PACIFIC AMERICAS SHOREBIRD CONSERVATION STRATEGY

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COVER PHOTO: Red Knots at Grays Harbor, Washington, USA, during spring migration. *Lucas DeCicco / U.S. Fish and Wildlife Service*

Juvenile Western Sandpiper
Lucas DeCicco / U.S. Fish and Wildlife Service

PREFACE

Shorebirds—plovers, oystercatchers, sandpipers, godwits, curlews—can be found along the entirety of the Pacific coast of the Western Hemisphere during some time of the year. Many species travel from Arctic breeding areas to spend their winter on the beaches and mudflats of México, Central America and South America, where they share the environment with resident species. Whether migrants or residents, shorebirds and the habitats they depend upon are exposed to an increasing myriad of anthropogenic threats. Although the challenges are great, they are not without solutions. Across the Western Hemisphere, shorebird scientists, conservationists and managers have banded together to tackle the conservation issues across the annual life cycle of this incredible group of birds. Although there is no doubt that successful conservation depends upon actions initiated locally, isolated interventions will have the best chance for positively affecting populations if coordinated at a flyway scale.

The strategy presented here follows a logical sequence of setting shorebird conservation targets, identifying major threats and identifying highly effective actions to restore and maintain shorebird populations throughout the Pacific Americas Flyway. The intent is to assemble and synthesize information to present a comprehensive approach to address the most pressing conservation needs in the flyway between Alaska and Chile, while considering the human communities that interact with shorebirds. Only with investments in the portfolio of strategies and actions will conservation of this extraordinary group of birds be achieved. The strategy is not a step-by-step recipe for conservation success but rather a framework for ceaseless collaboration, innovation and accomplishment.

Extensive partner involvement in the development of the Pacific Americas Shorebird Conservation Strategy will need to be sustained and augmented to achieve success across the flyway and to mold the broad strategies presented here into tangible, spatially explicit actions. A well-coordinated, collective effort will be needed to achieve overall strategy success; thus, people, and transparent communication among them, are crucial for success. Readers are encouraged to engage with the strategy's partners to endeavor to sustain shorebird populations along the Pacific Americas Flyway well into the future.

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Lucas DeCicco / U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

Shorebirds are especially vulnerable to environmental and anthropogenic perturbations and as a group are not faring well. Globally, 45% of Arctic shorebird populations are decreasing. In the Pacific Americas Flyway (hereafter, Flyway), 11% of shorebird populations demonstrate long-term declines, another 46% have unknown population trends and 43% are stable. Habitat conversion and degradation will almost certainly continue to stress ecosystems and impact shorebird populations, as will disturbance and direct mortality. Sea-level rise and other climate-related ecological changes will intensify current stresses to shorebirds, and societal responses to a changing climate (e.g., coastline hardening, flood control, large-scale reallocation of land uses) could magnify these stresses.

Along their twice-annual journeys, long-distance shorebird migrants in the Flyway use a series of critical stopovers in 14 countries to rest, refuel and make the transition between Arctic tundra, temperate rainforest mudflats and estuaries, coastlines, mid-latitude desert and tropical mangrove forest habitats. These habitats used by nonbreeding Nearctic migrants are shared with resident species and austral migrants. At any point in the year, Southern Hemisphere coastlines support some species of migrant shorebirds. Therefore, an effective strategy that includes all of the hemisphere's shorebirds must integrate conservation interventions across the full suite of geographic, ecological and cultural landscapes.

A number of international conservation efforts exist to benefit shorebirds. Within the Flyway, the Western Hemisphere Shorebird Reserve Network and Important Bird Areas program link many of the sites used by shorebirds on a flyway-scale. In addition, shorebird conservation plans at national, regional and local scales identify a variety of conservation needs and actions. If implemented separately, however, these plans may not achieve conservation for shorebirds at the population level.

Strategic conservation planning at a flyway-scale requires collaboration among stakeholders from conservation and science organizations, academia, government and the private sector. Guided by a small international steering committee, more than 85 individuals representing 53 unique institutions participated in a series of six workshops at which the scope and contents of the Pacific Americas Shorebird Conservation Strategy (hereafter, Strategy) were developed.

The Strategy focuses primarily on the Pacific coasts of North, Central and South America and spans 120 degrees of latitude from northeastern Russia and northwestern United States of America to southern Chile. The project area is subdivided into four focal geographic regions (e.g., Arctic/subarctic, North-temperate, Neotropical and South-temperate) that share broad habitat characteristics and similar conservation challenges and opportunities. Together, these regions encompass the suite of habitats used by 21 target shorebird species during their annual cycles along the Pacific coast of the Western Hemisphere. They were chosen as conservation targets because they are representative of specific habitats in the Flyway, populations of conservation concern or endemic to the Flyway.

Based on the *Open Standards for the Practice of Conservation*, the Strategy focuses on threats that ranked high or very high in the project-wide summary threat rating and includes the following significant threats: climate change, development, invasive species and problematic native species, disturbance from recreational activities, water use and management, aquaculture and shoreline and wetland modification.

Dunlin

Milo Burcham

Strategies and actions to address these threats were developed in the context of the existing framework of laws, institutions and funding in the Flyway. The following key strategies were identified as those likely to be most effective based on the ability to: 1) restore or reduce stress on targets; 2) change human behavior to reduce threats; or 3) create conditions for conservation actions to succeed and reduce threats:

- Manage and Conserve Existing Habitats
- Cultivate and Empower Conservation Constituencies
- Create Conservation Initiatives with Natural Resource Industries
- Strengthen Compliance and Enforcement
- Develop Environmental and Wildlife Protection Policies
- Improve Knowledge of Present and Future Habitats
- Increase Partner and Stakeholder Capacity

The ability to implement this Strategy and achieve successful conservation outcomes will be influenced by a variety of factors, including regulatory, financial, environmental, scientific, economic, social/cultural and institutional risks. Setting intermediate outcomes, measuring sequential results and coordinating monitoring of shorebirds and their habitats all play critical roles in evaluating the effectiveness of the Strategy's implementation, which, in turn, supports adaptive management and sound decision-making.

The Strategy frames threats, actions and priorities at a flyway scale. Although the focus is on action and is not an exhaustive list of research needs, robust information is clearly needed to design, implement and evaluate conservation actions. This Strategy places local action in a flyway context and facilitates collaboration at the scales necessary to be effective. The very process of developing the Strategy will better enable partners to work together throughout the Flyway to sustain shorebird populations for present and future generations.

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ACKNOWLEDGMENTS

The Pacific Americas Shorebird Conservation Strategy benefitted from the expertise, enthusiasm and commitment of its many collaborators. Development of the Strategy was managed by a small, international steering committee, with input from a larger planning committee. The committees include representatives from 15 countries in the Western Hemisphere. The final draft was improved by thoughtful reviews from members of both committees and an additional group of technical reviewers.

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Steering and planning committee members at the Western Hemisphere Shorebird Group VI meeting in Wallops Island, Virginia, USA.

Milo Burcham

CONSERVATION NEED

SHOREBIRD NATURAL HISTORY

Shorebirds—oystercatchers, plovers, sandpipers—favor open landscapes for breeding and feeding and occur throughout many grassland, beach, wetland and tundra habitats across the globe. The habitats used by shorebirds have been altered dramatically in the last century across the Western Hemisphere and indeed around the world (Hassan *et al.* 2005). Coupled with their reliance on habitats susceptible to change, shorebirds have a set of unique life-history traits that make them especially vulnerable to environmental and anthropogenic perturbations. Shorebirds are highly site faithful across their annual cycles and often depend on a few, discrete stopover, breeding and wintering sites. In particular, many long-distance migrants rely on a series of wetland and coastal habitats that provide sufficient foraging opportunities to fuel their demanding migrations. As a group, shorebirds tend to have low reproductive potential and high egg and chick mortality, but relatively high adult survival. Perhaps as a result, shorebirds have relatively small population sizes that also contribute to their vulnerability.

Commercial hunting and industrialization in the 19th and 20th centuries caused rapid habitat alterations and significant declines in North America's migrant shorebird populations. Although some populations rebounded, a multitude of current threats spanning the full length of the Western Hemisphere continue to stress the vitality of all shorebirds. Across the globe, 45% of Arctic-breeding shorebird populations are decreasing (Zöckler *et al.* 2013), and the Pacific Americas Flyway shorebird populations are no different. Within the Flyway, 11% of shorebird populations demonstrate long-term declines, another 46% have unknown population trends and 43% are stable (n = 28; Figure 1; Andres *et al.* 2012; Clay *et al.* 2014; Drever *et al.* 2014; Sauer *et al.* 2014; Tessler *et al.* 2014; Soykan *et al.* 2016; Wetlands International 2016). Habitat conversion and degradation will almost certainly continue to stress ecosystems and shorebird populations, as will disturbance and direct mortality. Sea-level rise, ocean acidification and other climate-related environmental changes will intensify current stresses to populations, and societal responses to a changing climate (e.g., armoring coastlines in response to sea-level rise) could magnify these stresses.

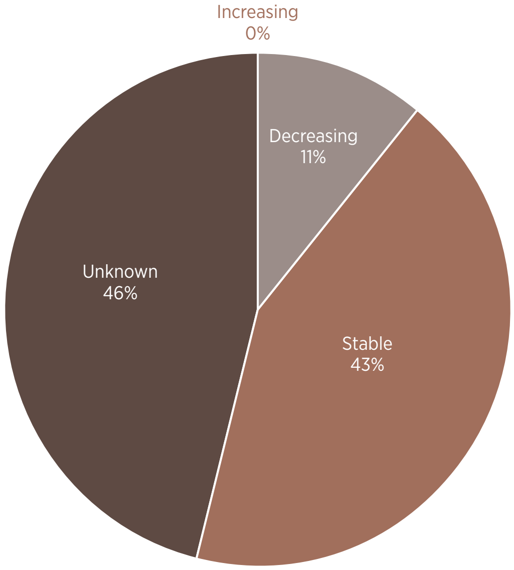


FIGURE 1. Long-term (30-year) trends of species/populations (n = 28) in the Pacific Americas Shorebird Conservation Strategy.

FROM TUNDRA TO TIERRA DEL FUEGO

The Pacific Americas Flyway project area spans 120 degrees of latitude and stretches more than 16,000 kilometers along the coast between northwestern Alaska and southern Chile (Figure 2). Each year, millions of shorebirds traverse the coastlines and open ocean of the Flyway, moving between breeding and nonbreeding grounds and back again. Along their journeys, long-distance migrants use a series of critical stopovers in at least 14 countries to rest, refuel and transition between Arctic tundra, temperate rainforest mudflats and estuaries, coastlines, mid-latitude desert and tropical mangrove forest habitats. At different sites throughout their annual cycles, migrant shorebirds interact with many other species and encounter varying conditions that reflect how human cultures value birds, their habitats and their conservation. Therefore, an effective strategy for long-distance migrant shorebirds must integrate conservation interventions across the full suite of geographic, ecological and cultural landscapes.

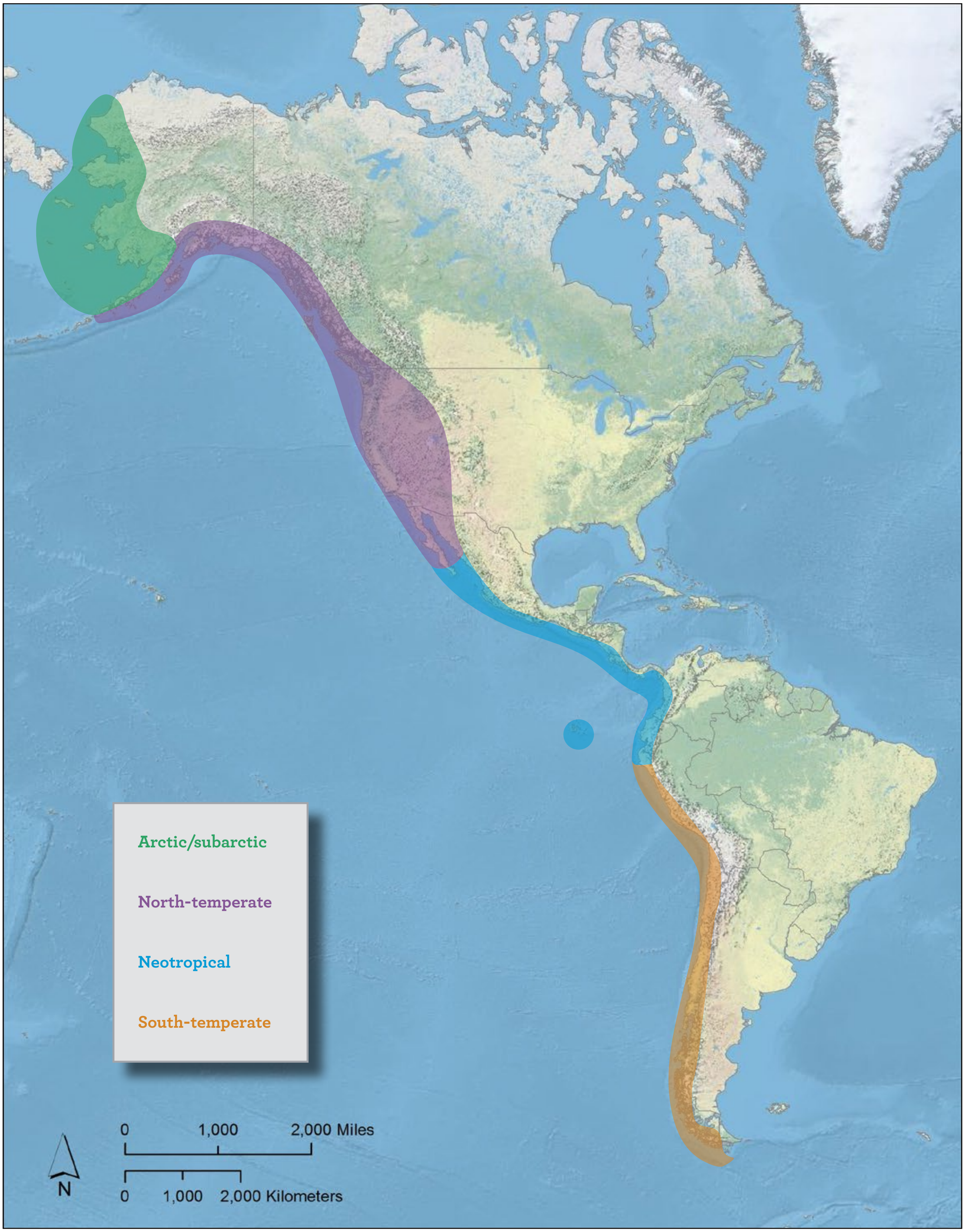


FIGURE 2. Project area for the Pacific Americas Shorebird Conservation Strategy. Map credit: Liling Lee/National Audubon Society.

Shorebirds use the Pacific Americas Flyway in a number of ways (Figure 3). For example, the Black Turnstone, Black Oystercatcher, Wilson's Plover (*beldingi*) and Snowy Plover (*occidentalis*) are completely restricted to the Flyway, where they migrate short distances or reside year-round. Other species, such as the Surfbird, migrate along the entire eastern Pacific coast, with some individuals reaching southern Chile, whereas the Dunlin (*pacifica*) terminates its migration in northwestern México. Some of the Red Knots (*roselaari*) found in the Flyway nest on Wrangel Island in Russia's Far East but migrate along the Western Hemisphere's Pacific coast. Hudsonian Godwits nesting in Alaska cross flyways to the Atlantic coast during their post-breeding migration only to end up back on the Chilean Pacific coast for the austral summer. Similarly, Marbled Godwits breeding around James Bay, Canada, traverse the North America continent to spend the nonbreeding period along México's Pacific coast. The Flyway also supports nonbreeding populations of Long-billed Curlews, Willets and Marbled Godwits that breed in North America's Great Plains and Intermountain West. Farther south, Rufous-chested Dotterels breed in southern Patagonia and migrate northward along the Chilean coast to spend the austral winter, mixing with Magellanic Oystercatchers that nested in Chile and Argentina. Thus, conservation of shorebirds and their habitats along the Pacific Americas Flyway impacts many countries, states and provinces.

WHY CONSERVE SHOREBIRDS?

Shorebirds are one of the most mobile groups of animals on the planet. Their unique natural history attracts and inspires us and makes these species vulnerable to natural and human-caused perturbations. Recent and future changes to wetland, grassland, beach and tundra habitats require us to act now. Shorebirds are a visible component of fully functioning ecosystems, which can positively affect human health. Functional grasslands and wetlands also provide livelihoods for people and ecosystem services such as water filtration, flood protection and shoreline stabilization. Protection of mangroves and other estuarine habitats used by shorebirds provides critical nursery grounds for local and industrial fisheries. Shorelines that provide good habitat for beach-nesting shorebirds also provide storm protection for coastal human residents. Wetland vegetation and grasslands can sequester carbon and help mitigate the effects of global climate change. Shorebirds can serve as sentinels to changes in the environment—changes that will ultimately affect human lives.
The stories of shorebirds and experiences of seeing these remarkable creatures in their natural environment fulfill human emotional, intellectual and spiritual needs, and it is no accident that people from around the world gather at critical wetlands to watch the great spectacle of shorebird migration. Indeed, festivals celebrating the return of the shorebirds now make important contributions to the economies of many communities. For all these reasons, shorebirds need and deserve our attention, and it is only through a flyway-scale approach that we can assure that a world with shorebirds is passed on to posterity undiminished in value.

> "Shorebirds form a valuable national resource, and it is the plain duty of the present generation to pass on to posterity this asset undiminished in value."
>
> ~ Wells Cooke, U.S. Biological Survey, 1910

Carlos Ruiz / Asociación Calidris

Local residents collecting Piangua mussels (*Anadara tuberculosa*) in mangrove estuaries along Colombia's Pacific coast.

FIGURE 3. Generalized migration paths of five focal species within the Pacific Americas Flyway project area. Map credit: Liling Lee/National Audubon Society.

VISION AND GOALS

VISION
Partners working together throughout the Pacific Americas to sustain shorebird populations for present and future generations.

PURPOSE OF THIS STRATEGY
Identify priority threats, effective conservation actions and coordinated approaches necessary to maintain and restore populations of shorebirds and their habitats in the Flyway.

BIOLOGICAL GOAL
Maintain and restore self-sustaining populations of shorebird species across the Flyway.

HUMAN WELLBEING GOAL
Enhance resiliency to a changing climate and sustain ecosystems that support both people and shorebirds.

Red Knots and Dunlins

Lucas DeCicco/U.S. Fish and Wildlife Service

Short-billed Dowitcher
Lucas DeCicco / U.S. Fish and Wildlife Service

MOVING TOWARD ACTION

The *Open Standards for the Practice of Conservation* (hereafter, *Open Standards*; Conservation Measures Partnership 2013) was used to develop the Strategy, including use of the Miradi™ software package (http://www.miradi.org). The *Open Standards* process provides a common lexicon (e.g., CMP Direct Threats and Actions Classification 2.0) and a logical framework to develop results-oriented actions that address threats faced by defined conservation targets. It is used by a number of international organizations in their conservation planning and follows an adaptive management approach. *Open Standards* incorporates the human dimensions of conservation throughout the planning process, whether developing planning teams, engaging stakeholders, addressing threats to conservation targets that are driven by human activity or implementing actions that collaterally benefit human wellbeing. For more details about *Open Standards*, see http://cmp-openstandards.org/.

THE FLYWAY APPROACH

The flyway approach for shorebirds owes much to Frederick Lincoln and his work on band recoveries of waterfowl in the United States of America (USA) in the early 1900s. Lincoln (1935) noted that individual waterfowl species had distinct migration tracks within regions of the USA and that, taken together, they formed "arterial boulevards" that he coined flyways. He identified four flyways in North America (Pacific, Central, Mississippi and Atlantic) and recognized that effective management of waterfowl should take place on the scale of flyways. Subsequently, in 1951 in New York, a National Waterfowl Council formed by the International Association of Game, Fish, and Conservation Commissioners included a Waterfowl Council in each of the flyways. These councils allowed for cross-border cooperative waterfowl management by federal, state and provincial governments, private conservation agencies and the general public (U.S. Department of the Interior 1959). The waterfowl management model has been used to address conservation of shorebirds and other nongame species (Schmidt 2006).

In 1987, Myers *et al.* published an important paper on a "Conservation Strategy for Migratory Species" that focused on long-distance migrant shorebirds and drew attention to their vulnerability and the necessity of international cooperation in programs to conserve them. As a result, the Western Hemisphere Shorebird Reserve Network (Western Hemisphere Shorebird Reserve Network 1990) was formed to explicitly recognize and provide a basis for conservation of shorebird habitats at a flyway scale. Subsequently, other international conservation efforts were initiated, in part, to benefit shorebirds. These included the African-Eurasian Waterbird Agreement under the Bonn Convention (Boere and Lenten 1998), Odessa Protocol on International Cooperation on Migratory Flyway Research and Conservation (Hötker *et al.* 1998) and East Asian-Australasian Shorebird Reserve Network (Watkins 1993).

National shorebird conservation plans beginning with Canada (Donaldson *et al.* 2000) and followed by the USA (Brown *et al.* 2001), México (SEMARNAT 2008) and Colombia (Johnston-

The flyway approach for shorebirds owes much to Frederick Lincoln and his work on band recoveries of waterfowl in the United States of America in the early 1900s.

Gonzalez *et al.* 2010) further recognized the importance of the flyway approach. In turn, these shorebird plans stimulated other regional and local conservation plans throughout the Flyway. In the USA, for example, regional plans cover the Intermountain West, the Southern Pacific Coast, the Northern Pacific Coast and Alaska (available at http://www.shorebirdplan.org/regional-shorebird-conservation-plans/). A summary of the conservation plans can be found in the Conservation Landscape section.

If implemented separately, however, these regional and national plans may not achieve conservation at the shorebird population level. The geographic scale of the annual cycle of shorebirds dictates that a collective and collaborative approach is needed to fully achieve conservation success. Even shorebird conservation at the scale of one flyway may not be sufficient because some species may use multiple flyways (e.g., Hudsonian Godwit). Ideally, the recommendations set forth in this Strategy can be integrated in multi-flyway efforts (see subsection on Conventions, legal frameworks and initiatives in Conservation Landscape section for examples). Development of the Pacific Americas Shorebird Conservation Strategy was informed by these national, regional and flyway-scale approaches (for example, see http://www.unep-aewa.org/) and is specifically modeled after the more recent approach of the Atlantic Flyway Shorebird Initiative (http://atlanticflywayshorebirds.org/). Both strategies are collaborative efforts intended to coordinate conservation at the scale used by migratory shorebirds. They build on past planning efforts and provide the most comprehensive and current set of actions needed to reverse shorebird population declines and maintain populations into the future, especially in the face of the threats that climate change and other human-mediated activities pose to shorebird populations and their habitats (Galbraith *et al.* 2002; Robinson *et al.* 2009; Sutherland *et al.* 2012).

CONSERVATION PLANNING FOUNDATION

One of the underlying goals of this Strategy is to draw on, incorporate and synthesize multiple published shorebird-specific conservation plans into this single flyway-scale document. We reviewed the contents of 40 conservation and implementation plans within the project area that identify threats, conservation strategies and actions necessary to conserve shorebirds in the Pacific Americas Flyway. Basic bibliographic information was tabulated for each plan (i.e., title, author(s), publication year and supporting organization), and each plan's bibliographic record was annotated with a list of supporting figures, tables and appendices that are relevant to the Strategy, with the following criteria: 1) included shorebird-specific information within the geographic scope of the Strategy; 2) contained species-specific information for the Strategy's target species; 3) delineated important shorebird sites and presented information on abundance; and/or 4) listed priorities for conservation and implementation (Appendix 1).

We reviewed four national conservation plans (Canada, USA, México and Colombia) and 11 regional shorebird plans (Alaska, USA; Northern Pacific Rainforest, Canada; Puget Sound, USA; Northern Pacific Coast, USA; Southern Pacific Coast, USA; Northwest México; Perú; Patagonia, Chile; Panamá Bay, Panamá; Ecuasal, Ecuador; and Chiloé Island, Chile). We reviewed six joint venture implementation plans for the USA (Intermountain West, Sonoran, Central Valley, North Puget Lowlands, Pacific Coast and San Francisco Bay) and eight State Wildlife Action Plans for each state within the project area in the USA (Alaska, Arizona, California, Idaho, Nevada, Oregon, Utah and Washington). Lastly, we reviewed the 11 species-specific conservation plans that were available for the target species (American and Black Oystercatchers, Wilson's Plover, Whimbrel, Long-billed Curlew, Hudsonian and Marbled Godwits, Red Knot, Sanderling, Dunlin and Western Sandpiper). The annotated bibliography serves as a concise summary of information that can be retrieved from the conservation and implementation plans. Moreover, it also helps to identify the current state of the shorebird information and knowledge across the project area. Many of the plans have recent project-specific information for priority projects that may be useful in determining costs for development of Strategy projects. It can be further used to build future Strategy project planning objectives, outcomes and cost estimates.

We closely assessed the suite of threats impacting the target species or their habitats for each plan reviewed. This list of significant threats was similar to the results of the Strategy's workshops. A theme in almost every plan (with the exception of the recently revised State Wildlife Action Plans) was the lack of information and management actions necessary to address or adapt to the cumulative impacts of climate change experienced by shorebirds during their annual cycle. This same theme was also evident during the planning workshops for the Strategy.

STAKEHOLDER INVOLVEMENT

Over the course of 4 years (2013–2016), development of this Strategy was organized and facilitated at six international workshops in four countries (Table 1). The inaugural meeting, held in conjunction with Partners in Flight (Utah, USA), focused on the development of the Strategy's conceptual framework and delineation of the geographic scope. The Santa Marta (Colombia) meeting, held in conjunction with the Western Hemisphere Shorebird Group (WHSG), focused on refining the geographic scope and identifying a preliminary list of shorebird conservation targets (i.e., shorebird species/populations). The La Paz (México) meeting was a proof of concept presentation for the Western Hemisphere Shorebird Reserve Network and the Copper River International Migratory Bird Initiative councils. The two councils confirmed a strong interest in and support for the development of the Strategy and provided preliminary content and contacts for development of the full Strategy. The Wallops Island (Virginia, USA) meeting, held in conjunction with the WHSG, focused on threat ratings and development of key ecological attributes. Two regional workshops were held that assembled experts from North America (USA, Canada and México) in San Diego, USA, and from Central America and South America (México, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panamá, Colombia, Ecuador, Perú and Chile)

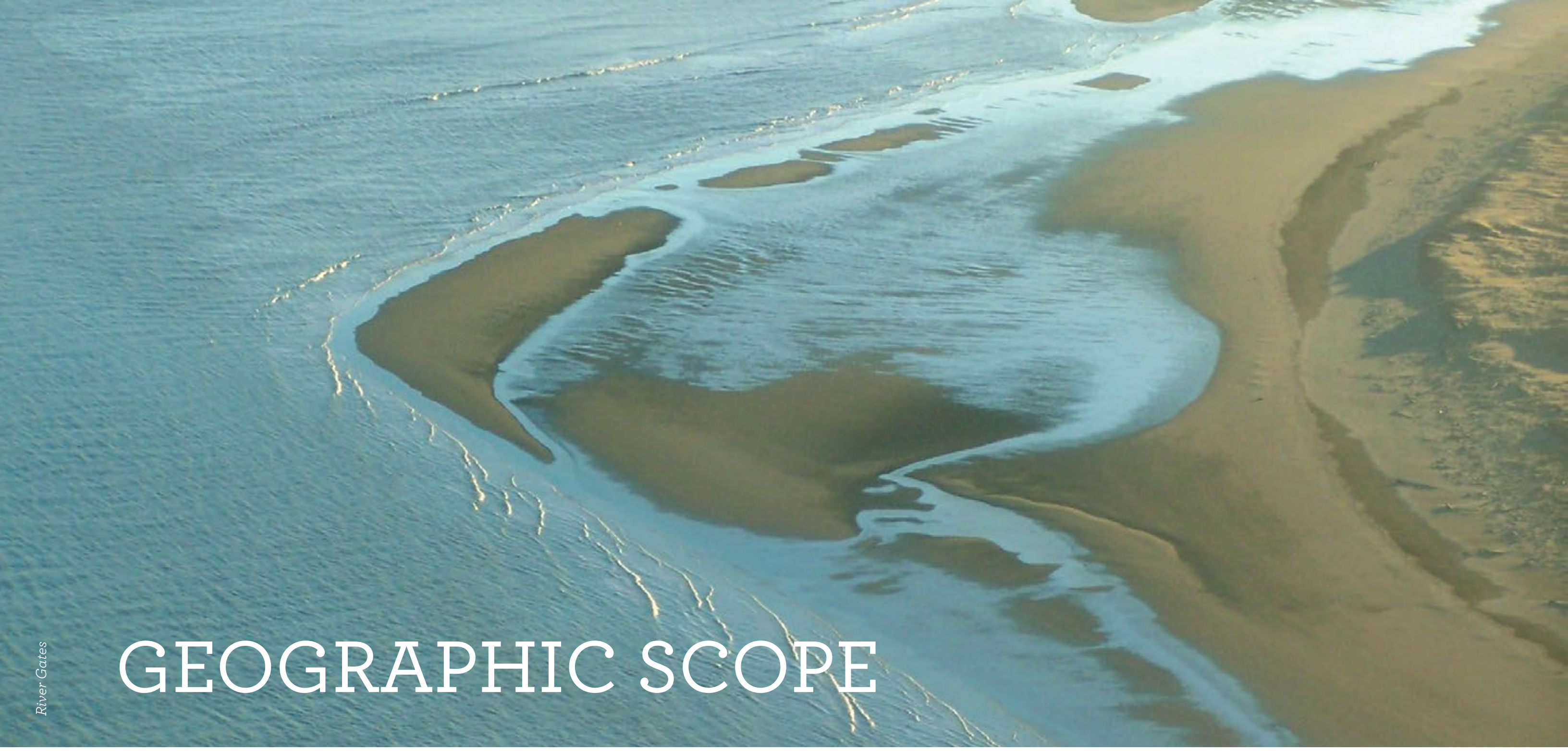
TABLE 1. Pacific Americas Shorebird Conservation Strategy workshop co-meetings, locations, dates, number of participants for each meeting and total number of unique participants.

