Standard Operating Procedures (5.1): Bird Abundance and Activity

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Standard Operating Procedures:
Bird Abundance and Activity

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Protocol Suitability Evaluation

A habitat suitability table containing appropriate estuarine wetland habitat types (of those evaluated) to implement bird abundance and activity protocols is displayed in Table 1 (i.e., site-wide, box count, and point count). A comparative assessment of cost, effort, and data quality are shown in Table 2. A matrix of additional detailed categorical evaluations of bird abundance and activity protocols can be found in Appendix 5.1A.

Table 1. Appropriate habitat types for bird abundance and activity protocols.

	Habitat Types					
Survey Protocol	**Tidal Channel**	**Mud/sand flat**	**Emergent salt marsh**	**Non-tidal salt marsh**	**Salt pan**	**'Degraded' / fill**
Site-wide	X	X	X	X	X	X
Box Count	X	X	X	X	X	X
Point Count	X	X	X	X	X	X

Table 2. Categorical assessment of cost/effort and data quality for bird abundance and activity protocols.

	Evaluation Metric	Site-wide	Box Count	Point Count	Notes
Time / Effort	Office Preparation Time	10-30 minutes	10-30 minutes	10-30 minutes	This may include printing maps and datasheets, prepping site locations, etc.
	Equipment Construction Time (one time)	Not Applicable	Not Applicable	Not Applicable	----
	Field Time (per unit)	> 120 minutes	5 minutes per station	5 minutes per station	Site-wide survey times can range from a few hours to multiple days depending on survey area
	Laboratory Time	Not Applicable	Not Applicable	Not Applicable	----
	Post-Survey Processing / QAQC Time	> 120 minutes	10-30 minutes	10-30 minutes	Site-wide surveys may require multiple days if all bird sightings are digitized into GIS to allow geospatial analyses
	Minimum Repetition (site-dependent)	Few Repetitions	Many Repetitions	Many Repetitions	Fewer repetitions for box count and point count may be conducted in salt pan or lower diversity habitat areas
	Relative Cost (equipment and supplies)	< $150	< $150	< $150	Only initial cost is binoculars and / or a spotting scope (higher cost)
Survey / Data Quality	Accuracy (at a survey area level)	High	Medium	Medium	Some level of observer-dependence; expertise
	Precision (at a survey area level)	Medium	Medium	Medium	Some level of observer-dependence; expertise
	Qualitative-Quantitative Score	Quantitative	Quantitative	Quantitative	----
	Subjectivity-Objectivity Score	Objective	Objective	Objective	----

Resulting Data Types

The application of bird survey protocols will yield quantitative data displayed in number of birds (or species richness) per unit area categorized by species, guild, and/or activity. Each protocol type will

result in different data outputs and should be determined by the goals of the monitoring program. These data are useful to characterize representative avian assemblages and spatial distributions within a particular site. These data may be used to identify changes in bird populations or guilds across time and space and in response to physical phenomena (e.g., rain, tides) or restoration activities. For some monitoring programs, supplemental specialized surveys such as protocol-level surveys for rare birds or nesting surveys may be necessary and are not covered in SOP 4.1 Bird Abundance and Activity.

Objective

The presence and distribution of avifauna within an ecosystem is often used as an index of habitat quality due to their diet and vulnerability to environmental conditions (Conway 2008). Bird communities are in constant flux. Turnover, especially at isolated sites, can be high with new species colonizing and rare species becoming extirpated (Cooper 2006). Regular, repeated surveys help maintain a clear picture of bird communities on a site. Additionally, sites with high habitat variability may employ multiple survey types to represent avifauna populations more accurately.

The primary purpose of these observational sampling methods is to develop maps of species presence and distributions including information on rare species, to quantify a snapshot of the avian community, and/or to supplement historical or volunteer data. Additionally, recording activity of each species will allow for an assessment of higher ecological function of the survey area. Bird surveys are conducted as an integral part of most monitoring programs, though individual programs have variations on specific survey details. Specific protocols are recommended here that are transferrable between programs.

