

Sonoran Desert Breeding Bird Surveys

Field Manual for Rapid Surveys



All Photos by Bruce Taubert



Arizona Bird Conservation Initiative

Arizona Coordinated Bird Monitoring Program

Troy Corman, Edwin Juarez, John Arnett, Jonathan Bart, Carol Beardmore, Leah Dunn

April 4, 2012

Introduction.....	3
Goals and objectives	3
Methods.....	3
Study area and project overview.....	3
Rapid surveys – Detailed instructions.....	4
Field Gear and Materials.....	4
Plot Access.....	5
Survey Dates and Timing.....	5
Weather and Surveys	5
Conducting an Area Search	5
Habitat Zones	6
Breeding Status	7
Migrants and Flyovers	7
Mapping Detections.....	8
Completion of Survey 1	9
Completion of Survey 2.....	9
Final Summary.....	9
Conducting Le Conte’s Thrasher Playback	10
Collecting Habitat Data.....	10
Documenting Raptor Nests.....	10
Literature Cited	11
APPENDICES	12
Appendix 1: Sonoran Desert Bird and Plant Abbreviations and Codes	12
Appendix 2. Example of a completed Rapid Survey Plot Map form	14
Appendix 3. Example of a completed Sonoran Desert Bird Survey Visit Summary form	15
Appendix 4. Example of a completed Sonoran Desert Bird Survey Final Summary Form	16
Appendix 5. Le Conte’s Thrasher Survey Instructions and Completed Data Form Example.	17
Appendix 6. Sonoran Desert Habitat Evaluation.....	20
Appendix 7. Example of a completed Sonoran Desert Plot Habitat Evaluation Form.....	22
Appendix 8. Photos of Sonoran Desert Invasive Plant Species.....	23
Appendix 9. Data Forms	31

Introduction

Arizona is undertaking a statewide Coordinated Bird Monitoring (AZCBM) program under the guidance of the Arizona Bird Conservation Initiative (ABCI). This program is similar to other state efforts, particularly in the western United States (e.g., Idaho, Nevada, Utah, Colorado). The main goals are to provide long-term statewide population trend data for species where this information is limited and evaluate the effects of management actions and stressors.

This document describes the goals, objectives and methods for the Sonoran Desert Breeding Bird Survey. Rapid area search methods are typically used for monitoring bird populations across large geographic areas and different habitat types. A disadvantage of many rapid methods is that they may provide only an index of bird abundance. Rapid surveys may also result in biased estimates of birds which are poorly detectable because they have a soft song, vocalize rarely, behave secretively, show strong seasonal changes in detectability and are temporarily undetectable because they are on a concealed nest or are foraging outside of their territory.

To obtain an estimate of these biases, intensive area searches can be used in a double-sampling approach (Bart and Earnst 2002). Intensive area searches are used primarily for two purposes, obtaining unbiased bird density estimates and inventorying and monitoring of high priority sites. An unbiased density estimate can be used to generate correction factors for density estimates obtained with rapid area search methods (Bart and Earnst 2002).

Goals and Objectives

Coordinated bird monitoring programs are usually designed to address several generic goals:

1. Identify species at risk or of concern
2. Help identify causes of declines or other trends of concern
3. Help design, evaluate and refine management programs
4. Document recovery, other successes, or continued problems

The long-term goal of the AZCBM Program is to monitor and determine population trends for all bird species throughout the year, as constrained by resource limitations. The current project, however, is focused on the breeding season and primarily on breeding birds within Sonoran Desert habitats.

The objectives, consistent with the goals above, are to estimate and monitor the number of birds and species that breed (or attempt to breed) within Sonoran Desert habitats in our study area and to elucidate relationships between breeding birds and their habitats.

Methods

Study area and project overview

The study area in southwestern Arizona includes native Sonoran Desert habitats such as dry (ephemeral) washes, mixed desert scrub, creosote-bursage flats, and other habitats. Primary areas excluded from the sample selection process were private lands, perennial and intermittent riparian corridors, sections of Department of Defense lands due to safety issues, and urban, residential and agricultural lands. GIS layers were used to identify the distribution of native desert habitats. Surveyed plots will be sub-divided by the person conducting the survey into “desert” and “wash” habitat based on vegetation density and structure. Birds will be assigned to these habitat types based mainly on where they are first detected (see detailed instructions later in this manual). This approach will let us estimate the density of each bird species breeding in desert and wash habitat within the plots.

We stratified the study area using land ownership, road access, and habitat. The ownership categories were tribal and all public lands of Arizona. Plots for potential selection were constrained to be within 3 km of an established road (including 2-tracks). The habitats were designated as either lower or upper Sonoran Desert based on GIS habitat layers. Ownership and road access were delineated using standard GIS layers and those provided by various managing entities.

The goal is to survey at least 100 plots each year during this three-year survey. We therefore selected 300 plots. Surveys will be conducted during the first 4-5 hours of daylight and will cover 16 ha. (upper Sonoran plots) or 24 ha. (lower Sonoran plots).

Double sampling is being used to carry out the surveys. In double sampling a large sample of plots is surveyed using a rapid method of unknown accuracy; a randomly selected subsample of all plots is also surveyed using an intensive method to determine true numbers present (i.e., a census). The ratio of the rapid survey results, on intensive survey plots, to the true numbers present there provides a “detection ratio” that is used to adjust the results of all rapid surveys.