Co-meeting	Location	Date	Participants
Partners in Flight V	Salt Lake City, Utah, USA	Aug 2013	7
Western Hemisphere Shorebird Group V	Santa Marta, Colombia	Sep 2013	15
Western Hemisphere Shorebird Reserve Network Council	La Paz, México	Nov 2014	20
Western Hemisphere Shorebird Group VI	Wallops Island, Virginia, USA	Sept 2015	36
Pacific Flyway Nongame Technical Committee	San Diego, California, USA	Jan 2016	31
Multi-national Waterbird Monitoring Coordination Workshop	Panamá City, Panamá	Feb 2016	30
All Workshops			72

in Panamá City, Panamá. The regional workshops focused on identifying contributing factors and opportunities to address threats, as well as development of strategies and preliminary theories of change (results chains) to reduce threats to target species. In addition to developing the conceptual model and the components of strategic planning, these workshops facilitated the building of working relationships that now provide a strong foundation for implementation of the Strategy.

Development of the Pacific Americas Shorebird Conservation Strategy involved more than 85 people representing 53 unique institutions. Of those participants, 60% represented nongovernmental conservation or science organizations and 23% represented federal or other government institutions. The remaining participants represented academic institutions (13%) and independent individuals (4%). The planning committee included participants that attended one or more meetings starting with the WHSG meeting in Colombia. We also solicited and received independent peer reviews from shorebird and bird conservation experts who were not part of the planning workshops. Twelve individuals from nine institutions provided feedback and are listed in the Acknowledgments section.

Steering and planning committee members at the North American regional meeting in San Diego, California, USA.



River Gates

GEOGRAPHIC SCOPE

The Strategy focuses primarily on the Pacific coastal areas of North, Central and South America and spans 120 degrees of latitude from northeastern Russia and northwestern USA to southern Chile (Figure 2). The project area is similar to the Pacific Americas Flyway as defined by BirdLife International (Kirby 2011), the International Wader Study Group and Boere and Stroud (2006). Use of the Pacific Americas terminology emphasizes the international character of this Flyway that spans the Western Hemisphere from north to south. One difference between the project area and the Pacific Americas Flyway is the omission of the Arctic Coastal Plain region of Alaska. We omitted this area primarily because the core breeding areas for the majority of long-distance target species are located in western Alaska (ASG 2008) and because this region has already been included in the Atlantic Flyway Shorebird Initiative focal areas (NFWF 2015). Moreover, the focal geographic regions in this Strategy were delineated to complement the Atlantic Flyway Shorebird Initiative.

Samantha Franks / British Trust for Ornithology

Western Sandpiper pair brooding chicks on the nest in Nome, Alaska, USA.

The Strategy is primarily focused on the Pacific coast but extends eastward (inland) in the contiguous USA to include the Great Basin's saline lakes and interior wetland valleys, which have shorebird connectivity to the Pacific coast through sites such as the Great Salt Lake, Utah. Within the USA, the eastern boundary corresponds to the eastern edge of the administrative boundary for the Pacific Flyway Council (USFWS 2015). The project area also encompasses a few coastal Pacific Ocean islands and island groups near the continental shorelines, but central Pacific Ocean islands (e.g., Hawaii) and pelagic ocean areas are not included. Fourteen countries are geographically represented in the project area (listed north-south) and include Russia, USA, Canada, México, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panamá, Colombia, Ecuador, Perú and Chile.

The Strategy's geography encompasses the suite of habitats used by target species during their annual cycles along the Pacific coast of the Western Hemisphere. The project area encompasses parts of 53 terrestrial ecoregions, although the interface of the terrestrial and marine ecoregions is often the most important for shorebirds (Appendix 2). The project area is subdivided into four focal geographic regions (groupings of terrestrial ecoregions) that share broad habitat characteristics and similar conservation challenges and opportunities: Arctic/subarctic (Figure 4), North-temperate (Figure 5), Neotropical (Figure 6) and South-temperate (Figure 7). With the exception of the Arctic/subarctic region, all regions covered by this Strategy support substantial breeding and nonbreeding shorebird populations. Because challenges and opportunities are often similar for shorebirds outside the short breeding season, the mobile migration period and more stationary "wintering" period are combined.

Brad Winn/Manomet

Rock Sandpiper on the breeding grounds at Yukon-Kuskokwim Delta, Alaska, USA.

ARCTIC/SUBARCTIC

This region supports the breeding source for many medium- and long-distance migrants within the Flyway. Habitats for breeding shorebirds include lowland and upland tundra, dwarf-shrub alpine and taiga wetlands within Alaska, USA; north-western Canada; and Wrangel Island, Russia (Figure 4). Although there are a few exceptions, breeding shorebirds generally prefer open areas, especially wetland habitats (Colwell 2010). Besides breeding habitats, coastal tidal flats and saltmarshes and inland wetlands provide stopover habitats for migrants. Aside from individuals of a few species (e.g., Rock Sandpiper, Sanderling), most shorebirds leave this region in the boreal winter.

Steven Mlodinow

Nonbreeding Long-billed Curlew at El Tanque, Chametla, Baja California Sur, México.

NORTH-TEMPERATE

The North-temperate region is extensive and stretches from south central Alaska, USA, to northern México (Figure 5). Within the USA, the region extends away from the coast to include wetlands within inter-montane valleys of California and Oregon and arid grasslands and sagebrush steppe of the interior. The region transitions from maritime Alaska Peninsula habitat in the north to desert scrub in the south. Although many Arctic-breeding shorebirds use coastal tidal flats and wetlands for stopovers and wintering, rocky and sandy shorelines, coastal and inland wetlands (both natural and human-made), agriculture fields and grasslands and sagebrush steppe provide breeding habitat for a number of species. Interior saline wetlands and lakes, such as Lahontan Valley Wetlands, Lake Abert, Salton Sea and Great Salt Lake, support large numbers of migrant shorebirds, including prairie-breeding species on their way to the Pacific coast. Coastal and nearby wetlands in the region support large numbers of wintering and breeding shorebirds.

Flickr Creative Commons

Wilson's Plover use sandy beaches throughout their annual cycle.

NEOTROPICAL

This region extends from the southern tip of México's Baja Peninsula to northern Perú (Figure 6) and is generally defined by the occurrence of mangrove ecosystems, which become more extensive near the equator. The Pacific coast mangrove forests begin at Estero Santa Rosa on the mainland coast of the Gulf of California, México, and extend southward to the Estero Río de Tumbes, Perú (Lacerda and Schaeffer-Novelli 1999). Mountains close to the coast are generally steep and restrict shorebird habitats to a fairly narrow fringe on the Pacific shoreline. A few shorebird species breed along the coast, but they are far outnumbered by nonbreeding species. Mangrove-lined tidal flats, coastal estuarine wetlands and beaches provide important foraging habitat for migrant and wintering shorebirds.

Antonio Larrea/Centro Bahía Lomas

Rufous-chested Dotterel at Estrecho de Magallanes, Chile.

SOUTH-TEMPERATE

The South-temperate region is unique in that it supports a year-round complement of Nearctic-migrant, resident and austral-migrant shorebirds (e.g., Blackish Oystercatcher, Rufous-chested Dotterel). Dry desert coastlines in Perú and northern Chile transitioning to Mediterranean vegetation in central Chile and then to temperate rainforests characterize this region (Figure 7). Because of the dryness in the north and steep topography in the south, shorebird habitats are generally restricted to coastal beaches and tidal flats. Although numbers here in the austral summer are not as great as farther north, the region is very important to certain boreal and austral species (Blanco and Galindo Espinosa 2009; Delgado *et al.* 2010).

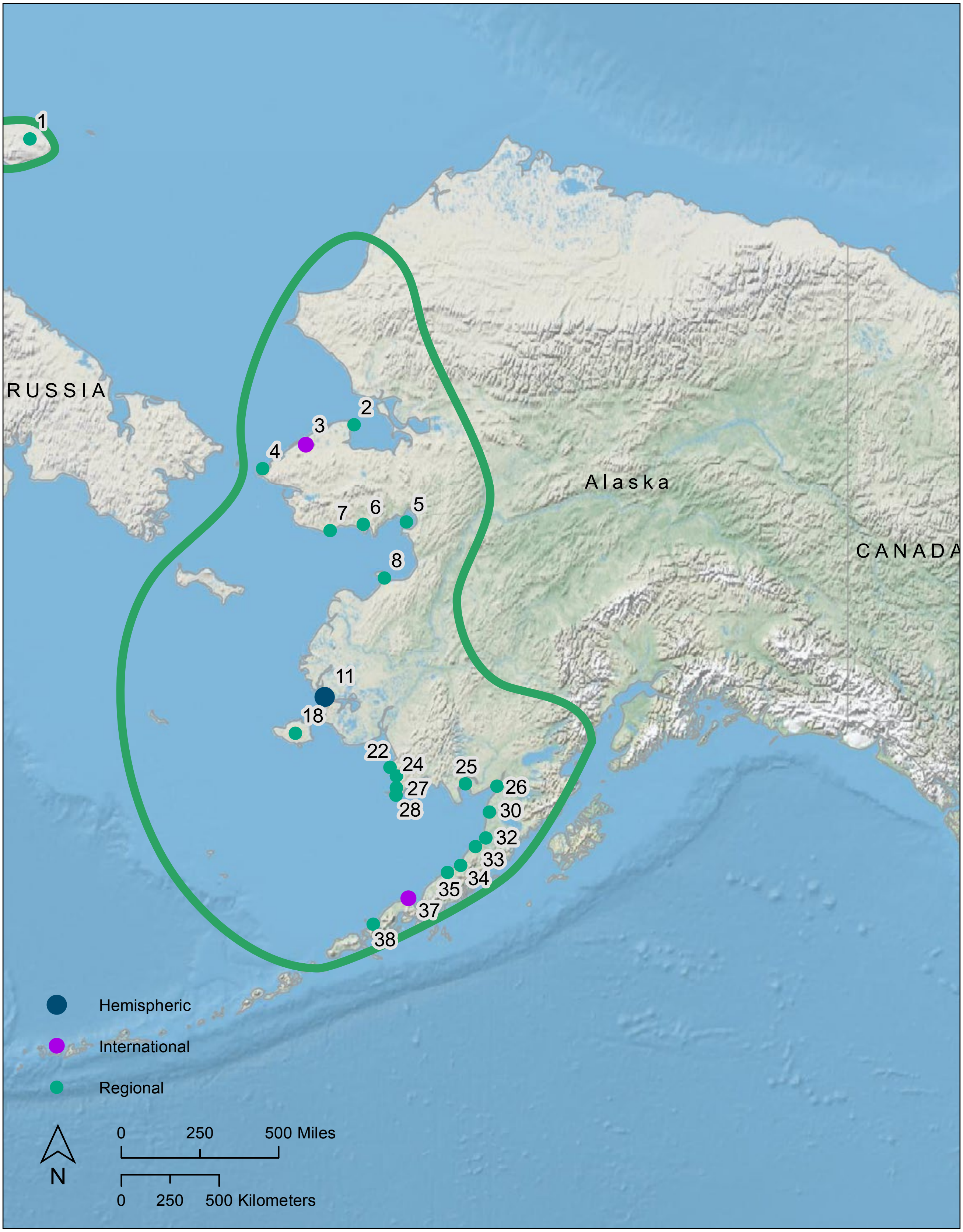


FIGURE 4. Arctic/subarctic focal geographic region and key shorebird sites for the Pacific Americas Shorebird Conservation Strategy (n = 23). Details on numbered sites can be found in Appendix 3. Map credit: Ben Sullender/Audubon Alaska.

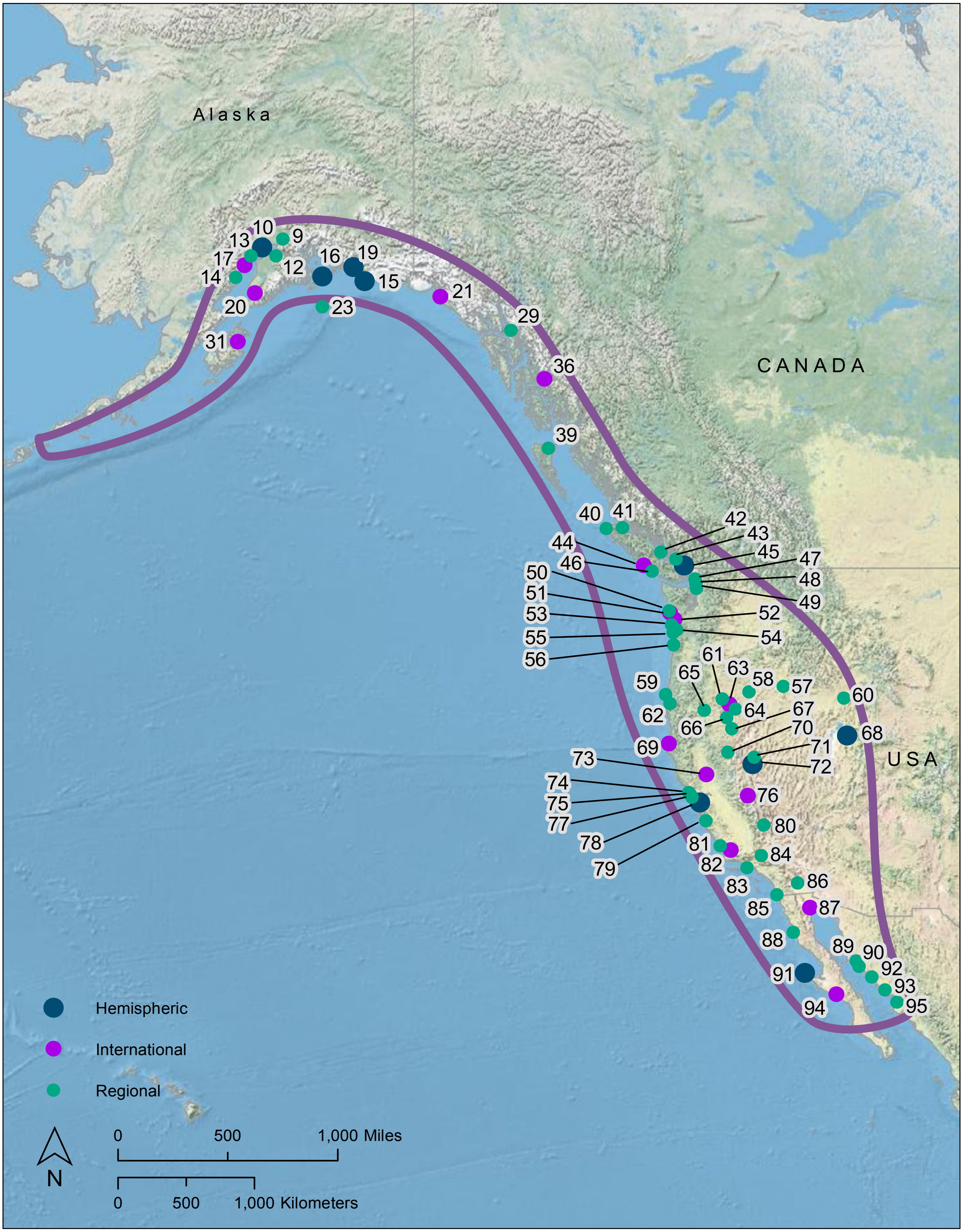


FIGURE 5. North-temperate focal geographic region and key shorebird sites for the Pacific Americas Shorebird Conservation Strategy (n = 72). Details on numbered sites can be found in Appendix 3. Map credit: Ben Sullender/Audubon Alaska.

FIGURE 6. Neotropical focal geographic region and key shorebird sites for the Pacific Americas Shorebird Conservation Strategy (n = 33). Details on numbered sites can be found in Appendix 3. Map credit: Ben Sullender/Audubon Alaska.

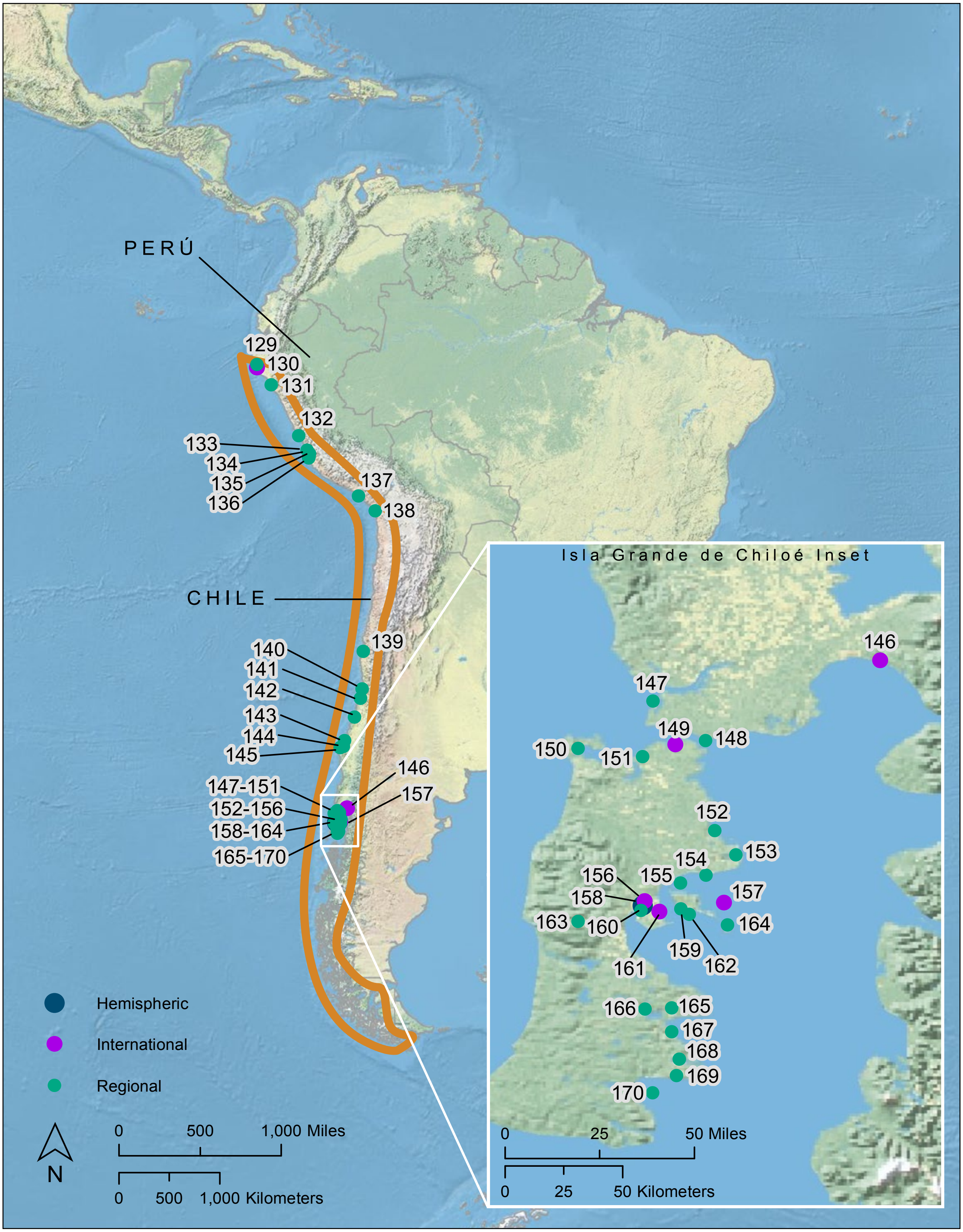


FIGURE 7. South-temperate focal geographic region and key shorebird sites for the Pacific Americas Shorebird Conservation Strategy (n = 42). Details on numbered sites can be found in Appendix 3. Map credit: Ben Sullender/Audubon Alaska.

KEY SHOREBIRD SITES WITHIN THE PACIFIC AMERICAS FLYWAY

We used the Western Hemisphere Shorebird Reserve Network's (WHSRN, http://www.whsrn.org/) criteria to delineate shorebird use of sites across the Flyway and throughout the annual cycle. We used four sources of information to compile a list of key shorebird sites including: 1) abundance data for target species from BirdLife International's World Bird/Biodiversity database; 2) WHSRN's site nomination information; 3) regionally specific Important Bird Area (IBA) reports (Devenish *et al.* 2009; Audubon Alaska 2014); and 4) extensive literature and expert review (Clay and Lesterhuis 2011; Senner and Angulo Pratolongo 2014; B. Andres, personal communication). For IBA sites, we used BirdLife International's A4i criterion (≥1% biogeographic population of a waterbird simultaneously; ≥5% over a season) as a minimum threshold to include in the list. We further refined the list of key shorebird sites to only include those important to the Strategy's shorebird conservation targets (Appendix 3).

Within the Flyway, there are 170 sites that are important for our target species (Figures 4–7, Appendix 3). Of these 170 sites distributed among 12 countries, 12 are hemispheric (at least 500,000 shorebirds annually, or at least 30% of the biogeographical population for a species), 28 are international (at least 100,000 shorebirds annually, or at least 10% of the biogeographical population for a species) and 130 are regional (at least 20,000 shorebirds annually, or at least 1% of the biogeographical population for a species). Forty-three sites are officially designated as Western Hemisphere Shorebird Reserve Network sites (Appendix 3). Sixty-one sites are recognized as globally Important Bird Areas by BirdLife International and the National Audubon Society, and an additional 21 sites are proposed or potential IBAs. An additional 50 sites are currently recognized at the state level by the National Audubon Society in the USA including one identified (Warner Basin) and two potential IBAs. Twenty-two sites are not formally recognized by the IBA or WHSRN programs. Within the Flyway, we were not able to identify any sites in Guatemala or Honduras (Figure 6, Appendix 3). This is likely due to lack of information and suggests that additional data gathering, analysis and partnership development will be helpful in determining key shorebird sites in these countries.

Shorebirds and other waterbirds roosting among young mangroves.

Monica Iglecia / Manomet

Whimbrel

Brad Winn / Manomet

CONSERVATION TARGETS

To establish conservation targets for the Strategy, focal shorebird species or populations were identified that: 1) are representative of specific types of habitats in the Pacific Americas Flyway; 2) are populations of conservation concern as defined in national shorebird conservation plans (SEMARNAT 2008; Blanco and Galindo Espinosa 2009; U.S. Shorebird Conservation Plan Partnership 2016); or 3) are endemic to the Flyway (Table 2). Throughout the Strategy, "population" refers to a full species (e.g., Magellanic Oystercatcher), a specific subspecies (e.g., *roselaari* subspecies of the Red Knot) or a recognized portion of a species or subspecies (e.g., Alaska-breeding Hudsonian Godwits) that uses the Flyway sometime during the year. The list of shorebird conservation targets was generated from existing plans and assessments and was reviewed and revised at each of the workshops. This set of conservation targets captures the breadth of habitats throughout the Flyway that are used by migrant and resident shorebirds.

Target species/populations were assigned to seasonal and geographic groups for more efficient planning and implementation (Figure 8). All target shorebird populations were partitioned into the Pacific Americas Flyway portions (i.e., species population estimates are for individuals using the Pacific Americas Flyway) and were then distributed seasonally among the four focal geographic regions of the Flyway (Appendix 4). Threats and actions within a geographic region are assumed to be similar for shorebird populations that are migrating through, staging or spending the stationary nonbreeding ("wintering") period. Conservation actions implemented to mitigate threats for focal shorebird groups will likely benefit numerous other birds and other biodiversity components, as well as enhance ecosystem services for people.

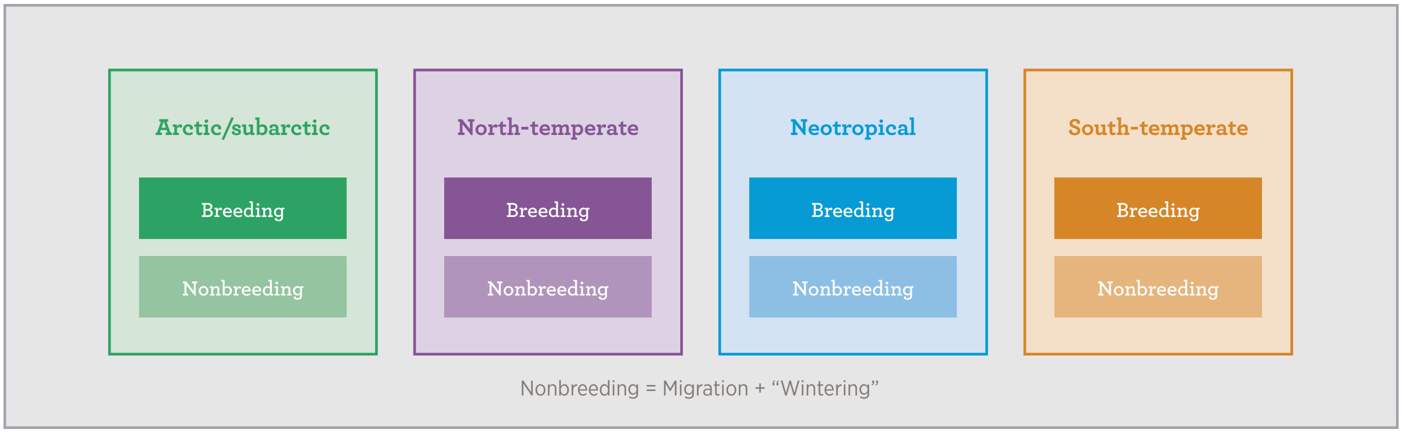


FIGURE 8. Geographic scope and partitioning of the annual cycle for the Pacific Americas Shorebird Conservation Strategy.

TABLE 2. Status of focal shorebird species/populations for the Pacific Americas Shorebird Conservation Strategy. Total population size and certainty/range for each population's estimate are from Andres *et al.* 2012.

Common Name	Population	Total Population Size	Population Size Certainty/Range	Population Trend	Pacific Americas Flyway	
					Period	Population Size
American Oystercatcher	*Haematopus palliatus*	43,300	43,300–53,300		B, N	16,800
	H. p. palliatus	20,000	moderate	stable[1,2]	N	1,000
	H. p. frazari	3,000	high	unknown[2]	B, N	3,000
	H. p. pitanay	12,500	10,000–15,000	unknown[2]	B, N	12,500
	H. p. galapagensis	300	high	unknown[2]	B, N	300
Black Oystercatcher	*Haematopus bachmani*	11,000	8,300–12,500	stable[1,3]	B, N	11,000
Blackish Oystercatcher	*Haematopus ater*	550,000	100,000–1,000,000	unknown[4]	B, N	367,000
Magellanic Oystercatcher	*Haematopus leucopodus*	62,500	25,000–1,000,000	unknown[4]	B, N	30,000
Snowy Plover	*Charadrius nivosus*	33,870	moderate		B, N	21,850
	C. n. nivosus (Pacific coast)	2,930	high	declining[1]	B, N	2,930
	C. n. nivosus (Interior)	22,940	16,600–29,200	unknown[1]	B, N	10,920
	C. n. occidentalis	8,000	6,000–10,000	declining[4]	B, N	8,000
Wilson's Plover	*Charadrius wilsonia beldingi*	7,500	6,500–8,500	unknown[4]	B, N	7,500
Rufous-chested Dotterel	*Charadrius modestus*	550,000	100,000–1,000,000	unknown[4]	B, N	250,000
Whimbrel	*Numenius phaeopus* (Alaska breeding)	40,000	moderate	unknown[1]	B, N	40,000
Long-billed Curlew	*Numenius americanus*	140,000	98,000–198,000	stable[5]	B N	72,500 32,000
Hudsonian Godwit	*Limosa haemastica* (Alaska breeding)	21,000	high	stable[1]	B, N	21,000
Marbled Godwit	*Limosa fedoa*	174,000	moderate		B N	3,000 164,000
	L. f. fedoa (Great Plains breeding)	170,000	moderate	stable[5]	B N	1,000 160,000
	L. f. beringiae	2,000	2,000–3,000	stable[1]	B, N	2,000
	L. f. fedoa (James Bay breeding)	2,000	high	unknown	N	2,000
Black Turnstone	*Arenaria melanocephala*	95,000	76,000–114,000	stable[6]	B, N	95,000
Red Knot	*Calidris canutus roselaari*	21,800	16,200–30,320	declining[1]	B, N	21,800
Surfbird	*Calidris virgata*	70,000	moderate	stable[6]	B, N	70,000
Sanderling	*Calidris alba*	300,000	low	unknown[1]	N	130,000
Dunlin	*Calidris alpina pacifica*	550,000	low	stable[6,7]	B N	550,000 475,000
Rock Sandpiper	*Calidris ptilocnemis ptilocnemis*	19,800	17,900–21,900	unknown[1]	B, N	19,800
Semipalmated Sandpiper	*Calidris pusilla* (Western)	1,450,000	1,023,700–1,876,300	stable[1]	B N	200,000 100,000
Western Sandpiper	*Calidris mauri*	3,500,000	moderate	stable[6,7]	B N	3,118,000 3,020,000
Short-billed Dowitcher	*Limnodromus griseus caurinus*	75,000	low	unknown[1]	B, N	75,000
Willet	*Tringa semipalmata inornata*	160,000	low	stable[5]	B N	20,000 120,000

Notes: Trends are considered as stable, unknown or declining per the superscripted references. Population sizes within the Pacific Americas Flyway are provided by breeding (B) and nonbreeding (N) periods. Population trends from: [1]Andres *et al.* 2012; [2]Clay *et al.* 2014; [3]Tessler *et al.* 2014; [4]Wetlands International 2016; [5]Sauer *et al.* 2014; [6]Soykan *et al.* 2016; [7]Drever *et al.* 2014.

Migrating Western Sandpipers at the Fraser River Delta, Canada.
Samantha Franks / British Trust for Ornithology

MAJOR THREATS

The planning committee systematically evaluated threats using the *Open Standards* lexicon by each threat sub-category to determine which would have the greatest impact on the ability to restore or maintain stable, self-sustaining populations of target shorebird species across the Flyway. Important components of the threat rating procedures include evaluating the degree to which a threat will impact the target shorebird species in a 10-year period of time (2016–2026) and the degree to which the target's population will be impacted (see Appendix 5 for specific details about the rating procedures and categorical criteria used during the process).