Equipment

Equipment and supplies needed for these surveys varies depending on the specific type of avifauna survey to be conducted. Three monitoring protocols are discussed, including site-wide, box count, and point count surveys. Several pieces of equipment are used in all bird surveys, including:

- Binoculars or a spotting scope (Figure 1)
- Watch or timer
- GPS (recommended)
- Pens and/or pencils
- Species code list (Appendix 5.1B); comprehensive American Ornithologists Union Checklist for North American Birds may be found at (field identification books also recommended): http://www.birdpop.org/docs/misc/Alpha_codes_eng.pdf
- Camera or phone with camera application (recommended for field verification of location or vegetation community. Note: photos that are not high resolution and zoomed in on the bird are difficult to use for subsequent bird identification)

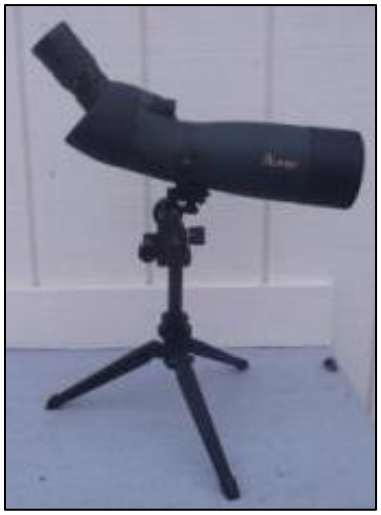

Figure 1. Spotting scope.

The site-wide surveys also require:

- Site maps displaying the entire area which should be surveyed. These maps will also serve as the datasheet as bird sightings will be recorded in the location they are identified. A representative example can be found in Appendix 5.1C.

The box count surveys also require:

- Site maps with 100 x 150 m grids outlining the survey area overlain on appropriate habitat types (Appendix 5.1D)
- Datasheet(s) (Appendix 5.1E)

The point count surveys also use:

- Site maps identifying survey points (Appendix 5.1F)
- Datasheet (Appendix 5.1E)
- Range finder (recommended)

Helpful hint: as an alternative to printed maps, data may be recorded using a GPS or other electronic field device, if preferred. *This would reduce errors in data transference through digitization methods but is slightly more time intensive in the field (e.g., entering fields into the GPS survey form). Survey point and box count maps can be digitized using a Geographic Information System (GIS) or Google Earth file.*

Field Preparation

Figure 2. Roosting White-tailed Kite (WTKI) (photo: Dan Cooper 2009).

Pre-defined maps of the survey areas appropriate for the survey type (e.g., Appendices 5.1C, D, and F) should be printed (see details in Field Methods section). Alternately, a GIS database should be developed with an attribute table listing all desired attributes to be recorded for each individual or group of birds. Required attributes should include species, count, activity, and others as required for program-specific information. Batteries for all electronic devices should be checked and replaced as needed, and relevant data sheets should be printed and attached to the clipboards. Bird activity and habitat codes can be found on the datasheet (Appendix 5.1A). A camera or phone application that can take high resolution photographs is recommended for field verification of species, as needed, or to document activity (Figure 2).

Additionally, for box count and point count surveys, the survey locations should be identified in the office. For box count surveys, Geographic Information System (GIS) should be used to create as many 150 x 100 m grid cells as possible within the survey area (e.g., Appendix 5.1D), including a space requirement of a 200 m gap between each box to reduce the potential for double counting. Each box should be assigned a number and a subset chosen for monitoring that best represent the wetland habitat variety, and to maximize the number of boxes that will fit within the study area.

Selections of which protocol to use and monitoring sites should be informed by the monitoring program goals and objectives (e.g., ambient monitoring, tracking restoration success, etc.), site access, impacts, and other considerations. Generally, it is recommended that surveys are conducted in at least 10% of the available habitat. Similarly, fixed points for the point count surveys should be spread across the proposed survey area and selected to broadly cover the habitat type fairly evenly, while maximizing the number of points that are at least 200 m from each other, and at least 150 m from the urban/non-wetland edge. Site-wide surveys are more effort-intensive, cover more area (possibility of vegetation trampling), but are more comprehensive.

Field Methods

Surveys should be conducted during both high and low tides twice annually in fall/winter and spring (Bache 2009, Johnston et al. 2011, 2012). Seasonality of surveys may also be dependent on the individual site/project goals or targeted during breeding seasons and may be replicated quarterly. Additional surveys are recommended if time and funds allow, due to the high level of variability of avian assemblages (Merkel & Associates 2009; Figure 3). Fall surveys (October is recommended) will capture migrating birds, and spring surveys (April is recommended) will survey birds during the breeding season. If conducting three times per year, April, August, and January (or mid-winter) is recommended. High tide surveys are designed to capture the presence of waterfowl and dabbling ducks. Low tide surveys target shorebirds and other species. One additional set of surveys in the seasonal wetland and seasonally ponded habitats should be conducted sometime during the wet season after the rains begin (e.g., once sometime between late October to early March).

Figure 3. Flock of tree swallows in a freshwater marsh system (photo: Neysa Frechette, Friends of Ballona Wetlands).

