U.S. Fish and Wildlife Service
U.S. Department of the Interior

National Wildlife Refuge System

National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats

An Integrated Waterbird Management and Monitoring Initiative (IWMM) Approach

Version 1.0 **January 2015**

ON THE COVER
Northern pintails in a shallow managed wetland. Photo Credit: William Coatney, St Louis, MO.

National IWMM Protocol Signature Page

Protocol Title: National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats, An Integrated Waterbird Management and Monitoring Initiative (IWMM) Approach

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Approvals

Action	Appropriate Signature/Name	Date
Survey Coordinator[2] Submitted by:		
Zone I&M[3] or equivalent Approval:		
Regional I&M[4] Approval:		
National I&M[5] Approval:	Jana Newman, National I&M Manager	1/22/2015

Version[1]	Date	Author	Change Made	Reason for Change

[1] Version is a decimal number with the number left of decimal place indicating the number of times this protocol has been approved (e.g., first approved version is 1.0.; prior to first approval all versions are 0.*x*; after first approval, all minor changes are indicated as version 1. *x* until the second approval and signature, which establishes version 2.0, and so on).

[2] Signature of station representative designated lead in development of a site-specific survey protocol.

[3] Signature signifies approval of a site-specific survey protocol.

[4] Signature by Regional I&M Coordinator signifies approval of a protocol framework to be used at multiple stations within a Region.

[5] Signature by National I&M Coordinator signifies approval of a protocol used at multiple stations from two or more Regions.

Survey Protocol Summary

This protocol provides a framework for rapidly assessing local habitat conditions and quantifying use of wetlands by waterfowl, shorebirds, and wading birds (hereafter referred to as waterbirds) during non-breeding periods. The majority of survey techniques described herein involve whole-wetland visual assessments of habitat conditions or counts of waterbirds conducted from the wetland perimeter. This protocol framework was developed as part of the Integrated Waterbird Management and Monitoring (IWMM) Initiative, a large-scale waterbird habitat conservation strategy currently focused on the U.S. Fish and Wildlife Service's (USFWS) Regions 3, 4, and 5. A primary purpose of this protocol is to standardize waterbird and habitat monitoring during the non-breeding period at a local-scale. Resulting data can then be compiled and analyzed across broader geographic units. IWMM is a collaborative effort including the USFWS, the U.S. Geological Survey, the States, Ducks Unlimited, and other non-governmental agencies. The content and structure of the protocols described below follows standards set forth in the U.S. Fish and Wildlife Service's *How to Develop Survey Protocols: a Handbook (Version 1.0)*. Each of eight elements is addressed, including a protocol introduction, sampling design, field methods, data management, analysis, reporting, personnel requirements and training, operational requirements, and references. Additionally, a series of standard operating procedures provides greater detail on recommended methods and technical aspects of this protocol. Data entry, archival, and multi-scale analysis are handled through an online database that is part of the Avian Knowledge Network. When their management objectives and information needs are similar, other USFWS Regions and partners are encouraged to use this framework to develop site-specific guidance for their waterbird and habitat condition surveys.

Suggested citation:
Loges BW, Tavernia BG, Wilson AM, Stanton JD, Herner-Thogmartin JH, Casey J, Coluccy JM, Coppen JL, Hanan M, Heglund PJ, Jacobi SK, Jones T, Knutson MG, Koch KE, Lonsdorf EV, Laskowski HP, Lor SK, Lyons JE, Seamans ME, Stanton W, Winn B, and Ziemba LC. 2014. National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats, an Integrated Waterbird Management and Monitoring Initiative (IWMM) approach. Natural Resources Program Center, Fort Collins, CO.

This protocol is available from ServCat: [http://ecos.fws.gov/ServCatFiles/Reference/Holding/40341]

Acknowledgments

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Contents

Narratives

Element 1: Introduction

Background

The Integrated Waterbird Management and Monitoring (IWMM) program was initiated by conducting structured decision-making (SDM) workshops to develop an operational framework for management and monitoring of waterfowl, shorebirds, and wading birds, collectively referred to as waterbirds, at the local, regional and flyway spatial scales (Coppen et al. 2007, Laskowski et al. 2008, Lor et al. 2008). Through these workshops the IWMM initiative developed a multi-scaled adaptive management process that will inform local, regional/state, and flyway managers about how they can best meet the needs and support populations of migrating and wintering waterbirds. The program includes a monitoring component that assesses how well managers at all scales are meeting their management objectives and an adaptive feedback loop that allows managers to adjust their management to address emerging threats.

This protocol framework was developed to guide the local monitoring component of the IWMM program at units within the National Wildlife Refuge System. As a protocol framework, it should be used by those cooperating in the IWMM program to develop site-specific protocols for inventory or monitoring of nonbreeding waterbirds and their habitats. Though this protocol framework was developed with emphasis on guiding surveys that inform management within and among Refuge System stations, it can also be used by other cooperators of the IWMM program.

Many state and federal lands in the Atlantic and Mississippi Flyways are managed to provide habitat for migrating or wintering waterbirds. Likewise, many state agencies have developed regional approaches to waterbird monitoring. Illinois has conducted continuous inventories of the middle Mississippi and Illinois River valleys since 1948 (Havera 1999). Several other states in the Midwest and lower Mississippi have recently developed or are developing aerial inventories with statistically valid sampling designs. Despite several limitations, mid-winter inventories have proven useful in assessing American black duck abundance and distribution in the Atlantic Flyway (Heusmann 1999, Brook et al. 2009). In addition to the benefits gained from the midwinter survey and many regionally coordinated efforts, a strategic approach to waterbird conservation will benefit from the integration of waterbird monitoring at national wildlife refuges, state, regional, and flyway scales (Soulliere et al. 2013).

The focus of this framework is a multi-species group of waterbirds that use the Atlantic and Mississippi Flyways of North America during winter and migration (excluding cryptic and secretive marshbirds; Conway 2011). Because every species has its own set of habitat needs, managers must consider many factors when integrating management of multiple species or groups. These factors include the annual wetland hydrological cycle, targeted portion of species' annual life cycles (Williams et al. 1996), budget and staff resources (i.e., capacity), and physical constraints of the wetlands being managed. The dynamic and interactive nature of these factors often presents different management opportunities or problems. Consequently, managers typically adjust objectives for different wetland units on an annual basis to take into consideration changing conditions. Site-specific versions of this protocol will help managers collect the data needed to inform these types of local management decisions.

Objectives

Management and sampling objectives should be considered when using this framework to develop site-specific guidance (USFWS 2013). Both types of objective statements should be sufficiently detailed, preferably following the SMART model (specific, measurable, achievable, results-oriented, time-fixed, and supported by a rationale statement; Adamick et al. 2004). Sampling objectives should be deduced from details provided in management objectives to help ensure suitable information is collected to inform management decisions. Elzinga et al. (2001:265–270) provide examples of detailed sampling objectives.

Both types of objective statements can vary according to spatial and temporal scales. In general, the results of surveys that follow this protocol will be useful for informing active management of waterbird habitat at local scales and broader waterbird conservation across multiple geographic scales. Sampling objectives will typically entail obtaining measures of waterbird habitat condition and the use of that habitat by multiple species of waterbirds. In a spatial context, these efforts may range from individual impoundments to Bird Conservation Regions. Temporally, survey efforts may range from short mid-winter periods to the entire nonbreeding portion of a species' annual life cycle.

This framework may be applicable to a number of local management or conservation objectives, which in turn, will require varying kinds of sampling objectives. We anticipate that local management objectives will require knowledge about waterbird use, guide state dependent decision making (choosing a soil disturbance prescription), assess the efficacy of management actions (accounting for management costs in terms of use-days or supported populations), or be to learn how to improve management (Lyons et al. 2008). Also, depending on the management objective, the survey activity will often entail assessing status and trends of habitat conditions or waterbird numbers. Resulting data may be used to calculate unit-specific use-days, document migration chronologies, and explore relationships between waterbird counts and habitat condition. Waterbird surveys resulting in assessments of relative abundance, density, general habitat factors, or species richness could also be designed under this framework.
Numerous examples of studies using one or more of these attributes to inform management or conservation can be found in the literature. These include use of: 1) abundance and richness of waterbirds from whole-area counts to design restored wetlands (Sebastián-González and Green 2013), 2) biweekly counts non-breeding waterbirds at playa wetlands to identify factors influencing distribution and richness in Nebraska's Rainwater Basin (Webb et al. 2010), and 3) estimates of use-days to understand the influence of refuge status on waterbird use in the Illinois and Central Mississippi valleys (Stafford et al. 2007). Rather than present all possible site-specific objectives here, common examples from studies and management plans are provided for reference and illustration (**Box 1.1**).

Box 1.1. Examples of site-specific management and sampling objectives.

Mingo NWR:

- Management objective: Through water manipulation, planting, mechanical, and chemical treatments provide quality moist soil habitat and high energy food resources for waterfowl. Provide a minimum of 800 acres of managed moist soil units (Figure 2) that annually produce an average of 3 million DEDs in support of the average of 11 million DED objective at Mingo NWR (USFWS 2011).

- Sampling Objective: The cooperator needs to be 90% confident that the estimated acres of quality moist-soil habitat with high energy food resources are within 20% of actual acres.

Muscatatuck NWR:

- Management objective: Annually maintain moist-soil units … to provide annual food crops and resting habitat for migratory waterbirds, Wood Duck habitat, and mudflats for shorebirds. ... Average annual target use-day levels for all managed wetlands combined are as follows: waterfowl (ducks, geese, swans) ~500,000 use-days; shorebirds ~200,000 use-days; wading birds (egrets, herons, etc.) ~40,000; cranes (sandhill and whooping) ~40,000 (USFWS 2012).

- Sampling Objective: The cooperator needs 80% confidence that the estimated annual mean waterbird guild use-days is within 10% of the actual mean.

Multi-refuge study of spring flooded emergent habitats:

- Management objective: On refuges *x*, *y*, and *z*, estimate the Jan 15th—May 15th waterfowl use-days in emergent dominated management units with concurrent hydro-regimes increasing the extent and depth of flooding.

- Sampling objective: Attain 80% confidence that the use-day estimates are within 20% of the estimated true value. Attain 80% confidence ($\alpha=\beta=20\%$, one-tailed test) of detecting a 50% increase in flooded acres and mean water depth, with a 20% chance of inferring an increase in flooded acres and mean water depth when one does not exist.

Element 2: Sampling Design

For meeting local-scale objectives, census techniques are used to assess environmental conditions and waterbird use by survey unit. A spatial sampling design is not required. Details related to setting up bounds for the survey unit (typically a 'management unit') are described in Standard Operating Procedures (SOP) 1. Since a theoretical design is not used to allocate a sample of locations within a management unit, we refer to the units as survey units instead of sample units.

Sample units and sampling frame

A survey unit is a single managed or unmanaged wetland on a single date during the non-breeding season. A management unit is defined as a fixed area where recurring waterbird management actions are frequently applied. Boundaries of the unit should be fixed through the season and across years to ensure data comparability (SOP 1).

To retain flexibility for the development of site-specific protocols, this framework does not provide a sampling design that selects representative management units. Inferences are therefore germane only to each management unit from where the census was conducted. If inference needs to be extend to a spatial scale beyond a single management unit (e.g., a habitat type within a refuge, an entire refuge, or across refuges within a flyway), then a representative sample should be drawn following a theoretically based design and appropriate sampling frame.

Temporally, the sampling frame for the vegetation survey spans all dates during the latter portions of the growing season while the frame for waterbird surveys spans all dates during the non-breeding period. This non-breeding period should be defined based on the station's desired scope of inference and can include or exclude fall migration, overwintering, and spring migration. Selected survey dates should fall within the defined non-breeding period to ensure data are relevant for producing period-specific summaries; common applications include migration chronology curves and bird use-days estimates. It is anticipated that observers will be able to use existing monitoring data, regional weather patterns, and regional habitat information to judge the beginning and ending dates for the non-breeding period on a year-to-year basis.

Sample selection, sample size, survey timing and schedule

The selection of a wetland for monitoring is based on the information needs of a station. For managed wetlands, bird count data can inform management planning and the evaluation of management actions. For example, managers can use migration curves to time management actions and resulting habitat conditions to bird arrival. Monitoring of an unmanaged wetland might be justified if the station desires an understanding of non-breeding use of the wetland.

A practical approach for selecting survey dates during the non-breeding season is to systematically conduct Waterbird and Unit Condition Surveys on a weekly or biweekly basis. Subjective selection of survey dates should be avoided because it can introduce bias into migration curves and bird use-day estimates. As an example, only conducting counts when many birds are present in a wetland will positively bias bird use-day estimates.

When estimating the total use-day parameter, the frequency of counts is the sample size for a single non-breeding season, which influences the estimate of sampling error (see Element 4).

The IWMM Population Monitoring Protocol Team (unpublished data) conducted a simulation to explore the relationship of survey frequency to use-day estimate error. In this analysis, the Team, (1) set bird use-days to a fixed value, (2) distributed bird use-days across a season to simulate a unimodal migration curve, (3) simulated semi-weekly, weekly, and biweekly counts during the survey season and (4) estimated bird use-days from the simulated counts. After 10,000 iterations, results showed that the average sampling error for seasonal use-day estimates was 14.7%, 20.5%, and 36.7% for semi-weekly, weekly, and biweekly counts, respectively. Based on these results, weekly counts represent a compromise between greater precision and logistical feasibility.

Sources of error

Detection of individual waterbirds is likely to be imperfect during surveys, thus biasing estimates or waterbird numbers or habitat use from raw or naïve (uncorrected) counts. In the context of this protocol, bias refers to the difference between the expected value for an estimator and its true value for a waterbird use or habitat parameter, whereas precision refers to variation among repeated estimates of a waterbird use or habitat metric (Thompson et al. 1998). The inaccuracy occurs when some individuals are unavailable for detection (e.g., waterbirds behind vegetation), or when individuals that are available are not perceived by the observer. Many factors can influence detectability, including observer ability and attention, species, habitat conditions, and weather. The use of raw counts to infer waterbird response to habitat management assumes that detectability remains constant as habitat conditions change. This assumption can be problematic if, for example, detectability is inversely related to actual habitat use. There are available techniques, such as distance sampling (Buckland et al. 2004) or concurrent multiple observers (Bart and Earnst 2002, Forcey et al. 2006), that would allow cooperators to estimate detectability, unbiased counts, and appropriate sampling variances. The application of these techniques can increase the reliability of survey results, but usually incur additional costs. Unadjusted counts targeting guilds with large populations and a large magnitude of change, often the case for migrating waterfowl, can be useful to assess changes over time, however adjusting for detectability is critical for surveys targeting rare species in low densities (Thompson 2002). The need to adjust for detectability also depends on the context of decisions being informed by the survey results. Decisions that will influence expensive or controversial will likely require methods with greater rigor and results with greater precision. This framework is developed for unadjusted counts but does not preclude accounting for detectability adjustments.

The habitat-use patterns of waterbirds can differ between diurnal and nocturnal periods (McNeil et al. 1992, Tamisier 1976, Cox and Afton 1997, Davis et al. 2009). Consequently, for some species, diurnal counts and associated habitat assessments would ideally be complemented by efforts to assess nocturnal use (Anderson and Smith 1999). When diurnal and nocturnal habitat-use are known or expected to differ, the potential influence of nocturnal activity on use estimated solely from diurnal counts should be acknowledged.

Sampling objectives addressing habitat metrics should also consider the potential impact of bias, inaccurate estimates and the level of achievable precision. The accuracy of visual estimates of annual percent cover, perennial percent cover, and total vegetation cover at the unit scale were similar to plot-based estimates in a 2012 validation study. A validation study completed in the fall of 2014 will further quantify differences between rapid, field-based habitat estimates from multiple observers and estimates from aerial photographs. Metrics evaluated include habitat class

cover, interspersion, and percent near tall edge. The study will also determine whether there is a positive, linear relationship between a seed production index (SPI) and the mass of seeds produced in moist-soil units.

Element 3: Field Methods and Processing of Collected Materials

Pre-survey logistics and preparation

Site, survey unit, and observer codes will be assigned by IWMM staff to ensure that they do not duplicate codes in use by other cooperators. Please contact the Science Coordinator (iwmmprogram@gmail.com) for assistance in assigning codes. If you do not know the codes, please leave them blank, but make sure that you fill in name details so that the codes can be completed subsequently. Please refer to SOPs 2 and 3 for additional information regarding pre-survey logistics and preparation including equipment needed for waterbird and vegetation surveys.

Establishment of sampling units

Information regarding establishing survey units can be found in SOP 1: Delineating Unit Boundaries.

Data collection procedures

Population Metrics—Waterbird surveys will use the direct /whole-area count method for tallying the number of individuals by species. This method attempts to count or estimate all waterbirds within the specified area. Please see SOP 2: Waterbird and Unit Condition Survey for detailed instructions.

Count all waterfowl, shorebirds, and waders. Identify all of these waterbirds to species, when possible. When species identification is not possible, use aggregate categories. See the "Unidentified Waterbirds" codes in Supplemental Materials 1 or 2. Species other than waterbirds may be recorded and entered into IWMM's database, but these species are not the focus of the IWMM's decision support efforts for managers.

Familiarization with the American Ornithologists' Union (AOU) four-letter Alpha codes is helpful when conducting the waterbird surveys. AOU codes for waterbirds likely to be encountered in the Atlantic and Mississippi Flyways are listed in Supplemental Materials 1 (taxonomic order) and Supplemental Materials 2 (alphabetical order). A full list of AOU codes can be found at: http://www.birdpop.org/alphacodes.htm. When counts are entered into IWMM's database, species should be identified by their AOU codes.

Habitat Metrics—Annual vegetation surveys, SOP 3, will be used to generate rapid assessments of plant community composition, seed production, and percent of the survey unit near tall edge. Each bird survey will also be accompanied by a range of unit condition measures representing weather, tide, salinity, water depth, percent ice, flood duration, habitat cover, interspersion, vegetation height, and disturbance. For detailed instructions please see SOP 2: Waterbird and Unit Condition Survey.

Recording Management Activities—To develop effective and informed strategies using an adaptive management approach, a reasonable range of management activities must be considered (Williams 2011). Thus, in addition to monitoring waterbird use and habitat response, routine short-term habitat management activities will be tracked for each management unit SOP 4). Managing wetlands as seral stages of vegetation communities enhanced by hydrological manipulations serves as the foundation of many wetland management programs (Gray et al 2013). Both components involve decisions with short-term consequences repeated within discrete management units, a situation well-suited to decision support based on adaptive management principles. The actions listed in SOP 4 are not meant to function as stand-alone actions in an adaptive management framework. The list is provided as a founding set of actions that can supplement or be compiled into an adaptive management framework.

Processing of collected materials

This protocol framework does not include procedures for routine collecting or processing of biological or abiotic materials. If carcasses of waterbirds are found, follow the guidelines provided in Supplemental Materials 8 and the Mortality Event Response instructions on the Wildlife Health office internal website: https://sites.google.com/a/fws.gov/fws-wildlife-health/products.

End-of-season procedures

All equipment should be accounted for, cleaned, and stored at the end of the season. Data sheets and maps should be turned in to the survey coordinator, who will archive the hard copy data sheets. Data entry should be kept current throughout the year. The IWMM Science Coordinator may establish entry deadlines on an as-needed basis.

Element 4: Data Management and Analysis

Data entry, verification, and editing

Cooperators should enter collected data into the IWMM's centralized, online database. IWMM's database is a member of the Avian Knowledge Network (AKN). This database will compile bird survey, vegetation survey, and management action data. The database can also be used for managing surveys and collaboration with others. The database is available to the public. Anyone can use the AKN including staff from refuges, national parks and forests, states and other cooperators like Ducks Unlimited or Joint Ventures that are counting waterbirds using the approach described in the protocol framework. For information about the AKN, please see www.avianknowledge.net.

Using AKN for data management will require access to a 'portal.' It will also require knowledge of the one or more database protocols that are used for data entry and associated with the design and approach for data collection described by this survey protocol framework. More specific instructions for entering data into this database can be found in SOP 5.

Metadata

Metadata need to adhere to AKN standards and will be accessible via the IWMM's database. The IWMM maintains a project record that documents administrative details regarding its national program which is available on request to iwmmprogram@gmail.com. Each site is encouraged to

maintain a project record, as a companion to the site-specific protocol, to record administrative and other historical information about the survey.

Data security and archiving

Refuge cooperators may add completed field-data sheets and notes as a digital holding in ServCat with an appropriate report, or archived independently in ServCat with its own metadata reference. For all cooperators, Point Blue Conservation Science (PBCS) will host IWMM's database on its servers. For hosted databases, PBCS provides (1) incremental daily backups onsite, (2) weekly offsite backups, and (3) semi-annual backups that occur offsite at Cornell University.

Analysis methods

Data from different management units should be analyzed independently unless they represent a representative sample of the target area of interest. Inferences to larger spatial scales based on unrepresentative data pooled across management units will have unknown reliability for drawing conclusions about the larger area (e.g., refuge, region, flyway). When the intent is to draw an inference for a larger target population or universe, then analysis and estimation by pooling site-specific data from a subset of sites should be restricted to those cases where those sites have been selected according to a theoretically known sampling design. Although this framework does not specifically address such a sampling design, the operating procedures are conducive to surveys that sample a subset of survey units from a target population of survey units (Tapp 2013).

Collected data should be analyzed using the most appropriate means for meeting the sampling objectives and providing the summaries that effectively inform the management objectives. This includes knowing the key assumptions for using the analytical techniques and whether the data are fit for the intended use and consequences to interpretation of the results when misused. Many of the typical analyses and summaries of the data provided by the surveys conducted under this protocol are fundamental and explained in basic guides to biological statistical texts (e.g., Krebs 1999, Zar 2010). I&M or IWMM staff or a Regional Biometrician can be consulted for analytical advice for more complex sampling objectives.

Tools and programmed analyses available from IWMM's database should be used to generate a standard migration curve and for calculating waterbird use-days (Farmer and Durbian 2006). Using the migration curve tool, users will be able to plot observed waterbird counts against date (Figure 5.1). Other reporting tools are available for producing customized summaries of these metrics by different time and geographic scales.

For the local scale, most analyses or summaries beyond the tools provided by IWMM will entail estimation of measures of central tendency or of variability. When sampling objectives are similar to the examples in Box 1, confidence intervals or specific statistical tests can be used to evaluate pre-established questions of 'difference'. The methods and estimators for these should be chosen in part by the distributional properties of the focal metrics like waterbird use-days or frequencies of environment or vegetation categories. Where they differ from the general summaries mentioned above, site-specific versions of this protocol should describe or give additional details about the analyses and data summaries that will be used to fulfill local sampling objectives.

Element 5: Reporting

Implications and applications

Ideally reporting should restate survey objectives and link findings to the management decisions. As described in other elements, the management decisions, management objectives, and survey objectives are developed under this framework in the site-specific protocols, and will shape the nature of the reports. Some core information or general guidance on reporting can be anticipated and is described here.

The data summary tools provided by the IWMM database will provide a foundation for cooperator lead reporting. Data summaries provided by the database represent common formats reported in migratory bird surveys; observation summaries, migration curves (Figure 5.1), and use-days (Figure 5.2). The spatial scale, time period, and taxon level of the data summaries will be defined by the database user (Figure 5.3). Bird observation summaries report frequency, average abundance, average count, birds/hour, maximum count, and total count for a user-defined period, scale, and taxon. Habitat summaries report habitat class proportions, dominant vegetation, and hydrographs by unit. Migration curves plot raw or percent of maximum counts for all surveys over a user-defined period. A data export function will also allow cooperators to summarize data outside of the IWMM database.

