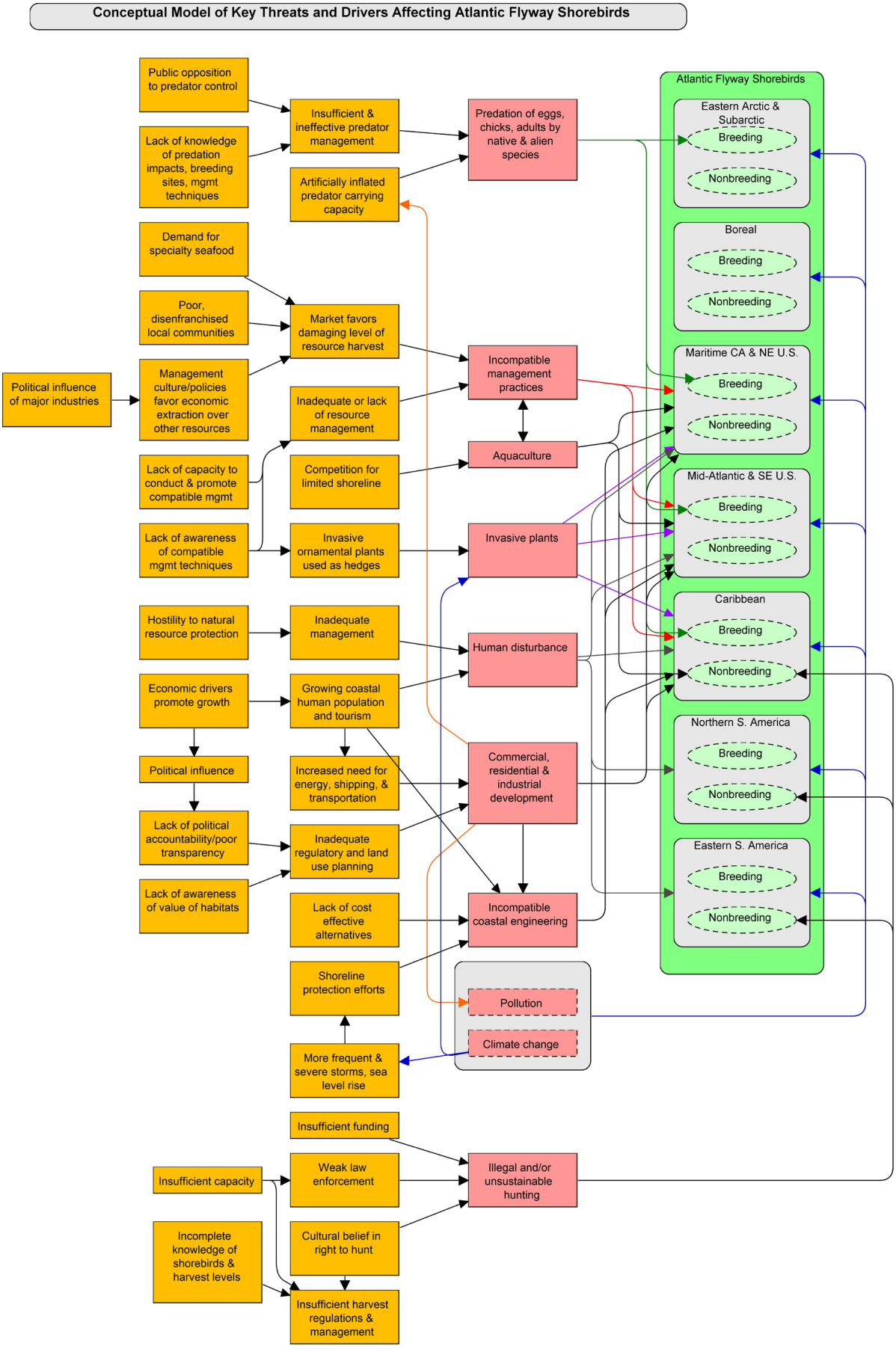
Appendix A: Conceptual model of key threats and drivers of the Atlantic Flyway Shorebird Initiative

Appendix B: Results chains

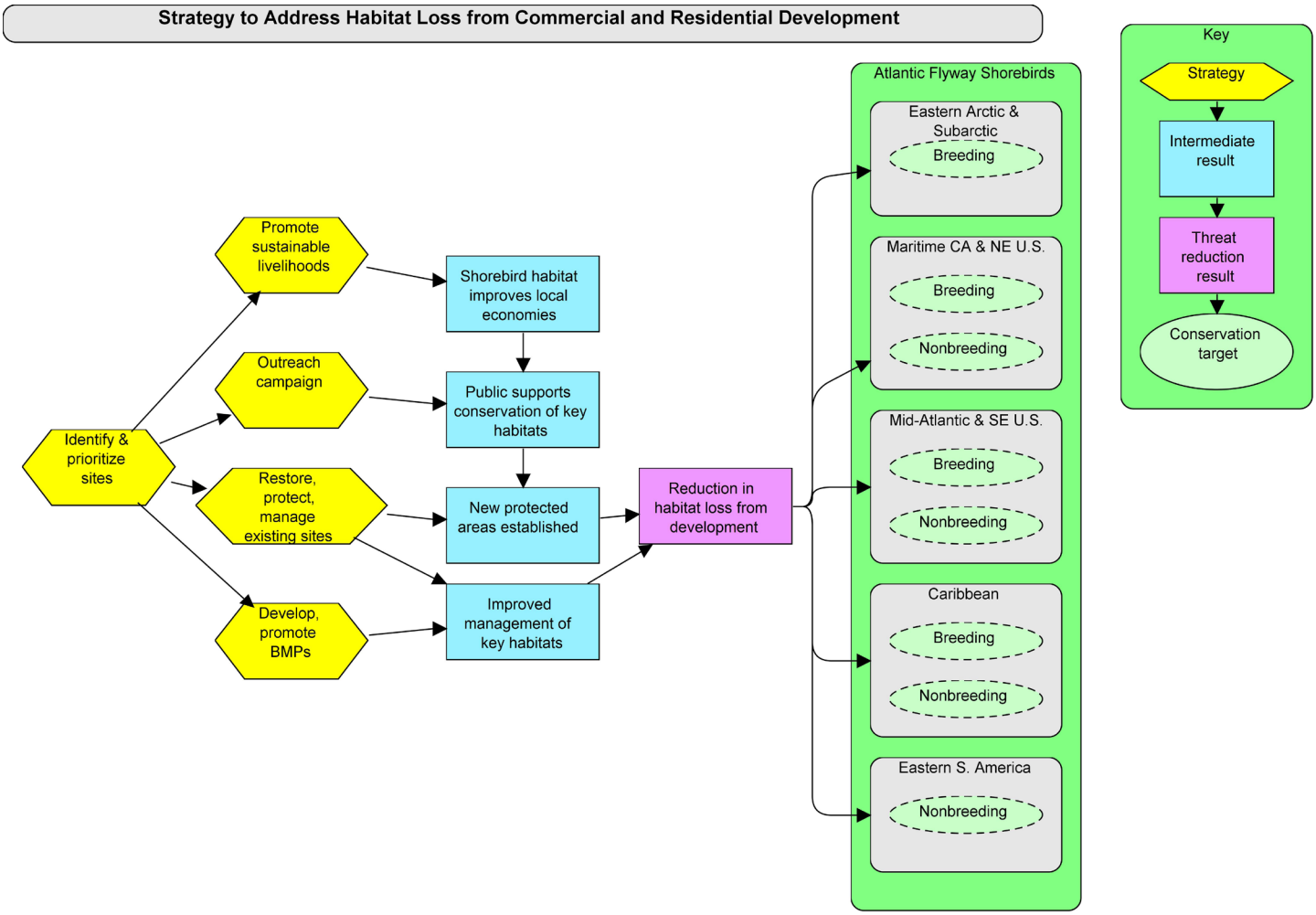
Appendix C: Objectives and metrics for measuring progress on Atlantic Flyway shorebird Focal Species and strategies