Data recorded during surveys should include wetland name or location, date, start time, end time, tide, weather, area/grid or point, species, numbers of each species, habitat conditions, and bird behavior (see datasheet in Appendix 5.1C for box count and point count surveys). All surveys will capture a seasonal snapshot of avian activity and distribution within the study areas. As such, birds are identified and enumerated quickly while moving throughout the study area.

Morning surveys should be conducted between 0600 and 1130, when birds are most vocal and easily detected (Johnston et al. 2011, 2012) with the second, afternoon survey performed any time after 1400 to capture either the following low or high tide, and to detect a separate bird community than present in the morning. Existing or pre-defined paths should be followed during each survey to ensure consistency and reduce disturbance and impacts. Surveys should not be conducted in fog, rain, or winds greater than 15 mph, which may reduce visual acuity and are known to decrease bird counts (Ralph et al. 1995, Conway 2008, Page et al. 2011).

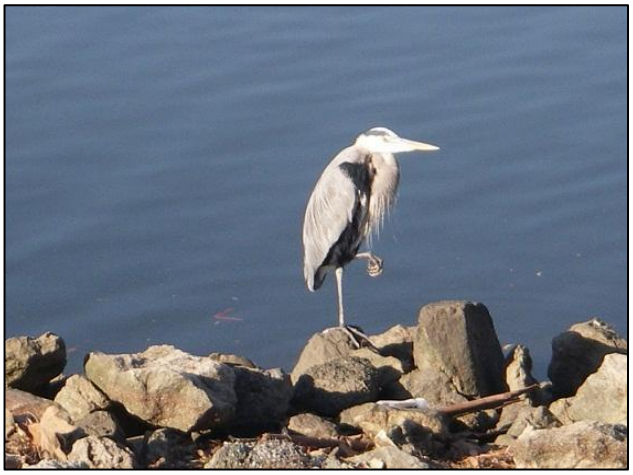

Figure 4. Great blue heron (GBHE) roosting along a rip-rap channel bank.

Birds observed on levees or other anthropogenic structures should be recorded as such (Figure 4). Each species is recorded using a standardized four-letter code for the common name used in the American Ornithologists Union Checklist for North American Birds (e.g., RTHA = red-tailed hawk, RPHE = ring-necked pheasant; Appendix 5.1B). If uncertain of the species of a bird, observers are to record the lowest taxonomic classification identifiable. For example, "dabbling duck", or "duck" if the species or foraging guild is unknown, while providing any conspicuous identification details (e.g., rufous crest) and a photo if possible. Observers are also to record the habitat and behavior for each bird or group of birds observed (codes are in Appendix 5.1C). Species and breeding dispositions (e.g., paired, singing, mating, and other behavior) of all birds encountered should be noted. Observations should be terminated for the day if adverse weather conditions arise which may reduce accuracy of the counts, or the ability to perform a normal count (e.g., wind, heat, cold). High water may alter the pathway taken during the low tide count, which should be noted on data sheets.

Site-wide Surveys

The study site may be partitioned in advance into 100 x 150 m grids overlaid on a site map for each set of wetland habitats using GIS so that an observer can reference the location in which birds are detected for the site-wide surveys, and to conduct box count surveys concurrently (Page et al. SONGS Wetland Monitoring Plan, 2011). Site-wide surveys employ spot-mapping survey methods wherein an ornithologist or birder walks the entire site or a selected area over multiple days (depending on site size) following timing requirements listed in 'field methods' and records the locations of all birds on an aerial photo (Appendix 5.1C) or on a GPS or other electronic device. In cases of a large flock (e.g., foraging swallows), rough outlines can be drawn around the position of the flock, noting species composition make-up and number of individuals. Completed spot-maps should then be digitized or transcribed within three days. Surveys should attempt to minimize double counting, with individuals suspected of being the same noted as such on the data sheets.

All birds within the survey areas should be counted (also include individuals that have originated or ended their flight within the study area). High flying birds overhead that do not land can be noted on the datasheet in the extra note column but should not be incorporated into analyses (Figure 5). Only birds within the study area on or near the ground/vegetation (e.g., Figure 6) should be counted. However, if of interest to the monitoring program, this may vary and other notes may be added; for example, birds of prey that are foraging overhead but fail to find prey during the survey time (e.g., kiting and soaring birds).