Pacific shorebirds face many threats across landscapes during their annual cycles. We identified seven major threats across the Pacific Americas Flyway that are likely responsible for shorebird population decline or instability. Strategy development was focused on threats that ranked high or very high in the summary threat rating (Table 3). Threats specific to a focal geography, but not the entire project area, can be found in Appendix 6.

CLIMATE CHANGE

Global climate change is an anthropogenic stressor that poses the greatest long-term challenge to shorebirds across their ranges. It was rated as high to very high in all regions of the Flyway. Changes in the climate impact shorebirds by: 1) reducing habitats throughout their annual cycle; 2) altering food availability and quality; 3) increasing exposure to severe weather events; 4) proliferating prevalence of disease; and 5) increasing drought conditions and lack of water at inland locations (Galbraith *et al.* 2014). Shorebirds, including many of the Strategy's target species, that spend part of their annual cycle in higher latitudes are thought to be at greatest risk, as impacts are currently evident and predicted to become more severe in the Arctic and subarctic (Meltofte *et al.* 2007; Robinson *et al.* 2009; Liebezeit *et al.* 2012; Galbraith *et al.* 2014; Wauchope *et al.* 2016). For example, encroachment of woody vegetation will alter nesting habitats (Tape *et al.* 2006; Cunningham *et al.* 2016), earlier migration arrival times and trophic mismatches will impact ecological synchronicity at key times (Tulp and

TABLE 3. Major threat ratings (breeding and nonbreeding composite ratings) for shorebird targets within each focal geographic region of the Pacific Americas Shorebird Conservation Strategy.

Threat	Arctic/ subarctic	North-temperate	Neotropical	South-temperate	Summary Threat Rating
Climate change	Very High	High	High	Very High	Very High
Development	-	Medium[N]	High	High	High
Invasive species and problematic native species	Low[B]	High	Low	High[N]	High
Disturbance from recreational activities	-	Low	High	High	High
Water use and management	-	High	Medium	Medium[N]	High
Aquaculture	-	High[N]	High	-	High
Shoreline and wetland modification	-	High	Low	Low[N]	High

Notes: [B]rating for breeding only, [N]rating for nonbreeding only, - threat evaluated but was not found to affect target populations in the next 10 years; see Appendix 5 for rating criteria.

Schekkerman 2008; Senner 2012; McKinnon *et al.* 2013; Senner *et al.* 2016) and range expansions will reduce breeding productivity and breeding habitats will be lost (Wauchope *et al.* 2016). These environmental changes, which directly affect shorebirds today, can be seen in earlier arrivals of breeding birds on their nesting grounds (Meltofte *et al.* 2007) and trophic mismatches that result in reduced growth and survival of young (van Gils *et al.* 2016). In 2014, a climate change vulnerability assessment for North American shorebirds was conducted and included 18 of the 21 conservation target species. All species assessed were found to have major or moderate loss of habitat during part of their annual cycle (Galbraith *et al.* 2014). Rufous-chested Dotterel and Blackish and Magellanic Oystercatchers have not been assessed for climate change vulnerability. However, climate change has been identified as a threat to Rufous-chested Dotterel in Chiloé, Chile (Delgado *et al.* 2010).

Sea level rise will impact the availability and quality of habitat throughout the Western Hemisphere (Iwamura *et al.* 2013; Thorne *et al.* 2015). The Intergovernmental Panel on Climate Change predicts that sea levels will rise between 1 and 2 meters by 2100, a rate never before seen that will greatly alter coastal habitats throughout the Pacific Americas Flyway (IPCC 2007). Habitat loss will be greatest where coastal inland migration abuts human-made infrastructures, which do not allow habitats to expand. Reduction in sediment transport within rivers due to glaciers disappearing and precipitation changes, especially in South America, could further reduce and degrade shorebird foraging habitats (Galbraith *et al.* 2002). Predicted intensification of drought conditions in the interior part of the Flyway will alter wetland and grassland habitats that shorebirds use during the breeding and nonbreeding periods. Drought will also change the way humans use water and will indirectly affect the availability of shorebird habitats at interior wetlands and saline lakes.

Besides the direct loss of habitat caused by rising sea levels, climate-induced changes in the ocean could directly and indirectly affect shorebird food resources. Changing ocean temperatures could alter coastal prey communities in yet unknown ways at specific sites used by shorebirds. Several target shorebirds rely on mollusks as a food source (Gazeau *et al.* 2007), and little is known about how geochemical changes (e.g., ocean acidification) in the ocean will affect shell-forming species. Moreover, rates of ocean acidification are greatest in high-latitude oceans (Duarte *et al.* 2014; Mathis *et al.* 2015). Other threats to shorebirds will interact in combination or synergistically with climate change in many unpredictable ways throughout the entire Flyway. Although addressing climate change directly is beyond the scope of the Strategy, actions to build resiliency, mitigate impacts and enhance the long-term viability of shorebird populations and habitats ("climate-smart conservation") are identified.

Ali Sheehey

Snowy Plovers use hypersaline habitats at Owens Lake, California, USA.

Besides the direct loss of habitat caused by rising sea levels, climate-induced changes in the ocean could directly and indirectly affect shorebird food resources.

DEVELOPMENT

Development is rated as medium to high in all areas of the Strategy with the exception of the Arctic/subarctic and impacts shorebirds throughout most of their range at both coastal and interior sites. Shorebirds are increasingly competing with people for critical coastal habitats, including beaches, mudflats, sand flats, emergent marshes, impounded wetlands, mangroves and saline ponds and lagoons, as well as for interior wetlands and saline lakes. Development to support growing economies, human populations and tourism, especially in Latin America, leads to habitat destruction, fragmentation and degradation, direct mortality and increased disturbance and predation at shorebird feeding, roosting and breeding sites. Coastal habitats are disproportionally impacted by the growing urban-suburban footprint, which is driven by the desire to live and vacation close to the ocean (e.g., Bildstein *et al.* 1991). According to the Inter-American Development Bank, the majority of the Latin American human population is located within 100–200 kilometers of the shoreline, and concentrations along the coast are expected to increase in the future (Simpson *et al.* 2012).

In North America, coastal development has been happening for many decades; many coastal habitats have already been altered by coastal settlements, jetties, beach armoring and beach raking, essentially eliminating some areas as suitable habitat. At interior sites, 90% of the wetlands of the Central Valley of California, USA, have been transformed into agriculture, housing developments and industrial areas. Saline lakes across the Intermountain West, USA, are increasingly threatened by water withdrawals for urban areas and agriculture. In México and elsewhere in Latin America, this type of development is in earlier stages, although these habitats are increasingly facing development pressure. For example, Tocumen International Airport, located adjacent to Panamá Bay, Panamá, has recently doubled in size to support growing air travel throughout Latin America. The surrounding industrial zone is also growing eastward along the coast, which will negatively affect one of the Flyway's most important shorebird wintering and stopover sites. In 2016, new ports and port expansions were announced or proposed for Ecuador, Colombia, Perú, Chile, Canada and the USA.

Although individual development projects may only have limited local impacts on shorebird habitats, the cumulative effect across the Pacific Americas Flyway could be catastrophic, as shorebirds travel thousands of miles and rely on a number of sites during their annual cycles.

INVASIVE SPECIES AND PROBLEMATIC NATIVE SPECIES

Invasive species and problematic native species pose substantial challenges to shorebirds across their ranges. This threat ranged from high to low across all regions of the Flyway and impacts shorebirds in several ways. Many non-native, invasive species of plants and animals have arrived on ships via ports or other nodes for international trade from their native lands and waters across the globe. Others, such as European beachgrass (*Ammophila arenaria*), have been planted or imported intentionally to address a particular need, only to result in other unintended consequences, such as a reduction in available shorebird habitat, direct predation or changes in food web dynamics. Some impacts of non-native species on shorebirds are clear and easily recognizable; for example, direct habitat loss due to encroaching non-native plants and direct consumption of eggs and chicks by predators. Other impacts may be less obvious but equally detrimental, such as marine species introduced with ballast water from ocean-going vessels that have altered populations of invertebrates in San Francisco Bay, California, USA, and possibly shorebird food resources (Cloern and Jassby 2012).

Early successional invasive plants pose a considerable threat to shorebird staging and nesting areas, especially in the USA. In the northwest USA, coastal dunes have become a monoculture of introduced beach grasses (*Ammophila arenaria* and *A.*

Urban development and solid waste ring the Bay of Panamá at Panamá City, Panamá.
Matt Jeffery / National Audubon Society

breviligulata) that have reduced the sparsely vegetated spaces required by breeding Snowy Plovers (Zarnetske *et al.* 2010). At the Fraser River Delta in Canada, Willapa and San Francisco Bays in the USA and other critical sites, introduced saltmarsh cordgrass (*Spartina alterniflora*) outcompetes and grows at lower elevations than native species, which results in encroachment on critical shorebird foraging sites (Stralberg *et al.* 2004).

Increases in introduced and native mammals and birds have a negative impact on breeding and migrating shorebirds. Increases in native predators, such as foxes, raccoons and avian predators, like corvids and gulls, created by artificially favorable conditions can be devastating to breeding shorebirds and have been attributed to the declines in some species, including the Snowy Plover (Page *et al.* 1983; USFWS 2007). Free-ranging domesticated and feral animals, such as dogs and cats, cause a significant threat where they have been shown to depredate shorebird nests, chase foraging birds and disturb roost sites (Page *et al.* 2002; Ruiz-Guerra 2004; Ruiz-Guerra *et al.* 2008; Delgado *et al.* 2010). The recent recovery of native raptors in North America has likely impacted migrating and wintering shorebirds by increasing predation and disturbance at critical feeding, stopover areas and major wintering areas (Ydenberg *et al.* 2007). It is difficult to evaluate these impacts relative to historical predation levels, but there is concern that some raptors, such as Peregrine Falcons (*Falco peregrinus*), are now nesting in habitats where they previously did not occur (Lank *et al.* 2003).

DISTURBANCE FROM RECREATIONAL ACTIVITIES

Human disturbance is recognized as a key threat in shorebird conservation and recovery plans, as well as in many published studies (see Brown *et al.* 2001; NFWF 2015), and received a high overall threat rating in this Strategy. Human disturbance does not typically destroy habitat but causes disruption to breeding and nonbreeding shorebirds. This, in turn, can have consequences on reproductive success and survivorship (Gill 2007). Shorebirds can exhibit the inability to gain weight and build fat reserves required for long-distance migration because of exclusion, interrupted access or changes in timing of access to food resources or roosting locations (Lafferty 2001).

Causes of disturbance at both breeding and nonbreeding sites include dogs (leashed and unleashed), horseback riding, beach grooming, surf casting, falconry, camping, jogging, clam digging, livestock grazing, sunbathing, picnicking, recreational illegal shooting, hang gliding, kite flying, model airplane flying, hunting, motorized vehicles and watercrafts, aquaculture activities and drones. Avian predators, particularly corvids, also cause disturbance and are increasingly attracted to areas that are in close proximity to urban areas, associated trash and powerlines.

Many peer-reviewed studies across the globe have documented the impacts of human disturbance to shorebirds. Piping Plover (*Charadrius melodus*) studies from the eastern USA indicate reduced reproductive success in areas with high human

Monica Iglecia / Manomet

Wastewater treatment facilities provide critical shorebird habitat in California's Central Valley, USA.

disturbance because of reduced foraging efficiency and the resulting depletion of fat reserves. In areas without disturbance, Piping Plovers spend up to 90% of their foraging time feeding versus less than 50% in areas with human disturbance (Burger 1994). Human disturbance caused thermal and energetic stress to chicks by interfering with brooding and foraging (Weston and Elgar 2005). Dogs can increase levels of disturbance by chasing shorebirds or by the birds perceiving dogs as potential predators (Drever *et al.* 2016; Murchison *et al.* 2016). Research has shown that dogs generally are perceived as predators regardless of whether or not they chase shorebirds. For example, in New Zealand, northern New Zealand Dotterels (*Charadrius obscurus aquilonius*) flushed off nests and remained off their nests longer following human disturbance from a person walking with a restrained dog versus a person running or walking without a dog (Lord *et al.* 2001). Declines in the coastal Pacific coast Snowy Plover population are partially attributed to increased beach recreation (Ruhlen *et al.* 2003) to the point where historic breeding areas are no longer used as breeding sites, despite the presence of otherwise apparently suitable habitat. An additional source of disturbance includes off-road vehicle use along beaches and inland habitats.

For nonbreeding shorebirds in large flocks, disturbance also has major impacts, particularly for species with high site fidelity at roost sites (Peters and Otis 2006). Disturbance limits the number and variety of sites shorebirds can use throughout the day under different tidal conditions. This can lead to increased competition for food resources, greater predation risk, reduced feeding ability and reduced fitness (Iverson *et al.* 1996; Warnock *et al.* 2004; Williams *et al.* 2007). Impacts of human disturbance at roost sites vary with the particular situation at a site, and impacts and management actions to reduce impacts should be considered locally (Peters and Otis 2006).

WATER USE AND MANAGEMENT

Water use and management is rated as high in overall threat rating in this Strategy and impacts all regions with the exception of the Arctic/subarctic focal geographic region. Water management changes water flow patterns from their natural range of variation either deliberately or as a result of other activities. Because so much of their natural habitat has been altered by human activity, shorebirds in many regions rely on tactical water management practices to maintain natural and artificial habitats throughout their annual cycle. Changes in human demand for water resources, increased frequency of droughts due to climate change and shifting agricultural practices make the allocation of water resources for shorebirds and other wildlife a complex and important issue throughout the Flyway (Harrington 2003).

Shorebird dependence on agricultural lands is concentrated primarily at inland areas within the North-temperate and Neotropical focal geographic regions. Habitats used by shorebirds that are reliant on active water management include irrigated or flooded agricultural lands, hypersaline natural lakes and evaporation ponds, irrigated pastures and managed freshwater wetlands (Hickey *et al.* 2003; Colwell 2010; Reiter *et al.* 2015). Inland water management practices can also affect the downstream quality and quantity of coastal estuarine wetlands. Globally, saline lakes and related wetland habitats are diminishing due to a warming climate and competition for water for agriculture or urban consumption (Williams 2002). This is certainly true in the Intermountain West, USA (North-temperate region), where sites of high importance for breeding and nonbreeding shorebirds are in jeopardy: for example, Lake Abert, Great Salt Lake and Salton Sea (e.g., Shuford *et al.* 2004; Thomas *et al.* 2013; Moore 2016). Managing water levels in salt evaporation ponds can have positive or negative impacts on roosting and overwintering shorebird abundance and diversity depending on timing, salinity levels, food availability and water depths (Warnock *et al.* 2002). Effective water allocation and management for shorebirds is needed to increase productivity of invertebrate prey communities, create seasonally reliable habitat and maintain safe roost sites (Taft *et al.* 2002; Taft and Haig 2006).

AQUACULTURE

Aquaculture includes shrimp or fin fish aquaculture, fish ponds on farms, hatchery and farmed salmon, seeded shellfish beds and artificial algal beds and has been given a high threat rating. Shrimp and shellfish beds are the primary types of aquaculture affecting shorebirds in the Pacific Americas Flyway, both on breeding and nonbreeding grounds.

In the North-temperate region, aquaculture operations are generally small and local but are increasing. Researchers documented a net decrease in overall shorebird use of open tidal flats developed for aquaculture in Tomales Bay, California, USA (Kelley *et al.* 1996). Although use of the area by some species (e.g., Willet) increased, others (Western Sandpiper and Dunlin, the most abundant shorebirds in the Bay) avoided the developed area. Even small losses in the extent or quality of available feeding habitat for shorebirds could result in proportionally greater decreases in some wintering shorebird populations.

Mussel and oyster farming are expanding or intensifying in places such as Humboldt Bay, California, USA, and Grays Harbor, Washington, USA, occupying both eelgrass and tidal mudflat habitats that are used by shorebirds and other waterbirds (Shuman 2015; Bayard 2016). In addition to loss or degradation of habitat and disturbance, there are concerns about use of chemicals for control of pest species, such as burrowing shrimp, in association with shellfish aquaculture, particularly at Willapa Bay and Grays Harbor in Washington, USA.

In parts of the Gulf of California, México, over 95% of the mangrove marshes have had shrimp farms developed adjacent to them in the past few decades (Páez-Osuna and Ruiz-Fernández 2005; Glenn *et al.* 2006; Lluch-Cota *et al.* 2007). Shrimp farming degrades habitat by altering spatial structure, increasing sedimentation, producing effluent discharge, Jorge Valenzuela / Centro de Estudios y Conservación del Patrimonio Natural

Local harvesters venture out during low tides to harvest algae from the mudflats on Chiloé Island, Chile.

reducing biodiversity, increasing disturbance from farming activities and causing a loss of intertidal foraging and high-tide roosting habitat, particularly to nonbreeding shorebirds (Páez-Osuna and Ruiz-Fernández 2005; Fleischner and Gates 2009). Some studies suggest that certain management practices associated with shrimp farming can create resting and foraging habitat (Navedo *et al.* 2015; Navedo *et al.* 2016). However, few studies exist to evaluate the full impacts or benefits of aquaculture activities including the context under which beneficial management practices may mitigate or offset habitat loss due to construction of aquaculture facilities. In Neotropical breeding and nonbreeding areas, shrimp aquaculture is expanding along the Pacific coast, particularly in northwest México and Central America in former mangroves and salt marshes (Valiela *et al.* 2001; Lugo 2002). In the South-temperate region, aquaculture in Chile consists of algae and salmon farming, shellfish cultivation and small shrimp aquaculture farms, which have started to appear in coastal areas of Perú (Delgado *et al.* 2010).

SHORELINE AND WETLAND MODIFICATION

Shoreline and wetland modification is defined as "actions that convert or degrade habitat in service of 'managing' natural systems to improve human welfare" and is ranked as high in overall threat rating in this Strategy. Rapid human population growth, coastal development and sea-level rise are primary causes of hardening or armoring the coast (the addition of concrete structures such as seawalls, jetties and groins). In places such as San Francisco Bay, California, USA, conversion of natural estuary to salt ponds and then subsequent restoration has resulted in a decline in availability of mudflat habitat (Warnock *et al.* 2002). The process of modification can accelerate erosion of beach habitat and reduce tidal wetlands used by shorebirds. Approximately 14% of the continental USA coastline (22,842 kilometers) has already been armored, and if trends continue 33% of the entire coast will be hardened by 2100 (Gittman *et al.* 2015). Not surprisingly, this threat ranked highest in Canada, the temperate USA and México, where there is greater funding available for coastal engineering projects. Beach nesting shorebird species are particularly vulnerable to the effects of coastal shoreline hardening, and natural beach processes are impacted, resulting in direct loss of nest sites and indirect changes in food resources (Bildstein *et al.* 1991). Armoring and riprap in interior sites, some of which will be strengthened to abate sea level rise, reduce the ability of wetlands to naturally absorb storms and tides and impact the availability of mudflats and other intertidal habitats.

Throughout the Flyway, wetlands are often considered an impediment to commercial and economic development. They are often seen as resources that should be transformed to support traditional agriculture, forestry, livestock ranching or aquaculture, or used for the construction of houses and other human infrastructure. Loss of coastal wetlands is not easily reversed. Loss of wetlands not only negatively affects shorebirds, but also alters people's livelihoods and quality of life.

In Panamá Bay, which lies on the edge of Panamá City, Panamá, many of the coastal wetlands have been filled and converted to development zones for housing and industry, and rivers and streams have been channelized. As a result, there is reduced filtration of pollutants entering the Bay that may harm shorebirds. Channelization is increasing flooding in the low-lying, often economically poor neighborhoods (Kaufmann 2012). This habitat conversion poses a serious threat to both shorebirds and the people who live in the region.

CONSERVATION STRATEGIES AND ACTIONS

Copper River Delta mudflats, Alaska, USA.
River Gates

As with the threat assessment, the *Open Standards* terminology for actions was used to systematically determine the most appropriate actions to reduce major threats that will maintain or restore target shorebird populations. Actions were ranked in the Miradi™ software based on their potential impact and feasibility factors (see Appendix 5 for additional procedural information). Within Miradi™, an algorithm is used to combine potential impact and feasibility rankings to obtain an overall rank of action effectiveness. The complete list of actions developed at the workshops was collapsed into seven key strategies that would be effective to: 1) restore or reduce stress on targets (Strategy 1); 2) cause human behavioral change to reduce threats (Strategies 2–4); or 3) create conditions for conservation actions to succeed and reduce threats (Strategies 5–7). As the Strategy is implemented, development of action plans to address specific threats, which will include detailed theories of change (results chains), will be encouraged (e.g., Atlantic Flyway Shorebird Initiative Hunting Working Group 2016). Action plans will also include costs to implement actions and specific evaluation metrics. The seven key Strategies and highly effective actions are summarized below; details on individual actions, their effectiveness ratings and the potential focal geographic regions where they can be implemented can be found in Appendix 7. The simplified conceptual model that includes all project components (e.g., strategies, contributing factors, threats, scope and conservation targets) is presented in Appendix 8.

As a companion to the *Open Standards*, the Conservation Measures Partnership (2016) has developed guidance on how to incorporate social aspects and human wellbeing into conservation projects (see Appendix 9). As stated by them: “Conservation is inevitably a social undertaking. Humans have dynamic roles in conservation since they can serve as conservation stewards, they depend on intact resources for their livelihoods and wellbeing, and they exert pressure on biodiversity and resources through unsustainable use or when they fail in their role as stewards.” The classification uses definitions and descriptions developed by the Conservation Measures Partnership (2016) for human wellbeing and ecosystem services. The five dimensions of human wellbeing include: 1) necessary material for a good life; 2) health; 3) good social relations; 4) security; and 5) freedom and choice. Ecosystem services are the services that intact, functioning ecosystems, species and habitats provide and that can benefit people; the four recommended service categories include: 1) provisioning; 2) regulating; 3) supporting; and 4) cultural. When considering how the Strategy’s actions affect human wellbeing and ecosystem services, it is important to focus on how the benefit is derived from or dependent upon conservation. Although a few examples are provided below, human wellbeing ecosystem services benefits should be more fully examined during the development of detailed actions plans.

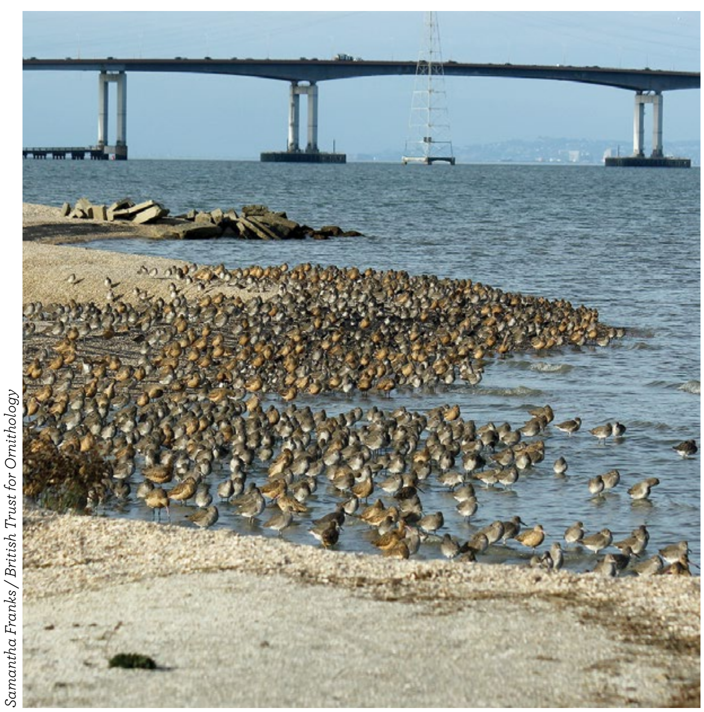
STRATEGY 1.
MANAGE AND CONSERVE EXISTING HABITATS

Management of terrestrial and aquatic habitats, on both public and private lands, is vital to sustain shorebird populations within the Flyway. Although many areas important to breeding and nonbreeding shorebirds are known, there is still a need to comprehensively identify and map sites and habitats throughout the Flyway. At sites where shorebird use is known, active management is often required to protect, maintain, enhance or restore breeding, foraging and roosting habitats. However, knowledge and implementation of land use practices most beneficial to shorebirds, on private and public lands, need to be improved. The value that private working lands (i.e., ranches, farms) contribute to the sustainability of shorebird populations should be more thoroughly understood, including if and how shorebirds use lands dominated by invasive plant species. Where the effects that invasive and problematic animal and plant species have on shorebirds are known, private and public managers may need to implement control programs to maintain and restore shorebirds and their habitats. In some regions of the Flyway, the lack of basic guidance on how to manage shorebird habitats hampers effective conservation of existing protected areas, and providing technical assistance to local and regional planning and management agencies could increase the priority of shorebirds as a management objective and ultimately improve and expand shorebird habitat. Because many shorebirds are dependent on wet landscapes, the coordinated and optimized use of water resources to consider all waterbirds, along with human use, would benefit shorebird populations. Water management infrastructure needs to be maintained in these landscapes, and securement of adequate water may include the purchasing of water rights or paying for allocations. Flood planning should incorporate considerations of how control actions will affect shorebird habitats. Overall, water planning and use should not just consider immediate shorebird habitats but should extend to upstream sources. Actions associated with management of shorebird habitats can also address ecosystem services provided to humans, such as clean water, carbon sequestration and human wellbeing, by providing adequate livelihoods (e.g., fishing, ranching).

Although many areas important to breeding and nonbreeding shorebirds are known, there is still a need to comprehensively identify and map sites and habitats throughout the Flyway.

Highly Effective Actions

- ❑ Identify, protect, maintain, restore and enhance breeding habitats for species of highest conservation concern and at sites of high nonbreeding shorebird concentrations.
- ❑ Secure water for shorebird habitats through purchase of water rights or other mechanisms.
- ❑ Develop and implement a coordinated, optimized water management process to sustain important wetland habitats for shorebirds at a regional scale.
- ❑ Provide technical assistance to support local and regional planning processes in priority shorebird areas.
- ❑ Develop and implement best management practices for wetland and upland crops, including irrigation practices, to enhance habitat quality for shorebirds.
- ❑ Develop and implement best management practices for managed wetlands that balance the needs of all waterbirds to optimize water management.
- ❑ Collaborate with the agricultural industry to identify and secure zoning classifications to protect agricultural lands that benefit shorebirds.
- ❑ Help develop watershed resource management plans to ensure that sufficient water is available for human and avian communities.



Samantha Franks / British Trust for Ornithology

Willets and Marbled Godwits in the San Francisco Bay, California, USA.

STRATEGY 2. CULTIVATE AND EMPOWER CONSERVATION CONSTITUENCIES

The current focus on the human dimensions of biodiversity conservation should be fully embraced by the traditional shorebird conservation community. Building constituencies for shorebirds at all levels and across the entire social landscape complements implementation of other conservation actions of the Strategy and is critically needed to achieve success for shorebirds. Given the breadth of the Flyway, a wide variety of people (urban and suburban residents, coastal recreational users, rural villages and traditional communities and indigenous cultures) must be engaged and encouraged to be part of conservation solutions. Similarly, public policy decision-makers at all levels, from local land use planners to national governments to global financiers, have a vital role to play in shorebird conservation. Involvement of a broader community, beyond the usual shorebird experts and enthusiasts, can lead to novel conservation approaches that will ultimately benefit shorebirds. Empowering local volunteers, community organizations and other stakeholders can extend the reach of government agencies lacking financial resources to adequately manage shorebirds and their habitats. Engaging local communities in citizen science projects can be a gateway to build more awareness and action for conservation. Peer-to-peer interactions and persuasion offered by community-based solutions (at any scale) are often the most effective way to initiate conservation action. There are already examples of strong conservation coalitions in the Flyway, such as the private-public Migratory Bird Joint Ventures in the USA, which can be used as models for alliance building. The Ramsar Convention provides a communication framework, the Program on Communication, Education, Participation and Awareness, to bolster outreach to lay audiences and should be developed and implemented in countries within the Flyway. It is well known that conservation education and outreach is most effective if materials and messages are produced and transmitted to specific audiences or constituencies (e.g., lending institutions' environmental safeguard teams, dog owners, beach users). If the human component is not linked to shorebird conservation actions, this Strategy will have little chance of long-term success. As more detailed action plans are developed, human wellbeing and ecosystem service goals should be fully considered.

Highly Effective Actions

- ❑ Expand and improve volunteer programs to reduce disturbance to shorebirds that use beaches by educating all beach recreationists.
- ❑ Develop and implement the Ramsar Convention's Program on Communication, Education, Participation and Awareness Action Plans that include shorebirds and target their important wetland sites throughout the Flyway to build support and appreciation for shorebirds and wetlands and the ecosystem services wetlands provide, including water management in entire watersheds.
- ❑ Engage volunteers in citizen science projects at important shorebird sites.
- ❑ Develop national education programs for responsible ownership of dogs and cats (e.g., keeping dogs on leashes/leads and cats indoors).
- ❑ Ensure that the environmental safeguard teams for major lending institutions have access to information about the importance of specific shorebird sites and habitats.

Chelsea Haisman / Haisman Photography

Kids enjoying a close look at Western Sandpipers on the Copper River Delta, Alaska, USA.

