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STANDARDIZED NORTH AMERICAN MARSH BIRD MONITORING PROTOCOLS

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Introduction

The amount of emergent wetland habitat in North America has declined sharply during the past century (Tiner 1984). Populations of many marsh birds that are dependent on emergent wetlands appear to be declining (Tate 1986, Eddleman et al. 1988, Conway et al. 1994), but we currently lack adequate monitoring programs to determine status and estimate population trends. Marsh birds include all species that primarily inhabit marshes (i.e., marsh-dependent species). Primary species of concern in North America include King Rails (*Rallus elegans*), Clapper Rails (*Rallus longirostris*), Virginia Rails (*Rallus limicola*), Soras (*Porzana carolina*), Black Rails (*Laterallus jamaicensis*), Yellow Rails (*Coturnicops noveboracensis*), American Bitterns (*Botaurus lentiginosus*), Least Bitterns (*Ixobrychus exilis*), Pied-billed Grebes (*Podilymbus podiceps*), Limpkins (*Aramus guarauna*), American Coots (*Fulica americana*), Purple Gallinules (*Porphyrula martinica*), and Common Moorhens (*Gallinula chloropus*). The U.S. Fish and Wildlife Service has identified Black Rails, Yellow Rails, Limpkins, and American Bitterns as *Birds of Conservation Concern* because they are relatively rare and we lack basic information on status and trends in most areas (U. S. Fish and Wildlife Service 2002). Many U.S. states consider these species threatened or of special concern for similar reasons. King Rails are federally endangered in Canada and Black Rails are federally endangered in Mexico. Because rails and bitterns consume a wide variety of aquatic invertebrates, populations may be affected by accumulation of environmental contaminants in wetland substrates (Odom 1975, Klaas et al. 1980, Eddleman et al. 1988, Gibbs et al. 1992, Conway 1995). Marsh birds are also vulnerable to invasion of wetlands by purple loosestrife (*Lythrum salicaria*) (Gibbs et al. 1992, Meanley 1992). Hence, marsh birds may represent "indicator species" for assessing wetland ecosystem quality, and their presence can be used as one measure of the success of wetland restoration efforts. Marsh birds also have high recreational value; many species are highly sought-after by recreational birders. Finally, several rails are game species in many states yet we lack responsible population surveys on which to base harvest limits.

For these reasons, numerous federal agencies are cooperating to monitor marsh bird populations in North America to estimate population trends. Continued monitoring will also allow resource managers to evaluate whether management actions or activities adversely impact wetland ecosystems. Any management action that alters water levels, reduces mudflat/open-water areas, alters invertebrate communities, or reduces the amount of emergent plant cover within marsh habitats could potentially affect habitat quality for marsh birds (Conway 1995). The survey protocol outlined below is a standardized survey methodology intended for use on National Wildlife Refuges and other protected areas across North America. Results will be pooled to estimate population trends in these protected areas. These protocols will be modified as problems are identified by participants during the first 1-2 years of the survey effort. Participants are strongly encouraged to follow protocols exactly and to report any problems with implementing the protocols immediately so that we can modify and revise the methodology.

During surveys for primary marsh birds, observers may (at their option) record species of secondary concern that are also under-sampled by other monitoring programs, e.g., grebes,

herons, egrets, waterfowl, Forster's and Black Terns (*Sterna forsteri* and *Chlidonias niger*), Wilson's Snipe (*Gallinago delicata*), Sandhill Cranes (*Grus canadensis*), Northern Harriers (*Circus cyaneus*), Belted Kingfishers (*Ceryle alcyon*), Alder and Willow Flycatchers (*Empidonax alnorum* and *E. traillii*), Sedge and Marsh Wrens (*Cistothorus platensis* and *C. palustris*), Red-winged and Yellow-headed Blackbirds (*Agelaius phoeniceus* and *Xanthocephalus xanthocephalus*), Sharp-tailed and LeConte's Sparrows (*Ammodramus caudacutus* and *A. leconteii*), Common Yellowthroats (*Geothlypis trichas*), etc. However, surveyors should limit the number of secondary species to only those species of management concern. Many of the species listed above are adequately sampled by the North American Breeding Bird Survey. Listening or looking for too many secondary species may reduce one's ability to detect primary species.

PARAMETERS TO BE ESTIMATED

Density/abundance indices

Abundance is the total number of birds within a defined area of interest. Density is abundance divided by area, or the number of birds/ha of emergent habitat within a wetland during one season. Surveys rarely count all individuals present in the sampling area because detection probability is typically less than 100%. However, number of birds responding during standardized surveys will provide an index to abundance that will allow comparisons among wetland basins and habitat types. Abundance indices will also allow examination of the effects of management actions (e.g., wetland restoration) on marsh birds by comparing changes in abundance indices between managed and un-managed sites both before and after activities have occurred. Indices also allow comparison among other areas in the region to determine the relative importance/quality of local habitats to regional marsh bird populations. The value of an abundance index relies on a **consistent** positive correlation between number of individuals detected during a survey and number of individuals actually present in the area sampled (i.e., low spatial and temporal variation in detection probability). Few reliable estimates of detection probability during marsh bird surveys are currently available (but see Conway et al. 1993, Legare et al. 1999, Bogner and Baldassarre 2002). However, because we are incorporating methods for estimating components of detection probability into these survey protocols, validation of indices based on call-broadcast surveys for primary marsh bird species will be possible. Because we will estimate distance to each bird detected, we will also evaluate the usefulness of distance sampling to provide estimates of density. We will calculate abundance indices for the primary marsh bird species during the breeding season.

Population trend

Population trend is the percent annual change in population size for a particular species at some defined spatial scale. Estimates of population trend allow managers to determine whether local or regional marsh bird populations are declining. Managers can establish *a priori* population trend thresholds or trigger points below which immediate management action should be taken. Such actions can prevent local extinctions by identifying population problems before they become severe. We will estimate population trends of marsh birds by using weighted linear regression to estimate annual changes in the number of individuals detected per survey point for each target species. Few estimates of marsh bird population trends currently exist, and reliable

estimates of population trends will probably require >5 years of survey data. We will estimate population trends for the primary marsh bird species during the breeding season. We will soon be able to conduct a meaningful power analysis to determine the percent annual change detectable with a specific number of survey points.

Trends in habitat availability

We will also estimate trends in emergent habitat availability at each site. Trends in habitat availability are the percent annual change in the amount of each major wetland habitat type. Information on emergent habitat availability will allow us to: 1) extrapolate density indices to estimate total numbers of marsh birds within a local area, 2) correlate changes in marsh bird numbers with changes in habitat availability to identify potential causes of observed population changes (Gibbs and Melvin 1993), 3) identify emergent habitats that need protection, and 4) design management actions in ways that either improve or minimize adverse effects to preferred habitat of marsh birds.