Appendix D: Ten-year budget to implement the Atlantic Flyway Shorebird Business Plan

APPENDIX A
Conceptual model of key threats and drivers of the Atlantic Flyway Shorebird Initiative



APPENDIX B
Results chains
Residential and Commercial Development



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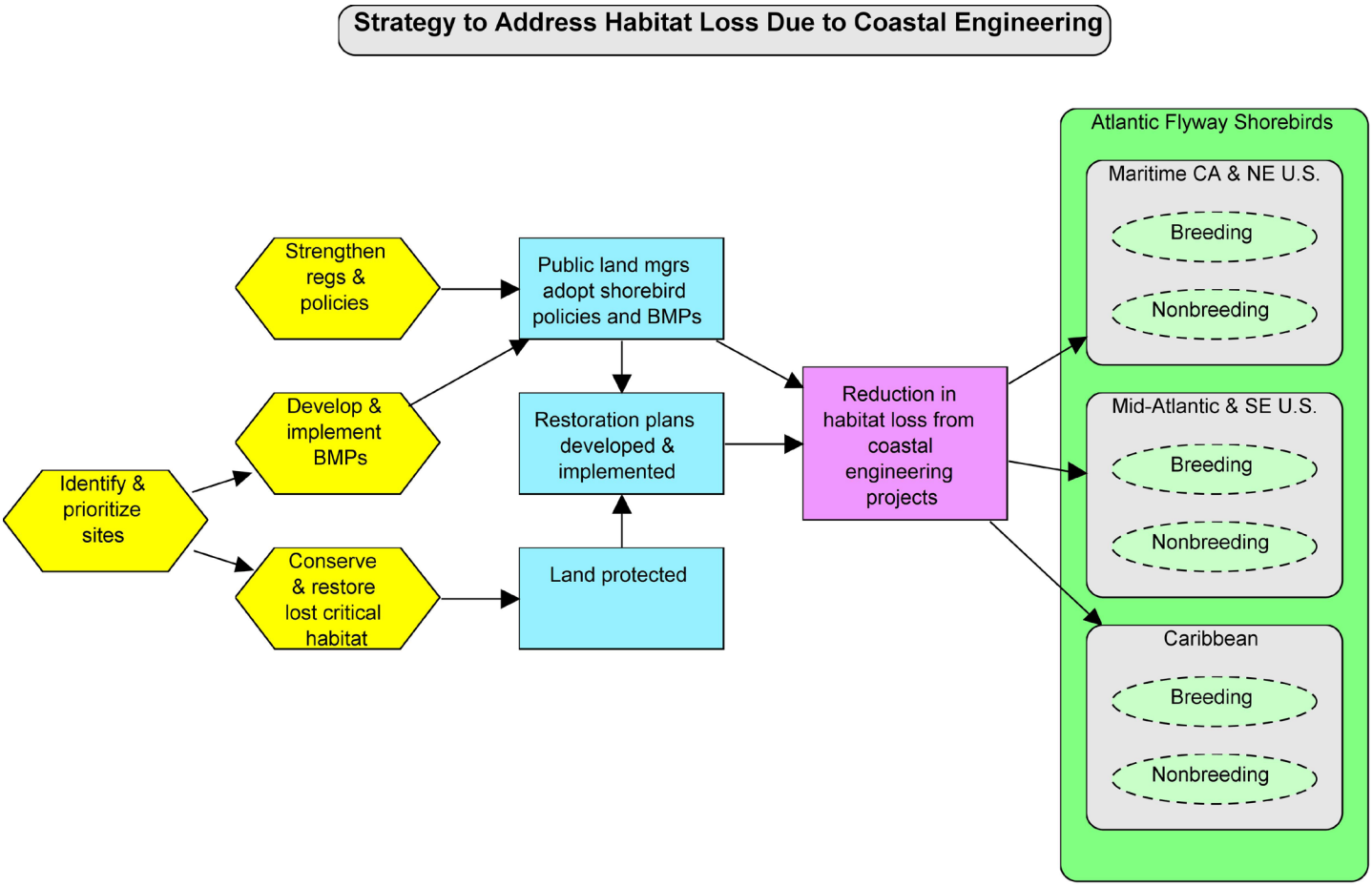
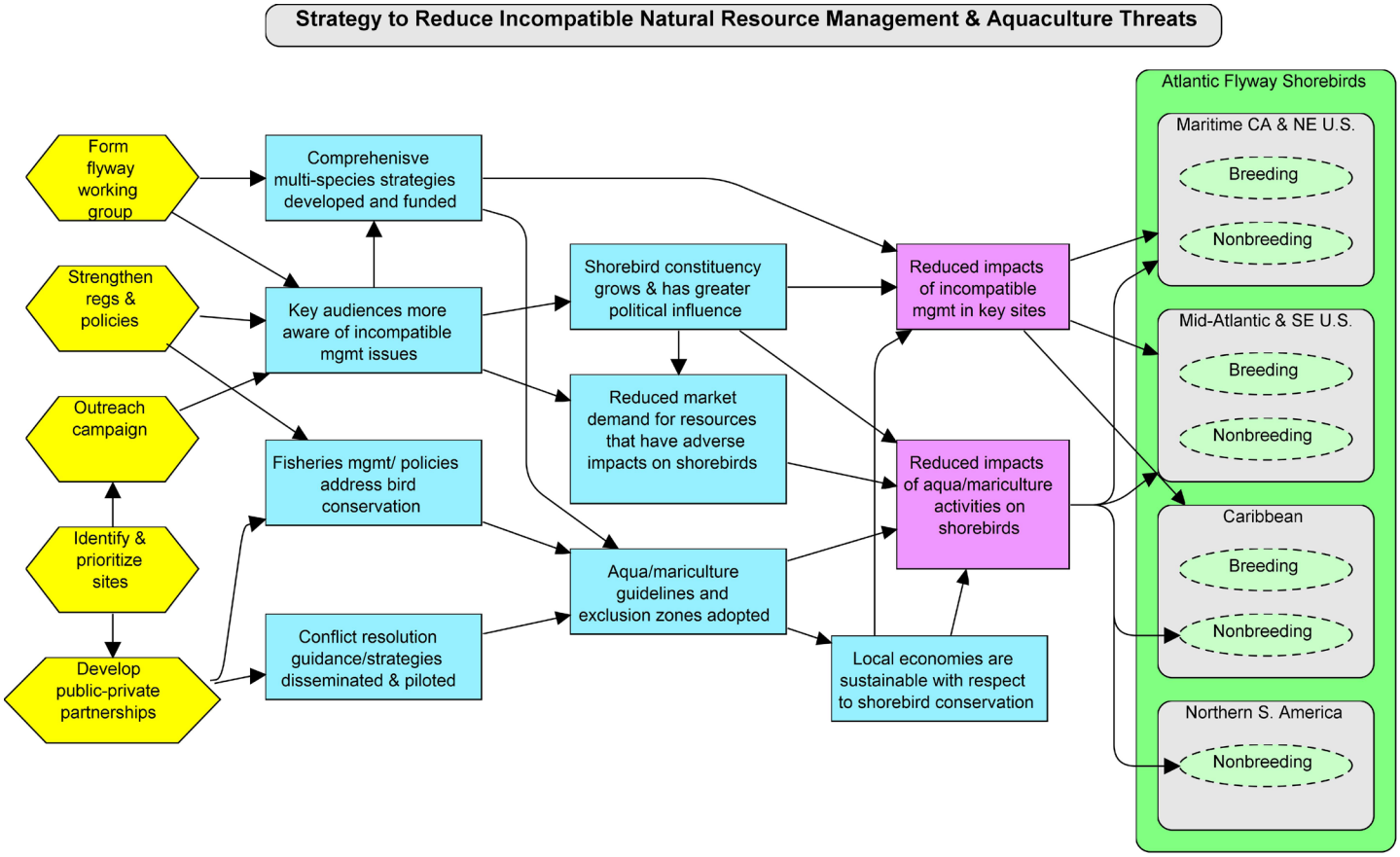
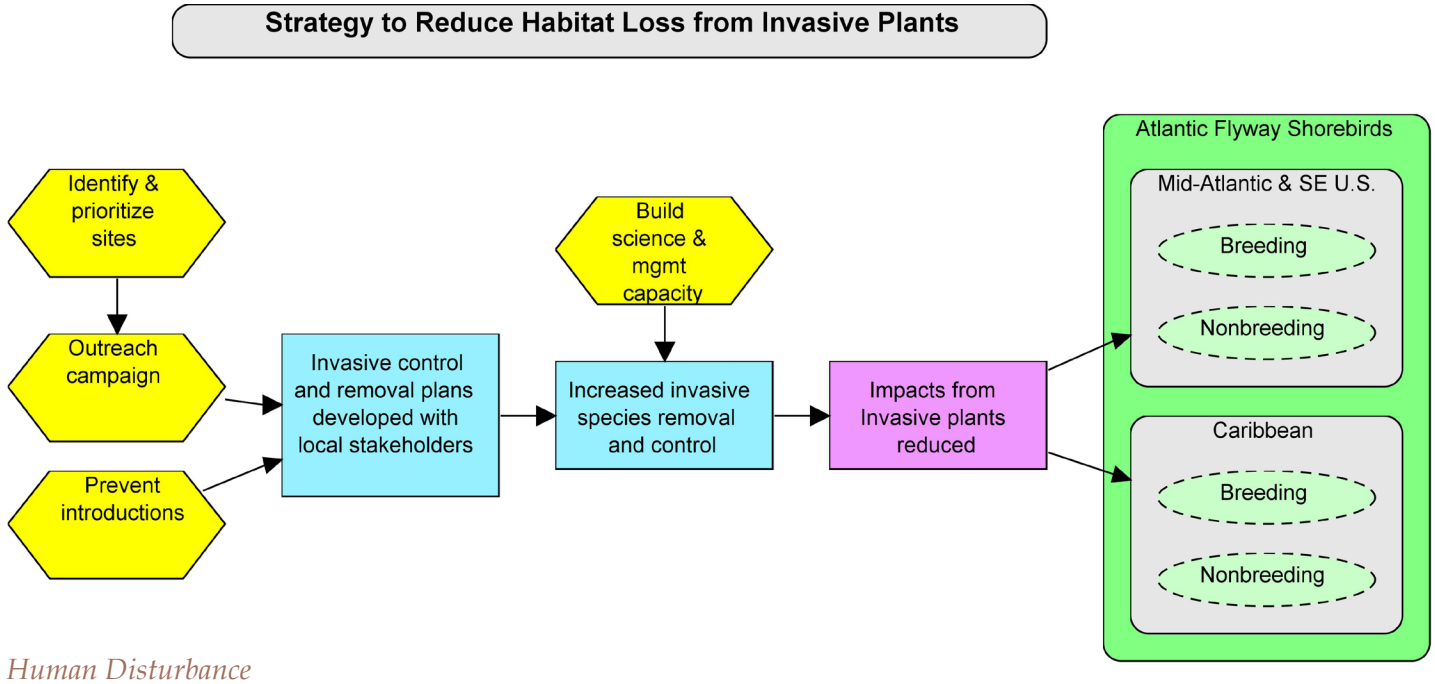


