

Preparation of Regional Shorebird Monitoring Plans¹

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Introduction

Shorebird monitoring programs in Canada and the United States are being developed under the auspices of PRISM, the Program for Regional and International Shorebird Monitoring. PRISM provides a single blueprint for implementing the monitoring proposals in the shorebird conservation plans prepared recently in Canada and the United States. It includes four segments: arctic and boreal breeding surveys, temperate breeding surveys, temperate nonbreeding surveys, and neotropical surveys. A separate document, available at <http://amap.wr.usgs.gov>, provides an overview of PRISM. Temperate non-breeding surveys have the potential to contribute to four of the five goals of PRISM: monitor stopover sites during the spring and fall migration, elucidate habitat relationships, help local managers meet shorebird conservation goals, and measure population trends. This program seeks to standardize site selection, data collection, and data storage among existing initiatives including the International Shorebird Survey, Maritimes Shorebird Survey, and Western Shorebird Survey. The temperate non-breeding surveys involve a major effort to identify shorebird concentration sites and develop ways to survey them for shorebirds. These analyses are termed “regional assessments” and are being conducted throughout southern Canada and the United States. This document provides guidelines for preparing regional assessments. It is intended for people who will use the shorebird survey data, so they can understand the sampling plans used to select sites, and for other waterbird specialists who may be interested in adapting the approach for their species. More detailed procedures and examples are available at <http://amap.wr.usgs.gov>.

The goal of the temperate, non-breeding surveys is to produce good estimates of the average number of shorebirds present during the “study period” for each “focal species.” The study period is 6-8 weeks in spring or late summer. A survey period during winter may also be defined. Final selection of the study period should

often not be made until other investigations, especially the design of waterbird monitoring programs, have been completed. The focal species occur in the monitoring region during the study period in high enough numbers that trends in the mean number of them present might be important in making management decisions at the regional, national, or international level. Trends for some additional species may be important at the local level (e.g., a Wildlife Management Area). A tentative list of focal species for the planning region is given in the introduction of each regional analysis.

Canada and the United States have been sub-divided into 158 “Bird Monitoring Regions” formed by intersecting a map of the Bird Conservation Regions with a map of Provinces and States (*fig. 1*). Small polygons were dissolved and edges were smoothed. A regional assessment is being prepared for each Bird Monitoring Region. The biologists preparing each regional assessment sub-divide the Bird Monitoring Region into “domains,” and sub-divide domains into “zones.” Domains are delineated using readily recognized features such as roads, water bodies, and administrative boundaries (*fig. 2*). Domains are kept small enough that all major shorebird sites within them can be depicted on a single page. Although they are useful for organization, domains are not a sampling unit and domain boundaries are not used in calculating population trend estimates. Therefore, the boundaries of domains can be changed without affecting trend estimates. Zones within domains are also delineated using readily recognized features. Typically, each major shorebird site within a domain is assigned to a separate zone, and zone boundaries are established at some point between these sites (*fig. 3*). Domains, and zones within a given domain, are each numbered sequentially starting with 1. The complete identifier for a zone includes the Bird Monitoring Region. Thus zone 63.5.2 is the 2nd zone in the 5th domain of Bird Monitoring Region 63.

The “shorebird-day” is used to measure and describe shorebird use. A shorebird-day is one shorebird spending 24 hours within the area of concern during the study period.

The mean number of shorebirds present in the area during the study period equals the total number of shorebird-days during the study period divided by the number of days in the study period. In deciding which areas to focus survey efforts on, we use rules based on

