

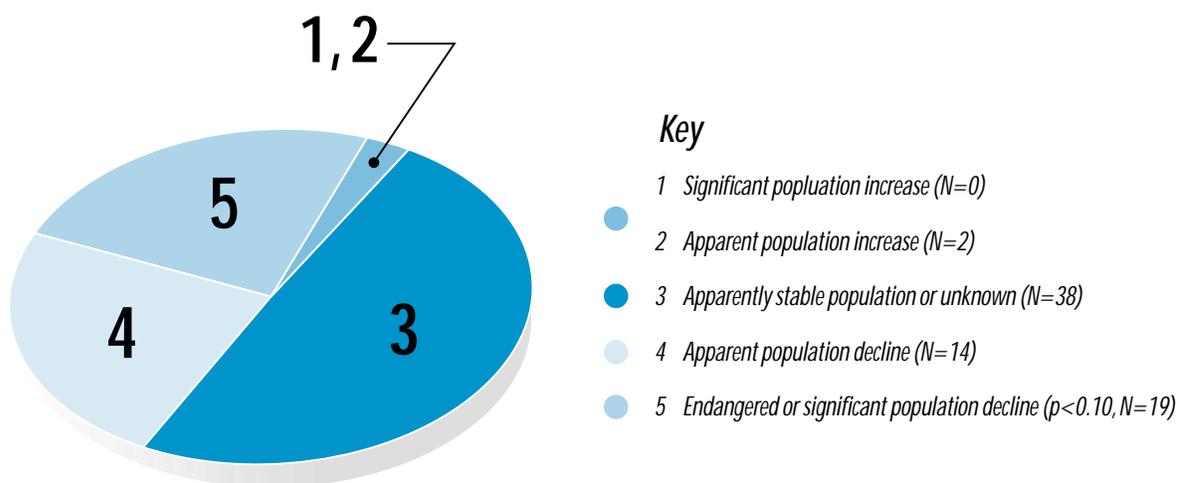
# Part 3: Shorebird Conservation Status, Populations, and Priorities

## Conservation Status of Shorebirds

As part of the U.S. Shorebird Conservation Plan and as a contribution to development of the Canadian National Plan, a technical working group focused on the difficult task of determining the conservation status of the shorebird species that regularly occur in northern North America (the U.S. and Canada). Their efforts were aimed at determining risks facing each species, and identifying factors needed to support populations of each species, so that the overall goals of the Plan can be met. An additional goal was to identify issues related to the maintenance of demographic and genetic stability for each species so that populations will persist far beyond the next century.

The baseline information from which these goals were determined was obtained through coordination and collection of species-specific information from 36 shorebird biologists from the U.S. and Canada. These results were summarized in a matrix containing over 150 pieces of information for each species. The full matrix, along with other supporting information, is presented in the accompanying technical report entitled the National Shorebird Conservation Assessment, which includes the following: 1) the assumptions on which all assessments were based; 2) some background information derived from data provided by the species experts as well as a review of the shorebird literature; and 3) conclusions and recommendations for shorebird conservation in the U.S.

The Conservation Assessment reported significant causes for concern related to many different aspects of shorebird biology and conservation. Only 10 of the 50 species considered (20%) have had a significant census undertaken. Most of these were censused during winter or migration and those censuses were not repeated regularly. Piping Plover is the only species for which annual, species-wide censusing takes place (with an in-depth winter and breeding census every five years). Thus, overall, we have very limited information on which to base population or trend estimates for most shorebirds. Twelve species (24%) have undergone a significant decline in breeding range, and there is insufficient information to evaluate 15 more. Significant threats were documented for 27 species (54%) during the breeding season, 36 species (72%) during migration, and 40 species (80%) on their wintering grounds. In addition, almost half of the shorebird species considered have significant or apparent population declines (Figure 2).



Population trends among US shorebirds based on 72 taxa (species and subspecies)

Figure 2. Population trends for shorebirds in the U.S. Compiled from the National Shorebird Conservation Assessment.

The Conservation Assessment reached the following major conclusions:

- There is not enough information available to thoroughly assess the status of most, if not all, North American shorebirds.
- The limited information that is available suggests that overall, northern North American breeding shorebird numbers need to increase substantially to meet the goals of the Plan.
- Adequate monitoring and research programs are among the highest priorities for the Shorebird Plan, so that the status and trends of each species can be properly addressed.

## **Estimates of Current Shorebird Populations**

### *Rationale for Estimating Population Sizes*

Knowledge of the number of animals in a population is not only of intrinsic biological interest, but for shorebirds and other waterbirds, has also assumed considerable practical application in conservation planning and action. Knowledge of population size is needed in assessing the viability of species with low numbers, and can provide a benchmark against which the success of management efforts may be measured. Population size is of particular importance for endangered or threatened species, but the development of population estimates has also been used in setting targets for a range of species, as in the North American Waterfowl Management Plan, and is being adopted as a broad-scale planning component of the Shorebird Conservation Plan. While the population estimates provided here are tentative and will require much additional work to support and refine, they nevertheless provide a broad overview of the status of current populations as currently understood. This information is of obvious value for setting broad policy goals for shorebird conservation.

