U.S. Fish & Wildlife Service
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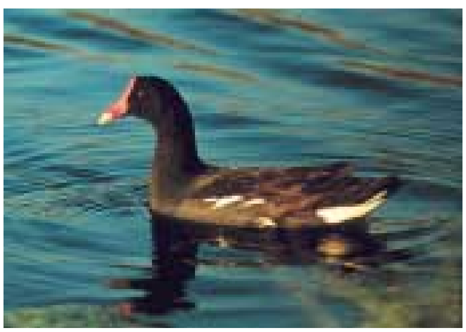
Proceedings of the Marsh Bird Monitoring Workshop











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Proceedings of the Marsh Bird Monitoring Workshop

U. S. Fish and Wildlife Service
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Acknowledgments

The Workshop Steering Committee would like to thank all of the participants of the workshop for their enthusiasm and willingness to help in developing a Marsh Bird Monitoring Program. We also thank Deb Ziebarth, Department of Wildlife Ecology, University of Wisconsin-Madison, and Linda Lee, U. S. Fish and Wildlife Service, Office of Migratory Bird Management, for administrative support. The U. S. Fish and Wildlife Service's Office of Migratory Bird Management and U. S. Geological Survey's Biological Resources Division provided financial support for the workshop.

Executive Summary

A Marsh Bird Monitoring Workshop was held at the National Wildlife Visitor Center located on the Patuxent Research Refuge in Laurel, Maryland, in April 1998, to discuss strategies for monitoring populations of wetland-dependent bird species. Inconspicuous marsh birds (e.g., rails, bitterns, moorhens, gallinules, snipe and coots) include both game and nongame species. These birds are sought by hunters and birders alike. Some (black and yellow rails and American and least bitterns) are U. S. Fish and Wildlife Service species of management concern because they are thought to be rare or declining, and many are included on state lists of rare or endangered species. However, inconspicuous marsh birds are difficult to detect and inhabit areas that are often not readily accessible. Therefore, they are poorly surveyed by the Breeding Bird Survey and other existing monitoring programs.

The workshop brought together experts actively working on marsh bird monitoring issues. The workshop reviewed current monitoring and research efforts related to marsh bird population assessment, initiated development of standardized protocols for monitoring marsh birds, identified information needs necessary for developing protocols and sampling schemes for monitoring marsh birds at national, regional, and local scales, and established a Steering Committee to continue the development of a Marsh Bird Monitoring Program.

Priority information needs identified by the participants are to understand statistical issues and potential biases of call-playback techniques and how to choose habitats for sampling. Secondary information needs are to evaluate: current wetland databases, how to accommodate habitat change over time, what habitat variables to collect, whether counts should be made in the morning or evening, how the index is linked to population size, and geographical differences in the timing of the breeding season. A tertiary information need relates to data quality issues, such as the use of volunteers.

Several topics were identified as needing further discussion. These include the geographic scale of the program, what trend changes will be acceptable to fulfill differing objectives, and how monitoring of local management impacts might be evaluated by the program.

A new Steering Committee composed of representatives from U. S. Federal and state agencies and Canadian organizations was constituted to further develop a Marsh Bird Monitoring Program. Activities of this committee will be communicated at the following web site: http://www.mp1-pwrc.usgs.gov/marshbird/

Need for a Workshop

Inconspicuous marsh birds (e.g., rails, bitterns, moorhens, and gallinules) are important components of the biodiversity of wetland ecosystems and include both game and nongame species. These birds are sought by hunters and birders alike, and some (black and yellow rails and American and least bitterns) are U. S. Fish and Wildlife Service (Service) species of management concern because they are thought to be rare or declining. These species also appear on many state agency lists of threatened and endangered species; they and their habitats are afforded varying levels of state regulatory protection. Many units of the National Wildlife Refuge System provide important habitat for these species, and the birds have undoubtedly benefitted from wetland restoration activities undertaken through the Service's Partners for Wildlife and the North American Waterfowl Management Plan programs. However, little is known about the abundance, population trends, or management needs of these species.

Inconspicuous marsh birds are difficult to detect and inhabit areas that are often not readily accessible. Therefore, they are poorly surveyed by the North American Breeding Bird Survey and other existing monitoring programs. A number of efforts have been made to standardize marsh bird surveys using taped playback response. Notable among these is the work by Gibbs and Melvin (1993), Bird Studies Canada's (formerly Long Point Bird Observatory) Marsh Monitoring Program, and the USGS Biological Resource Division's (BRD) listserver discussion group on marsh bird monitoring. The Service's Office of Migratory Bird Management (MBMO), through its Webless Migratory Game Bird Research Program, is currently funding a number of studies across the country that are aimed at developing marsh bird monitoring techniques and determining the relationship between indices derived from call-response surveys and other measures of abundance. Finally, a number of national wildlife refuges have monitored marsh birds using a variety of approaches with a wide range of scientific rigor.

There are several factors that limit the utility of data obtained from current marsh bird monitoring efforts. First, protocols are not standardized, making it difficult to compare results from different surveys. Second, a statistically based sampling framework for conducting these surveys has not been developed. A variety of sampling schemes is needed because monitoring is desired at several levels, specifically, large-scale monitoring to determine a species' range-wide or regional status and to set hunting regulations on a flyway basis, local monitoring on refuges and similar areas to determine presence, habitat associations, and responses to management, and nonrandom monitoring of special sites like the Great Lakes Areas of Concern that are the focus of Bird Study Canada's Marsh Monitoring Program. Finally, it is not known what the relationship is between indices obtained in call-response surveys and actual population levels of the target species.

To address the aforementioned needs, a workshop was held at the National Wildlife Visitor Center, Laurel, Maryland, in April 1998, to bring together biologists who are actively working on marsh bird monitoring issues. Invited speakers presented overviews of their work and then the group, through a facilitated discussion, attempted to reach consensus on standardized protocols and sampling schemes for monitoring marsh birds, and to prioritize research needs. Workshop participants are listed in Appendix 1.

Objectives

The workshop objectives were to:

1) Review current monitoring and research efforts related to marsh bird population assessment, focusing primarily on rails, bitterns, pied-billed grebes, common moorhens, and American coots.

2) Develop standardized protocols for monitoring marsh birds.

3) Develop sampling schemes for monitoring marsh birds at national, regional, and local scales.

4) Enhance communication among biologists and managers interested in marsh bird monitoring issues.

Objective 1 was met by presentations of current research (summarized below). To answer Objectives 2–4, the workshop participants divided themselves up into three working groups: Field Protocols for Marsh Bird Monitoring, Statistical Design and Sampling Considerations, and Implementation of a Marsh Bird Monitoring Program. The charges for each group are in Appendix 2. Each group was free to modify the questions posed and a group report was made to the assembled scientists. These reports are summarized below.

Scope of the Monitoring Program

The participants defined the primary species of interest as those species that are marsh- dependent and not well covered by existing monitoring programs. The primary species are grebes, rails, bitterns, moorhens, gallinules, snipe, and coots. Secondary species are herons, black and Forster's terns, sedge and marsh wrens, red-winged and yellow-headed blackbirds, Franklin's gull, sharp-tailed and LeConte's sparrows, common yellowthroat, willow and alder flycatchers, cranes, and belted kingfisher. See Appendix 3 for Latin names.

The participants further agreed to limit the program to the breeding season. It was noted that migration routes and wintering ground monitoring would be important but, at this time, beyond the scope of the workshop. The participants further agreed that trend information at the continental or rangewide, national, regional/provincial, and state levels should be considered in the discussion groups.

Workshop Results

Objective 1: Review current monitoring and research efforts related to marsh bird population assessment, focusing primarily on rails and bitterns

Researchers and agency biologists presented current work related to marsh bird monitoring. The presentations are summarized here by common themes. Abstracts of the presentations can be found in Appendix 4.

The first speaker, Sam Droege, set the development of a Marsh Bird Monitoring Program in perspective by reviewing general approaches to developing monitoring programs. Pertinent points made included the need to define what species are going to be covered by a new program, what magnitude of change is to be detected, and how often a program is going to be wrong in finding a change when there isn't one. Mr. Droege argued that a monitoring program, by its nature, should be willing to say there is a change before the decline is obvious, if the program is to serve as an early warning system. Otherwise the monitoring program merely documents that species have declined. He also pointed out that any program is vulnerable if there is no evidence that the index being used in the program actually reflects the population levels of the target species. Finally, a set of constituents that need to know or care about marsh birds were discussed, including hunting regulators, refuge managers (due to the Refuge Organic Act), conservationists, citizens, hunters, and anti-hunters.

The majority of speakers dealt with Field Methodology issues (Downs and Anderson; Gibbs, Melvin, and Crowley; Haramis and Kearns; Kirsch; Legare, Eddleman, Buckley, and Kelly; Monahan and Faulk; Paine; Skoloda and Ribic; Slack and Mizell; Therres, Brinker, and Tango; Vogel, Helmers, Fredrickson, and Humburg; Walther and Hohman) (Table 1). Most of the speakers dealt with rails; six of the eight presented information on sora and Virginia rail. Most of the presentations included information gleaned from point-count or transect surveys coupled with call-playback surveys, leading to information on multiple species. A few studies used other techniques to try to understand the relationship of call-playback surveys to species numbers. Some information was presented on rails during the non-breeding seasons.

Another set of speakers (Adamcik; Francis and Weeber; Gibbs and Melvin; Sauer; Shieldcastle; Weeber, McCracken, and Francis) dealt with the development of Marsh Bird Monitoring Programs. Current monitoring programs and their drawbacks were discussed. Site selection was a critical issue. Issues of the number of samples needed to detect certain trends with specified Type I error and power were presented. Typically, the number of routes may look high enough to detect trends but the number of routes on which specific species are actually detected can be low. These problems are not atypical when dealing with multiple species, leading to the recommendation that surveys need to be planned using the most variable species. Data needs for developing a monitoring program were presented. Problems with implementation were discussed. One issue was the use of refuges in such a program and that addressing refuge needs in the program would be critical in eliciting the participation of refuges.

The last speaker, Paul Adamus, presented information on the movement of the U.S. Environmental Protection Agency to develop an Index of Biotic Integrity for wetlands using marsh birds. This program is currently in development but gives another indication that marsh birds are of interest to other Federal agencies not typically considered to be concerned with this group of birds.

Objective 2: Develop standardized protocols for monitoring marsh birds

Report from Group 1: Field protocols for marsh bird monitoring

The group discussed issues related to standardizing field protocols for use in a Marsh Bird Monitoring Program.

1. Priority species

There was general agreement that priority species in a Marsh Bird Monitoring Program should include all rails, American and least bittern, common snipe, and pied-billed grebe. American coot, common moorhen, and purple gallinule could also be included in areas where they occur at low to moderate densities. However, in some regions these three species may be adequately monitored through existing programs that track populations of breeding waterfowl. Participants recognized that marsh bird surveys will likely yield detection rates that are significantly higher for many other species than those obtained on Breeding Bird Survey routes.

2. Chronology of surveys

It was agreed that first priority should be to develop monitoring programs for marsh birds on the breeding grounds. However, participants recognized that there may be interest in developing monitoring programs on wintering grounds or in migration areas for some species. Subsequent discussions focused primarily on field protocols for monitoring on the breeding grounds.

3. Use of playbacks

The issue of whether broadcasts of taped vocalizations (playback surveys) should be used to increase detection rates of some species of marsh birds received considerable discussion and was one of the major unresolved issues of the workshop. Participants identified the following benefits of using playbacks:

a. They significantly increase detection rates for some species over passive listening. Table 2 summarizes participants' species-specific recommendations regarding improvements in detection rates with playbacks.

b. They probably reduce variance in mean detections per survey station or per mini-route (multiple stations), by reducing numbers of "0" counts. This may be especially important in regions where target species occur at low to moderate densities, for example, in northeastern North America, and where marsh birds may be presented with fewer intraspecific stimuli to vocalize than in other regions (i.e., few calling individuals per wetland).

c. They probably increase proficiency of field staff. By repeatedly playing tapes and eliciting more responses from target species, field staff become more familiar with marsh bird vocalizations.

d. They probably increase long-term interest of field staff, especially volunteers. Playbacks significantly increase detections of several target species. It may be difficult to maintain the interest of volunteers if they seldom detect target species during surveys that consist only of passive observations.

e. Cooperators will likely want to use playbacks for intensive local surveys, to monitor patterns of distribution or habitat use, determine presence or absence of protected rare species, or monitor effectiveness of habitat management. It may be inefficient to conduct intensive local surveys with playbacks and extensive regional surveys without playbacks.

Table 1. Number of studies, by species, season studied, and techniques used, for presentations made in the Field Methodology section of the Marsh Bird Monitoring Workshop.

(Abstracts are in Appendix 4. Primary and secondary species were defined by the participants. Latin names of species mentioned are in Appendix 3.)

	Primary Species						Secondary Species
	Rails	*Bitterns*	*Moorhens*	*Grebes*	*Snipe*	*Coots/ Gallinules*	
Season and Technique							
Breeding							
Playback or Passive Surveys	8	4	3	4	1	2	4
Telemetry	2						
Trapping	1						
Nest Monitoring	1	1	1	1	1	1	1
Visual Observation	1		1				
Other	1				1		
Migration							
Playback	2	1			1	1	
Telemetry	1						
Wintering							
Telemetry	1						

However, participants also recognized potential disadvantages of using playbacks as part of extensive regional or continental monitoring efforts:

a. Playbacks introduce an additional source of bias. It would be necessary to standardize, as nearly as possible, playback equipment, tapes, and how they are used (for example, volume, distance from observer).

b. It may not be feasible to expect that all participants will be willing to purchase adequate playback equipment. On the other hand, volunteers that conduct Breeding Bird Surveys are expected to use binoculars, which are often 2–3X more expensive than adequate playback equipment.

Table 2. Summary of recommendations as to whether playback surveys can increase detection rates of marsh birds on the breeding grounds.
(Latin names of species are in Appendix 3.)

Species	*Are detection rates improved with playback surveys?*
Virginia rail	Yes
Sora	Yes
King rail	Yes[a]
Clapper rail	Yes[a]
Black rail	Yes
Yellow rail	Probably no
American bittern	Uncertain
Least bittern	Probably
Common moorhen	Yes
Purple gallinule	Uncertain
American coot	Probably yes at low breeding densities
Pied-billed grebe	Probably yes at low breeding densities
Other grebes	No

[a] *King and clapper rails may respond well enough to each other's vocalizations that only one or the other need be included in a playback survey protocol.*

Participants agreed that a research priority should be to determine detection rates for target species both with and without use of playbacks. Power analysis should then be used to estimate differences in species-specific sample size requirements for monitoring programs using playback versus passive observations only. Data sets already exist for a few species, for example, sora and Virginia rail, but for most species, additional research will be required. The prime determinant of whether or not to use playbacks will be whether sample sizes adequate to monitor population trends can be obtained for target species in all or most regions using only passive surveys.