Procedures for reporting survey results will depend on the type of audience intended to receive the results, needed format, level of review, schedule, distribution, and archiving. All reporting requirements should be documented by cooperators in site-specific protocols. Generally reports produced by IWMM cooperators will be seasonal summaries, interim project reports, or final project reports.

Reporting Schedule

For progress and final reports, the site-specific protocol should clearly specify the frequency and expected due dates of reports. A short-term inventory effort may produce only a final report soon after the all data are collected and analyzed. Whereas longer-term monitoring efforts are likely to require both progress reports and a final report. The established frequency and timing of reports should be integrated with the frequency and timing of the management decision-making process.

Report Distribution

The site specific protocol should identify to whom reports should be given and the appropriate medium for communications. A strategy for archiving reports should also be described. USFWS cooperators should ensure that field notes and reports are stored in compliance with Service Enterprise Architecture (270 FW 1), Data Resource Management (274 FW 1), and Electronic Records (282 FW 4) policies. Refuge System staff should also create accurate metadata and store data documents, metadata, reports, posters, graphs, maps, and any other documentation of results in ServCat.

Wildlife Health Reporting—Suspicious or unusually high-number of mortalities should be reported to wildlife health officials regardless of whether materials were collected. Contact information and instructions on reporting collected specimens or wildlife health issues can be

found at the Wildlife Health office's internal website: https://sites.google.com/a/fws.gov/fws-wildlife-health/products.

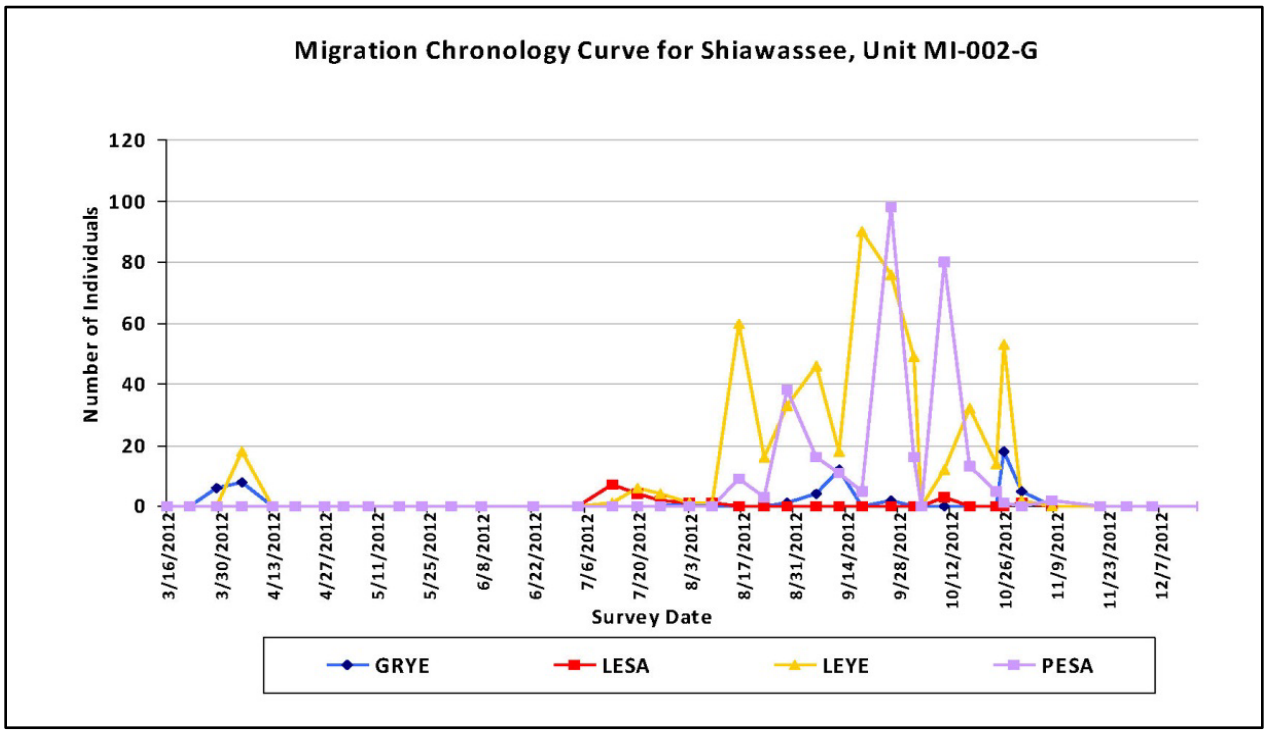
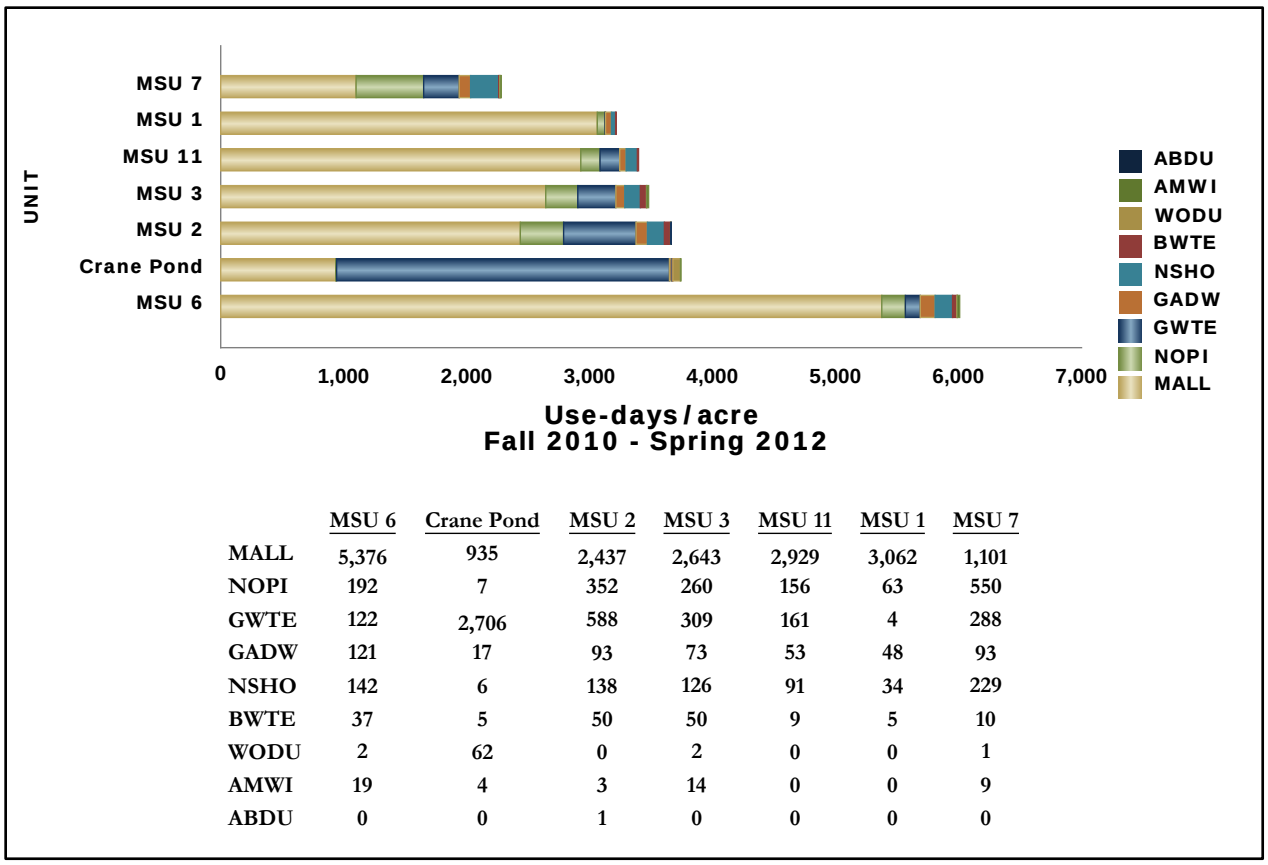


Figure 5.1: Migration chronology for greater yellowlegs (GRYE), least sandpiper LESA), lesser yellowlegs (LESA), and pectoral sandpipers (PESA) produced from an interim version of the IWMM database. Similar reports may be developed for a single unit or any compilation of units.



	MSU 6	Crane Pond	MSU 2	MSU 3	MSU 11	MSU 1	MSU 7
MALL	5,376	935	2,437	2,643	2,929	3,062	1,101
NOPI	192	7	352	260	156	63	550
GWTE	122	2,706	588	309	161	4	288
GADW	121	17	93	73	53	48	93
NSHO	142	6	138	126	91	34	229
BWTE	37	5	50	50	9	5	10
WODU	2	62	0	2	0	0	1
AMWI	19	4	3	14	0	0	9
ABDU	0	0	1	0	0	0	0

Figure 5.2: Dabbler use-day by unit and species illustrating variation in the relative composition of dabbler use density across units of interest at Clarence Cannon NWR. Use-days may be summarized by species or guilds for individual units, user defined unit groups, sites, site groups or flyway. Format may vary in the final database version. Dabbling duck species codes are for American Black Duck (ABDU), American Wigeon (AMWI), Wood Duck (WODU), Blue-winged Teal (BWTE), Northern Shoveler (NSHO), Gadwall (GADW), Green-winged Teal (GWTE), Northern Pintail (NOPI), and Mallard (MALL).

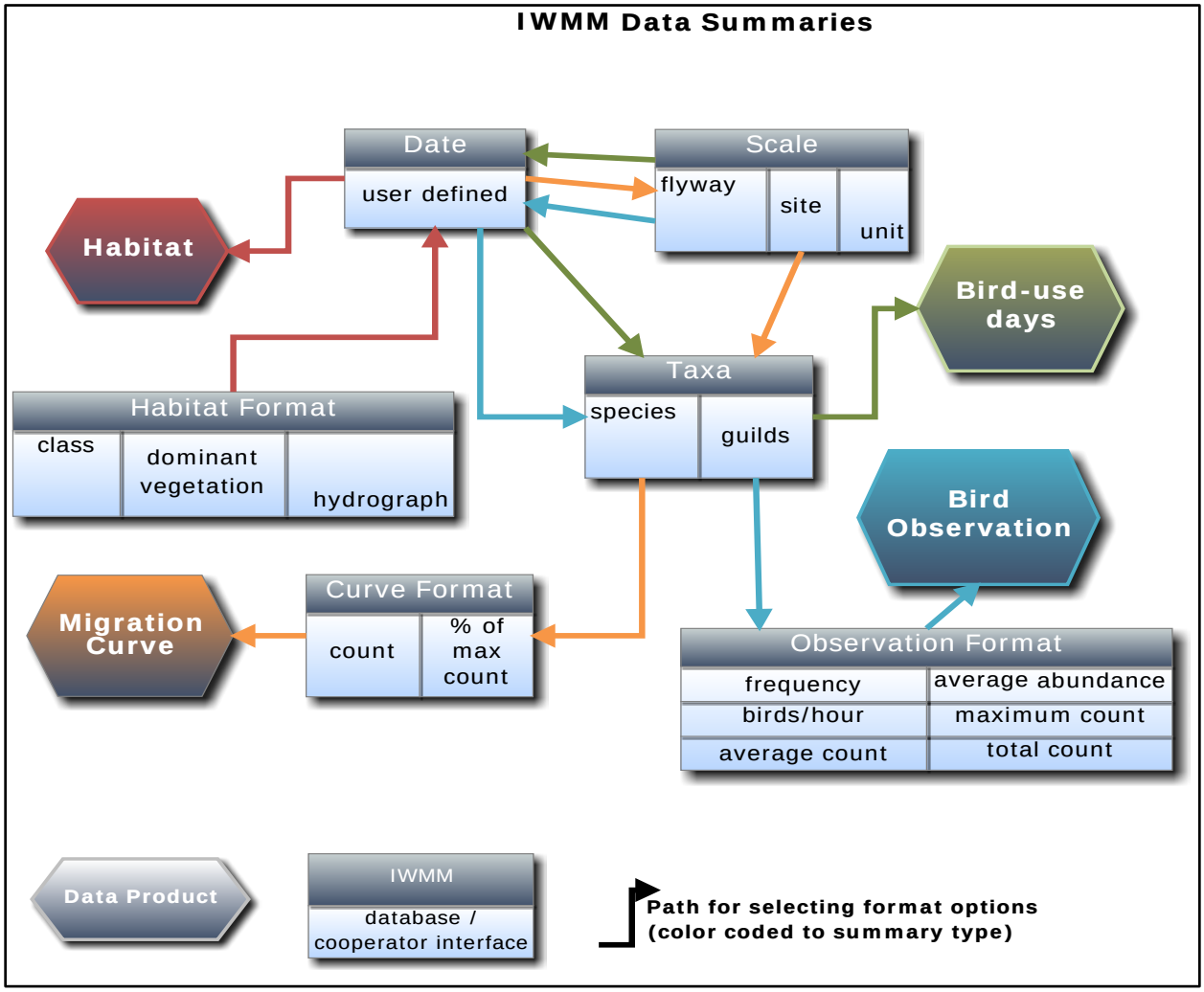


Figure 5.3 Formatting options and workflows for generating data summaries within the IWMM database Based on a preliminary database requirements document, summary options are not anticipated to change but some format options may vary in the final database version.

Element 6: Personnel Requirements and Training

Roles and responsibilities

IWMM National Project Coordinator—**Linda Wires**
USFWS, 5600 American Blvd West, Bloomington, MN 55427
Linda_wires@fws.gov

IWMM National Science Coordinator—**Tim Jones** (Interim)
USFWS, Merriam Lab, Room 215 11510 American Holly Drive
Laurel, MD 20708. iwmmprogram@gmail.com

IWMM Regional Contacts—Regional contacts communicate with potential cooperators, update groups within USFWS administrative regions on the initiative progress, and identify opportunities of for incorporating IWMM in Refuge inventory and monitoring plans.

- Upper Mississippi (Fish and Wildlife Service Region 3 - Midwest)
  Brian Loges, Two Rivers National Wildlife Refuge, HC 82 Box 107 Brussels, IL.
  Brian_Loges@fws.gov

- South Atlantic and Lower Mississippi (Fish and Wildlife Service Region 4 - Southeast)
  John Stanton, U.S. Fish and Wildlife Service, 185 L.A. Keiser Drive, Suite a. PO Box 210, Columbia, North Carolina 27925. John_Stanton@fws.gov

- North Atlantic (Fish and Wildlife Service Region 5 - Northeast)
  To be determined

IWMM Partners—U.S. Fish & Wildlife Service Regions 3, 4, and 5; Migratory Bird Program & National Wildlife Refuges; Joint Ventures; States; Ducks Unlimited; and other NGO's within the Atlantic and Mississippi Flyways. See IMWW Project Record for additional information.

Cooperators—Agency staff, NGO staff, or volunteers conducting surveys and individuals responsible for site scale coordination of surveys.

The survey coordinator for each cooperator is responsible for ensuring that staff members are properly trained to carry out surveys and that surveys are logistically feasible. Within participating USFWS regions, an IWMM regional coordinator will offer remote training opportunities as needed, and the IWMM will provide access to training materials for survey coordinator to train cooperator members as needed. The regional coordinator will also be the point of contact when a cooperator desires clarification about aspects of field protocol. It is the survey coordinator's responsibility to assess whether or not individual staff members possess the necessary competencies, e.g., waterbird identification skills, to conduct surveys. The survey coordinator will budget staff time and financial resources and plan equipment availability to enable survey objectives to be successfully met.

Qualifications

All surveys need to be conducted by qualified individuals. Surveyors should be able to:

- Identify waterbird species
- Identify common wetland plant species
- Estimate large numbers of waterbirds using advocated techniques
- Follow survey protocols

Training

Cooperators should visit the IWMM project website at: http://iwmmprogram.ning.com/ for a 20-minute webinar that will introduce IWMM and introduce the waterbird and vegetation survey methods. This webinar can be found on the Presentations page as IWMM Training Presentation 2012. Updates are presently being made for the 2014 season. Inexperienced waterbird counters are advised to practice their counting and estimation techniques before participating in IWMM. This can be done in the field or at a desktop computer using Wildlife Counts software: http://wildlifecounts.com/index.html.

Data collectors should also be trained for dealing with any local hazards and proper procedures for handling and collecting injured or dead wildlife. For instructions on how to handle and submit waterfowl carcasses for cause of death diagnosis, please see Supplemental Materials (SM-8) as well as the Mortality Event Response instructions on the Wildlife Health office internal website: https://sites.google.com/a/fws.gov/fws-wildlife-health/products.

Please use the Q&A forum within the website for general methodological queries. Alternatively, use the messaging feature to contact the Science Coordinator. To access the Q&A forum or messaging features, you will need a membership, email iwmmprogram@gmail.com.

Element 7: Operational Requirements

Budget

Cooperator Level Costs—First year and annual estimates of staff time and expenses outline the commitment and capacity required to conduct a survey to completion. Unless noted otherwise, the accounting base is a survey unit. Time and expenses for implementing management actions or producing a site-specific protocol for the survey are not included. Staff time commitments are derived from unit average completion times from all whole-area waterbird counts conducted from the spring of 2010 to the fall of 2012 from an earlier version of the IWMM database. Only units surveyed 12 or more times within this period were included. Average unit specific completion times were highly variable ranging from 2 minutes to nearly 5 hours. Due to a strong positive skewness (1.04) in the distribution of completion times, the median value of 29 minutes was used to estimate time required to complete a whole-area bird count for a single unit. Unit-scale time requirements for completing the vegetation surveys were based on prior experience with database entry, reporting tools and the revised vegetation survey procedures. Equipment costs are based on on-line retail prices for moderate quality optical and field survey equipment. Fuel cost estimate is based on a 30 mile survey route @ 15 MPG. Cost amounts are given in 2014 dollars; annual inflation factors of 2 to 4% can be applied to quickly predict costs in

subsequent years. If exact budgets are used in site-specific survey protocols, it is recommended that current prices are obtained from vendors.

Costs associated with tasks duplicated across survey units are presented as costs per unit to allow individual sites the ability to generate specific estimates. Survey set-up was estimated at 0.003 FTEs and $1231.25 in equipment and expenses plus an additional 0.001 FTE per survey unit. Survey set-up includes web-based training on the database and procedures and creating GIS layers for each survey unit. Annual staff time commitment was estimated at 0.003 FTE plus an additional 0.012 FTE per survey unit. Annual expenses are estimated at $174.00 per survey.

Using the total value of time and cost estimates assume a new survey is being started with little or no preexisting resources. However, it is anticipated that most cooperators will already have most of the equipment on hand. Many are also actively completing waterbird surveys using initial survey instructions or as general reconnaissance. For these situations, the budget presented in Table 7.1 will likely produce an overestimate of the actual costs associated with implementing IWMM surveys at the site scale if the per unit costs are represented as a product of the number of units on a site.

Table 7.1. Estimated annual cooperator level costs for an eight month weekly survey schedule.

		Staff (hours)						**Expenses**	
		Unit delineation	Protocol review training	Data entry	Data Collection	Data summary	Total FTE[1]	Fuel	Equipment
set up costs	per unit	2					.0001		
	survey		6				.003		$1,224.29
annual costs	per unit			5	16	1	.011	$14.00	
	survey		6				.003	$174.00	

[1] A full time equivalent, one employee or volunteer for a 2080 hour year

Staff time—The number, size, spatial arrangement, and accessibility of survey units influence the staff time required to complete a survey route. The effort required to complete a survey route is expected to vary considerably among cooperators due to variability in these site characteristics. Based on times to complete previous whole-area counts, the majority of cooperators (50^{th} percentile) will average 29 minutes or less per unit while conducting surveys to support IWMM. Most cooperators (75^{th} percentile) will average 2.5 hours or less per unit while completing whole-area counts. Though average annual time required for design and reporting was not specifically recorded, one should allow for approximately 20 and 8 hours, respectively for these activities, with the assumption that design costs will be >20 in the first years of coordinating the surveys and much less in subsequent years.

Program Level Costs—In addition to cooperator generated product, IWMM uses monitoring information in an adaptive management framework applied at three spatial scales to inform management decisions. Model development, decision support, data analysis, database maintenance, protocol development, and annual reports are all program level tasks that link cooperator generated data to larger spatial scales. Costs are derived from the IWWM Initiative project record from FY09 through FY12.
(Table 7.2).

Table 7.2. Estimated program level costs.

Item	Annual Operating	Annual Set-up phase
Cooperators, FWS staff	In-kind	In-kind
Jacobi fellowship		In-kind
USGS Post-doc	$129,006	$126,936
Project Coordinator	$90,000	$85,000
Model Development & revision contract (estimate)		$41,000
DU Cooperative agreement (5 field techs, tech editor)		$119,400
Online Database Development		$83,500
Online Database Maintenance	?	$40,000
Total	$219,006	$495,836

Coordination

IWMM developed the waterbird and vegetation survey SOPs within this document and publicly disseminates them through its website: http://iwmmprogram.ning.com/. These standardized procedures are meant to foster collaborative efforts across cooperators to design and execute research projects examining the effectiveness of alternative habitat management practices for waterbirds. IWMM's Science Coordinator can facilitate the design and execution of these research projects.

Schedule

Survey activities are seasonal and some are time-sensitive within the survey period. Please see Figure 7.2 and Element 2: Sampling Design for information relevant to scheduling survey activities.

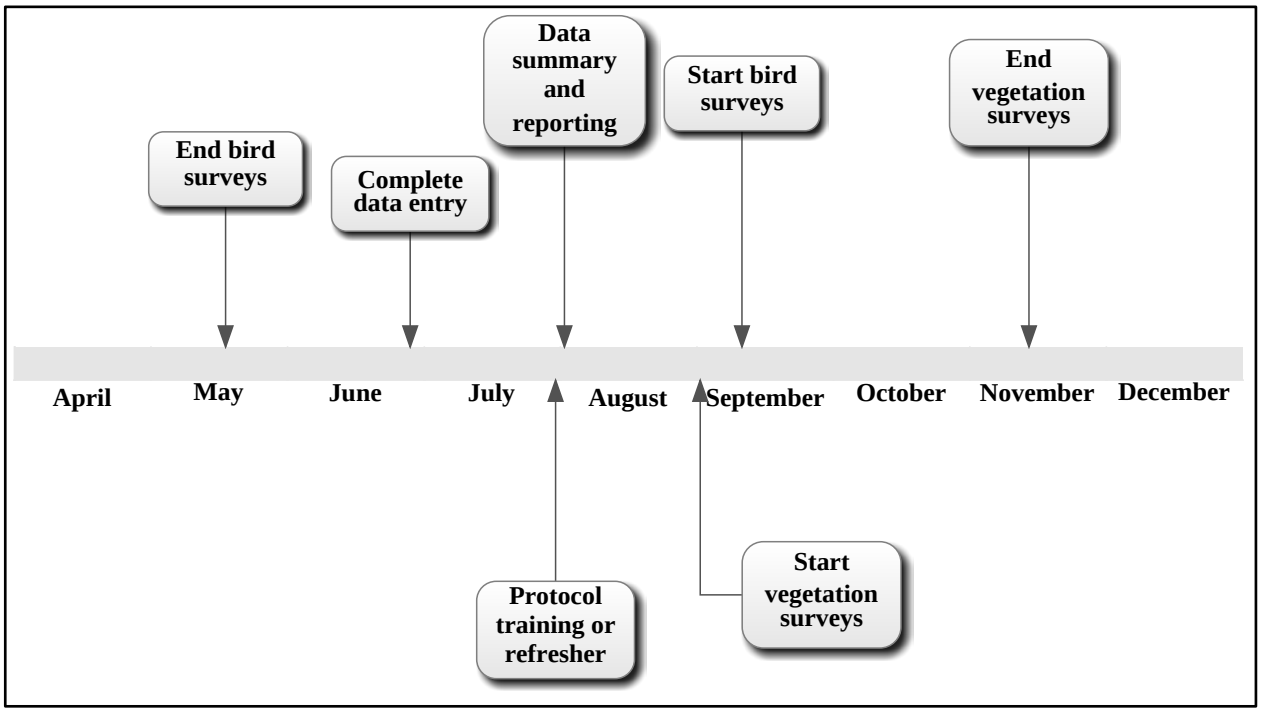


Figure 7.2. Generalized annual schedule for implementing waterfowl surveys, vegetation surveys, data entry, and reporting. Flexibility in assigning start and end dates for key tasks has been retained to facilitate customization of site-specific protocols.