In addition, several key initiatives relevant to the conservation of shorebirds and the wetlands upon which they depend are based on criteria involving the percentage of a flyway population using the site to determine that site's importance. For instance, the "Ramsar" Convention uses the criterion that a site should support 1% of a flyway population to be considered of international importance, and the Western Hemisphere Shorebird Reserve Network has adopted a scale of criteria (5%, 15%, 30%) to determine increasing levels of importance (from regional to hemispheric) of sites for shorebirds. Application of these criteria clearly requires a knowledge of the population sizes of the species being considered.

On a practical level, determination of the population sizes of shorebirds presents many difficulties, mainly related to the highly migratory nature of the birds. For instance, many species migrate from breeding grounds in the far north, where they are found dispersed at low densities over vast areas, through migration areas, where they occur in large but highly variable numbers, to wintering areas which may lie as far south as Tierra del Fuego at the southern tip of South America. Attempting to assess numbers at any of these stages brings with it a variety of problems relating to logistics, methodology, adequacy of geographic coverage, accuracy of estimates obtained, and the life history characteristics of the species being studied.

### *Methods for Estimating Numbers*

Only recently has enough information been obtained over a wide enough geographical area to attempt to piece together estimates of the population sizes of shorebird species. The present estimates have been assembled from a variety of sources, involving different methods and different geographical areas as appropriate for the species concerned. Major sources of data have included: 1) count data accumulated from volunteer survey networks, such as the International Shorebird Survey, the Maritimes Shorebirds Survey, and the Pacific Flyway Project; 2) compilation of data from a variety of sources, including the major summary of data from the interior of North America, and regional inventories of wetlands in Latin America; 3) aerial survey data from various projects and areas,



including James Bay, Delaware Bay, Pacific northwest Mexico, and the Canadian Wildlife Service “atlas” projects to determine wintering numbers and distribution in South America, Panama and Mexico; 4) data from projects directed towards particular species, such as Piping Plover, Mountain Plover, Black Turnstone, and Bristle-thighed Curlew; 5) investigations from breeding areas in temperate North America; 6) investigations from Arctic breeding areas, including both historical studies and more recent work using remote sensing to assess habitats and populations over particular regions; and 7) estimates based on extrapolations from schemes such as the Breeding Bird Survey and Christmas Bird Counts. Data from all available sources were assembled separately for each of the following four seasons and within particular flyways or regions to avoid overlap or duplication of records of the same birds as much as possible: breeding, northward migration, southward migration, and wintering. Since detectability, geographic coverage, and “countability” varied for the different areas and species, the maximum number found across the four seasons served as the basis for the current population estimate.

For most species, this information must still be considered a first approximation, and subject to refinement and revision as more information becomes available. The quality of the estimates varies from an educated guess, through a number resulting from assembly of information for which an overall error estimate is rarely calculable, to fairly complete census data for a particular species. The probable accuracy of each of the estimates is indicated in Appendix 1 and in the National Shorebird Conservation Assessment and must be borne in mind when using the information for purposes such as setting population targets.

Because the information on which to base population estimates is poor for many species, a classification system was developed to indicate the relative degree of accuracy associated with each estimate. The estimates are ranked on a scale from 1 to 5, as follows:

**Poor=1:** A population estimate based on an educated guess. Score 1 also given to Eskimo Curlew which has not been reliably seen in recent years.

**Low=2:** A population estimate based on broad-scale surveys where estimated population size is likely to be in right order of magnitude.

**Moderate=3:** A population estimate based on a special survey or on broad-scale surveys of a narrowly distributed species whose populations tend to concentrate to a high degree either a) in a restricted habitat, or b) at a small number of favored sites. Estimate thought to be within 50% of the true number.

**Good=4:** A calculated estimate based on broad-scale mark:recapture ratios or other systematic estimating effort resulting in estimates on which confidence limits can be placed.

**High=5:** Number obtained from a dedicated census effort and thought to be accurate and precise.

### *Shorebird Population Estimates*

The current estimates of shorebird populations in North America, listed in Appendix 1, should be considered tentative, particularly for the species where confidence in the estimate is moderate or lower.

### *Shorebird Species Prioritization*

In any conservation plan there is a need to prioritize specific conservation activities. This Plan uses the approach of prioritizing species according to their relative conservation status and risks, so that the relative importance of various conservation activities can be assessed by considering the status of the species that will be most affected. The system for prioritizing shorebird species of concern was developed for the U.S. Shorebird Conservation Plan with input from many individuals participating in the Research and Monitoring working group, including representatives



from across the country and from Canada. The goal of the system is to provide a clearly organized method for categorizing the various risk factors that affect the conservation status of each species in a format that can be easily updated as additional information becomes available. The system was designed in collaboration with Partners In Flight to ensure that it was as compatible as possible while reflecting the unique conservation risks for shorebirds.

### *Variables Used to Prioritize Shorebirds*

The variables used to prioritize shorebird species are the same ones used in the Partners In Flight prioritization system. However, the definitions of the variables, and the scoring system used to assign values from 1 to 5 for each variable, have been modified to better reflect the biology of shorebirds. Descriptions of the variables are provided here, and the details of the scoring system are provided in the National Shorebird Conservation Assessment.