FIELD PROCEDURES, METHODS, PROTOCOLS

Wetland basins included in surveys

Surveys will be conducted in all emergent marshes (freshwater, brackish, and salt marshes) within the "survey area" that are >0.5 ha in total area. Small, isolated wetland patches (<0.5 ha) can be included, but their inclusion is not mandatory (but once included, they can not be eliminated). The "survey area" can be an entire National Wildlife Refuge (for very small refuges) or a portion of a larger Refuge. If the "survey area" will be a portion of a larger refuge, the participant should divide the refuge or area into *x* potential "survey areas" and randomly select the one (or more) to be used for the survey. Observers should not choose the "survey area" non-randomly based on where they know marsh birds exist (or exist in high density). Such an approach is a biased sampling design that will always lead to perceived population declines (i.e., if you place samples in areas where density is highest then only declines are expected to occur). Hence, we will use an "area-based" sampling frame rather than a "marsh-based" sampling frame. Emergent habitat is not perennial and changes spatially over time - we want a sampling design that allows for that. By sampling "all emergent marshes within one or more defined survey areas" observers will have to add survey points as emergent habitat increases or shifts within their defined management area. If a refuge has various marsh types or fire histories that they want to incorporate into the survey and these marsh types are separated spatially, then the refuge can chose several discrete "survey areas" within which they commit to surveying all of the wetland habitat each year. Once the survey area(s) is selected, a map of the area should be obtained (aerial photo, hand-drawn map, etc.) that identifies roads and extent of emergent marsh patches. Again, **all** marsh patches within the "survey area" must be surveyed each year. As location of marsh patches in the "survey area" change annually, additional survey points must be added to ensure that all marsh patches are surveyed (but no survey points are ever 'dropped' from the survey). Surveys should include as many survey points as needed to cover the area of interest (survey area). The number of survey points to include within a local refuge or management area (or the size of the survey area selected) depends on personnel time available and other logistical constraints. For our pooled analyses, any number of points from a local

refuge will be useful. However, to obtain sufficient data to estimate population trends at the local scale, participants should consider approximately 50 survey points or more at a refuge if possible. More points will provide more power to detect local trends. The number of points to include on a particular survey route can vary among routes. The number of points on a particular survey route should correspond to the number that one surveyor can get done in a morning (or evening) survey window. If points are far apart or you are dealing with isolated wetlands, you may only be able to survey a small number of points in a morning (e.g., 6 or 8 or whatever). This would constitute a "route". If travel between adjacent points is relatively easy and the wetland is large, you may be able to complete 15 or more points in one morning/evening (and hence have 15 points on that survey route). One caveat is that the morning/evening survey window should correspond to when marsh birds are most vocal in your area. Although the protocol says that morning surveys should be completed by 10am, marsh birds in some regions may not be very responsive after 8 or 9am. Including fewer points per survey route and surveying an additional morning (rather than fewer routes with lots of points) will typically result in more detections. Remember, marsh birds are typically most vocal in the 2 hours surrounding sunrise and sunset. Once you choose the direction with which you conduct a particular survey route, be consistent (e.g., always conduct route *X* north to south). Being consistent in this respect will assure that each survey point is completed at the same time of day during each replicate survey. This consistency will help to reduce the bias created by diurnal decreases in vocalization probability of marsh birds as the morning progresses (Conway et al. 2004).

Location of survey points

Fixed, permanent survey points will be chosen and marked with inconspicuous markers in the field. If possible, locations of all survey points should also be plotted on maps of each wetland and UTM locations of each point recorded using a GPS receiver. Maps should include the direction in which the speakers should be pointed during the survey at each point. This is not always obvious to someone who has not surveyed the route before, and may create unwanted variation in numbers detected if speaker direction is not consistent. Point spacing in previous studies has varied from 40m to 800m. The more survey points included in an area, the more precise the resulting estimates of local population change. For the standardized continental monitoring program, distance between adjacent survey points is 400 m to avoid the risk of double-counting individual birds and increase the total area covered by monitoring efforts in a local area. If individual refuges want closer point spacing for some local reason (i.e., 50 points with 400m spacing is not possible at a small refuge) then use 200m spacing between points. We can ignore every other point at that particular site for the shared (pooled) data set if we choose to do so, but the individual refuge will still have an adequate local sample size to detect change over time (we can also use data from these individual refuges to evaluate the magnitude of the problem associated with double-counting if points are 200m apart). Once the survey area is selected, and a map of the survey area is available, the participant should choose the initial survey point randomly based on all possible locations for a survey point (all possible marsh-upland interfaces and all possible marsh-open water interfaces). Subsequent survey points should be at regular intervals of 400m. Survey points in ponds should be located either on the upland-emergent interface or on the open water-emergent interface, whichever will allow easier access and travel between survey points. Some marshes may be more effectively surveyed by

boat (with survey points on the open water-emergent interface) and others more effectively surveyed on foot (with survey points on the upland-emergent interface). Many local marsh bird survey efforts place survey points at the interface between emergent marsh and upland. This approach minimizes travel time between adjacent points, reduces trampling vegetation within the marsh, and may increase the distance at which observers can hear vocalizing birds due to increased elevation relative to the marsh vegetation. Each survey point receives a unique identification number. The number of survey points in each survey area will be correlated with amount of emergent marsh patches within that survey area. In marshlands that have access throughout, points should be in a 400m grid system (hence, 1 point per 16 ha of marsh). Most marshes will not have access to internal areas of the marsh and points in these marshes should be placed along the upland or open water edges. In many locations, emergent habitat occurs in small patchy marshes less than 16 ha in size. Include at least one survey point in all marshes >0.5 ha within the management area. Additional survey points can be added in small marsh patches as long as they are 400m away from all other survey points. If new marsh patches appear in future years in areas within the predefined management area that did not have emergent marsh previously and did not have survey points, additional survey points must be added (provided that they are ≥400m from existing survey points). Original survey points are never dropped from the survey and are always surveyed in subsequent years. If no appropriate marsh exists at an original survey point, then the observers still make an entry for that point but write in the "Comments" column "no survey conducted because no longer appropriate habitat".

Timing of surveys

Survey routes can be either morning or evening survey routes. Observers can conduct either morning or evening surveys on a route as long as each survey route is surveyed during the same period (morning or evening) consistently every year (once a route is designated an evening route, it will always be an evening route in perpetuity). Morning surveys begin 30 minutes before sunrise (first light) and should be completed prior to the time when marsh birds cease calling (but never later than 10:00 am). The time in the morning when marsh birds cease calling varies with weather, time of year, and among regions. Evening surveys begin 4 hours before sunset and must be completed by dark (in some regions, marsh birds may not begin calling until 3 or 2.5 hours before sunset). Vocalization probability is typically highest in the 2 hours surrounding sunrise and the 2 hours surrounding sunset - choose optimal survey windows for your region and stick to them each year. Including both morning and evening surveys into a standardized monitoring protocol will provide added flexibility and more potential survey hours for field personnel. Conduct at least 3 surveys annually during the presumed peak breeding season for all primary marsh birds in your area. Each of the 3 replicate surveys will be conducted during a 10-day window, and each of the 10-day windows will be separated by 7 days. Seasonal timing of these 3 replicate survey windows will vary regionally depending on migration and breeding chronology of the primary marsh birds breeding in your area. The first survey should be conducted when migratory passage is over, but prior to breeding. For example, in south-central Washington the first survey should be between 1-10 May, the second survey 17-27 May, and the third survey 3-13 June. Marsh birds are typically most vocal during courtship and egg-laying periods. Try to maintain 2 weeks between each replicate survey. Surveys in tidal marshes should always be conducted at a similar tidal stage for each replicate survey both within