Incompatible Management



Invasive Species



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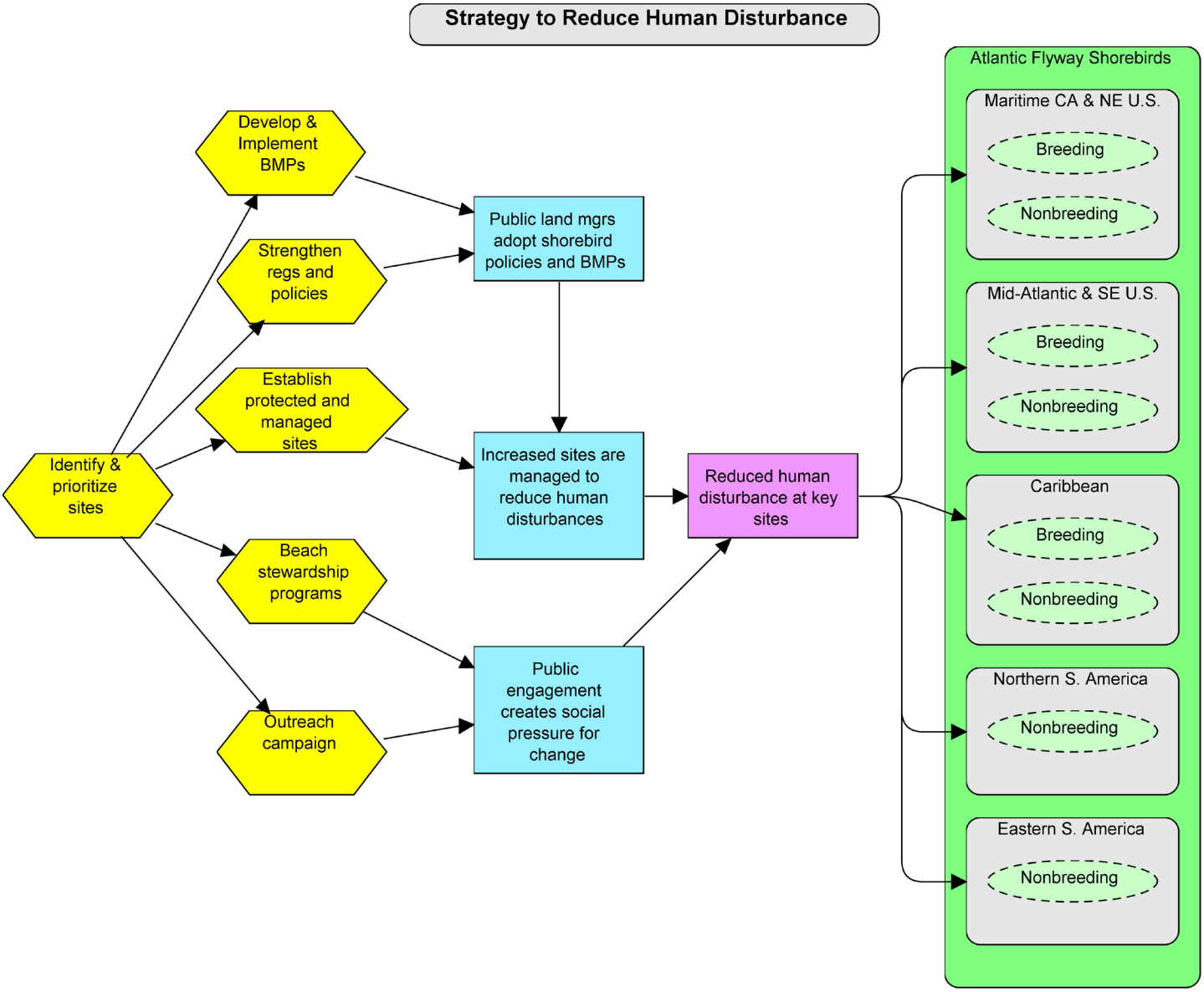