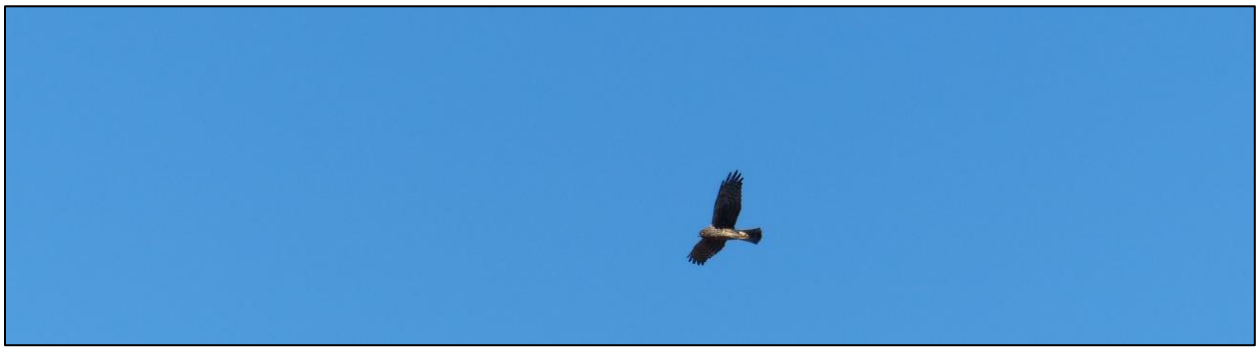

Figure 5. Red tailed hawk flying above and passing over survey area (photo: Neysa Frechette, Friends of Ballona Wetlands).

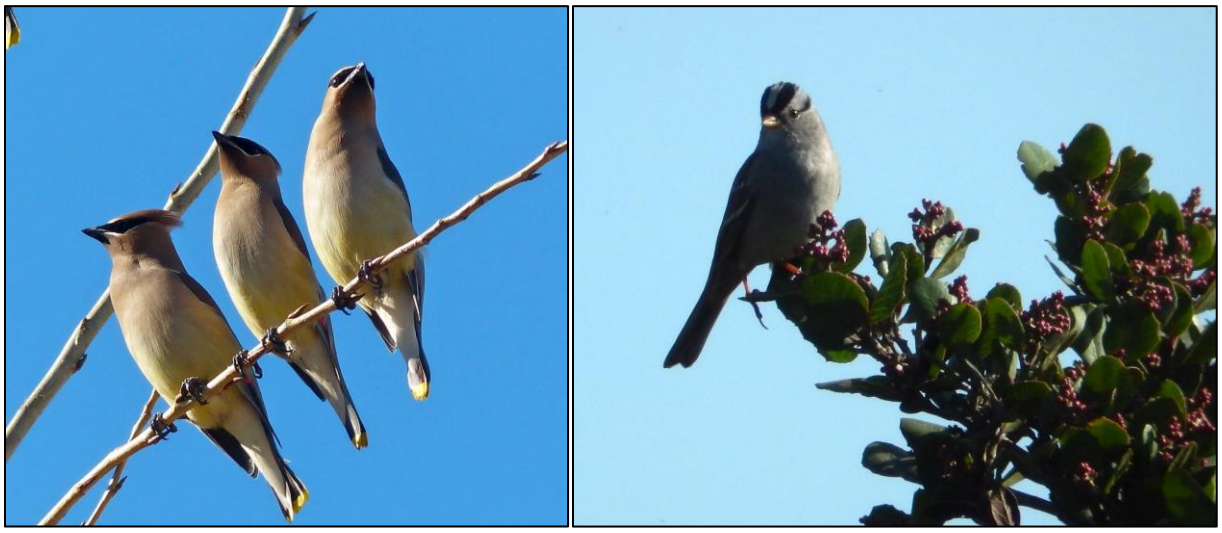

Figure 6. Cedar waxwings (left) and white crowned sparrow (right) perched on vegetation (photos: Neysa Frechette, Friends of Ballona Wetlands).

Box Count Surveys

Box count surveys follow guidelines developed for the SONGS Wetland Monitoring Program (CCC 2006). Using the pre-drawn survey grids, each grid cell, or "box" should be a minimum of 200 m from another to reduce the risk of double counting (Appendix 5.1D). Representative boxes spread throughout the site can adequately cover habitat types and reduce survey time. Survey boxes should be non-randomly placed (i.e., fixed locations) to cover all representative habitat areas selected by habitat maps, aerial photographs, and/or ground surveys. For larger sites, survey boxes may be selected using a random

number generator. Boxes should be placed throughout wetland or adjacent targeted habitats, but not on open water.

Once the locations of survey boxes are determined, "active boxes" to be surveyed during a given count may then be identified such that no two boxes are located closer than 200 m apart. These active boxes should be subjected to repeated counts during each survey period (i.e., certain boxes will never be counted, and certain ones will always be counted). Box count surveys should be limited to exactly five minutes within each box for consistency. All birds within the box (including individuals that have originated or ended their flight in or out of a box) should be recorded on the datasheet (Appendix 5.1E). High flying birds overhead that do not land can be noted on the datasheet in the extra "notes" column but should not be incorporated into analyses. Only birds within the study area on or near the ground/vegetation should be counted, and any bird seen moving from one active cell to another, or suspected of doing so, should be noted (these may be counted for just a single cell, or for both, depending on the analysis used).