STRATEGY 3.
CREATE CONSERVATION INITIATIVES WITH NATURAL RESOURCE INDUSTRIES

Some agricultural practices can create opportunities to provide suitable foraging, roosting and nesting habitat for shorebirds. Development, adoption and implementation of practices or standards for working lands, which minimize the impact on producers' revenues and provide sufficient benefits to shorebirds, can help offset habitat loss caused by an expanding human footprint. Within the USA, the Federal Government provides incentives to producers for agricultural land and wetland reserve easements, and the Migratory Bird Joint Ventures have been instrumental in initiating and maintaining industry partnerships. Successful voluntary, industry-supported rice-growing programs in the Central Valley of California, USA, and salt production facilities in coastal Ecuador and northwest México, should be used as models for the Flyway. Initial efforts should focus on the rice-growing, grass crop, ranching, shrimp aquaculture, algae-farming and salt-producing industries, which would likely generate the greatest benefits to shorebirds. Application of shorebird-friendly practices by producers within these industries should be recognized and promoted by the shorebird community and its partners. A first step for some of these industries is to determine the effects that practices have on shorebird populations and individual species, which can then be used to develop a set of best practices that minimize the impact or create benefits for shorebirds. As with many of the strategies presented here, the social context will need to be considered to determine which actions have the greater chance of success. Partners throughout the Flyway may have a larger role in conservation solutions than might be immediately apparent. For example, shrimp aquaculture has a local component through a producer, a national context through a producer association and an international element through importing companies. Thus, an effective action to develop shorebird-friendly shrimp aquaculture is needed at the Flyway scale. At a high level and large scale, convincing financial lending institutions to adopt environmental and social safeguard policies, such as the "Equator Principles", would certainly benefit shorebirds, other wildlife and local people.

Highly Effective Actions

- ❑ Identify economic activities at important sites that will benefit shorebirds and promote human wellbeing.
- ❑ Promote the World Bank's environmental safeguard policies to encourage the protection of livelihoods and important shorebird sites when investing in development projects through local, national and multilateral financial institutions.
- ❑ Promote use of the "Equator Principles", a risk management framework adopted by financial institutions, for determining, assessing and managing environmental and social risk in development projects.
- ❑ Work with partner organizations to develop a certification/recognition program to adopt best management practices by aquaculture, rice and salt producers when opportunities allow.

Development, adoption and implementation of practices or standards for working lands, which minimize the impact on producers' revenues and provide sufficient benefits to shorebirds, can help offset habitat loss caused by an expanding human footprint.

Shorebirds use flooded rice-fields during the nonbreeding period in California's Central Valley, USA.
Monica Iglecia / Manomet

Orlando Jarquín Guevara

American Oystercatchers and other shorebirds use aquaculture pond levees as roost sites at Estero Real, Nicaragua.

STRATEGY 4.
STRENGTHEN COMPLIANCE AND ENFORCEMENT

Although many countries in the Flyway have laws and policies that protect shorebirds and their habitats, enforcement of statutes and compliance with regulations is often lax. Protected areas may also have a set of policies that restrict some human uses but require a diligent enforcement presence. Ineffective enforcement usually arises from either inadequate resources or the lack of political will. The lack of resources can be addressed by increasing training and capacity of law enforcement officials, from officers to lawyers to judges. To offset the lack of political will, parallel public outreach and education efforts are needed to obtain effective enforcement and compliance. Creating an aware and motivated conservation constituency can be a powerful way to increase adherence to laws and policies and strengthen political will. Increased compliance and enforcement is usually most effective if it is coupled with a strong outreach campaign that raises local pride in natural resource protection. As a last resort, litigation may be needed to ensure appropriate compliance with laws and regulations. Where laws are well-established, management plans developed and capacity exists, balancing the human need for recreation with the recovery of protected species, particularly in coastal areas, presents a great challenge for managers, owners, users and regulatory agencies. In some cases, citizen community groups can assist environmental and wildlife law enforcement officials by being the "eyes on the ground". To protect beach-nesting shorebirds, volunteer stewards can use persuasion to induce compliant behavior of human beach goers rather than writing citations. Compliance through domestic laws and international agreements may need to be pursued concurrently to achieve solutions for conservation issues that transcend national borders (e.g., negative effects of mining effluents on downstream estuaries). Mitigation actions associated with regulatory compliance can provide opportunities to create habitats beneficial to shorebirds, such as dredge spoil deposits, and identification of other mitigation actions beneficial to shorebirds should be assessed throughout the Flyway.

Highly Effective Actions

- ❑ Create an aware constituency that respects environmental and wildlife policies and laws and adherence to protected area management plans.
- ❑ Reduce illegal shooting of shorebirds through education and enforcement.
- ❑ Establish community-based committees and patrols to monitor and report violations of environmental and wildlife policies at important shorebird sites.
- ❑ Strengthen compliance of domestic laws and binational agreements, such as mining operations to protect watersheds and estuaries.
- ❑ Develop capacity-building opportunities for law enforcement agents, park guards, lawyers and judges to learn about environmental legislation and the resources necessary to implement legislation.
- ❑ Manage beach access and use during the nesting season to protect key shorebird breeding areas.

STRATEGY 5. DEVELOP ENVIRONMENTAL AND WILDLIFE PROTECTION POLICIES

Although much can be accomplished through voluntary, goodwill conservation actions, a robust policy and legal framework is often needed to sustain conservation gains. Shorebirds across the Flyway would greatly benefit if lawmakers and resource managers would strengthen policies and regulations to conserve shorebird populations and their habitats at local, regional and international scales. Improved policy at the local scale could include the creation of protected area management plans that are transparent, involve all local stakeholders and consider shorebirds needs at the Flyway scale. Within the Western Hemisphere, homeowner associations and municipalities have been instrumental in supporting the recognition of important shorebird areas and passing ordinances that restrict human activities at these sites. Development of basic environmental laws, policies and regulations that benefit shorebirds needs to be linked, as much as possible, to collateral human wellbeing benefits, such as maintenance of artisanal fisheries in mangrove systems, emotional benefits of green open spaces, flood control and organized urban and suburban planning. Shorebird-friendly laws and policies could increase shorebird habitats, improve habitat quality or reduce disturbance stress on populations. Laws developed to reduce solid waste pollution would vastly improve habitat quality for shorebirds along much of the Central and South America coasts. Effective subsistence hunting policies, for example, would first require an assessment of the effect of harvest on shorebird populations, including consideration of the social context of the harvest, and involvement of local user groups in development and implementation of policies. Not all policy creation is regulatory; in some cases, government policies and laws that provide economic incentives and are supported by producers and conservation groups, such as conservation provisions of the U.S. Farm Bill, have great potential to create, restore and enhance shorebird habitats. Encouraging participation in international conventions and agreements can provide the nexus for governments to pursue flyway-scale conservation actions for shorebirds.

Highly Effective Actions

- ❑ Create a legal framework to enable economic incentives for protection of shorebirds and their habitats, including payments for wetland ecosystem services.
- ❑ Develop or strengthen laws and policies to lower the risk of solid waste pollution and pollution accidents from oil transportation from pipelines and transfer sites.
- ❑ Develop and enforce off-road vehicle management plans with key agencies and landowners to limit disturbance of nesting shorebirds.
- ❑ Develop policies, regulations and guidelines for beach access to protect key nonbreeding and breeding shorebird areas.

Within the Western Hemisphere, homeowner associations and municipalities have been instrumental in supporting the recognition of important shorebird areas and passing ordinances that restrict human activities at these sites.

Lucas DeCicco/U.S. Fish and Wildlife Service

Dunlin during spring migration at Grays Harbor, Washington, USA.

Lucas DeCicco/U.S. Fish and Wildlife Service

Surfbird on the breeding grounds at Seward Peninsula, Alaska, USA.

Antonio Larrea/Centro Bahía Lomas

Magellanic Oystercatcher at Parque Nacional Torres del Paine, Chile.

STRATEGY 6.
IMPROVE KNOWLEDGE OF PRESENT AND FUTURE HABITATS

To secure the future of shorebird populations, knowledge of how and why shorebirds use specific habitats is needed. Tangible conservation actions can be implemented within the Flyway now with existing data, but the level of knowledge varies widely among species, geographies, habitats and seasons and may change over time. The Strategy's approach to addressing climate change follows the development of "climate-smart" conservation principles including collaborating with local communities to find nature-based approaches and on-the-ground projects to protect people and ecosystems (for more information, see https://www.nwf.org/What-We-Do/Energy-and-Climate/Climate-Smart-Conservation.aspx). As the global climate changes, interactions among current threats and future conditions will increase in complexity, which will, in turn, increase the challenge of effective conservation and management decision-making. Solving complex problems requires robust information and the evaluation of multiple potential future scenarios. For example, information on the interaction of sea-level rise and increased siltation in coastal estuaries will need to be explored before effective management actions can be taken, and little is known on how ocean acidification will affect the abundance and distribution of shorebird food resources. Modeling of sea-level rise and other future land use changes with respect to important shorebird habitats and sites will inform investment decisions now that would ensure a future for shorebirds. With knowledge in hand, decision-makers will need to be persuaded to take actions that not only prepare for effects of a changing climate but also create resilient habitats for shorebirds, wildlife and people.

Beyond climate change, assessment of other emerging threats that could change the quality of shorebird habitats needs to be undertaken and acted on if needed (e.g., population-level effects of methyl mercury). Considering multiple future scenarios for shorebird habitats, increases in the protected area network for shorebirds should be tackled through the use of fee-title acquisition, conservation easements, concessions, leases and other tools. Protection decisions should be influenced by a thorough assessment across the Flyway of the ecosystem services provided by shorebirds and the habitats they occupy. Many of these decisions would benefit from the adoption of an adaptive resource management framework, which should be promoted by the Strategy's partners. Monitoring and evaluating the effects of conservation interventions is a key feature of the process.

Highly Effective Actions

- ❑ Educate and influence decision-makers about using climate-smart conservation principles and nature-based approaches to improve coastal resilience to current and growing risks of sea-level rise, increases in storm frequency and intensity and development at important shorebird sites.
- ❑ Evaluate breeding and nonbreeding shorebird use of agricultural and grazing lands dominated by invasive plants to understand the negative or positive contribution to the shorebird conservation landscape.
- ❑ Determine feasibility and value of removing excessive silt from tidal flats to increase shorebird foraging habitat and using spoil to create high-tide roosts.
- ❑ Conduct sea-level rise modeling, assess resilience and identify refugia for shorebirds across the Flyway.
- ❑ Create a science and adaptive management program, including establishing baseline data and considering climate change scenarios, to make management decisions at important shorebird sites.

Shorebird monitoring program in Panamá Bay, Panamá.
Bryan Watts / The Center for Conservation Biology

STRATEGY 7.
INCREASE PARTNER AND STAKEHOLDER CAPACITY

Effective conservation action requires adequate institutional knowledge and capacity of partners and all stakeholders across the entire Flyway. A core capacity of individuals, organizations and agencies already exists within the Flyway but needs to be strengthened and expanded to achieve the Strategy's goals. A strong, collective-minded, professional Flyway partnership is essential for delivering the actions outlined in the Strategy. Constructing and maintaining inclusive, multi-lingual communication platforms are essential for ensuring a continued collective and collaborative partner approach to Flyway shorebird conservation. Implementation of the actions in the Strategy will require capacity beyond the traditionally educated shorebird biologist and will need to embrace social scientists, community activists, policy experts and economists at all levels and scales throughout the Flyway.

Capacity can only be built with long-term financial commitment and organizations' application of good business practices. As an immediate need, an assessment and subsequent training on how provisions of international initiatives and agreements (e.g., free trade agreements, environmental safeguards) can be used to achieve shorebird conservation objectives would benefit current Strategy partners. Increased capacity and training are also needed to effectively manage protected areas and regional water use and to connect with non-traditional conservation elements of society. Capacity to engage in applied research is often needed to develop feasibility and effectiveness of potential conservation and management interventions. The bird conservation community has generally lacked broad-scale capacity to develop monitoring and evaluation programs that are necessary to measure success of financial and human capital investments. Increasing the capacity to measure and evaluate effects of conservation actions needs to be a prominent and crucial piece of Strategy implementation. Because of the complexity and broad scope of conservation issues facing shorebirds, building collaborative, multi-sector alliances is most certainly needed to achieve large-scale, population-level conservation success (e.g., Migratory Bird Joint Ventures, Migratory Shorebird Project). Sufficient capacity of partners and alliances will allow a greater engagement of other potential stakeholders.

Highly Effective Actions

- ❑ Assess how international initiatives and agreements (e.g., free trade agreements, environmental safeguards) can be used to achieve shorebird conservation and provide training to Flyway partners.
- ❑ Develop communication strategies to advocate for funding conservation and research projects through international conventions and free trade agreements.
- ❑ Work with existing conventions (e.g., Ramsar Convention, Convention on Migratory Species) to share knowledge and support flyway-scale conservation actions that benefit shorebirds.
- ❑ Create multi-sector alliances (e.g., joint ventures) to establish effective dialogues among stakeholders to implement conservation actions that reduce threats to shorebirds and their habitats.
- ❑ Maintain physical infrastructure and staff capacity and knowledge to conserve managed wetlands for shorebirds.

Open Standards conservation workshop at Wallops Island, Virginia, USA.

MONITORING, EVALUATION AND ADAPTATION

Rufous-chested Dotterel
Jorge Martin Spinuzza / avespampa.com.ar

Prioritizing conservation needs and tracking short- and long-term benefits of implemented conservation actions require a coordinated and systematic approach to monitoring and evaluation. Only through standardization and collaboration can site-based achievements be aggregated across the Flyway to assess large-scale, population-level conservation success. To ensure long-term sustainable monitoring and evaluation, methods need to be readily understandable, relatively easy to apply and cost effective. The *Open Standards* provides a structure for assessing short-term progress on specific project objectives through generation of results chains (theories of change), which include definitions of measures and indicators used to evaluate intermediate progress toward the Strategy's overall goals. Organizations involved with the Strategy have developed robust biological survey methods to evaluate large-scale and long-term outcomes of conservation actions taken to restore or maintain shorebird populations in the Flyway.

Implementation of effective monitoring and evaluation for the Strategy can also make a valuable contribution to measuring progress toward meeting global biodiversity targets for conservation and sustainable development. Nearly all of the countries within the Flyway have made commitments to meet global targets, such as the Aichi Biodiversity Targets of the Convention on Biological Diversity (https://www.cbd.int/sp/targets/), the Millennium Development Goals (http://www.un.org/millenniumgoals/) and objectives of other multilateral environmental agreements. Measurable indicators of changes in biodiversity status have been developed by the Biodiversity Indicators Partnership (http://www.bipindicators.net/globalindicators) and include those based on population trends and the extent of protection and effective management of critical habitats.

Support for monitoring, evaluation and data management needs to be an integral part of the actions developed to implement the strategies outlined in the Conservation Strategies and Actions section. Support will also be needed to maintain and expand existing monitoring programs and to develop metrics to evaluate success of meeting local and broad-scale human wellbeing goals.

EFFECTIVENESS OF SHORT-TERM OBJECTIVES

Monitoring and evaluation are critical components of the *Open Standards* process, and guidance is provided on identification of intermediate outcome indicators and metrics. Intermediate outcomes are used to track a series of interventions that are needed to affect a positive change in a shorebird conservation target and can be termed "effectiveness monitoring". Intermediate outcomes are derived from the contributing factors in the conceptual model (Appendix 8), where an action taken to address a contributing factor will mitigate a threat and improve or maintain the status of a shorebird conservation target. Effectiveness monitoring yields data on the immediate results of a management action and allows managers to adapt quickly in response to the observed, and potentially unexpected, outcomes. Metrics are directly tied to the action and could include measures such as the number of hectares of habitat conserved or the kilometers of beach restored. They may also include, for example, bird density, length of stay or estimates of productivity. Ideally, these data can be compared to similar data from the site prior to the conservation intervention or at other sites with similar characteristics that have not received the conservation intervention. Monitoring at this scale should demonstrate that conservation actions yield improving trends in parameters expected to be correlated with population status.

Coupled with these biological metrics, additional legal, institutional, financial and social measures will provide the most comprehensive view of what is and what is not working. Non-biological outcomes could include expansion of conservation legislation, strengthening of institutions, creation of new partnerships and increases in enforcement activities. Ecosystem services and human wellbeing provided by shorebirds and protection or management of their habitats is likely best measured by impacts on local communities, such as enhanced flood avoidance and protection, sustainability of natural resource-dependent incomes and inspirational values. Some measures will be specific to the results chains developed to implement detailed actions. The quick feedback provided by intermediate outcome measures allows for a truly adaptive process.

SUCCESS TOWARD LONG-TERM OUTCOMES

The same globe-spanning ranges that make shorebirds vulnerable to multiple threats also make them difficult to monitor. Population size and trends are currently known with certainty for only a handful of species (Andres *et al.* 2012). If the goal is to positively affect shorebird populations across the Pacific Americas Flyway, then a monitoring and evaluation program must match the scales of the proposed collective conservation actions. The ultimate measure of success of this Strategy is the restoration and maintenance of target species populations through actions that benefit shorebirds, people and whole ecosystems by reducing threats while providing resilience to climate change. Filling in the gaps in our knowledge across the Flyway is critical to plan the most effective actions, understand the consequences and suggest changes to specific practices and overall Strategy direction.

Using standardized protocols to gather data at sites where actions have been implemented for shorebirds across the Flyway can contribute to an overall assessment of the effectiveness of an action and an understanding of the differences in effectiveness of actions among regions. This is particularly feasible and effective if all data are centralized and linked across the Flyway using recently developed data management systems (see Data management subsection in Monitoring, Evaluation and Adaptation section). Engagement of social scientists to assist with development of human wellbeing measures will ensure applicability at local and flyway scales.

Shorebird Population Monitoring

Population monitoring is critical for understanding the size of the current population and even more importantly provides the big picture of our success at restoring populations (e.g., Andres *et al.* 2012). Measuring the success of actions occurring at a local scale can be achieved through effectiveness monitoring; however, combining these indices can be challenging when actions address different life-history stages or affect different portions of the population. Coordinated large-scale population monitoring provides the integrated signal needed to demonstrate the flyway-scale conservation successes sought by this Strategy (Bart 2005). Tracking progress toward this goal requires long-term and large-scale monitoring. Fortunately, there are several important existing programs to monitor shorebirds that achieve these goals or offer valuable starting points (see Appendix 10 for details and websites).

The Migratory Shorebird Project provides an annual index to large-scale population changes over time for over 20 species and a model-based estimate of population sizes. Additionally, the recently completed Coastal Shorebird Survey in Perú (Senner and Angulo Pratolongo 2014) and Chile provides a survey and sampling design methodology, similar to the Migratory Shorebird Project, to estimate population sizes every 4–5 years on wintering areas in coastal wetland habitats. Arctic PRISM (Program for Regional and International Shorebird Monitoring) has established baseline population estimates for 26 species from breeding ground surveys with the intention of repeating the surveys in 10 years to check population status (Bart and Johnston 2012). Bird Studies Canada started the British Columbia Coastal Waterbird Survey in 1999 to assess annual and long-term trends in waterbird population size and distribution along British Columbia's coastlines. The International Snowy Plover breeding and nonbreeding window surveys, Black Oystercatcher surveys and beach-nesting shorebird surveys in northwest México are examples of ongoing population size monitoring efforts that are designed to update the status of some shorebird species of conservation concern, which are target species of the Strategy. Efficiently linking population monitoring datasets, that each provide slightly different measures of population status and trend, will provide a robust approach for measuring the ultimate success of the Strategy.

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Tracking changes in the distribution and abundance of shorebird habitats across the Flyway could also provide a large-scale metric of success of the Strategy. While the field protocols and sampling designs of the Migratory Shorebird Project and the Coastal Shorebird Survey can provide an index to habitat changes, these programs were established based on the distribution of existing habitat and have relatively limited coverage. Additionally, annual wetland habitat availability data can be generated for large landscapes using satellite imagery (Reiter *et al.* 2015). Remote sensing should be used to establish a baseline of habitat availability across breeding and nonbreeding regions for target species in the Strategy that can then be used to estimate changes in habitat availability through time. These flyway-scale habitat data can also be paired with bird monitoring data to assess the influence of habitat changes at multiple scales, predict species distributions and identify priority conservation areas. Further, the spatial distribution of shorebird habitats can be a significant component to determining the ecosystem service and economic value of maintaining or restoring these habitats.

DATA MANAGEMENT

Data collected as part of any monitoring program are only as effective as the information provided, which requires accessing and analyzing the data. There is increasing recognition that monitoring data need to be stored in a consistent manner, linked with other datasets and made easily accessible to maximize the knowledge gained, particularly at national, flyway or hemispheric scales. The Migratory Shorebird Project and Pacific Flyway Shorebird Survey have made their widespread monitoring data readily available through online mapping and graphical summary applications. Data and data summaries generated in association with the Strategy should be made available online so they can be easily used to inform conservation and management.

The Avian Knowledge Network (AKN) and other online data repositories (e.g., Global Biodiversity Information Facility, http://www.gbif.org/) provide services to many of the existing monitoring programs in the Pacific Americas Flyway. Biological monitoring programs established in association with or that contribute to this Strategy should store their data with one of these repositories and consider using existing protocols to enable broad consistency in data quality and applicability. The online multi-lingual data entry portals developed for the AKN are protocol driven, which enables a wide diversity of data types to be stored and then accessed for analysis. Ensuring all data collected as part of the monitoring and evaluation are centralized and able to be easily linked will help ensure the success of the Strategy. Centralized data management like the AKN enables standardized datasets to be downloaded upon request and also for data to be visualized and made available through web-based data summary applications. Centralized data systems will facilitate use of data for tracking progress toward global biodiversity and sustainable development targets. Availability of similar infrastructure for social data to measure outcomes on human wellbeing needs to be explored.

Carlos Ruiz / Asociación Calidris

Children living in the Delta del Río Iscuandé Western Hemisphere Shorebird Reserve Network site, Colombia.


Milo Burcham

CONSERVATION LANDSCAPE

The Pacific Americas Shorebird Conservation Strategy has been developed within the context of an array of existing institutions, programs, treaties, conventions and funding sources. Though not integrated in a single framework, these institutions, programs, treaties, conventions and funding sources provide a foundation for successful implementation of the Strategy. The information in this section provides an overview and assessment of the existing conservation capacity within the Pacific Americas Flyway.

INSTITUTIONS

Capacity for management of shorebirds and other natural resources in national, state and local governments in the 14 countries comprising the Pacific Americas Flyway is highly variable. Relatively significant capacity in shorebird management and conservation exists in Canada and the USA. Both countries recognize the importance of shorebirds and have adopted national and regional shorebird conservation plans, but must compete for funds within agencies that already are inadequately funded. Shorebirds most often benefit indirectly from resources allocated for waterfowl, endangered species (e.g., endangered salmonids) or other conservation objectives. In the USA, Canada and México, joint ventures have been organized to integrate bird conservation efforts, and some joint ventures (e.g., Intermountain West, San Francisco Bay) have given a high priority to shorebirds.

Outside the USA and Canada, capacity specifically for shorebird management and conservation is limited. Only two countries in Latin America have a national shorebird conservation plan (Colombia, México), and a national plan is currently under development for Ecuador. Regional planning for shorebirds has taken place in Chile, Perú, Panamá and northwest México.

Within the private sector, there is a similar wide range of capacities, though nongovernmental organizations (NGOs) with significant interests in the conservation and management of shorebirds exist in each of the countries comprising the Flyway. Some of these organizations are large and national or international in scope with broad capacity in science, policy, advocacy and communications. Others focus primarily on research and monitoring, while still others build awareness and address conservation needs at a local scale. Overall, the history of conservation planning and the presence of NGOs, agencies and academic institutions interested in shorebird conservation are sufficient to initiate implementation of the Strategy.

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LEADERSHIP, COMMUNICATION AND COORDINATION

Due largely to the internet, telephone conferences and frequency of travel, information flows rapidly within and among organizations, agencies and individuals throughout, and beyond, the Flyway. Within the ornithological community, relatively frequent meetings facilitate one-on-one discussions and relationship building. The Neotropical Ornithological Congress, for example, meets every 4 years and attracts on the order of 1,000 biologists and others from throughout the Western Hemisphere, both south and north.

Within the shorebird community, which is largely composed of experts and enthusiasts from academic institutions and NGOs, as well as researchers and resource managers from government agencies, the Western Hemisphere Shorebird Group now meets every 2 years and typically attracts about 150 participants. In

2015, the 6th meeting of the Western Hemisphere Shorebird Group provided an opportunity to convene a side meeting focused on this Strategy. We anticipate convening another side meeting at the upcoming 7th meeting of the group being held at Paracas National Reserve, Perú, 10–14 November 2017. In addition, some countries, such as the USA, have formed national shorebird conservation councils, which meet periodically and exist to help coordinate and focus efforts.

The Executive Committee responsible for the Atlantic Flyway Shorebird Initiative has a chair and two individuals responsible for ongoing coordination for implementation of that initiative. This model may be useful in the Pacific Americas Flyway, and retaining some form of the steering committee that guided development of this Strategy may serve that purpose going forward.

Overall, however, the shorebird community in North and South America lacks a unified system of communications to advance conservation priorities and programs on a hemispheric scale. Access to higher-level decision-makers, many of whom must respond to conflicting mandates with limited resources, is also challenging. Close collaboration among more diverse partners is essential to overcoming the lack of financial resources and conflicting priorities for existing resources that pose significant challenges to both government management programs and private sector efforts to advance shorebird conservation. Some of the agreements and initiatives outlined below are available and potentially provide mechanisms to help achieve the collaboration and access to decision-makers necessary to conserve shorebirds.

CONVENTIONS, LEGAL FRAMEWORKS AND INITIATIVES

A wide range of international, national, regional and local laws, agreements and initiatives directly affect shorebird conservation. It is beyond the scope of this Strategy to detail them here, but certainly at the international level there is no lack of legal authorities and mandates to enable and support flyway-scale shorebird conservation in the Pacific Americas.

Historically, the earliest international agreement for bird conservation in the Flyway dates back to 1916 when Great Britain and the USA adopted the Convention Between the United States and Great Britain (for Canada) for the Protection of Migratory Birds (https://www.fws.gov/laws/lawsdigest/treaty.html#MIGBIRDCAN); the USA and México signed a similar convention in 1936 (https://www.fws.gov/laws/lawsdigest/treaty.html#MIGBIRDMEX). These two conventions, which apply only to Canada, México and the USA, essentially prohibit the killing of migratory nongame birds, including shorebirds, except for subsistence purposes. The earliest multilateral agreement spanning the Western Hemisphere was the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere (http://www.oas.org/juridico/english/treaties/c-8.html), which dates back to 1942 and includes sections on the multilateral protection of migratory species. The Organization of American States acts as the depositary for this agreement.

More recent agreements start with the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (http://www.ramsar.org/) adopted in 1971 (Ramsar Convention), to which all countries in the Flyway are party. The Ramsar Convention provides a framework for national action and international cooperation for the conservation and wise use of wetlands and related resources.

The Convention on the Conservation of Migratory Species (CMS) of Wild Animals (http://www.cms.int/) was adopted in 1979 and is under the guidance of the United Nations Environment Programme. Although at present only six countries in the Flyway are party to this global Convention, it provides a structure—including the Americas Flyways Framework (CMS Resolution 11.14)—for cooperation on conservation of migratory birds throughout the Western Hemisphere. CMS Recommendation 7.7 specifically calls on range states, whether a party to CMS or not, to support the development of a Pacific Americas Flyway program.

Lucas DeCicco / U.S. Fish and Wildlife Service

Red Knot on the breeding grounds on the Seward Peninsula, Alaska, USA.

The Convention on Biological Diversity (CBD) (https://www.cbd.int/), which was signed in 1992, is under the guidance of the United Nations Environment Programme. This Convention focuses on the conservation and sustainable use of biological resources. Of particular relevance to the conservation of shorebirds are the CBD Aichi Targets 11 (increase in protected areas) and 12 (prevention of extinctions), and the Program of Work on Marine and Coastal Biodiversity. This Convention has recognized CMS as the lead partner in conserving and sustainably using migratory species over their entire range, and parties are expected to fully integrate the needs of migratory species into their National Biodiversity Strategies and Action Plans.

The United Nations Framework Convention on Climate Change (http://unfccc.int/2860.php) acts as a framework for international cooperation to combat climate change by limiting average global temperature increases and by coping with impacts. Of particular relevance to the conservation (and creation) of shorebird habitats is the commitment for parties to develop National Adaptation Plans and National Adaptation Programs of Action.

Among other regional instruments of relevance to migratory bird conservation are free trade agreements, some of which include specific environmental cooperation agreements and mechanisms. Of particular relevance to the Pacific Americas Flyway are the North American Free Trade Agreement, which created the Commission for Environmental Cooperation; the Central American Integration System (Sistema de la Integración Centroamericana), which created the Central American Commission for Environment and Development (Comisión Centroamericana de Ambiente y Desarrollo); the Central America Free Trade Agreement, which includes an environmental cooperation agreement; and the Andean Community (Comunidad Andina), which has a regional strategy for biodiversity conservation. Other free trade type agreements have either not included provisions for environmental cooperation (e.g., Pacific Alliance) or have not implemented the environmental provisions (e.g., Mercosur). At a bilateral level, there are a number of free trade agreements that include environmental cooperation commitments and mechanisms.

In addition to these international treaties and agreements, the following non-binding memoranda of understanding, regional conservation plans, initiatives and programs carried out by government agencies, nongovernmental organizations or combinations of the two are relevant:

- Arctic Migratory Birds Initiative (an initiative of the Conservation of Arctic Flora and Fauna working group of the Arctic Council) (http://www.caff.is/arctic-migratory-birds-initiative-ambi)
- Copper River International Migratory Bird Initiative (http://www.fs.fed.us/global/wings/birds/crimbi/welcome.htm)
- Important Bird and Biodiversity Areas (http://www.birdlife.org/worldwide/programmes/sites-habitats-ibas)
- Migratory Bird Joint Ventures (http://mbjv.org)
- North American Bird Conservation Initiative (http://www.nabci.net/)
- Mesoamerican Biological Corridor (http://www.biodiversidad.gob.mx/v_ingles/corridor/mesoamericanCor.html)
- Pacific Flyway Council (http://www.pacificflyway.gov/)
- Trilateral Committee for Wildlife and Ecosystem Conservation and Management (http://www.trilat.org/)
- Western Hemisphere Migratory Species Initiative (http://www.eco-index.org/search/pdfs/WHMSI-brochure.pdf)
- Western Hemisphere Shorebird Reserve Network (http://www.whsrn.org)

FUNDING

This Strategy does not delve into individual projects and their costs, but the Atlantic Flyway Shorebird Business Plan includes specific projects with costs totaling about $90,000,000 (USD) over a 10-year period. This sum suggests the magnitude of funding required to support a major shorebird conservation initiative in the Pacific Americas Flyway.