Rapid Surveys – Detailed Instructions

Field Gear and Materials - Along with basic bird survey field gear such as binoculars, daypack, small notebook, clipboard for holding your Area Search map and other data forms, several pencils and pens, watch, compass, thermometer, small first aid kit, and lots of water and snacks, other gear and materials for this project should include:

- Geo-referenced aerial photograph of plot
- Blank map with grid outline of plot (for plotting bird locations and assigning categories to detections)
- Visit Summary, Final Summary, Vegetation, and Le Conte’s Thrasher survey data forms
- Lists of bird and plant names and codes
- GPS unit set in advance to UTM NAD83, and extra batteries
- Broadcast device (iPod, mp3 player or smartphone) w/speaker and extra batteries
- A laser rangefinder is highly recommended

Plot Access - For each plot, you will be provided several maps including a color geo-referenced aerial photograph of the plot and a survey map outlining the plot. A separate page will include UTM (NAD 83) coordinates for the basic four plot corners, various grid intersects, and points within the plot for conducting vegetation surveys. Though most plots will be within UTM Zone 12, some plots in far-western Arizona will be in UTM Zone 11. Prior to departing from home, estimate how long is required to travel to your plot, including time spent hiking from your vehicle. It is strongly suggested to conduct a reconnaissance of the plot before conducting the first survey (e.g., the evening before conducting the first survey). Without a prior visit to the plot, you may encounter one or more access issues such as poorer road conditions than expected, unforeseen locked gates, or steep topography.

Survey Dates and Timing – Because the goal is to determine the number of breeding territories/pairs for each species within the plot, each plot must be surveyed twice during the breeding season (or 3 times for plots in the southeastern corner of the Sonoran Desert – see below). Multiple surveys over the breeding season provide surveyors the opportunity to detect early and late breeders in a given plot. Try to document all breeding individuals/pairs of each species during your first survey; subsequent survey(s) only add NEW individuals/territories or update higher confirmation levels of breeding activity for previously detected individuals/pairs.

Three surveys may be needed if your plot is in sections of Pima and Pinal Counties, or local areas of adjacent counties. Each survey should be separated by at least three weeks and should occur within the following survey periods:

Sonoran Desert	First Survey Period	Second Survey Period	SE Regional Plots
Lower	1 February to 15 March	16 March to 30 April	
Upper	15 March to 20 April	21 April to 30 May	
Upper	15 March to 20 April	21 April to 30 May	15 July to 15 August

The same single surveyor should conduct both (or all 3) surveys for the plot, although for safety reasons, a second person is allowed if both remain together during the survey or clearly survey different sections of the plot. The key is to not double count any birds or territories.

Weather and Surveys – Typically, wind and rain greatly reduce the detectability of birds. Not only do birds vocalize and move (e.g., actively forage) less during inclement weather, but the movement and sound of swaying leaves and branches impairs your ability to hear bird vocalizations and reduces your ability to find, identify, and follow birds in the vegetation. Therefore, surveys should only be conducted when wind speed is <12 mph (<20 km/hr) and not during periods of sustained rain or heavy fog (we know it is the desert, but it could happen...). Your day in the field may last 6 or 7 hours, especially on the day you record the habitat measurements, so recognize that weather conditions may change during the day and plan accordingly.

Conducting an Area Search - Begin your Area Search survey 30 minutes before dawn; however, we realize that safety or logistic considerations may require a later start. Spend roughly 4 to 5 hours conducting the survey. When you first begin your area search, get out your Visit Summary Form. At the top of the Visit Summary form write the plot #, date, surveyor

name, start time, start temperature, percent cloud cover, and wind or precipitation data. Next, get out the blank plot map with a grid outline. Using the four-letter codes and the abbreviations described below, record the identity and location of adult birds on this blank map. Record birds at their location before they move in response to your presence. When your area search concludes, record your end time and current weather conditions on the Visit Summary Form.

During the “area search,” *cover the entire plot* making an effort to pass within 50 meters of every point in the plot. Feel free to spend more time where more birds are (or you believe might be) present. While there is no time limitation on this survey, you should be able to cover the entire plot during the prime time for bird activity, early to late morning. You do not need to walk an even pace; feel free to linger in a particular area to answer a question about a particular bird or territory. However, the time spent at a particular spot must be balanced with the need to finish the entire plot before bird activity greatly declines (approximately 4 or 5 hours after sunrise, or by 10-11 a.m.). At some point, you may need to move on without having determined breeding status for an individual or pair in order to finish surveying the entire plot. However, feel free to return to that spot after the survey to try to clarify the breeding status.

To help you stay on schedule, you may want to divide your plot into sections and decide how much time you can spend in each section. On your plot map, you will see that your plot is divided into sections of 4 hectares (a square with 200 m sides). If you decide to linger in a particular area, use the map to get a sense of how much ground you still must cover and set a time for when you should move on. Feel free to record birds for a few minutes from a given location, such as on top of a small hill or ridge that allows a wide view of the plot. This method can help you determine the number of distinct breeding pairs in your plot, delineate boundaries between bird territories, or watch birds as they fly across your plot toward a favored perch or nest. Another method that may help is to gradually cover your plot from East to West, keeping the sun behind you in order to reduce the number of “backlit” birds you encounter. However, this may introduce bias (you may spend too much time in the eastern portion of your plot during the peak hours of bird activity), so please account for that.

Habitat Zones – Your plot may include sections of open desert, denser and taller vegetation along dry washes or even areas lacking any vegetation. Please assign each bird detection to one of three zones. In most cases, simply record birds on the basis of where you first see them. If they are in wash habitat within the plot, record them that way (W). However, you may recognize that a bird or a flock is using the area only as a migrant stop-over rather than breeding. In this case, record the birds as an incidental (I). You might also see a bird that you know breeds in a habitat that does not occur within the plot (e.g., cliffs, adjacent riparian). It would be appropriate to record such birds as incidental.

HABITAT ZONES		
Code	Definition	Clarifications
W	Wash	breeding in the plot in desert wash habitat (typically taller and denser vegetation)
D	Desert	breeding in the plot in open desert, away from wash vegetation
I	Incidental	presumed to breed outside the plot, including migrants

Breeding Status - The goals of your Area Search are to classify each bird you detect within your plot into one of the Observation Types listed in the table below, and to record the highest level of breeding evidence observed for each individual or pair detected. For each adult bird, determine if it is a lone individual or is part of a breeding pair. The two-letter codes in the Occupied Nest category (NB, NE, NY, DD, and FY) are to be used only if you have confirmed nesting. Use PN if nesting is likely but undetermined. During your first survey, make your best effort to find and categorize all birds within your plot. During your second (or third) visit, make an effort to ‘upgrade’ the breeding status of birds you found during your previous visit(s). Upgrading, for example, an individual male (M) and an individual female (F), both found during your first survey, into a pair (P) or occupied nest (ON) during your second visit provides more valuable and accurate data and should be one of your goals.