Point Count Surveys

Field methods for point count surveys are similar to box count surveys, however, a 150 m radius around selected points (Appendix 5.1F) is used to define survey areas instead of grid cells. Points should be separated by at least 200 m to reduce double counting and should be at least 150 m from the edge of the habitat, typically a street or retaining wall, or non-wetland / urban habitat. Points should be printed on a site map for each set of wetland habitats using GIS software (Page et al. SONGS Wetland Monitoring Plan, 2011), or they can be navigated to using a handheld GPS. Survey points should be non-randomly placed to cover all representative habitat areas selected by habitat maps, aerial photographs, and/or ground surveys. For larger sites, survey points may be selected using a random number generator; however, most study sites are relatively small, and only a few survey points (typically five or fewer) should fit into each one. Points should be placed throughout wetland habitats, but not on open water. Survey points may be permanently marked, if desired and permitted (e.g., PVC pipe).

Surveys at each point should be limited to exactly five minutes. All birds within a 150 m radius should be recorded (also include individuals that have originated or ended their flight within the study area) (Appendix 5.1E). High flying birds overhead that do not land can be noted on the datasheet in the extra "notes" column but should not be incorporated into analyses. As with the above survey method, individual birds already counted and then seen flying into another point count circle should be noted as having done this, to avoid double-counting. Only birds within the study area should be counted. *Helpful Hint*: *Use a range finder to verify whether specific individuals are within the 150 m radius*.

Laboratory Methods

Not applicable.

Data QAQC Procedures

Data should be entered in the field using the appropriate data sheets (Appendices 5.1C and E), maps, and/or GPS or another electronic device. All required fields should be completed in full, and the data

recorder will assign their name at the top of the document(s). Data should be transferred to the appropriate electronic database within three days, and the hard copies filed in labeled binders. Electronic copies of all data should be housed on an in-house dedicated server and backed up to a cloud-based or off-site server nightly. Hard copies should be saved for five years. Electronic copies should be saved indefinitely.

Quality Assurance and Quality Control (QAQC) procedures should be conducted on all data. QAQC procedures should be conducted by the QA Officer and include a thorough review of all entries, double checking of all formulas or macros, and a confirmation that all data sheets, Chain-of-Custody forms, and field notes are filed appropriately with electronic back-up copies available. QAQC should verify that the entered data match the hard copies of the field data sheets. Any discrepancies should be corrected, and the initial data entry technician notified.

Data Entry and Analysis

After data have passed QAQC procedures, any new bird species should be added to the master bird list in the bird database. Data can be summarized by species richness, total bird abundance, or density per grid cell. If desired, completed spot maps can be digitized (if not field digitized) to assess habitat use of different species, or data can be analyzed by grid, area, or habitat.

Once summarized, bird survey data can be used in multiple analyses. Examples include:

1. Changes in bird composition over time, season, and/or since restoration action;
2. Differences in bird composition between high and low tide;
3. Spatial distribution of birds throughout and between study sites;
4. Differences in bird activity (Figure 7, or habitat use) by guild, season and/or study site;
5. Photo and data documentation of rare or special status species (Figure 8).

Health and Safety Precautions

Not applicable.