and across years. The tidal stage within which to conduct local marsh bird surveys should be based on when highest numbers of marsh birds are likely to be detected in your area; optimal tidal stage for surveys may vary among regions. Many salt marsh passerines are forced to renest during the peak spring high tide, and detection probability is highest during the week after a high spring tide. Clapper rail surveys have been conducted during high tide since 1972 at San Francisco Bay NWR, but high tide was a period of reduced vocalization probability for clapper rails in southern California (Zembal and Massey 1987) and for black rails in northern California (Spear et al. 1999). As a general guideline, surveys in tidal marshes should **not** be conducted on mornings or evenings when high or low tide falls within the morning (or evening) survey window. Our intent is to estimate trends over time in the number of breeding adults, so we want to complete all three annual surveys prior to the initiation of juvenile vocalizations. Three or more surveys are needed to confirm seasonal presence/absence of some marsh bird species in a wetland with 90% certainty (Gibbs and Melvin 1993). Three replicate surveys per year is warranted, **especially** in areas where personnel organizing survey times may not initially know local timing of the breeding cycle of their target species. And, timing of breeding cycle differs among co-existing species of interest (e.g., American bitterns often breed much earlier than least bitterns and rails in some regions, and clapper rails and king rails breed earlier than Virginia rails and soras in some regions). Finally, including $\geq$3 replicates per season will provide us with data on temporal variation in numbers counted (a key parameter needed to conduct reliable power analyses once enough preliminary data are available) and also allow us to estimate the proportion of sites occupied by each species (MacKenzie et al. 2002). However, if for some reason you can not conduct $\geq$3 surveys on your area, we can still use your data to estimate detection probability and to compare passive with call-broadcast survey methods. The 3 survey windows increase our probability of conducting at least one survey during the peak seasonal response period of all primary marsh bird species in a local management area. Contact the program coordinator (see contact information below) or your USFWS regional non-game bird coordinator to help choose the most appropriate survey windows for your area if you are unsure. One observer should expect to survey approximately 10-20 survey points each morning, depending on travel times between survey points and length of your broadcast sequence.

Survey methods

These standardized survey methods for marsh birds are based on suggestions from a 1998 multi-agency workshop at Patuxent designed to aid agencies developing marsh bird monitoring programs (Ribic et al. 1999). The survey methods and protocols described here expand upon suggestions made at the Patuxent marsh bird monitoring workshop (Ribic et al. 1999) and incorporate suggestions from Conway and Gibbs (2001) and recent methodological advances in estimating detection probability and observer bias. Because many marsh birds are secretive, seldom observed, and vocalize infrequently, we will use broadcast calls to elicit vocalizations during vocal surveys (Gibbs and Melvin 1993, Conway et al 2004). But because we want to estimate detectability, estimate density using distance estimators, evaluate the usefulness of call-broadcast for future survey efforts, and survey secondary species, we will also record birds during a passive period prior to broadcasting calls.

At each survey point, observers will record all primary species (rails, bitterns, and pied-billed grebe) detected during both a 5-minute passive period prior to broadcasting recorded calls,

and during a period in which pre-recorded vocalizations are broadcast into the marsh. The broadcast sequence includes calls of the primary marsh bird species that are expected breeders in that area and is broadcast using a portable cassette tape player, CD player, or MP3 player. A few potential broadcast systems include:

Cassette Tape Players: Optimus SCP-88 Stereo Cassette Player (Radio Shack #14-1231); or SONY Sports Series CFD-980; or Johnny Stewart Game Caller.

CD or MP3 players: Philips Jogproof CD player AX511217 ($49 at www.surprise.com); Lenoxx, model #CD-50 (Walmart $20); Aiwa XP-SP90 or XP-MP3 Portable CD Player; or Panasonic SL-SX286J or SL-SX280G Personal CD Player (e.g., Radio Shack #14-1231 or #42-6014); or Panasonic SLSX420 ($49.99 Circuit City). Or any cheap portable CD player.

Amplified Speakers: Optimus AMX-4 amplified speakers (Radio Shack #40-1407); or Sony portable speakers (Circuit City for $19.99).

CD or MP3 broadcast equipment will probably produce better quality and more consistent sound than cassette tapes. The recorded calls should be obtained from the Marsh Bird Survey Coordinator (contact info below); request a CD of the species of interest, and we will ensure that it coincides with the protocol. The tape/CD should include exactly 30 seconds of calls of each of the primary marsh bird species interspersed with 30 seconds of silence between each species. The 30 seconds of calls should consist of a series of typical calls interspersed with approximately 5 seconds of silence. For example, an entire survey sequence might look like this:

5 minutes of silence
30 seconds of calls of first primary species configured like this:
- 3 Least Bittern *coo-coo-coo* calls
  - 6 seconds of silence
- 3 Least Bittern *coo-coo-coo* calls
  - 6 seconds of silence
- 4 series of Least Bittern *kak* calls

30 seconds of silence
30 seconds of calls of second primary species configured like this:
- 2 Sora *whinny* calls
  - 5 seconds of silence
- 3 Sora *per-weep* calls
  - 5 seconds of silence
- 4 Sora *kee* calls

30 seconds of silence
30 seconds of calls of third primary species
- etc.

include a verbal "stop" at end of survey interval so that observers know when to stop the tape or CD

The chronological order of calls on the tape/CD will vary with each survey area, but will always be consistent within a particular survey area across replicate surveys and across years. Species to include in the call-broadcast is up to the individual organizing the local survey effort, but we suggest you include all species believed to be local breeders (species for which you expect to get responses). Order of calls should start with the least intrusive species first, and follow this chronological order: Black Rail, Least Bittern, Yellow Rail, Sora, Virginia Rail, King Rail, Clapper Rail, American Bittern, Common Moorhen, Purple Gallinule, American Coot, Pied-billed Grebe, Limpkin. The calls used for broadcast should include at least the primary advertising call of each species (e.g., '*whinny*' for Sora, '*grunt*' for Virginia Rail, '*clatter*' for Clapper Rail and King Rail, '*kickee-doo*' for Black Rail, *'click-click-click-click-click*' for Yellow Rail, '*coo-coo-coo*' for Least Bittern, '*pump-er-lunk*' for American Bittern). Other calls associated with reproduction should be included if the calls are common in your area for that species. Including all the common calls associated with reproduction of each species on the broadcast sequence will increase detection probability during different times of the breeding season and can help observers learn the less common calls of each target species. A list of common calls for each target species is attached. Calls given while flying or after being flushed (not associated with reproduction) are probably not useful to include in the broadcast sequence. Each individual bird detected (for primary species) during the survey period will be entered on a separate line on the field data form (see example data sheet attached). Observers should record when each individual is detected: during any of the initial 1-min passive segments, and/or during any of the 1-min call-broadcast periods. Observers do not record the number of times a bird responded during each segment. Simply record if the individual was detected during each of the 1-minute segments of the survey. Recording all the segments during which an individual bird is detected is extremely important so that we can determine whether call-broadcast is effective at eliciting additional responses for each of the primary species. These data will help us determine whether or not to use call-broadcast of all primary species during surveys in future years. Moreover, recording whether each individual responds during each 1-min sub-segment allows us to estimate detection probability using capture-recapture models (Farnsworth et al. 2002). Estimates of detection probability are essential for regional/national monitoring efforts so that we can determine how well the count data recorded index true population size/trends. Hence, observers must make a decision as to whether each vocalization heard at a survey point is a new individual for that point or is an individual that vocalized previously from that survey point. Observers should also estimate the distance from each individual bird to the survey point. Estimate distance to each bird when the bird is first detected (birds will approach the call-broadcast [Legare et al. 1999, Erwin et al. 2002] so observers need to record the distance to the bird when the bird was first detected). Recording distance to each individual will allow us to use distance sampling to estimate density for each species in each habitat type. Density indices by habitat type are useful because they allow managers to extrapolate survey data to estimate a minimum number of each marsh bird species on their entire management area. Estimating the distance to some individual birds will involve a lot of uncertainty (ie, estimating distance to birds 5m from the surveyor is much easier than estimating distance to birds that are >100m away). Cooperators are encouraged to add an additional column to their datasheet for "accuracy of distance estimate" where they assign accuracy to one of 3 accuracy categories:

