

Draft Version

Project Goals, Study Area Selection, and Study Design Considerations

The goals of your project and *your resource constraints* will determine the methodology and your methodology will determine both the potential uses and limitations of the survey data you collect. Observational data often face analysis challenges because it is frequently not possible to control the values of independent variables in a study. However, with forethought at the design stage, these data can be useful in addressing questions about:

- numbers of shorebirds that use an area
- the size of a shorebird population
- seasonal abundance patterns of shorebirds at a site or within a region
- species diversity or richness in an area or a region
- trends in species richness at a site
- trends in abundance over a period of years in an area or a region
- trends in abundance over a period of years for a population
- changes in shorebird abundance or species richness associated with management strategies
- changes in shorebird abundance or species richness associated with habitat conversion or restoration
- the use of habitat and habitat relationships for shorebirds

Because project goals, characteristics of the study area, and human and time resources strongly influence study design, it is not possible here to provide a detailed protocol for every study. You want your design to permit an unambiguous analysis of the effects of variable(s) you are examining. In recent years, a great deal of thought and work has been put into developing monitoring methods for a variety of wildlife. The USGS *Manager's Monitoring Manual* (<http://www.pwrc.usgs.gov/monmanual/>), designed for managers of refuges and other areas in which wildlife habitat is protected and monitored, and the National Park Service's *Inventory and Monitoring Guidance for Designing an Integrated Monitoring Program* (<http://science.nature.nps.gov/im/monitor/vsmTG.htm#Design>) may be especially helpful to you in designing your study or monitoring program. These manuals describe a wide range of monitoring methods and considerations; here we will provide background information and highlight methodology that is specific to shorebirds in non-breeding habitat. Ultimately, consultation with a statistician familiar with ecological questions will be very helpful in planning your study. Below are a few sketches of the kinds of studies you might plan:

- You want to estimate the total number of shorebirds in an area that is too large for one person to cover alone. You need to count each bird once and only once; hence, the movement of shorebirds within this large site will be a major challenge to an accurate estimate. To reduce census error due to movement of birds, you might divide the area into a number of manageable census sites that can be counted by teams of censusers simultaneously over short period of time. The timing of such a census, with respect to time-of-day or tide, should be when the most accurate overall count can be obtained, rather than when any single census site might be best covered.
- You are trying to estimate the numbers of shorebirds that use a seasonal wetland near a large tidal estuary. From a small pilot study you have found that shorebirds are mostly absent during low tide, but that they arrive at the seasonal wetland on rising tides to feed or roost during high tide. You want to know if there are seasonal (fall, winter, spring) or annual effects on numbers. You survey the site several times at high tide during a season, over several seasons, and over several years.
- You want to know whether a habitat restoration effort at several sites is effective at increasing shorebird use. You conduct shorebird surveys prior to the restoration on the restored sites, as well as at reference (hopefully comparable) sites. After the restoration is complete, but at the same time of year and under the same conditions, you survey shorebird number at both the restored and reference sites. You compare changes in shorebird numbers, from pre- to post-restoration, at the restored and reference sites.
- You want to determine the annual patterns of shorebird abundance at a site. You conduct regular surveys of the site under fixed conditions, starting the survey program just before shorebirds begin to return from their breeding grounds and continuing to the same time the following calendar year, or at least through their departure for breeding grounds.

Your study area may be determined by the need to monitor a particular wetland or beach but, if it is not, you should select your area carefully with your project goals in mind. Once a study area or site is defined, it is important that the boundaries not vary throughout a project (although you may add other study areas or sites to a project). Some study areas will be more suitable than others for a particular project. Important considerations and characteristics of a potential study area include:

1. is it large enough to regularly support enough target shorebirds for your purposes?
2. are reference or control sites necessary?
3. is it coincident with an entire wetland or is part of a larger area of suitable habitat?