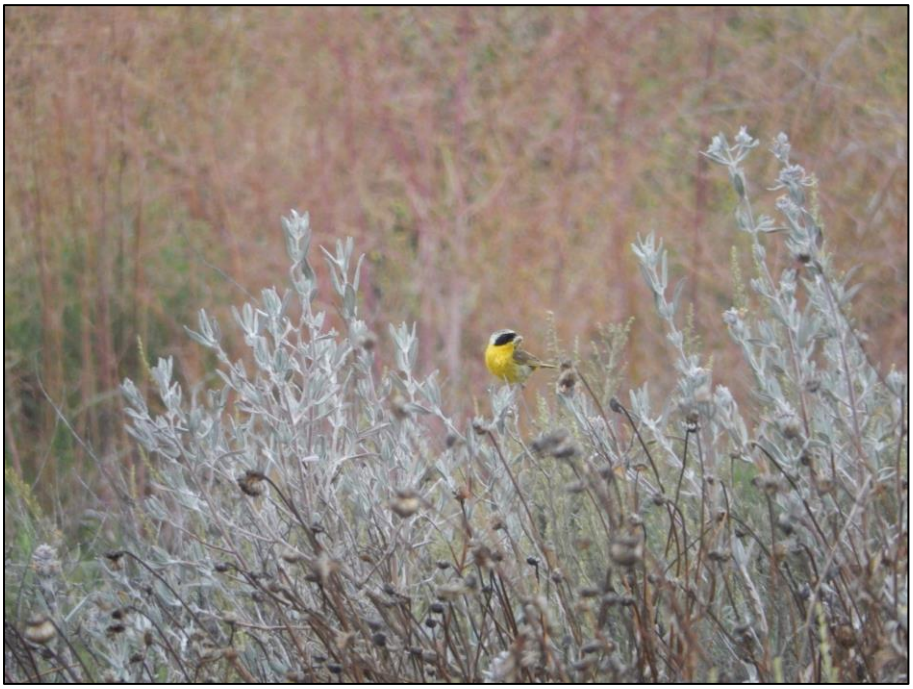

Figure 7. Common yellowthroat foraging (photo: Neysa Frechette, Friends of Ballona Wetlands).

Figure 8. Western snowy plover foraging along wrack line (photo: R. Abbott).

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Contact Information

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APPENDIX 5.1A

	Evaluation Metric	Site-wide	Box Count	Point Count	Notes
	Correlation to L2 CRAM	Not Applicable	Not Applicable	Not Applicable	Feeding activity is loosely correlated to vegetation
Personnel Requirements	Specialty Equipment or Clothing Required	Few Specialty Items	Few Specialty Items	Few Specialty Items	Binoculars, spotting scope, and/or range finder
	Ease of Transport (amount or weight of supplies)	Few items / Easy	Few items / Easy	Few items / Easy	----
	Ease of Implementation	Easy	Easy	Easy	----
	Expertise / Skill Level	Some Technical Knowledge	Some Technical Knowledge	Some Technical Knowledge	Familiarity with bird species identifications is required; species identification books are also recommended
	Number of Personnel	1-2	1	1	Additional personnel may also be used for data recording
	Training Requirements	None	None	None	Familiarity with avian species is important
	Seasonality of Survey Time	Spring and Fall	Spring and Fall	Spring and Fall	Frequency may be increased on a project- or site-level as needed. Seasonality should capture both the wintering and breeding guilds in a given area.
	Suggested Frequency	Semi-annual	Semi-annual	Semi-annual	----
Survey / Data Quality	Type of Output	Geospatial and numerical	Geospatial and numerical	Geospatial and numerical	----
	Active or Passive Monitoring Style	Passive	Passive	Passive	----
	Specialty Computer Software Required	Yes	None	None	Google Earth may be used for digitizing site-wide surveys, but specialty GIS software is necessary to conduct analyses
	Availability of Online / External Resources	Some	Some	Some	----
Potential Limitations	Wetland Type Applicability	All	All	All	Appropriate for any non-open water habitat
	Images or Multi-Media Required	Images Required	Images Required	Images Required	----
	Degree of Impact / Disturbance	Low Disturbance	No Disturbance	No Disturbance	----
	Vegetation Height Limitation	No Limitations	No Limitations	No Limitations	----
	Appropriate for Tidal / Wet Habitats	Yes	Yes	Yes	----
	Tide Height	All tides	All tides	All tides	Different species will be targeted for different tide heights
	Regional or Broad Implementation *	Almost always used	Almost always used	Almost always used	* based on monitoring literature review
	Potential for Hazards / Risk	Low to No Risk	Low to No Risk	Low to No Risk	----
	Restrictions	Special Status Species	Special Status Species	Special Status Species	----

Appendix 5.1B

Example species code list: American Ornithologists Union Checklist for North American Birds