#### *1) Population Trend, PT*

The population trend variable uses existing information on shorebird trends to estimate broad categories of population decline. Species with known declines in populations are likely to be at higher risk than species where ongoing study has detected no risk. However, many species may be declining even though trends have not been detected using current monitoring techniques. This is particularly true for species under-represented in ongoing monitoring programs. Only species with documented significant population declines ( $p < 0.10$ ) are considered highly imperiled (see Shorebird Prioritization categories below).

#### *2) Relative Abundance, RA*

This variable uses population size estimates to classify each species into 5 categories based on breaks in the distribution of population sizes among shorebirds. Species with smaller absolute population sizes are likely to be more at risk, either as a result of historic declines or from catastrophic disturbances. Population estimates were developed by Morrison et al. (Waterbirds 2000, Vol.23 No.3, pages 337-552). With increasing data about current population sizes, these estimates will be revised.

#### *3) Threats During Breeding Season, TB*

This variable ranks the threats known to exist for each species, and the scoring reflects the limited knowledge available for determining threats to most shorebirds.

#### *4) Threats During Non-breeding Season, TN*

This score uses the same criteria as the breeding threats scores, with the additional factor of concentration risk during migration explicitly considered.

#### *5) Breeding Distribution, BD*

This variable ranks the size of the breeding range for species that breed in North America, and only applies during the actual breeding season. The assumption is that species with relatively more restricted ranges are more susceptible to breeding failure from natural or human-induced causes. Threats that occur from factors such as concentration during migration to or from the breeding grounds are addressed in TN above.

#### *6) Non-breeding Distribution, ND*

This variable refers to distribution during the non-breeding season, which includes migration to and from the breeding grounds. The score reflects the relative risks associated with having a smaller absolute range size during the non-breeding season. This variable includes criteria for both the area of the non-breeding range, and also for length of coastline for coastal species where measuring area is not as representative of distribution. Threats resulting from concentration at some point during migration are addressed in TN above.

Many of these variables, while widely agreed to affect conservation status, are very difficult to estimate. Nevertheless, prioritization is important to ensure that species more at risk are given the attention needed to avoid





*Some North American shorebirds, such as the Wandering Tattler, winter on hundreds of oceanic islands, including dozens of different commonwealths and nations of the Pacific Ocean. Photo by Dennis Paulson.*

significant declines. Because appropriate data is often lacking, the classifications produced by this system are considered estimates of the actual conservation status of each species. Further study is needed for most species with respect to most of these variables. The classifications presented here will be revised within one year of the completion of the Shorebird Plan, and at regular intervals as appropriate, and should not be considered final. The specific variables used in the system, and the rules for classifying species, are described in detail in the National Shorebird Conservation Assessment report.

To develop regional species priorities, an additional variable called Area Importance is used to reflect the relative importance of each Planning Region to each species.

Considering area importance at the regional scale ensures that conservation effort will be directed at species that are relatively important in each region. The relative importance of each Planning Region for each shorebird species during the breeding, migration, and wintering seasons is shown in Appendix 2. An additional table showing the relative importance of each NABCI Bird Conservation Region is included in the National Shorebird Conservation Assessment. Area Importance scores are based on knowledge of distributions, expert opinion, and data on distributions for species' where it is available. Because management decisions based on species priorities must often be conducted at appropriate seasons, the scores for these variables are reported using a system that reflects both the relative area importance and the season or seasons during which the area is important, including breeding, wintering, and migration.

### Shorebird Prioritization Categories

The prioritization system classifies each species in one of the following categories:

#### 5) Highly Imperiled

All species listed as threatened or endangered nationally, plus all species with significant population declines and either low populations or some other high risk factor.

#### 4) Species of High Concern

Populations of these species are known or thought to be declining, and have some other known or potential threat as well.

#### 3) Species of Moderate Concern

Populations of these species are either: a) declining with moderate threats or distributions; b) stable with known or potential threats and moderate to restricted distributions; c) relatively small; d) relatively restricted; or e) declining but with no other known threats.

#### 2) Species of Low Concern

Populations of these species are either: a) stable with moderate threats and distributions; b) increasing but with known or potential threats and moderate to restricted distributions; or c) of moderate size.

#### 1) Species Not at Risk

All other species where there is apparently no current risk of population decline.

The prioritization scores for each species and subspecies are provided in Appendix 3.



*Some species, like this Whimbrel, survived an intense era of market gunning, while similar species like the Eskimo Curlew apparently did not, probably because of the Curlew's more limited distribution and more specific habitat needs. Photo by Elizabeth P. Mallory.*

## Shorebird Population Targets

### Rationale for Setting Population Targets

The vision of the U.S. Shorebird Conservation Plan is to ensure that stable and self-sustaining populations of all shorebirds are distributed throughout their range and habitats in the U.S. and across the Western Hemisphere, and that species which have declined in distribution or abundance be restored to their former status to the extent possible at costs acceptable to society. Making this vision a reality will require halting the declines of many shorebird species, and increasing the populations of many species to the point where they are stable and self-sustaining.

