Waterbirds around the world

A global overview of the conservation, management and research of the world's waterbird flyways

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Cover photography: Whooper Swans *Cygnus cygnus* arriving at Martin Mere, England. Photo: Paul Marshall. (www.paulmarshallphotography.com)

The Program for Regional and International Shorebird Monitoring (PRISM) in North America

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The Program for Regional and International Shorebird Monitoring (PRISM) provides guidance on how to monitor shorebirds that regularly nest in Canada and the United States. PRISM has five goals, but work so far has focused on one of the goals, namely estimating trends in population size. An accuracy target has been adopted and a substantial amount of work has been completed to design surveys in the arctic, boreal, and temperate regions of Canada and the United States. Less work has been done on surveys to be conducted in winter.

INTRODUCTION

National shorebird conservation plans in Canada (Donaldson 2001) and the United States (Brown *et al*. 2001), completed in the past few years, both recommended a comprehensive approach to monitoring shorebird populations in North America. These calls to action led to the formation of PRISM, the Program for Regional and International Shorebird Monitoring (Skagen *et al*. 2004, Bart *et al*. 2005a). The national plans identified 74 shorebird taxa, including 49 species, with populations in Canada and the United States large enough to warrant monitoring. PRISM has five goals:

- Estimate the size of breeding populations of shorebirds in Canada and the United States.
- Describe the distribution, abundance, and habitat relationships of shorebirds.
- Monitor trends in the size of shorebird populations.
- Monitor shorebird numbers at stopover locations.
- Assist local managers in meeting their shorebird conservation goals.

Estimating trends in population size was thought to be the most difficult goal to achieve, and so initial work has focused on this goal. PRISM has adopted the following accuracy target for trend estimation:

80% power to detect a 50% decline in population size, occurring during no more than 20 years, using a two-tailed test with a 0.15 significance level, and acknowledging effects of potential bias.

A three-part approach for trend estimation has been developed to achieve this goal:

- Surveys on the breeding grounds.
- Surveys on migration.
- Surveys on the wintering grounds.

Progress in the development of each of these surveys is described below.

SURVEYS ON THE BREEDING GROUNDS

Separate programs are being conducted in arctic, boreal, and temperate regions. During surveys, all shorebirds encountered are recorded, but in each region, programs are designed to survey only those species for which one-third or more of the population occurs in the region. For example, surveys in both the arctic and boreal regions are designed to survey Red-necked Phalaropes *Phalarope lobatus*, because more than one-third of their population is thought to occur in each region, but surveys in the Arctic are not designed specifically to monitor Semipalmated Plovers *Charadrius semipalmatus*, although they do occur in the Arctic, because more than two-thirds of their population are believed to breed in the boreal region.

Arctic regions

A great deal of work has been carried out in the arctic portions of Canada and Alaska during the past five years. Methods for surveying shorebirds were developed at a research station on the delta of the Colville River, using support from the US Fish and Wildlife Service and the US Geological Survey. The approach uses double sampling. A large sample of plots is selected, using formal probability methods, and surveyed a single time. A subsample of these plots is surveyed intensively to determine the number of shorebirds actually present. The number of birds "present" on a plot is defined as the number of territorial males whose first nest of the season, or territory centroid for non-nesters, is within the plot. This number is then doubled to obtain the estimate of population size. Other methods of estimation are needed if a substantial number of the males are non-territorial, but this is a situation that we have not yet encountered. The ratio of number recorded on rapid surveys of the intensive plots to number actually present is used as a correction factor to adjust results from the rapid plots and obtain an unbiased estimate of numbers actually present. Geographic information systems (GIS) methods are used to stratify the study area, and habitat-based models are used to extrapolate findings from the sample to the entire region. Two- or three-stage sampling is used to select survey plots depending on sampling intensity within the region. The field methods are described in Bart & Earnst (2002, 2005); the sampling plan and derivation of the estimators are described in Bart *et al*. (2005b).