1 = distance estimate is relatively accurate [i.e., $\pm$20m]

2 = accuracy of distance estimate is iffy [i.e., ±60m]
3 = accuracy of distance estimate is believed to be poor [i.e., ±100m])

This can be done after the survey is over at each point because the number of birds detected at a point affects the accuracy of distance estimates to each individual bird.

The broadcast player should be placed upright on the ground (or on the bow of the boat), and sound pressure should be 80-90 dB at 1 m in front of the speaker. Use a sound-level meter (available at Radio Shack) to adjust volume of the broadcast player at the beginning of each day. If sound quality distorts when volume on your broadcast equipment reaches 80-90 dB, you should obtain higher quality broadcast equipment. If the ground is wet, place the speaker on an object as close to the ground as possible. Observers should stand 2 m to one side of the speaker while listening for vocal responses (standing too close to the speaker can reduce the observer's ability to detect calling birds). Observers should point the speaker toward the center of the marsh and should **not** rotate the speaker during the call-broadcast survey. Speakers should be pointed in the same direction for all replicate surveys. At points where it is not obvious which direction to point the speakers (i.e., on a road or in a canal between two marshes) surveyors should record this information on a map and on their data sheets and refer to this information on all replicate surveys. If observers detect a new bird immediately after the survey period at a particular point (or while walking between points) they should record these birds in a separate column (e.g., write "before" or "after" in the *Comments* column). Observers have the option of recording secondary species (see attached list of example species). At each point, record the total number of each secondary species detected. Hence, individual birds of secondary species do not receive their own line on the data sheet and observers do not record detections in each of the 1-min sub-segments for secondary species (see example data sheet attached). The secondary species included by a surveyor will depend on the marsh birds of interest at that refuge, management area, or physiographic region. For example, participants may want to include secondary species which are thought to be declining or which are not sampled well by other survey efforts. However, surveyors should limit the number of secondary species to only those species of management concern. Many of the other marsh bird species are adequately sampled by the North American Breeding Bird Survey. Listening or looking for too many secondary species may reduce one's ability to detect primary species.

Surveys should only be conducted when wind speed is <20 km/hr, and not during periods of sustained rain or heavy fog. Even winds <20 km/hr (12 mph) affect the detection probability of marsh birds. Participants should postpone surveys if they believe winds are affecting calling probability of marsh birds. Recommendations for conducting surveys in very windy locations include:

1) determine what time(s) of day have the least wind in your area. The daily survey windows in the protocol are recommendations -survey times should be modified under conditions where wind regularly affects vocalization frequency. The important thing is that surveys are conducted during the same daily time window each year at a particular location, and the survey windows at a particular location should be the time of day/night that has the highest detection probability for your target species in your area. In some locations, surveys conducted after sunset (or before sunrise) may have higher detection probability compared to the morning and evening survey windows recommended in the protocol

because strong winds are less frequent during the middle of the night; and

2) try to be flexible with your schedule if you can. For example, plan to conduct a survey on a particular day but postpone to the following day if its too windy, and keep postponing until you get a low-wind day to complete the survey.

If wind speed increases to above 12km/hr during the survey (or sustained rain begins while the survey is already underway), participants should stop the survey and repeat the entire survey route another day (i.e., don't just go back and repeat the remaining points on the route). When surveyors are using a motorized boat or airboat to travel between survey points, the noise generated by the boat may cause birds to stop calling. In these situations, surveyors may choose to include a "settling" period of a fixed amount of time (e.g., 1 minute) prior to starting the 5-minute passive count at each point. We recommend that **no** settling period be included. If a participant includes an initial settling period prior to each survey, the participant should keep that settling period constant among all points and all replicate surveys. Furthermore, the participant should include a comment on every data form stating that such a settling period during which detections were not recorded was included. If included, make the settling period a part of the written survey protocol so that individuals wishing to repeat the effort in future years will know that a settling period was included.

Some areas or some survey points within a survey area will have so many marsh birds calling that observers will find it impossible to record each sub-segment during which each individual bird is detected. For example, an observer may see/hear >20 coots at one survey point. In these situations, simply write down an estimate of the total number of individuals detected for that particular species during the entire survey period on one line of the data sheet (e.g., write "23 AMCO" on one line of the data sheet - see example on sample data sheet attached).

Always conduct each survey route in the same direction with each survey point surveyed in the same chronology. This will reduce temporal variation in numbers counted over replicate surveys and provide greater power to detect trends.

Which species do I include in the call-broadcast sequence?

Most participants should include all of the "primary species" in the list attached that are thought to breed in the marshes to be surveyed. The # of species included on the call-broadcast portion of the survey increases the duration of the survey by 1 min per species at each point. So, with 8 species, you will spend 13 minutes (including the initial 5 min passive listening period) at each point. For participants who want to reduce the length of time at each point, here are several things to consider: only include species on the call-broadcast that you know/assume are breeders; reduce the # of species on the broadcast segment in year 2 to include only those that responded during surveys in year 1 (simply request a new CD); do not include very common species that are fairly well monitored by other survey efforts (e.g., AMCO) in the call-broadcast segment. All observers should still record all detections of all primary marsh bird species, even if you decide not to include all primary species present in your area in the broadcast sequence.