The rationale for setting specific population targets is to provide an objective measure of when the overall vision of the Plan has been achieved. Achieving the vision will require an understanding of how populations have changed in the past as well as estimates of approximate population levels today. However, this information is known with certainty for only a few of the shorebirds that occur in the United States. Other parts of the Shorebird Plan lay out procedures for monitoring shorebirds sufficiently to provide information on their population trend, and research priorities necessary to determine the factors limiting populations of shorebirds. This information will make the process of setting population targets much more precise and scientifically sound. Nevertheless, there is a current need to set approximate population goals for shorebirds to guide the early stages of implementation of the Plan. The population targets provided here are only a first approximation attempt to provide these goals. Establishing population targets known to be sufficient for achieving the vision of protecting shorebirds in the United States will require significant funding for the monitoring and research needs outlined here, and will result in modified targets that will be revised as more detailed information becomes available. **Updated information on population estimates and targets will be posted on the U.S. Shorebird Conservation Plan website at <http://www.manomet.org/USSCP.htm>.**

Many of the shorebird species that occur in the United States have defined subspecies, i.e. groups which have been geographically isolated so long that they are distinct. Other geographically isolated groups exist that have not been recognized as subspecies, yet are in all likelihood genetically distinct, and possess unique characteristics that should be preserved. In some cases one subspecies within a species may be declining or facing specific threats where another is not. Because of these and other complexities, the process of setting population targets was applied to all groups of shorebirds recognized as being geographically distinct.

### Methods for Establishing Population Targets

For most shorebird species, it is impossible to establish scientifically supported population targets that are known to meet the goal of achieving stable and self-sustaining populations. This is because current and past population sizes are unknown, and because insufficient information about conservation risks and factors limiting populations exists. Because information is lacking but the need for conservation action is clear, the working group established a simple approach to setting population targets based on the limited information available. This is not a scientific process, but a series of policy recommendations based on the simple set of assumptions and rationale outlined below. For the purposes of beginning conservation planning, tentative population targets were established based on the estimated population size, and the current assessment of whether the species has experienced recent population declines or not. In each case, both short-term and long-term goals are established.

#### 1) Species known to be declining

**Population Trend = 5.** The species or population has been documented to be in decline, or is listed as threatened or endangered under the United States Endangered Species Act (the Act). Conservation actions aimed at increasing the populations of species should be prioritized according to the species priority, with restoration of the highest priority species addressed first.



**Population goals.**

**Listed Species:** In the case of endangered or threatened species, the short term goal is to achieve the level of recovery recommended in the species recovery plan prepared under the Act. Long-term goals are not provided for these species because planning and management under the Act should be sufficient to support their long-term persistence as viable populations.

**Short-term Goal:** For remaining category 5 species the recommended short-term goal is to halt the population decline.

**Long-term Goal:** The long-term goal is to restore the population to the level estimated to have existed in the year when population trend analysis began (for most species in the early 1970's). This level was calculated by using the known rate of decline, and back calculating the population size to the year when data were first collected, using the current population estimate as the starting point. For example, Black-bellied Plovers have a current population estimate of 150,000, with a 45% decline. The long-term target is to restore the population to 272,000, the level that would have existed before the decline took place ( $272,000 - 45\% = 150,000$ ). For many species, these restoration targets are extremely conservative because historical declines are thought to have been large, but monitoring data are available only recently.

*2) Species thought to be declining*

**Population Trend = 4.** The species is thought by experts to have substantially declined, but lack of sufficient data has prevented statistical verification.

**Population goals.**

**Short-term goal:** The short-term goal for these species is to determine with certainty if declines are actually occurring, and to halt any declines that are occurring.

**Long-term goal:** The long-term target recommended for these species is restoration of the populations to the level likely held in the early 1970's, established by estimating the percentage of habitat loss the species has endured, and to increase from the currently estimated population size by a commensurate amount.

*3) Species with no decline suspected, or known to be stable*

These species have population trend scores of 3, 2, or 1.

**Population Trend = 3.** There is no information on population change, or insufficient information to assess past declines, but the species is thought to face future risks such as habitat loss.

**Population goals.**

Maintain population at current levels, with special attention to any declines that result from risks, or future information which indicates that the population status was actually declining when thought to be stable.

**Population Trend = 2.** The species' population is not declining, and is thought to be at historic levels. No population decline is expected, and the population is thought to be stable and self-sustaining.

**Population goals.**

Maintain population at current levels.

**Population Trend = 1.** The species' population size may be increasing above historic (i.e. pre-1800) levels. The National Shorebird Conservation Assessment indicated that no shorebird species are in this category. The specific population targets established for each species and population of shorebirds are shown in Appendix 1.



## Part 4: National Shorebird Conservation Strategies

### Priority Shorebird Monitoring Programs

Analyses of the North American Breeding Bird Survey (BBS) conducted since 1966 have demonstrated the conservation value of long-term population monitoring. Detection of population change is being used increasingly as a basis for setting bird conservation planning and management priorities, identifying research needs, and evaluating the effectiveness of bird management programs. For migratory species, data from monitoring programs are in demand not only at the state and national levels, but also in other countries that share the species. For the highly migratory shorebirds, virtually all countries in the Western Hemisphere have a stake in obtaining reliable population information.

Data from several shorebird inventory programs in North America in the past two decades strongly suggest that populations of the majority of species are declining, some at rates exceeding 5% per year. But, because these surveys were designed primarily for documenting distribution and patterns of relative abundance (rather than population size or population change), the statistical validity of the apparent population trends cannot be easily verified. Unfortunately the BBS method is not suited to habitats preferred by most shorebird species. Therefore, there is a compelling and urgent need for better shorebird monitoring methods and an institutional capacity for monitoring shorebirds. The level of funding presently allocated to migratory bird monitoring falls far short of what is needed to develop these programs.