There are no analyses of current annual spending on shorebird conservation in the Flyway (or more broadly), though allocations specifically directed at shorebird conservation, including research and monitoring, likely are only on the order of a few million dollars (USD) annually. If the costs of acquiring, protecting and managing wetland and other habitats that indirectly benefit shorebirds in some way are included, that figure will be many times higher.

Current funding, both direct and indirect, for shorebird conservation often comes from government agencies engaged in natural resource management at national, regional and state levels. The largest expenditures are primarily for costs associated with protected areas, such as wildlife refuges, parks, biosphere reserves and similar protected areas, though there are expenditures for endangered species conservation, research and monitoring. In addition to costs associated with their own protected areas, some governments provide funds for international programs, including shorebird-related projects, beyond their own borders.

Additional support for domestic and international work comes through private industry and nongovernmental conservation organizations. The funds supporting shorebird conservation by and through nongovernmental organizations largely come from foundations and individual major donors, which are critical sources of funding especially for work outside the USA and Canada. However, industry can also be a significant source of support, often at the site- or community-scale in association with local or regional business operations. There is, however, the opportunity to cultivate flyway-scale support from industries and businesses that operate at that larger scale.

National, binational and multinational development agencies and institutions also can be important sources of funds outside the USA and Canada. Support from these agencies may focus on building skills and capacity and is often linked to development activities, including ecotourism. Where such activities are compatible with shorebird conservation, there is great opportunity to directly or indirectly advance conservation objectives.

The financial mechanisms associated with international agreements, including trade and conservation agreements, are current and potential sources of support for shorebird conservation, either directly or indirectly. For example, as the financial mechanism for the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change (among others), the Global Environment Facility has a long history of supporting projects of direct relevance to migratory birds at both national and international levels.

In general, the most substantial current and future investments in shorebird conservation are likely to come through initiatives not specifically targeting shorebirds. Projects that are intended to advance human wellbeing but that also benefit shorebirds may be especially well positioned for success. At Owens Lake in California, USA, for example, the Los Angeles Department of Water and Power has invested hundreds of millions of dollars in restoring surface water to Owens Lake to suppress air pollution from wind-born dust. Restoring surface water to Owens Lake has, in turn, restored habitat for shorebirds, and species such as Western Sandpipers almost immediately resumed use of what had for decades been a dry lakebed.

Finally, it should be noted that securing funds to meet funders' matching requirements can be daunting and especially so outside the USA and Canada. Matching requirements, however, provide opportunities to leverage additional funds, and contributions from nongovernmental sources are especially critical in doing so.

Western Sandpipers
Milo Burcham

Hudsonian Godwit
Brad Winn / Manomet

RISKS TO SUCCESS

Despite the conservation landscape that is in place, implementation of this Strategy and the achievement of successful outcomes will be influenced by a variety of factors. Seven major risks to success for implementing the Strategy are described below. Some can be managed to some degree, whereas others are beyond the scope of this Strategy and perhaps can only be partially mitigated. In addition, information gaps, which create uncertainty and, in turn, increase the risks of investing in ineffective conservation activities, are discussed.

REGULATORY

Shorebirds that spend an entire annual cycle within a single political jurisdiction are subject to particular regulatory regimes governing harvest regulations, controls on water pollution, protection of intertidal foraging habitats and other factors that influence populations and their environments. In reality, however, most shorebirds, including most of the target species identified in this Strategy, cross multiple political boundaries both within (e.g., counties, states, provinces) and among nations. Although some international programs and agreements cross national boundaries (see Conservation Landscape section), shorebirds and the habitats on which they rely are subject to diverse regulatory frameworks and widely differing management and enforcement priorities and approaches. Sharing model statutes, policies, regulations and best management practices would help build a consistent, substantive flyway-scale framework that is beneficial to or at least compatible with shorebird conservation.

FINANCIAL

Conservation of shorebirds—or any other biodiversity component, for that matter—is rarely something that can be achieved with a one-time effort and then forgotten. Indeed, many threat reduction strategies, whether protecting a particular site from degradation or addressing human behavior, require ongoing management, monitoring and evaluation. Ideally, there would be funding streams to ensure the long-term sustainability of implemented management and monitoring actions. This risk is especially acute in México and in Central and South America, where capacity and funding to support natural resource conservation tend to be low. Encouraging the use of the *Open Standards* process will increase the ability of partners to describe and demonstrate both their challenges and successes to investors. Providing some infrastructure (e.g., Migratory Bird Joint Ventures and similar constructs in Latin America) to implement the Strategy and identify new funding streams will help diversify the funding potential.

ENVIRONMENTAL

Climate change adds a level of uncertainty to many actions undertaken for shorebird conservation along the Flyway, but conservation partners can adopt “climate-smart” principles for managing shorebird habitats, which by definition keep an eye toward adapting to and ameliorating the effects of a changing climate. The interaction of climate effects coupled with human responses (e.g., coastal armoring, flood control, competitive reallocation of land uses) will likely prove challenging for shorebird and other biodiversity conservation. Connecting shorebird conservation goals with those of human wellbeing and other ecological resources (e.g., waterfowl, fisheries) will likely present conservation opportunities that would not exist with a shorebird-only approach. Developing conservation strategies in the face of large-scale environmental changes with uncertain effects will require particularly rigorous scientific assessments and adaptive conservation planning, taking into account multiple scenarios for future carbon emissions.

SCIENTIFIC

Documenting whether and to what degree a shorebird population has responded to a conservation action is essential but can be challenging due to the difficulty of implementing well-designed, consistent monitoring efforts (see Monitoring, Evaluation and Adaptation section). In addition, even if changes in population size can be detected, it is not always possible to establish cause and effect due to the wide array of factors that combine to influence shorebird productivity and survival, especially for long-distance migrants. For both reasons—which are true for any group of birds or other mobile species—there is the risk of not being able to evaluate the ultimate effect of a conservation action at the level of a continental or hemispheric population. Long-term monitoring efforts at appropriate scales, however, will yield significant data and insights with which to evaluate the status and trends of shorebird populations.

In addition to the challenges of supporting and interpreting long-term monitoring, lack of basic scientific information creates uncertainty and, in turn, increases the risk of establishing priorities that are misguided or investing in conservation activities that are ineffective. For example, the breeding range of the *roselaari* subspecies of Red Knot is not well known; there is uncertainty about what proportion of the population nests in Alaska, USA, versus on Wrangell Island in extreme northeast Russia. That information could be critical in effectively allocating effort and resources for conservation of Red Knots. This is only one example of an important information gap. The workshops that led to development of the Strategy were focused on threats to shorebird populations and strategies and actions to address those threats. Hence, this Strategy does not systematically identify information gaps nor is it a research plan to address those gaps.

ECONOMIC

Economic pressures mainly affect shorebirds by driving alterations to their habitats. Short-term "return on investment" economic models usually favor static shorelines with residential, tourism or commercial development over dynamic, shorebird-friendly beaches, marshes and mudflats. Over the longer term, however, many such decisions may prove to be liabilities, since hardened shorelines and removal of coastal vegetation, such as mangroves, reduce the resiliency of shorelines in the face of increasingly intense storms with coastal flooding and high winds. In addition, shorebirds and their associated habitats should be factored into quality of life and human wellbeing goals. Conservation of shorebirds and their habitats benefit people in a variety of ways, and understanding and promoting these "ecosystem services" may help balance traditional economic arguments against conservation actions.

SOCIAL/CULTURAL

Prospects for successful, enduring conservation actions are enhanced with meaningful participation by, and significant support from, a broad, diverse set of stakeholders. In addition, there is a need to understand and give due consideration to local cultural practices, lifestyles and economic needs, which may be either positively or negatively affected by proposed conservation actions. Failure to actively consult with and engage local residents of areas impacted by management decisions during planning and decision-making phases can result in lack of support for conservation measures. Moreover, if projects are approved and implemented without local support, or if initial support is allowed to erode, conservation benefits can be compromised over time. Accordingly, education and outreach are an integral part of implementing this Strategy.

INSTITUTIONAL

Lack of institutional capacity—both in terms of staff and operational support—is a major risk to the success of shorebird conservation initiatives. Natural resource management and regulatory agencies have many mandates and priorities that change in response to social and political influences. Resources directly available for shorebirds and their habitats will be limited to the extent that the need for shorebird conservation is viewed as less than compelling. In México and in Central and South America, basic institutional funding and commitment to natural resources management are often lacking, even if the interest is there. Developing conservation strategies in the face of large-scale environmental changes with uncertain effects will require particularly rigorous scientific assessments and adaptive conservation planning. Capacity building and a strong understanding of human dimensions are clearly key components of implementing actions in the Strategy.

Education and outreach are an integral part of implementing this Strategy.

Monica Iglecia / Manomet

CONCLUSION AND NEXT STEPS

This Strategy represents the beginning of an initiative that integrates contributions from over 85 experts in shorebird conservation, research and management to identify priority threats and effective strategies and actions at a scale that matches the varying life histories of 21 conservation target shorebird species. The emphasis here is on action, as opposed to research, and the aim is to provide a foundation for coordinated flyway-scale efforts, which must come both from the ground up and the top down. Many of the individuals and institutions participating in this process are potential partners in implementing the Strategy, but it is also clear that success in shorebird conservation requires the engagement and support of new, more diverse constituencies, as well as deeper commitments by those already engaged.

To be successful, flyway-scale actions to conserve shorebirds must be accompanied by commitments to track and evaluate the effectiveness of those actions. Through the *Open Standards* process, the Strategy and supporting documentation provide a basis for evaluation of shorebird conservation programs and projects as they are implemented. Monitoring shorebird populations at local and flyway scales, as appropriate, is essential to the evaluation process. Monitoring not only provides the data needed to understand shorebird responses to conservation measures, but monitoring also is an engagement tool that draws in new constituencies and deepens engagement.

A key purpose of the Strategy is to provide guidance for those who want to invest energy, funds and other resources in shorebird conservation. Because this document is a strategy and not a detailed business plan, no specific projects and their costs are described here. Through this document, however, potential investors can identify priority species and places, key threats and effective strategies and actions to address those threats based on science and the best judgment of shorebird experts spanning the Pacific Americas Flyway. Appendix 7, for example, highlights key threats and effective strategies and actions by geographic region. Potential investors can then use a "request for proposals" process to invite project ideas responding to a funder's particular interests, whether based on geography or type of threat or strategy. Potential investors can also support planning efforts to apply the Strategy at regional, national or local levels, thus generating priority projects at finer scales than is possible in a hemisphere-spanning strategy.

A key purpose of the Strategy is to provide guidance for those who want to invest energy, funds and other resources in shorebird conservation.

American Oystercatchers in flight at Estero Real, Nicaragua.
Orlando Jarquín Guevara

Looking ahead, over the next three to five years, there are clear needs to address and steps to be taken to build on and sustain the momentum achieved to date through development of the Strategy:

- Maintain an active international Steering Committee to guide a transparent process as we seek to deepen support for and implement the Strategy;
- Support core staff capacity, ideally both in North America and in Latin America, to facilitate communication, coordination and implementation;
- Implement conservation projects at Western Hemisphere Shorebird Reserve Network sites, Important Bird Areas and key shorebird sites across the Flyway;
- Dedicate staff time at key nongovernmental organizations and government agencies to actively implement the Strategy on the ground;
- Provide the Strategy and supporting materials and resources to all users in English and Spanish via the internet through existing or new websites;
- Use forums such as the Western Hemisphere Shorebird Group meetings to report on progress, promote implementation and enhance capacity and planning;
- Market the Strategy to government agencies (at several levels), industries, international lending institutions and the implementing bodies of international treaties and agreements to obtain support, resources and commitments for implementation;
- Elevate the Strategy and coordinate implementation through bodies like joint ventures and flyway councils and create new multi-sector alliances where such entities do not already exist;
- Link the Strategy for shorebird conservation to larger environmental and human wellbeing issues, programs and projects;
- Communicate stories about threats to and successes of shorebird conservation to the public and seek new, nontraditional partners throughout the Flyway;
- Fill key information gaps that limit the ability to plan, implement or evaluate projects;
- Develop results chains and identify specific projects, including measures of success and monitoring, that are consistent with the priorities identified in the Strategy;
- Identify and seek funds at appropriate scales to implement actions described in the Strategy (from individual sites to the flyway scale); and
- Assess the progress of the Strategy, using monitoring and other data, in five years to adapt it as needed for more effective implementation going forward.

LITERATURE CITED

Wilson's Plover nest at Parque Nacional Natural Sanquianga, Colombia.
Asociacion Calidris

Ágreda, A. E. 2012. Plan de conservación de las piscinas artificiales de Ecuasal período 2012–2015 y estudio de capacidad de carga turística. Aves y conservación - BirdLife en Ecuador y Ecuatoriana de Sal y Productos Químicos C.A. Guayaquil, Ecuador. [in Spanish]

Alaska Department of Fish and Game (ADFG). 2015. Alaska wildlife action plan. Alaska Department of Fish and Game, Juneau, Alaska, USA.

Alaska Shorebird Group (ASG). 2008. Alaska shorebird conservation plan. Version II. Alaska Shorebird Group, Anchorage, Alaska, USA.

American Ornithologists' Union. 1998. Check-list of North American birds, 7th edition. American Ornithologists' Union, Washington, D.C., USA.

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.

Arizona Game and Fish Department (AGFD). 2012. Arizona's state wildlife action plan: 2012-2022. Arizona Game and Fish Department, Phoenix, Arizona, USA.

Atlantic Flyway Shorebird Initiative Hunting Working Group. 2016. Hunting Working Group results chains. http://atlanticflywayshorebirds.org/resources/.

Audubon Alaska. 2014. Important Bird Areas of Alaska. Version 3. Audubon Alaska, Anchorage, Alaska. http://databasin.org/datasets/f9e442345fb54ae28cf72f249d2c23a9.

Bart, J. 2005. Monitoring the abundance of bird populations. Auk 122: 15–25.

Bart, J. and V. Johnston (Eds.). 2012. Arctic shorebirds in North America: a decade of monitoring. Studies in Avian Biology 44, University of California Press, Berkeley, California, USA.

Bayard, T. 2016. Letter from Audubon Washington to Washington State Department of Ecology providing information concerning the Willapa-Grays Harbor Oyster Growers Association permit application for the National Pollutant Discharge Elimination Systems. July 7, 2016.

Bildstein, K. L., G. T. Bancroft, P. J. Dugan, D. H. Gordon, R. M. Erwin, E. Nol, L. X. Payne and S. E. Senner. 1991. Approaches to the conservation of coastal wetlands in the Western Hemisphere. Wilson Bulletin 103: 218–254.

Blanco, D. E. and D. Galindo Espinosa. 2009. Plan de recuperación de aves playeras en la Patagonia. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA. [in Spanish]

Boere, G. C. and B. Lenten. 1998. The African-Eurasian Waterbird Agreement: a technical agreement under the Bonn Convention. International Wader Studies 10: 45–50.

Boere, G. C. and D. A. Stroud. 2006. The flyway concept: what it is and what it isn't. Pages 40–47 *in* Waterbirds Around the World (G. Boere, C. Galbraith and D. Stroud, Eds.). The Stationery Office, Edinburgh, U.K.

Brown, S., C. Hickey, B. Harrington and R. Gill (Eds.). 2001. United States shorebird conservation plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Brown, S., C. Hickey, B. Gill, L. Gorman, C. Gratto-Trevor, S. Haig, B. Harrington, C. Hunter, G. Morrison, G. Page and others. 2000. National shorebird conservation assessment: shorebird conservation status, conservation units, population estimates, population targets, and species prioritization. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Buchanan, J. B. 2006. Nearshore birds in Puget Sound. Puget Sound Nearshore Partnership report number 2006-05, U.S. Army Corps of Engineers, Seattle District, Seattle, Washington, USA.

Burger, J. 1994. The effect of human disturbance on foraging behavior and habitat use in Piping Plover (*Charadrius melodus*). Estuaries 17: 695–701.

California Department of Fish and Wildlife (CDFW). 2015. California state wildlife action plan, 2015 update: a conservation legacy for Californians. California Department of Fish and Wildlife, Sacramento, California, USA.

California Pacific Coast Joint Venture (CA PCJV). 2004. Pacific Coast Joint Venture Coastal Northern California component. Strategic plan update 2004. California Pacific Coast Joint Venture, Arcata, California, USA. http://www.pacificbirds.org/wp-content/uploads/2015/03/Strategic-Plan-CAL-PCJV-20041.pdf.

Central Valley Joint Venture (CVJV). 2006. Central Valley Joint Venture implementation plan – conserving bird habitat. U.S. Department of the Interior, Fish and Wildlife Service, Sacramento, California, USA.

Clay, R. and A. Lesterhuis. 2011. Analysis of potential Western Hemisphere Shorebird Reserve Network sites in the Americas. Unpublished report prepared for Manomet Center for Conservation Science by BirdLife International, Asunción, Paraguay.

Clay, R. P., A. J. Lesterhuis, S. Schulte, S. Brown, D. Reynolds and T. R. Simons. 2010. Conservation plan for the American Oystercatcher (*Haematopus palliatus*) throughout the Western Hemisphere. Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Clay, R. P., A. J. Lesterhuis, S. Schulte, S. Brown, D. Reynolds and T. R. Simons. 2014. A global assessment of the conservation status of the American Oystercatcher *Haematopus palliatus*. International Wader Studies 20: 62–82.

Cloern, J. E. and A. D. Jassby. 2012. Drivers of change in estuarine-coastal ecosystems: discoveries from four decades of study in San Francisco Bay. Reviews of Geophysics 50: 1–33.

Colwell, M. A. 2010. Habitat conservation and management. Pages 241–263 *in* Shorebird Ecology, Conservation and Management. University of California Press, Berkeley, California, USA.

Conservation Measures Partnership. 2013. The open standards for the practice of conservation. http://cmp-openstandards.org/.

Conservation Measures Partnership. 2016. Incorporating social aspects and human wellbeing in biodiversity conservation projects. Version 2.0. http://cmp-openstandards.org/guidance/addressing-human-wellbeing/.

Cooke, W. W. 1910. Distribution and migration of North American shorebirds. Bulletin No. 35, U.S. Department of Agriculture, Biological Survey, Washington, D.C., USA.

Cunningham, J., D. C. Kesler and R. B. Lanctot. 2016. Habitat and social factors influence nest-site selection in Arctic-breeding shorebirds. Auk 133: 364–377.

Delgado, C., M. Sepúlveda and R. Álvarez. 2010. Plan de conservación para las aves playeras migratorias de Chiloé. Conservation Marina, Valdivia, Chile. [in English and Spanish]

Devenish, C., D. F. Díaz Fernández, R. P. Clay, I. Davidson and I. Yépez Zabala (Eds.). 2009. Important Bird Areas Americas - priority sites for biodiversity conservation. BirdLife Conservation Series No. 16, BirdLife International, Quito, Ecuador.

Donaldson, D., C. Hyslop, R. I. G. Morrison, H. L. Dickson and I. Davidson. 2000. Canadian shorebird conservation plan. Environment Canada, Canadian Wildlife Service, Ottawa, Ontario, Canada.

Drever, M. C., M. J. F. Lemon, R. W. Butler and R. L. Millikin. 2014. Monitoring populations of Western Sandpipers and Pacific Dunlins during northward migration on the Fraser River Delta, British Columbia, 1991–2013. Journal of Field Ornithology 85: 10–22.

Drever, M. C., B. A. Beasley, Y. Zharikov, M. J. Lemon, P. G. Levesque, M. D. Boyd, and A. Dorst. 2016. Monitoring migrating shorebirds at the Tofino Mudflats in British Columbia, Canada: is disturbance a concern? Waterbirds 39: 125–135.

Drut, M. S. and J. B. Buchanan. 2000. U.S. national shorebird conservation plan: northern Pacific coast working group regional management plan. U.S. Department of the Interior, Fish and Wildlife Service, Portland, Oregon, USA.

Duarte, C., J. M. Navarro, K. Acuña, R. Torres, P. H. Manríquez, M. A. Lardies, C. A. Vargas, N. A. Lagos and V. Aguilera. 2014. Combined effects of temperature and ocean acidification on the juvenile individuals of the mussel *Mytilus chilensis*. Journal of Sea Research 85: 308–314.

Environment Canada. 2013. Bird conservation strategy for bird conservation. Region 5: northern Pacific rainforest. Environment Canada, Canadian Wildlife Service, Delta, British Columbia, Canada.

Fellows, S. D. and S. L. Jones. 2009. Status assessment and conservation action plan for the Long-billed Curlew (*Numenius americanus*). Biological Technical Publication FWS/BTP-R6012-2009, U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA.

Fernández, G., N. Warnock, D. B. Lank and J. B. Buchanan. 2010a. Conservation plan for the Western Sandpiper (*Calidris mauri*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Fernández, G., J. B. Buchanan, R. E. Gill, Jr., R. Lanctot and N. Warnock. 2010b. Conservation plan for Dunlin with breeding populations in North America (*Calidris alpina arcticola*, *C. a. pacifica*, and *C. a. hudsonia*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Fleischner, T. L. and H. R. Gates. 2009. Shorebird use of Estero Santa Cruz, Sonora, México: abundance, diversity and conservation implications. Waterbirds 32: 36–43.

Galbraith, H., D. W. DesRochers, S. Brown and J. M. Reed. 2014. Predicting vulnerabilities of North American shorebirds to climate change. PLOS ONE 9: e108899.

Galbraith, H., R. Jones, R. Park, J. Clough, S. Herrod-Julius, B. Harrington and G. Page. 2002. Global climate change and sea level rise: potential losses of intertidal habitat for shorebirds. Waterbirds 25: 173–183.

Gazeau, F. P. H., C. M. L. Quiblier, J. M. Jansen, J. P. Gattuso, J. B. M. Middelburg and C. H. R. Heip. 2007. Impact of elevated CO^2 on shellfish calcification. Geophysical Research Letters 34: L07603.

Gill, J. A. 2007. Approaches to measuring the effects of human disturbance on birds. Ibis 149 (Supplement s1): 9–14.

Gittman, R. K., F. J. Fodrie, A. M. Popowich, D. A. Keller, J. F. Bruno, C. A. Currin, C. H. Peterson and M. F. Piehler. 2015. Engineering away our natural defenses: an analysis of shoreline hardening in the US. Frontiers in Ecology and the Environment 13: 301–307.

Glenn, E. P., P. L. Nagler, R. C. Brusca and O. Hinojosa- Huerta. 2006. Coastal wetlands of the northern Gulf of California: inventory and conservation status. Aquatic Conservation: Marine and Freshwater Ecosystems 16: 5–28.

Harrington, B. 2003. Shorebird management during the nonbreeding season – an overview of needs, opportunities and management concepts. Wader Study Group Bulletin 100: 59–66.

Hassan, R., R. Scholes and N. Ash (Eds.). 2005. Millennium ecosystem assessment: current state and trends. Island Press, Washington, D.C., USA.

Hickey, C., W. D. Shuford, G. W. Page and S. Warnock. 2003. The Southern Pacific shorebird conservation plan: a strategy for supporting California's Central Valley and coastal shorebird populations. Version 1.1. PRBO Conservation Science, Stinson Beach, California, USA.

Hötker, H., E. Lebedeva, P. S. Tomkovich, J. Gromadzka, N. C. Davidson, J. Evans, D. A. Stroud and R. B. West (Eds.). 1998. Migration and international conservation of waders: research and conservation on north Asian, African, and European flyways. International Wader Studies 10.

Idaho Department of Fish and Game. 2015. Draft Idaho state wildlife action plan 2015 revision. Idaho Department of Fish and Game, Boise, Idaho, USA. https://idfg.idaho.gov/swap.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change 2007: mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (B. Metz, O. R. Davidson, P. R. Bosch, R. Dave and L. A. Meyer, Eds.). Cambridge University Press, Cambridge, U.K.

Iverson, G. C., S. Warnock, R. Butler, M. A. Bishop and N. Warnock. 1996. Spring migration of Western Sandpipers along the Pacific coast of North America: a telemetry study. Condor 98: 10–21.

Iwamura, T., H. P. Possingham, I. Chadès, C. Minton, N. J. Murray, D. I. Rogers, E. A. Treml and R. A. Fuller. 2013. Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. Proceedings of the Royal Society B 280: 2013.0325.

Johnston-González, R., C. J. Ruiz-Guerra, D. Eusse-González, L. F. Castillo-Cortés, Y. Cifuentes-Sarmiento, P. Falk-Fernández and V. Ramírez De Los Ríos. 2010. Plan de conservación para aves playeras en Colombia. Asociación Calidris, Cali, Colombia. [in Spanish]

Kaufmann, K. W. 2012. Our wetlands, our future. Conservation plan for wetlands of Panamá Bay. Panamá Audubon Society, Panamá City, Panamá. [in Spanish]

Kelley, J., J. Evens, R. Stallcup and D. Wimpfheiner. 1996. Effects of aquaculture on habitat use by wintering shorebirds in Tomales Bay, California. California Fish and Game 82: 160–174.

Kirby, J. 2011. Review of current knowledge of bird flyways, principal knowledge gaps and conservation priorities. Flyway Working Group Review 2, Convention on Migratory Species Scientific Council. http://www.cms.int/sites/default/files/document/inf_04_2b_flyway_wg_review2_e_only_0.pdf.

Lacerda, L. D. and Y. Schaeffer-Novelli. 1999. Mangroves of Latin America: the need for conservation and sustainable utilization. Pages 5–8 *in* Ecosistemas de Manglar en América Tropical (A. Yáñez-Arancibla and A. L. Lara-Domínquez, Eds.). Instituto de Ecología A.C., Xalapa, Veracruz, México; Unión Internacional para la Conservación de la Naturaleza/Oficina Regional para Mesoamérica, San José, Costa Rica; National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, Maryland, USA.

Lafferty, K. D. 2001. Birds at a southern California beach: seasonality, habitat use and disturbance by human activity. Biodiversity and Conservation 10: 1949–1962.

Lank, D. B., R. W. Butler, J. Ireland and R. C. Ydenberg. 2003. Effects of predation danger on migration strategies of sandpipers. Oikos 103: 303–319.

Liebezeit, J., E. Rowland, M. Cross and S. Zack. 2012. Assessing climate change vulnerability of breeding birds in Arctic Alaska. Unpublished report prepared for the Arctic Landscape Conservation Cooperative, Wildlife Conservation Society, North America Program, Bozeman, Montana, USA.

Lincoln, F. C. 1935. The waterfowl flyways of North America. Circular No. 342, U.S. Department of Agriculture, Washington, D.C., USA.

Lluch-Cota, S. E., E. A. Aragón-Noriega, F. Arreguín-Sánchez, D. Aurioles-Gamboa, J. Jesús Bautista-Romero, R. C. Brusca, R. Cervantes-Duarte, R. Cortés-Altamirano, P. Del-Monte-Luna, A. Esquivel-Herrera and others. 2007. The Gulf of California: review of ecosystem status and sustainability challenges. Progress in Oceanography 73: 1–26.

Lord, A., J. R. Waas, J. Innes and M. J. Whittingham. 2001. Effects of human approaches to nests of northern New Zealand Dotterels. Biological Conservation 98: 233–240.

Lugo, A. E. 2002. Conserving Latin American and Caribbean mangroves: issues and challenges. Madera y Bosques 8: 5–25.

Mathis, J. T., J. N. Cross, W. Evans and S. C. Doney. 2015. Ocean acidification in the surface waters of the Pacific-Arctic boundary regions. Oceanography 28: 122–135.

McKinnon, L., E. Nol and C. Juillet. 2013. Arctic-nesting birds find physiological relief in the face of trophic constraints. Scientific Reports 3: 1816.

Melcher, C. P., A. Farmer and G. Fernández. 2010. Conservation plan for the Marbled Godwit. Version 1.2. Manomet Center for Conservation Science, Manomet, Massachusetts, USA.

Meltofte, H., T. Piersma, H. Boyd, B. McCaffery, B. Ganter, V. V. Golovnyuk, K. Graham, C. L. Gratto-Trevor, R. I. G. Morrison, E. Nol and others. 2007. Effects of climate variation on the breeding ecology of Arctic shorebirds. Meddelelser om Grønland Bioscience 59, Danish Polar Center, Copenhagen, Denmark.

Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: synthesis. Island Press, Washington, D.C., USA.

Moore, J. N. 2016. Recent desiccation of western great basin saline lakes: lessons from Lake Abert, Oregon, U.S.A. Science of the Total Environment 554–555: 142–154.

Murchison, C. R., Y. Zharikov and E. Nol. 2016. Human activity and habitat characteristics influence shorebird habitat use and behavior at a Vancouver Island migratory stopover site. Environmental Management 58: 386–398.

Myers, J. P., R. I. G. Morrison, P. Z. Antas, B. A. Harrington, T. E. Lovejoy, M. Salaberry, S. E. Senner and A. Tarak. 1987. Conservation strategy for migratory species. American Scientist 75: 18–26.

National Fish and Wildlife Foundation (NFWF). 2015. Atlantic Flyway shorebird initiative – a business plan. National Fish and Wildlife Foundation, Washington, D.C., USA. http://www.nfwf.org/amoy/Documents/afsi_biz_plan.pdf.

Navedo, J. G., G. Fernández, J. Fonseca and M. C. Drever. 2015. A potential role of shrimp farms for the conservation of Nearctic shorebird populations. Estuaries and Coasts 38: 836–845.

Navedo, J. G., G. Fernández, N. Valdivia, M. C. Drever and J. A. Masero. 2016. Identifying management actions to increase foraging opportunities for shorebirds at semi-intensive shrimp farms. Journal of Applied Ecology. DOI: 10.1111/1365-2664.12735.

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.

Olson, D. M., E. Dinerstein, E. D. Wikramanayake, N. D. Burgess, G. V. N. Powell, E. C. Underwood, J. A. D'Amico, I. Itoua, H. E. Strand, J. C. Morrison and others. 2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience 51: 933–938.

Oregon Department of Fish and Wildlife (ODFW). 2016. Oregon conservation strategy. Oregon Department of Fish and Wildlife, Salem, Oregon, USA.