If playbacks are to be used, additional research is needed to support development of standardized methods, including which calls to broadcast, sequence of calls, sound levels, and types of equipment to use.

Participants generally agreed upon interim guidelines for playback survey methodology. At each survey station, the following sequence of playback and passive observation/listening was recommended:

a. Begin with an initial passive listening period of 3-5 minutes.

b. Broadcast approximately 1 minute of vocalizations for each species. For each species, broadcast the type of call that is most likely to elicit a response (e.g., the "whinny" call for soras, the "grunt" call for Virginia rails).

c. Insert 30 seconds of silence after each minute of vocalizations for each species.

d. Broadcast vocalizations of the least intrusive species first, for example least bittern or black rail before American bittern and pied-billed grebe.

e. At each station, end the series of broadcasts with a "post-playback" listening period of approximately 1 minute.

Playback vocalizations should be broadcast in all directions over suitable wetland habitats (i.e., the playback arc should be 360 degrees from the observer). However, playback arc may be as little as 180 degrees at some survey stations along the edge of wetlands or along dikes.

4. Spacing of survey points

Spacing of survey points will be a compromise between spacing large enough to minimize double-counting of loudest species and smaller spacing that reduces travel time between stations and maximizes the number of points that will fit in a given wetland. Participants recommended a minimum spacing of 200-300 m between survey stations.

5. Seasonal timing of monitoring

Participants recognized that peak vocalizations occur in late spring and early summer. Regional differences in breeding phenology may exist and may be of sufficient magnitude to require regional differences in timing of surveys.

Participants recommended that marsh bird monitoring on the breeding grounds should take place during a 6-8 week period that is consistent over as large a region as possible (e.g., 15 May to 30 June). Sampling each survey station 2-3 times per season will likely reduce effects of annual variation in phenology. However, the relative benefits of reducing bias associated with annual variation in phenology should be compared to the cost of reduced sample size that will occur if points are sampled multiple times in a year.

6. Time of day

Most participants believed that detection rates of most species are highest in early morning, from approximately 1/2 h before sunrise to 4 h after sunrise. The logistics of accessing and returning from relatively large or remote wetlands are easier in early morning than in early evening or at night. Detection rates of secondary species, for example wetland passerines, may be highest in early morning, and wind speeds may be less in early morning than in late afternoon or early evening. Both of these assumptions need to be tested.

Bird Studies Canada already has in place a relatively large volunteer program based on monitoring between 6 and 9 p.m. This protocol results in only 2-4 stations per day, versus > 10 that can be done between 1/2 hour before to 4 hours after sunrise. However, if a regional monitoring program is based on volunteers, more volunteers may be available and willing to participate in early evening than in early morning.

7. Should surveys be done on foot or by canoe?

It was agreed that, when possible, surveys by canoe are preferable because they are quieter, often faster, and place the observer at the interface between water and emergent vegetation where many target species are most likely to be detected. However, there was also agreement that surveys by canoe are often not practical or necessary, for example, at remote palustrine wetlands where canoe access is not possible, at relatively small or narrow wetlands, and where easy foot access is possible to points at the edge of representative portions of the wetland being sampled.

8. Weather

Participants agreed that the Breeding Bird Survey weather standards should be observed for marsh birds surveys (i.e., no surveys during periods of sustained precipitation or when winds exceed 20 kph).

9. Habitat data collection

Participants agreed that collection of data on habitat conditions at survey stations or for entire wetlands where surveys are conducted is desirable, to be able to relate trends in habitat conditions to patterns and trends in marsh bird abundance and distribution. Participants agreed this topic needs further discussion.

10. Training

Participants agreed that some form of training is desirable for individuals that will be conducting marsh bird surveys. This is especially true when monitoring will be done by large groups of volunteers. This subject needs further discussion. The group did recommend that training should focus on primary target species.

Preliminary Recommendations for Survey Protocol

The recommendations of Group 1 were discussed with the larger group and the following preliminary protocol was agreed upon. We note that this protocol will change as more research is conducted and a Marsh Bird Monitoring Program is developed.

a. Surveys can be conducted in the morning (1/2 h before sunrise to 4 h after sunrise). Note that detection rate for snipe may be lower on morning surveys. Evening surveys are recommended if snipe is of primary concern. Field protocol for common snipe can be found in the abstract by Downs and Anderson (Appendix 4).

b. Surveys should be done when there is no steady precipitation and low wind (less than 20 knots). Use the Breeding Bird Survey recommendations for further weather restrictions.

c. Survey points should be a minimum of 200 m apart. Distances up to 800m may be appropriate in certain wetland types such as tidal marshes (due to the probability that birds will be heard at much longer distances in these marshes compared to other wetland types). Use some type of marking or mapping system so that the point can be found again for repeated surveys (e.g., a sketch map, marking of the point, use of Global Positioning System).

d. At a point, a 5-minute passive count should be made first, followed by tape playback, and then 1 minute of passive listening. For tape playback, 5-15 seconds of a species' call should be repeated 3 times with 5 seconds of silence between repeats for a total of 30-60 seconds per species. Thirty seconds of silence should be used before beginning another species' call. Use the call most likely to elicit a response (Table 3).

We suggest using the Cornell Laboratory of Ornithology's Library of Natural Sounds as a source for recordings of vocalizations. The order of calls on the tapes should be from the least intrusive to the most intrusive calls. An example of this ordering would be the calls of black rail, followed by least bittern, other rails, American bittern, and, lastly, pied-billed grebe. How loud to play the tape was not discussed though it was noted that quality of the tape and equipment would impact the quality of the sound if the volume was turned up to the maximum. Also, having the tape played too loudly could drown out some responses or inhibit nearby birds from vocalizing.

e. The number of surveys to be done at a survey point depends on the objectives of the survey. For a monitoring program, 1 survey may be adequate. For local information, we recommend at least 2 surveys during a 6-week period during the breeding season; surveys should be made at least 1 week apart. Three surveys per season may be necessary to accurately determine presence/absence of some species. Local information sources should be used to define the breeding season for a specific location.

f. The number of survey points to be done depends on the objectives of the study, size of wetlands, and spacing between points. No general number can be given. For example, the number of points per route for a regional monitoring program is still in need of research.

g. Use an arc that encompasses all wetland habitat adjacent to the survey station.

h. The habitat focus of the survey should be on emergent vegetation.

i. Points should be as close to or as far into the wetland as possible/feasible. Canoeing or walking into the wetland to place points are preferred. Doing surveys along a dike or along a shoreline are permissible where the preferred options are not possible/feasible.

j. The survey point should consist of a 100 m fixed-radius half-or whole-circle and then an area of unlimited radius. Birds should be noted as being within the 100 m radius or outside of the fixed radius.

k. Collect information on the major habitat within the fixed radius and beyond (where possible).

Some suggested habitat information includes: area and percent coverage of sedge/grass or cattail/bulrush, open water, aquatic bed (from Cowardin et al. 1979), shrubs, scrub, flooded timber; overall wetland area.

l. All participants should be trained in species identification (in the lab as well as in the field), estimation of distance, habitat assessment, establishment of points, and the mechanics of running a survey.

Table 3. Suggested calls to use in a playback survey.

Species	*Call*
Sora	Whinny
Virginia rail	Grunt
King/clapper rail	Mating call
Black rail	Kic-kic-kerr call
Common moorhen/Gallinule	Primary advertising call
Bitterns	Advertising call
American coot	Advertising call

Objective 3: Develop sampling schemes for monitoring marsh birds at national, regional, and local scales

Report from Group 2: Statistical design and sampling considerations

The group discussed issues of scale, sampling frame, sampling design, and field protocols, and reached the following conclusions:

1. Scale of the survey.

A strong consensus existed that the marsh bird survey should be multi-scale, responding to both local and regional needs. National needs could then be addressed by combining results from different regions.

2. Sampling framework.

There was a consensus that the sampling program should be based on sampling wetlands (i.e., habitat-based) and that the development of a sampling frame is a necessary prerequisite to developing a sampling design. There was uncertainty about what information is available to develop a list of habitats (i.e., sampling frame). Information from which a list of habitats could be constructed may already exist for many local and regional (e.g., statewide) areas. At the national level, no habitat-based frame currently exists. An alternative approach would be an "area-based" frame from which smaller areas could be selected—for example squares 10 km on a side—and sampling would then be conducted within such areas. More information is needed on the current and imminent availability of habitat-based frames, especially at the national level, and on the relative utility of habitat-based and area-based frames, especially at the regional and national level.

A first step using either approach should be to identify all areas that should definitely be sampled (e.g., Federal refuges, state wildlife management areas, waterfowl production areas), and these should be designated as comprising a separate stratum which would be sampled with 100% selection probabilities (i.e., all units in this stratum would be selected). This step is appropriate from a statistical standpoint and will insure that high-interest areas are included in the monitoring program.

3. Sampling plan to choose sites.

The group agreed that a sampling plan to develop strategies for choosing sites and stations (including geographical distribution) needs investigation. Such factors as specific objectives, costs, and results from simulations should be used to develop specific sampling plans. We did not feel that blanket statistical recommendations could usefully be made at this early stage in the development of monitoring programs. Some of the related issues that need consideration are the relative need for, and difficulty of, sampling edge vs. interior areas, the role of volunteers in selecting survey locations, and whether surveys can include both whole and half circles around the observer.

4. Field protocols.

The group discussed statistical issues related to field methods, identifying factors that affect detectability, and factors that might cause biases in average detectability through time or across other domains of interest (e.g., regions, habitats). The possibility that such biases might occur will be one of the most serious problems in interpreting results from the survey unless analysts can be sure that any such biases are substantially smaller than observed trends (otherwise observed trends might be due entirely to changes in detectability). The group agreed that this issue warrants careful study to determine how factors such as density, habitat, timing, and playbacks affect detectability.

Studying effects of playbacks will be important considering the popularity of using this technique and the fact that the use of playbacks in a monitoring program was recommended by the Field Methodology Discussion Group (see above). There are many issues. Only a few are discussed here. One important question concerns playback response and population density. Specifically, is there a nonlinear relationship between the number of calls from playback and density (i.e., does the number of calls level off when density is high?). Another issue is the possible movement of birds towards the observer. This means that one cannot census a plot of known size (i.e., densities or indices cannot be calculated; only presence/absence information is obtained) and that this movement may depend on the habitat and density of the species (it cannot be assumed that there is a standard movement towards the observer across all habitats and densities). Such information would lead to guidelines for how field methods should be standardized.

In conclusion, the group targeted investigating sampling frames, sample selection designs based on them, and studying detectability as issues of importance from a statistical standpoint.

Report from Group 3: Implementing a Marsh Bird Monitoring Program

This discussion group initially attempted to identify the important needs that might be addressed by the implementation of an operational Marsh Bird Monitoring Program. These needs are summarized in order of importance as evaluated by the group:

1. Estimates of annual population trends.

Many aspects of the biology of marsh birds remain relatively poorly known as compared with other groups of birds. Even fairly basic information such as distribution during the breeding and winter seasons, timing and status of migrants, and specific habitat preferences throughout the year are poorly documented in the literature in many geographic areas. While obtaining these data may not be the primary purpose of a marsh bird monitoring program, some monitoring data may be helpful in "filling the gaps" of our knowledge of these species.

The ability to obtain basic population trend estimates for marsh birds is very important because existing surveys do not adequately sample most species. Trend estimates would be needed at various geographic scales, particularly state/provincial, regional, and continental estimates. While local trends of marsh birds may be of interest to land managers, these survey methods probably lack sufficient precision to reliably estimate local population trends. Ideally, marsh bird surveys conducted at the state/provincial scale would contribute to trend estimates at larger geographic scales. The adoption of consistent survey methodologies is critical to accomplish this goal. However, sample sizes and survey designs necessary to obtain trend estimates at the state/provincial scale may be different from those of regional and continental surveys. Greater sampling effort would be needed to obtain reasonable trend estimates at smaller geographic scales, and the distribution of survey points may be different to meet the specific needs of the states/provinces conducting the surveys. However, the participants agreed that these specific sample designs could probably be accommodated within the framework of sample designs for the regional/continental surveys.

In addition to the basic need to obtain population trend estimates, this monitoring program would be important for the following purposes:

- To obtain adequate population trend data for establishing hunting regulations for hunted marsh bird species.

- To better understand the population trends of rare or declining marsh bird species at the Federal and state/provincial levels, and to better ascertain the status of species of management concern before they require formal listing as threatened or endangered.

- To help state agencies develop information on population trends, distribution, and effects of management as a basis for regulatory protection for species of marsh birds already listed as endangered, threatened, or of special concern under state laws.

- To meet various Federal legislative requirements pertaining to the need for monitoring bird populations, including the Migratory Bird Treaty Act, Fish and Wildlife Conservation Act, and National Wildlife Refuge System Improvement Act.

- To focus research and management activities for the benefit of marsh bird species.

2. Habitat assessment.

To better understand the overall importance of population trend estimates, trends must be placed within the context of changes occurring within the wetland habitats occupied by these species. Hence, there is a need to:

- Obtain information on the habitat associations of the various marsh birds. Since bird- habitat associations can vary geographically, this information is needed throughout the ranges of these species.

- Obtain information on the trends of these habitats. As was true for the population trend estimates, habitat trend estimates will also be needed at various geographic scales.

3. Monitor the effectiveness of management actions.

At the local scale of individual wildlife refuges or similar management areas, there is a need to understand how marsh birds respond to management activities. Projects studying the effects of management activities on marsh birds require knowledge of population levels within the area of interest, knowledge of the specific bird-habitat associations of the region, and possibly some demographic data to understand the factors responsible for the observed changes in population levels. Additionally, the survey design and allocation of survey points would reflect the specific questions being addressed at each area, and may be very different from the survey design used to collect large-scale population trend data.

The group participants recognized the need to include a variety of stakeholders in monitoring efforts for marsh birds, expanding beyond the agencies and participants present at the workshop. Various governmental and non-governmental organizations, private industry, researchers, and the general birding public will need to be involved in various aspects of this program for these monitoring efforts to be successful. Additionally, marsh bird monitoring efforts have to focus beyond the goal of simply obtaining population trend estimates; they must also relate to wetland habitat management, development of regional conservation plans for birds, research, and actions devoted to the recovery of declining species.

The group participants recognized that the three needs listed above cannot be accomplished with a single survey design. Hence, a tiered approach should be considered that would allow managers to collect the desired data according to their needs. The first tier of data collection consists of the survey design and methodology needed to estimate the population trends of marsh birds. A consistent methodology should be followed at all locations, and the survey design should allow for the estimation of population trends at several geographic scales.