Once the basic method was developed, tests were made to evaluate and refine it for use throughout the Arctic in Alaska and Canada. Trials were carried out in 15 sites, widely distributed across the Arctic (Fig. 1). A manuscript summarizing results and presenting a proposed plan for conducting the surveys during the next 10-20 years has been prepared and is undergoing peer review by a panel of experts. Following peer review, the plan will be revised as needed, submitted for publication in a scientific journal, and then implemented in the coming years.

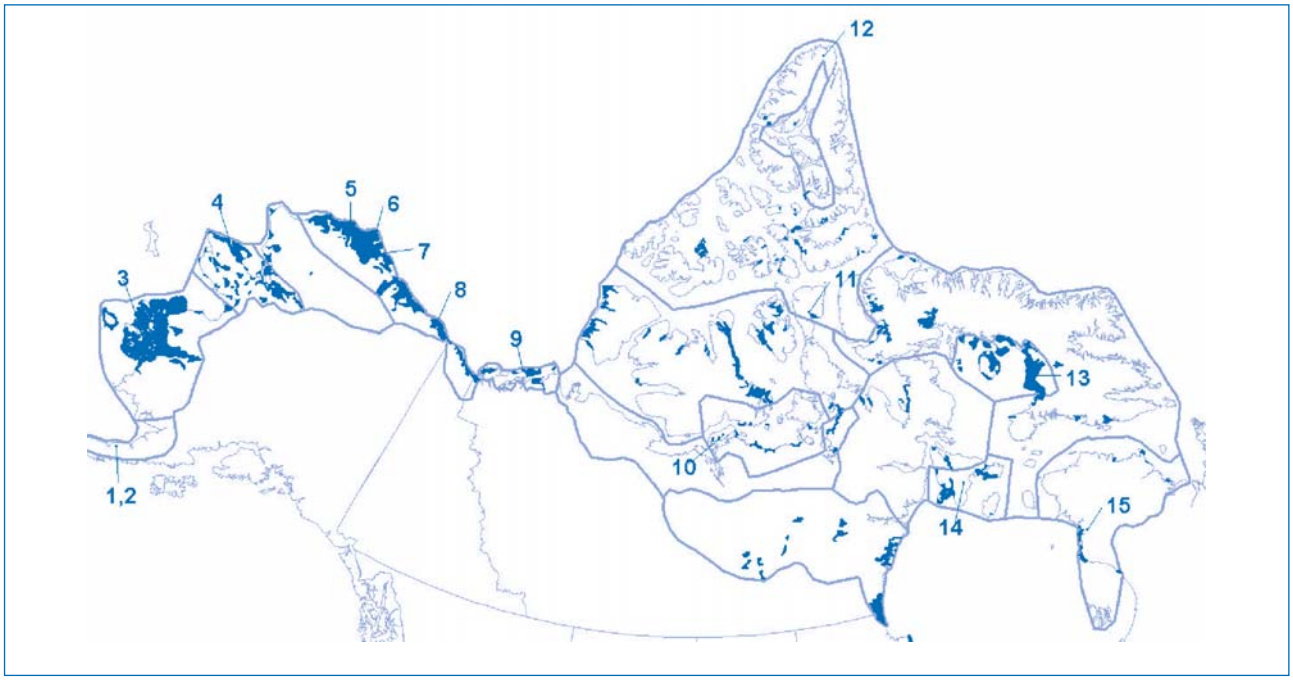

Fig. 1. North American Arctic (i.e. Alaska and northern Canada), showing location of field sites at which the methods for the long-term survey were developed (numbers 1-15) and the regions (thick gray lines) which form the starting point for the sampling plan. Black areas are wetlands, as indicated by the Circumpolar Arctic Vegetation Map (CAVM Team 2003).

The next step in developing the PRISM arctic surveys is to broaden coverage, where appropriate, to include other birds and perhaps to collect data on other organisms and environmental parameters. A decision was made in 2003 that surveys in Canada would record all species, because many of the areas being surveyed have rarely if ever been visited by biologists on the ground. A commitment has also been made to contact other Arctic researchers to determine the importance of collecting other kinds of information.