Páez-Osuna, F. and A. C. Ruiz-Fernández. 2005. Environmental load of nitrogen and phosphorus from extensive, semi-intensive, and intensive shrimp farms in the Gulf of California ecoregion. Bulletin of Environmental Contamination and Toxicology 74: 681–688.

Page, G. W., L. E. Stenzel, D. W. Winkler and C. W. Swarth. 1983. Spacing out at Mono Lake: breeding success, nest density, and predation in the Snowy Plover. Auk 100: 13–24.

Page, G. W., J. C. Warriner, J. S. Warriner, C. Eyster, K. Neuman, S. Connors, R. DiGaudio, J. Erbes and D. George. 2002. Nesting of the Snowy Plover in Monterey Bay and on the beaches of northern Santa Cruz County, California in 2002. Publication No. 990, PRBO Conservation Science, Stinson Beach, California, USA.

Palacios, E., X. Vega, D. Galindo, E. S. Amador-Silva, J. A. Castillo-Guerrero, E. González-Medina, O. Hinojosa-Huerta and P. Rodríguez. 2009. Proyecto de recuperación de aves playeras en el Noroeste de México. Unpublished report, Centro de Ciencias de Sinaloa, Culiacán, Sinaloa, México; Pronatura Noroeste, A.C., Ensenada, Baja California, México. [in Spanish]

Payne, L. X. 2010. Conservation plan for the Sanderling (*Calidris alba*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Peters, K. A. and D. L. Otis. 2006. Shorebird roost-site selection at two temporal scales: is human disturbance a factor? Journal of Applied Ecology 44: 196–209.

Petrie, M. 2013. Habitat and population objectives for wetland birds and waterbirds: North Puget Lowlands Ecoregion. Pacific Coast Joint Venture, Vancouver, Washington, USA.

Reiter, M. E., N. Elliott, S. Veloz, D. Jongsomjit, C. M. Hickey, M. Merrifield and M. D. Reynolds. 2015. Spatio-temporal patterns of open surface water in the Central Valley of California 2000–2011: drought, land cover and waterbirds. Journal of the American Water Resources Association 51: 1722–1738.

Robinson, A., H. Q. P. Crick, J. A. Learmonth, I. M. D. Maclean, C. D. Thomas, F. Bairlein, M. C. Forchhammer, C. M. Francis, J. A. Gill, B. J. Godley and others. 2009. Travelling through a warming world: climate change and migratory species. Endangered Species Research 7: 87–99.

Ruhlen, T. D., S. Abbott, L. E. Stenzel and G. W. Page. 2003. Evidence that human disturbance reduces Snowy Plover chick survival. Journal of Field Ornithology 74: 300–304.

Ruiz-Guerra, C. 2004. Distribution and behavior of shorebirds in the National Park Sanquianga (Nariño, Colombia). Undergraduate thesis, Universidad del Atlántico, Barranquilla, Colombia.

Ruiz-Guerra, C., Y. Cifuentes-Sarmiento, C. Hernández-Corredor, R. L. Johnston-Gonzalez and F. Castillo-Cortes. 2008. Reproduction of two subspecies of Wilson's Plover (*Charadrius wilsonia*) in Colombian coast. Ornitología Colombiana 6: 15–23.

San Francisco Bay Joint Venture Science-subcommittee (SFBJV). 2001. Measuring conservation delivery effectiveness in an evolving landscape: the San Francisco Bay Joint Venture monitoring and evaluation plan phase I. San Francisco Bay Joint Venture Office, Fairfax, California, USA.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr. and W. A. Link. 2014. The North American breeding bird survey, results and analysis 1966 - 2013. Version 01.30.2015. U.S. Department of the Interior, Geological Survey, Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Schmidt, P. R. 2006. North American flyway management: a century of experience in the United States. Pages 60–62 *in* Waterbirds Around the World (G. C. Boere, C. A. Galbraith and D. A. Stroud, Eds.). The Stationary Office, Edinburgh, U.K.

Secretariat of the Environment and Natural Resources (SEMARNAT). 2008. Estrategía para la conservación y manejo de las aves playeras y su hábitat en México. Secretariat of the Environment and Natural Resources, Tlalpan, Distrito Federal, México. [in Spanish]

Senner, N. R. 2010. Conservation plan for the Hudsonian Godwit. Version 1.1. Manomet Center for Conservation Science, Manomet, Massachusetts, USA.

Senner, N. R. 2012. One species, but two patterns: factors affecting spring migration timing in Hudsonian Godwits. Auk 129: 670–682.

Senner, N. R. and F. Angulo Pratolongo. 2014. Atlas de las aves playeras del Perú - sitios importantes para su conservación. CORBIDI, Lima, Perú. [in Spanish]

Senner, N. R., M. Stager and B. K. Sandercock. 2016. Ecological mismatches are moderated by local conditions in two populations of a long-distance migratory bird. Oikos. DOI: 10.1111/oik.03325.

Shuford, W. D., N. Warnock and R. L. McKernan. 2004. Patterns of shorebird use of the Salton Sea and adjacent Imperial Valley, California. Studies in Avian Biology 27: 61-77.

Shuman, C. 2015. Letter from California Department of Fish and Wildlife to Humboldt Bay Harbor Recreation and Conservation District regarding the initial study for the Coast Seafoods Company Humboldt Bay shellfish culture permit renewal and expansion project. February 27, 2015.

Simpson, M. C., C. S. L. M. Clarke, J. D. Clarke, D. Scott and A. Clarke. 2012. Coastal setbacks in Latin America and the Caribbean: a study of emerging issues and trends that inform guidelines for coastal planning and development. Technical Note No. IDB-TN-476, Inter-American Development Bank, Washington, D.C., USA.

Sonoran Joint Venture Technical Committee (SJV) and C. J. Beardmore (Ed.). 2006. Sonoran Joint Venture bird conservation plan. Version 1.0. Sonoran Joint Venture, Tucson, Arizona, USA.

Soykan, C. U., J. Sauer, J. G. Schuetz, G. S. LeBaron, K. Dale and G. M. Langham. 2016. Population trends for North American winter birds based on hierarchical models. Ecosphere 7: e01351. 10.1002/ecs2.1351

Stralberg, D., V. Toniolo, G. W. Page and L. E. Stenzel. 2004. Potential impacts of non-native *Spartina* spread on shorebird populations in South San Francisco Bay. Unpublished report to California Coastal Conservancy (contract #02-212), PRBO Conservation Science, Stinson Beach, California, USA.

Sutherland, W. J., J. A., Alves, T. Amano, C. H. Chang, N. C. Davidson, C. M. Finlayson, J. A. Gill, R. E. Gill, P. M. González, T. G. Gunnarsson and D. Kleijn. 2012. A horizon scanning assessment of current and potential future threats to migratory shorebirds. Ibis 154: 663–679.

Taft, O. W. and S. M. Haig. 2006. Importance of wetland landscape structure to shorebirds in an agricultural valley. Landscape Ecology 21: 169–184.

Taft, O. W., M. A. Colwell, C. R. Isola and R. J. Safran. 2002. Waterbird response to experimental drawdown: implications for multispecies management of wetland mosaics. Journal of Applied Ecology 39: 987–1001.

Tape, K., M. Sturm and C. Racine. 2006. The evidence for shrub expansion in northern Alaska and the pan-Arctic. Global Change Biology 12: 686–702.

Tessler, D. F., J. A. Johnson, B. A. Andres, S. Thomas and R. B. Lanctot. 2010. Black Oystercatcher (*Haematopus bachmani*) conservation action plan. Version 1.1. International Black Oystercatcher Working Group, Alaska Department of Fish and Game, Anchorage, Alaska, USA; U.S. Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska, USA; Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Tessler, D. F., J. A. Johnson, B. A. Andres, S. Thomas and R. B. Lanctot. 2014. A global assessment of the conservation status of the Black Oystercatcher *Haematopus bachmani*. International Wader Studies 20: 83–96.

Thomas, S., B. Andres and J. Vest. 2013. Shorebirds. Chapter Five *in* Intermountain West Joint Venture. 2013 Implementation Plan – Strengthening Science and Partnerships. Intermountain West Joint Venture, Missoula, Montana, USA.

Thorne, K. M., B. D. Dugger, K. J. Buffington, C. M. Freeman, C. N. Janousek, K. W. Powelson, G. R. Gutenspergen and J. Y. Takekawa. 2015. Marshes to mudflats: sea-level rise effects on tidal marshes along a latitudinal gradient in the Pacific Northwest. Open-File Report 2015–1204, U.S. Department of the Interior, Geological Survey, Sacramento, California, USA.

Tulp, I. and H. Schekkerman. 2008. Has prey availability for Arctic birds advanced with climate change? Hindcasting the abundance of tundra arthropods using weather and seasonal variation. Arctic 61: 48–60.

U.S. Department of the Interior. 1959. The waterfowl councils: a conservation partnership. U.S. Department of the Interior, Washington, D.C., USA.

U.S. Fish and Wildlife Service (USFWS). 2007. Recovery plan for the Pacific coast population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). Volumes 1 and 2. U.S. Department of the Interior, Fish and Wildlife Service, Sacramento, California, USA.

U.S. Fish and Wildlife Service (USFWS). 2015. USFWS administrative waterfowl flyway boundaries. Vector digital data. U.S. Department of the Interior, Fish and Wildlife Service, Falls Church, Virginia, USA.

U.S. Shorebird Conservation Plan Partnership. 2016. U.S. shorebirds of conservation concern – 2016. http://www.shorebirdplan.org/science/assessment-conservation-status-shorebirds/.

Utah Wildlife Action Plan Joint Team. 2015. Utah wildlife action plan: a plan for managing native wildlife species and their habitats to help prevent listing under the Endangered Species Act. Publication No. 15-14, Utah Division of Wildlife Resources, Salt Lake City, Utah, USA.

Valiela, I., J. L. Bowen and J. K. York. 2001. Mangrove forests: one of the world's threatened major tropical environments. BioScience 51: 807–815.

van Gils, J. A., S. Lisovski, T. Lok, W. Meissner, A. Ozarowska, J. de Fouw, E. Rakhimberdiev, M. Y. Soloviev, T. Piersma and M. Klaassen. 2016. Body shrinkage due to Arctic warming reduces Red Knot fitness in tropical wintering range. Science 352: 819–821.

Warnock, N., J. Y. Takekawa and M. A. Bishop. 2004. Migration and stopover strategies of individual Dunlin along the Pacific coast of North America. Canadian Journal of Zoology 82: 1687–1697.

Warnock, N., G. W. Page, M. Ruhlen, N. Nur, J. Y. Takekawa and J. T. Hanson. 2002. Management and conservation of San Francisco Bay salt ponds: effects of pond salinity, area, tide, and season on Pacific Flyway waterbirds. Waterbirds 25 (Special Publication 2): 79–92.

Washington Department of Fish and Wildlife (WDFW). 2015. Draft 2015 State wildlife action plan. Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Watkins, D. 1993. A national plan for shorebird conservation in Australia. RAOU Report No. 90, Australasian Wader Studies Group, Royal Australasian Ornithologists Union, Moonee Ponds, Victoria, Australia.

Wauchope, H. S., J. D. Shaw, Ø. Varpe, E. G. Lappo, D. Boertmann, R. B. Lanctot and R. A. Fuller. 2016. Rapid climate-driven loss of breeding habitat for Arctic migratory birds. Global Change Biology. DOI: 10.1111/gcb.13404.

Western Hemisphere Shorebird Reserve Network. 1990. Going global. Conservation and biology in the Western Hemisphere. WHSRN Network News 3: 1–11.

Weston, M. A. and M. A. Elgar. 2005. Disturbance to brood-rearing Hooded Plover *Thinornis rubricollis*: responses and consequences. Bird Conservation International 15: 193–209.

Wetlands International. 2016. Waterbird population estimates. Retrieved from http://wpe.wetlands.org/ on 21 November 2016.

Wildlife Action Plan Team. 2012. Nevada wildlife action plan. Nevada Department of Wildlife, Reno, Nevada, USA.

Wilke, A. L. and R. Johnston-González. 2010. Conservation plan for the Whimbrel (*Numenius phaeopus*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Williams, T. D., N. Warnock, J. Y. Takekawa and M. A. Bishop. 2007. Flyway scale variation in plasma triglyceride levels as an index of refueling rate in spring migrating Western Sandpipers. Auk 124: 886–897.

Williams, W. D. 2002. Environmental threats to salt lakes and the likely status of inland saline ecosystems in 2025. Environmental Conservation 29: 154–167.

Ydenberg, R. C., R. W. Butler and D. B. Lank. 2007. Effects of predator landscapes on the evolutionary ecology of routing, timing and molt by long-distance migrants. Journal of Avian Biology 38: 523–529.

Zarnetske, P. L., E. W. Seabloom and S. D. Hacker. 2010. Non-target effects of invasive species management: beachgrass, birds, and bulldozers in coastal dunes. Ecosphere 1: Article 13.

Zdravkovic, M. G. 2013. Conservation plan for the Wilson's Plover (*Charadrius wilsonia*). Version 1.0. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

Zöckler, C., R. Lanctot, S. Brown and E. Syroechkovskiy. 2013. Waders (shorebirds). Pages 92–102 *in* Arctic Report Card 2012 (M. O. Jeffries, J. A. Richter-Menge and J. E. Overland, Eds.). National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA. ftp://ftp.oar.noaa.gov/arctic/documents/ArcticReportCard_full_report2012.pdf.

Black Oystercatchers nest on rocky shores in Prince William Sound, Alaska, USA.
Melissa Gabrielson / U. S. Forest Service

Appendix 1

Regional and national shorebird conservation plans, joint venture implementation plans and State Wildlife Action Plans pertaining to the geographic scope and target species of the Pacific Americas Shorebird Conservation Strategy. See Literature Cited section for complete citations and Conservation Planning Foundation section for relevance criteria.

NATIONAL CONSERVATION PLANS (4)

United States Shorebird Conservation Plan (Brown *et al.* 2001)

http://www.shorebirdplan.org/plan-and-council/

A national shorebird conservation plan with priorities for monitoring, research needs, education and outreach and habitat management strategies.

Table 1. Number of United States-breeding shorebird species showing different nonbreeding distribution patterns.
Figure 1. Major routes of concentrated shorebird migration to and from the United States during spring and fall.
Appendix 1. Shorebird population estimates and population targets.
Appendix 2. Relative importance of each shorebird planning region for each species.
Appendix 3. National shorebird prioritization scores.
Appendix 5. Shorebird planning regions and Bird Conservation Regions.

Canadian Shorebird Conservation Plan (Donaldson *et al.* 2000)

https://waterbirds.org/wp-content/uploads/CW69-15-5-2000-eng.pdf

A national conservation plan with the goal of fulfilling the needs for research, monitoring, evaluation, conservation, communication and international linkages for shorebird conservation.

Appendix 1. Estimated population sizes and abundance status for 47 shorebirds breeding or regularly occurring in Canada.
Appendix 2. Summary of recently updated and other selected trend analyses of shorebird populations in North America.
Appendix 3. The Western Hemisphere Shorebird Reserve Network in Canada.
Appendix 4. Priority setting system for shorebirds in the United States and Canada.

Strategy for the Conservation and Management of Shorebirds and their Habitats in México (SEMARNAT 2008)

http://www.whsrn.org/conservation-plans/mexico-shorebird-strategy

A national conservation strategy that promotes the development of national programs and projects in México for the conservation and management of shorebirds and the wetland habitats on which they depend.

Table 2. Relative abundance estimates for 28 important shorebird sites in México.
Table 3. Priority wetlands for shorebirds and their winter counts.
Table 4. Western Hemisphere Shorebird Reserve Network sites in México and their network classification.
Appendix 4. Important areas for threatened species and their current status.

Conservation Plan for the Shorebirds of Colombia (Johnston-González *et al.* 2010)

http://calidris.org.co/wp-content/uploads/2012/02/plan_aves_playeras_colombia.pdf

A conservation plan for shorebird species and key sites in Colombia.

Tables 1 and 2. Priority conservation concern species and subspecies of shorebirds in Colombia (Neotropical and Nearctic).
Table 3. Species of shorebirds with more than 1% of biogeographic population in Colombia.
Table 5. Important sites for shorebirds in Colombia.
Figure 1. Map of important sites for shorebirds in Colombia.

REGIONAL SHOREBIRD CONSERVATION PLANS (11)

Alaska Shorebird Conservation Plan (ASG 2008)

https://www.fws.gov/alaska/mbsp/mbm/shorebirds/pdf/ascp_nov2008.pdf

Alaska provides breeding habitat for more shorebird species than any other state in the USA. Thirty-seven species of shorebirds regularly breed in the state.

Table 2. Conservation prioritization scores.
Table 3. Distribution of priority species in Bird Conservation Regions (BCR).
Tables 4–8: Priority species in BCRs 1–5.
Appendix 1. Status of shorebirds in Alaska.
Appendix 4. Seasonal habitat preferences of shorebirds in Alaska.
Appendix 5. Important shorebird sites in Alaska.
Appendix 6. Shorebird conservation organizations and agencies.
Appendix 7. Nonbreeding areas and flyways used by Alaska shorebirds.
Maps 1–6. Important shorebird site maps for BCRs 1–5 in Alaska.

Bird Conservation Strategy for Bird Conservation Region 5: Northern Pacific Rainforest (Environment Canada 2013)

https://www.ec.gc.ca/mbc-com/DF49C9A5-E2A7-466F-B06C-2DF69B0E0664/BCR-5-PYR-FINAL-Feb-2013.pdf

A conservation strategy that builds on the existing framework for implementing bird conservation in Canada.

Figure 15. Percent of identified threats to priority species in herbaceous habitat in each threat sub-category.
Figure 24. Percent of identified threats to priority species in coastal habitat in each threat sub-category.
Figure 29. Percent of identified threats to priority species (by threat sub-category) in BCR 5 Pacific and Yukon when they are outside Canada.
Table 12. Threats addressed, conservation objectives, recommended actions and priority species affected for herbaceous habitat in BCR 5 Pacific and Yukon Region.
Table 21. Priority species that use coastal habitat, regional habitat sub-class, important habitat features, population objectives and reason for priority status.
Table 22. Threats addressed, conservation objectives, recommended actions and priority species affected for coastal habitat in BCR 5 Pacific and Yukon Region.
Table A1. Complete list of species in BCR 5 Pacific and Yukon, when they are in the BCR (breeding, migrant, winter) and their priority status.

Nearshore Birds in Puget Sound (Buchanan 2006)

http://www.pugetsoundnearshore.org./technical_papers/shorebirds.pdf

Review of threats and opportunities for Dunlin and Black Oystercatcher in Puget Sound, Washington, USA.

Table 1. High counts (only those of at least 1,000 birds are shown) of Dunlin at Puget Sound sites that supported at least 1,000 Dunlins in winter or spring.
Figures 2 and 3. Conceptual models of linkages between Dunlin and Black Oystercatchers and nearshore restoration actions.
List of critical uncertainties (page 10).
Appendix 1: Bird species and associated habitats.

Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000)

http://www.shorebirdplan.org/wp-content/uploads/2013/01/NPACIFIC4.pdf

A plan that sets conservation priorities for 40 shorebird species that occur regularly within the Northern Pacific Region, USA.

Table 1. Issues of management concern for shorebirds in western Washington and western Oregon, according to major habitat type.
Table 2. Ownership and protection status of important shorebird sites in western Washington and western Oregon.
Table 3. Conservation priority of regularly occurring shorebird species in the Northern Pacific Region in western Washington and western Oregon.
Table 4. Summary of “natural” and human-created habitat types in the North Pacific Coast Region, and some of the shorebird species known to use them.
Sites of regional and international significance for inclusion in the Western Hemisphere Shorebird Reserve Network.

Southern Pacific Shorebird Conservation Plan (Hickey *et al.* 2003)

http://www.prbo.org/cms/docs/wetlands/SPSCPlan_010904.pdf

A strategy for supporting the Central Valley of California, USA, and coastal shorebird populations.

Table 1. National prioritization scores for U.S. Fish and Wildlife Service Species of Conservation Concern within the region; regional scores for population trend, and threats to breeding and nonbreeding populations; relative importance of the region during migration, winter, and breeding; and national conservation category.
Table 2. Percent of 13 shorebird species attributed to 38 wetlands in fall, winter and spring along the USA Pacific coast.
Figure 2–8. Important wetlands and beaches by California county.
Appendix B. Wetlands of importance on the California coast. Wetland sites, organized by county from north to south, known to hold at least hundreds of shorebirds.
Appendices C–E. Agencies and organizations responsible for oversight of wetlands and beaches of importance on the northern and southern coasts of California, and the San Francisco Bay Area.

Shorebird Recovery Project in Northwest México (Palacios *et al.* 2009)

https://www.manomet.org/sites/default/files/publications_and_tools/Northwest Mexico Shorebird Recovery Plan_2009.pdf

Threats and conservation strategies for shorebirds in northwestern México.

Table 1. Western Hemisphere Reserve Network designated sites of importance to shorebirds in northwest México.
Table 7. Overall summary of ecological viability and qualifications for each of the conservation targets.
Table 8. Key attributes, indicators and variation intervals to assess the current and desired health of each conservation object.
Table 9. Objectives and goals for conservation and monitoring plan for conservation targets' viability status assessment.
Table 10. Overall summary threats analysis for the conservation targets.
Figure 1. Map of Western Hemisphere Shorebird Reserve Network sites in northwest México.
Figures 4 and 5. Conceptual model identifying areas of opportunity where intervention and mitigation pressures, improve the viability of the targets and strengthen conservation capacity.
Figure 6–8. Results chains for the following strategies: site designation and management of priority conservation areas, aquaculture, shorebirds and monitoring.

Atlas of the Shorebirds of Perú (Senner and Angulo-Pratolongo 2014)

http://www.corbidi.org/uploads/4/9/8/9/49890817/atlas-de-las-aves-playeras-del-per%C3%BA-final-web.compressed.pdf

Summary of multi-year effort to document the shorebird populations in Perú.

Table 1. List of shorebird species included in the census.
Table 2. List of sites that were studied.
Figure 1. Important shorebird sites throughout Perú.
Species accounts that include regional population estimates, important sites and count totals.
Appendix 1. Population estimates for each species at each site per region and in total.
Appendix 2. Population estimates for each species per region and in total.
Appendix 3. Total population estimates and intervals of confidence per habitat in each region and in total.

Recovery Plan for Shorebirds in Patagonia (Blanco and Galindo Espinosa 2009)

http://www.whsrn.org/sites/default/files/file/Plan_Patagonia_12_06-04.pdf

Conservation plan for Patagonia's shorebird populations including six conservation habitats.

Table 1. Species of shorebirds in the Patagonian coastal area.
Table 3. Key attributes and indicators to assess the health of conservation targets.
Table 4. Overall ecological viability and qualification for each of the conservation targets.
Table 5. Global threats to the shorebird conservation targets of Patagonia.
Table 7. Action plan and implementation costs.
Appendix 5. Major threats and sources of pressure.

Conservation Plan for the Wetlands of Panamá Bay (Kaufmann 2012)

(not currently available on the internet)

A conservation plan for wetlands that provide ecosystem services in Panamá Bay, Panamá.

Table 1. Status of shorebirds with minimum counts in Panamá Bay representing more than 1% of the total population.
Table 2. Important site designations at Panamá Bay.
Table 3. Conservation targets of Panamá Bay.
Figure 2. Annual commercial catch of white shrimp in pounds and fishing effort in days at sea from 1960 to 2006.
Figure 3. Classification of current threats of each of the conservation targets following *Open Standards* procedures.
Map 1. Geographic scope of the project area.
Map 2. Location of conservation target in Panamá Bay.
Map 3. Areas affected by the threats.
Figure 4. *Open Standards* situational analysis.

Conservation Plan and Tourism Capacity Study for the Artificial Salt Lakes of ECUASAL, Santa Elena Province, Ecuador (Ágreda 2012)

(not currently available on the internet)

A plan with detailed conservation planning and actions. Eleven of the Strategy's target species occur regularly at this site.

Table 3. Status (migratory, wintering, accidental) of migratory birds that occur in the artificial salt lakes.
Table 13. Summary of programmatic conservation objectives.
Figure 13. Threats identified by the participants.

Appendix 1. Species list of birds observed in the artificial salt lakes.
Appendix 2. Species list of boreal migratory birds observed in the artificial salt lakes that are of concern in the Western Hemisphere.

Conservation Plan for Migratory Shorebirds in Chiloé (Delgado *et al.* 2010)

http://www.whsrn.org/sites/default/files/file/Plan_de_Conservacion_Chiloe.pdf

This plan focuses on conservation planning at Chiloé Island, Chile, for Hudsonian Godwit, Whimbrel and Rufous-chested Dotterel.

Table 3. Threats ranking and state of conservation targets.
Figure 2. Planning area site complexes for migratory shorebirds in Chiloé.
Section 7 includes strategies and actions to address threats.

MIGRATORY BIRD JOINT VENTURES IMPLEMENTATION PLANS (6)

Migratory Bird Joint Ventures are cooperative, regional partnerships that work to conserve habitat for the benefit of birds, other wildlife and people (http://mbjv.org/). Joint ventures focus on building collaborative relationships among stakeholders to deliver on-the-ground conservation solutions.

Intermountain West Joint Venture Implementation Plan, Chapter 5 (Thomas *et al.* 2013)

http://iwjv.org/resource/2013-implementation-plan-chapter-5-shorebirds

The 2013 Intermountain West Joint Venture (IWJV) Implementation Plan was developed through extensive collaboration with partners in the Intermountain West.

Table 1. Seasonal occurrence of shorebird species in the Intermountain West.
Table 2. Regional and Bird Conservation Region area of importance scores for shorebirds in the Intermountain West.
Table 3. National, regional and state conservation status of shorebird species in the Intermountain West.
Table 5. Population estimates and objectives for passage shorebirds by Bird Conservation Region in the Intermountain West Joint Venture area.
Table 6. Population estimates and objectives for breeding shorebirds within the Intermountain West Joint Venture.
Table 7. Status of primary key sites according to Western Hemispheric Shorebird Reserve Network criteria.
Table 8. Secondary sites for shorebird conservation within the Intermountain West identified by the Shorebird Science Team.
Appendix B. Status of shorebird species identified through regional conservation scores in the United States Shorebird Conservation Plan.

Sonoran Joint Venture Bird Conservation Plan (SJV Technical Committee and Beardmore 2006)

http://sonoranjv.org/wp-content/uploads/2011/02/SJVConsPlan121206.pdf

A binational all-bird conservation plan for the Sonoran Bioregion in northern México and the southwestern United States.

Table 2. Continental concern species in the Arid Borderlands region.
Priority species for freshwater wetlands, coastal wetlands, islands and agricultural habitats.
Appendix D. Priority shorebirds from the United States Shorebird Conservation Plan.

Central Valley Joint Venture Implementation Plan (CVJV 2006)

http://www.centralvalleyjointventure.org/assets/pdf/CVJV_fnl.pdf

Extensive summaries of regional planning and conservation efforts including detailed acreage of habitat types (i.e., managed wetlands, sewage ponds, rice fields, evaporation ponds).

Chapters 6 (nonbreeding) and 7 (breeding). Conservation planning for shorebirds with detailed habitat modeling.

Habitat and Population Objectives for Wetland Birds and Waterbirds: North Puget Lowlands Ecoregion (Petrie 2013)

http://www.pacificbirds.org/wp-content/uploads/2015/03/North-Puget-Lowlands-Habitat-and-Population-Objectives-Wetland....pdf

This implementation plan was based on the following factors: 1) priority bird species' habitat needs; 2) historic wetland complex and changes to that wetland complex since Euro-American settlement; and 3) the forecasted effects of sea-level rise on coastal habitats.

Table 2. Shorebird species found in North Puget Lowlands and occurrence.
Table 3. North American population estimates and peak counts for shorebirds at estuaries in North Puget Lowlands.
Table 12. Priority shorebird species for North Puget Lowlands and trends in populations.
Table 15. Priority shorebird species in North Puget Lowlands and their associated habitats.
Table 19. Peak counts of shorebirds at sites in North Puget Lowlands between 1990 and 1996.
Figure 17. Peak shorebird counts in North Puget Lowlands estuaries.
Appendix I. Historic and existing habitats.
Appendix IV. Sea-level rise effects in the Pacific Northwest.

Pacific Coast Joint Venture Coastal Northern California Component Strategic Plan (CA PCJV 2004)

http://www.pacificbirds.org/wp-content/uploads/2015/03/Strategic-Plan-CAL-PCJV-20041.pdf

This strategic plan outlines objectives and projects to expand conservation projects for the benefit of riparian and wetland bird habitats.

Table 2. Special conservation status bird species of northwestern California.
Recommended conservation actions by subregion (i.e., watersheds).

San Francisco Bay Joint Venture Monitoring and Evaluation Plan–Shorebirds and Waterbirds (SFBJV 2001)

http://www.sfbayjv.org/pdf/monitoring-evaluation-plan/4_SFBJV%20M&E%20Plan%20Phase%20I_Section%20IV%20Shorebirds%20and%20Waterbirds.pdf

The SFBJV plan focuses on mechanisms to monitor and evaluate the implementation of SFBJV shorebird and waterbird conservation programs.

Table 4.2. Habitat types utilized by shorebird and other waterbird species in the San Francisco Bay Joint Venture region.
Identifies priority research needs for shorebirds (page 16).

STATE WILDLIFE ACTION PLANS (8)

The State Wildlife Action Plan program facilitates the creation and implementation of comprehensive plans for conserving each state's fish and wildlife and the natural habitats on which they depend. All state strategies are required to identify priorities based on species with low and declining populations and species that are indicative of the diversity and health of wildlife of the state. Plans unique to each of the 50 states in the USA include conservation actions that respond to current and future challenges with objectives and goals that are specific, measurable and time measured. Plans are revised every 10 years and represent a proactive planning process to prevent wildlife species from becoming endangered.