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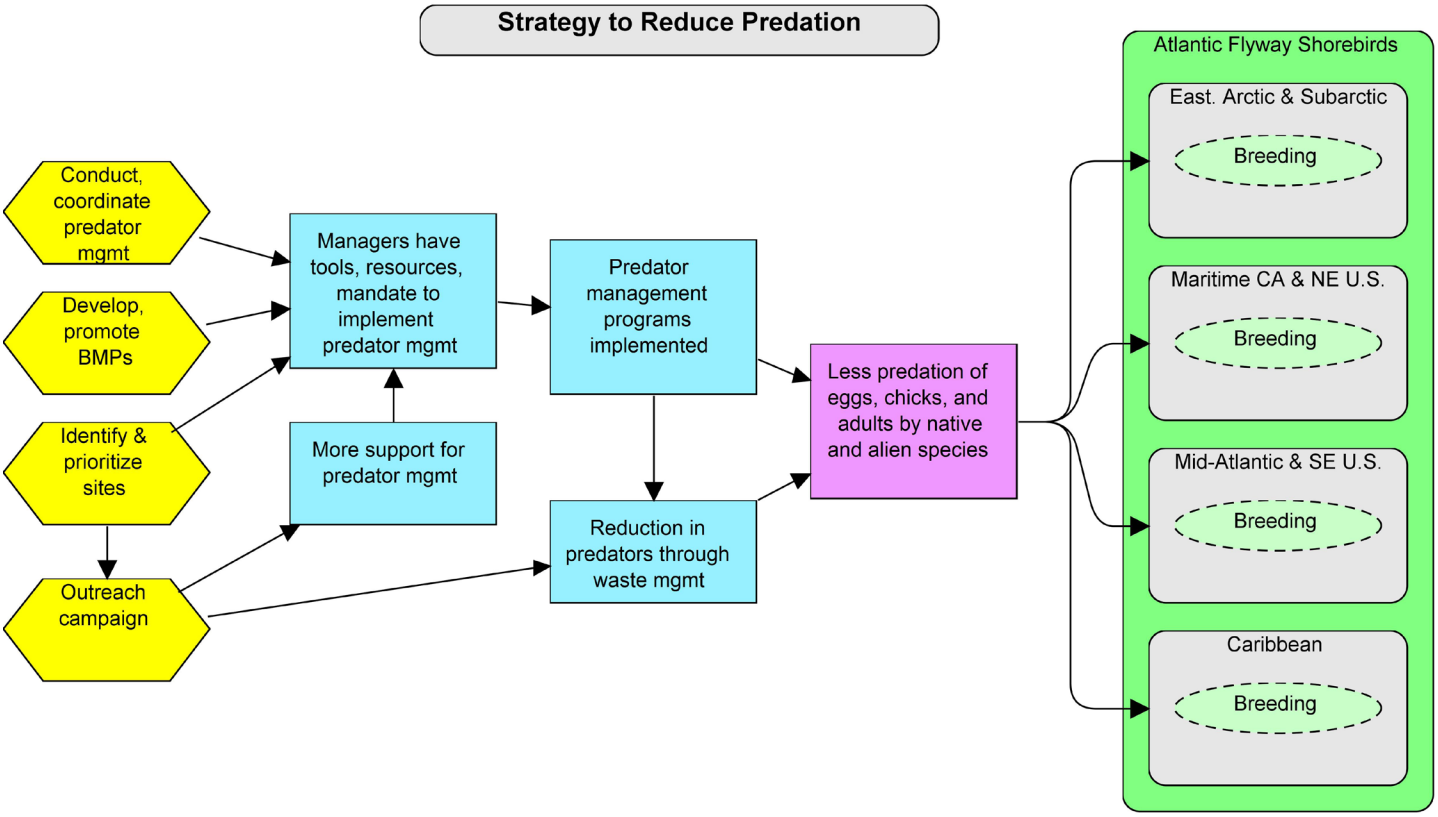
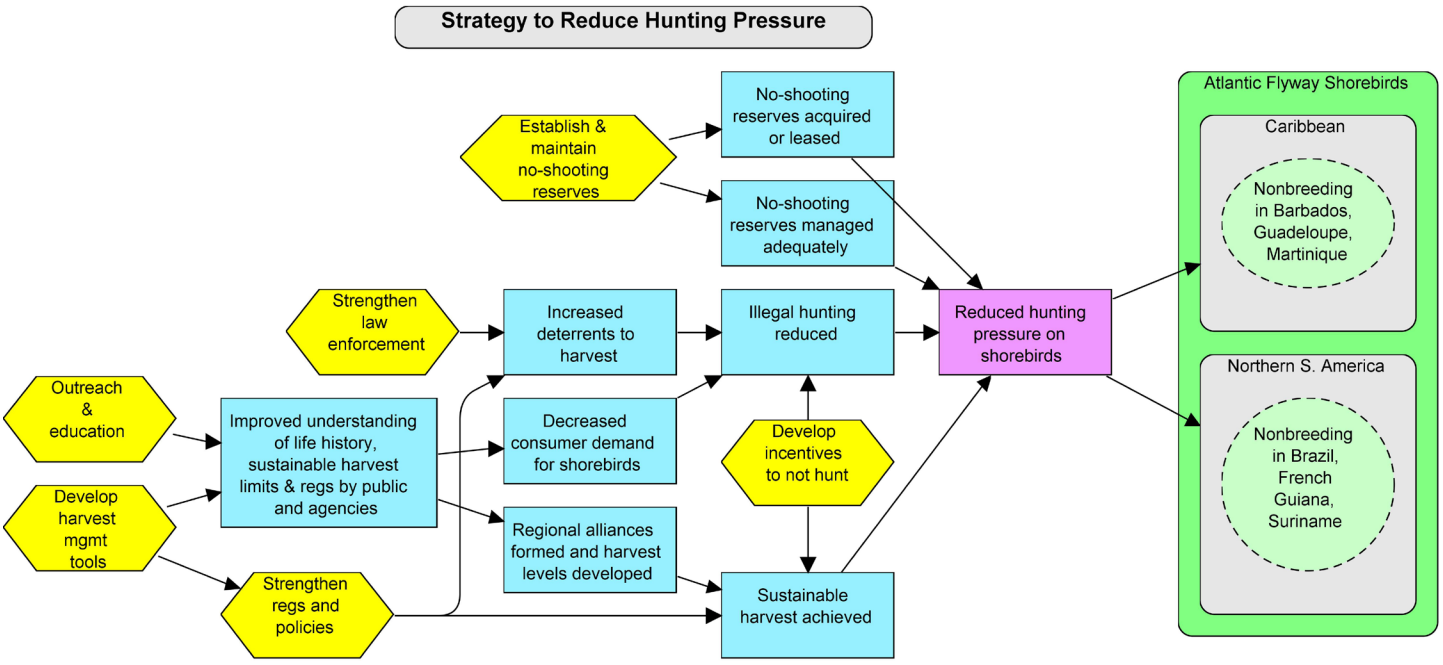


Hunting



APPENDIX C

Objectives and metrics for measuring progress on Atlantic Flyway shorebird Focal Species and strategies.