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the fraction of the shorebird-days that occur within different portions of the area. “Type 1” areas have shorebirds present during the survey period in substantial numbers. “Type 2” areas have shorebirds present but in small numbers. “Type 3” areas have virtually no shorebirds present during the study period. The goal in delineating Type 1, 2, and 3 areas within a Bird Monitoring Region is that >75 percent of the shorebird-days for each focal species occur in Type 1 habitat; <20 percent of the shorebird-days occur in Type 2 habitat, and <5 percent of the shorebird-days occur in Type 3 habitat. Type 1 habitat will be surveyed each year using a detailed protocol that provides an estimate of the mean number of shorebirds present in the habitat during the study period. Type 2 habitat will be surveyed every few years, using more flexible methods, to verify the assumption that <20 percent of the shorebird-days for each focal species occur in these areas. Type 3 habitat will not be surveyed regularly but bird watchers and biologists will be notified that these areas are thought to be virtually devoid of the focal shorebirds during the study period, and they will be asked to contact us if they find evidence that this assumption is wrong. Zone borders are often drawn so that most of the area within each zone is in one or two habitat Types. Zones are sometimes referred to by the highest quality habitat they contain. Thus, a Type 2 zone has some Type 2 habitat and may have some Type 3 habitat but does not have any Type 1 habitat. Because surveys from Type 1 habitat only are used to estimate population trends, much of the regional assessment focuses on sampling plans for Type 1 habitat. Surveys in Type 2 habitat are used primarily to verify that there has not been a shift in shorebird use areas.

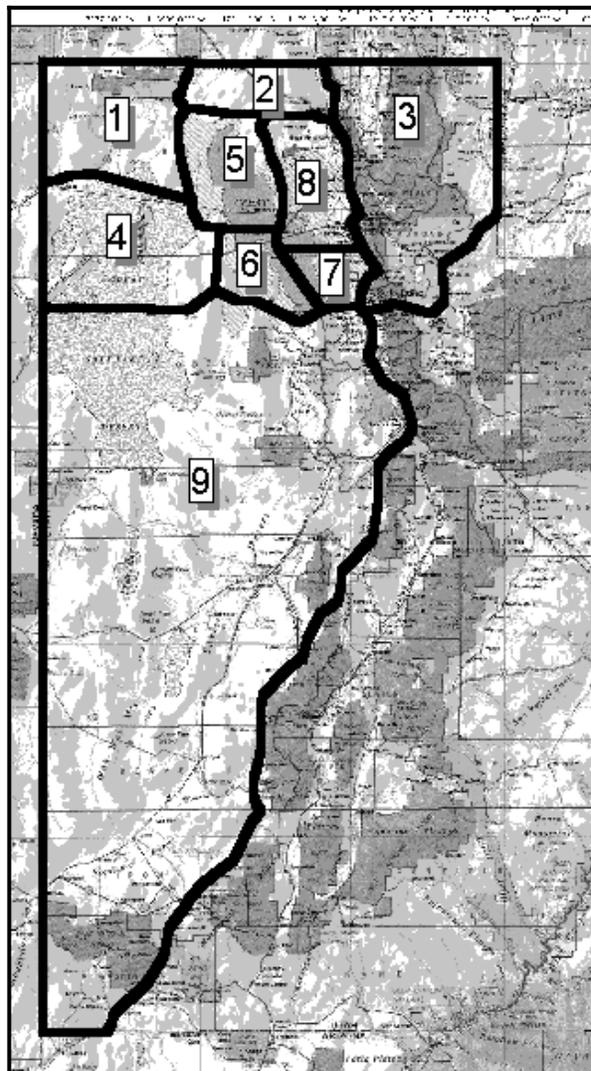


Figure 2— Example of a Bird Monitoring Region (Utah-BCR 9 - Great Basin) subdivided into domain.

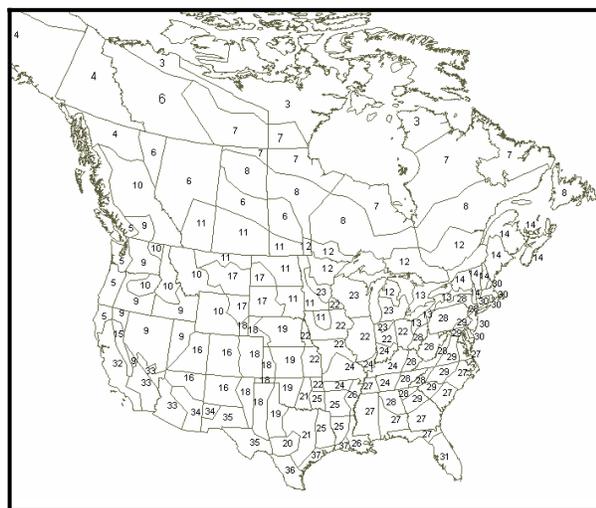


Figure 1— Bird Monitoring Regions in Canada and the United States.