Filling out the data sheet

The data sheet included below must be tailored by each participant to reflect the number and identity of species the participant includes on the broadcast sequence for their area. The number of species columns on the data sheet will differ regionally; include only those species for which call-broadcast is used in your survey (see the 3 sample data sheets attached). For example, if you intend to only broadcast calls of 3 species, then you will have an 8-minute survey sequence at each point (5 minutes of passive listening and 1 minute of call-broadcast for each of 3 species) and will need a data sheet with 8 response columns. If you intend to broadcast calls of 5 species, you will have a 10-minute survey sequence at each point (5 minutes of passive listening and 1 minute of call-broadcast for each of 5 species) and will need a data sheet with 10 response columns. See the example data sheets attached. Prior to the beginning of the survey, write down the day, month, and year at the top of the data sheet. Also write the full name of all observers present during the survey. If more than one observer, write down who recorded the data and **all** individuals that helped identify calling birds. Using multiple observers to detect birds at a point may confound observer bias issues when estimating trend, so its important to record any and all observers who contributed to marsh bird detections (see paragraph regarding double-observer surveys at end of this protocol). Write down the name of the marsh, the name of the refuge and/or management area, and other location information (distance and direction to nearest town, county, state). Write down whether this is the first, second, or third survey of the year at these points in the "Survey #" space at the top of the data sheet. Record ambient temperature, wind speed, wind direction, % cloud cover, precipitation, and other notes of weather conditions, and whether (and when) conditions change during the course of the morning.

When you arrive at the first survey point, write down the unique identification number of the survey point and the time. Start the survey. When a bird is detected, write the species name in the "Species" column. You can use the 4-letter acronym for the species or write the full species name. A list of 4-letter AOU species acronyms is attached to this protocol. Put a "**1**" in each column in which that individual is detected based on vocalizations and put a "**s**" in each column in which the individual is detected visually (including flying overhead). For example, if an individual Virginia Rail calls during the first 1 minute of passive listening, put a "1" in the first column. Regardless of whether that individual calls once or many times during the first minute, you only put one "1" in the first column. If that same individual bird is still calling during the second minute of passive listening, then also put a "1" in the second column. If the same individual calls during the 30 second Sora sequence or the 30 seconds of silence immediately following the Sora sequence, put a "1" in the column for "SORA". If that same individual bird calls again during the Virginia Rail sequence, you also put a "1" in the column "VIRA", and so on. Hence, if an individual bird is calling constantly throughout the survey period, you will have a "1" in every column for that individual. If the individual is heard **and** seen, put both a "1" and a "**s**" in the appropriate column. If you hear a call of the same species but from a different individual (or from an individual of another species), you start a new line on the data sheet and follow the same protocol just described for this individual bird. The difficulty is determining whether a call is coming from a new individual or a individual detected earlier at that survey point. Observers must make this decision without seeing the bird by using their best judgement. Follow the same procedure at subsequent survey points. If an individual detected at one survey point is thought to be an individual that was recorded at a previous survey point,

write "y" in the "*Detected at a Previous Point*?" column. Be conservative when in doubt as to whether an individual bird detected at the current point was the same individual recorded at a previous point (i.e., record "y" when in doubt). The number of lines filled out on the data sheet will differ among survey points and will correspond to the total number of individual marsh birds detected at each point. If no marsh birds are detected at a survey point, record the point number and starting time, and write "no birds" in the comment column. A sample data sheet is included as an example of what survey data might look like. If the observer hears a marsh bird but is unsure of its identity, the observer should write "unknown" in the Species column and record all data for this individual as described above. Make a verbal description of the unknown call in the *Comments* column (e.g., 'soft kak-kak-grr - sounds like BLRA but harsher'). This will aid future identification of unknown calls if that call is heard repeatedly. When the survey is complete at a point, write down the UTM coordinates (and datum used) from the GPS unit (or return on another day and record). Because location of survey points may affect trends, record whether each point is adjacent to an upland-wetland interface, a water-wetland interface, is in the marsh interior, and/or is along a roadside. Record any ancillary information that may have influenced vocalizations or detection probability in the Comments column (e.g., record whether surveyor is using a different boat or different boat motor that is more or less noisy than that used on previous surveys). There are indications that periodic burning of emergent marshes may benefit some marsh birds. Indeed, several refuges are involved with local studies examining the effects of fire on marsh birds. Hence, it would be useful for all participants to record the "month and year of last burn" for the 100-m radius area surrounding each survey point. If all you know is that the area surrounding a particular survey point hasn't burned in the past *x* years, then record >*x* years at that point. This information will allow us to evaluate the effects of fire on marsh bird abundance at a large (continental) spatial scale with the pooled data. The data produced will supplement the more detailed studies evaluating the effects of fire being conducted on specific refuges and will help make management recommendations regarding the usefulness of fire as a tool for managing marsh bird populations.

Difficulty when many individuals of the primary species are detected at a point

Because many of these species occur at relatively low densities through much of their range, most participants will detect few or no individual birds at any given survey point. However, the large number of individuals detected at some points make recording difficult. For example, if >5 individuals of 1 species are heard during any 1-minute segment during the survey, I have difficulty recording them all in the correct columns/rows and keeping up with which row goes with which individual bird. When many birds are calling simultaneously, it can be difficult for the observer to 1) decide whether they are hearing new individuals or previously-detected ones, 2) write new individuals on a new line of the datasheet, and 3) find the correct line where they wrote down previously-detected birds. In these situations, here are a few comments, observations, and suggested remedies. First, individual surveyors do get better at this with practice even with relatively high numbers of calling birds at a point. However, everyone has a threshold when the numbers of calling marsh birds get too high at a particular point. This problem occurs more frequently when a cooperator has lots of species (and hence columns) on their call-broadcast sequence. If a participant knows at the end of the call-broadcast at a particular point that he/she was overwhelmed and didn't effectively assign the correct calls to the

correct columns (individuals), then write a note in the Comments Column saying that the sub-interval information is dubious. If this problem is common on your surveys, below is a list of solutions in decreasing order of preference. If you choose options #3 or #4 you need to make a very clear comment on your data sheet about what you were and were not recording at each point:

1) Include a circle next to each marsh bird detected and make a 'tick' identifying the general direction of that individual (this will help you differentiate one individual from other individuals of that species as more are detected at that point),
2) Reduce the number of species in your call-broadcast sequence. Only use call-broadcast for species of management/conservation interest and/or species known to respond well to call-broadcast (e.g., eliminate bitterns, coots, pied-billed grebes, and moorhens from your call-broadcast sequence so that you have <5 species on your call-broadcast sequence). Still record data for all individuals of all marsh bird species in the same way, but just reduce the # of columns.
3) For those primary species that are of lower management/conservation interest in your survey area (e.g., coots, moorhens, pied-billed grebes), only record the total number of individuals detected at that point and only use the sub-intervals for the primary species of higher management concern (e.g., black rails, yellow rails, king rails, clapper rails, bitterns). Make sure you make a clear note on the top of your datasheets that explains your deviation from the standard protocol.
4) Only record the **first** interval during which each individual is detected (as opposed to each and every interval). Be sure that you make a clear note on the top of your datasheets that you are only recording the **first** interval during which each individual is detected.