Bird Code	Common	Scientific Name
ALHU	Allen's Hummingbird	Selasphorus sasin
AMCO	American Coot	Fulica americana
AMCR	American Crow	Corvus brachyrhynchos
AMGO	American Goldfinch	Spinus tristis
AMKE	American Kestrel	Falco sparverius
AMPI	American Pipit	Anthus rubescens
AMRO	American Robin	Turdus migratorius
AMWI	American Wigeon	Anas americana
ANHU	Anna's Hummingbird	Calypte anna
ATFL	Ash-throated Flycatcher	Myiarchus cinerascens
AUWA	Audubon Warbler	Setophaga coronata auduboni
BAWW	Black-and-white Warbler	Mniotilta varia
BBPL	Black-bellied Plover	Pluvialis squatarola
BCNH	Black-crowned night Heron	Nycticorax nycticorax
BEKI	Belted Kingfisher	Megaceryle alcyon
BEWR	Bewick's Wren	Thryomanes bewickii
BGGN	Blue - grey Gnatcatcher	Polioptila caerulea
BHCO	Brown Headed Cowbird	Molothrus ater
BHGR	Black-headed Grosbeak	Pheucticus melanocephalus
BLPH	Black Phoebe	Sayornis nigricans
BLSK	Black Skimmer	Rynchops niger
BANO	Barn Owl	Tyto alba
BNST	Black-necked Stilt	Himantopus mexicanus
BARS	Barn Swallow	Hirundo rustica
BOBO	Bobolink	Dolichonyx oryzivorus
BOGU	Bonaparte's Gull	Chroicocephalus philadelphia
BRBL	Brewer's Blackbird	Euphagus cyanocephalus
BRPE	Brown Pelican	Pelecanus occidentalis
BSSP	Belding's Savannah Sparrow	Passerculus s. beldingi
BTYW	Black-throated Grey Warbler	Setophaga nigrescens
BUFF	Bufflehead	Bucephala albeola
BUOR	Bullock's Oriole	Icterus bullockii
BUOW	Burrowing Owl	Athene cunicularia
BUSH	Bushtit	Psaltriparus minimus
CAGN	California Gnatcatcher	Polioptila californica
CANG	Canada Goose	Branta canadensis
CAKI	Cassin's Kingbird	Tyrannus vociferans
CALT	California Towhee	Melozone crissalis

Appendix 5.1B

Bird Code	Common	Scientific Name
CATE	Caspian Tern	Hydroprogne caspia
CATH	California Thrasher	Toxostoma redivivum
CHSP	Chipping Sparrow	Spizella passerina
CITE	Cinnamon Teal	Anas cyanoptera
CLSW	Cliff Swallow	Petrochelidon pyrrhonota
COHA	Cooper's Hawk	Accipiter cooperii
COHU	Costa's Hummingbird	Calypte costae
COPO	Common Poorwill	Phalaenoptilus nuttallii
CORA	Common Raven	Corvus corax
COYE	Common Yellowthroat	Geothlypis trichas
DCCO	Double-crested Cormorant	Phalacrocorax auritus
DOWO	Downy Woodpecker	Picoides pubescens
DUNL	Dunlin	Calidris alpina
ELTE	Elegant Tern	Thalasseus elegans
EUST	European Starling	Sturnus vulgaris
FOSP	Fox Sparrow	Passerella iliaca
GADW	Gadwall	Anas strepera
GBHE	Great Blue Heron	Ardea herodias
GCSP	Golden-crowned Sparrow	Zonotrichia atricapilla
GHOW	Great-horned Owl	Bubo virginianus
GREG	Great Egret	Ardea alba
GRHE	Green Heron	Butorides virescens
GRSP	Grasshopper Sparrow	Ammodramus savannarum
GRYE	Greater Yellowlegs	Tringa melanoleuca
GTGR	Great-tailed Grackle	Quiscalus mexicanus
GWTE	Green-winged Teal	Anas crecca
HETH	Hermit Thrush	Catharus guttatus
HOFI	House Finch	Haemorhous mexicanus
HOOR	Hooded Oriole	Icterus cucullatus
HOSP	House Sparrow	Passer domesticus
HOWR	House Wren	Troglodytes aedon
KILL	Killdeer	Charadrius vociferus
LAGO	Lawrence's Goldfinch	Spinus lawrencei
LBCU	Long-billed Curlew	Numenius americanus
LBDO	Long-billed Dowitcher	Limnodromus scolopaceus
LBVI	Least Bell's Vireo	Vireo b. pusillus
LEGO	Lesser Goldfinch	Spinus psaltria
LESA	Least Sandpiper	Calidris minutilla
LETE	Least Tern	Sternula antillarum
LISP	Lincoln's Sparrow	Melospiza lincolnii