Boreal regions

The Boreal PRISM committee carried out an assessment of methods for surveying shorebirds in the boreal region (Aubry *et al*. 2004). They identified nine priority species, of 19 species that breed regularly in boreal regions, and considered how best to survey each one in each boreal Bird Conservation Region (BCR). A primary conclusion was that methods currently used to survey species other than shorebirds should be used rather than developing methods solely for shorebirds. The assessment discusses methods used for land-birds (North American Breeding Bird Survey, off-road point counts), waterfowl (helicopter aerial surveys of wetlands, roadside waterfowl surveys), marsh birds (Marsh Bird Monitoring), and migrant shorebirds (aerial and ground-based stopover site surveys). Their conclusions (Aubry *et al*. 2004, p. 33) were:

> Because of differences among boreal species in geographic distribution and habitat use, no one survey type can be used to monitor all boreal shorebirds. For some species, such as the high alpine breeders Surfbird *Aphriza virgata* and Wandering Tattler *Heteroscelus incanus*, adequate population monitoring on the breeding grounds may not be feasible in the near future, and surveys during migration and wintering should be further investigated. For species with very limited breeding ranges, such as Hudsonian Godwit *Limosa haemastica* and Short-billed Dowitcher *Limnodromus griseus*, species-specific surveys may be required within small geographic areas. For some species, expanding coverage of the Breeding Bird Survey, which is well established and relatively inexpensive to conduct, to encompass the many roads within the boreal region that are not currently surveyed, may prove adequate for population monitoring. Roadside surveys which target wetlands, such as roadside waterfowl surveys and marsh bird surveys, may also be valuable, cost-effective tools for monitoring some boreal shorebirds.

Their report includes numerous recommendations on work needed to determine how the existing survey protocols and programs can best be used to survey each of their high priority species.

In Canada, bird monitoring in the boreal forest has recently gained prominence through programs initiated by both government (e.g. Canadian Wildlife Service) and non-government (e.g. Ducks Unlimited) agencies. Boreal PRISM is viewed as one part of a broader boreal bird monitoring effort. The PRISM program will collaborate closely with boreal monitoring by other bird groups to ensure maximum program efficiency. We anticipate proceeding with testing the adequacy of existing methods for monitoring boreal shorebirds in the spring of 2005.

Temperate regions

Seventeen shorebird species nest in temperate regions in sufficient abundance to be focal species for this region. The PRISM accuracy target appears to be met for Piping Plovers *Charadrius melodus* and American Woodcock *Scolopax minor*, and may be met for five other species that are frequently recorded on the Breeding Bird Survey, although more work is needed to assess potential bias. A detailed survey has been made for American Oystercatchers *Haematopus palliatus* that nest within the United

States (Brown *et al*. 2005). In 2004, a three-year study was initiated to study Long-billed Curlews *Numenius americanus*. The results will achieve the PRISM trend monitoring target as well as providing information on habitat relationships and conservation priorities for this species. A comprehensive plan is needed for monitoring the other eight species. Comprehensive programs recently initiated in several States may be helpful, but work focused on these shorebird species will also be needed.

SURVEYS ON MIGRATION

Most shorebird species can be monitored during migration, and much work has been carried out to develop rigorous surveys for this period. The International Shorebird Survey (Howe *et al*. 1989, Brown *et al*. 2001) and the Maritimes Shorebird Survey (Morrison *et al*. 1994, 2001) have collected information on migrating shorebirds since the mid-1970s, but without a well-defined sampling frame or written, site-specific protocols. PRISM investigators have developed approaches for defining the sampling frame and preparing survey protocols. Canada and the United States have been divided into bird monitoring regions, created by intersecting a Province and State map with a map of Bird Conservation Regions (BCRs) which were delineated by the North American Bird Conservation Initiative (NABCI 2000). This approach permits stepping up results either to the Province and State level or to the BCR level. Each bird monitoring region is partitioned into two or more strata. One stratum consists of "designated sites", i.e. sites with a sufficient number of birds, and people to survey them, for them to be non-randomly selected for inclusion in the shorebird survey. The rest of the region is referred to as the matrix, and may be sub-divided into two or more matrix strata depending on shorebird distribution and appropriate survey methods. For example, reservoirs might be common in one part of a region and might be surveyed by boat; another part of the region might contain extensive marshes where ground surveys would be needed, and the rest of the region might have too few shorebirds to be worth surveying.