The other tiers of data collection would be optional and depend upon the needs of the local habitat manager or the state/province coordinating the survey efforts. The second tier of data collection would emphasize the habitat characteristics at the survey sites. While the complexity of these habitat data depends upon the specific management or research questions under study, in general, these data should be fairly easy to obtain by the survey participants and should not interfere with the bird population surveys. A recommended set of habitat parameters and survey methods should be developed to promote the consistent collection of habitat data across sites. The third tier of data collection would relate to specific management issues that require additional study. While the nature of these surveys would vary from site to site depending upon the management questions under study, these surveys should try to adopt the survey methodology used to estimate population trends while allocating samples to meet specific needs, such as to compare treatment with control sites. In this way, some data could contribute to the first-tier surveys that estimate population trends, while all of the data would be available to address the specific management questions.

Uncertainties

The group participants identified a number of questions that need to be addressed prior to the actual implementation of an operational Marsh Bird Monitoring Program. The answers to these questions will significantly influence the direction and success of these monitoring efforts.

1. Observer-related issues.

Recruiting and retaining qualified observers to conduct marsh bird surveys is fundamental to the success of the program. Paying biologists to conduct every survey is probably not a realistic option for a continental monitoring program, because the costs would greatly exceed the available funds, and coordinating the logistics of many field crews scattered across the continent would be a very time-consuming task for the agency responsible for the monitoring program. Hence, a volunteer-based effort comparable to the Breeding Bird Survey (BBS) is a more realistic approach for a continental Marsh Bird Monitoring Program. However, there also are several problems associated with the use of volunteers to conduct these surveys:

■ The expertise in bird identification required to conduct these surveys will dictate the number of potential volunteers in an area. If the marsh bird surveys are restricted to a relatively small number of species, then the potential pool of qualified volunteers will be larger since it may be possible to provide the necessary training to people with more limited bird identification skills so they can participate in these surveys. Conversely, marsh bird surveys that require the identification by voice of all species present in the wetland would require a much greater level of bird identification skills, comparable to those required for the BBS, and would reduce the pool of qualified volunteers to a relatively small proportion of the birders living in an area.

■ Volunteers will not be evenly distributed across the landscape, but will tend to be concentrated near urban areas. Hence, rural areas may have few potential volunteers so that some volunteers may have to drive considerable distances to conduct marsh bird surveys. A survey method that requires multiple visits to each site may discourage regular coverage of distant locations.

■ The availability of volunteers to conduct marsh bird surveys may be a limiting factor since many qualified birders also participate in other bird monitoring programs. This problem may be compounded by survey methods for marsh birds that require relatively greater effort on the part of the volunteer, either to conduct multiple surveys or to gain access to survey sites, for example.

While any Marsh Bird Monitoring Program will require volunteers to collect data, this program may also have to rely on paid biologists to participate in order to achieve consistent coverage across the continent. Hence, cooperation with Federal, state, or other agency biologists will be important to obtain coverage at some managed sites that may not be easily accessed by volunteers. In more remote areas where volunteers and agency biologists are scarce, some paid field crews may be necessary to conduct these surveys.

2. Access/logistic issues.

The methods and survey design implemented for this marsh bird monitoring program will play an important role in the long-term success of these efforts. The methods should be kept as simple as possible to collect accurate data but not impose hardships on the volunteers collecting the data. These methods should also minimize the logistical considerations of the agency managing the monitoring program. For example, the use of tape playbacks may increase detection rates for some species but would require the development of region-specific tapes, and the necessity to routinely provide the participants with new copies of the tapes and broadcast equipment so that the same methods are uniformly applied at each site. Considerable resources would be necessary to provide the tapes and broadcast equipment to observers scattered across a continent.

The survey design should try to select sites that have relatively easy access, either near roads or on public lands, rather than a strictly random process. Factors such as requirements for multiple visits each year, the need to use boats to conduct surveys, obtaining permission to visit sites on private property, and crossing difficult terrain in darkness would discourage participation by volunteers and reduce the number of surveys conducted each year. Incorporating off-road sites into the sampling scheme may complicate the ability of some Federal and state biologists to participate on surveys located on private property. Such factors should be implemented in the monitoring program only if there are no acceptable alternatives.

3. Funding issues.

Questions regarding how to obtain the necessary funding for a Marsh Bird Monitoring Program were largely beyond the realm of this discussion group. Some source of consistent funding will be required to implement and operate this monitoring program, but whether these funds are derived from additions to base budgets or the redirection of existing funds would have to be decided by others. However, the coordinating agency(ies) should develop partnerships with a broad spectrum of governmental and non-governmental groups to assist in the development and implementation of these monitoring efforts. These partnerships may reduce some of the funding requirements for both the initiation and long-term operation of marsh bird monitoring.

4. Coordination role.

Questions regarding who will coordinate the development and operation of the marsh bird monitoring program were also beyond the realm of this discussion group, although the group participants felt strongly that a Federal agency should take the lead in this process. Since the trend data for some species would be used in the establishment of annual hunting regulations, the U.S. Fish and Wildlife Service will want to be closely involved with most aspects of this program; coordination by a non-governmental agency may not be appropriate. Since USGS Biological Resources Division has a mandate to monitor the continental wildlife resources and has considerable expertise in monitoring non-game bird populations at large geographic scales, this agency should also be involved in various aspects of any Marsh Bird Monitoring Program.

Regardless of which agency takes the lead coordination role for marsh bird monitoring, operating this monitoring program will require a sizable commitment of resources. Unless large amounts of new funding are available, one possibility would be to have one agency coordinate the operational aspects of the monitoring efforts, while another agency would manage the data and coordinate additional research studies. Programmatic responsibilities could be shared through other means, but various options should be explored to reduce the amount of funding required by a single agency to initiate marsh bird monitoring efforts.

5. Habitat information.

Many uncertainties surround the collection of habitat data. For example, which parameters to measure, how to measure them, and to what distance from the sample point should habitat data be collected are some of the topics that remain controversial. These issues need to be resolved before a habitat component can be incorporated into the marsh bird monitoring program and sampling methodologies can be developed that would be consistent across sites. Whatever methods are developed, they should be as simple as possible since adding a detailed habitat component to the monitoring protocol would increase the cost of training/supervision to prepare volunteers to collect habitat data and increase difficulty of recruiting and retaining qualified volunteers by adding additional work.

Habitat data will also be needed at large geographic scales in addition to the site-specific information. Defining wetland physiographic strata at regional scales may be important in any analysis of population trends. Understanding regional trends in habitats may be valuable in identifying factors influencing marsh bird populations. Wetland habitats at large geographic scales are currently classified by the National Wetlands Inventory (NWI), but additional information and ground truthing may be needed to more precisely establish the distribution and abundance of wetlands at the landscape level.

6. Outreach/public education.

The group participants recognized an important need to broaden the base of support for marsh bird monitoring efforts and the conservation of these species. The desirability of creating partnerships with a variety of governmental and non-governmental agencies to promote the marsh bird monitoring program is described above. Additionally, marsh birds need to receive a higher level of recognition in ongoing bird conservation efforts, such as the conservation planning processes underway within Partners in Flight, the North American Waterfowl Management Plan (NAWMP), and the U. S.Shorebird Conservation Plan. Given that marsh birds occupy the same habitats as waterfowl, there is a natural linkage to include all marsh-inhabiting birds within the NAWMP. Increasing the visibility of marsh birds within these planning processes will be necessary to obtain and maintain the necessary funding to implement an operational Marsh Bird Monitoring Program.

Recommendations

After discussing these topics, the group participants developed the following list of recommendations concerning the implementation of a Marsh Bird Monitoring Program:

1. Overall coordination of the marsh bird monitoring program should be at the level of the Federal government in the United States and at a national level within Canada, with assistance provided by non-governmental organizations, states, and provinces.

a. A central database should be created for this program, which should be managed by the Federal government.

b. The BBS should be used as a model for establishing a coordination network of volunteers willing to conduct these surveys.

2. Coordination between the U.S. Fish and Wildlife Service and USGS Biological Resources Division will be required to develop the budget initiatives and necessary institutional support to implement marsh bird monitoring across North America. These agencies cannot be successful by themselves, but will have to develop partnerships with a variety of governmental and non-governmental agencies to support these efforts. For example, the International Association of Fish and Wildlife Agencies and Waterfowl Flyway Councils should be enlisted to elevate the priority of marsh bird monitoring efforts within the states and provinces. These activities also should be coordinated with the Partners in Flight, NAWMP and shorebird conservation planning activities.

3. The survey methods should be as simple as possible but still collect adequate data for estimating population trends at various geographic scales. The survey design should consider the accessibility of sites during the site-selection process. Feasibility of the program may mean the use of boats and use of sites far removed from roads may have to be minimized. Volunteers will be required to collect much of the survey data, and their long-term participation in marsh bird monitoring efforts will be directly related to the amount of time and effort required to conduct these surveys.

4. A combination of volunteers, agency biologists, and personnel paid to specifically conduct marsh bird surveys will probably be needed to implement a continental monitoring program. The paid personnel may be needed in the more remote areas where few qualified volunteers are available, but their use should be kept to a minimum. Training materials will have to be developed for the volunteers, to ensure that the methodology is consistently followed across sites. These materials may also be helpful to recruit new volunteers who may currently lack the necessary expertise to conduct marsh bird surveys. The necessity for use of tape playbacks should be carefully considered, because many significant logistical problems would be associated with providing tapes and broadcast equipment to the survey participants.

5. To associate marsh bird population data with habitat changes, wetland habitat databases should be developed for relatively large geographic scales. Available sources such as the National Wetlands Inventory and GAP projects will provide the initial information for these databases, but the reliability of these data for the regional monitoring of habitats remains uncertain. Resources may be necessary for ground-truthing of available habitat data or to obtain data from other sources.

6. Outreach and communication strategies should be developed at the same time as the marshbird monitoring program is being developed. Marsh birds are currently overlooked members of communities in many areas, and their visibility within bird conservation and monitoring efforts has to improve in order to develop all of the financial and volunteer resources needed to implement a continental Marsh Bird Monitoring Program.

Information Needs

The workshop participants agreed that specific research should be undertaken as soon as possible to further the development of a Marsh Bird Monitoring Program. The following topics were identified by the participants as being important to the success of a Marsh Bird Monitoring Program and ranked according to priority of which should be done first (Table 4).

First Priority

1. Statistical issues using call-playback techniques.

The Field Protocol Group recommended using call-playback techniques because of the belief that using call-playbacks would increase detectability of certain species, leading to a reduced number of zero counts and an assumed decrease in variance. However, the Statistical Design group argued that call-playbacks should not be used because an unknown area is being sampled, birds most likely move into an area in response to the call-playback, and bird movement is dependent on a variety of currently unknown habitat (e.g. size of marsh, vegetation type) and biological factors (e.g. bird density). Some members of the Statistical Design Group argued that call-playbacks could lead to an increase in variance rather than a decrease. Therefore, an information need identified was the following: In comparing passive and call-playback observations, (a) is there an improvement of detectability with call-playback? (b) is there a change in the variance and in what direction? If there is a reduction, how much of a reduction is seen? and (c) What are the implications for required sample sizes in a power analysis?

2. Evaluation of a sampling frame/scheme.

The workshop participants agreed that local protected areas such as refuges and state protected areas could form their own stratum and be completely or almost completely sampled without impact to the validity of the Program. The major concern was how to pick samples from the non-protected/non-priority sites. Two suggested schemes were proposed though there is no reason to think there are only these two alternatives. The first alternative was a habitat-based approach that is dependent on existing maps for choosing wetlands according to some statistically-based scheme. A second alternative is an area-based approach where areas are picked by some statistically-based scheme, these areas are evaluated for the existence of wetlands, and then those wetlands are sampled by some statistically-based scheme. The workshop participants agreed that a high priority research need is to evaluate different sampling schemes for use in a Marsh Bird Monitoring Program.

Second Priority

3. Development of habitat information.

The workshop participants agreed that the habitat classification of Cowardin et al. (1979) should be used for site selection. An alternative, the hydrogeomorphic scheme, may be useful at individual points. But it was acknowledged that a status review of current databases was needed. Some databases to consider are the National Wetlands Inventory and GAP databases. Concerns were raised about how current the databases were and at what scale(s) they would be helpful. There was no information on potential Canadian databases nor what databases were currently being developed. Another aspect to investigate is how well the habitat of priority species would be covered by the existing databases. There was some debate about whether or not this would be covered under the Evaluation of a Sampling Frame/Scheme. This need may or may not be met, depending on the scope of the proposed sampling frame project.

4. Documenting habitat change over time (including what type of habitat data should be collected).

An acknowledged difficulty was the fact that wetlands change over time. This means that habitat information needs to be collected at the survey points as well as documenting the existence of the wetland (which may disappear due to development or succession). This information will be important in understanding trends seen in the data as well as impacting the design of the program (e.g., fixed points versus new points every year versus some kind of mixture). So the information need is to determine how wetland/habitat change will be accommodated in the program. Some of these issues may be addressed in the Evaluation of a Sampling Frame/Scheme, depending on the proposed project.

5. Timing of counts (a.m. versus p.m.).

An issue that was brought up was the timing of the counts from a biological point of view and from an operational point of view. Some of the priority species are not detected during morning surveys while timing may not make a difference for other priority species. Secondary species, though, may be detected at much lower rates during evening surveys. An operational problem is that if the

Table 4. Information needs and importance as ranked by participants in the Marsh Bird Monitoring Workshop.
(Not all information needs were ranked by all participants, therefore, row sums will not be equal.)

Information need	*Very Important*	*Secondary Importance*	*Can be done later*
Statistical issues using call-playback techniques	31	8	0
Evaluation of a sampling frame/scheme	31	6	1
Development of habitat information	16	15	6
Documenting habitat change over time	11	18	8
Timing of counts (morning vs. evening)	14	16	7
Assessing what the index means	13	15	9
Phenology or geographical differences that influence the timing of surveys	11	15	9
Data quality issues	5	13	19

program is to be volunteer-based and volunteers are only available during the evenings, then should an evening survey period be used? Some workshop participants indicated they thought that the data probably exist to answer the biological questions and that all that needs to be done is to evaluate this information.

6. Assessing what the index means.

The issue of what the index means in terms of population density or size is a critical one and is an issue for all monitoring programs. Most of the programs that are considered weak are those whose index cannot be linked to some measure of population size. However, trying to answer this question will be difficult to study.

7. Phenology or geographical differences that influence the timing of surveys.

When to do the surveys will vary by region and the workshop participants discussed the need to understand these differences to provide guidance to the monitoring program. There was some agreement that the databases exist to answer this question and that the information just needs to be evaluated. One participant suggested a national team could be used to do this.

Third Priority

8. Data quality issues.

The participants agreed that evaluating the quality of the data collected by any program is important. In particular, we need to understand the costs, benefits, and trade-offs between using volunteers (which can include professional biologists) and using a dedicated set of technicians to collect the monitoring data. Other issues, such as hearing ability and song identification, were also discussed.

Topics Needing Further Discussion

Scale of the program.