Alaska State Wildlife Action Plan (ADFG 2015)

http://www.adfg.alaska.gov/index.cfm?adfg=species.wap2015revision

Table 1. Number of nominee species by taxonomic category in the 2006 State Wildlife Action Plan versus Species of Greatest Conservation Need in the 2015 revised plan.
Table 3. Species that are considered a threat to wildlife and their habitats in Alaska as invasive species (human-facilitated).
Appendix A. Species of Greatest Conservation Need in Alaska by justification.
Appendix C. Alaska population estimates for Species of Greatest Conservation Need.
Appendix D. Distribution of Species of Greatest Conservation Need in Alaska by habitat type.

Arizona's State Wildlife Action Plan (AGFD 2012)

https://www.azgfd.com/PortalImages/files/wildlife/2012-2022_Arizona_State_Wildlife_Action_Plan.pdf

Table 1. Number of Species of Greatest Conservation Need in each tier by taxon.
Figure 12. Species of Greatest Conservation Need Richness index.
Figure 17. Species and habitat conservation guide.
Appendix E. Species of Greatest Conservation Need.

California State Wildlife Action Plan (CDFW 2015)

https://www.wildlife.ca.gov/SWAP/Final

Tables 1-8. Conservation targets and strategies for the following provinces: North Coast and Klamath; Cascades and Modoc Plateau; Bay Delta and Central Coast; Central Valley and Sierra Nevada; South Coast; Deserts; and Marine.
Table 9-12. Most commonly identified key ecological attributes, stresses, pressures and strategies.
Table 13. Number of conservation strategy categories addressing each pressure.
Table 8.3-1. Results, objectives and effectiveness measures for all strategies.
Appendix C. Species of Greatest Conservation Need. Includes Snowy Plover (coastal and interior populations), Black Oystercatcher, Black Turnstone, Sanderling, Red Knot and Surfbird.
Appendix G. Climate adaptation strategies cross-reference guide.
Figures Figure 8.3-1–11. Results chains for conservation strategies.

Idaho State Wildlife Action Plan (IDFG 2015)

https://idfg.idaho.gov/swap

Appendix X. Species of Greatest Conservation Concern Tier 2: Long-billed Curlew.
Appendix F. Conservation status assessment for Long-billed Curlew.

Nevada Wildlife Action Plan (Wildlife Action Plan Team 2012)

http://www.ndow.org/Nevada_Wildlife/Conservation/Nevada_Wildlife_Action_Plan/

Species accounts for Long-billed Curlew, Western Sandpiper and Western Snowy Plover.
Appendix E. Great Basin Bird Observatory report - bird responses to effects of climate change.
Appendix F. 2012 Species of conservation priority lists.
Appendix G. State Wildlife Action Plan conservation landscape and focal areas.

Oregon Conservation Strategy (ODFW 2016)

http://www.oregonconservationstrategy.org/

Appendix 1. Conservation strategies for species including the following Strategy conservation targets: Black Oystercatcher, Long-billed Curlew, Rock Sandpiper and Western Snowy Plover.
Strategy Species List. Tabular information on conservation strategy species including federal and state listing statuses, ecoregions, special needs, limiting factors, data gaps and conservation actions.
Table. Conservation opportunities areas profile.
Section. Oregon nearshore strategy.

Utah Wildlife Action Plan (Utah Wildlife Action Plan Joint Team 2015)

https://wildlife.utah.gov/wap/Utah_WAP.pdf

Appendix - Species accounts (birds): Snowy Plover.
Appendix - Threats by Species of Greatest Conservation Need look-up tables.

Washington State Wildlife Action Plan (WDFW 2015)

http://wdfw.wa.gov/publications/01742/wdfw01742.pdf

Chapter 3. Species of Greatest Conservation Need.
Appendix A2. Species fact sheets for birds including the following Strategy conservation targets: Marbled Godwit, Red Knot, Rock Sandpiper and Snowy Plover.
Appendix B. Western Snowy Plover potential range and habitat distribution map (page 8).

TARGET SPECIES CONSERVATION PLANS (11)

The species conservation plans were developed by Manomet's Western Hemisphere Shorebird Reserve Network and partner organizations to describe each species' ecology, status, population estimates, habitat needs, threats and important sites (http://www.whsrn.org/conservation-plans).

Conservation Plan for American Oystercatcher throughout the Western Hemisphere (Clay *et al.* 2010)

Table 1. Wetlands International (2006) population estimates and trends for *Haematopus palliatus*.
Table 2. Revised population estimate for *H. palliatus palliatus*.
Table 3. Revised population estimates for *Haematopus palliatus* subspecies.
Key breeding and nonbreeding sites for each subspecies.
Figure 1. Distribution of the five subspecies of American Oystercatcher.

Black Oystercatcher Conservation Action Plan (Tessler *et al.* 2010)

Table 1. Rangewide population estimates.
Table 2. Important sites for Black Oystercatchers with abundances by region and season.
Table 3. Summary of high priority action items, estimated timelines, estimated costs, cooperating partners, and anticipated results.
Appendix 1. Threats following the Unified Classification Union and the Conservation Measures Partnership.
Appendices 2 and 3. Program or research collaborators and individuals directly involved in research, conservation, and management of Black Oystercatchers.

Conservation Plan for the Wilson's Plover (Zdravkovic 2013)

Map 1. Wilson's Plover range-wide subspecies map.
Map 2. Wilson's Plover annual range map.
Map 3. Wilson's Plover (*Charadrius wilsonia*) range-wide known important breeding areas.
Map 4. Wilson's Plover (*Charadrius wilsonia*) range-wide known important nonbreeding areas.
Table 2. Wilson's Plover (*Charadrius wilsonia*) range-wide subspecies population estimates.
Table 5. Sites of importance for > 1% of Wilson's Plover (*Charadrius wilsonia*) species' and subspecies' populations.

Appendix 1. Conservation rankings and status of the Wilson's Plover.
Appendix 2. List of current or potential collaborators.
Appendix 4. Wilson's Plover range-wide important sites and descriptions.

Conservation Plan for the Whimbrel (Wilke and Johnston-González 2010)

Table 1. Summary of existing population estimates, by country and/or region, for the Whimbrel during the boreal winter in the Western Hemisphere.
Table 2. List of important migratory stopover/staging sites or regions for the Whimbrel in the Western Hemisphere, arranged alphabetically by country.
Table 3. List of important nonbreeding (boreal winter) sites or regions for the Whimbrel in the Western Hemisphere, arranged alphabetically by country.
Figure 1. Map of Whimbrel distribution within the Western Hemisphere.

Conservation Plan for the Hudsonian Godwit (Senner 2010)

Table 1. List of important Hudsonian Godwit sites (or complex of sites) during northward migration.
Table 2. List of threats posed to the conservation of Hudsonian Godwits and the strategies to be employed to address those threats.
Table 3. List of possible collaborators on research projects and conservation actions.

Status Assessment and Conservation Action Plan for the Long-billed Curlew (Fellows and Jones 2009)

Table 1.1. State, Provincial, and Natural Heritage status, season of presence, and relative abundance of
Long-billed Curlews in Canada, México, and U.S.
Table 1.2. Primary Long-billed Curlew range, numbers, and physiographic divisions (Jones *et al.* 2008).
Primary breeding areas are divided into Bird Conservation Regions.
Table 2.1. Recommended prioritized conservation actions for Long-billed Curlews throughout their range.
Figure 1.1. Current breeding and wintering range of Long-billed Curlews.

Conservation Plan for the Marbled Godwit (Melcher *et al.* 2010)

Appendix 3. Provides regional summaries of principal threats and conservation priorities. Universal threat identified is lack of coordination and communication required to realize effective integrated shorebird management and conservation throughout the species entire range.
Table 3. Important migration/winter sites.

Red Knot Conservation Plan for the Western Hemisphere (Niles *et al.* 2010)

Population size and trends of *Calidris canutus roselaari*.
Table 1. Population estimates of the six subspecies of the Red Knot.
Table 2. Recent population estimates of Red Knots wintering in the New World.
Figure 1. Worldwide distribution of the six recognized subspecies of the Red Knot.
Figure 14. International Shorebird Survey Data showing distribution of Red Knots in winter in the U.S.
Figure 15. International Shorebird Survey Data showing distribution of Red Knots during fall migration in the U.S.

Conservation Plan for the Sanderling (Payne 2010)

Appendix II. Relative importance of shorebird planning regions to the Sanderling during migration and winter, as classified by the U.S. Shorebird Conservation Plan.
Appendix V. Very Important Sites for Sanderling known to host 1,000 individuals during migration and/or at least 500 during winter, representing 1% of the estimated flyway or wintering population.

Conservation Plan for the Western Sandpiper (Fernández *et al.* 2010a)

Table 1. Survival estimates for Western Sandpipers studied at breeding and wintering sites.
Table 2. List of important Western Sandpipers sites (or complexes of sites) during the annual cycle. Site designation categories: Western Hemisphere Shorebird Reserve Network, Important Bird Area, RAMSAR, Biosphere Reserve, National Wildlife Refuge, State Wildlife Area, Protected Area.
Figures 2–4. Important sites for Western Sandpipers in Canada and Alaska; Conterminous United States; México, Central America and South America.
Appendix 1. List of, and contact information for, Western Sandpiper contacts and potential future collaborators.

Conservation Plan for Dunlin with Breeding Populations in North America (Fernández *et al.* 2010b)

Table 1. Population estimates for three subspecies of Dunlin that breed in North America.
Table 3. List of important sites (or complexes of sites) used by *Calidris alpina pacifica* during migration.
Appendix 2. Contacts and potential collaborators for Dunlin conservation and research.

ENDANGERED SPECIES RECOVERY PLANS (1)

U.S. Fish and Wildlife Service recovery plans are coordinated and implemented by various stakeholders to help recover and protect species protected by the U.S. Endangered Species Act (https://www.fws.gov/Endangered/species/recovery-plans.html).

Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (USFWS 2007)

http://www.westernsnowyplover.org/recovery_plan.html

This recovery plan focuses on the Pacific coast population of Snowy Plover (Charadrius alexandrinus nivosus).

Table 1. Status of Western Snowy Plovers at four nesting sites in Washington (1993–2006).
Table 2. Number of adult Western Snowy Plovers observed on window surveys of the Oregon coast during the breeding season (1978–2006).
Table 3. Comparison of population estimates of adult Western Snowy Plovers on the Oregon coast during the breeding season (1993–2005) based on three different measures of abundance.
Table 4. Number of adult Western Snowy Plovers observed during breeding season window surveys of the California coast.
Table 5. Breeding season window surveys of Western Snowy Plover adults at selected sites along the coast of San Luis Obispo, Santa Barbara and Ventura Counties.
Table 6. Total number of nests at habitat restoration areas on the Oregon Coast 1994–2004.
Table 7. Total number of fledged young at habitat restoration areas on the Oregon Coast 1994–2004.
Table 8. Threats to the Pacific coast population of the Western Snowy Plover and steps within the recovery plan to reduce or eliminate threats.
Figure 1. Map of known breeding and wintering distribution of the Pacific coast population of the Western Snowy Plover.
Figure 12. Chart of recovery planning and implementation efforts.
Appendix A. Locations of current or historical Snowy Plover breeding and wintering areas.
Appendix B. Information on Snowy Plover breeding and wintering locations.
Appendix C. Summary of current and additional needed management activities for Snowy Plover breeding and wintering locations.
Appendix D. Population viability analysis for Pacific coast Snowy Plovers.
Appendix E. Associated sensitive species of the coastal beach-dune ecosystem and adjacent habitats.
Appendix G. Priorities for recovery of threatened and endangered species.
Appendix H. Conservation tools and strategies.
Appendix I. Summary of potential funding sources for recovery actions.
Appendix L. Maps of Snowy Plover sites.

Appendix 2

List of regions (bold), biomes (bold italics), and ecoregions (regular font) within the geographic scope of the Pacific Americas Shorebird Conservation Strategy (based on Olson *et al.* 2001). Within these regions, actions will be focused on beach, shoreline, wetland, grassland, tundra and alpine habitats.

Arctic/subarctic

Tundra

Wrangel Island arctic desert
Beringia lowland tundra
Beringia upland tundra
Arctic Foothills tundra (partial, coastal)

North-temperate

Tundra

Alaska-St. Elias Range tundra (partial, coastal)
Pacific coastal mountain icefields and tundra

Boreal forests/taiga

Cook Inlet taiga (partial, coastal)
Alaska Peninsula montane taiga

Temperate coniferous forests

Northern Pacific coastal forests
British Columbia mainland coastal forests
Central Pacific coastal forests
Northern California coastal forests
Queen Charlotte Islands (Haida Gwaii)
Puget lowland forests

Temperate broadleaf and mixed forests

Willamette Valley forests

Temperate grasslands, savannas and shrublands

Palouse grasslands
California Central Valley grasslands

Mediterranean forests, woodland and shrub

California coastal sage and chaparral
California interior chaparral and woodlands
California montane chaparral and woodlands

Deserts and xeric shrublands

Snake-Columbia shrub steppe
Great Basin shrub steppe
Mojave desert
Sonoran desert
Gulf of California xeric scrub
Baja California desert

Tropical and subtropical dry broadleaf forests

Sonoran-Sinaloan transition subtropical dry forest
Sierra de la Laguna dry forest

Deserts and xeric shrublands

San Lucan xeric scrub
Galápagos Islands scrubland mosaic

Flooded grasslands and savannas

Guayaquil flooded grasslands

Neotropical

Mangrove

Northern Mesoamerican Pacific mangroves
Southern Mesoamerican Pacific mangroves
South American Pacific mangroves

Tropical and subtropical dry broadleaf forests

Sinaloan dry forests
Jalisco dry forests
Baisas dry forests
Southern Pacific dry forests
Central American dry forests
Panamánian dry forests
Ecuadorian dry forests
Tumbes-Piura dry forests

Tropical and subtropical moist broadleaf forests

Costa Rican seasonal moist forests
Isthmian-Pacific moist forests
Isthmian-Atlantic moist forests
Chocó-Darién moist forests
Western Ecuador moist forests

South-temperate

Deserts and xeric shrublands

Sechura desert
Atacama desert

Temperate grasslands, savannas and shrublands

Patagonian steppe

Mediterranean forests, woodlands and shrub

Chilean matorral

Temperate broadleaf and mixed forests

Valdivian temperate forests
Magellanic subpolar forests

Appendix 3

List of key shorebird sites in the Pacific Americas Flyway including Important Bird Areas and Western Hemisphere Shorebird Reserve Network sites. Officially designated Western Hemisphere Shorebird Reserve Network sites are in bold.

ID[1]	Key Shorebird Site[2]	Bird Use[3]	Country	Global IBA[4]	National IBA[5]	Official IBA or WHSRN Site Name(s)[6]
1	Wrangel Island	R	Russia	Y	N	
2	Cape Espenberg	R	USA	N	Y	
3	Shishmaref Inlet	I	USA	PO	N	
4	Lopp Lagoon	R	USA	N	Y	
5	Norton Bay	R	USA	PO	N	
6	Golovin Lagoon	R	USA	N	PO	
7	Safety Sound	R	USA	N	Y	
8	Stebbins - St. Michael	R	USA	Y	N	
9	Knik River Flats	R	USA	N	Y	Palmer Hay Flats IBA
10	Susitna Flats	H	USA	Y	N	
11	**Yukon-Kuskokwim Delta**	H	USA	Y(2)	Y	Yukon River Delta,Central Yukon-Kuskokwim IBAs
12	Chickaloon Flats	R	USA	N	N	
13	Trading Bay	R	USA	Y	N	
14	Redoubt Bay	I	USA	Y	N	
15	**Copper River Delta***	H	USA	Y	N	
16	Northeast Montague Island	H	USA	Y	N	Northern Montague Island IBA
17	Tuxedni Bay	R	USA	N	Y	
18	Nunivak Island	R	USA	PO	N	Nunivak Island Coastal IBA
19	**Controller Bay***	H	USA	Y	N	Copper River Delta IBA/WHSRN
20	**Kachemak Bay**	I	USA	Y(3)	N	Kachemak Bay, Fox River Flats, Homer Spit IBAs
21	Yakutat Forelands	I	USA	Y	N	Yakutat Bay IBA
22	Carter Bay	R	USA	(Y)	N	Jacksmith Bay to Cape Pierce IBA
23	Middleton Island	R	USA	Y	N	Middleton Island Colony IBA
24	Goodnews Bay	R	USA	Y	N	Goodnews Bay Colony IBA
25	Nushagak Bay	R	USA	(Y)	N	Nushagak and Kvichak Bays IBA
26	**Kvichak Bay**	R	USA	(Y)	N	Nushagak and Kvichak Bays IBA
27	Chagvan Bay	R	USA	(Y)	N	Jacksmith Bay to Cape Pierce IBA
28	Nanvak Bay	R	USA	(Y)	N	Jacksmith Bay to Cape Pierce IBA
29	Mendenhall Wetlands	R	USA	Y	N	
30	Egegik Bay	R	USA	(Y)	N	Nushagak and Kvichak Bays IBA
31	Kodiak Island	I	USA	Y(5)	N	Uganik Bay and Viekoda Bay, Marmot Bay, Chiniak Bay, Eastern Kodiak Island Marine, Flat Island Colony IBAs
32	Ugashik Bay	R	USA	(Y)	N	Nushagak and Kvichak Bays IBA
33	Cinder-Hook Lagoons	R	USA	(Y)	N	Nushagak and Kvichak Bays IBA
34	Port Heiden	R	USA	(Y)	N	Northern Alaska Peninsula Coastal IBA
35	Seal Islands	R	USA	(Y)	N	Northern Alaska Peninsula Coastal IBA
36	Stikine River Delta	I	USA	Y	N	
37	Nelson Lagoon/Mud Bay	I	USA	Y	N	Nelson Lagoon Colonies IBA

ID[1]	Key Shorebird Site[2]	Bird Use[3]	Country	Global IBA[4]	National IBA[5]	Official IBA or WHSRN Site Name(s)[6]
38	Izembek-Moffet Lagoons	R	USA	Y	N	Izembek Lagoon and Bechevin Bay IBA
39	Delkatla Slough	R	Canada	N	N	
40	Queen Charlotte Strait	R	Canada	N	N	
41	Hansen's Lagoon	R	Canada	N	N	
42	Baynes Sound	R	Canada	Y	N	K'omoks Comox IBA
43	White Islets and Wilson Creek	R	Canada	Y	N	
44	**Tofino Flats/Chesterman Beach**	I	Canada	Y	N	Tofino Mudflats IBA, Tofino Wah-nah-jus Hilth-hoo-is Mudflats WHSRN
45	**Fraser River Delta**	H	Canada	Y	N	Boundary Bay - Roberts Bank - Sturgeon Bank (Fraser River Estuary) IBA
46	Barkley Sound	R	Canada	Y	N	
47	Padilla Bay	R	USA	Y	N	Samish/Padilla Bays IBA
48	**Greater Skagit and Stillaguamish Delta**	R	USA	Y	N	Skagit Bay IBA
49	Port Susan Bay	R	USA	N	Y	
50	Ocean Shores/Copalis Beach	R	USA	N	Y	Damon Point/Oyhut IBA
51	Grays Harbor	I	USA	N	Y	Bowerman Basin IBA
52	Willapa Bay	I	USA	N	Y(2)	North Willapa Bay (Willapa River Estuary), South Willapa Bay (Shoalwater Bay) IBAs
53	North Beach - Longbeach	R	USA	N	Y	Leadbetter Point IBA
54	**Columbia River Estuary**	R	USA	N	Y	
55	Sunset Beach	R	USA	N	Y	Clatsop Beaches IBA
56	Tillamook Bay	R	USA	N	Y	
57	Lake Lowell	R	USA	N	Y	Deer Flat National Wildlife Refuge IBA
58	Harney Basin	R	USA	Y	N	Malheur National Wildlife Refuge IBA
59	Coquille River Estuary	R	USA	N	Y	Bandon Marsh National Wildlife Refuge IBA
60	**Springfield Bottoms/ American Falls**	R	USA	Y	N	American Falls Reservoir IBA
61	Summer Lake	R	USA	N	Y	Summer Lake Wildlife Management Area IBA
62	Coos Bay	R	USA	N	Y	Coos Estuary IBA
63	Lake Abert	I	USA	N	Y	
64	Warner Wetlands	R	USA	N	N	Warner Basin (identified) IBA
65	Klamath Basin	R	USA	N	Y	Klamath Marsh National Wildlife Refuge IBA
66	Goose Lake	R	USA	N	Y	Goose Lake (and Garrett Ranch) IBA
67	Alkali Lakes	R	USA	N	Y	Surprise Valley IBA
68	**Great Salt Lake**	H	USA	Y(5)	N	Gunnison Bay/North Arm, Bear River Bay, Ogden Bay, Farmington Bay, Gilbert Bay/South Arm IBAs
69	**Humboldt Bay Complex**	I	USA	Y	N	Humboldt Bay IBA
70	Honey Lake	R	USA	N	Y	Honey Lake Valley IBA
71	Humboldt Wildlife Management Area	R	USA	N	Y	Boyd Humboldt Valley Wetlands IBA
72	Lahontan Valley Wetlands	H	USA	N	Y	
73	**Sacramento Valley**	I	USA	Y(1)	Y(2)	Yolo Bypass Area (Global), Sacramento Valley Wetlands (State), Sacramento-San Joaquin Delta (State) IBAs
74	**Tomales Bay**	R	USA	N	Y	
75	Drakes/Limantour esteros	R	USA	Y	N	Point Reyes – Outer IBA

ID[1]	Key Shorebird Site[2]	Bird Use[3]	Country	Global IBA[4]	National IBA[5]	Official IBA or WHSRN Site Name(s)[6]
76	**Mono Lake**	I	USA	N	Y	Mono Lake Basin IBA
77	Bolinas Lagoon	R	USA	N	Y	
78	**San Francisco Bay**	H	USA	Y(2)	Y(9)	San Pablo Bay Wetlands (Global), Suisun Marsh (Global), Benicia State Recreation Area (State), Brooks Island (State), Concord Marshes (State), Corte Madera Marshes (State), Eastshore Wetlands (State), North Richmond Wetlands (State), Richardson Bay(State), San Francisco Bay – South (State), Alameda Wildlife Refuge (State) IBAs
79	**Elkhorn Slough**	R	USA	N	Y	
80	Owens Lake	R	USA	N	Y	
81	Morro Bay	R	USA	N	Y	
82	**Grasslands Ecological Area**	I	USA	Y	N	
83	Piute Ponds	R	USA	Y	N	Edwards Air Force Base IBA
84	Mugu Lagoon	R	USA	Y	N	Point Mugu IBA
85	Salton Sea	R	USA	Y	N	
86	**South San Diego Bay**	R	USA	Y	N	San Diego Bay – South IBA
87	Alto Golfo de California y Delta de Río Colorado	I	México	PR	N	Delta del Río Colorado IBA
88	**Complejo Lagunar San Quintín**	R	México	PR	N	Área San Quintín IBA
89	Estero Santa Cruz	R	México	PR	N	
90	Estero Cardonal	R	México	PR	N	
91	**Complejo Lagunar Ojo de Liebre - Guerrero Negro**	H	México	PR	N	
92	Estero Lobos	R	México	N	N	
93	**Estero Tóbari**	R	México	PR	N	Sistema Tóbari IBA
94	**Complejo San Ignacio**	I	México	PR	N	
95	Agiabampo	R	México	PR	N	
96	Topolobampo	R	México	N	N	
97	**Bahía Santa Maria**	I	México	PR	N	
98	**Bahía Magdalena**	R	México	PR	N	Bahía Magdalena-Almejas IBA
99	**Ensenada de Pabellones**	I	México	PR	N	
100	**Bahía de Guadalupana/ Playa Ceuta**	R	México	PR	N	Bahía de Ceuta-Cospita IBA
101	**Ensenada de la Paz**	R	México	PR	N	
102	**Sistema Lagunar Huizache-Caimanero**	R	México	PR	N	
103	**Marismas Nacionales**	I	México	PR	N	
104	Laguna Cuyutlán y Estero Palo Verde	R	México	PR	N	
105	Istmo de Tehuantepec-Mar Muerto	R	México	PR	N	
106	Laguna la Joya	R	México	N	N	
107	Golfo de Fonseca	R	El Salvador	Y	N	Bahía La Unión IBA
108	**Delta del Estero Real**	I	Nicaragua	Y	N	Delta del Estero Real y Llanos de Apacunca IBA
109	Golfo de Nicoya	R	Costa Rica	Y	N	Manglares y franja costera del Golfo de Nicoya IBA
110	**Upper Bay of Panamá**	H	Panamá	Y	N	Parte Alta de la Bahía de Panamá IBA/WHSRN

ID[1]	Key Shorebird Site[2]	Bird Use[3]	Country	Global IBA[4]	National IBA[5]	Official IBA or WHSRN Site Name(s)[6]
111	Bahía de Chorrera	R	Panamá	Y	N	
112	Humedales de Chimán	R	Panamá	Y	N	
113	Humedales de Sierpe y Península de Osa	R	Costa Rica	Y	N	
114	Punta Patiño Nature Reserve and Wetlands	R	Panamá	Y	N	Reserva Natural y Humedales de Punta Patiño IBA
115	Bahía de Parita	R	Panamá	Y	N	
116	Humedales de la Ensenada de Garachiné	R	Panamá	Y	N	
117	Bahía de Buenventura	R	Colombia	N	N	
118	**Bocana de Iscuandé**	R	Colombia	N	N	
119	**Delta del Río Iscuandé**	R	Colombia	N	N	
120	Bahía Guapi	R	Colombia	N	N	
121	Parque Nacional Natural Sanquianga	I	Colombia	Y	N	
122	Ciénaga de La Segua	R	Ecuador	Y	N	
123	**Humedales de Pacoa***	R	Ecuador	Y	N	
124	Pungay Salt Works	R	Ecuador	N	N	
125	**Lagunas de ECUASAL-Salinas***	R	Ecuador	Y	N	
126	Bahía de Tumbes	R	Perú	N	N	
127	Manglares de Tumbes	R	Perú	N	N	
128	Reserva Ecológica Arenillas	R	Ecuador	Y	N	
129	**Manglares de San Pedro de Vice**	R	Perú	Y	N	
130	Estuario de Virrilá	I	Perú	Y	N	
131	Faclo Grande	R	Perú	N	N	
132	Ventanilla	R	Perú	N	N	
133	Boca del Río Cañete	R	Perú	N	N	
134	Boca del Río Chincha	R	Perú	N	N	
135	Humedales de Pisco	R	Perú	N	N	
136	**Bahía de Paracas**	R	Perú	Y	N	Reserva Nacional de Paracas IBA
137	Río Tambo y Lagunas de Mejía	R	Perú	Y	N	
138	**Humedal del Río Lluta**	R	Chile	Y	N	Desembocadura del Río Lluta IBA
139	Bahía de Coquimbo	R	Chile	Y	N	
140	Estero Mantagua/ Desembocadura del Río Aconcagua	R	Chile	Y	N	
141	**Desembocadura del Río Maipo**	R	Chile	Y	N	
142	Desembocadura Río Mataquito	R	Chile	Y	N	
143	Humedal-Marisma Rocuant Andalién	R	Chile	Y	N	
144	Playa Laraquete	R	Chile	Y	N	

ID[1]	Key Shorebird Site[2]	Bird Use[3]	Country	Global IBA[4]	National IBA[5]	Official IBA or WHSRN Site Name(s)[6]
145	Humedal-Estuario Tubul-Raqui	R	Chile	Y	N	
146	Desembocadura del Río Chamiza, Coihuin-Pelluco	I	Chile	Y	N	
147	**Humedales de Maullín**	R	Chile	Y	N	Estuario de Maullín y Cerro Amortajado IBA
148	Chacao	R	Chile	Y	N	
149	Santuario de las Aves Bahía de Caulín	I	Chile	Y	N	
150	Sistema Quetalmahue, Quilo y Mar Brava	R	Chile	Y	N	
151	Pudeto-Quempillén	R	Chile	Y	N	
152	Quemchi Aucar	R	Chile	Y	N	
153	Colo	R	Chile	N	N	
154	Desembocadura del Río San Juan	R	Chile	Y	N	
155	Teguel	R	Chile	N	N	
156	Bahía de Putemun	I	Chile	Y	N	
157	Bahía Curaco de Vélez	I	Chile	Y	N	
158	**Humedales Orientales de Chiloé**	H	Chile	Y	N	Parque Nacional Chiloé IBA
159	Huenao/Coñao	R	Chile	N	N	
160	Sistema de Bahías TenTen Castro	R	Chile	Y	N	
161	Playa de Pullao	I	Chile	Y	N	
162	Bahía de Chullec	R	Chile	Y	N	
163	Bahía Rilán	R	Chile	Y	N	
164	Bahía de Quinchao	R	Chile	Y	N	
165	Pallidad/Contuy	R	Chile	N	N	
166	Estero Compu	R	Chile	Y	N	
167	San Antonio de Chadmo	R	Chile	N	N	
168	Estero Huildad	R	Chile	Y	N	
169	Bahía de Quellón	R	Chile	Y	N	
170	Bahía de Yaldad	R	Chile	Y	N	

[1]Map ID number referenced on each focal geographic region map (Figures 4–7).

[2]Key shorebird sites in the project area (see Key Shorebird Sites within the Pacific Americas Flyway section for description of criteria used to include in list).

[3]WHSRN criteria: H = Hemispheric Shorebird Use (at least 500,000 shorebirds annually, or at least 30% of the biogeographic population for a species), I = International Shorebird Use (at least 100,000 shorebirds annually, or at least 10% of the biogeographic population for a species), R = Regional Shorebird Use (at least 20,000 shorebirds annually, at least 1% of the biogeographic population for a species).

[4]BirdLife International's A4 category for globally important congregations of birds. PO = potential IBA, PR = proposed IBA. Parentheses with a number indicate that the key shorebird site has more than one IBA or WHSRN site. (Y) indicates that more than one key shorebird site is included in a single IBA or WHSRN site.

[5]National Audubon Society and State Chapter Important Bird Areas. PO = potential IBA.

[6]Official IBA or WHSRN site names if different than key shorebird site place name.

* designates key shorebird sites that are part of one WHSRN site.

Appendix 4

Seasonal partitioning of population sizes, by regions, of focal shorebird species for the Pacific Americas Shorebird Conservation Strategy.