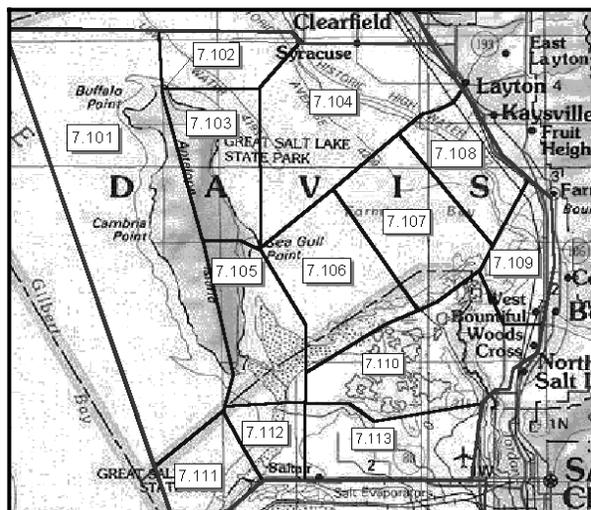


Figure 3— Example of a domain sub-divided into zone.

Much attention is given, in preparing each regional assessment, to “measurement error,” “measurement bias,” and “selection bias.” The objective on surveys is to detect all shorebirds present in the survey area (e.g., a plot) at the time of the survey. Pilot studies are often recommended to develop the needed survey methods. Measurement error is the difference between the number recorded and the number present. Measurement bias is a long-term trend in the index ratio, defined as “number recorded”/“number present.” The reason for the distinction between measurement error and measurement bias is that measurement error alone does not necessarily cause any bias in the trend estimate. For example, if about half the birds present are recorded, but there is no long-term trend in this detection rate, then the long-term trend estimated from the counts is unbiased. Substantial measurement error - which is defined here as an index ratio <0.80 or >1.20 - means that a long-term trend in the index ratio, causing measurement bias, could occur. Thus, while measurement error alone does not cause any bias, it creates a situation in which measurement bias could occur. The description for each zone includes a heading for “Measurement error and measurement bias.” When measurement error is negligible ($<\pm 20$ percent), “Not applicable” is entered for measurement bias.

Selection bias is caused by (1) some parts of the zone being non-surveyable due to access problems, and (2) a long-term trend in the proportion of birds within these non-surveyable areas. Selection bias can also occur if a previously unsuitable area becomes suitable, for example through habitat management. More typically, an area becomes unsuitable for example due to encroachment by an invasive species, flooding, or development. The description for each zone contains a heading for “Access and selection bias.” If all areas are accessible, then “not applicable” is entered for selection bias.

The potential for selection bias is also discussed at the regionwide level. Some entire zones might be in the non-surveyable category, which introduces a potential for bias not discussed within the individual zone descriptions. Furthermore, while there might be substantial potential for selection bias in some zones, it might be felt that spurious negative and positive trends would approximately balance each other at the regional level.

Preparation of the regional shorebird monitoring plans proceeds in up to three stages. Each stage may produce a separate document, and several drafts may be needed to produce the final draft. Each stage is described below.

Document One: Summary of Existing Information

This document contains background information and notes prepared for initial visits to each domain. It is a working document, continually revised and expanded as the investigation proceeds. It usually includes maps with preliminary delineation of areas to be examined, a description of each one, and issues to be investigated during field trips such as visibility, numbers of birds, and access. After initial visits have been made to a domain, a draft section describing the zones and needed pilot studies is prepared. This section may be revised several times as the work proceeds. Eventually, it is transferred to the second document (“Needed Pilot Studies”). Procedures for preparing the document are described below.