Though the participants agreed that the program should focus on trends at multiple geographic scales, there was little discussion in the breakout groups about the implications of multi-scale monitoring on the design and objectives of the program. The Statistical Design Group explicitly suggested a multi-scale program at local and regional scales, noting that national trends would come from the regional programs. However, other than pulling the local protected areas out as an individual stratum, little was done to address design at multiple-scales. Another suggestion was to consider all scales suitable to establish hunting regulations, assess threatened and endangered species and species of management concern, and to address other legislative requirements. Clearly, more discussion is needed on the objectives and scale of the program.

2. What trend and other details.

One aspect of the program that was not discussed in detail was the time-scale over which true changes needed to be detected. One group suggested that detecting differences in trend on an annual basis was necessary. But there was little discussion in the other groups. Most concurred that, at this stage, one scenario was unrealistic and that research could address different scenarios of trend/Type I error/power that would be helpful in setting realistic goals.

3. Evaluation of habitat relationships/management impacts.

Though identified as one of the goals of a program, no discussion of how these questions might be addressed in a monitoring program was made. Clearly, specific local goals and how they might interact with a monitoring program need further discussion and development.

Objective 4: Enhance communication among biologists and managers interested in marsh bird monitoring issues

This workshop was the first step in forming a network of professionals interested in marsh birds and monitoring. It was recognized that this was only the first step.

It was agreed that the research priorities identified in the workshop should be used to keep the momentum going in the development of the Marsh Bird Monitoring Program. The participants also agreed that a pilot program building on Bird Studies Canada's Marsh Monitoring Program, and having a heavy research emphasis, is needed. However, long-term strategies are needed for obtaining institutional support for such a program. The U.S. Fish and Wildlife Service and the USGS Biological Resources Division were identified as the appropriate agencies for developing a strategy for a Marsh Bird Monitoring Program. A new Steering Committee composed of representatives from U.S. Federal and state agencies, and Canadian organizations was established to go forward with the development of a Marsh Bird Monitoring Program. The Committee consists of the following people:

Marshall Howe, USGS-BRD (Chair)

Robert Blohm, USFWS, Office of Migratory Bird Management

Peter Blancher, Canadian Wildlife Service

Russell Weeber, Bird Studies Canada

Scott Melvin, Massachusetts Division of Fisheries and Wildlife (representing the International

Association of Fish and Wildlife Agencies)

Bruce Peterjohn, USGS-BRD

Jon Bart, USGS-BRD.

Activities of this committee will be communicated at the following web site:
http://www.mp1-pwrc.usgs.gov/marshbird/

Letters of Support

Statement of Support from the Deputy Chief Biologist, USGS Biological Resources Division

August 12, 1998

The Biological Resources Division (BRD) of USGS recognizes secretive marsh birds as one of several guilds of North American birds whose populations are not effectively monitored by existing methods. The April 1998 marsh bird workshop, co-sponsored by the US Fish and Wildlife Service (FWS) and USGS, has successfully summarized the existing state of knowledge about marsh bird populations and has defined the information and research needs that will enable a marsh bird monitoring program to be implemented. USGS is fortunate to have a considerable body of expertise in sampling design and in development of population monitoring protocols. USGS also places a high priority on achievement of these goals for marsh birds and is committed to contributing its expertise accordingly. We propose to incorporate eventual databases derived from a monitoring program into the national bird population data center being developed at Patuxent Wildlife Research Center. We look forward to working cooperatively with the FWS and other entities working for marsh birds in reaching these goals.

Susan D. Haseltine
Deputy Chief Biologist for Science
Biological Resources Division

Statement of Support from the Assistant Director, Refuges and Wildlife, U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service acknowledges secretive marsh birds as an integral component of North America's avifauna. Yet, little is known about their abundance, distribution, and population status. The Service considers the acquisition of scientific information to enhance management decisions extremely important to its mission and fully supports research, monitoring and management efforts to remedy these limitations. Consequently, high priority will be placed on development of standardized survey protocols for monitoring marsh birds, through future budget initiatives and other opportunities for cooperative support. The Service looks forward to working with the Biological Resources Division of the U.S. Geological Survey, States, and other agencies and organizations to share research and management expertise and improve our collective ability to manage this historically-overlooked group of birds.

Daniel W. Ashe
Assistant Director—Refuges and Wildlife

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Appendix 1. Participant List for the Marsh Bird Monitoring Workshop

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Appendix 2. Topics for the Discussion Groups at the Marsh Bird Monitoring Workshop.

Discussion Group I:
Field Protocols for Marshbird Monitoring
Leader: Scott Melvin
Recorder: Marshall Howe

(a) Develop a list of species (or groups of species) covered by marsh monitoring. Describe any techniques or protocols already in place for specific species or species groups.

(b) What time of day should surveys be conducted? The participants may want to come up with a list of species or species groups that should be monitored at dawn, dusk, day, or at night, and any species or groups that could be monitored at a variety of times).

(c) What weather restrictions are there for doing surveys?

(d) Where should the sampling points be located? On roads, off roads by walking into the habitat, in the water done by boat? This will bring in practicality issues. The group may want to discuss the optimum location but consider the implications if the optimum cannot be reached. Are the alternatives acceptable? One of the criticisms of the BBS is that the surveys are all done from roads. Can this criticism be avoided at the outset? Is it an important consideration?

(e) For call-playback surveys, what quality, loudness, length, and order of play should tapes be?

(f) Can multiple survey methodologies be combined into one survey? What are the implications of doing that? What are the drawbacks? What are the benefits?

(g) Consider logistical restrictions when sampling at a refuge level, on a statewide level, and on a range-wide level that might impact recommended protocols.

(h) Should habitat information be collected every time a survey is done? If so, what habitat variables should be measured and what protocols should be used?

(i) What are the highest priority research needs in the area of field protocols, e.g. where should we be putting our limited research dollars?

Discussion Group II:
Statistical Design and Sampling Considerations
Leader: Jon Bart
Recorder: Chris Ribic

(a) How would design and sampling change for surveys done at various spatial scales:

1. Local (e.g., refuge) need information on presence, abundance (maybe in just a gross sense), habitat associations, and responses to management.

2. State need information on abundance and trends, especially for state-protected rare species. For hunted species, also need information for setting hunting seasons.

3. National need information on status and landscape relationships. For hunted species, also need information for setting hunting seasons.

4. North America (e.g. rangewide) need information on status, trends and landscape relationships.

(b) What are the implications for the sampling unit when monitoring at these different scales?

(c) Would stratification be an important tool to consider? What would be some possible stratification variables?

(d) What data are necessary to do a power analysis for a multi-species monitoring program at the different scales?

(e) For call playback surveys, what is the relationship of call-count indices to true population levels?

(f) What are the highest priority research needs in the area of sampling and statistical considerations (e.g., where should we be putting our limited research dollars)?

Discussion Group III:
Implementation of a Marshbird Monitoring Program
Leader: Bruce Peterjohn
Recorder: Glen Therres

(a) What species and geographic areas (e.g., refuge, states, U.S.) should be focused on?

(b) What are the agencies' needs?

(c) What role should each agency and organizations (e.g., states, FWS, BRD, Flyway Councils, NGOs) play in monitoring marshbirds?

(d) Is a central database desirable? If so, can BRD oversee this?

(e) To what degree can volunteers be used in implementing a monitoring program?

Appendix 3. Common and Latin Names of Bird Groups and Species in Report.

Latin names are taken from AOU (1998).

Group/Species	Latin Name
Grebes	Family Podicipedidae
Bitterns and herons	Family Ardeidae
Rails, gallinules, moorhens, coots	Family Rallidae
Cranes	Family Gruidae
Snipe	Order Charadriiformes
Pied-billed grebe	Podilymbus podiceps
American bittern	Botaurus lentiginosus
Least bittern	Ixobrychus exilis
Yellow rail	Coturnicops noveboracensis
Black rail	Laterallus jamaicensis
Clapper rail	Rallus longirostris
King rail	Rallus elegans
Virginia rail	Rallus limicola
Sora	Porzana carolina
Purple gallinule	Porphyrula martinica
Common moorhen	Gallinula chloropus
American coot	Fulica americana
Common snipe	Gallinago gallinago
Franklin's gull	Larus pipixcan
Forster's tern	Sterna forsteri
Black tern	Chlidonias niger
Belted kingfisher	Ceryle alcyon
Alder flycatcher	Empidonax alnorum
Willow flycatcher	Empidonax traillii
Sedge wren	Cistothorus platensis
Marsh wren	Cistothorus palustris
Common yellowthroat	Geothlypis trichas
Red-winged blackbird	Aegelaius phoeniceus
Yellow-headed blackbird	Xanthocephalus xanthocephalus
LeConte's sparrow	Ammodramus leconteii
Saltmarsh sharp-tailed sparrow	Ammodramus caudacutus

American Ornithologists' Union (AOU). 1998. Check-list of North American birds, 7th ed. Allen Press, Lawrence, KS.

Appendix 4. Abstracts of Invited Presentations at the Marsh Bird Monitoring Workshop

26-28 April, 1998.

Considerations Regarding Refuge Participation in Landscape Scale Monitoring

Robert S. Adamcik, Division of Refuges, U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, Arlington, VA 22203

The National Wildlife Refuge System includes the single most extensive network of wetland reserves in the United States. Hence, continental, national, or regional marshbird monitoring initiatives will likely include refuges as sampling units. Gaining the participation of refuges in such initiatives requires a firm understanding of the ecological and administrative context in which refuges function, the factors driving refuge survey activities, and the manner in which refuge managers choose those surveys in which to participate. Surveys on refuges can contribute to biological objectives at three spatial scales: (1) refuge-specific surveys driven by specific refuge objectives, such as assessment of management activities; (2) landscape scale surveys that address issues relevant to both the refuge and surrounding landowners; and (3) regional, national, or continental monitoring programs. Refuge priorities are focused on Category 1, which are derived from specific management objectives for each refuge. These surveys often provide critical information for adaptive management. Refuge participation in the other two categories may be related to relevance of the project to the refuge, as well as availability of funding and staff.

Recruitment of refuges into broader geographic monitoring initiatives will depend heavily upon whether the data gathered are relevant to ongoing or proposed refuge management, and whether the sampling technique and intensity are simple enough that a manager will not have to forego other management priorities.

Proposed Applications of Data from a Marshbird Monitoring Network

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If implemented, a continental or regional marshbird monitoring program would serve mainly to detect temporal trends in populations of individual species. However, with modification such a program could also analyze spatial trends in collected data to identify areas where the biological integrity of wetlands and their associated landscapes is being degraded. Especially when used with data from monitoring of other taxa, knowledge gained from a marshbird monitoring program could form a basis for remedial action, such as selection of particular wetland sites for restoration or implementation of watershed management plans.

Conceptually, one tool for interpreting and presenting the data from a marshbird monitoring program might be the "Index of Biotic Integrity" (IBI). Aquatic biologists have developed and validated IBI's regionally, using fish and macroinvertebrates, to indicate the condition of streams and lakes. Developing and applying wetland bird IBI's probably would require identification of all bird species at each monitoring site, and assignment of the species to guilds or assemblages known to be sensitive to pollution and other human disturbance (as distinct from extreme naturally-occurring conditions). Pilot projects in riparian habitats in Pennsylvania, Maryland, the mid-Atlantic highlands, and the Southwest have supported the usefulness of bird communities as indicators of landscape disturbance, so continued development and validation of bird IBI's is warranted. Further research should focus on (1) defining the domain of regions, landscapes, wetland types, and disturbance types over which wetland bird IBI's can provide accurate information on environmental impairment, (2) identifying which wetland bird assemblages are most sensitive to human-caused disturbances, and (3) identifying the metrics (combinations of variables) most able to separate human-related from natural, macroscale spatial variation in bird community structure.

Since 1996 the USEPA has sponsored a Biological Assessment of Wetlands Work Group (BAWWG), consisting of scientists from state and federal agencies and universities, to organize and communicate information on protocols for monitoring and analyzing data on wetland birds, amphibians, macroinvertebrates, algae, and plants. BAWWG has recently prepared information for state agencies to use in developing and testing bird IBI's in wetland and riparian habitats.

Evaluation and Development of Survey Techniques for Common Snipe

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Common snipe (*Gallinago gallinago delicata*) numbers in North America are unknown. No survey technique to monitor their numbers has been developed and doubts exist about using the Breeding Bird Survey (BBS) to monitor snipe trends. In order to help solve these problems, this research project focused on four major objectives: (1) evaluate existing labor intensive techniques such as tape playback, territorial mapping, territorial/spot mapping, flush counts and nest searches; (2) develop and evaluate indices (call, winnow and call/winnow counts) that could monitor snipe numbers on a continental scale; (3) identify important habitat characteristics; (4) evaluate the effectiveness of the BBS for common snipe. Four labor intensive techniques were evaluated for effectively estimating the number of snipe or territories. Territorial/spot mapping was found to be the most effective technique because the results obtained accurately represented the number of territories present. Flush counts were the second best technique because they did not accurately estimate the number of snipe present in all snipe habitats. Flush counts worked best in long narrow strip habitats that could be easily covered by a few people. In large continuous habitats flush counts did not accurately estimate snipe numbers because snipe were harder to flush. Tape playback territorial mapping and nest searches did not accurately estimate snipe numbers due to varying snipe responses and difficulty in finding nests. An index that counts the number of different calling and winnowing snipe heard most accurately monitored snipe numbers because the probability of detection, percentage of snipe detected and the estimate of snipe numbers was the greatest, most consistent and most accurate. The index should be conducted during the 20 day time period before snipe begin to incubate and after the arrival of females. This 20 day time period usually falls after the full moon in April and before the first quarter in May. Transects should be established in the habitat with points spaced 1 km apart. minimum of seven points should be used to conducts surveys from in order to obtain good results. The survey is conducted at dusk approximately 5 minutes after most of the snipe become active and should be discontinued when snipe cease or decrease activity. The survey period is short (only usually lasts 30-45 minutes), so only 3 points or less may be surveyed in one night. Each point should be visited at least 3 times during the 20 day time period. There are six factors (season, time of day, lunar cycle, wind speed, solar radiation, and temperature) that effect snipe winnowing and calling and should be considered or at least measured when conducting snipe surveys. Driving roads the season prior to actual surveying will help identify possible snipe areas. Those areas should also be searched for snipe nests the season prior to surveying, in order to have good phenological information about the snipe area in question, which will help identify appropriate survey times the following season. Surveyors should be standardized prior to conducting actual surveys if more than one surveyor is used. For more detailed information about surveying for snipe refer to Downs (1998). From our results, we identified four important characteristics (distance to nearest shrubby cover, water depth, soil moisture, the dominance of sedges and sedge heights) and used them to construct a ranking criteria for categorizing snipe habitats. We found the BBS is not conducted at the right time of day nor does it consider the variables (season, lunar phase, solar radiation and temperature) that affect snipe activity to be effective in detecting snipe trends. As a result, the numbers of snipe the BBS detects is low and the snipe activity detected could be related to nest success more than abundance. A final report by Masters candidate Kevin D. Downs will be completed during the spring of 1998. These results are from the last year of a 3-year study funded by the 1995 Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service and the U.S. Geological Survey-Biological Resources Division), U.S. Fish and Wildlife Service (Migratory Bird Management Office), Wyoming Game and Fish Department and the Wyoming Cooperative Fish and Wildlife Research Unit.