Element 8: References

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Standard Operating Procedures

SOP 1: Delineating Unit Boundaries

Before conducting waterbird and vegetation surveys, follow these instructions to delineate the boundaries of each unit surveyed. Once boundaries are established for a unit those boundaries should remain the same throughout the season and year to year.

Equipment

- GPS
- Printed aerial images
- GIS & digital imagery

Observers should define survey unit boundaries to accommodate whole-area waterbird counts and vegetation surveys. On managed lands, wetlands are often divided into management units. Wherever possible, existing management units will be used as survey units. A management unit is defined as a fixed area where recurring waterbird management actions are applied. Management actions may vary in type and frequency. Cooperators have the discretion to survey units ranging from intensively managed moist-soil systems to protected natural wetlands with no habitat manipulation.

It is expected that the observer will be able to visually assess > 70% of the survey/management unit (Figure SOP-1.1). If an observer cannot visually assess >70% of a unit's area, additional vantage points should be added in lieu of splitting the management unit into multiple survey units. This criterion applies to the surface area of a unit not to the visibility of birds within a unit. While multiple observation points can be established around the perimeter of the unit to meet this criterion, but observers should bear in mind the need to complete the count on the unit within a single morning and to minimize multiple counting of individual birds. Note that the boundaries of the unit should be fixed through the season and across years to ensure data comparability.

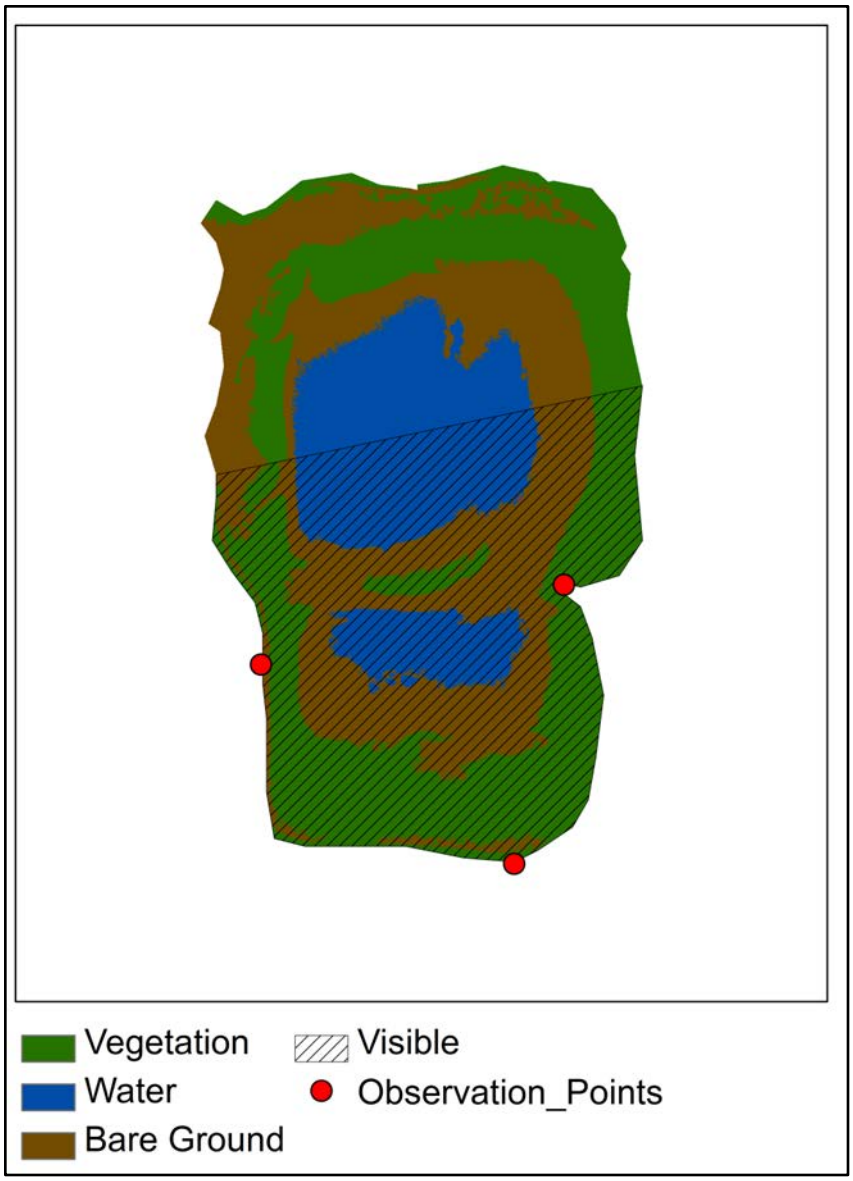

Figure SOP-1.1. Percentage of survey unit within a whole-area count. In this case, 70% of the unit falls within the whole-area count.

Full pool (spillway elevation) levels in managed impoundments or seasonal high water marks in areas with uncontrolled water levels can be used to delineate unit boundaries. Units may include areas above these high-water marks. Observers may use remote sensing resources to identify the boundaries of the wetland basin or GPS permanent topographic or other physical features in the field to define the management unit's extent. GPS accuracies meeting or exceeding 3–16 feet (1–5 meters) are acceptable (USFWS 2012):

- Commercial-grade GPS receivers with WAAS enabled (to provide differential correction) should be used.

- Relatively inexpensive GPS receivers or hand-held (cell phones) devices do not provide the needed 3–16 feet meter accuracy.
- Position averaging is recommended to meet the accuracy requirement.
- Metadata should reflect estimated accuracies from field personnel during data collection activities.

To facilitate inter-year comparisons of observations, survey unit boundaries should not be altered. Observers should create and maintain printed maps and geospatial layers as aids in maintaining consistent boundaries.

Digitized files with identified accuracy, projections, and coordinate systems (ArcGIS shape files or KML files digitized from Google Earth) will be submitted through the on-line database. Please see Figure SOP-1.2 for flow chart that will help guide decisions regarding survey units.

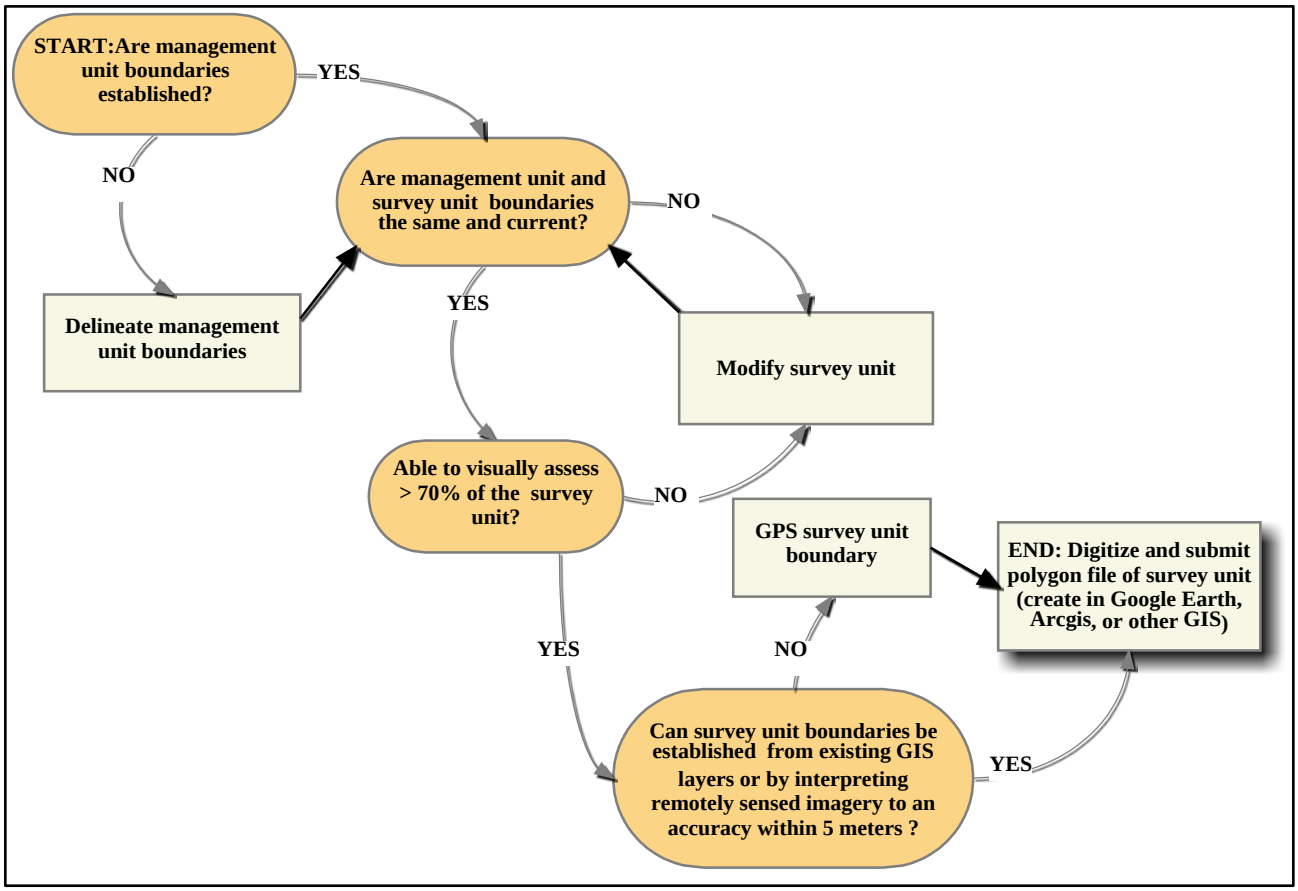

Figure SOP-1.2. Decision Flowchart for creating new or modifying existing management unit into IWMM survey units.

References

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SOP 2: Waterbird and Unit Condition Survey

Follow these instructions for preparing and conducting waterbird counts and assessing site conditions for each unit at time of survey. Associated data collection sheets can be found in Supplemental Materials 3 and 4.

Measurements

- Counts of waterbirds by species
- Visibility (%)
- Wind speed (mph class)
- Tide position (class)
- Salinity (ppt)
- Water depth (cm class)
- Ice (% cover class)
- Flood duration (days class)
- Habitat cover (% of cover class)
- Interspersion of habitat patches (class)
- Vegetation height (cm or m class)
- Waterbird disturbance response (class)
- Disturbance source (class)
- Chronic human disturbance (class)

Equipment

- Good optical equipment, including a spotting scope
- Thermometer (˚F)
- Refractometer or hydrometer
- Map of the site and unit boundaries
- AOU species code sheet (Supplemental Materials 1: alphabetical order or Supplemental Materials 2: taxonomic order)
- Waterbird Survey Form (Supplemental Materials 3: Single unit and Supplemental Materials 4: multiple units)

Survey Schedule

Waterbird surveys should ideally be conducted at least once per week during the peak migration periods for waterfowl and shorebirds (see Element 2: Survey timing and schedule). Estimates of use-days using weekly counts have greater statistical power than those conducted on a biweekly schedule (B. Tavernia, USGS, personal communication).

It is best to designate a particular day of the week for the surveys so that they are spaced as evenly as possible. In coastal areas, surveys should be conducted within two hours of high tide to control for the effect of the tidal state of nearby mudflats. At inland sites, the time of a 24 hour period for conducting surveys should be based on the management objective. For example, if a manager is interested in supporting roosting activities, the counts should occur during a period when birds are

most likely to be roosting in a site. Flexibility in the timing of surveys is needed to address constraints such as staffing, other activities taking place within units (e.g. hunting or management), and weather.

If multiple units are surveyed, it is good practice to change the order of surveys by choosing different starting units on each visit (wherever possible). If count numbers are expected to be compiled, counts for all units should be completed in one day to minimize the interchange of birds across units. Multiple-counting of individual waterbirds should be avoided. If birds regularly flush from units during counts, then efforts to minimize disturbance during surveys or concurrent surveys may be needed to minimize the multiple-counting of birds. Include waterbirds in the totals for only the first unit in which you encounter them. Waterbirds observed outside the unit boundaries during flood events, as flyovers or on adjacent dry land should not be included in the survey unit observations.

There is no time limit for surveys. The observer should tally the waterbirds present when the observation starts but should cease when there is a great deal of movement into the unit. Ideally, all units within a site should be surveyed on the same day.

NOTE: During the waterfowl hunting season it is important to avoid conflict with hunting interests. Disturbance can be avoided by surveying from accessible points around the perimeter of wetlands, and by avoiding surveys when hunting activity is highest.

Site, unit and observer codes

Please contact the Science Coordinator (iwmmprogram@gmail.com) for assistance on assigning codes. Site, survey unit, and observer codes must be assigned by IWMM staff to ensure that they do not duplicate codes in use by other cooperators. If you do not know these codes, please leave them blank, but make sure that you provide enough detail (e.g., name of observer, location of surveys) so that the codes can be completed subsequently.

Percent Visibility

To conduct whole-area counts, it is required that you be able to see $\geq$70% of the survey unit from one or multiple vantage points placed around the unit's perimeter. Estimate the percentage of the survey unit included within the whole-area count (Figure SOP-2.1).

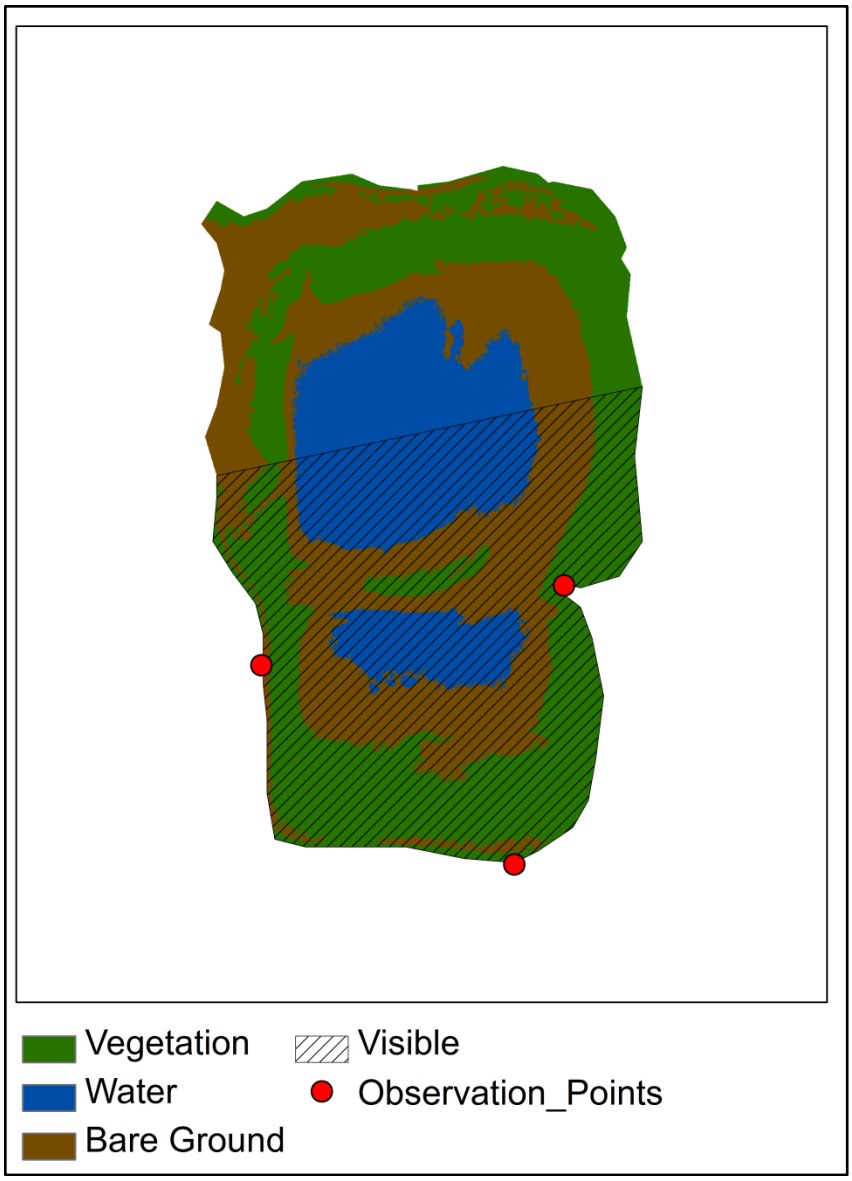

Figure SOP-2.1. Percentage of survey unit within whole-area count. In this case, 70% of the unit falls within the whole-area count.

Appropriate Weather

Surveys during inclement weather should be avoided. Whenever possible, do not survey waterbirds in fog, rain or strong winds (Beaufort force $\geq$ 3). Temperatures (˚F) at the start of the survey and Beaufort wind scale (Table SOP-2.1) are to be recorded. Estimate average wind speed (Beaufort scale) at the start of the survey.

Table SOP-2.1. The Beaufort Wind Scale

MPH	Beaufort	Description	Appearance of wind effects
<1	0	Calm	Calm, smoke rises vertically
1-3	1	Light Air	Smoke drift indicates wind direction, still wind vanes
4-7	2	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
8-12	3	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
13-18	4	Moderate Breeze	Raises dust and loose paper; small branches are moved
19-24	5	Fresh Breeze	Small trees in leaf begin to sway
25-31	6	Strong Breeze	Large branches in motion; umbrellas used with difficulty

Local Tide Conditions

Please classify local tide conditions into one of the categories found in Table SOP-2.2 (from International Shorebird Survey protocol; http://ebird.org/content/iss/).

Table SOP-2.2. Local Tide Conditions.

Class	Description
1	High
2	Almost high and rising
3	Almost high and falling
4	Half tide, rising
5	Half tide, falling
6	Almost low, rising
7	Almost low, falling
8	Low
9	Not observed, not applicable, or observations made during more than one of these periods

Salinity

If your unit is exposed to saltwater, then measure salinity using a either a hydrometer or a refractometer (SOP 3); salinity should be reported in parts per thousand.

Salinity may vary throughout your unit, so careful consideration needs to be given to the number and distribution of salinity samples taken. No single sampling approach will apply universally, but the following considerations are offered as guides:

- Seek background on your unit, looking for information specific to factors that may cause salinity to vary (e.g., location of freshwater inlets)
- Ensure that selected sampling locations can be safely and legally accessed
- Select sampling locations that will have standing water under most circumstances
- Use a GPS unit to record the position of sampling locations.
- Sampling designs should be clearly documented to allow a consistent approach to be used by the same observer across multiple years or by multiple observers.

Please send inquiries for further guidance regarding salinity sampling designs to iwmmprogram@gmail.com.

If multiple samples are taken, report the mean value. If you do not take readings, report "NA". If you are certain that the unit is never subject to saltwater incursion, report "**< 0.5"** (the numerical definition of freshwater).

Water Gauge Reading

If the unit has a water level gauge, please record a reading each time a count is conducted. Be sure to provide the measurement units of the water level gauge.

Water Depth

Estimate the percent of the unit in each of five water depth categories (Table SOP-2.3) corresponding to waterbird guild use (Ma et al. 2010). Percent cover estimates should sum to 100% across the six depth categories.

Table SOP-2.3.
Categories of water depth.

Category
Dry
Saturated/mudflat
0 to 5 cm (0 to 2 in)
5 to 15 cm (2 to 6 in)
15 to 25 cm (6 to 10 in)
>25 cm (> 10 in)

If ice is present, **do not** treat it as dry – instead estimate the depth of water & ice.

There are two alternative approaches for estimating percent covers for water depth categories: (1) the preferred alternative is to use a water bathymetry map in conjunction with a water gauge reading to estimate percent covers (SOP 4); (2) the non-preferred alternative is to use an ocular assessment.

Percent of ice cover

Across the entire survey unit, visually estimate and record the percent of the water surface that is covered by ice.

Flood Duration

For flooded areas within your survey unit, please indicate how long surface water has been present by assigning these areas to one of the flood duration categories found in Table SOP-2.4. These flood duration categories are related to the abundance and energy content of food resources (e.g., Fredrickson and Reid 1991).

Table SOP-2.4. Flood Duration Categories

Code	Description
1	Surface water present > 90 days
2	Surface water present 30-90 days
3	Surface water present <30 days
4	Permanent Inundation
5	No information

Assignment to these categories should be based on the majority condition (i.e., >50% of the area) for areas with surface water. **Note that if the majority of the unit is permanently covered by surface water; please select "Permanent Inundation" from the flood duration categories.**

This assessment can be made using either of two approaches: (1) the preferred approach is to use a time series of water gauge readings tied to bathymetric maps (SOP 4) to identify flooded areas and their periods of inundation; (2) the non-preferred approach is to base the assessment on personal or second-hand (i.e., through communication with local manager) knowledge of water-level management of the survey unit.

Habitat Cover

Use ocular estimation to assess what percentage of a survey unit is water, bare ground/mudflat, emergent, scrub-shrub, or forest. These classes are defined using classes found in the *Classification of Wetland and Deepwater Habitats of the United States* (Cowardin et al. 1979). See Table SOP-2.5 for a crosswalk between IWMM's habitat classes and those found in Cowardin et al. (1979).

Table SOP-2.5. Habitat classification crosswalk between the IWMM Initiative Protocol and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979).

IWMM Habitat Class	Wetlands and Deepwater Habitats Class
Water	See rock bottom, unconsolidated bottom, aquatic bed
Scrub-shrub	See scrub-shrub
Forest	See forest
Emergent	See emergent, vegetated unconsolidated shore
Bare ground	Streambed, rocky shore, unvegetated unconsolidated shore

The following conditions apply when estimating cover of the different habitat classes:

- Percent covers for individual classes are considered mutually exclusive, so percent cover estimates across all habitat classes must sum to 100%.
- Because this measure is intended to assess habitat structure not energy content, senesced vegetation (i.e., dead vegetation) should be included in percent cover estimates for applicable habitat classes.

Interspersion

The configuration of vegetation and water/bare ground patches within a survey unit can influence habitat quality. For this metric, vegetation patches are defined to include scrub-shrub, forest, and emergent vegetation areas whereas water/bare ground patches are defined to include open water, submerged aquatic vegetation, floating-leaved aquatic vegetation, and bare ground.
A survey unit can fall into one of three configuration classes (Figure SOP-2.2) based on Suir et al. (2013). The three configuration classes are:

- Class L includes large and connected patches of water/bare ground features
- Class S contains small, disconnected patches of water/bare ground
- Class M contains discernible regions of both classes L and S

These classes reflect the interspersion, or inter-mixing, of vegetation and water/bare ground patches. Assign the survey unit to one of the configuration classes as an indicator of interspersion. Note that, when water/bare ground covers >60% of a unit, the only possible configuration class is L.