OBSERVATION TYPE		
Code	Definition	AZ Breeding Bird Atlas Examples and Clarifications
ON	Occupied Nest	Could also use the following codes if known: nest building (NB), nests with eggs (NE), nests with young (NY), distraction display (DD), adult feeding flightless fledglings or young (FY)
PN	Probable Nest	adult consistently flies into the same likely nest site, but nest structure can not be seen
P	Pair	male and female seen together or within one presumed territory
M	Male	male observed or heard singing, but no female detected
F	Female	female observed or heard calling, but no male detected
U	Unknown Sex	used only for adults of species where sexual dimorphism is not readily apparent
#	Group Number	document the actual number of individuals in flock, typically for migrants and for all adult nonbreeding individuals (do not use for family groups or juveniles)

Family Groups and Juveniles: Please note, if you observe a family group such as an adult female and three begging dependent fledglings that you determined likely nested nearby within the plot then the code used would be “ON”. Juveniles or fledglings capable of sustained flight *should not be included on the Survey Summary forms*. They are not part of the breeding population, but a successful outcome of a breeding pair on or near the plot. Although you may be tempted to list them as “Unknown Sex” or Group #, these codes were not established for young of the year or nonbreeding juveniles so please do not include them.

Migrants and Flyovers – Each surveyor will likely encounter several individuals or flocks of birds within or flying over the plot that are determined to not nest within the plot because they are either migrants or are nesting outside the plot boundaries. If you are unsure if a particular observation is a migrant then please record the location (a point or a polygon) of the bird in question on your maps and try to make a determination about this bird during your next or final visit. You will often not know for sure that they are migrants until the end of the season, when you realize that they were only on the plot briefly and didn’t show any sustained territorial behaviors. Birds determined to be migrants are noted as incidentals (I) and should be transferred over to the Final Summary data form which is completed soon after the final survey. Their presence provides us with useful information about migration chronology and about important habitats and locations for migrants. The Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005) is useful for determining if a species should be classified as a migrant based on timing, elevation and habitat.

Birds flying over the plot that are not actively using the plot do not need to be recorded on the plot map, but should be recorded along the edge of the plot map as incidental (I). Typical

flyovers in Arizona include vultures, raptors, ravens, swifts and swallows. However, if you discover a nest or observe them loafing in a plot that contains appropriate nesting habitat, they are of course recorded in the same manner as all other active users of the plot. Some “flyover” species cause some confusion. Birds that are doing foraging or mating flights (e.g., swallows, hummingbirds) over the plot should not be recorded as flyovers, but as active users of the plot instead and would be denoted with the habitat code (D or W) for the area over which the bird spent the most time. For Upper Sonoran plots, recall that the Desert Purple Martin, a subspecies of high research and conservation interest, nests locally in saguaro cavities; please be observant and patient if you see Purple Martins over your plot and watch for a flying martin to spend time over or land at a large saguaro with suitable cavities. Please note there is also a small, primarily Mexican subspecies of Violet-green Swallow that has also been occasionally documented nesting in saguaro cavities in the Organ Pipe Cactus National Monument region.

Mapping Detections - For all records of birds determined to likely be nesting on the plot, record each detection on the plot map outline using its four-letter code (Appendix 2), the (habitat) zone, and the type of observation. Each complete observation thus has three parts (species, zone, type). As examples: “CRTH-W-M” indicates a male Crissal Thrasher in the wash zone of the plot. “ROWR-D-ON” means an occupied nest of a Rock Wren discovered within the plot. “BRSP-I-10” means a flock of 10 Brewer’s Sparrows judged not to be breeding within the plot (even though they might have been seen and heard singing within the plot).

Place a dot on the map indicating the approximate location of the detection and with a connecting line, print the appropriate series of codes documenting the detection. Please make sure the letters are large and dark enough to be read easily even after some fading occurs (a few people tend to write in extremely small, faint letters that are virtually impossible to read; if you tend to write this way *please* be careful to insure that your observations are easy for someone else to decipher). To assist in delineating between visits 1 and 2 detections and notations, we suggest you use a different colored ink (red) on the map for your second visit (Appendix 2).

Partial (Edge) Territories - Territories that are only partially inside the area search plot need special attention, since they can significantly influence our breeding density estimate. If a territorial bird spends part of its time inside and part of it outside the area search plot, the surveyor needs to delineate the territory as 0.5 or basically $\frac{1}{2}$ a territory. This delineation would also be true for a territorial bird that you may only have detected within the plot, but it was so close to the edge, that its nest could just as easily be in the adjacent habitat outside the plot. Therefore a singing male Black-throated Sparrow noted within, but at the edge of the plot would be coded: “0.5 BTSP-D-M”. So for those edge territories where an active nest was never found the surveyor will be responsible at the end of the season for determining if a territory should remain 0.5, dropped completely, or upgraded to 1.0 (full territory) within the plot.

Although many species have territories smaller than a few hectares, habitat will drastically change the average home range of a species based on density and resource availability. Map birds that are singing just off your plot because next time they may be in your plot. Remember, it is important to spend more time with the edge birds since counting these birds in or out of the plot can bias counts high or low.

Migrants and Non-breeders - For migrants and individuals detected that are determined not to be breeding on the plot (those individuals listed as “I” – Incidental) use the 4-letter species code and list them along the edge of the data form and keep count of individuals. As an example, TOWA III and OSFL I would indicated 3 Townsend’s Warblers and 1 Olive-sided Flycatcher were detected while conducting the plot survey (Appendix 2).