During 1999 a group of distinguished experts on North American shorebirds convened on several occasions to review the current state of knowledge of shorebird populations and to recommend an approach to establishing a science-based, national shorebird monitoring program. They concluded that a comprehensive program with maximum conservation impact should have the following goals:

- Goal #1** Statistically valid monitoring of long-term, species-specific population trends.
- Goal #2** More precise estimates of the size of species' total populations.
- Goal #3** Monitoring shorebird use of major staging, migration, and wintering areas in the United States and Canada.
- Goal #4** Ensuring that shorebird population information is effectively integrated into the national bird conservation planning and implementation process.

Goals 1 and 2 address two approaches to assessing population change at the national or continental scale. Although it is often desirable to obtain actual estimates of total population (goal 2), indices to population size (goal 1) are usually easier to derive and serve the purpose of documenting direction and magnitude of long-term population change. Developing programs to meet goals 1 and 2 will help establish and periodically update strategic shorebird conservation priorities. Goal 3 addresses management needs at the local and regional scales and ensures that important habitats and habitat management actions are adequately monitored. Achieving goal 4 will require the establishment of a structure for effective communication between the academic and wildlife management communities. This will ensure that the national bird conservation dialogue (e.g., the North American Bird Conservation Initiative, NABCI) benefits by having the best available population information on shorebirds, and that monitoring scientists are apprised of the most critical monitoring needs faced by the wildlife management community. A practical mechanism is also necessary for assuring that wildlife managers are adequately informed on how to design and carry out shorebird monitoring programs as a means of evaluating effectiveness of habitat management projects.

Each of the over 70 species or distinctive populations of shorebirds in North America has a unique breeding and wintering distribution pattern and migration strategy. Breeding and wintering ranges of many species are not



easily accessible. The challenges presented by this diversity are evidenced by the absence of effective monitoring programs for all but one or two species. The North American Shorebird Monitoring Plan examines some underlying statistical issues related to survey design and counting methodology that become particularly relevant in the face of such complexity. Factors such as estimating numbers of birds in large flocks are common to most non-breeding surveys. Aerial surveys, while the only feasible method in certain situations, present special difficulties both for numbers estimation and species identification. Lack of information on turnover rates confounds interpretation of surveys of migrating birds. Because the particular mix of difficulties is different at different seasons, the relative merits of monitoring at different times of the year are explicitly identified in the full report. All of these problems need to be addressed during the course of survey development and many constitute fertile ground for research. A list of important research needs related to shorebird monitoring also is presented in the full Monitoring Plan.

The Shorebird Monitoring Plan presents prescriptions for 30 mostly new monitoring protocols. The Monitoring Working Group felt that a generalized methodology for monitoring a large number of species outside of the breeding season would severely compromise population trend estimation for most species and should only be considered for species that presented no realistic alternatives. Therefore many of the proposed protocols are species-specific or target a small number of species that can likely be monitored by a common method. The species and goals each would address are identified, a rationale for each method is described, and assumptions and primary issues requiring further study are identified. Particular attention is given to sources of bias and ways of reducing or eliminating them. A definition is provided for species that are "well-monitored". Under currently existing programs, only 2-3 species can be considered well-monitored, but if the protocols are developed and forged into a single, well-integrated monitoring program, then all, or nearly all, of the 72 species, subspecies, and distinct populations considered in the Plan will be well-monitored.

An implementation strategy for the program is proposed in the monitoring report. A competitive process is suggested through which grants to develop proposed new surveys will be awarded. Once designs are peer-reviewed and approved, funding will be redirected into implementation of operational surveys. The national avian data center at the USGS Patuxent Wildlife Research Center (Patuxent) is a logical repository for long-term databases generated by this program. It is proposed that Patuxent will: 1) develop software to allow web-entry and web-retrieval of data; 2) conduct regular analysis of population change; and 3) deliver relevant summary information to wildlife policymakers and managers. A Shorebird Monitoring Working Group established under the Plan will oversee continuity and effectiveness of the new surveys and broker technical assistance to wildlife managers. This group will communicate with the NABCI Monitoring Committee to elevate shorebird monitoring needs to the national and international levels and to receive information on local and regional bird conservation developments in need of monitoring guidance. The initial cost estimate for development and implementation of the proposed suite of surveys and for maintaining a centralized data management and analysis center is \$1.5 million per year.



*Three subspecies of Dunlin breed in North America, with major wintering zones including a) the Atlantic and Gulf coasts of the US and Mexico, b) the Pacific coast of North America, and c) the coastlines of central east Asia. Photo by Tim Bowman.*

## Priority Shorebird Research Needs

Populations of many of North America's shorebird species are in steep decline. In order to reverse these declines, and to assure stable, self-sustaining populations, fundamental knowledge of shorebird biology is essential. However, vast gaps exist in our knowledge of North America's shorebirds. For example, for only a few of the rarest species is there a scientifically valid estimate of population size. In addition, the factors limiting the populations of most species are unknown. Maintenance of stable and self-sustaining shorebird populations is the central goal of the National Shorebird Research Program (NSRP) proposed as part of the U.S. Shorebird Plan. Shorebird conservation efforts cannot succeed in the absence of sound knowledge on various aspects of shorebird biology.