Appendix 5.1B

Bird Code	Common	Scientific Name
LOSH	Loggerhead Shrike	Lanius ludovicianus
LIBU	Lazuli Bunting	Emberiza pusilla
MAGO	Marbled Godwit	Limosa fedoa
MALL	Mallard	Anas platyrhynchos
MAWR	Marsh Wren	Cistothorus palustris
MERL	Merlin	Falco columbarius
MODO	Mourning Dove	Zenaida macroura
MYWA	Myrtle Warbler	Setophaga coronata coronata
NAWA	Nashville Warbler	Oreothlypis ruficapilla
NOHA	northern Harrier	Circus cyaneus
NOMO	Northern Mockingbird	Mimus polyglottos
NRWS	Northern Rough-winged Swallow	Stelgidopteryx serripennis
NUWO	Nuttall's Woodpecker	Picoides nuttallii
OCWA	Orange-crowned Warbler	Oreothlypis celata
ORBI	Orange Bishop	Euplectes franciscanus
ORJU	Oregon Junco	Junco h. oregonus
PAWA	Palm Warbler	Setophaga palmarum
PBGR	Pied-billed Grebe	Podilymbus podiceps
PEFA	Peregrine Falcon	Falco peregrinus
PSFL	Pacific-slope Flycatcher	Empidonax difficilis
RBGU	Ring-billed Gull	Larus delawarensis
RCKI	Ruby-crowned Kinglet	Regulus calendula
ROPI	Rock Pigeon	Columba livia
RSFL	Red-shafted Flicker	Colaptes a. cafer
RSHA	Red-shouldered Hawk	Buteo lineatus
RTHA	Red tailed Hawk	Buteo jamaicensis
RUDU	Ruddy Duck	Oxyura jamaicensis
RWBL	Red-winged Blackbird	Agelaius phoeniceus
SAFI	Saffron Finch	Sicalis flaveola
SAPH	Say's Phoebe	Sayornis saya
SEPL	Semipalmated Plover	Charadrius semipalmatus
SNEG	Snowy Egret	Egretta thula
SORA	Sora	Porzana carolina
SOSA	Solitary Sandpiper	Tringa solitaria
SOSP	Song Sparrow	Melospiza melodia
SPSA	Spotted Sandpiper	Actitis macularius
SPTO	Spotted Towhee	Pipilo maculatus
SSHA	Sharp-shinned Hawk	Accipiter striatus
SAVS	Savannah Sparrow	Passerculus sandwichensis
SWTH	Swainson's Thrush	Catharus ustulatus

Appendix 5.1B

Bird Code	Common	Scientific Name
TOWA	Townsend's Warbler	Setophaga townsendi
TRES	Tree Swallow	Tachycineta bicolor
VASW	Vaux's Swift	Chaetura vauxi
VEFL	Vermilion Flycatcher	Pyrocephalus rubinus
VESP	Vesper Sparrow	Pooecetes gramineus
VGSW	Violet-green Swallow	Tachycineta thalassina
WCSP	White-crowned Sparrow	Zonotrichia leucophrys
WEKI	Western Kingbird	Tyrannus verticalis
WEME	Western Meadowlark	Sturnella neglecta
WESA	Western Sandpiper	Calidris mauri
WETA	Western Tanager	Piranga ludoviciana
WFIB	White-faced Ibis	Plegadis chihi
WHIM	Whimbrel	Numenius phaeopus
WILL	Willet	Tringa semipalmata
WISN	Wilson's Snipe	Gallinago delicata
WIWA	Wilson's Warbler	Cardellina pusilla
WREN	Wrentit	Chamaea fasciata
WESJ	Western Scrub-Jay	Aphelocoma californica
WTKI	White-tailed Kite	Elanus leucurus
WTSW	White-throated Swift	Aeronautes saxatalis
YHBL	Yellow-headed Blackbird	Xanthocephalus xanthocephalus
YEWA	Yellow Warbler	Setophaga petechia

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Appendix 5.1C

Example completed site-wide survey data sheet (hand written) for digitization

Aud. cottontail-15

Appendix 5.1D

Example box count locations map

APPENDIX 5.1E

Bird Area Survey Datasheet **Date:** **Tide:**

Observers	Start Tide/End Tide	Start Time/End Time	Temp	Wind	%Cloud cover	Precipitation
	/	/				

Habitat/Environment: **MF** = mudflat (exposed during low tide), **MP** = marsh plain, **BD** = bare dirt, **OW** = open water, **SH** = shallow water, **UL** = upland, **LV** = levee or dike **PO** = pond or pooled water, **AE** = aerial, **CE** = channel edge, **CW** = in channel water**, SC** = dry or seasonal channel, **UNK** = unknown, note if on manmade structure

Behavior: **FO** = foraging, **RO** = roosting, **CA** = calling, **FL** = flyover, **SW** = swimming, **PR** = preening, **AL** = alert, **UN** = unknown, **CD** = courtship display, **CN** = carrying nest material, **CF** = carrying food, **AG** = aggressive display

Grid	Species	Number	Habitat/Environment	Behavior	Notes/Time
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	

APPENDIX 5.1E

Grid	Species	Number	Habitat/Environment	Behavior	Notes/Time
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
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			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
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			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
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			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	
			MF MP BD OW SH UL LV PO AE CE CW SC UNK	FO RO CA FL SW PR AL UN CD CN CF AG	

APPENDIX 5.1F

Example point count survey locations map