1. *Prepare regionwide analyses*

- a. Gather information on the distribution and abundance of staging, migrating, and wintering shorebirds throughout the region and year. Collect information from birders and biologists familiar with the areas as well as publications and reports such as regional shorebird conservation plans. Reviewing data may be helpful but detailed analyses are usually more time-consuming than is worthwhile. Plot major concentration sites (during the proposed survey period) on a map of the region.
- b. Make an initial choice for domain boundaries, trying to define domains so that major shorebird areas in each domain can be displayed on a single page. Domains are defined purely for presentation convenience. They have no statistical significance and their boundaries can be changed at any time.
- c. Make an initial choice for the survey period (e.g., July & August) and explain why the period was selected. Regional bird finding guides, reports, and local experts can be very helpful in this endeavor.
- d. Identify major landowners and other groups in or adjacent to the region who might wish to participate in development and implementation of the survey. Coordination with the Regional Shorebird Conservation Plan Working Group is recommended as they can provide information on shorebirds in the area and may know of the best individuals to contact when surveys are initiated.

2. *Prepare descriptions of each domain.*

- a. Review all shorebird, and other, information about the domain.
- b. Consider when during the day surveys should be conducted. In general, all surveys in a zone should be made during a single period particularly within tidal areas. Failure to do this raises the possibility that birds might tend to be double-counted or missed completely, and that the proportion of birds double-counted or missed might change through time causing (frame) bias. For example, if areas counted at low tide became unsuitable through time, birds might move to zones that were not surveyed thus causing a spurious trend in numbers counted. If the survey period is the same for all zones, then double-counting or missing birds does not cause any bias because, on average, these errors will balance each other and there will be no tendency for a long-term trend in such errors. Timing of surveys is especially important at tidal sites but may be important at other sites due to the sun or other factors. Note that if the number of shorebirds present varies rapidly, as is often the case with tidal areas, then the survey period should be brief. Otherwise, surveyors may gradually learn when surveys will yield the highest counts and may be tempted to visit at these times. This behavior would generate an increasing trend even if the mean number of birds present during the survey period did not change. For this reason, mean rather than peak counts will be used as an index to population. This method also preserves data elasticity, providing flexibility in timing with less emphasis on catching peak shorebird movements which may vary by year, weather, and other factors. In addition, mean counts make it possible to compare data gathered with different survey methodology (e.g. aerial vs. ground counts).
- c. Partition the domain into “zones” (i.e., every point within the domain is in exactly one zone). Try to describe the distribution of Type 1, 2, and 3 habitat within each zone. Begin to identify pilot studies needed to complete the delineation and description of zones. Summarize this information in writing (this helps insure wise use of field time) but without spending time on writing style or guesswork.
- d. Visit the domain, examining each zone and trying to improve the descriptions of where Type 1, 2, and 3 habitat occurs. Consider how to survey the Type 1 habitat in each zone. A first

step is to decide whether sampling, rather than complete coverage, will be needed. If complete coverage is likely to be too time-consuming (the usual case) then consider different ways to sample the area. Stratification will often be useful as a first step, after which a wide variety of approaches should be considered. Studying completed plans for other regions and contact with PRISM personnel may be useful at this stage.

- e. Begin preparing the information for each zone that will be incorporated into the Needed Pilot Studies document and eventually into the sampling plan.

Document Two: Needed Pilot Studies

This document summarizes results from the initial work and identifies the pilot studies needed before a sampling plan can be prepared. It serves as a proposal to obtain the needed funding and other resources for carrying out the pilot studies. The format is flexible but might include the following sections.