Long-billed Curlew *Numenius americanus*. Photo: Gary Kramer.

Table 1. Information recorded about each designated site in the PRISM migrating shorebird monitoring program.

1.	**Boundaries and ownership** – A brief description of who owns the land. If special permission or permits are needed to access the site, note this. Include local contact names and phone numbers, if appropriate. Briefly describe habitat at the site.
2.	**Focal species using the site and timing of use** – Describe shorebird use of the site including species, numbers, and timing.
3.	**Location of Type 1 and 2 habitat within the site** – Delineate the areas used most intensively by birds (Type 1 habitat) and areas used less frequently but often enough to warrant occasional surveys (Type 2 habitat). Try to define these areas so that >75% of the bird-days are in Type 1 habitat and >20% of the bird days are in Type 2 habitat.
4.	**Access to Type 1 and 2 habitat and the visibility of the birds** – Describe access to the site, including observation points, boat access and permission requirements. Identify any areas that are inaccessible. Describe problems with seeing all birds during a survey, if any. If visibility is different for different species note this (e.g. "large waders are easily detected, but distances are too great to accurately identify smaller waders").
5.	**Past and current surveys** – Briefly describe past or current surveys at the site. Summarize any available survey data briefly.
6a.	**Potential survey methods: description** – Identify and describe the best methods for surveying the site. Consider access, visibility and past survey results. Consider differences in survey methods among seasons, if appropriate. Consider when during the day surveys should be conducted. In general, all surveys in a site should be made during a single period. 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 birds 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.
6b.	**Potential survey methods: selection bias** – If some areas are not accessible, then discuss whether density in surveyable portions of the site may differ from the site-wide density and, if so, whether long-term trends might occur in the ratio: (density in the surveyable area)/(overall density). Any such trend will cause bias in the trend estimate. Consider whether occasional surveys might be conducted (e.g. from the air) of the entire site.
6c.	**Potential survey methods: measurement error and bias** – Missing birds cause measurement error; a trend in the proportion of birds that are missed causes measurement bias. Discuss the potential for measurement bias and ways to minimize it (e.g. by intensive surveys on a sub-sample of plots).
7.	**Needed Pilot Studies** – Identify any information needed to complete the sampling plan.

In such a case, three matrix strata might be distinguished. Sampling frames, following this approach, have been developed for the east coast of the United States (see http://www.shorebird-world.org/fromthefield/PRISM/PRISM1.htm) and several western States and areas (e.g. see http://www.gbbo.org/abc_maps.htm), and work in several other States is proceeding. A comprehensive list of designated sites and matrix strata is in the final stages of preparation for the continental United States.

Detailed guidelines have also been prepared for developing site-specific survey methods (Table 1). The guidelines include a description of the site (boundaries, habitat, ownership, access), species likely to be encountered, and survey methods. Particular attention is given, in the survey methods section, to the potential for selection bias (because some portions of the site are inaccessible), measurement error (because some birds in surveyed areas are not detectable), and measurement bias (because a long-term trend exists in the proportion of the birds detected). A final section identifies any pilot studies needed before the surveys can be fully designed. Examples of site descriptions are provided in Bart *et al*. (2005c) and at the internet sites above.

SURVEYS ON THE WINTERING GROUNDS

Extensive surveys of wintering shorebirds have been carried out by Morrison *et al*. (1998) and Morrison & Ross (1989), and some species-specific surveys have been conducted. Most of this work preceded the formation of PRISM, or has been carried out independently of it. An exception is the detailed survey, mentioned above, of American Oystercatchers, carried out as part of PRISM by the Manomet Center for Conservation and colleagues (Brown *et al*. 2005). A comprehensive strategy for surveying shorebirds on their wintering grounds is still needed, and will need to be developed cooperatively with countries that would host these surveys. Collaboration between those who have developed PRISM and organizers of the Wetlands International mid-winter waterbird counts would be especially valuable. Such discussions should include the possibility of expanding those counts into the USA and Canada.

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