As information on shorebird biology unfolds, it is difficult to predict what topics will emerge as key issues for conservation. For example, population declines may turn out to have sources in breeding areas, along migration routes, or on the wintering grounds, or even a combination. Issues such as acid rain, pollution, global warming, or habitat loss might be involved, or other issues not presently recognized may be key. Alternatively, with improved information, we may discover that some declines that originally appeared to be alarming are actually the results of natural population fluctuations.

### *The National Shorebird Research Program*

In order to provide the up-to-date, scientifically rigorous information essential for shorebird conservation, the U.S. Shorebird Conservation Plan recommends the institution of the National Shorebird Research Program, (NSRP). This program will support essential conservation-based research on shorebirds through establishment of a competitive grants program administered by the Biological Resources Division of the United States Geological Survey, acting upon the recommendation of a panel of experts. The program should include annual funding of \$2 million for national research priorities, and \$1.75 million per year for regional research priorities.

The NSRP should be administered at USGS Patuxent Wildlife Research Center, and should work with the Shorebird Plan Council to identify panel members, each with the highest scientific credentials and possessing skills representative of various research areas (e.g., breeding and non-breeding biology, coastal and inland areas). The function of the panel is to assure that funds are spent in a manner most likely to enhance the goal of assuring stable and self-sustaining shorebird populations. Proposals submitted to the NSRP must explain to the evaluation panel how the research will contribute knowledge important to the restoration or maintenance of stable shorebird populations. The panel will rank proposals on the basis of their likelihood to enhance shorebird conservation through restoration or maintenance of stable populations. The panel will have the national shorebird conservation priorities as a guide in prioritizing proposed research. Partnerships among federal, state, non-governmental organizations, and academic scientists will be encouraged where this is logical for achieving the goal of stable and self-sustaining shorebird populations. While the goal of this program is population based, this in no way infers that high priority research could not be funded at other levels, such as mechanistic research dealing with the behavior or physiology of shorebirds, their prey and predators, community, ecosystem or landscape-level ecology, etc. But, in the end, the goal is to maintain stable and self-sustaining populations. Therefore, mechanistic, community, ecosystem, or landscape proposals all have the obligation of demonstrating their relevance to conservation of shorebird populations.

In addition to the support necessary for the NSRP, significant additional funding is needed to support regional research. Just as the national shorebird community has established national conservation priorities, regional groups are ranking conservation priorities of species within regions. Sometimes these are concordant with national priorities, sometimes they are different. Regional support should be sought for research primarily of importance relative to regional conservation priorities, or for monitoring or management research primarily of regional application.

### *Example Priority Research Topics*

The details of priority research topics are provided in the technical report on National Shorebird Research Needs. The following topics are among those considered by the technical group to be of high priority:

#### *1) Essential research designed to facilitate stable and self-sustaining shorebird populations, especially those of high national conservation priority.*

The most critical need is the identification of population limiting factors, so that we can understand which factors must be changed to increase shorebird populations. Other important topics include: understanding patterns of shorebird distribution and abundance, and factors controlling them; exploration of factors affecting space use and dispersal decisions, including the relationship of key habitat features such as foraging benefit, predator risk, and information acquisition to relative use of space; increasing our understanding of the dynamics of migration



patterns, including how populations move among sites, and why; understanding the timing of landscape-level habitat use, which is critical for monitoring studies, and understanding factors affecting turnover rates; analysis of dietary requirements, elucidation of dietary preferences, nutritional requirements, and metabolic needs, and identifying geographic population subdivision; and determining conservation issues below the species level, and identification of the role of subspecies in the overall population dynamics of a species.

### *2) Management research with application across regions.*

Active management is necessary to enhance shorebird populations across multiple regions. Important areas of research to improve the effectiveness of management include: research to develop techniques for reducing specific population limiting factors, such as techniques for reducing nest predation; reducing risks from toxicants; improving or providing habitat; modeling potential impacts and development of management protocols to mitigate effects of global climate change; development of techniques to deter predators, such as aversive conditioning to reduce losses from both avian and mammalian predators; controlling disturbance effects on foraging and breeding; and techniques for increasing productivity, including captive breeding reintroduction and associated techniques.

### *3) Monitoring research and development of protocols for tracking population trends.*

Research is needed to improve our ability to monitor species of national conservation concern, many of which are experiencing population declines of unknown magnitude.

## **Priority Education and Outreach Programs**

In order to ensure the conservation of shorebirds and the habitat upon which they depend, it will be necessary to develop and implement programs that raise awareness of shorebirds among the general public. These programs, both local and regional in scope, should serve to educate targeted audiences (e.g., farmers, beach-goers, resource managers, etc.) as well as provide information on shorebirds for the general population.

It is essential that significant education and outreach efforts support the other activities undertaken as part of the U.S. Shorebird Plan.