Completion of Survey 1 - At the completion of the first survey find a nearby shady location (this is a good time for a short rest) and complete the Visit Summary form. This only takes a few minutes but it is essential that you do it in the field while the observations are still fresh in your mind (e.g., you may realize that you forgot to record a bird on the map or an abbreviation may be hard to read). Note that we require the full common name for each species on the summary form (too many errors arise when four-letter codes are used at this stage). As you transfer each observation from the map to the Visit Summary form, you may want to place a small, light check mark next to the observation on the map. This will help you avoid transcription errors but will enable you and others to study the maps (especially after the second survey when you are deciding whether detections of a species on both surveys are of the same or different individuals). As with the maps, *please* print your entries insuring that they are large, not too faint, and legible. On this form, use a separate line for each unique species-zone combination and use hash marks or final tally to indicate the number of records of each observation type (Appendix 3). **Please do not use a separate line for each individual observation as this takes too much space.** As an example, for a plot with numerous territorial Black-throated Sparrows within open desert habitat, please include all records for that species on a single line. So for Black-throated Sparrow in desert habitat ‘D’, your single line entry may include something like one occupied nest, four pairs, and 16 singing males for the entire plot.

For any migrants or otherwise birds noted as Incidental ‘I’ within the plot, simply place the total number of individuals detected in the “# in Group” column for each species. Please do not place them in the male, female or unknown columns even when the sex is known.

Completion of Survey 2 (or 3) - After completion of the second (or last) survey, sit down in the field and prepare a Visit Summary form using the same approach as described for the first survey. However, only record NEW birds or higher confirmation levels of breeding detected during the previous visit (and a 3rd visit for some plots in se. AZ). Thus if you noted a singing male on territory during your first visit, but observed a pair at this same general location during your second visit, then this individual male would be upgraded to a pair. As mentioned before, this process of ‘upgrading’ your bird detections to the highest level of breeding status possible is an important goal of your surveys. The plot outline maps are used to help decide whether detections on both surveys were of the same bird (e.g., if they were recorded in about the same general location) or not (e.g., if they were recorded in quite different locations).

Final Summary – After all visits to the plot have been completed, a Final Summary form must be prepared (Appendix 4). This form summarizes both surveys (as captured on the Visit Summary forms) documenting your best conclusion as to the species and the number of breeding individuals/pairs of each species within the plot. The estimates include all birds recorded within the plot on the first survey plus any NEW birds or higher confirmation levels of breeding

detected during the second (and/or third) visit. Birds recorded on multiple surveys are only included once in the estimate.

At the top of the form, write the plot number, year, and your name (as surveyor). Fill in the Final Summary form as you've done for the Visit summaries, but enter the "highest" evidence of breeding for birds that were seen on both visits. The order of evidence is nest, followed by probable nest, and so on (the columns in the summary form are in order with highest evidence on the left). As noted above, deciding whether two birds seen on different surveys were the same or different individuals will require some judgment, but making this determination is very important. Also note that the totals for some species may be decimals and not whole numbers. If, for example, the only Rock Wren you find is at the edge of plot and you call it "0.5 ROWR-D-M", then on your Final Summary Form your final count of Rock Wrens is 0.5.

Conducting Le Conte's Thrasher Playback— The reclusive Le Conte's Thrasher, found only in the sparsely vegetated lower Sonoran and Mohave Desert region, typically breeds during the late winter and early spring period. In Arizona it is considered a Species of Greatest Conservation Need (SGCN) and data are needed to document its geographic distribution and to track population trends. To increase detectability of this species, we will use a 6-minute call playback survey. This extra call-broadcast survey must be conducted at all lower Sonoran Desert plots (but not Upper Sonoran), immediately after you have completed the Area Search survey for the entire plot and after EACH of your Area Search visits to each plot. Please study the data sheet and detailed instructions (Appendix 5) carefully in advance of your first survey, and please accurately record your data in the appropriate 1-minute block of time on the sheet. The success of our analyses of these extra data depends greatly on your ability and willingness to follow the survey protocol, and on your skillful and accurate recording of field data.

Collecting Habitat Data - The plot map includes four to six point locations at which we would like you to record simple and basic habitat information. The coordinates (using the UTM system, NAD 83, typically Zone 12 or Zone 11 in far-western Arizona) are included on an additional sheet. You can use them with a GPS unit or find the approximate location just using the map. If relying on the GPS unit, when you are about 25 paces from the location start counting down from 25 and when you reach 0 accept that as the location (exact locations are virtually impossible to find using a GPS; this procedure helps you avoid uncertainty about exactly where to record the habitat data). The habitat data are recorded on a separate form with more detailed instructions (Appendix 6). The vegetation information only needs to be collected during one of the visits to the plot. We recommend collecting the vegetation an afternoon before one of your two visits or immediately after completing your bird surveys. As a suggestion, we recommend collecting the vegetation data as early in the season as possible since temperatures in the desert quickly climb to uncomfortable levels as the season progresses. Recording the information at a single location should only take a few minutes, especially after you have done the first few locations.

Documenting Raptor Nests— We are also interested in obtaining specific nest site information for several sparsely distributed raptor species that you may encounter on or off your plot(s) while traveling or camping. These include the cliff-nesting raptors - Prairie Falcon, Peregrine Falcon, and Golden Eagle - and Harris's Hawk which typically nests in more vegetated areas of the

upper Sonoran Desert. If you discover an active nest, please record the date, the UTM coordinates (NAD 83), and briefly describe what breeding evidence was observed.

Please return all completed summary forms, survey plot maps and vegetation form **by 10**

September to: Troy Corman

Nongame Branch

Arizona Game and Fish Department

5000 W. Carefree Hwy.

Phoenix, AZ 85086

Literature Cited

Bart, J., and S. Earnst. 2002. Double-sampling to estimate density and population trends in birds. *Auk* 119:36-45.

Corman, T.E., and C. Wise-Gervais (editors). 2005. *Arizona Breeding Bird Atlas*. Univ. of New Mexico Press, Albuquerque.

APPENDICES

Appendix 1: Sonoran Desert Bird and Plant Abbreviations and Codes.