Downs, K. D. 1998. Common snipe surveys, habitat and evaluation of the breeding bird survey. M.S. thesis, University of Wyoming, Laramie. 91pp.

A 12-Step Program for Creating a Monitoring Program: An Extended Abstract Written in the Everyday Language of the Wildlife Biologist

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The traditional approach to designing a new program is to pick the technique your buddies use, put in as many samples as looks good on a map, locate those samples so that you get to hang out in your favorite habitats, and hope that 20 years down the road someone will analyze and interpret it all for you.

In this document I propose an alternative model, one hopefully superior to that of the traditional one. For those of you still captivated by the traditional approach, consider this a 12-step plan to freedom. When examples are needed they will be for the situation of setting up a monitoring program for marsh inhabiting birds.

Step 1.
First comes the question of which species are being targeting for monitoring. All birds that live in and around marshes? Some ranking of primary species, secondary species, and collateral? What of things like frogs, toads, and other non-birds too?

Step 2.
Over what time periods do you want your monitoring program to report on trends of marshbirds?

2, 3, 5, 10, 25, 100?

Step 3.
What MINIMUM magnitude of change or trend in marshbirds should this program be able to detect over the time period stated in Step 2?

10%, 50%, 100%, ….- 3% per year, 5% per year?

Step 4.
Over what geographic region do you want to talk about changes in marshbird populations?

A refuge? A province? A country? A continent? Now we need to work through the whole notion of how precisely you might want to talk about these trends.

Step 5.
Please designate your willingness to cry wolf, done via the setting of alpha (Type I error)

levels. That is, how often are you willing to claim that a significant population trend has occurred when, in actuality, none has. For example, alpha (Type I error) can be 5%, 10%, or 20%. Hint: It is better to cry wolf 20% of the time and spend a little bit of time following up false leads than it is to set you alpha level so small that populations have all gone to Hell while you waited for everything to be extremely statistically significant.

Step 6.
Designate what proportion of the time the monitoring program should detect a trend if one

was really going on. This is known as setting the power of the program. For example, power can be 80%, 90%, 95%, or even, 100%. Hint: Detecting trends is the whole point of a monitoring program;. No?, so set your power high.

Now we come to the phase of inspecting the monitoring technique you propose to use track population trends and ask the question: Can it really deliver the goods?

WARNING: Pilot data required.

Step 7.
Either find someone who has used the methodology you are considering for your monitoring program (and is willing to share their data with you) or go out and collect some pilot data on your own.

Step 8.
Ask your pilot data the following questions (Hint: These are simple calculations of means and sample standard deviations and you can do them in any spreadsheet program).

What are the mean counts on plots or routes that get your target species? Low mean counts (<10) are undesirable because the smaller the mean the greater your likelihood of getting a slug of zeros on a significant number of your counts. Because the existence of negative birds is still a hotly debated topic among biostatisticians (they really should spend more time out in the field) you have effectively run into a wall with your monitoring program (that is, once your reach zero birds, no more information is available regarding status) and the mathematics become difficult.

What is the spatial variation, that is, how variable are counts geographically (among plots or routes) for each species?

How many completely zero plots or routes turn up (that is, plots that never get the species) when you set your samples out? Sites that do not have the target species obviously tell you nothing about the trend in that species, so, when you estimate how many samples you need to monitor a species you must adjust the sample size upwards to account for the fact that a certain proportion of those plots will be always be zero.

How variable are counts for each species at a single site? The best way to answer this question is by looking at long-term datasets, so that you can look at how the numbers vary over a period of years. If you only have one year to collect pilot data and no existing datasets are available to mine, then you can take repeated counts at a single site to get some minimum idea about sampling variation. However, be warned that repeated counts WITHIN a year underestimate the overall count variation which must account for within and among year variation in counts (this captures the variation due to the slop in your technique AND due to normal fluctuations in numbers of critters among years).

Step 9.
Can a poorly performing technique be saved by covariates? If you find an ungodly amount of variation in your counts, it may be possible that you can account for some of that noise (and decrease your needed number of samples while increasing your power to detect trends) by accounting for the effects that phenology, weather, and observers have on your system.

Step 10.
So that is all well and good, now how do I figure out how many samples I need?

What follows is a simple recipe for calculating that sample size. First go to the power analysis cookbook web site at:

http://WWW.MP1-PWRC.USGS.GOV/powcase/powcase.html

(note: the occurrence of the letter one in the domain name, that is not the letter L)

And download the MONITOR.EXE sample size ez-baker and read over the enclosed directions for proper use of this product. Then add the following ingredients into the MONITOR.EXE program:

- Take the mean and standard deviations of counts and make some CVs.
- Calculate the proportion of zero routes.
- Mix well with your targets for:
- Length and steepness of trend.
- Precision of the estimates targets.
- Bake your worst species CV first.
- Double the number of samples to make sure that you have enough.

Now we come to the very hardest part of the process, the part where most of us fall from grace.

Step 11.
Prove that the method you are using yields an unbiased view of trends in the critters you are monitoring. Several paths are open to you, pilgrim.

High Road:
Empirically prove that there is a relationship between the index you propose and the real number of birds out there.

Road to Nowhere:
Heuristically prove that the likelihood of bias affecting the counts or affecting the sign of the slope is low to nil.

See http://WWW.MP1-PWRC.USGS.GOV/…. for an example using counts of frogs and toads.

Road to Ruin:
This would be the attitude expounded by Baron Ernest Rutherford: "If your result needs a statistician then you should design a better experiment"

In general, discovering the effects of bias is a difficult and expensive path to travel upon. But by avoiding that path you take the risk of your program painting a false picture of the trends in your target animals. At minimum, an attempt should be made to use the technique in conjunction with a set of mark-recapture populations to investigate the relationships between count and population over several potentially biasing situations.

Step 12.
Ok, now that you have reached sainthood by passing through the previous 11 steps you are ready to figure out where you are going to put out your samples. Keep in mind the following: All things being equal all things should be equal, that is, plot and route placement should be random or systematic. However, completely random placement of plots is rarely efficient and you will likely need to think about setting up a set of decision rules (e.g., only wetlands near roads will be surveyed) along with some stratification rules (e.g., we will put in a higher density of samples in these areas because they are more important or they have more potential observers).

Congratulations, you have made it through the 12 Step Monitoring Program. Now go check in with your neighborhood statistician and have him check under the hood of your sampling design just to make sure you have really been cured of your old habits.

Statistical Issues Related to Monitoring Marsh Birds

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We examined a number of statistical issues related to monitoring marsh birds that arose from a scientific evaluation of the Marsh Monitoring Program (MMP) that has been run in the Great Lakes basin by Bird Studies Canada (Long Point Bird Observatory) in collaboration with Environment Canada since 1995. Some of these issues are discussed in the companion presentation by Weeber et al. Here, we focus on three themes: route selection, sampling intensity (number of surveys per year), and power for trend detection.

1. Route Selection

The MMP was developed to sample marsh habitats throughout the Great Lakes basin, with particular emphasis on marshes in "Areas of Concern" (AOC's). The sampling procedure for AOC's is different from that outside of these areas. Within AOC's, the survey goal has been to sample every marsh. Although this has not been completely achieved, all AOC's and most marshes within them are covered by at least one route. As such, to the extent that stations are suitably positioned along these routes, the routes should provide a fairly good sampling of AOC marshes (although sampling intensity is generally not adequate to characterize individual AOC's well). Outside of AOC's, routes have been primarily picked by volunteers, and we can be much less confident that they are representative of non-AOC marshes within the survey area (the Great Lakes basin).

There are many challenges to developing a more representative (i.e. stratified randomized) sample of marshes with a volunteer-based survey such as this one. One approach would be to select marshes based upon a GIS database of all marshes/wetlands in the region. Selection could be based on strata determined by criteria such as marsh characteristics (e.g. size, adjacent land use), ecoregions, and location (e.g. distance from potential sources of surveyors). This method could provide known sampling probabilities for all marshes in the study area, but has several potential difficulties. In practice, the sampling would have to be further constrained by accessibility (not too far from a road and accessible by foot or possibly by canoe). Discrete marshes are not necessarily easy to delineate. Problems could arise if the database is incomplete (e.g. if some types or sizes of marshes are inadequately represented), if it does not accurately differentiate all marshes from other types of wetlands, or if accessibility cannot readily be determined from the database. At present, sampling for the whole Great Lakes Basin would require GIS databases from several sources that probably differ in their characteristics.

An alternative sampling procedure would be to select random positions in the landscape, with appropriate stratification, in a similar fashion to route selection for the Breeding Bird Survey, then survey the nearest accessible marsh. This approach would be cheaper and easier to implement (GIS technology not required), but will not lead to equal selection probability for all marshes: marshes with few neighboring marshes will have a higher probability of being selected than marshes with many neighbors, and large marshes will be more likely to be picked than small marshes. Stratification of the landscape by marsh density (if suitable data are available to do this) could reduce but not eliminate this problem.

Regardless of the selection procedure, there are further constraints associated with matching routes and volunteers. If routes are pre-selected, and volunteers allowed to choose from among the selected routes, then the sample will no longer be strictly random if any of the selected routes are not covered—those farthest from population centers or least accessible may be less likely to be picked. If routes are selected upon demand for each volunteer, selections will need to be constrained to within a reasonable radius from the volunteer's home base. Furthermore, regardless of initial assignments, volunteers may be less likely to continue surveying routes that are difficult or otherwise unattractive.

In view of the preceding limitations, it is quite possible that population trends on our volunteer-picked routes will not be any less representative of the basin as a whole than those on randomly picked routes. For this reason, we are currently encouraging volunteers to continue to survey existing routes, to ensure adequate continuity for trend analysis using route regression. However, we plan to adopt some sort of randomization procedure for selection of new routes as they are required in the future.

2. Number of Surveys

The MMP protocol for sampling birds requests two surveys per year on each route, at least 10 days apart between May 20 and July 5 each year. Two surveys were chosen to reduce the effects of seasonal variation in detectability of some species, and to increase the number of species detected at each station. However, because the second survey carries a cost of reduced total numbers of routes surveyed, it is appropriate to consider in some detail the actual benefits of two surveys based upon data from 1995-97. In each year, 70-80% of stations were surveyed twice within the desired time frame. Of these, a mean of 0.5-1.1 (depending upon the year) more species were detected on the first survey (mean date June 5) than on the second survey (mean date June 25). On average, only 40% of species were detected on both surveys—the second survey increased the number of species detected at each station from a mean of 17 to a mean of 24. Considering only marsh nesting birds detected at 10 or more stations each year (22 species), 11 species were significantly more likely to be detected on the first survey, but 4 species were more likely to be detected on the second survey, highlighting the fact that the optimal survey time differs among species. For 4 of these species, there were significant ($p < 0.05$) differences among the three years in the relative value of the first and second survey. This indicates that a single survey might confound annual variation in seasonal detectability (possibly due to variation in vegetation phenology) with annual variation in populations. Thus the second survey clearly does have benefits especially for evaluation of individual routes. From the perspective of trend estimation, we do not know how many additional routes volunteers might be able to run if only a single survey were required each year (it would probably be much less than double), and hence whether this would outweigh the benefits of the second survey.

3. Survey Power for Estimating Trends.

We estimated the power of the survey to detect long-term population trends in mean numbers of 11 species of marsh-nesting birds considered of particular conservation concern. We assumed analysis using log-linear route regression models, and extrapolated variance estimates from changes on routes run in both 1995 and 1996. For 10 of the 11 species, a sample of 100 routes per year (on which the species was detected) was estimated to be sufficient to detect a consistent annual change of 1-3% over 10 years (at $p < 0.05$, power = 0.80). However, of 91 routes run in both years, most of the target species were detected on fewer than half of the routes. Thus, for some of these species, the survey with its current sampling intensity could not be expected to detect changes less than 4% per year over a 10-year period.

Techniques for Monitoring Inconspicuous Waterbirds: Results from Studies in Maine and Massachusetts

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We broadcast vocalizations of pied-billed grebe (*Podilymbus podiceps*), American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), Virginia rail (*Rallus limicola*), and sora (*Porzana carolina*) at 60 wetlands in Maine in 1989 and 1990 to derive standardized methods to monitor breeding populations of these species. All wetlands contained 0.1-125.0 ha of emergent vegetation. Broadcasts of tape-recorded calls at 1-10 stations per wetland between 1 May and 15 July improved detectability for all species by 93 to 1,320% over 15-min passive observation periods at the edge of each wetland. Detection rates at wetlands where target species were known to occur ranged between 0.56 (least bittern) and 0.86 (pied-billed grebe) per survey visit. Three visits to a wetland were adequate to determine presence or absence of all species with 90% certainty. Least bitterns, soras, and Virginia rails were detected primarily within 50 m of observers, while pied-billed grebes and American bitterns were detected up to 500 m away. Most detections were of birds heard and not seen. Responsiveness of each species varied in relation to seasonal chronology, time of day, wind, precipitation, and cloud cover.

We surveyed 123 emergent wetlands in Massachusetts and Maine during the 1991 and 1992 breeding seasons to determine if broadcasts of tape-recorded calls increased detection rates of pied-billed grebes, American bitterns, least bitterns, green herons (*Butorides striatus*), Virginia rails, and soras. Following a 3-minute passive listening period at each station, we broadcast 1 minute of calls for each species at 1-10 survey stations per wetland. Detection rates of Virginia rails and soras were greater during the conspecific call portion of the broadcast sequence than during passive listening periods. In addition, both rails exhibited a peak of response within the broadcast sequence during broadcast of conspecific calls. In contrast, both green heron and American bittern had higher detection rates during passive listening periods than during broadcasts of calls. However, due to small sample size and potential bias, we recommend further study of responses of American bitterns to broadcasts of taped vocalizations. Sample sizes of pied-billed grebe and least bittern were too small for analysis.

We suggest that regional populations of marsh birds can be monitored using standardized surveys along mini-routes comprised of 10-15 point-count stations per route. From 10-15 survey points can be done in a morning, either within 1 large or several smaller wetlands. In the northeastern United States, we recommend that broadcasts of tape-recorded vocalizations be used to increase detection rates of pied-billed grebes, least bitterns, Virginia rails, soras, and, perhaps, American bitterns. Except for wetlands that are small and easily accessible, surveys should be conducted by canoe. Surveys should be conducted between 0430 and 1000 h on days with calm or light winds and no steady precipitation. Randomly stratifying sampling effort between large, species-rich wetlands and wetlands that are small, of marginal habitat quality, were historically occupied by target species, or have been recently created, for example by beavers, may be desirable. This design would balance the need to maximize detection rates while surveying populations over a representative sample of available habitats. Finally, monitoring habitat changes along mini-routes would be important for interpreting population trends of marsh birds.