Common Name[1]	Population[2]	Season[3]	PacAm Popn. Size[4]	Arctic/ Subarctic[5]	North-temperate[5]	Neotropical[5]	South-temperate[5]
American Oystercatcher	*Haematopus palliatus palliatus*	N	1,000			1,000	
	H. p. frazari	B, N	3,000		1,200	1,800	
	H. p. pitanay	B, N	12,500			1,000	11,500
	H. p. galapagensis	B, N	300			300	
Black Oystercatcher	*H. bachmani*	B, N	11,000	1,600	9,400		
Blackish Oystercatcher	*H. ater*	B, N	367,000				367,000
Magellanic Oystercatcher	*H. leucopodus*	B, N	30,000				30,000
Snowy Plover	*Charadrius nivosus nivosus* (Pacific coast)	B, N	2,930		2,930		
	C. n. nivosus (Interior)	B, N	10,920		10,120	800	
	C. n. occidentalis	B, N	8,000			1,500	6,500
Wilson's Plover	*C. wilsonia beldingi*	B, N	7,500		600	6,400	500
Rufous-chested Dotterel	*C. modestus*	B, N	250,000				250,000
Whimbrel	*Numenius phaeopus* (Alaska breeding)	B	40,000	40,000			
		N	40,000		1,000	14,000	25,000
		M	40,000		40,000	39,000	
Long-billed Curlew	*N. americanus*	B	72,500		72,500		
		N	32,000		32,000		
Hudsonian Godwit	*Limosa haemastica* (Alaska breeding)	B	21,000	21,000			
		N	21,000				21,000
Marbled Godwit	*L. fedoa fedoa* (Great Plains breeding)	B	1,000		1,000		
		N	160,000		140,000	20,000	
		M	140,000		140,000		
	L. f. beringiae	B	2,000	2,000			
		N	2,000		2,000		
	L. f. fedoa (James Bay breeding)	N	2,000			2,000	
Black Turnstone	*Arenaria melanocephala*	B	95,000	95,000			
		N	95,000		95,000		
Red Knot	*Calidris canutus roselaari*	B	21,800	21,800			
		N	21,800		11,800	9,000	1,000
		M	21,800		21,800	10,000	
Surfbird	*C. virgata*	B	70,000	70,000			
		N	70,000		35,000	25,000	10,000
		M	70,000		70,000	35,000	
Sanderling	*C. alba*	N	130,000		60,000	30,000	40,000
		M	130,000		130,000	70,000	

Common Name[1]	Population[2]	Season[3]	PacAm Popn. Size[4]	Arctic/ Subarctic[5]	North-temperate[5]	Neotropical[5]	South-temperate[5]
Dunlin	*C. alpina pacifica*	B	550,000	550,000			
		N	550,000		470,000	5,000	
		M	550,000		550,000		
Rock Sandpiper	*C. ptilocnemis ptilocnemis*	B	19,800	19,800			
		N	19,800		19,800		
Semipalmated Sandpiper	*C. pusilla* (Western)	B	200,000	200,000			
		N	100,000			50,000	50,000
		M	100,000		100,000	100,000	
Western Sandpiper	*C. mauri*	B	3,118,000	3,118,000			
		N	3,020,000		1,470,000	1,500,000	50,000
		M	3,118,000		3,118,000	1,550,000	
Short-billed Dowitcher	*Limnodromus griseus caurinus*	B	75,000	75,000			
		N	75,000		45,000	30,000	
		M	75,000		75,000		
Willet	*Tringa semipalmata inornata*	B	20,000		20,000		
		N	140,000		95,000	40,000	5,000
		M	140,000		120,000	45,000	

[1]Common and scientific names are listed according to the Check-list of North American Birds 7th edition (AOU 1998) and supplements through 2016.

[2]Subspecies and population nomenclature follows Brown *et al.* (2000) with updates in Andres *et al.* (2012).

[3]Breeding = B, migration = M or nonbreeding = N (relatively stationary "winter" period).

[4]Population estimate in Pacific Americas Flyway.

[5]See Geographic Scope section.

Appendix 5

Procedures and criteria to rank threats and strategies during the Pacific Americas Shorebird Conservation Strategy workshops. For more information about the *Open Standards for the Practice of Conservation*, see http://cmp-openstandards.org/.

Threat rating procedures

Threats were evaluated based on their scope, severity and irreversibility within each of the four focal geographic regions; each of the threat ratings elements has categorical criteria to rate it as low, medium, high or very high. The Miradi™ software combined ratings of magnitude (scope + severity) with irreversibility to determine an overall threat rating across all regions of the Pacific Americas Flyway (Appendix 6).

Threats are rated using the following three criteria; the Miradi™ software rolls them into a single score for each threat by each focal geographic region and season, and a summary rating for the entire project area.

Scope

Most commonly defined spatially as the proportion of the target that can reasonably be expected to be affected by the threat within 10 years given the continuation of current circumstances and trends. For target species, the scope is measured as the proportion of the target's population.

- *Low:* The threat is likely to be very narrow in its scope, affecting the target across a small proportion (1–10%) of its occurrence/population.
- *Medium:* The threat is likely to be restricted in its scope, affecting the target across some (11–30%) of its occurrence/population.
- *High:* The threat is likely to be widespread in its scope, affecting the target across much (31–70%) of its occurrence/population.
- *Very High:* The threat is likely to be pervasive in its scope, affecting the target across all or most (71–100%) of its occurrence/population.

Severity

Within the scope, the level of damage to the target from the threat that can reasonably be expected given the continuation of current circumstances and trends. For target species, the severity is measured as the degree of reduction of the target population within the scope.

- *Low:* Within the scope, the threat is likely to only slightly degrade/reduce the target or reduce its population by 1–10% within 10 years or three generations.
- *Medium:* Within the scope, the threat is likely to moderately degrade/reduce the target or reduce its population by 11–30% within 10 years or three generations.
- *High:* Within the scope, the threat is likely to seriously degrade/reduce the target or reduce its population by 31–70% within 10 years or three generations.
- *Very High:* Within the scope, the threat is likely to destroy or eliminate the target or reduce its population by 71–100% within 10 years or three generations.

Irreversibility

The degree to which the effects of a threat can be reversed and the target affected by the threat restored.

- *Low:* The effects of the threat are easily reversible and the target can be easily restored at a relatively low cost and/or within 0–5 years (e.g., off-road vehicles trespassing in wetland).
- *Medium:* The effects of the threat can be reversed and the target restored with a reasonable commitment of resources and/or within 6–20 years (e.g., ditching and draining of wetland).
- *High:* The effects of the threat can technically be reversed and the target restored, but it is not practically affordable and/or it would take 21–100 years to achieve this (e.g., wetland converted to agriculture).
- *Very High:* The effects of the threat cannot be reversed and it is very unlikely the target can be restored, and/or it would take more than 100 years to achieve this (e.g., wetlands converted to a shopping center).

Strategies rating procedures

As with the threat assessment, the *Open Standards* terminology for actions was used to systematically determine the most appropriate actions to reduce major threats to maintain or restore target shorebird populations. Actions were ranked in the Miradi™ software based on their potential impact and feasibility factors (each factor had specific criteria for rating at low, medium, high or very high levels). Miradi™ combined potential impact and feasibility rankings to obtain an overall rank of action effectiveness. The list of actions was collapsed into seven key strategies that would be effective to: 1) restore or reduce stress on targets; 2) cause human behavioral change to reduce threats; or 3) create conditions for conservation actions to succeed and reduce threats.

Potential Impact

If implemented, will the strategy lead to desired changes in the situation at your project site?

- *Very High:* The strategy is very likely to completely mitigate a threat or restore a target.
- *High:* The strategy is likely to help mitigate a threat or restore a target.
- *Medium:* The strategy could possibly help mitigate a threat or restore a target.
- *Low:* The strategy will probably not contribute to meaningful threat mitigation or target restoration.

Feasibility

Would your project team be able to implement the Strategy within likely time, financial, staffing, ethical and other constraints?

- *Very High:* The strategy is ethically, technically AND financially feasible.
- *High:* The strategy is ethically and technically feasible, but may require some additional financial resources.
- *Medium:* The strategy is ethically feasible, but either technically OR financially difficult without substantial additional resources.
- *Low:* The strategy is not ethically, technically OR financially feasible.

Appendix 6

Complete ranking of threats identified during the workshops for the Pacific Americas Shorebird Conservation Strategy. Threats Classification Version 2.0 (Conservation Measures Partnership 2016).

Threat Category	Arctic/ Subarctic Breeding	Arctic/ Subarctic Nonbreeding	North-temperate Breeding	North-temperate Nonbreeding	Neotropical Breeding	Neotropical Nonbreeding	South-temperate Breeding	South-temperate Nonbreeding	Summary Threat Rating
Residential and Commercial Development									
Urban/suburban development	-	-	Medium	Medium	High	High	High	High	High
Commercial and industrial development	-	-	-	Medium	Medium	Medium	-	High	Medium
Tourism development	-	-	-	Low	High	High	Very High	Very High	Very High
Agriculture and Aquaculture									
Agriculture	-	-	Medium	High	-	-	-	Medium	Medium
Wood plantations	-	-	-	Low	-	-	-	-	Low
Livestock	Low	-	Low	Low	Low	Low	-	Low	Low
Aquaculture	-	-	-	High	High	High	Medium	Medium	High
Energy Production and Mining									
Oil and gas drilling, spill at drill site	Low	Low	Medium	Medium	-	-	-	Medium	Medium
Mining	Medium	Medium	Low	-	Low	Low	-	Low	Medium
Wind farms	Low	Low	-	High	Low	Medium	-	Medium	Medium
Transportation and Service Corridors									
Roads	Low	Low	Medium	Medium	Low	Low	-	Medium	Medium
Utility and service lines	Low	Low	-	Medium	Low	Low	-	-	Low
Shipping lanes	-	-	-	-	Medium	Medium	-	-	Medium
Flight paths	-	-	-	Medium	-	-	-	-	Low
Biological Resource Use									
Subsistence harvest	-	Low	-	-	-	-	-	-	Low
Logging and wood extraction	-	-	Low	Low	Medium	Medium	-	Low	Low
Fishing	Low	Low		Low	Low	Low	-	-	Low
Human Intrusions and Disturbance									
Recreational activities	-	-	Low	Low	High	High	High	High	High
Armed conflict	-	-	-	-	Low	Low	-	-	Low
Work and other activities	-	-	-	-	Low	Low	-	-	Low

Threat Category	Arctic/ Subarctic Breeding	Arctic/ Subarctic Nonbreeding	North-temperate Breeding	North-temperate Nonbreeding	Neotropical Breeding	Neotropical Nonbreeding	South-temperate Breeding	South-temperate Nonbreeding	Summary Threat Rating
Natural System Modifications									
Wetland modification	-	-	High	High	Low	Low	-	Low	High
Dams and water management	-	-	Medium	Very High	Medium	Medium	-	Medium	High
Reducing human maintenance	-	-	-	-	Low	Low	-	-	Low
Invasive and Problematic Species, Pathogens and Genes									
Invasive and other problem species	-	-	High	High	Low	Low	-	High	High
Problematic native species	Low	-	High	High	-	Low	-	-	High
Red tides	-	Low	-	-	-	-	-	Medium	Low
Pollution									
Household sewage and urban waste	-	-	-	Medium	Medium	Medium	-	-	Medium
Industrial pollution, oil spill during transport	Medium	Medium	Medium	Medium	Medium	Medium	-	Medium	Medium
Agricultural pollution	-	-	-	Medium	Medium	Medium	-	Medium	Medium
Solid waste	-	-	-	-	Medium	Medium	-	Low	Medium
Air-borne methyl mercury	Low	Low	-	-	-	-	-	-	Low
Excess energy	-		-	-	Low	Low	-	-	Low
Geologic Events									
Earthquakes/tsunamis	-	-	Low	Low	-	-	-	Medium	Low
Landslides	-	-	-	-	-	-	-	Low	Low
Climate Change									
Ecosystem encroachment	Very High	Very High	Very High	Very High	High	High	High	High	Very High
Geochemical changes	Medium	Medium	High	High	Very High	Very High	High	High	Very High
Temperature changes	Very High	Very High	Very High	Very High	Very High	Very High	High	High	Very High
Changes in precipitation and hydrology	High	High	Very High	Very High	Very High	High	High	High	Very High
Severe weather	High	High	High	High	Very High	Very High	High	High	Very High

Appendix 7

Pacific Americas Shorebird Conservation Strategy effective strategies and actions, major threats that each action addresses and potential focal geographic regions where actions can be implemented. Refer to Appendix 6 for full title of abbreviated threat names presented here. Water Use and Management and Storm/Flood Control refer to general threat of Natural System Modifications.

	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 1. MANAGE AND CONSERVE EXISTING HABITATS															
Highly effective actions															
Identify, protect, maintain, restore and enhance breeding habitats for species of highest conservation concern and at sites of high nonbreeding shorebird concentrations.	X	X				X	X	X	X	X	X	X	X	X	X
Secure water for shorebird habitats through purchase of water rights or other mechanisms.							X						X		
Develop and implement a coordinated, optimized water management process to sustain important wetland habitats for shorebirds at a regional scale.							X						X		
Provide technical assistance to support local and regional planning processes in priority shorebird areas.	X	X	X	X			X	X			X	X	X	X	X
Develop and implement best management practices for wetland and upland crops, including irrigation practices, to enhance habitat quality for shorebirds.		X					X						X		
Develop and implement best management practices for managed wetlands that balance the needs of all waterbirds to optimize water management.		X					X						X	X	X
Collaborate with the agricultural industry to identify and secure zoning classifications to protect agricultural lands that benefit shorebirds.		X					X						X		
Help develop watershed resource management plans to ensure that sufficient water is available for human and avian communities.							X							X	X
Moderately effective actions															
Identify and map important shorebird habitats to assist land use and conservation planning.	X	X					X					X	X	X	X
Develop a basic standards framework for managing protected areas important to shorebirds.					X	X				X				X	X
Support invasive species management programs to reduce predator populations and invasive plant species (e.g., *Spartina*, feral cats/dogs, beachgrass).									X				X	X	X
Ensure flood control programs consider management and maintenance of shorebird habitats.							X	X			X		X		

	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 2. CULTIVATE AND EMPOWER CONSERVATION CONSTITUENCIES															
Highly effective actions															
Expand and improve volunteer programs to reduce disturbance to shorebirds that use beaches by educating all beach recreationists.						X							X	X	X
Develop and implement the Ramsar Convention's Program on Communication, Education, Participation and Awareness Action Plans that include shorebirds and target their important wetland sites throughout the Flyway to build support and appreciation for shorebirds and wetlands and the ecosystem services wetlands provide, including water management in entire watersheds.	X	X				X	X	X	X	X	X	X	X	X	X
Engage volunteers in citizen science projects at important shorebird sites.	X				X	X			X	X	X		X	X	X
Develop national education programs for responsible ownership of dogs and cats (e.g., keeping dogs on leashes/leads and cats indoors).						X							X	X	X
Ensure that the environmental safeguard teams for major lending institutions have access to information about the importance of specific shorebird sites and habitats.	X	X	X	X						X				X	X
Moderately effective actions															
Educate decision-makers and planners on impacts of land use, water use and engineering decisions on shorebird habitats.	X	X	X	X			X	X		X	X		X	X	X

	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 3. CREATE CONSERVATION INITIATIVES WITH NATURAL RESOURCE INDUSTRIES															
Highly effective actions															
Identify economic activities at important sites that will benefit shorebirds and promote human wellbeing.		X			X	X							X	X	X
Promote the World Bank's environmental safeguard policies to encourage the protection of livelihoods and important shorebird sites when investing in development projects through local, national and multilateral financial institutions.	X	X	X	X										X	X
Promote use of the "Equator Principles", a risk management framework adopted by financial institutions, for determining, assessing and managing environmental and social risk in development projects.	X	X	X	X									X	X	X
Work with partner organizations to develop a certification/recognition program to adopt best management practices by aquaculture, rice and salt producers when opportunities allow.		X	X										X	X	X
Moderately effective actions															
Create an alliance of businesses, government bodies and non-government organizations to develop and promote best management practices for aquaculture at priority shorebird sites.		X								X				X	

	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 4. STRENGTHEN COMPLIANCE AND ENFORCEMENT															
Highly effective actions															
Create an aware constituency that respects environmental and wildlife policies and laws and adherence to protected area management plans.	X				X	X			X	X		X	X	X	X
Reduce illegal shooting of shorebirds through education and enforcement.					X							X	X		
Establish community-based committees and patrols to monitor and report violations of environmental and wildlife policies at important shorebird sites.					X	X				X			X	X	
Strengthen compliance of domestic laws and binational agreements, such as mining operations to protect watersheds and estuaries.			X	X						X			X		X
Develop capacity-building opportunities for law enforcement agents, park guards, lawyers and judges to learn about environmental legislation and the resources necessary to implement legislation.					X	X				X		X	X	X	X
Manage beach access and use during the nesting season to protect key shorebird breeding areas.						X							X	X	X

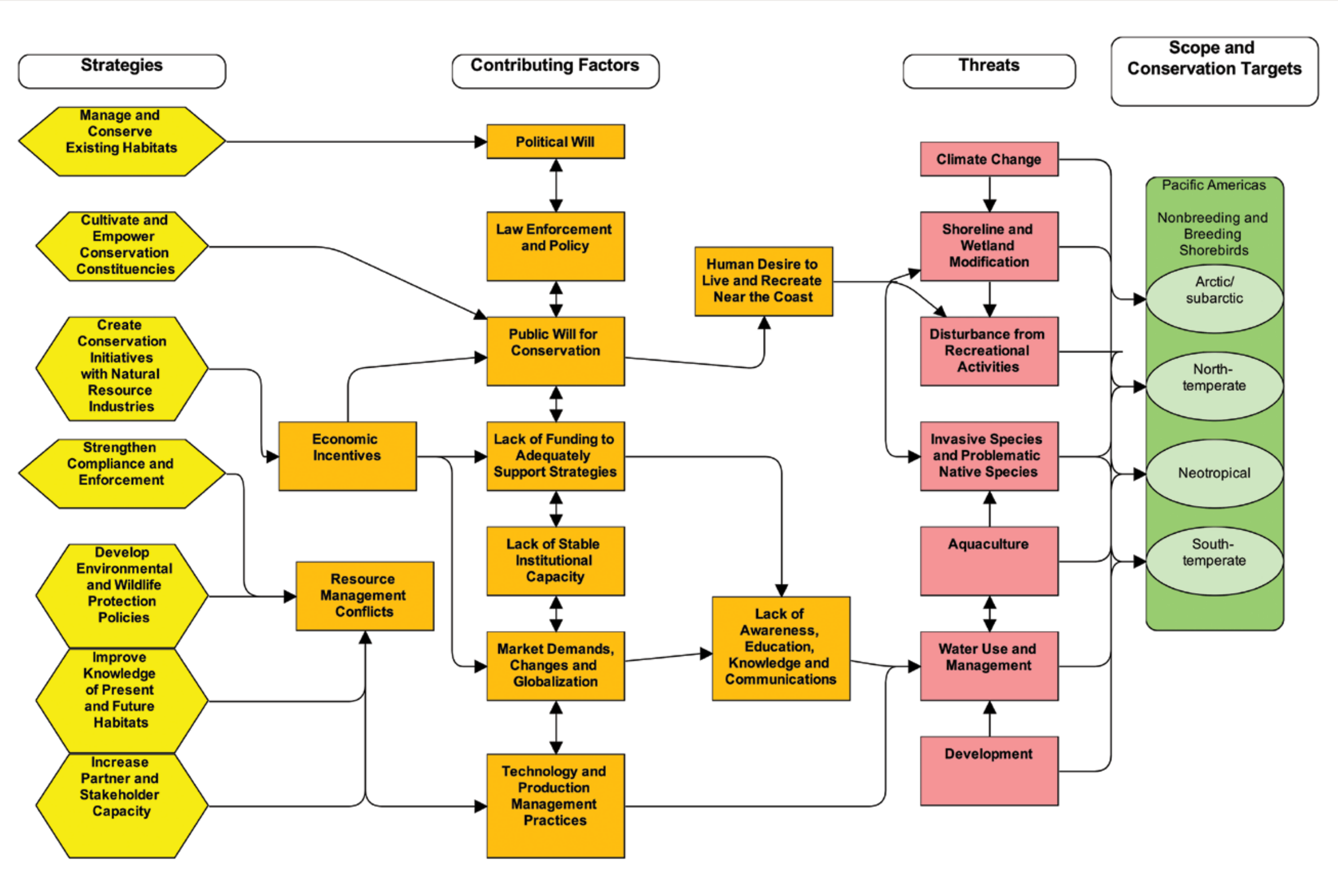
	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 5. DEVELOP ENVIRONMENTAL AND WILDLIFE PROTECTION POLICIES															
Highly effective actions															
Create a legal framework to enable economic incentives for protection of shorebirds and their habitats, including payments for wetland ecosystem services.	X	X	X										X	X	X
Develop or strengthen laws and policies to lower the risk of solid waste pollution and pollution accidents from oil transportation from pipelines and transfer sites.				X						X		X	X	X	X
Develop and enforce off-road vehicle management plans with key agencies and landowners to limit disturbance of nesting shorebirds.				X		X						X	X		
Develop policies, regulations and guidelines for beach access to protect key nonbreeding and breeding shorebird areas.						X							X	X	X
Moderately effective actions															
Promote policies to control dogs in important coastal shorebird sites.						X								X	X
Identify gaps in laws and policies that protect wetlands and promote improved legislation.	X	X	X	X										X	X
Assess subsistence harvest of shorebirds and determine sustainability of the harvest.					X							X			

	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 6. IMPROVE KNOWLEDGE OF PRESENT AND FUTURE HABITATS															
Highly effective actions															
Educate and influence decision-makers about using climate-smart conservation principles and nature-based approaches to improve coastal resilience to current and growing risks of sea-level rise, increases in storm frequency and intensity and development at important shorebird sites.	X							X			X	X	X	X	X
Evaluate breeding and nonbreeding shorebird use of agricultural and grazing lands dominated by invasive plants to understand the negative or positive contribution to the shorebird conservation landscape.		X							X				X		
Determine feasibility and value of removing excessive silt from tidal flats to increase shorebird foraging habitat and using spoil to create high-tide roosts.	X	X									X		X	X	
Conduct sea-level rise modeling, assess resilience and identify refugia for shorebirds across the Flyway.											X	X	X	X	X
Create a science and adaptive management program, including establishing baseline data and considering climate change scenarios, to make management decisions at important shorebird sites.					X	X	X							X	X
Moderately effective actions															
Map sources and occurrence of methyl mercury and determine its impacts on shorebird populations and reduce air-borne methyl mercury emissions.										X		X			
Increase protected area network of important shorebird sites through fee-title acquisition, conservation easements, concessions, leases and other tools.	X	X	X	X							X		X	X	X
Conduct studies that evaluate the ecosystem services provided by shorebird habitats.	X	X	X	X							X	X	X	X	X
Monitor shorebird population responses to all aspects of climate change.											X	X	X	X	X
Determine effect of ocean acidification on shorebird food resources.											X	X	X	X	X

	Threats											Focal Regions			
	Development	Agriculture and Aquaculture	Energy Production and Mining	Transportation and Corridors	Biological Resource Use	Human Disturbance	Water Use and Management	Storm/Flood Control	Invasive Species	Pollution	Climate Change	Arctic/Subarctic	North-temperate	Neotropical	South-temperate
STRATEGY 7. INCREASE PARTNER AND STAKEHOLDER CAPACITY															
Highly effective actions															
Assess how international initiatives and agreements (e.g., free trade agreements, environmental safeguards) can be used to achieve shorebird conservation and provide training to Flyway partners.	X	X	X	X			X			X			X	X	X
Develop communication strategies to advocate for funding conservation and research projects through international conventions and free trade agreements.	X	X	X	X	X	X	X	X	X	X	X			X	X
Work with existing conventions (e.g., Ramsar Convention, Convention on Migratory Species) to share knowledge and support flyway-scale conservation actions that benefit shorebirds.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Create multi-sector alliances (e.g., joint ventures) to establish effective dialogues among stakeholders to implement conservation actions that reduce threats to shorebirds and their habitats.	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Maintain physical infrastructure and staff capacity and knowledge to conserve managed wetlands for shorebirds.							X						X		
Moderately effective actions															
Strengthen local capacity for stakeholders to engage in land use and protected area management decisions.	X	X	X	X		X			X	X		X	X	X	X
Engage non-traditional partners in conservation activities that benefit shorebirds.	X	X				X	X	X		X	X	X	X	X	X
Increase capacity to effectively manage existing protected areas.		X			X	X			X	X	X	X	X	X	X
Develop funding mechanisms to support effective enforcement of environmental and protected area laws and regulations.	X				X	X				X				X	X

Appendix 8

Simplified conceptual model for the Pacific Americas Shorebird Conservation Strategy.



Appendix 9

Definitions related to human wellbeing and ecosystem services (Conservation Measures Partnership 2016).

Human Wellbeing

The Millennium Ecosystem Assessment (2005) identifies five dimensions of human wellbeing:

- Necessary material for a good life: including secure and adequate livelihoods, income and assets, enough food at all times, shelter, furniture, clothing and access to goods;
- Health: including being strong, feeling well and having a healthy physical environment;
- Good social relations: including social cohesion, mutual respect, good gender and family relations and the ability to help others and provide for children;
- Security: including secure access to natural and other resources, safety of person and possessions and living in a predictable and controllable environment with security from natural and human-made disasters; and
- Freedom and choice: including having control over what happens and being able to achieve what a person values doing or being.

Ecosystem Services

Ecosystem services are the services that intact, functioning ecosystems, species and habitats provide and that can benefit people. The Millennium Ecosystem Assessment (2005) offers four categories of ecosystem services and examples within those categories.

Provisioning services – products obtained from ecosystems. Examples include:

- Food (including seafood and game, crops, wild foods and spices)
- Fuelwood
- Water
- Minerals (including diatomite)
- Pharmaceuticals, biochemicals and industrial products
- Energy (hydropower, biomass fuels)

Regulating services – benefits obtained from regulation of ecosystem processes. Examples include:

- Carbon sequestration and climate regulation
- Waste decomposition and detoxification
- Purification of water and air
- Crop pollination
- Pest and disease control

Supporting services – services necessary for production of all other ecosystem services. Examples include:

- Nutrient dispersal and cycling
- Seed dispersal
- Primary production
- Soil formation

Cultural services – non-material benefits obtained from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences. Examples include:

- Cultural diversity
- Spiritual and religious fulfillment
- Knowledge systems (traditional and formal)

Appendix 10

Shorebird monitoring programs being implemented to some degree within the Pacific Americas Flyway.

Existing monitoring programs along the Flyway use volunteers and professional biologists to provide cost effective annual indices of population status and generate trend estimates. The Migratory Shorebird Project and the Pacific Flyway Shorebird Survey were designed to minimize sampling biases associated with volunteer-driven efforts and provide a protocol, data management and analysis framework to gather essential data to track shorebird population trends at multiple spatial scales and evaluate hypotheses of factors/issues influencing populations. Other programs such as the Neotropical Waterbird Census, Central American Waterbird Census and Coastal Shorebird Survey (Chile and Perú) are in a period of growth, and opportunities exist to support the programs and empower them to contribute to the monitoring objectives of this Strategy through broader coordination. The International Shorebird Survey (ISS) and the Integrated Waterbird Management and Monitoring Program provide data on migration patterns and trends for target focal species that migrate through the Central or Atlantic Flyways; ISS surveys have also been conducted in the Pacific Americas Flyway. PRISM (Program for Regional and International Shorebird Monitoring) has established baseline population estimates for 26 species from breeding ground surveys with the intention of repeating the surveys in 10 years to check population status (Bart and Johnston 2012). Lastly, the Arctic Shorebird Demographics Network provides critical information about what limits population sizes of Arctic-breeding shorebirds from the Pacific Americas Flyway (e.g., adult survival, productivity and breeding success). Data from this program provide a baseline for future demographic assessments to determine whether conservation actions from this Strategy have improved important demographic parameters. Annual long-term citizen science programs such as the Christmas Bird Count and Breeding Bird Survey engage citizens and agency personnel to produce population trend data for wintering and breeding birds, respectively. The eBird program is adding greatly to our knowledge about the distribution and phenology of shorebirds and has promise for helping determine trends of shorebird species. Ensuring data collected from these various programs are centralized (e.g., the Avian Knowledge Network) and able to be linked will ensure successful monitoring at regional and flyway scales.

Additional information for each program can be found on their respective websites.

- Migratory Shorebird Project: http://www.migratoryshorebirdproject.org
- Pacific Flyway Shorebird Survey: http://www.pointblue.org/pfss
- International Waterbird Census: https://www.wetlands.org/our-approach/healthy-wetland-nature/international-waterbird-census/
- Coastal Shorebird Survey: http://www.minam.gob.pe/diversidadbiologica/wp-content/uploads/sites/21/2014/02/Atlas-de-las-Aves-Playeras-del-Perú-FINAL-WEB.compressed.pdf
- Integrated Waterbird Management and Monitoring Program: http://iwmmprogram.org/
- PRISM (Program for Regional and International Shorebird Monitoring): http://www.shorebirdplan.org/science/program-for-regional-and-international-shorebird-monitoring/
- Arctic PRISM: https://www.ec.gc.ca/reom-mbs/default.asp?lang=En&n=FC881C1B-1
- Arctic Shorebird Demographics Network: https://www.manomet.org/program/shorebird-recovery/arctic-shorebird-demographics-network-asdn
- International Shorebird Survey: https://www.manomet.org/program/shorebird-recovery/international-shorebird-survey-iss
- Christmas Bird Count: http://www.audubon.org/conservation/science/christmas-bird-count
- North American Breeding Bird Survey: http://www.pwrc.usgs.gov/bbs/
- Avian Knowledge Network: http://www.avianknowledge.net/

Short-billed Dowitchers, Dunlins and Red Knots during spring migration at Grays Harbor, Washington, USA.

Lucas DeCicco/U.S. Fish and Wildlife Service

PACIFIC AMERICAS SHOREBIRD
CONSERVATION STRATEGY