Four-letter codes for birds

In most cases, the code consists of the first two letters of the first and last names (e.g., BETH = Bendire's Thrasher). When the first name is hyphenated, the first letter of each word is used (e.g., BCFL = Brown-crested Flycatcher). When the last name is hyphenated, the first two letters of the *first* word are used (e.g., WESO = Western Screech-Owl). When two species would have the same code, adjustments are made (e.g., CANW = Canyon Wren; CACW = Cactus Wren). Codes for bird species which regularly breed in Sonoran Desert and dry wash habitats in Arizona are shown below.

Species	Code	Species	Code	Species	Code
Abert's Towhee	ABTO	Elf Owl	ELOW	Pyrrhuloxia	PYRR
American Kestrel	AMKE	European Starling	EUST	Phainopepla	PHAI
Ash-throated Flycatcher	ATFL	Ferruginous Pygmy-Owl	FEPO	Prairie Falcon	PRFA
Barn Owl	BANO	Gambel's Quail	GAQU	Purple Martin	PUMA
Bell's Vreo	BEVI	Gila Woodpecker	GIWO	Red-tailed Hawk	RTHA
Bendire's Thrasher	BETH	Gilded Flicker	GIFL	Rock Wren	ROWR
Black-tailed Gnatcatcher	BTGN	Golden Eagle	GOEA	Rufous-crowned Sparrow	RCSP
Black-throated Sparrow	BTSP	Greater Roadrunner	GRRO	Rufous-winged Sparrow	RWSP
Black Vulture	BLVU	Great Horned Owl	GHOW	Say's Phoebe	SAPH
Bronzed Cowbird	BRCO	Harris's Hawk	HASH	Scott's Oriole	SCOR
Brown-crested Flycatcher	BCFL	Hooded Oriole	HOOR	Turkey Vulture	TUVU
Brown-headed Cowbird	BHCO	Horned Lark	HOLA	Varied Bunting	VABU
Cactus Wren	CACW	House Finch	HOFI	Verdin	VERD
Canyon Towhee	CANT	Ladder-backed Woodpecker	LBWO	Vermilion Flycatcher	VEFL
Canyon Wren	CANW	Le Conte's Thrasher	LCTH	Violet-green Swallow	VGSW
Chihuahuan Raven	CHRA	Lesser Nighthawk	LENI	Western Kingbird	WEKI
Common Poorwill	COPO	Loggerhead Shrike	LOSH	Western Meadowlark	WEME
Common Raven	CORA	Long-eared Owl	LEOW	Western Screech-Owl	WESO
Costa's Hummingbird	COHU	Lucy's Warbler	LUWA	White-throated Swift	WTSW
Crested Caracara	CRCA	Mourning Dove	MODO	White-winged Dove	WWDO
Crissal Thrasher	CRTH	Northern Cardinal	NOCA	Zone-tailed Hawk	ZTHA
Curve-billed Thrasher	CBTH	Northern Mockingbird	NOMO		

Four-letter codes for plants

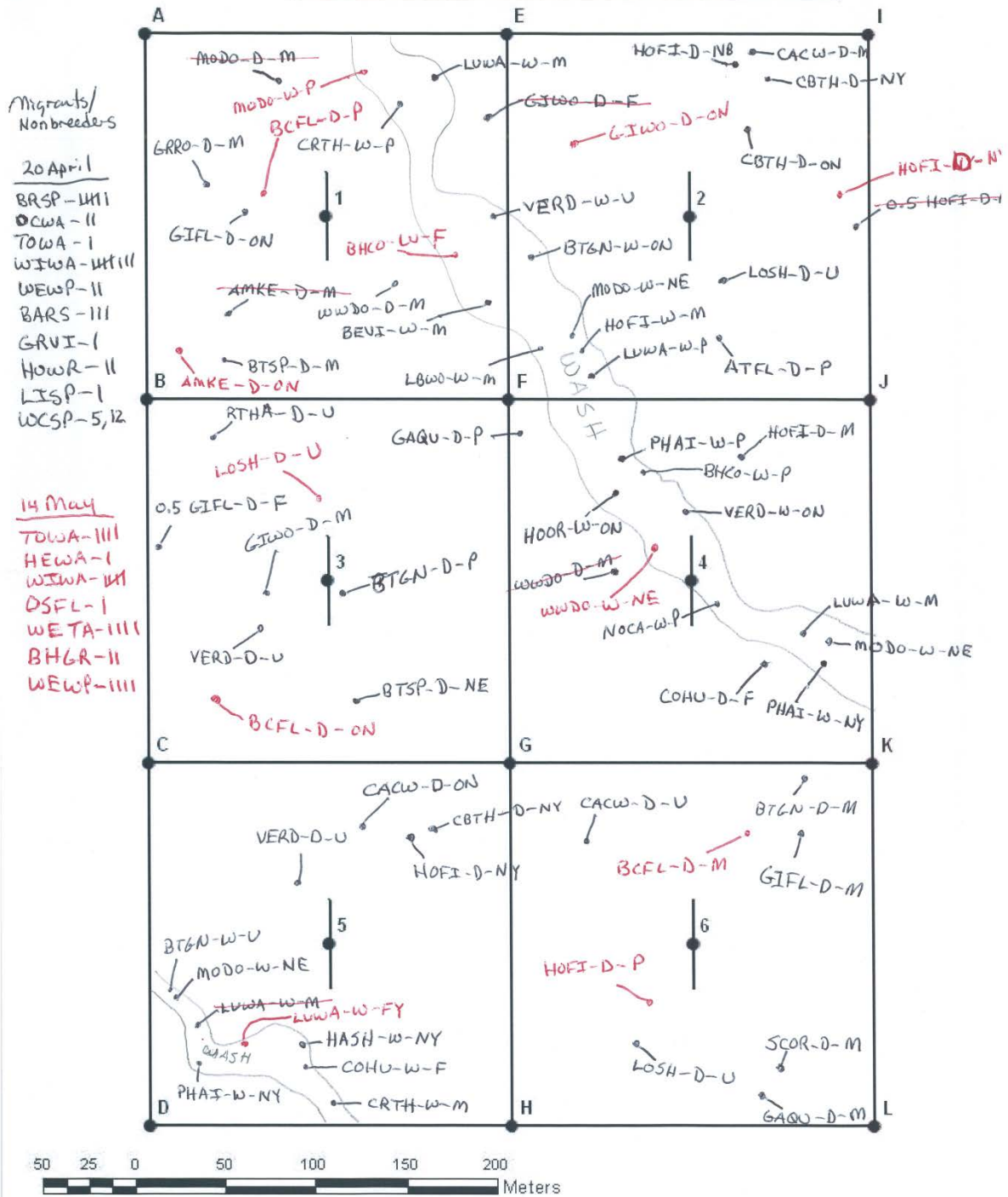
Codes for trees and woody plants commonly found in Sonoran Desert and associated dry washes in Arizona are shown below.