Designing Effective Regional Monitoring Programs for Marshbirds

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In developing regional monitoring programs, biologists should retain a focus on the major challenge that we face: to devise sampling methods that permit unbiased and statistically powerful surveys of marshbird populations in a logistically feasible manner. Clear articulation of monitoring objectives (time frame, trend strength sought for detection, alpha, and beta) is the first step in this process. Based on a decade of experience with marshbird monitoring in Maine and Massachusetts, we highlight several considerations for the effective design of regional marshbird monitoring programs. These include whether call-response surveys adequately "index" marshbird abundance, use of waterbird mini-routes' as the unit for sampling marshbird populations, and tools for estimating the trade-offs between survey effort and power to detect trends in marshbird populations.

Sora Rail Studies on the Patuxent River, Maryland

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The freshwater marshes of the tidal Patuxent River are well known for their annual fall concentration of migrant soras (*Porzana carolina*) and were formerly the most famous rail hunting grounds in the Chesapeake Bay region. Because of concern over the apparent long-term decline in number of soras and the decline in the quality of the Patuxent marshes, especially the loss of wild rice (*Zizania aquatica*), the Maryland National-Capital Park and Planning Commission (MNCPPC), co-steward of the Jug Bay National Estuarine Research Reserve, sponsored rail-related research beginning in 1987. Past efforts focused on developing efficient trapping techniques, age and sex criteria, and monitoring body mass dynamics. Noted progress was made in developing digital playback systems and trap improvements to enhance sora captures. These improvements increased capture success by over an order of magnitude and resulted in capture of 2,315 soras and 276 Virginia rails (*Rallus limicola*) in the 5 year period, 1993-97. Although these methods demonstrate the efficacy of banding large numbers of soras on migration and possibly winter concentration areas, captures at the Patuxent River site have been 70-90% hatching-year birds and recoveries and recaptures have been virtually nonexistent. With the present effort, this outcome precludes population parameter estimation using traditional capture-recapture or recovery model methodologies.

In 1996, studies were initiated to employ radio telemetry methods to investigate length of stay, habitat use, survival, and migration characteristics of fall migrant soras. These studies are ongoing and will be continued through 1998 with a grant from the U.S. Fish and Wildlife Service's Webless Migratory Game Bird Research Program and support from the U.S. Geological Survey's Patuxent Wildlife Research Center. Supplemental funding has also been provided by MNCPPC, FWS Region 5, the Maryland Ornithological Society, Quail Unlimited, and Prince Georges Community College.

During 1996-97 we developed a successful radio transmitter attachment technique to secure 1.8g radio transmitters over the synsacrum of migrant soras. We modified Rappole and Tipton's (1991) leg-loop attachment method by addition of a waist loop to prevent soras from slipping transmitters over their short tails. Thin gauge (0.6mm) elastic thread proved ideal for attachment and allowed for girth expansion associated with fattening during stopover. Sixty instrumented soras have been monitored in two years of study from early September until early November. Only a single mortality was recorded and 41 (68%) were confirmed and another 13 (total 90%) were believed to have migrated from the study area. Only a single bird slipped a radio transmitter. Most birds demonstrated a sedentary nature in the marsh throughout stopover. Average length of stay was 44 days in 1997 ($n = 29$) with peak departure occurring 20-24 October.

Departing migrants were detected using a receiver/data-logger monitoring system placed 4 miles down river from the study site. Thirty-six of 37 (97%) soras departed in a 2-hour window of time, beginning 1 hour after sunset. Departure was synchronized with cold fronts on clear, starlit nights. Twenty-five soras were monitored on migration from 8 km to as far away as 770 km. Findings indicate migration flight speeds of 40 to 50mph and a direct southward orientation from the study site at least until contact with the Atlantic Ocean west of Cape Lookout, North Carolina. We also attempted to monitor passage of migrant soras radio tagged at Iroquois National Wildlife Refuge in western New York by biologist Soch Lor. None were recorded passing a monitoring unit at Haldeman Island in the middle of the Susquehanna River 10 miles north of Harrisburg, Pennsylvania. This further corroborates our findings that when migrating overland, soras move in a direct southward orientation and are not following land features such as major rivers. We will attempt to expand our tracking effort of migrant soras especially in the deep South in fall 1998.

In 1997 we further examined the effect of our audio lure on the age, sex, and capture rate of soras. We alternated 5 trap lines with and 5 lines without playback every 2 days for a period of about 5 weeks. The results indicated a 2 x capture rate with playback ($p < 0.001$), with no effect related to age ($p > 0.1$), or sex among AHY birds ($p > 0.9$). Sex effect among HY birds was less conclusive because of sexing error. Using DNA finger printing techniques on a grab sample of 81 HY soras, we determined our sexing error to be about 13% in favor of males. Applying this correction, our test was marginally significant ($p = 0.06$, $n = 622$). The DNA sexing results indicate that it is unlikely that HY soras can be sexed at a confidence level of 90% or better. This finding is preliminary and we intend to reexamine this issue in 1998.

Comparison of Point Count and Play Back Survey: Techniques for Detecting Breeding Wetland Birds

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Tape play back can be effective for detecting inconspicuous wetland birds. However, in a broader study focusing on breeding passerines, I wanted to determine if playing the tape affected detectability of wetland passerines, and if tape play back could increase detectability of the inconspicuous species although the survey design was not optimal for them. Therefore, both survey types were conducted consecutively during a single visit at each point. Within a 50 m radius of an observer, neither survey method was better than the other (paired t-test) for detecting total numbers of birds, numbers of species, and individuals of most species. The exception was that more Virginia rail (*Rallus limicola*) were detected with play back than point count. At an unlimited distance, however, more birds, species, and individual Marsh Wrens (*Cistothorus palustris*), Song Sparrows (*Melospiza melodia*), Swamp Sparrows (*M. georgiana*), Willow Flycatchers (*Empidonax trailii*), Yellow Warblers (*Dendroica petechia*), and Red-winged Blackbirds (*Agelaius phoeniceus*) were detected with point counts. At an unlimited distance, play back was more effective for detecting Virginia Rails and Soras (*Porzana carolina*), but not Least Bitterns (*Ixobrychus exilis*), Common Moorhens (*Gallinula chloropus*), and Pied-billed Grebes (*Podilymbus podiceps*). Survey order did not affect comparisons between the 2 methods for either distance. If all wetland birds are the target for study or monitoring, an unlimited detection distance is desired, and only a single visit to survey sites is possible, both methods should be used.

Vocalization Behavior and Response of Black Rails

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We measured the vocal responses and movements of radio-tagged black rails (*Laterallus jamaicensis*) (n = 43, 26 males, 17 females) to playback of vocalizations at 2 sites in Florida during the breeding seasons of 1992-95. We used regression coefficients from logistic regression equations to model the probability of a response conditional to the birds' sex, nesting status, distance to playback source, and the time of survey. With a probability of 0.811, non-nesting male black rails were most likely to respond to playback, while nesting females were the least likely to respond (probability = 0.189). Linear regression was used to determine daily, monthly, and annual variation in response from weekly playback surveys along a fixed route during the breeding seasons of 1993-95. Significant sources of variation in the linear regression model were month (F = 3.89, df = 3, $p = 0.0140$), year (F = 9.37, df = 2, $p = 0.0003$), temperature (F = 5.44, df=1, $p = 0.0236$), and month*year (F = 2.69, df = 5, $p = 0.0311$). The model was highly significant ($p < 0.0001$) and explained 53% of the variation of mean response per survey period ($R^2 = 0.5353$). Response probability data obtained from the radio-tagged black rails and data from the weekly playback survey route were combined to provide a density estimate of 0.25 birds/ha for the St. Johns National Wildlife Refuge.

Density estimates for black rails may be obtained from playback surveys, and fixed radius circular plots. Circular plots should be considered as having a radius of 80 m and be located so the plot centers are 150 m apart. Playback tapes should contain one series of Kic-kic-kerr and Growl vocalizations recorded within the same geographic region as the study area. Surveys should be conducted from 0-2 hours after sunrise or 0-2 hours before sunset, during the pre-nesting season, and when wind velocity is <20 kph. Observers should listen for 3-4 minutes after playing the survey tape and record responses heard during that time. Observers should be trained to identify black rail vocalizations and should have acceptable hearing ability.

Given the number of variables that may have large effects on the response behavior of black rails to tape playback, we recommend that future studies using playback surveys should be cautious when presenting estimates of "absolute" density. Though results did account for variation in response behavior, we believe that additional variation in vocal response between sites, with breeding status, and bird density remains in question. Playback surveys along fixed routes providing a simple index of abundance would be useful to monitor populations over large geographic areas, and over time. Considering the limitations of most agency resources for webless waterbirds, index surveys may be more appropriate. Future telemetry studies of this type on other species and at other sites would be useful to calibrate information obtained from playback surveys whether reporting an index of abundance or density estimate.

Avian Community Structure of Front Range Wetlands: Effects of Area, Shape, Hydrology and Vegetation

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This study explored the factors shaping avian use of 36-closed canopy, cattail wetlands on the Colorado Piedmont. Six species (sora and Virginia rail, red-winged and yellow-headed blackbird, yellowthroat, and song sparrow) were censused on three dates by one of three methods, song playback for rails, visual scanning for blackbirds, and line transects for yellowthroats and song sparrows. The presence and breeding status of other bird species (principally waterfowl species but also mourning dove, common grackle, and American coot) were recorded while censusing the six "target" species. Wetland shape, size and edge density were determined from aerial photographs. Transect sampling was used to quantify hydrologic and vegetation features (floristics and physiognomy) of each wetland. Objectives of the study were to identify habitat correlates of avian species richness and densities of individual wetland residents.

Breeding bird richness on individual wetlands varied from 1 to 13 with a modal value of 5 to 6 species. In general, the species makeup of individual communities was a function of community size. Thus, redwings were the only species to appear alone, yellowthroats typically joining redwings in two-species communities, song sparrows or Virginia rails being the third member of 3-species communities, and so on. In effect, the species tended to form a "nested series," implying that the resource needs of the habitat specialists were subsumed under those of the habitat generalists. Soras and yellow-headed blackbirds were uncommon members of these communities (12 and 4 sites, respectively) and only occurred on sites that also had other members of the breeding bird community.

Roughly half the variance (R^2 of 52%) in avian species richness across sites was accounted for variation in wetland size (range, 0.5 to 5.0 ha). Using stepwise regression analysis, within site diversity in water depth accounted for the next largest fraction of the variance in avian species richness (R^2 of 73% for the two-variable model). The various measures of plant floristics and physiognomy showed little or no associations with avian species richness after wetland size and hydrology were taken into account. Likewise, wetland shape, as measured by edge length relative to wetland area, had little or no measurable effect on avian species richness. Results were similar when wetlands were compared for variation in richness of individual bird taxons (6 species of songbirds, 3 species of rails, and 5 species of waterfowl.

Variation in wetland size was the single strongest correlate of resident population size for song sparrows (R^2 of 36%), red-winged blackbirds (R^2 of 49%), Virginia rails (R^2 of 49%), and yellowthroats (R^2 of 68%). Sora numbers correlated most strongly with area of wetland containing standing water (R^2 of 64%). When subjected to stepwise regression analysis, models incorporating wetland size and hydrology accounted for most of the explained variation in population sizes of these 6 resident species.

For closed canopy, cattail wetlands on the Colorado Piedmont, avian species richness in the breeding season is likely to be highest on sites that are large, spatially diverse in depth of standing water, and settled by soras and/or yellow-headed blackbirds. Soras and Virginia rails were the only two wetland specialists among webless species in these breeding bird communities. For purposes of estimating resident population size of these two rail species, the present results point to area of measurable water as a reliable indicator.

Effectiveness of Marsh Bird Monitoring Methods

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Standard survey methods that rely on passive observation are ineffective for many wetland bird species because individuals vocalize infrequently and are difficult to observe in dense wetland habitats. Biologists have been using playbacks of pre-recorded calls to increase detection rates of rails and other marsh birds for more than 20 years, but few studies have evaluated the effectiveness of the method and its possible biases. Variation resulting from differences in observers, weather, time of day, date, and other factors complicates analyses of large scale bird population surveys and sometimes makes results difficult to interpret. Use of broadcast calls in population surveys further complicates this situation by introducing an array of potential new sources of variation including 1) the number of species included in broadcasts, 2) the number of repetitions of each call, 3) the type of calls that are used, 4) the order of recorded calls, 5) the length of the silent period between calls, and 6) the volume of broadcasts. The more species that are included in broadcasts, the greater the problems. It is important that we weigh the relative costs and benefits of using call broadcasts in population surveys and understand the biases associated with their use before designing a national scheme for monitoring marsh birds.

In 1995, the Max McGraw Wildlife Foundation initiated a project to develop multi-species survey techniques to estimate abundance and nesting productivity of wetland birds. Point counts using playbacks of pre-recorded calls were conducted on 11 northeastern Illinois marshes once every two weeks from mid-April through July, 1995 –1997. Points were placed at least 25 m from the edge of wetlands in a rough 200 m grid. Counts were conducted from dawn until five hours after dawn. During each point count, 8 minutes of passive observation was followed by playback of 8 minutes of recorded calls. Tapes including calls of 4 or 11 wetland bird species were played at alternating points. Wetlands were searched for nests once every two weeks and nests were re-visited once a week to determine their fate.

Thirty-four wetland associated species were detected 10 or more times during 910 point counts. Both passive observation and playbacks proved effective in monitoring wetland bird populations. More birds were first detected during the initial 8-minute passive observation period than during the subsequent 8-minute playback period in four of the eight common species included in playbacks ($p < 0.010$, American coot, least bittern, green heron, and marsh wren). No difference in the number of birds first detected during the passive and playback periods could be found in two species (common moorhen and pied-billed grebe). Only Virginia rails and soras were detected more frequently ($p < 0.033$) during playback than passive observation. However, the preceding analysis assumed a 1:1 expected ratio between the number of detections in the first and second half of a 16-minute observation period. This assumption proved wrong. New detections declined steadily from minute one through eight of the passive observation period and likely would have continued to decline through an additional eight minutes of passive observation. Further analyses that accounted for declines in the rate of new detection with time spent at a point indicated that playback during observation minutes 9-16 increased detection rates over predicted values for passive observation by 13.0 times for Virginia rail, 6.3 times for common moorhen, 2.2 times for sora, 2.0 times for American coot, 1.9 times for green heron, and 1.6 times for pied-billed grebe ($p < 0.027$). Playbacks could not be shown to increase detection rates in least bitterns or marsh wrens ($p > 0.100$).

The number of species included in broadcasts, which species are included, the length of broadcast for each species, and the overall length of the observation period all potentially impact

the number of individuals detected during a point count. It is impossible to standardize all of these factors simultaneously across multiple studies and regions with different species compositions.