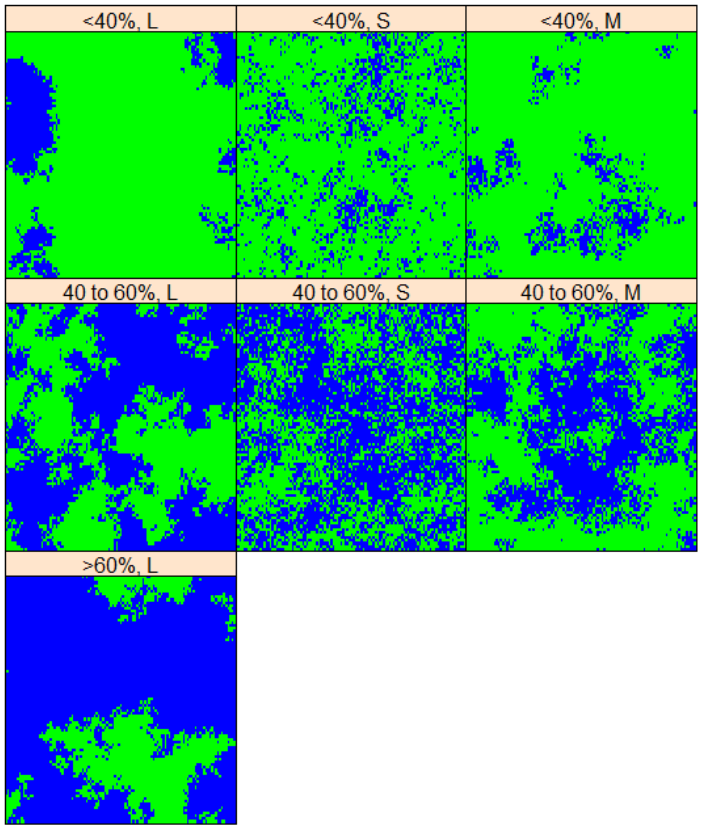

Figure SOP-2.2. Examples of three configuration categories (L; S; M). The three categories are illustrated for different levels of water/bare ground cover (<40%; 40 to 60%; >60%). Water/bare ground areas are represented in blue above whereas vegetated areas are represented in green.

Height

Use ocular estimation to assess what percentage of the unit is in each of seven categories of vegetation height (Table SOP-2.6). Note the height being measured is the uppermost canopy, so the percent cover estimates should sum to 100% across all categories.

Table SOP-2.6. Categories of vegetation height**.**

Category	Description
<2.5 cm	includes bare ground (e.g. mudflat) and water
2.5 to 15 cm	short vegetation, e.g. grazed grassland, sprouting crops, dwarf spikerush, etc.
15 to 30 cm	short herbaceous
30 to 60 cm	medium forbs and grasses
60 cm to 3 m	shrubs and low trees plus tall herbaceous vegetation and grasses.
3 to 6 m	shrubs, trees, tall herbaceous
>6 m	tall trees

Disturbance severity

Please record whether there is a disturbance affecting the behavior or number of waterbirds in the survey unit either during your survey or immediately prior to it. Cooperators can conduct "flush counts" (surveys designed to intentionally flush a majority of birds in an effort increase detectability) to get more accurate counts of waterbirds in large or densely vegetated areas. Here, we are interested in disturbances that negatively influence your ability to get an accurate count. Score the disturbance on a scale 1 to 4 (Table SOP-2.7):

Table SOP-2.7. Severity scale and associated definitions of waterbird response to disturbance.

Scale	Severity	Definition
1	Light/none	no effect on waterbirds
2	Moderate	some waterbirds move but stay within unit
3	Heavy	some waterbirds leave unit
4	Limiting	most/all waterbirds leave the unit

Disturbance source

If there is a disturbance of waterbirds (see *Disturbance Severity* above), check the appropriate box to identify its source. Several sources can be ticked. For example, a fisherman in a boat should be ticked as both "Fishing" and "Boats". Potential sources are listed in Table SOP-2.8.

Table SOP-2.8. Types of disturbance.

Code	Description
1	Pedestrian
2	Loose dog
3	Hunting
4	Fishing
5	Boats
6	Motor vehicles
7	Aircraft
8	Raptor
9	Other

Chronic Human Disturbance

Characterize the unit for the period between the last and the current waterbird survey (Table SOP-2.9). For private lands, ask the site manager or landowner. For public lands, check site regulations or consult with management or law enforcement staff.

Table SOP-2.9. Chronic disturbance classes and their definitions.

Class	Description
1	No entry into the unit for any reason.
2	Closed to all use with entry into unit by resource managers or designees for management activities, surveys, or other controlled non-hunting activities.
3	Managed access for all activities including firearms hunting. May include effort to control use levels and temporal closures (i.e. hunting units that close in the afternoon).
4	Open access via trail, viewing platforms etc. No firearms hunting allowed.
5	Open access, including firearms hunting, often with routine restrictions but without a site specific management program to control the level of authorized use.
6	Unknown

Counting and estimating waterbird numbers

Counts or approximated counts of individual waterbirds are recorded by species on either the Waterbird Count or Survey Condition form for an individual survey unit (SM-3), or on the alternate form for surveying multiple management units (SM-4). Counts of species listed in table SOP-2.10 should always be recorded.

Be careful not to count individual waterbirds more than once. When in doubt about whether an individual waterbird was already seen, err on the side of not double-counting and assume it was already counted. If you find that no waterbirds are present, still record survey condition information (e.g., disturbance, depth, etc.), and enter the survey condition data into the database.

Visually scan the wetland systematically, counting individual waterbirds of each species listed in Supplemental Materials 1. For larger sites, or sites where there are large numbers of waterbirds, it is often more practical to estimate numbers. A spotting scope will be required at most wetlands Estimating numbers may also be necessary if waterbirds move around the wetland or are in very tightly packed flocks.

To count waterbirds in a flock, first estimate a 'block' of waterbirds, e.g. 5, 10, 20, 50, 100, 500, 1000 waterbirds depending on the total number of waterbirds in the flock and the size of the waterbirds. To do this, count a small number of waterbirds (e.g., 10) to gain a sense of what a group of 10 waterbirds "looks like." Then count by 10s to 50s or 100 waterbirds to gain a sense of what 50 or 100 waterbirds "looks like." The block is then used as a model to measure the remainder of the flock. In the example below (Figure SOP-2.3) we use 'blocks" of 20 birds to arrive at an estimate of 320 waterbirds.

In some instances, it might not be possible to get an accurate count of each species in a mixed flock, particularly if the flock contains similar species, such as scaup or small shorebirds (i.e., "peeps"). In such cases, try to estimate the percentage of the flock belonging to each species by "sub-sampling". To do this, choose several subsets of waterbirds across the flock, then count and identify all individuals within those subsets. Then use these estimates to provide an extrapolated estimate of numbers of each species in the entire flock. When using this method, be mindful of the fact that species may not be distributed evenly among the flock, so carry out several sub-samples. As an example, in the raft of ducks in Figure SOP-2.3, you might count the waterbirds in 3 subsamples of 20 waterbirds, identifying 12, 10 and 14 Redheads among them. These 36 Redheads represent 60% of the 60 waterbirds in those 3 subsamples - extrapolating this to the whole flock (previously estimated to be 320 waterbirds) would produce an estimate of 192 Redheads.

SURVEY TIP: If you are surveying sites with large numbers of waterbirds, it is often best to count in teams of two, one person counting while the other records the numbers on the field sheet. Alternatively, some people like to use recording devices, so that they are not constantly interrupting counts to record information.

Figure SOP-2.3. Estimating flock size for a raft of ducks. Count members within a visualized group, for example 20 individuals, then see how many groups there are in the flock. In this example 16 groups x 20 individuals/group = 320 individuals in the flock.

Training—First-time IWMM cooperators should view the IWMM overview entitled IWMM Introduction located at http://iwmmprogram.ning.com/page/presentations.

Inexperienced waterbird counters are advised to practice their counting and estimation techniques before participating in IWMM. This can be done in the field or at a desktop computer using Wildlife Counts software: http://wildlifecounts.com/index.html.

Young waterbirds/broods—Do not include dependent young waterbirds in counts. For geese, swans and ducks, assume juveniles are independent when they can fly. Any juveniles that did not hatch in the immediate vicinity should be included in counts (e.g. juvenile swans migrating in family groups).

Special survey techniques

Aerial Surveys—Although we do not require aerial waterbird surveys in the IWMM initiative, we would very much like to include aerial survey data if they are being completed for sites participating in the program. If you conduct aerial surveys, collect the same data as a standard ground-based whole-area count, using the same waterbird survey form.

If aerial surveys are employed, the cooperators should note this in the IWMM database. In the bird survey database form select "Aerial Surveys" in the "Survey Type" dropdown box.

Flush Counts—Cooperators can conduct "flush counts" to get more accurate counts of waterbirds in large or densely vegetated areas. Flush counts are not required by IWMM, but if this method is employed, the cooperators should note this in the IWMM database. In the bird survey database form in select "Flush Counts" in the "Survey Type" dropdown box.

References

Cowardin LM, Carter V, Golet FC, LaRoe ET. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Washington, D.C.

Fredrickson LH, Reid FA. 1991. 13.1.1 Nutritional values of waterfowl foods, Waterfowl Management Handbook. U.S. Fish and Wildlife Service, Washington, D.C.

Ma Z, Cai Y, Li B, Chen J. 2010. Managing wetland habitats for waterbirds: an international perspective. Wetlands 30:15–27.

Suir GM, Evers DE, Steyer GD, Sasser CE. 2013. Development of a reproducible method for determining the quantity of water and its configuration in a marsh landscape. Journal of Coastal Research, Special Issue 63:110–117.

SOP 3: Measuring Salinity

If measuring salinity with a hydrometer, you will also need a large, clear jar and a thermometer. The protocol for measuring salinity with a hydrometer (EPA 2006):

1. Put the water sample in a hydrometer jar or a large, clear jar.
2. Gently lower the hydrometer into the jar along with a thermometer. Make sure the hydrometer and thermometer are not touching and that the top of the hydrometer stem (which is not in the water) is free of water drops.
3. Let the hydrometer stabilize and then record the specific gravity and temperature. Read the specific gravity (to the fourth decimal place) at the point where the water level in the jar meets the hydrometer scale. Do not record the value where the meniscus (the upward curvature of the water where it touches the glass) intersects the hydrometer (Figure SOP-3.1).
4. Record the specific gravity and the temperature on your data sheet.
5. Use a hydrometer conversion table that comes with your hydrometer to determine the salinity of the sample at the recorded temperature. Record the salinity of the sample on the data sheet.

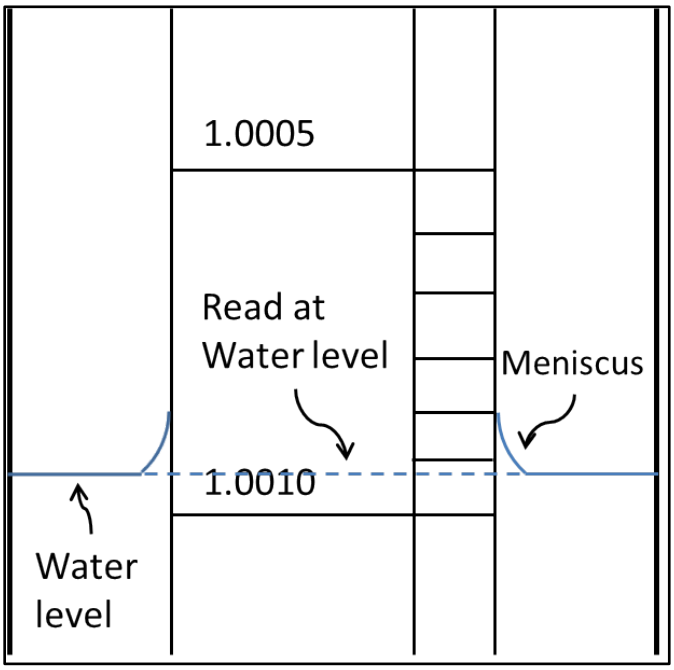

Figure SOP-3.1. Reading specific gravity from a hydrometer. Note that the reading should be taken at the water level NOT the meniscus. Redrawn from EPA (2006).

If measuring salinity with a refractometer, you will also need a dropper and a container of distilled water. The protocol for measuring salinity with a refractometer (EPA 2006):

1. Lift the lid that protects the refractometer's specially angled lens.
2. Place a few drops of your sample liquid on the angled lens and close the lid.
3. Peer through the eyepiece. Results appear along a scale within the eyepiece.
4. Record the measurement on your data sheet.

Rinse the lens with a few drops of distilled water, and pat dry, being very careful to not scratch the lens' surface.

References

[EPA] Environmental Protection Agency. 2006. Chapter 14: Salinity Pages 1–8 in Ohrel RL J., Register KM, editors. Volunteer estuary monitoring manual, a methods manual. 2nd edition. Washington, D.C.: EPA-842-B-06-003. Available: http://water.epa.gov/type/oceb/nep/monitor_index.cfm (January 2015).

SOP 4: Bathymetry Mapping

Adapted from Lyons et al. 2006.

Goal

Create a basin contour map that will provide estimates of the quantity of different water depth categories for any given water level (measured at a permanent water gauge).

Personnel

Survey unit basin contour mapping will require two individuals.

Equipment

Highly accurate GPS receiver (e.g., Trimble GeoXM or GeoXT, or similar), meter stick or sounding line marked in cm, Bathymetry data sheet. A disc of ¼ inch plywood or similar material may be attached to the bottom of the meter stick to facilitate depth measurements over unconsolidated bottoms.

Timing

Once per survey unit, preferably early in spring when the unit is at full pool. *Measurements should be made on a calm day* following a period of stable water levels to be sure that water is evenly distributed within the unit. Permanent water gauge readings should be made at the beginning and end of each day.

General Methods

The bathymetry method outlined below involves measuring the depth of the unit across a grid of points *when the impoundment is at full pool* and water levels have been stable for at least a few days before the survey. The basin contour map will allow us to estimate the amount of mudflat and proportions of the impoundment in various water depth classes throughout the drawdown.

This procedure *requires* the use of a highly-accurate GPS unit, such as a Trimble GeoXT or GeoXM, or similar. Recreational handheld GPS units made by Garmin, Magellan, and others are not likely to be accurate enough (± 1 m). If the cooperator is a member of the USFWS and needs access to an adequate GPS unit, he or she may be able to borrow one from regional staff or a nearby refuge if possible.

In the field, GPS locations and water depth measurements will be collected in a spatial arrangement approximating a grid; this does not require the creation of a grid of sampling points ahead of time with a GIS. Grid spacing (typically between 25 to 100 m) will determine how frequently data points will be collected and should be informed by the size of the survey unit and the variability of water depth conditions within the unit. The resulting file of GPS points will resemble a grid once imported to GIS (see Figure A6.1). It may be possible, depending on the GPS unit used, to enter water depth measurements directly into the GPS unit as the data points are collected. This will reduce data entry required after field work and the likelihood of data entry errors. In addition, field crews are encouraged to record water depth data on the paper data sheets as well as a hard-copy back-up.

Steps

1. Before starting, obtain an appropriate GPS unit, if necessary, or prepare your GPS unit to collect bathymetry data for your survey unit. If you are not familiar with the GPS technology you are using, IWMM staff can provide detailed step-by-step instructions for its use.
2. Record the water level at the permanent water gauge at the start of each day of bathymetry work.
3. Starting with one edge of the impoundment, traverse a series of parallel transects, taking periodic readings.
    a. Place points along transects at a standardized frequency.
    b. As necessary, collect additional sampling points along each transect whenever there is a significant change in slope. For example, if a low spot or ditch is encountered, collect a point at the edge of it, at its lowest point, and at a point where elevation rises again. *These extra points are critical for accurate mapping of the basin contour.*
    c. If areas with a significant change in slope occur between transects, data points should be collected in those locations as well. (See Figure A6.1 for a diagram of this data collection process.)
4. At each sampling point :
    a. Collect the location with the GPS. GPS points are automatically numbered in sequence as they are collected in the field. A Point ID and UTM coordinates will be stored in the unit.
    b. Record the water depth (cm) using the meter stick or the sounding line. (Begin sampling points at the edge of the impoundment. Water depth at this location will be 0.) Water depth can be typed into the GPS unit directly and/or written on the data sheet. If entering the water depth data directly into the GPS unit, the use of the data sheet as a hard-copy backup is optional, but highly encouraged.
    c. Record comments for impoundment edge, ditch, change slope, top slope, bottom slope, etc.
    d. When using the data sheet, Point ID is simply a sequentially assigned number given to the points in the order they are collected (1, 2, 3, etc.). Thus, written depth data should be collected in the same order as GPS data points, so that the data corresponds correctly.
5. Once the entire impoundment has been sampled, record the water level at the permanent water gauge at the end of each day. Since staff gages mounted on posts can be dislodged, the staff gage present at the time of the survey should also be referenced against multiple points on a more permanent structure such as a culvert bottom, concrete water control structure, bridge footing, etc. to maintain a consistent datum. Although not required, mean sea level surveys could establish elevation references for all staff gages and permanent reference points.

For an example converting field data to bathymetry maps for use, please refer to Los Huertos and Smith (2013).

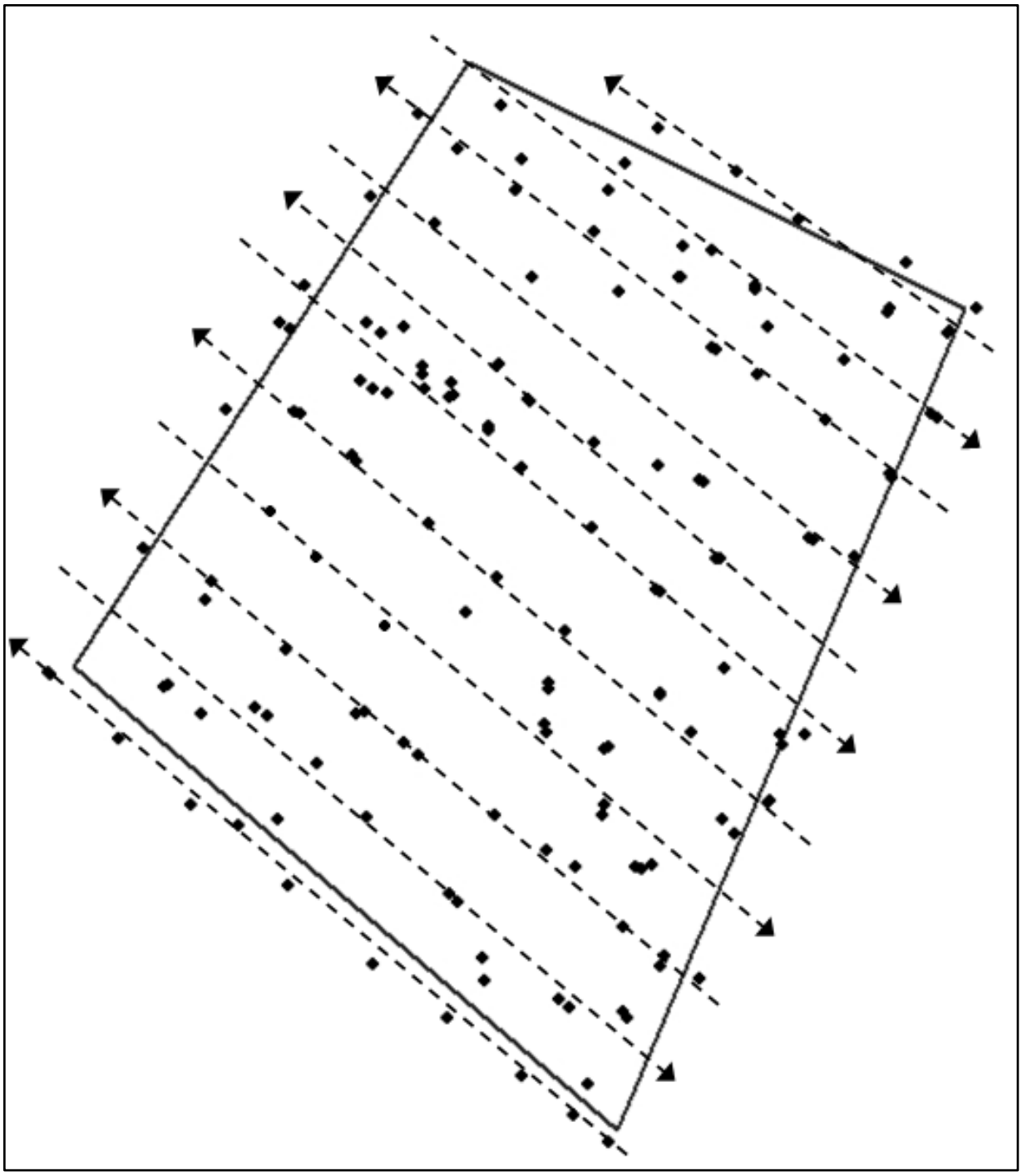

Figure SOP-4.1. Example data from bathymetry work at Prime Hook NWR, illustrating the arrangement of parallel data collection transects approximately 50 meters apart, and the collection of data points along the transects. Note that data points are not always spaced 50 meters apart; some are clustered and/or located between transects, as necessary, to capture areas with changes in slope.

References

Lyons JE, Runge, MC, Kendall WL, Laskowski H, Lor S, Talbott S. 2006. Timing of impoundment drawdowns and impact on waterbird, invertebrate, and vegetation communities within managed wetlands:.Study Manual Final Version Field Season 2006. USGS-Refuge Cooperative Research Program. Laurel, Maryland.

Los Huertos M, Smith D. 2013. Wetland Bathymetry and Mapping. Pages 49–86 in Anderson JT, Davis CA, editors. Wetland Techniques: Foundations. Volume 1. Secaucus, New Jersey: Springer.

SOP 5: Vegetation Survey

Follow these instructions for preparing and conducting vegetation surveys and assessing site conditions of each unit. Associated data collection sheet can be found in Supplemental Materials 7.

Equipment

- Map of the site and unit boundaries
- Annual Vegetation Survey Form (See Supplemental Materials 4)
- Seed Head Photographic Guide (See Supplemental Materials 5)

Survey Schedule

Vegetation surveys are to be completed once annually, typically late in the growing season when dominant plant species have started to senesce. To improve the accuracy of the seed head index, surveys should also be completed prior to the shattering of influential moist-soil species.

Plant Community Composition

Plant community composition will be assessed by measuring the cover of individual, emergent plant species in areas of emergent vegetation within the survey unit. **Only emergent vegetation from the current growing season should be included in plant community composition assessments.** Two major steps are involved in the assessment of plant community composition: (1) assessment of percent emergent cover within the survey unit and (2) species inventory and species-specific percent cover assessments within areas of emergent vegetation.

Cooperators should determine the location of all emergent vegetation patches within a survey unit. This could be done through a visual assessment around the perimeter of the survey unit. Preferably, patches would be identified via a combination of aerial photograph (e.g., Google Earth imagery) and field-based visual inspections. Once the cooperator is confident they have identified all emergent vegetation patches, they should estimate and record the percent of the survey unit covered by emergent vegetation. Percent cover is defined as the percentage of the survey unit covered by vertical projections from the outermost perimeter of plants' foliage (Anderson 1986) (Figure SOP-5.1). Again, for this metric, percent cover assessments should exclusively consider vegetation from the current season's growth.