1. A description of PRISM showing how the proposed work relates to achieving regional, national, and international goals. This material will be similar in each proposal.
2. Description of the region including outer boundaries, domains, major concentration sites, numbers of birds present, organizations with shorebird interests and/or responsibilities, etc.
3. Methods used to develop the proposal.
4. A list of the proposed pilot studies with descriptions of the needed work, budgets, schedule, and perhaps suggestions about parties to carry out the work including priorities for each.
5. In an appendix, a first draft of the “description” portion of the sampling plan for the region (see “Document Three” below). This material is included so that reviewers can examine how the information to be collected in the pilot studies will be used.
6. A “summary,” prepared after all of the above sections have been completed, placed near the beginning of the document. The summary integrates the zone-specific studies. For example, aerial surveys may be needed in several zones, but it may be most efficient to carry them out at the same time. Ground surveys may be needed in several zones, but it may be most efficient to carry them out by hiring a single person.

Document Three: The Shorebird Sampling Plan

This report describes the sampling plan for each region. It cannot be completed until after the pilot studies have been completed but it is helpful to begin the report while preparing the “Needed Pilot Studies” document both to help identify and prioritize needed pilot studies and to demonstrate to reviewers how the pilot studies will permit completion of the sampling plan. The following information should be included.

1. Description of the region, probably taken directly from the “Needed Pilot Studies” document.
2. Description of the Type 1 habitat in each zone using the format in *table 1*.
3. Consideration of alternate sampling plans for each zone including a discussion of whether the zone is sampled or censused and, if sampled, how plots are selected (e.g., systematic, simple random, cluster sampling).
4. Description of how the weighting factors, used in combining the survey results with results from other zones, will be calculated. If the zone has no inaccessible areas (so either it is censused or all parts of it could be included in the sample of plots), then the weighting factor (for each species) is simply the estimated mean number of birds present in the zone from the surveys. If some areas cannot be surveyed, then a description must be provided of how weights will be calculated (e.g., by occasional aerial surveys of non-surveyable areas).
5. A description for surveyors of the zone, areas to be surveyed, survey protocols, etc., following the format used in the Western Shorebird Survey (<http://wss.wr.usgs.gov>). This material is transferred directly to the website and is distributed in printed form as appropriate.
6. An overview of the sampling plan, prepared after the zone descriptions have been written but usually included as an introduction to the zone-specific parts of the report.

Conclusion

The approach described above provides a rigorous conceptual basis for designing shorebird sampling plans for sites located throughout southern Canada and the United States. The approach needs to be extended gradually to all areas used by North American shorebirds during the survey period. Accomplishing this task would reduce frame bias dramatically because the study area - aside from areas that are non-surveyable due to access - would cover all locations occupied by shorebirds. This task should probably be the highest priority for the non-breeding surveys portion of PRISM. A second priority should be extending the regional analysis to all waterbirds. This task must be carried out largely by waterbird specialists under the auspices of the Waterbirds Initiative with additional assistance from the Waterfowl and Landbirds Initiatives.

Table 1—*Information provided for each zone.*

Category	Description
Description	Capsule description (e.g., a wide beach; a shallow lagoon) of the zone. Additional comments as appropriate on ownership, access, boundaries, and timing of surveys. Brief description of the species and numbers occurring during the survey period.
Classification	Describe where type 1, 2, and 3 habitats occur. These habitats are not normally mapped within zones so descriptions need to be clear.
Survey Methods	Brief discussion of what methods would probably work best; does not include final recommendations on methods or sample sizes.
Measurement Error and Measurement Bias	Discuss “measurement error,” the expected difference between the number of birds present in the zone or surveyed parts of it and the number recorded, and “measurement bias,” a long-term trend in the ratio, “number recorded”/“number present.” Minimizing both quantities is important in the design. See “Introduction” above for a discussion of these terms.
Access and Selection Bias	Selection bias is a long-term trend in the proportion of birds present in areas that cannot be surveyed, usually due to access (including ownership) problems. It is “not applicable” if all areas can be accessed. See “Introduction” above for a discussion of these terms.
Pilot Studies	List separate studies describing goals and methods for each and including “priority” (high, medium, low).