4. are avian predators regularly present at the area?
5. is human activity light or heavy?
6. could access become a problem at some point during your project?
7. is the area likely to be developed or otherwise altered?
8. do birds regularly move between this area and another, already monitored, area?
9. is the site typically used for feeding, roosting, or both?

A small pilot study may be necessary to assess the suitability of potential study areas. Some areas are used irregularly or by such small numbers of birds that they may not provide enough information. If you are focused on particular species, you will want to ensure that they use the areas you intend to survey.

Reference or multiple sites may be necessary. If you are trying to assess the efficacy of a restoration or change of management, reference sites that are reasonably comparable to your focal site will provide a basis to assess changes after habitat or management modifications. Some research questions require data from more than one study area.

High variability in numbers that are due to nuisance variables, or to shorebird movement that is not of interest in your project, decreases your power to detect effects from the variable(s) you are studying. A carefully chosen study area can minimize such nuisance variation from your survey data. Points 3-6 may influence variation because shorebirds are more likely to move in and out of the study area in response to short-term changes in local food availability, exposure to predators, or human disturbance if there is nearby suitable habitat.

Points 7-9 are issues if you are trying to set up a long term monitoring project. Is your ability to survey the area dependent on access? Is ownership of the area public or private? If you are interested in long-term population monitoring, impending access or development issues could make the area unsuitable. Alternatively, you may be interested in documenting use of the area *because it is* slated for development or a change in human use. If your study area is to be part of a multi-site monitoring project, it should be independent of other areas in the sample so as to not compromise design of the overall monitoring project. This means that the individuals you are counting should be different from those at other areas. For example, you would not want to include both the high tide roost and a low tide feeding area for the same group of shorebirds in the multi-site analysis.

Point 10: While some areas are used by shorebirds throughout their daily cycle, others are primarily used as feeding areas and or as roosting or loafing areas. It is common in both tidal and non-tidal

habitat for shorebirds to follow activity patterns in which they alternate between feeding over a wide area for some part of the day or tidal cycle, and then congregating in flocks to roost, preen, or bathe. The most effective method of counting shorebirds in an area will depend on factors such as the number of birds that use an area, the accessibility of different parts of an area, how the birds disperse (or congregate) in an area at different periods in their daily cycle, or the effects of raptors or human disturbance in the area.

It is usually easiest to count shorebirds when they are loosely dispersed along linear habitat and not being pressured to run or fly. Factors that may complicate a survey include:

- rapidly rising or falling tides that force or allow the birds to reposition themselves with respect to the water line (*it is often easier to conduct a survey under neap tide conditions*)
- excessive human disturbance (*when possible avoid weekends or holidays; there are often few people about in early mornings*)
- pressure from raptor attacks (*there's no easy fix for this problem but we suggest field techniques that may help in Conducting the Censuses*
http://www.prbo.org/tools/shorebird/docs/SDP_HowToCount.pdf)
- poor lighting conditions (*avoid midday censuses, when possible; lighting constraints may dictate whether feeding or roosting conditions are the best times for censuses*)

Independent variables you may want to consider in your design are: human activity, weather, time of day, season, and year (at all sites) and tide level (at coastal sites). Some variables may be of research or monitoring interest to you, others may be potential determinants of shorebird numbers that you must account for in your design. If a variable is the focus of your study, you will want it to vary as widely as possible at the sites and time period of your project. You will want to recognize at the design stage when independent variables are confounded with one another (i.e. they co-vary such that their potential effects are indistinguishable). For example human activity at your study site always may be low in the morning and high in the afternoon. If so, it won't be possible at this site to determine whether it is time-of-day or human activity that is associated with differences between morning and afternoon counts. Understanding the effect of independent variables on shorebird counts is important in designing long-term monitoring programs. If a variable, such as time of day or tide level, has a large effect at a site, it is important that the surveys are conducted under fixed values of that variable for the duration of the project. Alternatively, if a variable does not affect the number of shorebirds at the site, you have flexibility to schedule surveys around other variables or constraints.