Habitat measurements

Natural changes in water level and management activities (e.g., dredging, wetland restoration efforts, prescribed burning, etc.) can lead to dramatic changes in marsh vegetation. Patterns of distribution and local population trends of marsh birds can often be best explained by local changes in wetland vegetation. Consequently, quantifying the proportion of major vegetation types (e.g., % *Typha domingensis*, *Scirpus olneyi*, *Scirpus californicus*, *Phragmites communis*, *Spartina foliosa*, *Salicornia virginica*, *Baccharis glutinosa*, *Populus fremontii*, open water, mudflat) surrounding each survey point each year can help identify the cause of observed changes in marsh bird populations. Vegetation will be quantified at 2 scales: observers should visually estimate the proportion of each major vegetation type within a 50m-radius circle around each survey point, and aerial photographs will be used to periodically determine the amount of each major vegetation type on the management area. In some locations, there is substantial seasonal change in annual growth in emergent plants. Participants should record vegetation data at a time that overlaps the breeding season for all of their target marshbirds. The important thing is to sample at a time when you are most likely to detect important changes in vegetation 5 or 10 years from now (changes that might help explain increases or decreases in number of marshbirds detected). If the vegetation doesn't change during the annual survey period, participants should consider quantifying vegetation within the 50-m radius circles during their final survey each year. However, **vegetation data does not have to be collected while the vocal survey is being conducted** (it might be most effective to make a separate trip to each survey point to collect

vegetation data). Whichever time vegetation surveys are conducted, participants should be sure to quantify vegetation at that same time each year. As an example, visual estimates of proportions of each vegetation type at a survey point might look like this: 15% water, 10% California bulrush, 20% three-square bulrush, 5% southern cattail, 20% seep willow, 10% mudflat, 20% upland shrub community. Record vegetation data to the species level because some marsh birds preferentially use only one species of emergent plant. Record vegetation data in the Comments column of the data sheet or on a separate data form. Vegetation at each point is only recorded once each year. Participants should enlist the help of a botanist or other qualified assistance to conduct vegetation surveys (remember, these survey do not have to be conducted during one of your vocal surveys). If the vegetation changes substantially at a particular point during the course of a single survey season, participants should make a note in the Comments column stating how the vegetation has changed over the course of the season. Participants should collect vegetation data at all points each year (even if no emergent vegetation currently exists at some points during some years) to document changes over time in habitat availability. Not conducting the marsh bird survey at a set of points from a previous year due to lack of suitable habitat may occur in some years due to reduction in the water table, but you should still fill out a data sheet for these points and write in the Comments section "these points were not surveyed due to lack of suitable emergent vegetation resulting from local/regional drought". It is important that we do this so that the points get entered into the regional database as "no suitable habitat" (as opposed to failure to survey for logistical reasons). Because most survey points will be at the marsh/upland or marsh/open-water interface, approximately half of the 50-m radius circle within which you record vegetation data might be “upland vegetation". There is no need to characterize upland vegetation by species. Hence, include categories in your vegetation classification called "upland vegetation", “road”, and "open water" if appropriate. There may be some points that are on peninsulas or in narrow open water channels (surveyed by boat) and these points may have emergent marsh within most of the 50-m radius circle. Differentiating plants by species is difficult in some taxa and not all participants will be able to consult with a botanist prior to categorizing the vegetation types at each of their survey points. In these cases, participants can pool species by taxa or functional group (e.g., sedge spp., bulrush spp., mixed shrub). Aerial photographs of the entire survey area that allow delineation of the area of emergent vegetation should be obtained annually if possible.

Personnel and Training

All observers should have the ability to identify all common calls of primary and secondary marsh bird species in their local area. Regularly listening to the recorded calls used for surveys can help learn calls, but observers should also practice call identification at marshes (outside the intended survey area if necessary) where the primary species are frequently heard calling. All observers must pass a self-administered vocalization identification exam each year prior to conducting surveys. This exam should be a sequence requested from the program coordinator. Observers should not have heard the exam CD prior to taking the exam. All observers should also be trained to accurately determine distance to calling marsh birds, and to identify the common species of emergent plants on the management area. Methods for training observers to accurately estimate distance include: 1) place a tape recorder in the marsh at an known distance and have observers estimate distance, 2) choose a piece of vegetation in the

marsh where the bird is thought to be calling from and use a range-finder to determine distance, 3) have an observer estimate the distance to a bird that is calling with regularity and is near a road or marsh edge, then have a second observer walk along the road/edge until they are adjacent from that calling bird, and then measure this distance (by pacing or use of a GPS) and see how accurate the observer was at estimating distance. *Two-observer surveys* (see below) are very useful here - after the survey is complete have the 2 observers discuss not only what they heard, but how far each person estimated the distance to each bird. Periodic double-observer surveys not only produce estimates of detection probability (see below) but also allow participants to determine whether one person is constantly underestimating or overestimating distance to calling birds. Observers should also have a hearing test (audiogram) at a qualified hearing or medical clinic before, during, or immediately after the survey season each year. These data will be included as a covariate and will help control for observer bias in trend analyses. New participants should do at least one "trial run" before their first data collection window begins because it takes time to get used to the data sheet and recording the data appropriately.

Equipment/materials

Where possible, fixed survey points will be permanently marked with inconspicuous markers and numbered. Portable GPS receivers should be used to mark survey points onto aerial maps. GPS coordinates of each permanent survey point should be recorded and saved for reference in future years. CDs with calls of primary species should be obtained from the program coordinator (see contact info below), and new CDs should be requested if quality declines. CD players and amplified speakers should be good quality and batteries should be changed or re-charged frequently (before sound quality declines). Participants should routinely ask themselves if the quality of the broadcast sound is high. Observers should always carry replacement batteries on all surveys. A sound level meter with $\pm$5 dB precision (e.g., Radio Shack model #33-2050 for $34.99; or EXTECH sound level meter, $99 from Forestry Suppliers, Inc.) should be used to standardize broadcast volume (alternatively, Radio Shack should be willing to help you set your broadcast level appropriately using the sound meter in the store). If participants need help with purchasing broadcast equipment, contact the coordinator below. A small boat/canoe may be useful for surveying larger wetland habitats adjacent to open water, reducing travel time between survey points. When using a boat, use the same boat and motor on each survey each year to control for possible effects of engine noise on detection probability. If a different boat or different motor is used (or the same boat/motor just sounds better or worse than usual) make a note of the change in the *Comments* column. A spare CD player should be kept close-by in case the primary unit fails to operate. Three prototype field data forms for use on vocal surveys are attached to this protocol. The number of columns on the data sheet will vary among survey areas depending on the number of bird species included in the call-broadcast segment of your survey so participants will have to tailor one of the data sheets below to suite their own broadcast sequence.

DATA COLLECTION, ANALYSIS, SUMMARY AND ROUTINE REPORTING

A. Field data. Field data will be manually entered in the field on a data form (see example attached) and transferred weekly to an electronic form. At each survey point, observers

should record: full name of observer, name of data recorder (if different from observer), name of wetland, date, survey point #, start time, species of each individual detected, the intervals during which each bird was detected, and distance to each individual bird from the survey point. Each individual bird detected should be recorded on a new line on the data form. An overview map of the survey area with all roads and all survey points numbered on the map should be developed for field personnel conducting surveys and made available for future years. All data forms should be reviewed by a supervisor within 24 hours of each survey so that mistakes can be identified and corrected promptly. Copies of original data forms should be stored in two separate locations.