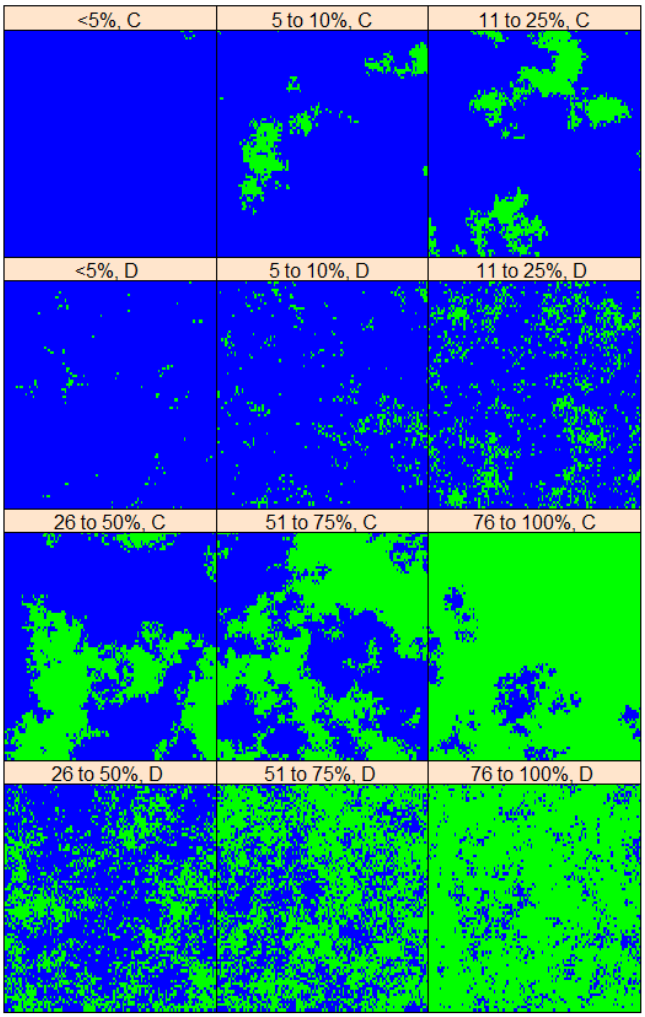

Figure SOP-5.1. Different levels of vegetation cover (green patches). Panels labeled with a "C" show clumped patches of vegetation and water whereas those with a "D" show dispersed or spread out patches.

For a single composite representing all areas of emergent vegetation, cooperators will compile a list of common plant species and estimate each species' percent cover. For this assessment, the following pertains to percent cover estimates:

- For individual plant species, cover is defined as above except that it is *estimated as a percentage of emergent vegetation area* **not** as a percentage of total survey unit area. As an example, consider a survey unit that contains only cattail as an emergent plant species. Cattail may cover 50% of the total survey unit area, but as an individual plant species, it covers 100% of the emergent vegetation area within a survey unit; report 100% as the estimate.
- Cover should be estimated only for common species, species covering >5% of the emergent vegetation area.
- Total cover across species can exceed 100% due to the stratification of plant species with varying heights and growth forms.

Cooperators have two options for creating a list of the common plants and estimating their percent covers:

1. Entry, Ocular Assessments (Preferred)

Preferably, cooperators will be able to physically enter the unit to identify emergent plant species and to assess their covers. Physical entry will especially help cooperators identify and account for plant species occupying lower strata that may be over-topped by taller growth forms.

2. Non-entry, Ocular Assessments (Non-preferred)

While not the preferred option, cooperators can identify emergent species and assess their covers entirely from vantage points around the perimeter of the survey unit. Vantage points should offer cooperators a comprehensive view of the emergent vegetation within the unit. This may be the only viable assessment option when a cooperator does not have permission to enter a unit.

Seed Head Assessments

For important waterfowl food species identified in the *Plant Community Composition* assessment (see above), choose a category for seed-head size and density for each species (Naylor et al. 2005).

Using ocular estimation, qualitatively assess seed head size for a given species as average, smaller, or larger than the average size for the species. For example, *Polygonum pensylvanicum* would be compared to average size of seed heads for this species. Use the "Not Assessed" category for species that have deteriorated seed heads at the time of assessment or difficult to assess seed heads.

We provide a photographic guide to assist you in making seed head size assessments (see Supplemental Materials 6). The guide includes many common waterfowl food sources but may exclude some regionally important species. If you encounter a species that is energetically important and not listed in the photographic guide, please email iwmmprogram@gmail.com to suggest the species as an addition to the guide.

For each common plant species, visually assess seed head density based on two considerations:

- The density of stems for a species.
- The proportion of a species' stems with seed heads

Through ocular assessments, seed head density is assigned to ordinal categories including low, moderate, or high. Low seed head density is characterized by large areas of bare ground and a low proportion of seed heads to plant stems. High stem density is assigned to areas with little bare ground and a high proportion of seed heads to stems. Moderate stem densities fall between these two extremes.

Percent near tall edge

A "tall edge" is defined as an edge of the survey unit bordered by trees >6 m tall. There are two alternatives for assessing the percent of a survey unit near a tall edge.

1. Aerial Photograph Assessment (Preferred)

The preferred option is to use available imagery in Google Earth or other remote sensing images to assess what percentage of the survey unit is within 50 m of a tall edge.

2. Ocular Assessment (Non-preferred)

While not the preferred option, observers may visually assess the percentage of the unit within 50 m of a tall edge. This option should be employed only if available aerial imagery for a survey unit no longer reflects conditions on the ground, i.e., the photo is too old to use for the assessment.

Figure SOP-5.2 illustrates different values for this metric. In example A, the metric is 50% - most of wetland edge forested, but around half of wetland is more than 50 m from trees. In example B, the metric is 5%, there are some tree lines, but the wetland is mostly surrounded by other habitats (i.e., short vegetation). In example C the metric is 80%, a narrow riparian wetland with forested edge. Forested wetland will generally have a higher percentage of wetland within 50 m of trees. For some forested wetlands this metric could be 100%.

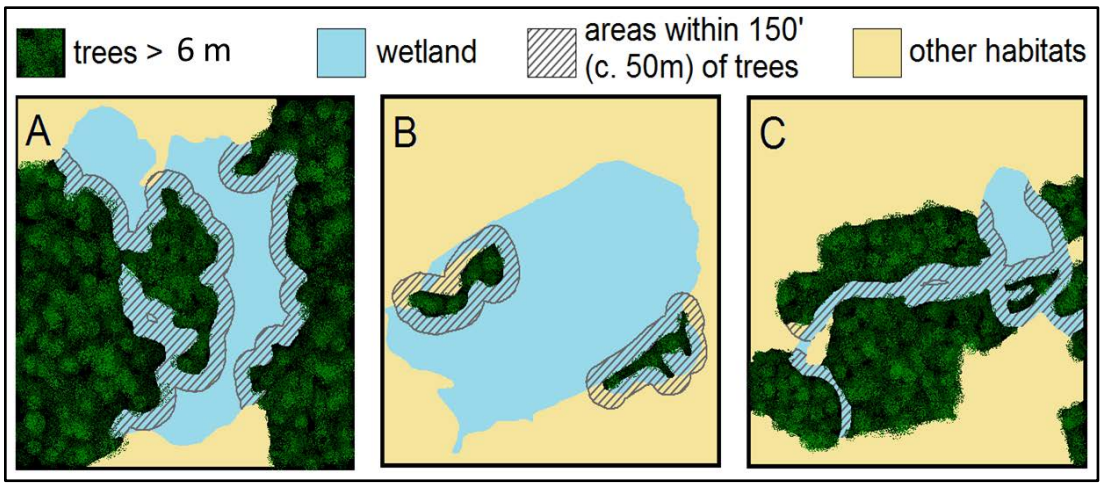

Figure SOP-5.2. Examples of Percent near tall edge, A=50%, B=5%, C=80%

Data Entry

The IWMM will be transitioning to an online database that will be part of the Avian Knowledge Network (AKN). This database will provide centralized data entry and reporting capabilities for IWMM cooperators. As a member of the AKN, IWMM will be able to share data and tools with other members, such as the International Shorebird Survey.

References

Anderson EW. 1986. A guide for estimating cover. Rangelands 8:236–238.

Naylor LW, Eadie JM, Smith WD, Eichholz M, Gray MJ. 2005. A simple method to predict seed yield in moist-soil habitats. Wildlife Society Bulletin 33:1335–1341.

SOP 6: Recording Management Actions

Follow these instructions for recording and tracking management actions for each unit surveyed. Associated management record sheet can be found in Supplemental Materials 7.

Resources

- Map of the site and unit boundaries
- Wetland management activities record (Supplemental Materials 7) for recording implemented actions.

In addition to monitoring waterbird use and habitat response, routine habitat management activities need to be tracked for each management unit. To develop effective and informed strategies in an adaptive management approach, a reasonable range of management activities must be considered (Williams 2011). The details of timing, extent, and frequency will be recorded by cooperators via a wetland management record (Supplemental Materials 9) to document individual actions (as listed in Table SOP-6.1) as planned and implemented prescriptions. A much smaller set of management actions maximized for differences among actions will later be defined from recorded prescriptions to meet the needs of the decision targeted for support (Williams 2009). Infrequent management activities involving major modifications or infrastructure development are excluded.

1. Create wetland management activities record (Supplemental Materials 9) for each unit and fill in all planned actions. Use annual habitat management plans or other annual goals & objectives to match planned activities for a unit to an action code in Table SOP-4.1. Broad classes are provided to narrow the search for matching actions. Start the annual tracking period at the beginning of the growing season that precedes the subsequent nonbreeding period.

2. Update the record through the season as actions are implemented. Create a new entry for repeat applications when the interval between applications exceeds the time required for a single application. Record the geographic extent (footprint as the proportion of a management unit) for each log entry. Total percent manipulated may exceed 100% since applications may overlap.

3. Cooperators should enter information from the management action record into IWMM's centralized, online database on a routine basis with a complete entry concurrent with the last waterbird survey for a survey period.

The following action groups are provided to guide the selection of individual actions:

Agriculture—Includes all activities related to the production of a harvested crop or a crop left standing. Cultivation or other actions commonly used in agriculture are excluded if a crop was not produced. Sowed stands of millet cultivars should be included here but not volunteer stands.

Chemical—Use of herbicides or fertilizers to manage vegetation not related to crop production. Estimate of actual costs should be used to interpret weed control density low<$54.00/acre, mod $54-$212/acre and high >$212/acre (NRCS 2012, NRCS 2014 a, b).
Fire-Prescribed—Controlled burns completed within a range of prescriptions described in an approved burn plan.
Mechanical—Managing soil, herbaceous vegetation, or light woody vegetation <4.5 inches diameter at breast height (dbh) with mechanized equipment. Action includes common agricultural tillage practices not related to the production of a crop in the current year.

Mechanical-woody—Removal or other manipulation of tree size (> 4.5 inches dbh) woody vegetation.

Prescribed grazing—Controlled grazing completed within a range of prescriptions described in an approved grazing plan.

Restoration herbaceous—Introducing seed of desired non-crop herbaceous vegetation.

Restoration woody—Actions relating to the direct planting or promotion of woody vegetation through natural succession.

Water level management—Actions applied to manipulate water levels through adjusting water control structures, pumping, or facilitating water movement.

A strategy list from the Refuge Lands Geographic Information System (RLGIS, USFWS 2010) served as foundation for a compiled list of actions (Table SOP-6.1). The RLGIS Actions were modified and fitted with costs from Natural Resources Conservation Service (NRCS) cost-share practices (NRCS 2012, NRCS 2014 a, b). Pumping logs, pump specifications, power source fuel use, and an irrigation study served as a basis for the fuel-use based pumping cost estimates (SRS Crisafulli Inc. 2014, University of NE 2011, Henggeler 2012). Crop input costs are based on production agriculture cost estimates (Dhuyvetter et al., Dobbins et al. 2012, Duffy 2014, Greer et al. 2012, USDA 2012). Estimates for prescribed goat grazing in wetlands and mechanical marsh shredders are derived from Greenfield et al. (2006). Costs for chemical control of woody invasive plants based on Rathfon and Ruble (2006) and NRCS (2012).

All costs estimates are very general and applied to actions with highly variable costs. The estimates are not recommended for use in budgeting purposes, cost benefit analysis, or other purposes requiring increased accuracy. Cooperator generated cost estimates should be used in these situations and included in the site-specific survey protocol. In a decision support context, the costs will be used to classify actions into high, moderate, or low cost.

Table SOP-6.1 Wetland Management Actions.

Strategy group	Strategy	code	unit	unit cost	cost class
agriculture	aerial seeding-ag	agr1	acre	$9	low
agriculture	buckwheat	agr2	acre	$74	low
agriculture	conventional corn	agr3	acre	$312	mod
agriculture	conventional rice	agr4	acre	$469	high
agriculture	dirty rice	agr5	acre	$234	mod
agriculture	grain harvest	agr6	acre	$28	low
agriculture	grain sorghum	agr7	acre	$253	mod
agriculture	grassy corn	agr8	acre	$160	mod
agriculture	irrigation	agr9	acre	$100	low
agriculture	millet (cultivars)	agr10	acre	$73	low
agriculture	other crop	agr11	acre	~	~
agriculture	post-harvest mowing	agr12	acre	$15	low
agriculture	soybeans	agr13	acre	$148	mod
agriculture	wheat	agr14	acre	$177	mod
chemical	aerial boom	che1	acre	$242	mod
chemical	aerial spray	che2	acre	$20	low
chemical	basal bark, low	che3	acre	$242	mod
chemical	broadcast	che4	acre	$242	mod
chemical	chemical injection, low	che5	acre	$242	mod
chemical	cut stump, low	che6	acre	$242	mod
chemical	foliar spray, low	che7	acre	$83	low
chemical	foliar spray, high	che8	acre	$383	high
chemical	hack and squirt, low	che9	acre	$31	low
chemical	herbaceous weed control high density	che10	acre	$707	high
chemical	herbaceous weed control low density	che11	acre	$54	low
chemical	herbaceous weed control mod density	che12	acre	$212	mod
chemical	spot spray	che13	acre	$54	low
Fire-Prescribed	prescribed burn	Fir1	acre	$27	low
mechanical	backhoe excavation of macrophytes	mec1	acre	$2,142	high
mechanical	chisel	mec2	acre	$15	low
mechanical	conventional tillage	mec3	acre	$13	low
mechanical	cookie cutter	mec4	acre	$526	high
mechanical	cultipacked	mec5	acre	$8	low
mechanical	disking (cutting/offset)	mec6	acre	$16	low
mechanical	disking (finish)	mec7	acre	$13	low
mechanical	drum chop	mec8	acre	$324	mod
mechanical	harrow	mec9	acre	$9	low
mechanical	hay	mec10	acre	$12	low
mechanical	mow	mec11	acre	$16	low
mechanical	other mechanical	mec12	acre	~	~
mechanical	packing	mec13	acre	$8	low
mechanical	plow	mec14	acre	$19	low
mechanical	raked	mec15	acre	$5	low
mechanical	roller (smooth drum)	mec16	acre	$19	low
mechanical	roller Chop	mec17	acre	$19	low
mechanical	subsoiler	mec18	acre	$17	low
mechanical	terminator, amphibious	mec19	acre	$982	high
mechanical	terminator, aquaplant	mec20	acre	$9,130	high
mechanical woody	bank axe	mec21	acre	$385	high
mechanical woody	brush control high	mec22	acre	$795	high
mechanical woody	brush control low	mec23	acre	$385	high
mechanical woody	brush control moderate	mec24	acre	$636	high
mechanical woody	chainsaw	mec25	acre	$576	high
mechanical woody	dozer	mec26	acre	$877	high
mechanical woody	drum chop-woody	mec27	acre	$324	mod
mechanical woody	feller buncher bar saw head	mec28	acre	$324	mod
mechanical woody	feller buncher high speed head	mec29	acre	$324	mod
mechanical woody	feller buncher intermittent head	mec30	acre	$324	mod
mechanical woody	hydro-axe	mec31	acre	$324	mod

Strategy group	Strategy	code	unit	unit cost	cost class
mechanical woody	mulching mower fecon/gyro track	mec32	acre	$324	mod
mechanical woody	other mechanical woody	mec33	acre	~	~
mechanical woody	Tree shear	mec34	acre	$467	high
mechanical woody	wood gator	mec35	acre	$324	mod
prescribed Grazing	flash grazing goats - emergent	pre1	acre	$1,251	high
prescribed Grazing	traditional biweekly rotation	pre2	acre	$85	low
restoration herbaceous	broadcast seeding-aerial	res1	acre	$9	low
restoration herbaceous	broadcast seeding-terrestrial	res2	acre	$23	low
restoration herbaceous	other restoration herbaceous.	res3	acre	~	~
restoration woody	direct seeding	res4	acre	$722	high
restoration woody	hand plant container	res5	acre	$490	high
restoration woody	mechanical tree planter	res6	acre	$554	high
restoration woody	other restoration. woody	res7	acre	~	~
restoration woody	allow natural succession	res8	acre	$0	low
water level	active draw down pumped (>18,000 GPM)	wat1	acre-foot	$6	low
water level	active draw down pumped (3000 -18,000 GPM diesel)	wat2	acre-foot	$15	low
water level	active draw-down gravity flow	wat3	acre-foot	$0	low
water level	active draw-down pumped (<3000GPM diesel)	wat4	acre-foot	$23	low
water level	active draw-down pumped (<3000GPM electric)	wat5	acre-foot	$11	low
water level	drain completely	wat6	acre-foot	$0	low
water level	excavation	wat7	acre	$413	high
water level	flood up gravity flow	wat8	acre-foot	$0	low
water level	flood up opportunistic	wat9	acre-foot	$0	low
water level	flood up pumped (<3000 -18,000 GPM diesel)	wat10	acre-foot	$15	low
water level	flood up pumped (<3000GPM diesel)	wat11	acre-foot	$23	low
water level	flood up pumped (<3000GPM electric)	wat12	acre-foot	$11	low
water level	flood up pumped (>18000 GPM)	wat13	acre-foot	$6	low
water level	levee removal, ditch plugs and floodplain features	wat14	acre	$116	mod
water level	natural draw-down	wat15	acre-foot	$0	low
water level	other water	wat16	acre-foot	~	~
water level	sediment removal ditch plug	wat17	acre	$1,307	high
water level	tile removal	wat18	acre	$445	high
water level	topographic feature creation, high	wat19	acre	$1,356	high
water level	topographic feature creation, low	wat20	acre	$728	high
water level	water level maintenance (<3000GPM diesel)	wat21	acre-foot	$23	low
water level	water level maintenance (<3000GPM electric)	wat22	acre-foot	$11	low
water level	water level maintenance (>18,000 GPM)	wat23	acre-foot	$6	low
water level	water level maintenance (3000 -18,000 GPM diesel)	wat24	acre-foot	$15	low

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SOP 7: Data Entry and Management Instructions

Data collected using this survey protocol and IWMM approach will need to be entered into the Avian Knowledge Network (AKN) database. This SOP describes the database for waterbird counts and provides instructions for data entry, data verification, and database administration.

Terminology

Using the database to enter or manage data requires knowledge of a few salient terms. In the AKN system:

- AKN "Project Leader" = Typically a Survey Coordinator (Refuge or Zone Biologist) as defined by the NWRS I&M policy (701 FW 2) or in general a 'cooperator' using this survey protocol framework. This person can give permissions to field biologists and technicians for data entry and validation. This is the person that will be contacted if there are questions about the data and who has a commitment to the accuracy and the validity of data entered from your site. Throughout this SOP we will refer to this role as the "Project Leader" to denote that this is not the Refuge Project Leader.
- Project = the name of the refuge, park, forest or other area over which a survey is conducted.
- Field Observer = the person or persons collecting data in the field via this protocol.
- Data Entry Technician = the person entering data collected via this protocol.

Gain Access to the Database

The Survey Coordinator is the refuge lead on the survey and will need to have database access permission from IWMM's Science Coordinator before survey data for the refuge can be entered. He or she will assign, to a "Project Leader" (Survey Coordinator), permissions for project creation, project access, and data entry. If this is an ongoing survey, the project should already exist in the AKN database.

Proof and Archive the Data Sheets

Data entry errors influence the quality and utility of collected data. However, many of these types of errors can be controlled through data organization, checking and entry techniques. The following steps should be used to reduce errors in the data base and make original data recording materials available for future reference, back-up or checking.

1. Organize data sheets by survey unit to facilitate data upload. Proofread the data sheets ensuring that they have been filled out completely. If more than one person is collecting data, have someone that did not collect these particular data conduct the review.
2. Mark corrections on copied data sheets with red pen. Any corrected errors, or changes made by the data "proofer" (that are entered differently into the database than they appear on the data sheet) should be circled, initialed, and corrected. Notes should be written in the margins or in the comments section whenever necessary to document the reason for the corrections.
3. Once reviewed and corrected, scan the data sheets to have a digital archive. If a portable computer or personal digital assistant (PDA) is used, export the file that is uploaded into AKN, or as a csv file, to an appropriate digital storage. The process and location of this back-up information should be specified in a site-specific survey protocol.

4. After data entry into AKN, archive the scanned data sheets or exported PDA file. If the data are associated with a survey report, include these data as an Appendix to the report and archive the report in ServCat. The original completed data forms or PDA file can also be stored on site in a safe place, preferably in a designated fireproof safe or cabinet.

Enter the Data

Prepare for data entry:

1. Organize your data and guidance materials to aid data entry process.
2. A data form will help verify that you have all the right data entry fields for your project.
3. A description or knowledge of the methods used for this survey.
4. The name and address of the Survey Coordinator (the person who can be contacted regarding questions about these data, once entered).

Enter the data into the AKN database:

1. Navigate through the IWMM website (http://iwmmprogram.ning.com) to the database interface and log in to the data entry web site using your email address and password.
2. Enter all waterbird, unit condition, and vegetation data from the datasheet into the database. The database is intended to accept data uploaded from spreadsheets or stand-alone databases. Check with IWMM's Science Coordinator or website to determine formats that can be accepted for uploading waterbird data.
3. After all data from each data sheet have been entered or uploaded, proof the data in the database, reviewing the data forms and sorting summaries (from queries) to check for typos, errors, and blank fields. As each data sheet (or any PDA output) is proofed, date and initial that the input data were reviewed and checked against the original data records. The data entry person will also verify the data has been proofed in the database by changing the status of the data records to the next appropriate level (see the user's manual for the database).

Verify and Validate

In general, AKN uses a tiered set of levels for indicating the data validation and access (Table SOP-7.1). Once the person entering data is finished, he or she needs to notify the "Project Leader" responsible for AKN data management (for the Refuge System, this is typically the survey coordinator) that data are ready to be proofed in the database. The Project Leader will:

1. Ensure all datasheets have been initialed.
2. Compare the data sheets with the data records in the database and if there are no errors, then change the status of the records to the next appropriate level (see the user's manual for the database).
3. Discuss any questionable data entry or field observer errors with the Data Entry Technician and/or Field Observer. If there are errors, the Project Leader will open up the records for editing.
4. After all errors are satisfactorily resolved in the database, set the status back. Then the Project Leader will change the status of the records in the database.

Table SOP-7.1. The following are the Avian Knowledge Network's data access levels. These are applicable to each and every record in the network individually, so that different records may have different access levels. Data published using one of the five Levels below are stored in the AKN's primary data warehouses. The warehouses serve as the primary archives of all AKN data. No applications connect directly to the warehouses, but data from a warehouse are ported to separate data views created specifically to optimize the performance of an application that connects to it. Data owners can specify how their data can be used in the data views, with the option that their data are not exposed to the public at all.