Common Name	CODE	Scientific Name
acacia, catclaw	ACCA	<i>Acacia greggii</i>
acacia, whitethorn	ACWH	<i>Acacia constricta</i>
barberry, spp.	BARB	<i>Berberis</i> , spp.
barrel cactus, spp.	BACA	<i>Ferocactus</i> spp.
brittlebush	BRIT	<i>Encelia farinosa</i>
bursage, white	BUWH	<i>Ambrosia dumosa</i>
bursage, triangle-leaf	BUTR	<i>Ambrosia deltoidea</i>
burrobrush	BURR	<i>Hymenoclea salsola</i>
canyon ragweed	CARA	<i>Ambrosia ambrosioides</i>
cholla, chain-fruit	CHCH	<i>Cylindropuntia fulgida</i>
cholla, cane	CHCA	<i>Cylindropuntia spinosior</i>
cholla, teddybear	CHTE	<i>Cylindropuntia bigelovii</i>
chuparosa	CHUP	<i>Justicia californica</i>
creosotebush	CREO	<i>Larrea tridentata</i>
crucifixion thorn	CRTH	<i>Canotia holacantha</i>
desert broom	DEBR	<i>Baccharis sarothroides</i>
desert lavender	DELA	<i>Hyptis emoryi</i>
desert senna	DESE	<i>Senna covesii</i>
desert willow	DEWI	<i>Chilosopsis linearis</i>
elephant tree	ELTR	<i>Bursera microphylla</i>
globemallow, spp.	GLOB	<i>Sphaeralcea</i> spp.
graythorn	GRAY	<i>Ziziphus obtusifolia</i>
hackberry, desert	HADE	<i>Celtis pallida</i>
hackberry, netleaf	HANE	<i>Celtis laevigata</i> var. <i>reticulata</i>
hopbush	HOPB	<i>Dodonaea viscosa</i>
ironwood	IRON	<i>Olneya tesota</i>
jojoba	JOJO	<i>Simmondsia chinensis</i>
juniper, spp.	JUNI	<i>Juniperus</i> spp.
mesquite, honey	MEHO	<i>Prosopis glandulosa</i>
mesquite, velvet	MEVE	<i>Prosopis velutina</i>
mimosa, spp.	MIMO	<i>Mimosa</i> spp.
Mormon tea	EPHE	<i>Ephedra</i> spp.
ocotillo	OCOT	<i>Fouquieria splendens</i>
paloverde, blue	PABL	<i>Parkinsonia florida</i>
paloverde, foothill	PAFO	<i>Parkinsonia microphylla</i>
prickly pear, spp.	PRPE	<i>Opuntia</i> spp.
saguaro	SAGU	<i>Carnegiea gigantea</i>
saltbush, fourwinged	SAFO	<i>Atriplex canescens</i>
saltbush, littleleaf	SALI	<i>Atriplex polycarpa</i>
scrub live oak	SLOA	<i>Quercus turbinella</i>
tamarisk (salt cedar), spp.	TAMA	<i>Tamarix</i> spp.
white ratany	WHRA	<i>Krameria grayi</i>
wolfberry, spp.	WOLF	<i>Lycium</i> spp.
unknown shrub	UNSH	
unknown tree	UNTR	

Appendix 2. Example of a completed Rapid Survey Plot Map form.

Arizona Coordinated Bird Monitoring Program
Rapid Survey Plot Map

Plot: 80816



Appendix 3. Example of a completed Sonoran Desert Bird Survey Visit Summary form.

Rapid Survey	AZCBM- Sonoran Desert Bird Survey Visit Summary		Page 1 of 2	
Plot number: <u>80816</u> Date: <u>20 April 2012</u> Surveyor: <u>Seymore Byrds</u>				
Visit # (check) <input checked="" type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3				
TIME-- Start: <u>0550</u> End: <u>1035</u> TEMP-- Start: <u>53</u> End: <u>81</u>				
% Cloud Cover: <u>10</u> Wind: <u>1</u> Precipitation: <u>Ø</u>				
Comments: _____				

Species	Zone	Occup. Nest	Prob. Nest	Pair	Male	Female	Unk. sex	# in Group
Mourning Dove	D				1			
Mourning Dove	W	3						
Crissal Thrasher	W			1	1			
Lucy's Warbler	W			1	3			
Verdin	W	1					1	
Verdin	D						2	
Gilded Flicker	D	1			1	0.5		
Black-tailed Gnatcatcher	W	1					1	
Black-tailed Gnatcatcher	D			1	1			
White-winged Dove	D				2			
Black-throated Sparrow	D	1			1			
Gila Woodpecker	D				1	1		
House Finch	D	2			1.5			
House Finch	W				1			
Cactus Wren	D	1			1		1	
Curve-billed Thrasher	D	3						
Loggerhead Shrike	D						2	
Red-tailed Hawk	D						1	
Gambel's Quail	D			1	1			
Phainopepla	W	2		1				
Brewer's Sparrow	I							6
Orange-crowned Warbler	I							2
Townsend's Warbler	I							1
Gray Vireo	I							1
Wilson's Warbler	I							8

Please record dates using the format 23 Apr 2012.
 Record cloud cover as percent of the sky covered by clouds.
 Precipitation codes are brief/steady and light/medium (i.e., brief light).
 Codes for zones are D=desert, W=wash, I=incidental (not breeding on plot).
 Use the ON=occupied nest only if the nest was seen or other confirmed nesting behavior observed.
 Record wind using the Beaufort Scale: **0** = Smoke rises vertically (<1 mph), **1** = Wind direction shown by smoke drift (1-3 mph),
2 = Wind felt on face; leaves rustle (4-7 mph), **3** = Leaves, small twigs in constant motion (8-12 mph),
4 = Dust rises; small branches move (13-18 mph), **5** = Small trees in leaf begin to sway (19-24 mph)

Appendix 4. Example of a completed Sonoran Desert Bird Rapid Survey Final Summary Form.