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Focal Species		Increase shorebird population levels by 10-15%.	10-15%	% increase in population
		Increase American Oystercatcher (AMOY) population level by 30%.	30%	% increase in population
		Increase AMOY reproductive success from 0.25 to 0.5 chicks/pair.	0.5	# young per breeding pair
		Increase Red-necked Phalarope, Golden Plover, Greater and Lesser Yellowlegs, Marbled Godwit, Piping Plover, Purple Sandpiper, Red Knot, Ruddy Turnstone, Sanderling, Snowy Plover, Wilson's Plover, and Whimbrel population levels by 10-15%.	10-15%	% increase in population
		Increase Semipalmated Sandpiper population level by 5%.	5%	% increase in population
Protect and Manage Habitat: Commercial and Residential Development Strategy	Strategy Outcome by 2025	Prevent decline and/or increase the number of acres of shorebird habitat by 10% from 2014 levels.	10% increase in habitat protected	Acres restored or protected
	Strategy Outcome by 2025	Increase shorebird use at managed sites by 10%.	10% population increase	% increase in population
	Identify and prioritize critical shorebird sites across the entire Atlantic Flyway	By 2015, compile, map, and rank known priority sites for conservation action; by 2020, identify, map, and assess 25 new priority sites for shorebirds. Develop a guidance document that identifies and prioritizes the major shorebird sites in the mid-Atlantic U.S. by 2015; the southeast U.S., northeast U.S., and Atlantic Canada by 2016; and the Caribbean and South America by 2020.	25 sites 3 documents	% of prioritization effort complete
	Increase the management, enhancement, restoration, and protection of existing shorebird sites	By 2025, protect, restore, enhance or improve management on 50,000 acres of priority habitat to benefit shorebirds.	50,000 acres	Acres protected, enhanced, or restored or acres under improved management
	Build capacity and promote sustainable livelihoods at important shorebird sites*	By 2025, facilitate and promote sustainable nature-based economic opportunities that benefit local communities at 30 priority sites. Complete economic analyses or pilot projects to demonstrate financial success and number of acres protected.	30 sites	# of conservation demonstration sites

Purple Sandpiper. Tim Lenz

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Protect and Manage Habitat: Commercial and Residential Development Strategy	Develop outreach campaigns to build a constituency supporting conservation of shorebird habitats*	By 2025, develop and implement targeted outreach campaigns for 15 priority shorebird sites. Success will be evaluated using a number of metrics including: (1) the # of stakeholders petitioning for new protected lands and better management; (2) the # of businesses developing "shorebird friendly" policies; and (3) the # of private landowners requesting information on protecting, restoring, and enhancing their lands for shorebirds.	15 sites	# of individuals reached by outreach, training, or technical assistance activities or # of individuals demonstrating a minimum level of behavior change (see objective column for specific behavioral metrics)
	Develop Best Management Practices for shorebird habitat management and protection*	By 2019, develop BMPs to guide management and protection of shorebird habitats; implement BMPs at up to 50% of priority shorebird sites. By 2025, at least 25% of jurisdictions responsible for shorebird sites incorporate BMPs into local legislation and enforcement policies.	up to 50% of sites 25% or more of sites	# of BMP recommendations developed or # of management plans into which BMPs were incorporated

Building a conservation constituency can be as simple as showing a child what a shorebird is.
Caleb Spiegel

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Protect and Manage Habitat: Coastal Engineering Strategy	Strategy Outcome by 2025	Restore 20,000 acres of high quality, intertidal (wet sand) habitats.	20,000 acres	Acres restored
	Strategy Outcome by 2025	Restore 3,000 acres of supratidal (dry sand) habitat.	3,000 acres	Acres restored
	Develop Best Management Practices for coastal projects	In collaboration with the coastal states and federal agencies, secure long-term protection for shorebird habitats through effective coastal engineering legislation that requires the use of BMPs, and institutes a mandatory regional planning process for protecting shorebird habitat in coastal areas. With a no-net-loss policy agreement, apply BMPs to a minimum of 60% of the engineering projects carried out by the North Atlantic District, South Atlantic District, and Caribbean Region of the USACE by 2025.	60% of projects	# of management plans into which BMPs were incorporated
	Enact regulatory and policy reform	By 2025, at least 10 of 17 states (60%) in the U.S. Atlantic Flyway adopt regulations and policies regarding coastal sediment management that include BMPs and no-net-loss terminology for intertidal and supratidal shorebird habitat.	60% of sites (states)	# of management plans into which BMPs were incorporated
	Conserve and restore critical habitat, sediment deposition, and inlet function	Restore the function of coastal processes that maintain and create critical habitat for shorebirds by working within at least 10 states, or 60% of the U.S. Atlantic Flyway coastline, 50% of the USACE Caribbean Islands Region, and opportunistically throughout the Caribbean Island nations. Coastal habitat projects increase shorebird use of historical and new priority sites by a minimum of 15 percent on average.	60%, 50% of sites 15%	# of habitat units with improved status or acres under improved mgmt. % increase in population
	Prioritize inlets and deltas for restoration and protection	By 2025, all Focal Geographies throughout the temperate and tropical regions of the Atlantic Flyway will have been assessed for historical, current, and potential future shorebird use and importance. Build a portfolio of sites assessing overall value, vulnerability, and potential for improvement of function as viable shorebird habitat.	100% of sites	% of prioritization effort complete

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Protect and Manage Habitat: Incompatible Natural Resource Mgmt Strategy	Strategy Outcome by 2025	BMP guidance documents and model projects are developed to demonstrate integration of species and stakeholder needs and contribute to overall shorebird conservation objectives	TBD	# of BMP documents and model projects developed
	Strategy Outcome by 2025	Effects of incompatible management reduced at 50% of the critical shorebird sites throughout the Atlantic Flyway	50% of sites	Acres under improved management
	Form a flyway-wide working group to address multi-species management that averts conflicts	By 2016, convene initial meetings in North America, the Caribbean Basin, and South America to assess the scale and scope of incompatible management practices across the flyway.	3 meetings	# meetings
	Develop public/ private partnerships that address conflicts between shorebird conservation needs and wildlife resource extraction objectives	By 2025, develop, implement, and complete ten pilot projects throughout the flyway to inform future implementation projects. By 2025, implement ten projects using conflict resolution strategies developed through pilot projects.	10 pilots	# successful pilot projects
	Develop guidance documents that assist site and natural resource managers in resolving conflicts identified by flyway-wide working group	By 2020, develop a guidance document informed by expertise from the flyway-wide working group and lessons learned from pilot public/private partnership and implementation projects.	1 document (2020)	# of BMP recommendations developed
	Improve education and outreach	Design a social marketing campaign that guides consumers toward fishery and aquaculture products that result from balanced management via public/private partnerships.	1 campaign	# people reached, media hits
	Strengthen legislation and policies*	By 2020, obtain one positive policy change regarding an incompatible management issue.	1 policy change	Completion of policy