Validation / Access Code [1]	Definition and Description
Level 1	Some information is made available to others than project members about the data. Specifically, only metadata about the datasets are made available to any application or service.
Level 2	Same as Level 1 with the following addition: data can be used in certain publicly available, predefined visualizations (i.e. maps and graphs), but direct access to the data is restricted.
Level 3	Data are used in publicly available, predefined visualizations (i.e. maps and graphs). Additionally, the complete BMDE data set is available upon request, subject to approval from the original data provider.
Level 4	Data can be used in publicly available, predefined visualizations (i.e. maps and graphs) and also may be available upon request. Additionally, some components of the data are made available to existing bioinformatic efforts (GBIF and ORNIS). These bioinformatic efforts only provide the data "marked-up" to Darwin Core, used to describe primary occurrence (location, date and species for example).
Level 5	Data are used in publicly available, predefined visualizations (i.e. maps and graphs) and are available to existing bioinformatic efforts. Additionally, the complete BMDE data set is available for download directly via download tools.
Raw	Data were input but no further review or processing has taken place. Data are available for project use only and not to the AKN.
Clean	Data were input and reviewed by member(s) of the project team. Data are available for project use only and not to the AKN.
Approved	Data were reviewed by project management, but no indication has been made of AKN data sharing levels. Data are available for project use only and not to the AKN.
Restricted	Same as APPROVED and not distributed and shared to other AKN partners automatically. All access to data must come through requests to the contributing institution project management.

[1] Some nodes have extended levels to help users manage the entire data lifecycle (Raw, Clean, Approved, Restricted).

Data Maintenance and Archiving

AKN is responsible for performing periodic backups of all data residing in the database. Editing of data that has already been "verified" in the database must be made in the AKN database by the Project Leader via the interface. Contact IWMM's Science Coordinator for assistance if numerous edits are needed. A detailed log identifying any changes to records already verified as correct and dates of the change must be maintained by the Survey Coordinator and stored along with the archived datasets in the annual reports stored in ServCat.

Supplemental Materials

SM 1: AOU Species Codes in Family Order

Species (Common Name)	AOU code	Species (Common Name)	AOU code
Canvasback	CANV	*Unidentified goldeneye*	*UNGL*
Greater Scaup	GRSC	Ruddy Duck	RUDU
Lesser Scaup	LESC	*Unidentified teal*	*UNTE*
Redhead	REDH	*Unidentified dabbling duck*	*UNDA*
Ring-necked Duck	RNDU	*Unidentified diving duck*	*UNDI*
Black-bellied Whistling-Duck	BBWD	*Unidentified scaup*	*UNSC*
Fulvous Whistling-Duck	FUWD	*Unidentified duck*	*UNDU*
American Black Duck	ABDU	*Unidentified goose*	*UNGO*
American Wigeon	AMWI	*Unidentified swan*	*UNSW*
Blue-winged Teal	BWTE	*Unidentified waterfowl*	*UNWF*
Eurasian Wigeon	EUWI	Wood Stork	WOST
Gadwall	GADW	Limpkin	LIMP
Green-winged Teal	GWTE	Black-crowned Night-Heron	BCNH
Mallard	MALL	Cattle Egret	CAEG
Mottled Duck	MODU	Great Blue Heron	GBHE
Northern Pintail	NOPI	Great Egret	GREG
Northern Shoveler	NSHO	Green Heron	GRHE
Wood Duck	WODU	Little Blue Heron	LBHE
Brant	BRAN	Reddish Egret	REEG
Cackling Goose	CACG	Snowy Egret	SNEG
Canada Goose	CANG	Tricolored Heron	TRHE
Greater White-fronted Goose	GWFG	Yellow-crowned Night-Heron	YCNH
Mute Swan	MUSW	American Bittern	AMBI
Ross's Goose	ROGO	Least Bittern	LEBI
Snow Goose (all morphs)	SNGO	Sandhill Crane	SACR
Trumpeter Swan	TRUS	Whooping Crane	WHCR
Tundra Swan	TUSW	Glossy Ibis	GLIB
Barrow's Goldeneye	BAGO	Roseate Spoonbill	ROSP
Black Scoter	BLSC	White Ibis	WHIB
Bufflehead	BUFF	White-faced Ibis	WFIB
Common Goldeneye	COGO	*Unidentified night-heron*	*UNNH*
Common Eider	COEI	*Unidentified Plegadis ibis*	*UNPL*
Common Merganser	COME	*Unidentified heron*	*UNHE*
Harlequin Duck	HADU	*Unidentified large tern*	*UNLT*
Hooded Merganser	HOME	*Unidentified Sterna tern*	*UNST*
Long-tailed Duck	LTDU	*Unidentified Larus gull*	*UNLG*
Red-breasted Merganser	RBME	*Unidentified small gull*	*UNSG*
Surf Scoter	SUSC	American Golden-Plover	AMGP

SM 1: (Continued).

Species (Common Name)	AOU code	Species (Common Name)	AOU code
Killdeer	KILL	*Unidentified yellowlegs*	*UNYE*
Piping Plover	PIPL	Anhinga	ANHI
Semipalmated Plover	SEPL	Common Loon	COLO
Snowy Plover	SNPL	*Unidentified loon*	*UNLO*
Wilson's Plover	WIPL	Bonaparte's Gull	BOGU
American Avocet	AMAV	Franklin's Gull	FRGU
American Oystercatcher	AMOY	Great Black-backed Gull	GBBG
Black-necked Stilt	BNST	Herring Gull	HRGG
Baird's Sandpiper	BASA	Laughing Gull	LAGU
Buff-breasted Sandpiper	BBSA	Lesser Black-backed Gull	LBBG
Dunlin	DUNL	Ring-billed Gull	RBGU
Greater Yellowlegs	GRYE	*Unidentified gull*	*UNGU*
Hudsonian Godwit	HUGO	American White Pelican	AWPE
Least Sandpiper	LESA	Brown Pelican	BRPE
Lesser Yellowlegs	LEYE	Double-crested Cormorant	DCCO
Long-billed Curlew	LBCU	Great Cormorant	GRCO
Long-billed Dowitcher	LBDO	Neotropic Cormorant	OLCO
Marbled Godwit	MAGO	*Unidentified cormorant*	*UNCO*
Pectoral Sandpiper	PESA	Eared Grebe	EAGR
Purple Sandpiper	PUSA	Horned Grebe	HOGR
Red Knot	REKN	Pied-billed Grebe	PBGR
Red-necked Phalarope	RNPH	American Coot	AMCO
Ruddy Turnstone	RUTU	Black Rail	BLRA
Sanderling	SAND	Clapper Rail	CLRA
Semipalmated Sandpiper	SESA	Common Gallinule	COGA
Short-billed Dowitcher	SBDO	King Rail	KIRA
Solitary Sandpiper	SOSA	Purple Gallinule	PUGA
Spotted Sandpiper	SPSA	Sora	SORA
Stilt Sandpiper	STSA	Virginia Rail	VIRA
Upland Sandpiper	UPSA	Yellow Rail	YERA
Western Sandpiper	WESA	Black Skimmer	BLSK
Whimbrel	WHIM	Black Tern	BLTE
White-rumped Sandpiper	WRSA	Caspian Tern	CATE
Willet	WILL	Common Tern	COTE
Wilson's Phalarope	WIPH	Forster's Tern	FOTE
Wilson's Snipe	WISN	Gull-billed Tern	GBTE
Unidentified dowitcher	*UNDO*	Least Tern	LETE
Unidentified godwit	*UNGD*	Royal Tern	ROYT
Unidentified peep	*UNPE*	Sandwich Tern	SATE
Unidentified shorebird	*UNSH*	*Unidentified tern*	*UNTR*

SM 2: AOU Species Codes in Alphabetical Order

Species (Common Name)	AOU code	Species (Common Name)	AOU code
American Avocet	AMAV	Eared Grebe	EAGR
American Bittern	AMBI	Eurasian Wigeon	EUWI
American Black Duck	ABDU	Forster's Tern	FOTE
American Coot	AMCO	Franklin's Gull	FRGU
American Golden-Plover	AMGP	Fulvous Whistling-Duck	FUWD
American Oystercatcher	AMOY	Gadwall	GADW
American White Pelican	AWPE	Glossy Ibis	GLIB
American Wigeon	AMWI	Great Black-backed Gull	GBBG
Anhinga	ANHI	Great Blue Heron	GBHE
Baird's Sandpiper	BASA	Great Cormorant	GRCO
Barrow's Goldeneye	BAGO	Great Egret	GREG
Black Rail	BLRA	Greater Scaup	GRSC
Black Scoter	BLSC	Greater White-fronted Goose	GWFG
Black Skimmer	BLSK	Greater Yellowlegs	GRYE
Black Tern	BLTE	Green Heron	GRHE
Black-bellied Plover	BBPL	Green-winged Teal	GWTE
Black-bellied Whistling-Duck	BBWD	Gull-billed Tern	GBTE
Black-crowned Night-Heron	BCNH	Harlequin Duck	HADU
Black-necked Stilt	BNST	Herring Gull	HRGG
Blue-winged Teal	BWTE	Hooded Merganser	HOME
Bonaparte's Gull	BOGU	Horned Grebe	HOGR
Brant	BRAN	Hudsonian Godwit	HUGO
Brown Pelican	BRPE	Killdeer	KILL
Buff-breasted Sandpiper	BBSA	King Rail	KIRA
Bufflehead	BUFF	Laughing Gull	LAGU
Cackling Goose	CACG	Least Bittern	LEBI
Canada Goose	CANG	Least Sandpiper	LESA
Canvasback	CANV	Least Tern	LETE
Caspian Tern	CATE	Lesser Black-backed Gull	LBBG
Cattle Egret	CAEG	Lesser Scaup	LESC
Clapper Rail	CLRA	Lesser Yellowlegs	LEYE
Common Eider	COEI	Limpkin	LIMP
Common Gallinule	COGA	Little Blue Heron	LBHE
Common Goldeneye	COGO	Long-billed Curlew	LBCU
Common Loon	COLO	Long-billed Dowitcher	LBDO
Common Merganser	COME	Long-tailed Duck	LTDU
Common Tern	COTE	Mallard	MALL
Double-crested Cormorant	DCCO	Marbled Godwit	MAGO
Dunlin	DUNL	Mottled Duck	MODU

SM 2: (Continued).

Species (Common Name)	AOU code	Species (Common Name)	AOU code
Mute Swan	MUSW	*Unidentified cormorant*	*UNCO*
Neotropic Cormorant	OLCO	*Unidentified dabbling duck*	*UNDA*
Northern Pintail	NOPI	*Unidentified diving duck*	*UNDI*
Northern Shoveler	NSHO	*Unidentified dowitcher*	*UNDO*
Pectoral Sandpiper	PESA	*Unidentified duck*	*UNDU*
Pied-billed Grebe	PBGR	*Unidentified godwit*	*UNGD*
Piping Plover	PIPL	*Unidentified goldeneye*	*UNGL*
Purple Gallinule	PUGA	*Unidentified goose*	*UNGO*
Purple Sandpiper	PUSA	*Unidentified gull*	*UNGU*
Red Knot	REKN	*Unidentified heron*	*UNHE*
Red-breasted Merganser	RBME	*Unidentified large tern*	*UNLT*
Reddish Egret	REEG	*Unidentified Larus gull*	*UNLG*
Redhead	REDH	*Unidentified loon*	*UNLO*
Red-necked Phalarope	RNPH	*Unidentified peep*	*UNPE*
Ring-billed Gull	RBGU	*Unidentified scaup*	*UNSC*
Ring-necked Duck	RNDU	*Unidentified shorebird*	*UNSH*
Roseate Spoonbill	ROSP	*Unidentified small gull*	*UNSG*
Ross's Goose	ROGO	*Unidentified Sterna tern*	*UNST*
Royal Tern	ROYT	*Unidentified swan*	*UNSW*
Ruddy Duck	RUDU	*Unidentified teal*	*UNTE*
Ruddy Turnstone	RUTU	*Unidentified tern*	*UNTR*
Sanderling	SAND	*Unidentified waterfowl*	*UNWF*
Sandhill Crane	SACR	*Unidentified yellowlegs*	*UNYE*
Sandwich Tern	SATE	Upland Sandpiper	UPSA
Semipalmated Plover	SEPL	Virginia Rail	VIRA
Semipalmated Sandpiper	SESA	Western Sandpiper	WESA
Short-billed Dowitcher	SBDO	Whimbrel	WHIM
Snow Goose (all morphs)	SNGO	White Ibis	WHIB
Snowy Egret	SNEG	White-faced Ibis	WFIB
Snowy Plover	SNPL	White-rumped Sandpiper	WRSA
Solitary Sandpiper	SOSA	White-winged Scoter	WWSC
Sora	SORA	Whooping Crane	WHCR
Spotted Sandpiper	SPSA	Willet	WILL
Stilt Sandpiper	STSA	Wilson's Phalarope	WIPH
Surf Scoter	SUSC	Wilson's Plover	WIPL
Tricolored Heron	TRHE	Wilson's Snipe	WISN
Trumpeter Swan	TRUS	Wood Duck	WODU
Tundra Swan	TUSW	Wood Stork	WOST
Unidentified night-heron	*UNNH*	Yellow Rail	YERA
Unidentified Plegadis ibis	*UNPL*	Yellow-crowned Night-Heron	YCNH

SM 3: Waterbird Survey Form Single Unit (2 sides)

This is the standard field recording form for weekly waterbird counts. ONE FORM PER SURVEY UNIT (MAY BE SEVERAL UNITS PER SITE). Either Ctrl+Click anywhere on data sheet or refer to the website for the most up-to-date data form: http://iwmmprogram.ning.com/

Integrated Waterbird Management and Monitoring Program

Waterbird & Unit Condition Survey

Individual Survey Unit Recording Form

Site name			**Site code***		
Unit name			**Unit code***		
Observer			**Observer codes***		
Date (e.g. 08/21/2015)	_ _/_ _/_ _ _ _	**Start time** (24 hr clock)	_ _ : _ _	**Finish time** (24 hr clock)	_ _ : _ _
Start Temp (°F)		**Survey Type:** whole area ☐ flush ☐ aerial ☐	**Wind (Beaufort)**	**% Visibility (≥ 70%)**	
Local Tide Conditions[a]		**Salinity**		**Water Gauge (units =)**[b]	

Water Depth: % of unit in each category (sum to 100)	*Dry*	*Saturated/ mud*	*0 to 5 cm ≈ 0-2"*	*5 to 15 cm ≈ 2-6"*	*15 to 25 cm ≈ 6-10"*	*>25 cm ≈ >10"*

Percent Ice Cover		**Flood Duration**[c]	

Habitat Cover % of unit in each category (sum to 100)	**Water (Include SAV**[d] **& Floating – Leaved)**	**Scrub-shrub**	**Forest**	**Emergent**	**Bare Ground**

Interspersion[e]		**Disturbance Severity**[f]		**Disturbance Sources**[g]		**Chronic Disturbance**[h]	

Height % of unit in each category (sum to 100)	*<2.5cm ≈<1"*	*2.5 to 15 cm ≈1-6"*	*15 to 30 cm ≈6-12"*	*30 to 60 cm ≈2-4'*	*60 cm to 3 m ≈4-10'*	*3 to 6 m ≈10-20'*	*>6 m ≈>20'*

Species	Count	Species	Count	Species	Count

a, tide conditions: 1 = high; 2 = almost high, rising; 3 = almost high, falling; 4 = half tide, rising; 5 = half tide, falling; 6 = almost low, rising; 7 = almost low, falling; 8 = low; 9 = not observed, not applicable, or observations made during more than one period
b, gauge units: 1=feet/tenths, 2=feet/inches, 3=meters
c, flood duration: 1 = surface water present for > 90 days; 2 = surface water present 30-90 days, 3 = surface water present < 30 days; 4 = permanent inundation; 5 = no information
d, submersed aquatic vegetation
e, interspersion: class "L" = includes large water/bare ground features with connected patches and linear edge; Class "S"= contains small, disconnected patches of water/bare ground with increased random distribution and fewer instances of connection; Class "M" = consists of patterns that contain discernible regions of both configuration classes L and S
f, disturbance severity: 1 = no effect on waterbirds; 2 = some waterbirds move but stay within unit; 3 = some waterbirds leave unit; 4 = most/all waterbirds leave unit
g: disturbance codes (may be more than one): 1=Pedestrian, 2=Loose dog, 3=Hunting, 4= Fishing, 5=Boats, 6=Motor Vehicles, 7=Aircraft, 8=Raptor
h, chronic disturbance: 1 = no entry into the unit for any reason; 2 = Closed to all use with entry into unit by resource managers or designees for management activities, surveys, or other controlled non-hunting activities; 3 = Managed access for all activities including firearms hunting. May include effort to control use levels and temporal closures; 4 = open access via trail, viewing platforms etc. No firearms hunting allowed; 5 = Open access, including firearms hunting, often with routine restrictions but without a site specific management program to control the level of authorized use; 6 = unknown

* Please leave blank if unknown

SM 4: Waterbird Survey Form Multiple Units (2 sides)

This is the standard field recording form for weekly waterbird counts - **for up to six units surveyed on the same day**. ***Print double-sided***. If printed single sided, be sure to add site, unit and date to the second sheet! Either Ctrl+Click anywhere on data sheet or refer to the website for the most up-to-date data form: http://iwmmprogram.ning.com/

IWMM - Waterbird & Unit Condition Survey

Recording Form for multiple units

Site name			**Site code**	_ _--_ _ _	**Start temp (°F)**						
Observers (codes if known)			**Date**	__/__/____	**Wind** (Beaufort 0-6)						
			unit:		unit:		unit:		unit:		unit:		unit:	
Survey start/end time (24 hr Clock)			/		/		/		/		/		/	
Survey type (whole area, flush, aerial)												
% Visibility												
Local Tide Conditions[a]												
Salinity												
Water Gauge[b] (units=)												
Water Depth % of unit in each category (sum to 100)	Dry											
	Saturated/mud											
	0 to 5 cm(≈ 0-2")											
	5 to 15 cm(≈ 2-6")											
	15 to 25 cm(≈ 6-10")											
	>25 cm(≈ >10")											
Percent of ice cover												
Flood Duration[c]												
Habitat Cover % of unit in each category (sum to 100)	Water (Include SAV.[d] & Floating-Leaved											
	Scrub-shrub											
	Forest											
	Emergent											
	Bare Ground											
Interspersion[e]												
Height % of unit in each category (sum to 100)	<2.5 cm (≈<1")											
	2.5 to 15 cm (≈1-6")											
	15 to 30 cm (≈6-12")											
	30 to 60cm (≈2-4')											
	60 cm to 3 m (≈4-10')											
	3 to 6 m (≈10-20')											
	>6 m (≈>20')											
Disturbance severity[f]												
Disturbance sources[g]												
Chronic human disturbance[h]												

To be completed if not printed double-sided:		Site code	_ _-_ _ _	Date	_ _ /_ _ /_ _	
Species	unit:	unit:	unit:	unit:	unit:	unit:

a, tide conditions: 1 = high; 2 = almost high, rising; 3 = almost high, falling; 4 = half tide, rising; 5 = half tide, falling; 6 = almost low, rising; 7 = almost low, falling; 8 = low; 9 = not observed, not applicable, or observations made during more than one period
b, gauge units: 1=feet/tenths, 2=feet/inches, 3=meters
c, flood duration: 1 = surface water present for > 90 days; 2 = surface water present 30-90 days, 3 = surface water present < 30 days; 4 = permanent inundation; 5 = no information
d, submersed aquatic vegetation
e, interspersion: class "L" = includes large water/bare ground features with connected patches and linear edge; Class "S"= contains small, disconnected patches of water/bare ground with increased random distribution and fewer instances of connection; Class "M" = consists of patterns that contain discernible regions of both configuration classes L and S
f, disturbance severity: 1 = no effect on waterbirds; 2 = some waterbirds move but stay within unit; 3 = some waterbirds leave unit; 4 = most/all waterbirds leave unit
g: disturbance codes (may be more than one): 1=Pedestrian, 2=Loose dog, 3=Hunting, 4= Fishing, 5=Boats, 6=Motor Vehicles, 7=Aircraft, 8=Raptor
h, chronic disturbance: 1 = no entry into the unit for any reason; 2 = Closed to all use with entry into unit by resource managers or designees for management activities, surveys, or other controlled non-hunting activities; 3 = Managed access for all activities including firearms hunting. May include effort to control use levels and temporal closures; 4 = open access via trail, viewing platforms etc. No firearms hunting allowed; 5 = Open access, including firearms hunting, often with routine restrictions but without a site specific management program to control the level of authorized use; 6 = unknown

SM 5: Annual Vegetation Survey Form

Either Ctrl+Click anywhere on data sheet or refer to the website for the most up-to-date data form: http://iwmmprogram.ning.com/

Integrated Waterbird Management and Monitoring Program

Annual Vegetation Survey - Recording Form

Unit code	_ _-_ _ _ - _ _	**Date**	_ _ /_ _ /_ _	**Start Time** 24 hour Clock		**End Time** 24 hour Clock	
Observers			**Percent near tall edge**		**Percent Emergent Vegetation**[a]		
If using ocular, non-entry to estimate plant species cover, estimate the % of the unit that is visible from perimeter					**% Visibility**		

Plant Species	% Cover[b]	Seed Head Size (**A**verage; **L**arge; **S**mall)				Seed Head Density			
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
		A	L	S	NA	High	Mod.	Low	NA
Data Entry Date	_ _ /_ _ /_ _								

a, percent emergent vegetation = estimate for the entire survey unit

b, % cover for individual plants = estimate as a percentage of the emergent vegetation not the unit; percent cover total across individuals species may sum to >100% because of differences in plant growth form (i.e., some plant species will over-top others).

SM 6: Seed Head Assessment Guide for Selected Wetland Plants with Food Value to Waterfowl

Seed head assessments for the purposes of the IWMM habitat protocol will consist of assigning seed head size and density categories to selected emergent plant species based on the methodology developed by Naylor et al. 2005. Naylor et al. developed methods to evaluate percent cover and seed-head characteristics of 6 common moist-soil plant types and used these data to create an index of seed production.

The species selected for this guide originated from pilot IWMM vegetation surveys (Fall 2010 through Spring 2013). Initially, a candidate list included all co-dominant plant species listed on pilot vegetation surveys. We narrowed this list by applying two filters: (1) the species must have a high food value to waterfowl (refer to table SM-6.1) and (2) the species must be listed as a co-dominant on at least 50 vegetation surveys from the pilot survey seasons. **We acknowledge that this guide will not be comprehensive, so we intend this guide to be a living document. Additional species will be added based on suggestions from IWMM cooperators. Cooperators should send suggestions for additions to iwmmprogram@gmail.com.**

Average seed head size for selected plant species was calculated using technical drawings for each species, knowledge of natural seed head variability for selected species across the IWMM study area, and reviews of the following references: USDA National PLANT Database, Common Marsh, Underwater and Floating-leaved Plants of the United States and Canada (Hotchkiss 1972), Food of Game Ducks in the United States and Canada (Martin and Uhler 1939), and A Manual of Marsh and Aquatic Vascular Plants of North Carolina with Habitat Data (Beal 1977).