However, length of nonspecific call broadcasts may influence detection rates less than the other factors listed above. We found broadcast of calls of four versus eleven species (120 s and 45 s of calls per species, respectively) had no impact ($p > 0.200$) on effectiveness of playbacks in three of the four species included on both tapes (sora, Virginia rail, and common moorhen). The 4-species tape was more effective ($p = 0.026$) in eliciting responses from American coots, suggesting a longer sequence of calls may improve detection rates in coots.

We also located and monitored over 900 nests of 13 wetland species from 1995-1997. Nest location and status information was used to identify point counts conducted near active nests. To evaluate survey effectiveness, we determined whether or not adult birds were detected near nests for all point counts conducted within 75m of active nests. In red-winged blackbirds, marsh wrens, and yellow-headed blackbirds, at least one adult was detected within 50m of active nests during 89-94% of counts. Common moorhen, sora, and Virginia rail adults were detected within 75m of active nests during 53-68% of point counts. Adults were detected in the vicinity of active nests less frequently in pied-billed grebes (33% of 15 counts), least bitterns (28% of 43 counts) and American coots (40% of 5 counts).

Mayfield nest success for years combined was 38% in red-winged blackbirds (n = 377), 42% in least bitterns (n = 60), 73% in yellow-headed blackbirds (n = 102), 30% in marsh wrens (n = 64), 33% in common grackles (n = 48), 78% in common moorhens (n = 34), 73% in pied-billed grebes (n = 17), 32% in sora (n =17), 52% in Virginia rail (n = 17), and 83% in black terns (n = 39). Nest success for most species was at or above values that have been reported in the literature, and monitoring methods appeared to have no dramatic impact on nest success.

Marsh Birds and the North American Breeding Bird Survey: Judging the Value of a Landscape Level Survey for Habitat Specialist Species with Low Detection Rates

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The North American Breeding Bird Survey was started in 1966, and provides information on population change for >400 species of birds. It covers the continental United States, Canada, and Alaska, and is conducted once each year, in June, by volunteer observers. A 39.4 km roadside survey route is driven starting 30 min before sunrise, and a 3 min point count is conducted at each of 50 stops spaced every 0.8 km. Existing analyses of the data are internet-based (http://www.mbr-pwrc.usgs.gov/bbs/bbs.html), and include maps of relative abundance, estimates of population change including trends (%/yr), composite annual indices (pattern in time), and maps of population trend (pattern in space).

At least 36 species of marsh birds are encountered on the BBS, and the survey provides estimates with greatly varying levels of efficiency for the species. It is often difficult to understand how well the BBS surveys a species. Often, efficiency is judged by estimating trend and its variance for a species, then by calculating power and needed samples to detect a prespecified trend over some time period (e.g., a 2%/yr trend over 31 yr). Unfortunately, this approach is not always valid, as estimated trends and variances can be of little use if the population is poorly sampled. Lurking concerns with BBS data include (1) incomplete coverage of species range; (2) undersampling of habitats; and (3) low and variable visibility of birds during point counts. It is difficult to evaluate these concerns, because known populations do not exist for comparison with counts, and detection rates are time-consuming and costly to estimate.

I evaluated the efficiency of the BBS for selected rails (Rallidae) and snipes (Scolopacidae), presenting estimates of population trend over 1966-1996 (T), power to detect 2%/yr trend over 31 yr, needed samples to achieve power of 0.75 with alpha= 0.1, number of survey routes with data for the species (N), average abundance on survey routes (RA), and maps of relative abundance. Examples include Yellow Rail (*Coturnicops noveboracensis)* (T=12 %/yr; P= 0.0085; N=28; routes; RA=0.05; Power=0.37; Needed samples=85), Black Rail *(Laterallus jamaicensis)* (No trend data or power information available, N=8), Clapper Rail (*Rallus longirostris)* (T=1.9%/yr; P=0.55; N=64; RA=0.31; Power=0.35; Needed samples=590), King Rail *(Rallus elegans)* (T=-4.2 %/yr; P= 0.03; N=76; Power=0.41; Needed samples=159), Sora *(Porzana carolina*) (T=0.98 %/yr; P= 0.24; N=720; RA= 0.92; Power=0.69; Needed samples= 377), and Common Snipe *(Gallinago gallinago)* (T=-0.24 %/yr; P= 0.54; N=1412; RA= 2.19; Power=0.98; Needed samples=205).

With regard to quality of BBS data, marsh birds fall into 3 categories: (1) almost never encountered on BBS routes; (2) encountered at extremely low abundances on BBS routes; and (3) probably fairly well sampled by BBS roadside counts. BBS data can provide useful information for many marsh bird species, but users should be aware of the limitations of the BBS sample for monitoring species that have low visibility from point counts and prefer habitats not often encountered on roadsides.

The Ohio Breeding Bird Survey

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The Ohio Division of Wildlife Strategic Plan, Ohio Partners in Flight and the Lower Great Lakes Joint Venture of the North American Waterfowl Management Plan all point out that severe wetland habitat loss has most likely resulted in population reduction of wetland birds. A survey designed to establish wetland breeding bird abundance was initiated in 1990 by the Ohio Division of Wildlife (ODOW) and Ohio Cooperative Wildlife Research Unit (OCWRU). The Research Unit was contracted by the ODOW, to first determine what species in Ohio are not adequately covered by the Federal BBS and to secondly, develop a survey that would fill this gap in knowledge. Species inadequately monitored were predominately wetland species but also included forest patch specialist, nocturnal and relatively non-vocal species (Andres, 1990; Earnst and Andres, 1996).

An experimental wetland breeding bird survey (WBBS) has been conducted since 1991. Volunteers are utilized for the survey and data was compiled by the OCWRU until 1994 and since by the Wetland Research Station of the ODOW. Approximately 40 survey routes were initiated by volunteers on wetlands familiar to them. Study design is composed of a series of stops conducted on pre-determined routes from May 15 to June 10 (Andres 1991). All birds seen or heard in a five minute period within an arc of 100 yards of the observer are recorded. During the five minute period, a tape is played containing calls of the American bittern, least bittern, sora, Virginia rail, and king rail. Any birds flushed from the survey zone upon approach, or flying through the zone, are counted. Each route is to start 2 hour before sunrise, and continue for three hours, or until the route is completed. Selected species are recorded.

Several points stand out that need to be dealt with to have a useable survey for statewide wetland breeding bird trends. There is considerable concern with the method of wetland selection. Nearly half of the sites are located in the Lake Erie marsh region which is substantially different from the rest of the state. The Lake Erie wetlands are all control level marshes that may have very different water regimes and associated birds from year to year. Inland wetlands are most often located along roads and were chosen by volunteers because of birding interest. These wetlands tend to be small and highly variable in quality, It is unknown as to the representation these wetlands have to Ohio's wetland habitat base. A patchwork of data collection has been a result of volunteers having only mornings available to conduct surveys. Often a volunteer has only one or two opportunities to complete their survey.

ODOW has initiated a graduate level study to investigate both survey timing and to evaluate the quantity and location of various wetland habitats throughout Ohio. Survey timing will look at the feasibility of utilizing evening surveys to increase volunteer participation and compliance in survey needs. Wetland habitats in Ohio will be stratified by GIS analysis of the wetland inventory completed in Ohio and wetlands will be systematically chosen for inclusion in the long term study design. Wetlands in the Lake Erie marsh region will be stratified between drawdown and water units and individual points will shift between these strata from year to year depending on land management.

Objectives of the Ohio survey are to develop a long term wetland breeding bird monitoring program representative of Ohio wetlands with adequate sample size and consistent coverage to evaluate population health at state wide and habitat type levels.

Density Indices for Sora and Virginia Rails

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Recently, interest in developing standardized monitoring techniques for inconspicuous marsh birds has grown. In order to develop standard protocols more information is needed about the meaning of call-playback surveys in relation to population size. In addition, designing surveys for rails at the refuge level has been hampered due to lack of long-term baseline data. We report on (1) a comparison of call playback surveys to a population index based on live trapping and (2) evaluating survey effort and timing in a refuge-wide monitoring program based on 11 years of past survey data. Each one will be discussed separately below.

Comparison of vocalization and trapping indices

Call-playback surveys and live-trapping surveys were conducted at 10 sites at Horicon National Wildlife Refuge (NWR), Wisconsin, during the breeding season (May to July) in 1996 and 1997. Trap sites were 50 m radius circles (0.88 ha), randomly placed along dikes throughout the refuge. At each site there were two modified cloverleaf traps, a drift fence, and a center platform with a sound system. Call-playback surveys were done at the trap sites the day before trapping or as close to the corresponding trapping date as weather permitted. We surveyed and live-trapped each site at dawn, bi-weekly until 15 July. Call-playback indices were the average number of birds detected per site.

We originally planned on doing a mark-recapture estimate based on trapping. However, recapture rates within and between years were too low (no soras and only two Virginia rails were recaptured within a season; none of either species was recaptured between years). Therefore we developed a population index based on trapping of adults. Trapping indices were the average number of adults caught per site.

Trap sites were classified as breeding and non-breeding based on whether or not juveniles were trapped at the site before 15 July. We plotted vocalization indices against trapping indices. Correlations of the indices were calculated using Spearman's rank correlation coefficient. Tests for significant positive correlation were made using an a of 0.05.

Sora vocalization and trapping indices showed a significant positive correlation in 1996. This correlation was strongly influenced by two points. In 1997 the sora indices were not significantly correlated and there were no influential points. Vocalization and trapping indices for the Virginia rail had a significant positive correlation in 1996. This correlation was even stronger when one influential point was removed. There was no significant correlation between vocalization and trapping indices for Virginia rails in 1997. Removal of an influential point did not change this.

More work is needed to understand the relationship between both indices and population size for sora and Virginia rail. Vocalization surveys should be used until trapping can be investigated more thoroughly.

Evaluating refuge-level survey design using 11 years of survey data

Horicon NWR has surveyed rails using call-playback surveys in the spring and summer 1983-1986 and 1990-1996. Each year 16 to 18 survey points were established along refuge roads. Location and number of the sites varied from year to year depending on habitat and water conditions. Survey points were semicircles of one hectare in size (80 m diameter). These sites were surveyed weekly, usually for 10 weeks (late April through mid June) using call-playback point counts. When designing a survey for rails, questions arise about how many sites to survey and when to do them. We use subsets of the 11 years of survey data to determine when surveys should be done and how many sites should be surveyed in order to adequately track population trends on a refuge scale.

We averaged results from sites and weeks within years to get yearly indices for the 11 years for both sora and Virginia rail. This was assumed to be a true representation of the population trend over time at Horicon NWR and we refer to this as the true trend. We then created random subsets of weeks and sites and compared results from these subsets to the true trend using Pearson's correlation coefficient; significance was assessed at an a of 0.05.

We wanted to determine if conducting a single annual survey would result in a trend similar to the true trend and what the optimum timing for a single annual survey would be. First we compared trends obtained from all single-week indices (averages of all sites within a single week) to the true trend. All trends resulting from the single-week subsets were significantly similar to the true trend. For data on sora, the median correlation was between 0.76 and 0.81. For data on Virginia rail, the median correlation was between 0.88 and 0.92.

Given that any week would be suitable for doing a single annual survey we chose two

weeks, the second week in May and the second week in June, to test random subsets of reduced number of sites. These weeks were chosen specifically to test for differences in sora call rates; in June, sora typically do not respond to call-playback tapes. There is no such major refractory period for Virginia rail. For each of the two weeks we took subsets of sites by randomly selecting 10, 20, 30, 40, 50, 60, 70, 80, and 90% of the sites. This random selection was repeated 20 times for each percentage level. If surveys were done in the second week of May, at least 40-50% of the sites would need to be surveyed to have correlations of greater than 0.6 with the true trend for both sora and Virginia rails. If the surveys were done in the second week of June at least 70% of the sites would need to be surveyed to obtain these same correlations with the true trend for both species.

Because it is unrealistic to assume that a refuge biologists will be able to survey in a given week every year, we wanted to investigate what would happen to the trend if the biologist could do the survey in one out of three chosen weeks with a fixed subset of random sites. To do this we randomly selected the week within a three week window (the second, third and forth weeks of May) in one of three ways. Weeks were selected using either a uniform random distribution, normal random distribution with a standard deviation of a half a week, or normal random distribution with a standard deviation of one week. We ran this simulation assuming 16 sites would be surveyed. We ran 30 trials for each of the 3 methods of randomly selecting a week. We found that consistent surveying in one week was important; trends from the normal random distribution methods were more likely to have correlations greater than 0.70, regardless of species.

At the refuge scale less effort is needed to maintain sufficient monitoring. Subsets from the 11 years of Horicon data show that we can do single annual surveys with fewer sites and still obtain results similar to those obtained using more effort. Surveys done in May require less effort when covering both rail species than when done in June. We suggest that, at the refuge level, it would be beneficial to do a pilot study to locate areas where rails are heard and use these sites to choose a random subsample for future monitoring.

Monitoring King and Yellow Rails in Texas

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Texas coastal wetlands serve as wintering or breeding grounds for 6 species of rails. King rails (*Rallus elegans*), clapper rails (*Rallus longirostris*), and black rails (*Laterallus jamaicensis*) are known to breed and winter in Texas, whereas yellow rails (*Coturnicops noveboracensis*), soras (*Porzana carolina*), and Virginia rails (*Rallus limicola*) are winter residents only. These rails inhabit coastal marshes throughout the western gulf coast as well as freshwater wetlands associated with rice agricultural fields.

Rails are almost entirely associated with wetlands and therefore are likely important indicators of wetland ecosystem quality. Coastal wetlands in Texas have declined by more than 52% during the last 200 years. Remaining wetlands have been fragmented and degraded. Declining rail numbers on wintering grounds are likely related to habitat loss, but also may be an indication of degradation in quality of remaining wetlands. Although the nature of wetland degradation is not fully known; factors which may contribute to changes in wetland quality include: nonpoint source pollution, alterations of hydrology, and declines in food availability.

We report on efforts to monitor local populations on two national wildlife refuges, primarily designed to determine presence, habitat associations and responses to management. We have chosen to focus on king and yellow rails studied at the Attwater Prairie Chicken National Wildlife Refuge and Anahuac National Wildlife Refuge. These two species were selected because of differing periods of residency in Texas. Because the king rail breeds and winters in Texas coastal freshwater marshes, we used both audio techniques and radio telemetry to determine habitat associations. Responses of king rails to taped calls were recorded most frequently from early spring to the onset of summer in freshwater marshes associated with nearby rice agriculture. Audio techniques were supplemented by use of radio-telemetry during the non- breeding season. On the other hand, the yellow rail presents a significant monitoring challenge. Because the yellow rail only winters in Texas, attempts to elicit vocal responses to audio techniques were unsuccessful. Therefore, we used radio-telemetry with a geographic positioning system to determine habitat associations and home range sizes of yellow rails.