The Education and Outreach Working Group developed a plan for effective and appropriate shorebird education tools and methods, entitled Shorebird Education and Outreach Needs in the United States. This plan delineates target audiences, develops key messages that can be used to reach these audiences, and makes recommendations as to how the messages can be imparted within relevant programs. The Working Group compiled existing materials and programs used for shorebird education, along with information on priority conservation needs and the messages wildlife professionals felt needed to be broadcast in order to address these needs. The Group then determined where gaps existed in the tools available, and therefore where the need to develop additional material and programs was the greatest. Finally, the Group made recommendations as to how the priority conservation needs can be reconciled with effective outreach and education programs and how these programs can be implemented.

## **Existing Resources**

The Working Group developed an outreach survey to determine current national education and outreach efforts and programs for shorebirds and their habitats. Existing shorebird education materials varied greatly in their ability to reach targeted audiences. Most shorebird education materials have been developed for audiences in the U.S., although some are broader in scope and incorporate audiences within the Western Hemisphere. Many existing materials were either unavailable or not in compliance with National Science Standards, making their use difficult



*Subspecies of Marbled Godwits have breeding populations separated by hundreds or thousands of miles; little is known about wintering locations of the different groups, making conservation planning challenging. Photo by Pablo A. Canevari.*

for classroom teachers to justify. State and federal agencies, non-profit education organizations, and international organizations were asked about the type of materials used, the nature of their audience, the type of messages they feel are important, and the tools needed to assist in delivering these messages.

Most organizations surveyed are set up to deliver key messages and support future education efforts, but would benefit from some national coordination. In particular, they need increased community involvement, expanded partnerships, and better interactions with private landowners. Taking advantage of the World Wide Web and satellite distribution of educational programs could serve to broaden the scope of the national outreach efforts.

### *Priority Outreach and Education Issues*

The Education and Outreach Working Group distributed a questionnaire to the regional working groups to help determine the priority shorebird conservation issues. Habitat loss emerged as the major category of concern at the national level. Other high priority issues included threats from agriculture, disturbance of shorebirds, and degradation of habitat from a variety of factors that differed among regions.

The most pressing gaps in resource information identified by the group included: 1) a lack of awareness of shorebirds among the general public; 2) absence of materials to convey the economic incentives for protection of shorebirds and their habitats, such as eco-tourism; and 3) a general lack of understanding of the threats to shorebirds. The Group found that much of the material in existence was not easily accessible or well-advertised, and developed a consolidated directory of materials to address this need.

### *Outreach Programs that Meet Identified Needs*

Using the priority issues identified by the group, outreach plans were developed to address the national priorities among target audiences. These plans can either be adopted nationally or regionally. Full details regarding each program are included in the Education and Outreach Needs report, including plans for: 1) a national Shorebird Sister Schools and Sister Cities Program; 2) The Great Shorebird Trail; 3) Protecting Shorebirds and Coastal Habitat on the Massachusetts Coast; 4) Delaware Bay Shorebird Conservation; and 5) Training for Conservation Staff.

### *Habitat Management Philosophy*

In addition to the specific programs for shorebirds described above, there is a national need to set broad goals for the integrated management of habitats used by shorebirds and other wetland-dependent wildlife. This section details some of the principles most important to achieving shorebird management goals in the context of multiple species management of wetlands and associated habitats. Management of shorebird habitats requires a wide range of specific techniques in many diverse habitats, and achieving regional priorities requires management for different species at different seasons. Detailed management regimes can only be designed at the scale of specific sites, but the specific habitat management issues in each region are detailed in the Regional Shorebird Plans. The general principles provided here apply to many situations where integrated wetland management for shorebirds and other wetland wildlife is the goal.

#### *1) Wetland shorebird habitats should be managed as dynamic systems.*

Wetland habitats are dynamic systems, and management regimes should reflect this basic characteristic of natural wetlands. Wetland management that includes maintenance of static water levels over long periods dramatically reduces shorebird habitat availability. However, persistent management of wetlands for the shallow-water environments used by many shorebirds would result in similar overall losses in habitat quality and diversity. Managed wetland systems should be designed to perpetuate the natural fluctuations in water level that drive dynamic processes, resulting in high quality habitat for a wide diversity of wetland species. Dynamic regimens also set back succession, keeping wetlands from becoming overgrown by persistent vegetation with consequent reductions to biodiversity. In addition, it is sometimes important to include upland habitats in management plans for breeding and migrating shorebirds.

It is essential that shorebird management consider regional as well as local habitat dynamics. Management objectives that are based only on local information may be inappropriate and incomplete. Many wetlands function as part of a complex of habitat types at multiple temporal and spatial scales. Habitat may be available at some sites only in certain years, but those sites can still play critical roles by providing habitat when it is limited in other areas due to water availability, vegetation cycles, or predator populations. Understanding that birds use multiple wetlands at different times according to natural cycles is critical to successful landscape-scale management.

*2) Naturally self-maintaining systems should be preserved and are generally preferable to sites requiring ongoing management.*

Active habitat management requires considerable inputs of time and money, and can be difficult to maintain over the long term. In some situations, active management is the only solution for providing appropriate wetland and shorebird habitat, and should be a priority. However, preference should be given when feasible to programs that attempt to maintain wetland complexes in natural states, so that habitat can be provided through natural cycles rather than through relatively expensive management. Nevertheless, activities such as control of exotic plants or animals, or dredging of areas degraded by sedimentation, may be necessary to maintain high wildlife diversity. Many of these natural sites provide good conditions for shorebirds. Protection from conversion to other land uses, and maintenance of natural dynamic cycles of water levels and disturbance regimes are critical. Acquisition and maintenance of high quality, natural shorebird habitats should be an ongoing priority whenever possible.