How to Use this Guide

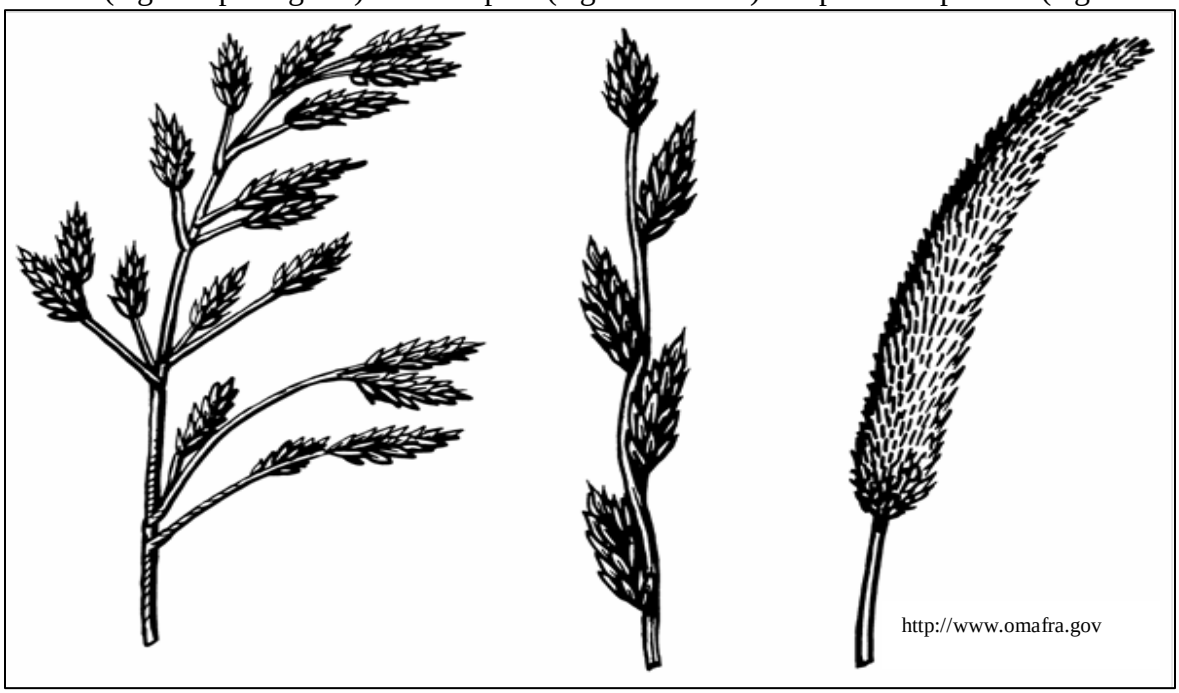
Seed head size—Seed head size categorization was plant-type specific and based on the deviation of the average size of inflorescences (for each plant species) within a wetland from that of the observed average size throughout a managed wetland (Naylor et al. 2005). For all the selected species in this guide, an average seed head size by species is indicated by a blue "arrow" to allow you to quantitatively assess seed head size as average, smaller than average, or larger than average (see below).

For example, in the field, Pennsylvania smartweed (*Polygonum pensylvanicum*) would be compared to its average size of seed head size for this species. If the seed head size is consistent with the size displayed by the blue arrow, assign it to the "average" category. If the seed head size is greater than average indicated by the blue arrow, assign it to the "large seed" category. Finally, if the seed head size is below the average seed head size as indicated by the blue arrow, assign it to the "small seed" category. Lastly, use the "Not Assessed" category for species that have deteriorated seed heads at the time of assessment or are too difficult to assess seed heads (e.g. damaged).

NOTE**:** Refer to the red arrow on individual plant photos or line drawings to maintain consistency when measuring actual seed heads in the field.

Types of inflorescence (seed heads)—There are three forms of seed heads, but for the purposes of this guide all three forms of seed heads will be treated collectively as inflorescences.

Panicle (e.g. fall panicgrass) Spike (e.g. smartweed) Spike-like panicle (e.g. foxtail)

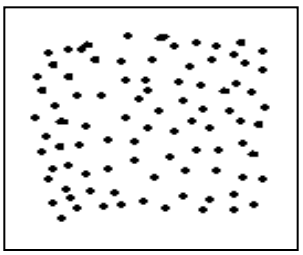


Seed head density—Seed head density should be assigned to ordinal categories by visually assessing the relative abundance of seed heads within a patch of each plant species. In the field, visually assess seed head density based on two considerations (1) the density of stems for a species; (2) the proportion of a species' stems with seed heads.

Conduct a visual assessment in the field of seed head density by assigning a seed head density category to a species by ordinal categories of high, moderate, or low using the pictorial representation of these ordinal categories below.

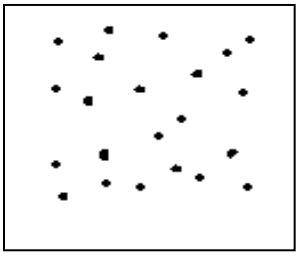
Stem Density—High stem density is assigned to areas with little bare ground, open water, or other plant species and a high proportion of seed heads to stems. Low seed head density is characterized by large areas of bare ground, open water, or other plant species and a low proportion of seed heads to plant stems for the species being assessed. Moderate stem densities fall between these two extremes.

High seed head density & **High** stem density

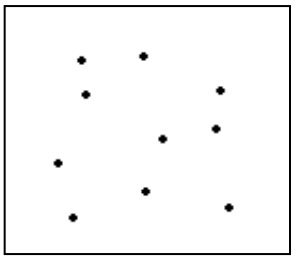


High stem density
Low bare ground

Moderate seed head density & **Moderate** stem density



Moderate stem density
Moderate bare ground



Low stem density
High bare ground

Low seed head density & **Low** stem density
Seed Head Size Assessment Guide for Selected Wetland Plants

Barnyardgrass or wild millet (*Echinochloa crus-galli*)

http://plants.usda.gov

http://plants.usda.gov

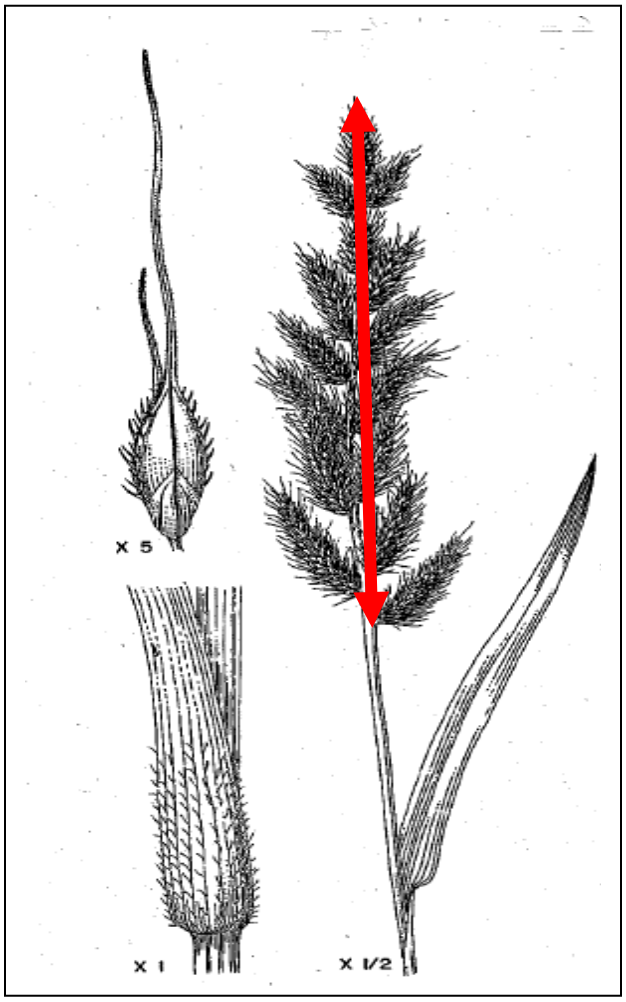
4-8” AVERAGE

Less than 4 inches **(SMALL)** Greater than 8 inches **(LARGE)**

- Measure 1 - 2 individual inflorescences from 3-5 separate plants; calculate average for seed head size.

Coast cockspur grass or Walter's millet (*Echinchloa walteri*)

USFWS



Martin and Uhler

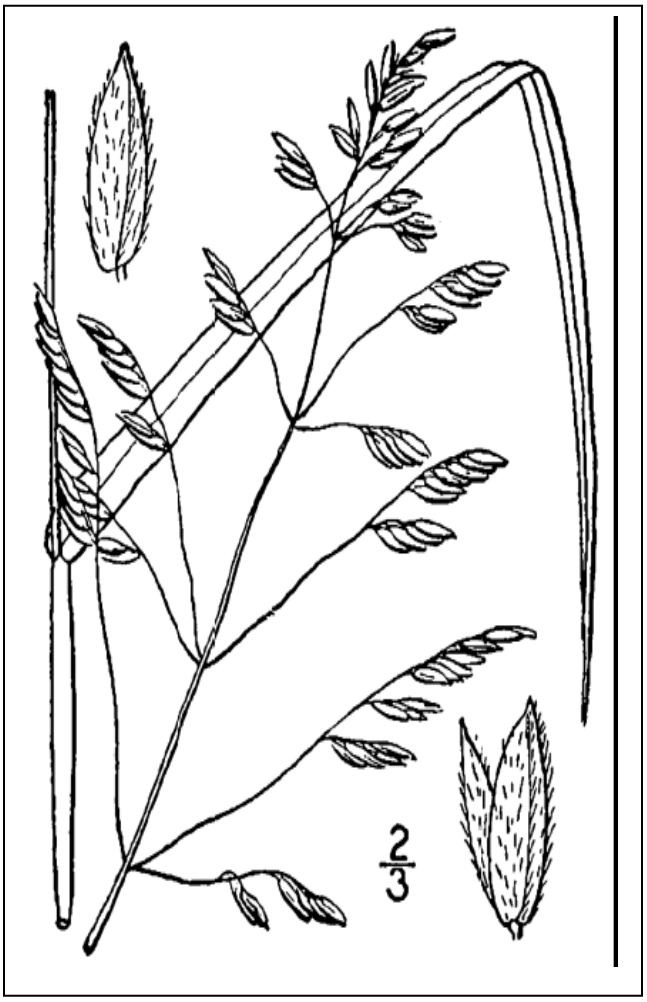
6-10" AVERAGE

Less than 6 inches (**SMALL**) Greater than 10 inches (**LARGE**)

- Measure 1-2 individual inflorescences (for this species it would include the entire seed head cluster) from the top to the bottom of the seed head cluster from 3-5 separate plants; calculate average for seed head size.

Rice Cutgrass (*Leersia oryzoides*)

http://plants.usda.gov



http://plants.usda.gov

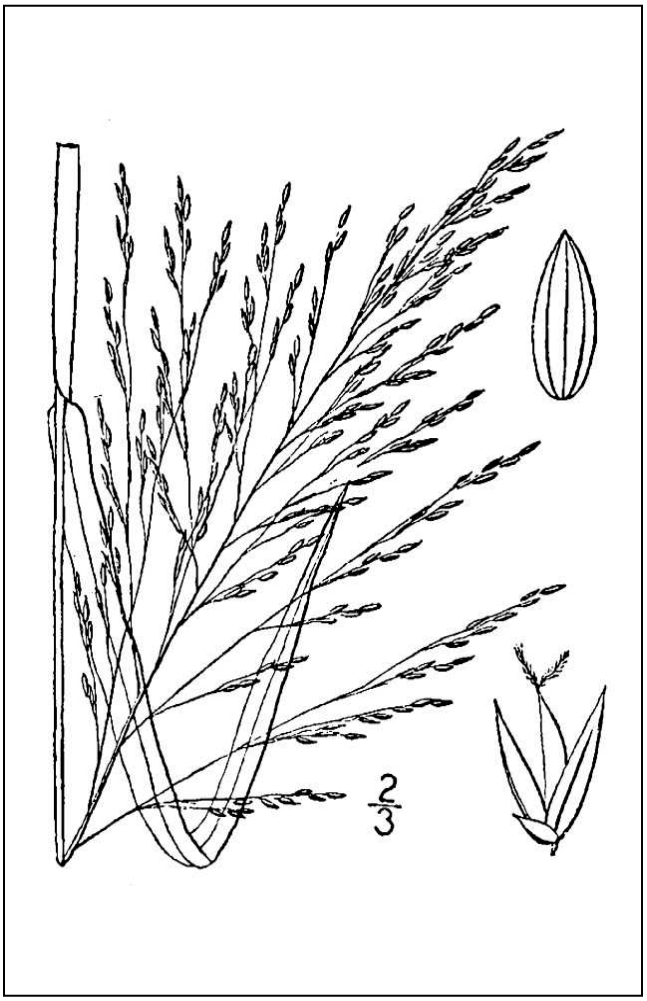
5-8" AVERAGE

Less than 5 inches (**SMALL**) Greater than 8 inches (**LARGE**)

- Measure 1-2 individual inflorescences from 3-5 separate plants; calculate average for seed head size.

Fall panicgrass (*Panicum dichotomiflorum*)

USFWS



http://plants.usda.gov

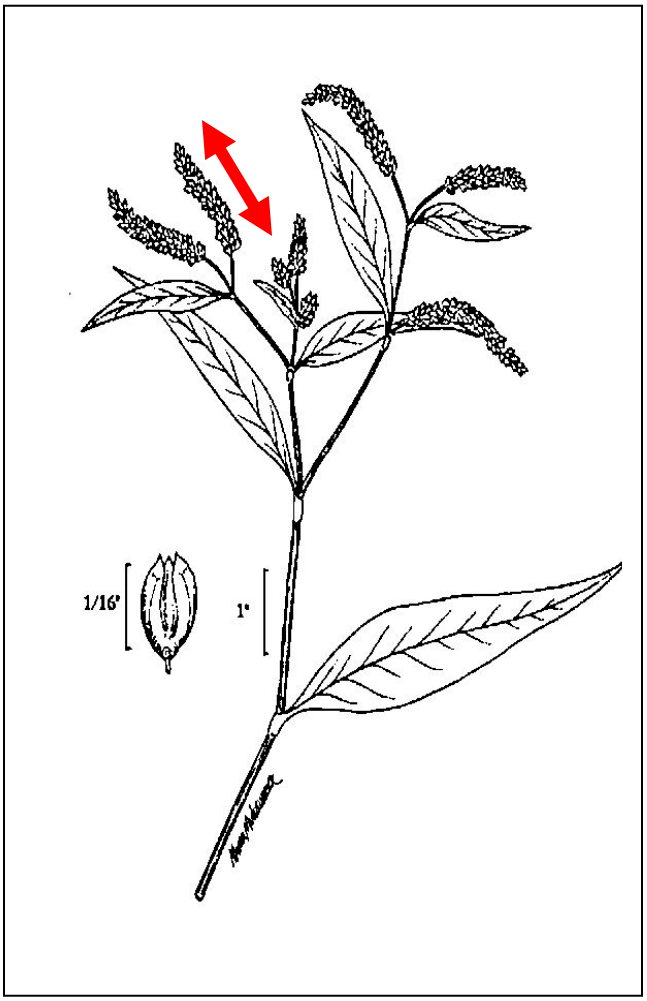
5-8” AVERAGE

Less than 5 inches (**SMALL**) Greater than 8 inches (**LARGE**)

- Measure 1-2 individual inflorescences (for this species it would include the entire seed head cluster) from the top to the bottom of the seed head cluster from 3-5 separate plants; calculate average for seed head size.

Curlytop knotweed (*Polygonum lapathifolium*)

USFWS



http://plants.usda.gov

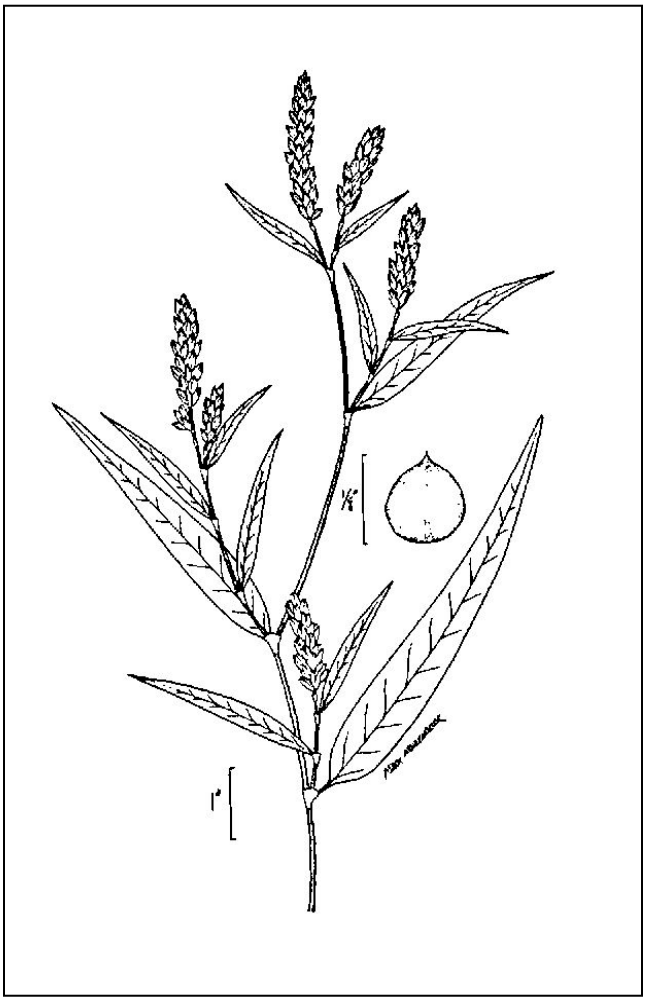
2-4" AVERAGE

Less than 2 inches (**SMALL**) Greater than 4 inches (**LARGE**)

- Measure 1-2 individual inflorescences from 3-5 separate plants; calculate average for seed head size.

Pennsylvania smartweed or pinkweed or big seeded smartweed (*Polygonum pensylvanicum*)

http://plants.usda.gov



http://plants.usda.gov

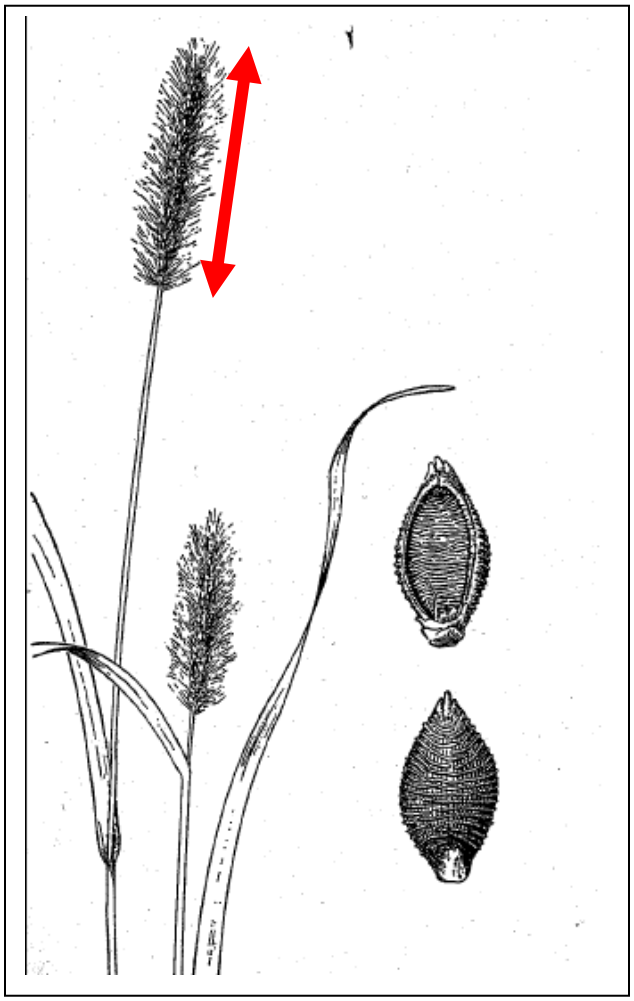
1-2”AVERAGE

Less than 1 inch (**SMALL**) Greater than 2 inches (**LARGE**)

- Measure 1-2 individual inflorescences from 3-5 separate plants; calculate average for seed head size.

Foxtail (*Setaria spp.*)

http://plants.usda.gov



Martin and Uhler

Giant Foxtail *S. Faberi*
2-4" AVERAGE

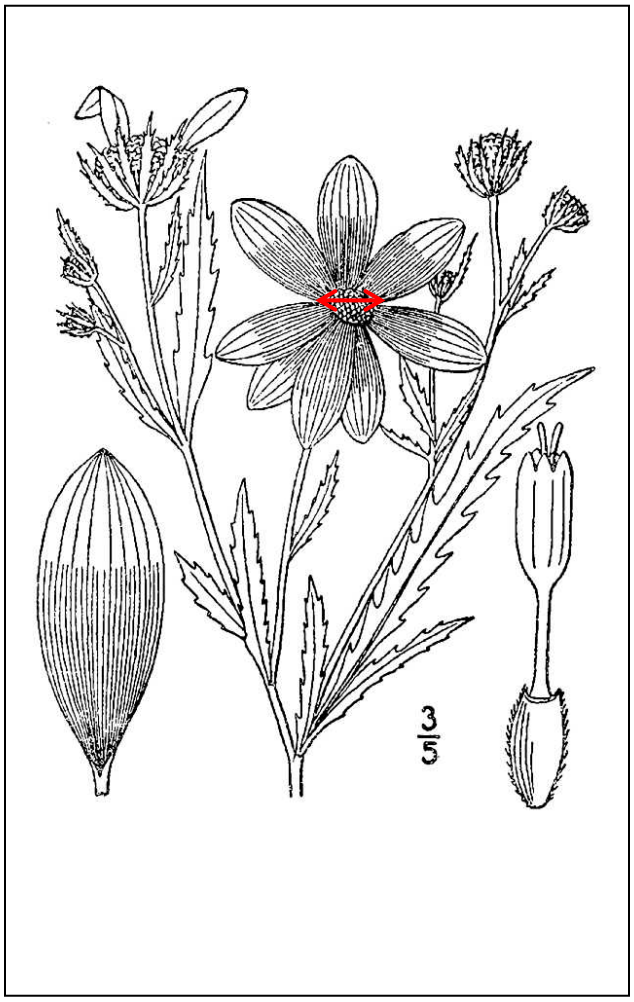
Less than 1.75 inches (**SMALL**) ⟷ Greater than 1.75 inches (**LARGE**)

Green & yellow Foxtail S. pumila & S. viridis
1-2" AVERAGE

- Measure 1-2 individual inflorescences from 3-5 separate plants; calculate average for seed head size.