B. Data entry/Database management. Data will be entered into a common spreadsheet program (EXCEL, Lotus, QuattroPro, dBase, etc) as soon after collection as possible, preferably within 1 week of data collection. Timely data entry limits mistakes, reduces probability of loss of data, and helps identify potential sampling biases and logistical problems that might be corrected in future surveys. Completed surveys will be printed out after entry into the spreadsheet and compared to original data forms to assure data quality. Electronic spreadsheets containing field data will be backed up weekly. If data entry time is not available at the local site, send copies of the data sheets to the address below and we will enter the data for you. Submit your data promptly at the end of the field season to the address below so that regional summaries and analyses can be conducted and sent back to program participants. Also, submit a copy of the tape or CD used during the survey effort on your area.

C. Data reporting. Send or email the name, address, phone#, and email address of all participants to the address below. This list will be used to disseminate information to each participant at the end of each field season and to send results of annual data analyses. An annual report should be completed each year for each site. After each season, survey data should be summarized and summaries should include the mean number of individuals detected per survey point during both passive and broadcast periods for each marsh bird species. Summaries should identify locations on the management area with seasonal concentrations of marsh birds. After several years, survey data can be used to estimate population trends of marsh birds on the management area using regression analyses. Survey data will also allow comparison of birds detected during initial passive periods and during call-broadcast to evaluate the usefulness of using call-broadcast surveys to monitor marsh birds. These comparisons will allow improvement of field methods in future years. On a regional basis, estimates of population trend from areas undergoing management activities can be compared to trends from areas that have not been subject to management activities to evaluate the long-term effectiveness of management efforts.

REGIONAL CONTEXT AND INTEGRATION WITH OTHER MONITORING PROTOCOLS

Estimates of population change in marsh bird populations on the survey area will be compared to local population changes in other parts of the region and to other regions. Comparisons among other local areas in the region will allow local managers to determine the importance of local wetlands to regional population health by identifying whether marsh bird

populations on their management area are doing better or worse relative to other areas. Several U.S. Fish and Wildlife Service National Wildlife Refuges began using these marsh bird survey methods in 1999. We currently have over 60 refuges and management areas participating. We will continue refinement of survey methods based on feedback, logistical problems identified, and inconsistencies identified by participants. Your participation is needed now to ensure that **your** national monitoring program works. Survey data collected using the protocol described above will help our efforts to develop the most rigorous continental monitoring program possible for marsh birds. Please send any survey data to the address below. For assistance obtaining appropriate CDs, additional information, or questions regarding standardized marsh bird survey methods, please contact:

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USGS-BRD
Arizona Coop. Fish & Wildlife Research Unit
104 Biological Sciences East
University of Arizona
Tucson, AZ 85721
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ADDITIONAL OPTIONAL COMPONENTS TO SURVEY PROTOCOL

Recording water depth at each point (or each management unit)

Water level definitely influences abundance and distribution of marsh birds. Water levels vary annually and even daily in some marshes and these fluctuations can explain spatial and temporal changes in marsh bird abundance. Some National Wildlife Refuge control water levels in some of their management units and have the ability to directly benefit marsh birds via water management. Participants are encouraged to place gauges for measuring water level in permanent locations at numerous points within their survey area(s). Water level should be recorded before or after each marsh bird survey. If water levels vary annually (or seasonally) within your survey area, we recommend that this component be incorporated into your marsh bird survey effort.

Recording noise level at each point

Recording the level of background noise during the survey at each survey point is useful for trend analysis. This information can be used as a covariate in future trend analyses because level of background noise varies spatially and temporally and influences detection probability. Categorize background noise at each point on a scale from 0 to 4 (0= no background noise, 1=faint background noise, 2=moderate background noise (probably can't hear some birds beyond 100m), 3=loud background noise (probably can't hear some birds beyond 50m), 4=intense background noise (probably can't hear some birds beyond 25m). Each cooperator can decide whether they have the time and/or need to record noise level at each point. If noise levels are periodically high enough to reduce observers' ability to detect calling marsh birds, this

optional component is recommended.

Recording types of calls given

Knowing season patterns of different call types in a local area provides useful information. For example, the frequency of different calls given (e.g., single *clatter*, paired *clatter*, *kek*, or *kek-burr* for a clapper rail) varies throughout the season. Frequency of different calls given may also vary across regions. Different call types have different functions and can indicate pairing status and stages of the nesting cycle in a local area (allowing refinement of local survey windows). Moreover, detection probability and observer bias may differ with different call types (e.g., least bittern '*kak*' and Virginia rail '*tick*' can be confused with clapper rail '*kek*' calls) and accuracy of distance estimation may vary with call type. Hence, incorporating call types into trend analyses can potentially increase power to detect true population trends. For these reasons, observers are encouraged to record all types of calls given for each target marsh bird detected. Add an additional column (*"Calls*") to your data sheet and record call type(s) given for each individual bird detected (see sample data sheets).

Multiple-observer surveys

Estimating detection probability associated with a particular survey protocol is essential when attempting to interpret count data produced from a monitoring program. The extent to which trends in count data represent the underlying trend in true abundance depends on detection probability and observer bias associated with the particular survey method. We will estimate observer bias associated with our survey effort using the double-observer method (Nichols et al. 2000). This approach involves 2 or more trained observers recording data independently at a series of survey points (Conway et al. 2004). Hence, whenever possible, surveys should be conducted by 2 or more observers simultaneously. Each observer should fill out a separate data sheet and should record their data separately without discussing anything with the other observer. Observers should not point out a call or a bird to the other during the survey period. Each observer should stand 1-2 meters away from each other and should keep their pen on their data sheet at all times so that one observer is not cued by the sudden writing activity of another observer. Once the survey at a particular point is completed, the observers can look over each others data at that point and discuss discrepancies, but that data should not be altered; obvious mistakes should be noted in the *Comments* column **but not changed.** The differences between the observers in number of birds detected at each point is what allows us to estimate observer bias so these differences should not be altered. Double-observer surveys will obviously not be possible at all times and at all locations, but try to use multiple observers whenever possible so that we can obtain sufficient data to estimate observer bias.

Recording salinity content of water

In coastal marshes or any marshes with varying salinity levels, participants are encouraged to record the salinity content of the water directly in front of each point on each survey. Salinity levels affect use by various species of marsh birds and such information is relatively easy to collect and can be used as covariates to control for variation in models estimating population change. Participants can get an Oregon Scientific Handheld Salinity Meter [ST228] for $25.