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Protect and Manage Habitat: Invasive Species Strategy	Strategy Outcome by 2025	Impacts of invasive species reduced at 10 priority (location specified) shorebird sites	10 sites	# sites or # acres
	Develop preventive measures for invasive species introductions	By 2020, develop a cooperative initiative with relevant agencies to inform and implement a program to minimize the introduction of invasive species detrimental to shorebird survival.	TBD	TBD
	Map critical shorebird sites impacted by invasive organisms	By 2016, identify priority shorebird sites impacted by invasive species with a focus on temperate and tropical regions.	All priority sites	% of prioritization complete
	Develop an awareness campaign to empower local stakeholders to participate in invasive species prevention and management efforts at priority shorebird sites	By 2018, develop site-specific invasive control and removal strategies for 10 shorebird sites. By 2025, implement invasive species management strategies at 10 sites to enhance priority shorebird habitats.	# sites or amount of area	# acres, # sites
	Build local science and management capacity in the Caribbean*	By 2018, increase the number of staff in the Caribbean who have knowledge to develop, implement, fund, and manage invasive plant eradication projects.	5	# people
Minimize Predation Impacts Strategy	Strategy Outcome by 2025	Reduced predation (number of nests, chicks, and adults lost annually to predators) at approximately 180 priority breeding sites for AMOY, SNPL, WIPL, and PIPL	180 sites	# of sites with predation goals met
	Develop and promote best practices for predator monitoring and management	Evaluate the effectiveness of existing predator management practices and, where appropriate, implement updated cost-effective and efficient techniques that minimize risks to non-target predators. By 2016, develop, disseminate, and promote a BMP document that will facilitate effective and efficient predator management at scale.	1 document	# of studies completed whose findings are reported to management # of BMP recommendations developed
	Implement and coordinate predator management efforts	Develop a coordinated process for organizations to implement predator management at a network of approximately 180 priority breeding sites.	180 priority sites	# sites
	Outreach campaign for predator management support*	Implement outreach efforts in 75% of communities adjacent to or near critical shorebird breeding sites. Develop and implement a scoring system to track improvements in waste management practices that reduce resources supporting predator populations.	75% of communities, sites;	# of individuals reached by outreach, training, or technical assistance activities or # of individuals demonstrating a minimum level of behavior change; local funding levels for improved waste and predator management

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Reduce Human Disturbance Strategy	Strategy Outcome by 2025	Human disturbance events reduced by 90% on all actively managed sites	90% of sites	Acres (or miles) with disturbance reduced to a minimum level
	Identify and prioritize key shorebird sites	By 2015, assess and prioritize sites threatened by human disturbance.		% of prioritization effort complete
	Develop Best Management Practices	By 2016, develop, publish, and distribute BMPs for controlling human disturbance of breeding, migrating, and wintering shorebirds, with endorsement by the Atlantic Flyway Shorebird Group.	1 document	# of BMP recommendations developed
	Establish a network of sites protected and appropriately managed to reduce disturbances	Establish a stewardship fund for protection and restoration of Atlantic Flyway shorebird habitat on private lands within priority sites managed to reduce disturbances.	Network establish-ed	# of sites in the network active and functioning
	Establish beach stewardship programs*	By 2018, reduce threats from human disturbance at 350 sites through active stewardship by 3,000 beach stewards.	3,000 stewards	# of individuals demonstrating a minimum level of behavior change
	Increase awareness of shorebirds*	Improve public attitudes toward shorebird protection by 25% within 3 years of implementing a social marketing campaign.	25% increase	# of individuals demonstrating a minimum level of behavior change
	Strengthen conservation regulations and policies*	By 2020, BMPs for reducing human disturbance threats are formally adopted as management policy on 90% of state and federal conservation lands and are required for all mitigation projects associated with federal permits that impact shorebirds or shorebird habitats.	90% of sites	# of management plans into which BMPs were incorporated
Reduce Hunting Pressure Strateg	Strategy Outcome by 2025	Reducing hunting pressure 20%.	20% reduction	Mortality rate
	Strengthen law enforcement	By 2025, reduce illegal hunting 20%, with initial focus on the Caribbean, French Guiana, and Suriname.	20% reduction	Mortality rate
	Develop harvest management tools	By 2018, conduct assessments in four countries (French Guiana, Suriname, Barbados, Guadeloupe and associated French Territories) where hunting is known to occur and information is lacking.	4 assess-ments (2018)	% of prioritization effort complete
	Strengthen legislation and policies	By 2018, obtain one positive policy change in each jurisdiction.	1 change	
	Establish and maintain no-shooting reserves*	By 2020, establish one new no-shooting reserve and adequately manage three existing no-shooting reserves for shorebirds.	1 new, 3 managed reserves	Acres under improved management