Beggarticks (*Bidens spp.*)

http://plants.usda.gov



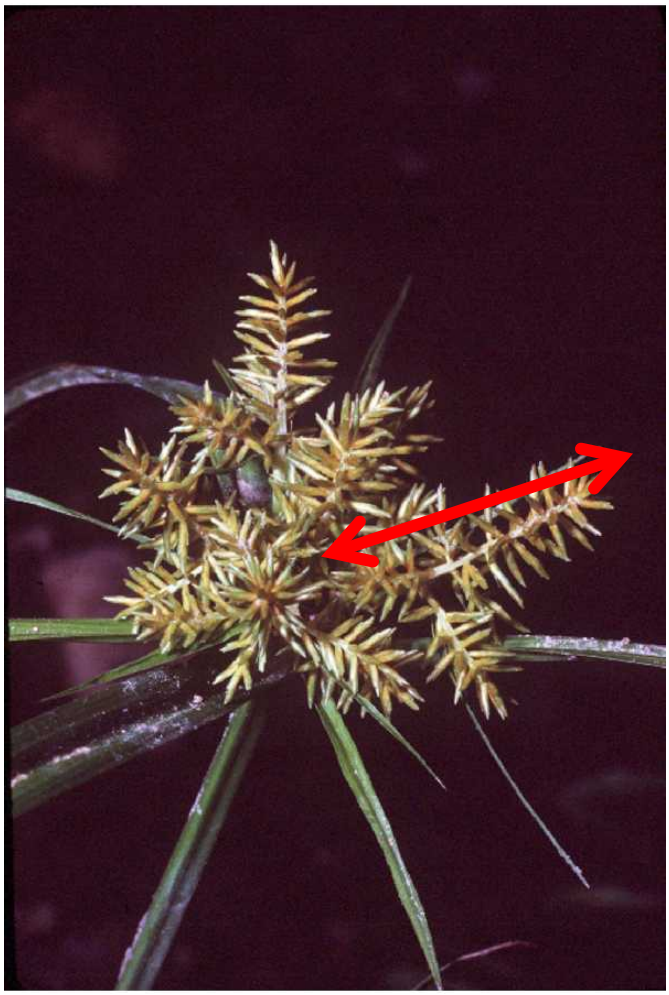
http://plants.usda.fgov

AVERAGE

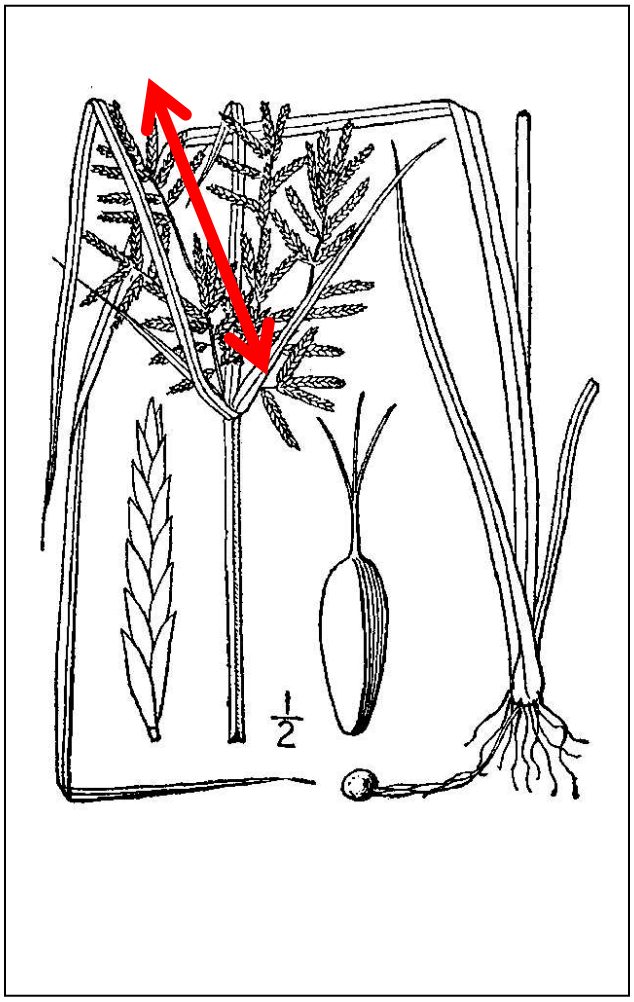
Less than 0.375 inches **(SMALL)** Greater than 0.375 inches **(LARGE)**

- Measure the width of 1-2 seed heads (excluding the flower petals) from 3-5 separate plants; calculate average for seed head size.

Yellow Nutsedge (*Cyperus esculentus*)



http://plants.usda.gov



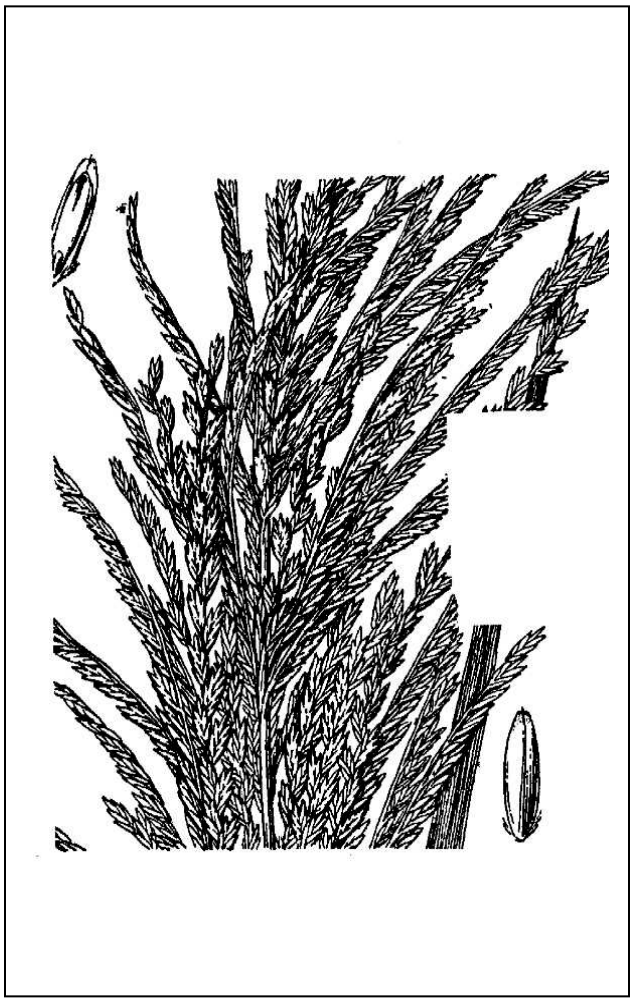
http://plants.usda.gov

2-4” AVERAGE

Less than 2 inches **(SMALL)** Greater than 4 inches **(LARGE)**

- Measure 1-2 individual inflorescences (for this species it would include the entire seed head cluster) from the top to the bottom of the seed head cluster from 3-5 separate plants; calculate average for seed head size.

Amazon sprangletop (*Leptochloa panicoides*)



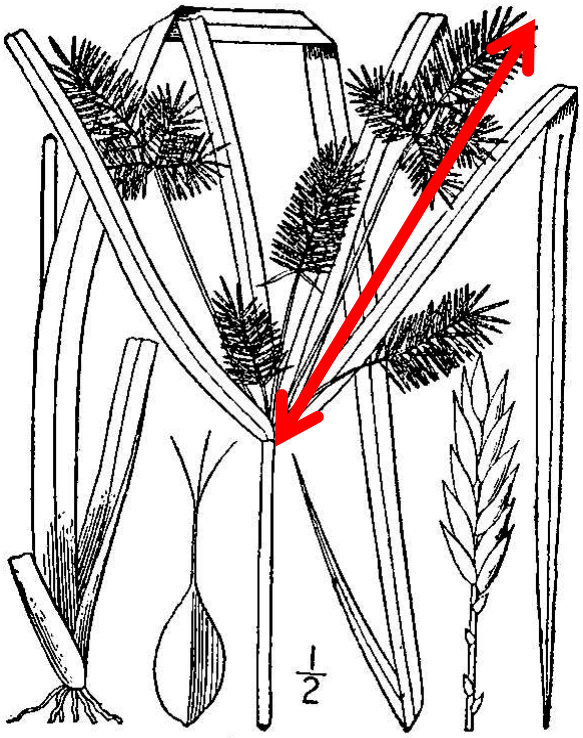
http://courses.missouristate.edu/pbtrewatha/amazon_sprangletop.htm

6-8” AVERAGE

Less than 6 inches **(SMALL)** Greater than 8 inches **(LARGE)**

- Measure 1-2 individual inflorescences (for this species it would include the entire seed head cluster) from the top to the bottom of the seed head cluster from 3-5 separate plants; calculate average for seed head size.

Redroot flatsedge (Cyperus erythrorhizos)



http://plants.usda.gov/

4-6” AVERAGE

Less than 4 inches **(SMALL)** Greater than 6 inches **(LARGE)**

- Measure 1-2 individual inflorescences from 3-5 separate plants; calculate average for seed head size.

References

Beal, EO. 1985. A manual of marsh and aquatic vascular plants of North Carolina with habitat data.. The North Carolina Agricultural Research Service, Raleigh, North Carolina. Technical Bulletin 247.

Hotchkiss N. 1972. Common marsh plants of the United States and Canada. New York, New York. Dover Publications.

Martin AC, Uhler FM. 1939. Food of game ducks in the United States and Canada. U.S. Department of Agriculture, Washington, D.C. Technical Bulletin No. 634.

Naylor LW, Eadie JM, Smith WD, Eichholz M, Gray MJ. 2005. A simple method to predict seed yield in moist-soil habitats. Wildlife Society Bulletin 33:1335–1341.

USDA, NRCS. 2014. The PLANTS Database. Available: http://plants.usda.gov. (April 2014). National Plant Data Team, Greensboro, North Carolina.

Table SM-6.1. Relative waterfowl food values for selected wetland plant species.

Plant species	Co-Dominant Count	Food value	Parts Consumed	Seed head size assessment guide*
Acer rubrum	50	L	seed	
Acer saccharinum	19	L	seed	
Amaranthus spp.	227	M	seed	
Ambrosia artemisiifolia	102	L	seed	
Ammannia spp.	14	L	seed	
Bacopa spp.	57	H	stem/leaves	
Bidens spp.	240	H	seed	X
Brasenia schreberi	17	L	seed	
Carex lacustris	11	M	seed	
Carex spp.	130	M	seed	
Cephalanthus occidentalis	239	L	seed	
Chara spp.	11	M	stem/leaves	
Cyperus erythrorhizos	45	H	seed	X**
Cyperus esculentus	83	H	seed/tuber	X
Cyperus spp.	60	H	seed	X
Digitaria spp.	39	L	seed	
Distichlis spicata	106	L	seed	
Echinochloa crus-galli	655	H	seed	X
Echinochloa esculenta	28	H	seed	
Echinochloa muricata	13	H	seed	
Echinochloa spp.	23	H	seed	
Echinochloa walteri	58	H	seed	X
Eleocharis parvula	63	H	seed	
Eleocharis quadrangulata	15	H	seed	
Eleocharis spp.	249	H	seed	
Eragrostis spp.	12	M	seed	
Fagopyrum esculentum	17	L	seed	
Glycine max	86	H	seed	
Juncus spp.	101	L	seed	
Lachnanthes caroliniana	11	H	seed	
Leersia oryzoides	153	H	seed/roots	X
Lemna spp.	133	M	leaves	
Leptochloa fascicularis	47	H	seed	
Leptochloa panicoides	11	H	seed	X**
Ludwigia palustris	10	L	seed	
Ludwigia spp.	159	L	seed	
Myriophyllum spp.	22	L	stem/leaves	
Najas guadalupensis	15	H	stem/leaves	
Nelumbo lutea	87	L	seed	

Nuphar spp.	58	L	seed	
Nymphaea odorata	83	L	seed	
Panicum dichotomiflorum	187	H	seed	X
Panicum spp.	138	H	seed	
Phalaris arundinacea	433	L	seed	
Polygonum coccineum	300	M	seed	
Polygonum hydropiperoides	125	M	seed	
Polygonum lapathifolium	130	H	seed	X
Polygonum pensylvanicum	169	H	seed	X
Polygonum punctatum	10	M	seed	
Polygonum sagittatum	11	M	seed	
Polygonum spp.	422	L	seed	
Pontederia cordata	35	M	seed	
Potamogeton pectinatus	41	H	stem/turions/leaves	
Potamogeton spp.	37	H	seed/leaves	
Rumex spp.	47	M	seed	
Ruppia maritima	44	H	stem/leaves	
Sagittaria spp.	45	M	seed	
Salicornia europaea	13	M	stem/leaves	
Salicornia spp.	36	M	stem/leaves	
Schoenoplectus fluviatilis	306	L	seed	
Schoenoplectus spp.	67	L	seed	
Scirpus americanus	81	M	seed	
Scirpus cyperinus	61	L	seed	
Scirpus robustus	110	M	seed	
Scirpus spp.	24	L	seed	
Scirpus validus	59	M	seed	
Sesbania spp.	139	L	seed	
Setaria spp.	122	H	seed	X
Sorghum vulgare	36	H	seed	
Sparganium spp.	51	M	seed	
Spartina alterniflora	213	L	seed	
Spartina cynosuroides	140	L	seed	
Spartina patens	306	L	seed	
Spartina pectinata	11	L	seed	
Typha angustifolia	10	L	tuber	
Typha spp.	1106	L	tuber	
Zea mays	258	H	seed	
Zizania aquatica	30	H	seed	
Zizania miliacea	31	H	seed	

*Plants with >50 records and High food value

**Some selected plants with <50 records and high food value.

SM 7: Wetland Management Record

This is the standard field recording form for management activities. ONE FORM PER SURVEY UNIT (MAY BE SEVERAL PAGES PER UNIT). Either Ctrl+Click anywhere on data sheet or refer to the website for the most up-to-date data form: http://iwmmprogram.ning.com/

Wetland Management Record

Unit Name	Unit Code	Activity Year[1]

Log of Planned and Implemented Actions[2]: Page 1 of _____

Action Code[3]	Planned start date	Planned end date	Planned % of unit	Actual start date	Actual end date	Implemented % of unit[4]

1. Start of growing season year one through start of the growing season for year two (2014/15).
2. Create a new entry for repeated applications of an action when the interval between applications exceeds the time required for a single application.
3. See Wetland Management Action Table (Table SOP-4.1).
4. Report as surface coverage of manipulated water for water level actions.

SM 8: Updated Employee Health and Safety Guidance for Avian Influenza Surveillance and Control Activities in Wild Bird Populations, 2014.

This is document guides procedures for protecting personal while handling wild birds. Also refer to the Wildlife Health office internal website at https://sites.google.com/a/fws.gov/fws-wildlife-health/products.

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

July 17, 2014

Memorandum

To: Bureau/Office Heads
Solicitor
Inspector General

Attention: Bureau/Office Emergency Coordinators
DOI Safety Council

From: Laurence Broun
Director, Office of Emergency Management

Diane Schmitz
Director, Office of Occupational Safety and Health

Subject: *Updated Employee Health and Safety Guidance for Avian Influenza Surveillance and Control Activities in Wild Bird Populations, 2014*

This memorandum announces a revision of the guidance document, *Employee Health and Safety Guidance for Avian Influenza Surveillance and Control Activities in Wild Bird Populations*. The original guidance was developed in 2006 during interagency/intra-departmental pandemic/avian influenza planning efforts. The revised guidance reflects recent research findings and shifts in the ecology of influenza viruses.

The revised guidance provides additional information related to handling birds including the need for influenza vaccinations and anti-viral medication for DOI personnel, and the need for personal protective equipment (PPE).

In addition to providing updated guidance, this memo serves as a reminder to DOI personnel, as well as their supervisors and managers, to be mindful of the tendency to normalize risk where behaviors are accepted because they have not resulted in adverse effects to the individual in the past. Managers, supervisors and employees need to be watchful of this tendency and must implement robust management and supervisory controls to prevent this from occurring in all types of field operations.

Please distribute this guidance to the appropriate personnel in your bureaus. If you have questions regarding this document, please contact your Bureau Safety Manager of CAPT Tim Radtke, Office of Occupational Safety and Health, at (303) 236-7128 ext. 226.

Updated Employee Health and Safety Guidance for Avian Influenza Surveillance and Control Activities in Wild Bird Populations, 2014

This document provides guidance for protecting Department of the Interior (DOI) employees involved in handling wild birds. The risk of exposure to influenza viruses, and consequent safety recommendations, are dependent on the suspected presence of one or more zoonotic avian influenza viruses (strains that are infectious to humans) in wild birds in North America or the Pacific Islands. Zoonotic avian influenza outbreaks in poultry or other domestic birds may or may not present risk to wild birds or people handling wild birds. Discuss any questions or concerns with your regional Wildlife Health Office or Health and Safety Office.

I. Personal Protective Equipment (PPE)

Instruction and up-to-date information must be provided to personnel at risk of coming in contact with zoonotic avian influenza:

- while handling infected animals - trapping and handling of wild birds, euthanasia, carcass collection and disposal
- while working with contaminated objects or surfaces - cleaning and disinfection of equipment/vehicles/non-disposable PPE
- through contact with infected persons

DOI agencies are required to provide the necessary PPE to at-risk personnel. PPE use and training is done in accordance with 29 CFR 1910.132 – 134.

The table below describes conditions and general activities and the protective measures required to minimize exposure to zoonotic avian influenza. It specifies the **minimum personal protective equipment** to be used for each activity. Other PPE and safety precautions may be necessary depending on specific conditions of the worksite or the tasks.

It is important to note that the table does not attempt to cover all tasks that may be assigned to DOI personnel. High exposure tasks not anticipated in the table should be evaluated in consultation with DOI health and safety officers.

Guidance on PPE will continue to be re-evaluated as more information becomes available and as the characteristics of different avian influenza viruses are better defined.

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GUIDANCE FOR HANDLING WILD BIRDS DEPENDING ON THE CURRENT CONDITIONS:			
CONDITIONS	**ACTIVITY**	**PPE**	**WORK PRACTICE**
1.a. Zoonotic avian influenza is **not known or suspected** in wild birds within North America or the Pacific Islands.	Handling apparently healthy birds.	Follow all PPE and standard work practices recommended for normal operations at your station. Consult regional health and safety expertise regarding zoonotic disease risks in your area.	1. Wash your hands often and thoroughly for at least 30 seconds (using soap/water or alcohol-based hand sanitizer) before eating, smoking, using cell phone and touching your face, hair, or exposed skin. 2. If working indoors, work in well-ventilated areas. When working outdoors, work upwind of animals to decrease the risk of inhaling airborne particulate matter such as dust, feathers, or dander. 3. Gloves, aprons, goggles, face shields, rubber boots, and coveralls that can be easily disinfected may also be worn to prevent skin and mucous membrane contact with biological materials, and prevent movement of biological materials to other sites.
1.b. Zoonotic avian influenza is **not known or suspected** in wild birds within North America or the Pacific Islands.	Handling sick or dead birds.	Follow all PPE and standard work practices recommended for normal operations at your station. Consult regional health and safety expertise regarding zoonotic disease risks in your area.	1. Remove gloves and wash your hands often and thoroughly for at least 30 seconds (using soap/water or alcohol-based hand sanitizer) before eating, smoking, using cell phone and touching your face, hair, or exposed skin. 2. If working indoors, work in well-ventilated areas. When working outdoors, work upwind of animals to decrease the risk of inhaling airborne particulate matter such as dust, feathers, or dander. 3. Aprons, goggles, face shields, rubber boots, and coveralls that can be easily disinfected may also be worn to prevent skin and mucous membrane contact with biological materials, and prevent movement of biological materials to other sites.
2.a. Zoonotic avian influenza is **confirmed**[1] **or presumed to be present** in wild birds within North America or the Pacific Islands.	Handling, investigation, or disposal of any healthy or sick, live or dead wild birds.	• Impermeable gloves (pvc or nitrile) or heavy duty rubber work gloves • Goggles • NIOSH-approved disposable N-95 particulate respirator[2]. Workers must be fit-tested and medically cleared annually prior to wearing a respirator. • Disposable Tyvek coveralls or raingear that can be disinfected • Waders, hip-boots, rubber boots or boot covers	In addition to the work practices listed above: 1. Suppress dust at the work site using water 2. Minimize direct contact with birds and their secretions, feathers, and dander. 3. Minimize contact with carcasses when bagging birds. 4. Contact recipient laboratories prior to collection and shipping; follow their guidelines. Remove PPE in the following order: 1. Carefully remove coveralls and boot covers and discard as contaminated material if disposable. 2. Disinfect rubber boots. 3. Remove gloves and immediately wash hands thoroughly with soap and water (or an alcohol-based hand gel when soap and clean water are not available). 4. Remove eye protection and place in designated receptacle for subsequent cleaning and disinfection. 5. Remove N-95 disposable respirator and discard. 6. Immediately after all PPE has been removed, wash hands thoroughly a second time and wash face.

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2.b. Zoonotic avian influenza is **confirmed**[1] **or presumed to be present** in wild birds within North America or the Pacific Islands	Cleaning and disinfecting equipment known or suspected to be contaminated with zoonotic avian influenza	• Impermeable gloves (pvc or nitrile) or heavy duty rubber work gloves • Goggles • NIOSH-approved disposable N-95 particulate respirator[2]. Workers must be fit-tested and medically cleared annually prior to wearing a respirator. • Disposable Tyvek coveralls or raingear that can be disinfected • Waders, hip-boots, rubber boots or boot covers	In addition to the work practices listed above: 1. Clean surfaces of equipment and reusable PPE with detergent and water, then disinfect with a virucide (such as Virkon®) that kills avian influenza viruses. Follow the label instructions. 2. www.epa.gov/pesticides/factsheets/avian.htm lists registered products. If a registered product is not available, use 3/4 cup of household bleach (5.25-6.00% sodium hypochlorite) per gallon of water for hard, non-porous surfaces. 3. Avoid generating mists with water sprayers during equipment decontamination procedures. 4. Do not touch any part of exposed person (especially the face) with gloved hands. Replace torn or damaged gloves immediately. 5. Additional protection (such as aprons and face shields) may be desired during equipment decontamination to prevent contact with contaminated material. 6. If there is known exposure to body fluids of the carcass (examples: knife cut, needle stick) contact your health care professional and provide a complete history of your activities. Carefully remove PPE in the order as described above in section 2a.
Key for colored conditions sections:	Green - Low risk conditions	Orange - Medium risk conditions	Red - High risk conditions

[1] Refers to situations where the National Veterinary Services Laboratory confirmed the presence of an avian influenza virus that is pathogenic for humans in a wild bird or a presumptive diagnosis of an avian influenza virus from a wild bird found dead or moribund.

[2] Use of respirators including N-95 filtering facepiece respirators requires implementing a Respiratory Protection Program as required by the Occupational Safety and Health Administration. This includes training, fit-testing, and fit-checking to ensure appropriate respirator selection and use. To be effective, respirators must provide a proper sealing surface on the wearer's face. Detailed information on respiratory protection programs is provided at: www.osha.gov/SLTC/etools/respiratory/index.html and www.cdc.gov/niosh/topics/respirators/. Under certain high risk conditions such as handling large numbers of birds in a confined area confirmed to have the HPAI virus, it may be necessary to upgrade respiratory protection to powered air purifying respirators (PAPR) or other protection options.

Opening carcasses in the field is not recommended as this may increase the risk of disease transmission and decrease the diagnostic value of the carcass. Consult DOI health and safety officers for more guidance if this activity is necessary.

Designated protective measures should be applied for at least 30 days after the date of the last detection of zoonotic avian influenza in wild birds within North America or the Pacific Islands.

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II. Vaccination, anti-viral medications, and medical monitoring

Personnel should obtain the seasonal influenza vaccine. Follow the Advisory Committee on Immunization Practices (ACIP) annual recommendations for the prevention and control of influenza with vaccines, which include information on the available vaccine products, timing of vaccination, and vaccination of individuals who could have complications from receiving the vaccine. The annual ACIP recommendations can be found on the Centers for Disease Control and Prevention (CDC) website (http://www.cdc.gov/flu/index.htm).

Vaccination for seasonal influenza viruses will reduce the possibility of an individual being infected with both avian and human influenza viruses at the same time. There is a small possibility that dual infection could occur and result in viral re-assortment, which would result in new, previously unrecognized virus subtypes.

During a threat or occurrence of an actual pandemic, CDC will develop guidance on anti-viral medication and emergency vaccine use based on population risk during an influenza pandemic.

DOI personnel who develop influenza symptoms within 10 days after working with wild birds or being in contact with people suspected to be ill with avian influenza should have prompt telephone access to a health care provider and access to medical care within 48 hours after symptom onset.

- Instruct workers to be vigilant for the development of fever, respiratory symptoms, and/or conjunctivitis (i.e., eye infections) for 10 days after last exposure to avian influenza-infected or exposed birds or to potentially avian influenza-contaminated environmental surfaces.
- Individuals who become ill with symptoms mentioned above should promptly seek medical care and prior to arrival notify their health care provider that they have been working under conditions where zoonotic avian influenza virus was potentially present. In addition, employees should notify their Bureau health and safety representative. They should limit contact with others if at all possible.
- With the exception of visiting a health care provider or seeking emergency care if necessary, individuals who become ill should be advised to stay home until 24 hours after resolution of fever, and follow the guidance of their health care providers. While at home, ill persons should practice good cough and hand hygiene to lower the risk of transmission of virus to others. For further information, visit the CDC website: http://www.cdc.gov/flu/protect/covercough.htm

U.S. Fish and Wildlife Service
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National Wildlife Refuge System