Radio telemetry requires capture of individuals and successful attachment of appropriate radio transmitters. Attempts to capture king rails included the unsuccessful use of cloverleaf and havahart traps. We were successful using drop nets in capturing individual king rails foraging in irrigation canals. Back-pack harnesses were used for attachment of transmitters to king rails. Unsuccessful attempts to capture yellow rails included drift lines with funnel traps and mist nets. We were successful in capturing yellow rails by pulling weighted drag lines through the marsh to flush individuals at night. Flushed birds were captured using hand nets. Transmitters were affixed to the bird using a modified synsacrum attachment. This attachment placed the weight of the transmitter in the pelvic region and was used on 38 yellow rails during the winters of 1997 and 1998. Transmitters attached in the scapular region were unsuccessful.

Data from these studies indicated that while present in Texas these species exhibited different habitat associations. King rails were found in freshwater coastal marshes and inland wetlands, including those associated with rice agriculture. King rails were located in marshes with relatively dense vegetation and water ranging in depth from 3-10 cm. Yellow rails were found in marshes characterized by >50% vegetative cover and at sites with <2.5 cm water depth. In addition, yellow rails have been reported to inhabit dry, mature rice fields. In addition, king and yellow rails were associated with marshes receiving burning and grazing management regimes.

Few studies have been documented on king and yellow rail populations along the western Gulf coast and little is know about their current status. Studying king and yellow rails require large investments of effort. Therefore, it is our opinion that future studies should use available monitoring techniques and investigate new methods. Rails are characteristic of Texas coastal wetlands and are indicative of the condition of these wetlands.

Evaluation of a Tape Playback Survey Method for Nocturnal Marshbirds in Maryland

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The tidal marshes of the Chesapeake Bay support a high diversity of breeding marshbirds, including five species of rails, both American and Least bitterns, Pied-billed Grebe and Common Moorhen. No reliable estimates of breeding populations of these obligate wetland birds were known for Maryland. Since marshbirds are inconspicuous and not easily surveyed by traditional breeding bird surveys, special survey methodology is needed for these species. The use of tape playback techniques have been used for marshbirds elsewhere with success. This study was initiated to evaluate the use of tape playback techniques for surveying marshbirds in Maryland.

To evaluate the playback methodology, two study sites were selected. These sites were selected to represent different tidal marsh communities in the Maryland portion of the Chesapeake Bay. At these sites tape playback surveys were conducted weekly in 1990 and biweekly in 1991 to determine seasonal, daily, environmental and others effects on marshbird response rates. At each study site, four sample points were surveyed during each visit. The survey protocol used consisted of 5 minutes of listening for spontaneously calling birds, followed by broadcasting the calls of the nine target species, and concluding with another 5 minutes of listening without playbacks. During the broadcast portion of this protocol, vocalizations of each species were broadcast for 2 minutes each followed by 2 minutes of listening without broadcasted vocalizations then repeated again with the next species. Surveys were initiated just prior to sunset and continued until after sunrise.

Seasonal patterns of response indicated that the period May 15 through July 15 was the optimum period for surveying breeding marshbirds in Maryland. Highest daily responses occurred during the dawn survey period. Probability of detection, defined as the probability of detecting a given species during a single visit, ranged from 0.11 for Black Rail to 1.00 for Common Moorhen. Effective distances of detection for most species surveyed were to 200 m.

Of particular interest during this study were the effects of marshbird responses to the lead species broadcasted on the tape and the effects of the sequence of species broadcasted. Four different lead species vocalizations were tested. Analysis of responses to the different tape sequences found no differences, indicating that the sequence of species vocalizations did not influence the overall responsiveness of each species. This is important for multiple species surveys. The use of tape playback increased the responsiveness of two of four species tested, namely King Rail and Virginia Rail. Probabilities of detection for the rare species also seemed enhanced by the use of tape playback.

Recommendations for designing a survey the marshbirds include: (1) use tape playback methodology to enhance marshbird responses, (2) for multiple species surveys in the Chesapeake Bay broadcast vocalizations of Black Rail, Clapper Rail, Virginia Rail and Common Moorhen at a minimum, (3) broadcast rare species first, (4) conduct breeding surveys in the Chesapeake Bay area between May 15 and July 15, (5) initiate surveys 2-3 hours before sunrise and continue 1-2 hours after sunrise, (5) conduct each survey at least three times during the season, (6) space survey points at least 800 m apart, and (7) avoid surveying on windy days or days with precipitation.

Migration Chronology and Habitat Use of Webless Migratory Game Birds in the Lower Missouri River Floodplain

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This study focuses on webless migratory game birds such as rails, coots, and snipe in relation to their habitat use within the Missouri River floodplain. This group of birds primarily uses the lower Missouri River as a corridor for migration between wintering and breeding habitats. Some breeding by rails probably occurs within the study area but the location and extent of nesting is poorly documented. In order to develop management strategies for intensively managed areas and restoration projects in the Missouri River floodplain, additional information is needed on chronology of use, relative densities of birds, and habitat use. Because this group uses diverse wetland habitats from open water to shallowly flooded dense robust emergents, the physical and biological conditions within different wetland types is essential in the development of sound wetland management. Migration chronology, relative densities of migrating and breeding birds, microhabitat conditions, and landscape features associated with wetland type, size, and distribution are included in the study objectives.

A total of 6 floodplain wetland types (remnant, managed moist-soil impoundment, connected scour, non-connected scour, farmed temporary wetland, and unfarmed temporary wetland) were studied in 1996 and 1997. Four sites from each type were selected for this study. The field season was separated into two different sampling periods, spring and fall. The spring season was from late March until mid-June and consisted of visual surveys, flush counts, and call response surveys. The fall season was from mid-August until mid-October and consisted of visual surveys and flush counts.

Information on the chronology of use, densities of birds, and habitat use of webless migratory game birds is incomplete for lower Missouri River floodplain wetlands. The objectives of this study are to: (1) determine the chronology of use and determine densities of webless game birds using floodplain wetlands; (2) compare the microhabitat characteristics of sites that are used by webless game birds; and (3) compare the macrohabitat characteristics among the different wetland types. Visual surveys of open water and mud flat areas and flush counts through vegetated areas were conducted weekly on each site. Call response surveys were also used in the spring to detect king rails, Virginia rails, and sora. Flush counts and call response surveys were compared to determine if either of the techniques proved more effective in detecting birds. Preliminary analysis of the data showed no significant difference in detecting rail species. Survey data from both years show high numbers of American coot and common snipe using several sites. Significant numbers of sora were detected in many sites. Small numbers of Virginia rails were detected and no king rails were detected. Preliminary analyses of the survey data show that webless game bird use was highest in managed moist-soil impoundments and remnant wetlands. There was moderate use of temporary wetlands, and virtually no use of scoured basins. All 24 sites were mapped with a Global Positioning System (GPS) unit in 1996 and 1997. These data will be analyzed to determine the relationships between bird use and macrohabitat availability.

These are results from a 2-year study funded by the 1995 Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service and U.S. Geological Survey-Biological Resources Division), Missouri Department of Conservation, and University of Missouri.

Factors Affecting Vocalization Rates of Common Moorhens

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Reliable, standardized population survey methods are lacking for Common Moorhens (*Gallinula chloropus*). In response to this important management need, we examined the effect of month, time of day, sex, and taped calls on vocalization rates of Common Moorhens.

This study was conducted in southwestern Louisiana from April to June 1997. We located birds visually during morning (to 3 hours after sunrise), evening (3 hours before sunset), and midday (3 hours after sunrise to 3 hours before sunset). We recorded spontaneous vocalizations made by selected Common Moorhens for 5 minutes after which we played a one minute tape with clucks, purrs and primary advertising calls. Common Moorhen vocalizations were recorded from initiation of the tape to 3 minutes after the tape. Two additional sets of one minute taped calls were then played, each followed by 3 minutes of vocalization monitoring. Vocalizations made by other Common Moorhens while observing the individual were also recorded. A subset of birds was collected and necropsied to determine sex.

Time of day and month did not significantly affect Common Moorhen vocalization rates. Males vocalize significantly more ($p = 0.01$) than females. Common Moorhens vocalized more in response to taped calls than spontaneously, with an increase in the number of vocalized responses while the tape played and for the first minute after the taped calls stopped. During the next 2 minutes, vocalization rates were similar to spontaneous rates.

This project was made possible by support from the USFWS Office of Migratory Bird Management, Louisiana Department of Wildlife and Fisheries Fur and Refuge Divisions Rockefeller State Wildlife Refuge, Louisiana State University—Louisiana Cooperative Fish and Wildlife Research Unit, Cameron Prairie National Wildlife Refuge, USGS/BRD National Wetlands Research Center, and Miami Corporation.

The Marsh Monitoring Program of Bird Studies Canada (Long Point Bird Observatory)

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The Marsh Monitoring Program (MMP) was initiated in 1994 by Long Point Bird Observatory (now Bird Studies Canada) and Environment Canada in response to a recognized need for information on the status and trends of marsh breeding amphibian and bird populations, particularly in some highly impacted Great Lakes coastal wetlands (Areas of Concern). The MMP is an international, volunteer-based program focused on surveying birds and calling frogs and toads in coastal and inland marsh habitats in the Great Lakes basin. The program's main objectives are to: monitor populations of marsh birds and amphibians, both spatially and temporally; investigate habitat associations of marsh birds and amphibians; contribute to assessments of Areas of Concern; and to disseminate results and conclusions to the public and the scientific community.

Several aspects of alternative protocols were explored in 1993, including: fixed-distance and unlimited distance survey methods; morning and evening surveys; mid-season (late June) and late-season (mid-July) visits; survey durations from 5 to 20 minutes; and detection rates prior to and after broadcasts of taped bird calls. The selected protocol was tested in Ontario in 1994 and expanded to the whole basin in 1995.

Under the current MMP protocol, participants select survey routes consisting of one to eight stations. Routes must be surveyed within a single evening, by a single surveyor. Stations are 100 m radius semi-circles, positioned along the wetland edge and containing marsh vegetation (i.e. non-woody, emergent plants). Stations surveyed for birds must be at least 250 m apart and those sampled for amphibians must be at least 500 m apart. Participants are free to conduct surveys for marsh birds, amphibians, or both groups but are encouraged to commit to bird surveys only if they can correctly identify at least 50 common bird species, with particular emphasis on those associated with wetlands. All volunteers receive a Training Kit containing: a protocol booklet; data forms; a broadcast tape used to elicit calls from the more inconspicuous marsh bird species; and an instructional tape with examples of the songs and calls of marsh birds and amphibians most likely to be encountered in the Great Lakes basin. The protocol booklet contains instructions for establishing survey routes, conducting surveys for amphibians and marsh birds, and summarizing wetland habitat characteristics. The broadcast tape includes calls of Virginia Rail *(Rallis limicola*), Sora (*Porzana carolina*), Least Bittern (*Ixobrychus exilis*), Pied-billed Grebe (*Podilymbus podiceps*), and the paired calls of Common Moorhen (*Gallinula chloropus*) and American Coot (*Fulica americana*), with the call of each species separated on the tape by a silent listening period. Marsh Monitoring Program participants also receive an annual newsletter that summarizes survey results and includes articles on marsh ecology, amphibians and marsh birds.

Each station surveyed for marsh birds is visited twice each year between May 20 and July 5, no less than 10 days apart, in the early evening, with surveys ending at or before sunset. Each station is surveyed for 10 minutes, with the 5-minute broadcast tape played during the first half of the survey. All birds observed or heard within a 100 m radius semi-circular sample area are counted, and birds detected flying over or outside the station area are tallied separately.

Marsh Monitoring Program participants also describe general habitat characteristics of their survey stations between May and early June. Within the station area, volunteers classify the percent cover of five major habitat types (e.g. herbaceous emergent vegetation or open water/submergents), of submergent plants within open water areas, and of the four dominant plant genera within the emergent vegetation zones. Participants are also asked to classify the wetland size and adjacent upland land use, and to note obvious human influences such as dykes or channels.

Marsh Monitoring Program routes are distributed throughout the Great Lakes basin, in Ontario and in each of the Great Lakes states. Between 1995 and 1997, 425 routes have been surveyed during at least one of these years. Almost 40% of these routes have been surveyed for both amphibians and marsh birds, with the remaining routes split about equally between amphibian routes and bird routes. Of routes established in 1995, 49% have been monitored in three years, 11% in 1995 and 1996 only, 6% in 1995 and 1997 only, and 34% were surveyed in 1995 only. Of those routes established in 1996, approximately half were surveyed again in 1997.

Guided by a formal scientific evaluation of the program and the survey protocols, and incorporating lessons learned during four years of administering and conducting the surveys, we are currently considering a variety of refinements to the program design. Issues concerning route allocation, survey intensity and statistical power are discussed in a companion paper (Francis and Weeber), others are presented here. Of particular concern is a clear definition of the sampling objectives of the survey, which has implications for both the selection of survey routes and selection of stations along routes. Should the survey be intended to sample a particular wetland type (i.e. dominated by a specific vegetation assemblage) or a particular vegetation assemblage within aquatic systems in general (e.g. herbaceous emergents in wetlands or along lake edges)? If station selection is based on particular vegetation characteristics, how should the protocol address temporal changes in plant composition and density within the station area? Ideally, survey stations would be randomly allocated within selected strata (e.g. within wetland or vegetation types). How should station allocation strategies for volunteer-based, long-term programs integrate constraints such as those imposed by a required minimum distance between stations (i.e. to avoid overlapping counts); differing accessibility to potential stations; and limitations in surveyor motivation and knowledge of the waterbody surveyed? Similarly, how can assessments of wetland habitat characteristics and landscape context measure the habitat attributes actually involved in marsh bird habitat selection most effectively, and at appropriate spatial and temporal scales? Unfortunately, habitat selection criteria are not well understood for marsh bird communities, and the design of these assessments can be further constrained by surveyor's motivation and knowledge of wetland habitat measures, and by access to information ranging from wetland nutrient status through regional land use patterns.

Stimulated by a concern for wetlands and wetland dependent wildlife, interest in marsh bird monitoring appears to be increasing, as shown by the terms of reference for this workshop. Bird Studies Canada is interested in exploring the need and practicality of developing an expanded version of the MMP, applicable across Canada as well as the Great Lakes basin. Implementation of any such expanded program will be contingent on sufficient interest and funding.

Front Cover Photos

Left column from top
Least bittern, USFWS photo by Jill Parker
Clapper rail, photo by Gregory Kearns
Common moorhen, USFWS photo by G. Gentry
Horned grebe, USFWS photo by E. McLaury

Center column from top
King rail, photo by Gregory Kearns
Virginia rail, photo by Jack Bartholmai
Yellow rail, USFWS photo by Hollingsworth
Sora, photo by Gregory Kearns

Right column from top
Common snipe, photo by Travis Olson
Red-necked grebe, USFWS photo by J. Nickles
American bittern, USFWS photo by Hollingsworth

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