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National Marsh Bird Monitoring Program Survey Data Sheet

Date *(eg 10-May-04)* **:**

Name of marsh or route :

Observer(s) *(list all)** **:**

Survey replicate # :

	Before	**After**
Temperature *(°F)* **:**		
Wind speed *(mph)* **:**		
Cloud cover *(%)* **:**		
Precipitation *(see below)* **:**		

**list all observers in order of their contribution to the data collected*

put an "S" in the appropriate column if the bird was seen, a "1" if the bird was heard, and "1S" if both heard and seen

Station#	Start Time (military)	Background noise	Species	**Responded During:**											Call Type(s)	Direction	Distance (meters)	Detected at a Previous Point	Comments
				Before	Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA 5-6	LEBI 6-7	VIRA 7-8	CLRA 8-9	After					

Call Types: BLRA: *kicky-doo, grr, churt* CLRA: cltr, kburr, kek, khurrah LEBI: *coo, kak, ert* VIRA: *grunt, ticket, kicker*

If the call type is not one of the above listed types, describe the call in the comments column

Precipitation: light rain, rain, heavy rain, light snow, snow, heavy snow, fog, none

Background noise: 0 *no noise* 1 *faint noise* 2 *moderate noise (probably can't hear some birds beyond 100m)*
3 *loud noise (probably can't hear some birds beyond 50m)* 4 *intense noise (probably can't hear some birds beyond 25m)*

Pg___of____

Date *(eg 10-May-04)*: **Name of marsh or route :** **Observer(s)** *(list all)**:

Station#	Start Time (military)	Background noise	Species	Responded During:											Call Type(s)	Direction	Distance (meters)	Detected at a Previous Point	Comments
				Before	Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA 5-6	LEBI 6-7	VIRA 7-8	CLRA 8-9	After					
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National Marsh Bird Monitoring Program Survey Data Sheet

Date *(eg 10-May-04)* **:** *20 April 2006*

Name of marsh or route : *Hidden Shores Marsh*

Observer(s) *(list all)**: *Chris Nadeau, Bob Blabla*

Survey replicate # : *2*

	Before	After
Temperature *(°F)* **:**	*10*	*21*
Wind speed *(mph)* **:**	*0*	*1*
Cloud cover *(%)* **:**	*15*	*60*
Precipitation *(see below)* **:**	*none*	*none*

**list all observers in order of their contribution to the data collected*

put an "S" in the appropriate column if the bird was seen, a "1" if the bird was heard, and "1S" if both heard and seen

Station#	Start Time (military)	Background noise	Species	Responded During: Before	Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA 5-6	LEBI 6-7	VIRA 7-8	CLRA 8-9	After	Call Type(s)	Direction	Distance (meters)	Detected at a Previous Point	Comments
HSM1	*1710*	*0*	*BLRA*		*1*	*1*				*1*					*grr*		*95*	*N*	
			BLRA			*1*				*1*	*1*	*1*	*1*	*1*	*kicky-doo*		*110*	*N*	
			VIRA				*1S*					*1*			*ticket, grunt*		*30*	*N*	
HSM2	*1721*	*1*	*CLRA*	*1*											*p-cltr*		*40*	*N*	
			CLRA	*1*											*p-cltr*		*45*	*N*	
			VIRA									*1*			*grunt*		*100*	*Y*	
			CLRA											*1*	*throaty hoo*		*10*	*N*	
HSM3																			Not surveyed unsuitable habitat
HSM4	*1750*	*1*	*COMO*		*1*	*1*	*1*		*1*		*1*		*1*		*wipeout*		*150*	*N*	
			SORA									*1*			*perweep*		*210*	*N*	

Call Types: BLRA: *kicky-doo, grr, churt* CLRA: cltr, kburr, kek, khurrah LEBI: *coo, kak, ert* VIRA: *grunt, ticket, kicker*

If the call type is not one of the above listed types, describe the call in the comments column

Precipitation: light rain, rain, heavy rain, light snow, snow, heavy snow, fog, none

Background noise: 0 *no noise* 1 *faint noise* 2 *moderate noise (probably can't hear some birds beyond 100m)*

3 *loud noise (probably can't hear some birds beyond 50m)* 4 *intense noise (probably can't hear some birds beyond 25m)*

List of AOU 4-letter species acronyms for primary marsh birds in North America.

Primary species

SORA	sora
VIRA	Virginia rail
CLRA	clapper rail
KIRA	king rail
BLRA	black rail
YERA	yellow rail
AMCO	American coot
COMO	common moorhen
PUGA	purple gallinule
LIMP	limpkin
PBGR	pied-billed grebe
AMBI	American bittern
LEBI	least bittern

Examples of Secondary Species (these are just some examples - there are other wetland birds that a participant may want to include; each cooperator should decide which secondary species to include in their surveys in advance and list these species on their datasheet so that all participants in future years will know the list of species recorded in prior years)

LEGR	least grebe (1 cooperator has included LEGR in their call-broadcast sequence)
EAGR	eared grebe (1 cooperator has included EAGR in their call-broadcast sequence)
GRHE	green heron (1 cooperator has included GRHE in their call-broadcast sequence)
GBHE	great blue heron
GLIB	glossy ibis
WFIB	white-faced ibis
WHIB	white ibis
NOHA	northern harrier
SACR	sandhill crane
WILL	willet
WISN	Wilson's snipe (1 cooperator has included WISN in their call-broadcast sequence)
FOTE	Forster's tern
BLTE	black tern
BEKI	belted kingfisher
ALFL	alder flycatcher
WIFL	willow flycatcher
SEWR	sedge wren
MAWR	marsh wren
COYE	common yellowthroat
YEWA	yellow warbler
SSTS	saltmarsh sharp-tailed sparrow
NSTS	Nelson's sharp-tailed sparrow
LCSP	LeConte's sparrow
SWSP	swamp sparrow
SAVS	Savannah sparrow
SESP	seaside sparrow (1cooperator has included SESP in their call-broadcast sequence)
RWBL	red-winged blackbird
YHBL	yellow-headed blackbird
BTGR	boat-tailed grackle

List of the most common calls for the primary target species of marsh birds

Black Rail: *kickee-doo* (primary breeding call), *grr-grr-grr, churt, ticuck*
Least Bittern: *coo-coo* (male advertisement), *kak-kak-kak*, *gack-gack* (given from nest), *ank-ank* (given when flushed)
Yellow Rail: *click-click*, *wheese* (female call), *descending cackle* (pair maintenance), *squeak* (given by retreating bird)
Sora: *whinny* (territorial defense and mate contact), *per-weep*, *kee* (may be given to attract mates)
Virginia Rail: *grunt* (pair contact, territorial call), *tick-it* (male advertisement call), *kicker* (female advertisement call), *kiu* (sharp, piercing call)
King Rail: *chac-chac* (pair communication), *kik-kik-kik* (mating call)
Clapper Rail: *clatter* (pair contact, territorial call), *kek* (male advertisement call), *kek-burr* (female advertisement call), *kek-hurrah ,hoo, squawk* (chase squeal), *purr*
American Bittern: *pump-er-lunk* (territorial/advertisement call), *chu-peep* (given during copulation ceremony), *kok-kok-kok* (given when flushed)
Common Moorhen: *cackle* (primary advertising call), *squawk, yelp, cluck*, *purr*
Purple Gallinule: *cackle* (primary advertising call), *squawk*, *grunt*
American Coot: *pow-ur* (crowing for territorial defense), *puhk-ut* (warning), *puhk-kuh-kuk* (crowing for territorial challenge), *puhlk*, *tack-tack* (cackling), *kerk* (sharp cough)
Pied-billed Grebe: 3-part gurgling song, *quaa-aaa-aaa* (wavering, guttural copulation call), *kwah* (alarm call), *ek-ek-ek* (rapid, staccato greeting call), *tshick-tshick*
Limpkin: *krr-oww*