Rapid Survey	AZCBM- Sonoran Desert Bird Survey							Page <u>1</u> of <u>2</u>
*Final Summary								
Plot number: <u>80816</u> Year: <u>2012</u> Surveyor: <u>Seymore Byrds</u>								
Species	Zone	Occup. Nest	Prob. Nest	Pair	Male	Female	Unk. sex	# in Group
Mourning Dove	W	3		1				
Crissal Thrasher	W			1	1			
Lucy's Warbler	W	1		1	2			
Verdin	W	1					1	
Verdin	D						2	
Gilded Flicker	D	1			1	0.5		
Black-tailed Gnatcatcher	W	1					1	
Black-tailed Gnatcatcher	D			1	1			
White-winged Dove	D				1			
White-winged Dove	W	1						
Black-throated sparrow	D	1			1			
Gila Woodpecker	D	1			1			
House Finch	D	3		1	1			
House Finch	W				1			
Cactus Wren	D	1			1		1	
Curve-billed Thrasher	D	3						
Loggerhead Shrike	D						3	
Red-tailed Hawk	D						1	
Brown-crested Flycatcher	D			1	1			
Gambel's Quail	D			1	1			
Phainopepla	W	2		1				
American Kestrel	D	1						
Brown-headed Cowbird	W			1		1		
Hooded Oriole	W	1						
Harris's Hawk	W	1						
Ash-throated Flycatcher	D			1				
Brewer's Sparrow	I							6
Townsend's Warbler	I							5
Gray Vireo	I							1
Wilson's Warbler	I							13
Olive-sided Flycatcher	I							1
Western Tanager	I							4
Western Wood-Pewee	I							4
Barn Swallow	I							3

*Summarize all survey visits documenting your best determination as to the species and the number of breeding individuals/pairs of each species within the plot.

Appendix 5. Le Conte's Thrasher Survey Instructions and Completed Data Form Example
FIELD INSTRUCTIONS FOR LE CONTE'S THRASHER SURVEYS
John Arnett, Troy Corman

Please record the **Date**, **Plot Number**, and name of **Observer(s)** on top of the form.

For each point (Station), record weather and other environmental data. The methods to measure **Sky**, **Wind** (Beaufort scale), and **Noise** are described at the bottom of the data sheet. In advance of the survey day, please familiarize yourself with these measurement methods.

You may want to refer to the Le Conte's (LCTH) Survey example data sheet (found after the instructions) as you read through the following directions. On the LCTH Survey data sheet record the **Station #** which is the plot number followed by the vegetation sampling point number (for example 17283-01). You have been provided a 6-minute audio recording which should be played once at each of the 6 vegetation sampling points of your plot. At the start of each playback record the **Start Time**.

The recording begins with a voice (courtesy of Pierre Deviche) that announces "One" followed by 1 minute of silence (minute 0-1); this is **Pass #1**. Next is **Pass #2**, with 1 minute of silence (minute 1-2). Next is **Pass #3**, which includes about 45 seconds of a LCTH song (minute 2-3). Next is **Pass #4** with a 1 minute of silence (minute 3-4). Next is **Pass #5**, which includes about 45 seconds of a LCTH song (minute 4-5). Next is **Pass #6** (minute 5-6). The survey concludes when the recording announces "End." The volume of the playback should be loud enough to broadcast approximately 200 m, but not so loud that the song is distorted.

For each LCTH you detect during the survey, record "LCTH" in the **Species** column. Each individual bird gets its own row on the data sheet. In the column for each of the 6 **Passes**, write an 'S' for a seen bird, a '1' for a heard bird, and '1S' for a bird heard and seen. These directions are printed at the top of the data sheet, just above the table.

The specific vocalization(s) heard for any LCTH should be noted in the column **LCTH Vocal Type(s)**. Please write '1' for the typical male song, '2' for the "drip" call, or '3' for Other. Please accurately describe any 'Other' vocalizations in the form's comments section; it may be a vocalization we are not familiar with or is not described in the literature.

During your call-broadcast, be alert for a thrasher coming from the direction of your previous point. If you detect a LCTH that followed you from a previous survey point, please write "Y" in the "**Detected at a previous point**" column. Write "N" for a thrasher you had not previously detected.

Please note that you may detect a thrasher AFTER you have completed the 6-minute survey. If this happens, please record on the data sheet that this thrasher was detected **Outside the Survey Period**. Do not include it as a bird detected during the official 6-minute survey.

During and following the playback be alert all around you for silent thrashers running toward you or perched atop a distant shrub or small tree. If you detect a thrasher during the 6-minute

survey, please keep track of the bird while you complete the survey. Always play the full 6 minute recording. At the end of the recording, if you still know where the thrasher is located, quietly and stealthily follow the bird to evaluate whether it's breeding within the plot (see *Noting Species Detections on Area Search Plot Map* section below) then proceed to your next survey point and resume your playback surveys.

Other Thrasher Species

During the 6-minute survey, you may detect a thrasher but you cannot identify it to species. Be advised that other thrasher species may respond to the LCTH playback, and some of their vocalizations may sound similar to the LCTH song. AFTER the conclusion of the 6-minute survey, you may follow the unidentified thrasher to identify it. All thrashers other than LCTH should be noted on the Area Search Plot Map, and NOT on the LCTH Survey Form.