*3) Management for diverse species groups is generally preferable to management for single species, except for species at high risk.*

Whenever possible, managers should target flooding regimes to provide habitat for entire guilds of wetland wildlife, including shorebirds, rather than attempting to manage for single or specialized groups of species. Ecologically based, broad management goals should be set within the landscape context of the management area. Exceptions can be made in extreme circumstances, such as management for endangered species.

*4) Management activities should be timed seasonally to have the maximum impact on critically limiting resources.*

Shorebirds have specific habitat requirements at different points during the year, and management efforts focused on them should be timed to coincide with the periods when resources are limiting. For example, shallow-water habitats during the southern migration period of shorebirds are extremely limited in the Mississippi Alluvial Valley, and early fall habitat is generally more limited than is late fall habitat. Regional landscape management plans that attempt to provide habitat during critical periods in each region are needed. It is also important to understand the life cycles of the local invertebrate populations that are affected by water level manipulation. Invertebrate species consumed by shorebirds have a wide diversity of life strategies and may require varying types of flooding regimes to breed and survive.

*5) Management of impoundments for shorebirds and wildlife diversity should be increased on publicly managed wildlife areas.*

Many refuges have impoundment systems that use gravitational flow devices, tidal gates, and/or a system of pipes, ditches, culverts, and dikes. These systems have partial control over water management dependant on geographical conditions and weather. Such systems may be able to lower water levels in areas that historically receive higher rainfall, or snow melt in the spring. Many of these same areas experience little rainfall in the late summer and early fall months. Without the capacity to pump water from nearby sources, it is difficult to provide appropriate shorebird habitat for this migratory period. Management efforts should include developing a means of returning water to dry impoundments at strategically important wildlife areas by developing pumping capability.

Impoundments with water pumping capability can be more intensively managed for shorebirds. Provision of shorebird habitat can be achieved by coordinating drawdown of water levels with peak periods of shorebird migration. Appropriate timing can provide maximum habitat for the greatest number of birds. In some cases lowering water

levels for shorebirds must be tested on a small scale to ensure coordination with the water requirements of other species, with possible loss of vegetation or disease control, so as to provide appropriate habitat for shorebirds but not be detrimental to other management goals. In addition, water management should not be used to circumvent natural wetland cycles where drawdowns have important ecological effects, and the effects of pumping on downstream systems and salinity levels must be carefully managed.

*6) Greater efforts are needed to support improved shorebird management activities on private lands.*

Private lands provide important habitats for shorebirds. These include floodplains, farmed and tilled wetlands, and grazed fields. Some human activities can help to maintain shorebird habitat while others destroy or severely degrade it. For example, tillage agriculture can provide extensive areas of open habitat, as for example rice agriculture in the U.S. Gulf Coastal Plain or in the California Central Valley. Numerous opportunities exist for cooperative wildlife management efforts on landscape scales between private and governmental agencies. Management should include efforts to support compatible land uses that can coexist with sustainable shorebird habitats. Human recreational activity often encroaches on shorebird habitat, particularly in marine areas. Chronic disturbance can disrupt shorebird behavior, impair migration readiness, and reduce nesting activity. Shorebird management goals should take these activities into account, as well as include efforts to educate the public about the potential effects that chronic disturbance has on these birds.

*7) Successful management for shorebirds requires a detailed understanding of historical conditions at each site and across entire landscapes.*

Understanding the geomorphology as well as the geography of wetlands is critical for management to be effective at landscape scales. Formative processes determine the type, distribution, and size of wetlands. Substrates, in combination with climatic conditions and water, determine salinity and nutrient availability. In turn, these physical conditions control water quality as well as plant and animal communities and their distribution. Successful management over the long term requires a full understanding of the historical context of areas which historically provided shorebird species with the resources to survive. Managers need to understand how current and projected habitat conditions match or differ from historic conditions, and then evaluate management actions that can provide the missing resources.

*8) Shorebird management should be coordinated among multiple agencies and programs.*

Shorebird management plans should be developed at large geographic scales and should be linked with private, federal, state, or local agencies whose coordinated activities are essential to implementation of landscape planning. For example, water commissions often control the timing and amount of water released from reservoirs that affect water levels of refuges downstream. Shorebird managers may also find themselves competing with marine fisheries for the same resources, such as the horseshoe crab. Successful management for shorebird habitat will require cooperative and coordinated efforts among all agencies or groups whose activities influence shorebird management strategies. The Shorebird Planning Regions established for this Plan will serve as regions within which management agencies should strive to coordinate, but many issues will involve more than one region working cooperatively.

*9) Multiple use management of natural areas requires careful balancing of public access with acceptable levels of human disturbance to shorebirds.*

Many managed natural areas increasingly have multiple uses, and in particular, habitats used by shorebirds are often used for intensive recreational purposes. Disturbance of shorebirds on nesting, feeding, and roosting areas may significantly reduce survival and reproductive success. Increased research is needed to determine levels of disturbance that do not affect shorebird populations, so that managed areas can be used for educational and recreational purposes while contributing to overall shorebird recovery goals.