Category	Strategy Actions	Species Goals/ Strategy Objectives	2025 Target	Standard Metrics
Reduce Hunting Pressure Strateg	Strategy Outcome by 2025	Reducing hunting pressure 20%.	20% reduction	Mortality rate
	Strengthen law enforcement	By 2025, reduce illegal hunting 20%, with initial focus on the Caribbean, French Guiana, and Suriname.	20% reduction	Mortality rate
	Develop harvest management tools	By 2018, conduct assessments in four countries (French Guiana, Suriname, Barbados, Guadeloupe and associated French Territories) where hunting is known to occur and information is lacking.	4 assessments (2018)	% of prioritization effort complete
	Strengthen legislation and policies	By 2018, obtain one positive policy change in each jurisdiction.	1 change	
	Establish and maintain no-shooting reserves*	By 2020, establish one new no-shooting reserve and adequately manage three existing no-shooting reserves for shorebirds.	1 new, 3 managed reserves	Acres under improved management
	Develop incentives to not hunt*	By 2020, develop and implement a hunting guide and monitoring program in Guadeloupe and a biological monitoring scheme in Suriname. By 2020, assess pilot initiatives that provide incentives to reduce shorebird hunting at priority sites in Barbados and the French territories.	1 document	# of tools developed or # of studies completed whose findings are reported to management
	Improve education and communication*	Build a hunter association forum over the next three years to discuss management of the shorebird harvest at regional scales, which can be modeled on the Flyway Councils used to manage game birds in the U.S. Initial focus on increased coordination and information exchange among French-speaking Focal Territories, provinces and departments.	1 forum (2018)	Presence of forum
Fill Knowledge Gaps Strategy	Refine baseline population estimates for shorebird Focal Species	By 2020, obtain and use population size and/or trends for Focal Species to inform conservation efforts throughout the Atlantic Flyway.		
	Establish a flyway approach to monitoring populations of shorebird Focal Species	By 2017, establish a unified monitoring protocol to measure changes in shorebird population along the Atlantic Flyway.		

APPENDIX D

Ten-year budget to implement the Atlantic Flyway Shorebird Business Plan.

Budget:
Atlantic Flyway Shorebird Initiative

1. Manage and Protect Habitat - Commercial and Residential Development

Strategy	Tier	Costs ($US)	
		Annual	2015-25
Increase the management, enhancement, restoration, and protection of existing shorebird sites	1	1,381,000	13,810,000
Build capacity for and promote sustainable livelihoods at important shorebird sites	2	170,000	1,700,000
Develop targeted outreach campaigns to build a constituency that supports conservation of key shorebird habitats	2	590,000	5,900,000
	Subtotal	**2,141,000**	**21,410,000**

2. Manage and Protect Habitat - Coastal Engineering

Strategy	Tier	Costs ($US)	
		Annual	2015-25
Develop BMPs for coastal projects	1	350,000	1,750,000
Regulatory and policy reform	1	175,000	1,750,000
Conservation and restoration of critical habitat, sediment deposition, and inlet function	1	120,000	1,200,000
	Subtotal	**645,000**	**4,700,000**

3. Manage and Protect Habitat - Incompatible Natural Resource Management

Strategy	Tier	Costs ($US)	
		Annual	2015-25
Form a flyway-wide working group to address multi-species management that averts conflicts	1	60,000	360,000
Develop public/private partnerships that address shorebird conservation needs and wildlife resource extraction objectives	1	675,000	6,750,000
Develop guidance documents to assist site/natural-resource managers in resolving conflicts identified by flyway-wide working group	1	50,000	250,000
Improve education and outreach about incompatible natural resource management	1	300,000	600,000
Strengthen legislation and policies regarding incompatible management	2	100,000	100,000
	Subtotal	**1,185,000**	**8,060,000**

4. Manage and Protect Habitat - Invasive Species Management

Strategy	Tier	Costs ($US)	
		Annual	2015-25
Seek preventive measures for exotic species	1	100,000	1,000,000
Develop an awareness campaign to empower local stakeholders to participate in invasive species management efforts at critical shorebird sites	1	220,000	1,320,000
Build local science and management capacity in the Caribbean	2	100,000	1,000,000
	Subtotal	**420,000**	**3,320,000**

5. Minimize Predation Impacts

Strategy	Tier	Costs ($US)	
		Annual	2015-25
Develop and promote best practices for predator monitoring and management	1	205,000	410,000
Implement and coordinate predator management efforts	1	953,000	9,530,000
Outreach campaign for predator management support	2	100,000	1,000,000
	Subtotal	**1,258,000**	**10,940,000**

6. Reduce Human Disturbance

Strategy	Tier	Costs ($US)	
		Annual	2015-2025
Develop BMPs	1	80,000	240,000
Protect/manage sites	1	6,000,000	15,000,000
Strengthen regulations/policies	2	65,000	325,000
Beach stewardship	2	1,000,000	10,000,000
Increase awareness	2	500,000	5,000,000
	Subtotal	**7,645,000**	**30,565,000**

7. Reduce Hunting Pressure

Strategy	Tier	Costs ($US)	
		Annual	2015-25
Strengthen law enforcement	1	50,000	500,000
Develop harvest management tools	1	80,000	800,000

Strengthen legislation and policies	1	30,000	300,000
Maintain no-shooting reserves	1	90,000	900,000
Establish no-shooting reserves	2	variable	250,000
Develop incentives to not hunt	2	30,000	300,000
Improve education and communication	2	40,000	400,000
	Subtotal	**320,000**	**3,450,000**

8. Fill Knowledge Gaps			
Strategy	Tier	Costs ($US)	
		Annual	2015-25
Identify and prioritize critical shorebird sites across the entire Atlantic Flyway	1	250,000	500,000
Establish baselines of demographic parameters for Arctic-breeding shorebirds and evaluate hypotheses for causes of population decline (ASDN)	1	50,000	100,000
Determine the abundance and distribution of Arctic-breeding shorebirds (PRISM)	1	400,000	1,200,000
Obtain more rigorous data describing shorebirds' use of all Focal Areas by developing and implementing a formal sampling plan	1	400,000	4,000,000
Provide essentially unbiased estimates of population size and trends for shorebirds that aggregate at beach stopovers of the Atlantic flyway	1	135,000	405,000
Identify important stopover and wintering sites for shorebirds in the Caribbean and monitor trends in population size and distribution	1	210,000	630,000
Assess population status (abundance and distribution) of shorebirds wintering along the coast of northern South America	1	10,000	100,000
Assess population status (abundance, distribution, and trends) of shorebirds wintering in South America	1	100,000	1,000,000
	Subtotal	**1,555,000**	**7,935,000**
TOTAL		15,169,000	90,380,000

Biologists spend long days in the Arctic conducting bird surveys ; spotting species like the American Golden plover on their breeding grounds. Shiloh Schulte


ATLANTIC FLYWAY
SHOREBIRD
INITIATIVE