Noting Species Detections on Area Search Plot Map

If you detect a Le Conte's Thrasher during the 6-minute survey, please note the location of the bird on the plot map with the code series beginning with "PB" (playback). Therefore the code series for a Le Conte's Thrasher 'LCTH' of unknown sex 'U' detected in desert habitat 'D' would look like "PB-LCTH-D-U". If you detect a single individual on a perch, check on the ground or in an adjacent shrub for another thrasher. As with the rest of your Area Search, it is important to determine if a single thrasher is actually part of a breeding pair whose territory is wholly or partially within your plot. Also, try to determine if the bird(s) was already in the plot, or if it entered into your plot in response to the playback. Thrashers may follow you from one point to the next.

During each LCTH 6-minute survey period the focus is obviously on detecting any LCTHs, however if you observe any other birds that may be breeding in the plot (and that have not already been marked on the Area Search map) evaluate their breeding status and properly record them on the Area Search plot map. Mapping of any other birds should be done only after the 6-minute survey period has been completed.

Field Prep

Practice the playback protocol – study the data sheet, make sure you understand how the 6-minute recording, with 6 survey periods, corresponds with the LCTH data sheet. Your speaker(s) must broadcast the thrasher recording loudly and clearly (minimal sound distortion). You will need to load the 6-minute file into a playback device (e.g., iPod, smartphone, or mp3 player). Please have plenty of batteries for your playback device and speaker(s).

The playback file can be obtained at the Bird Sounds Library at the Arizona Field Ornithologists website (www.azfo.org) or by emailing Troy Corman (tcorman@azgfd.gov) or Edwin Juarez (ejuaraz@azgfd.gov).

Completed LCTH Data Form Example

Lower Sonoran Desert Bird Monitoring - Le Conte's Thrasher Survey

Pg_1__of__2__

Date (eg 3-Dec-12): **17-MAR-2012** Observer(s) (list all)**: **Scooter Magruder**

Plot Number: **17283**

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

Station#	Temp C or F	Sky	Wind	Noise	Start Time (military)	Species	Responded During						LCTH Vocal Type(s)	Detected at a Previous Point	Was LCTH in plot before responding? Other comments?
							Pass 1 (0-1)	Pass 2 (1-2)	Pass 3 (2-3)	Pass 4 (3-4)	Pass 5 (4-5)	Pass 6 (5-6)			
17283 - 01	18 C	1	1	0	955	LCTH	0	0	0	1	1S	1S	1	N	yes
17283 - 02	18	1	1	1	1021	LCTH	1	1	0	0	0	1	2	N	yes
17283 - 03	19	1	1	0	1039	none									
17283 - 04	19	1	1	0	1058	LCTH	0	0	0	0	0	1	1	Y	previously detected at 17283-04
17283 - 05	19	1	1	0	1122	none									
17283 - 06	20	1	0	1	1144	LCTH	0	0	0	S	S	S		N	No, this pair came in from outside the plot
							0	0	0	S	1S	1S	1		

Sky: 0 clear or a few clouds 1 partly cloud or variable sky 2 cloudy or overcast 4 fog or smoke 5 drizzle 6 snow 8 showers
 Wind (Beaufort) scale: 0 smoke rises vertically 1 wind direction shown by smoke drift 2 wind felt on face; leaves rustle 3 leaves, small twigs in constant motion; light flag extended 4 raises dust and loose paper; small branches are moved 5 small trees with leaves sway; crested wavelets on inland waters
 Noise: 0 no noise 1 faint noise 2 moderate noise (probably can't hear some birds beyond 100m)
 3 loud noise (probably can't hear some birds beyond 50m) 4 intense noise (probably can't hear some birds beyond 25m)
 LCTH Vocal Types: 1 typical male song 2 "drip" call 3 Other (please describe)

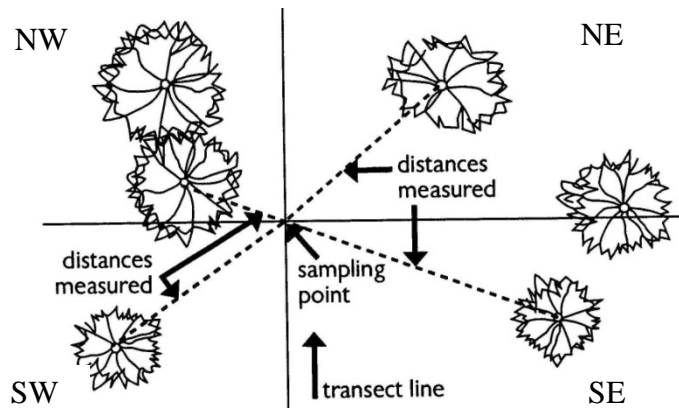
Appendix 6. Sonoran Desert Habitat Evaluation.

In Arizona, Sonoran Desert habitats fall into three basic categories:

Habitat/Elevation (ft)	Common Sonoran Desert Trees, Shrubs and Cacti
Lower Sonoran/ <1800	Creosotebush, triangleleaf bursage, white bursage, brittlebush, cholla, mesquite, foothill paloverde, wolfberry, littleleaf saltbush
Upper Sonoran/ 1200 - 3600	Saguaro, cholla, barrel cactus, prickly pear, blue and foothill paloverde, velvet mesquite, ironwood, creosotebush, ocotillo, jojoba, brittlebush, triangleleaf bursage, wolfberry
Dry Wash/ 100 – 3600	Ironwood, blue paloverde, velvet mesquite, catclaw acacia, desert hackberry, desert willow, desert broom, saltbush, creosotebush, canyon ragweed, graythorn

The dominant plant species, diversity of plant species, density and abundance of vegetation, plus the structure (age/height) of the vegetation often dictate the diversity and density of the breeding birds within an area. In an effort to begin to address this important relationship, each plot includes four (upper Sonoran) or six (lower Sonoran) sets of UTM coordinates designating locations at which we need basic information on the vegetation. Using your GPS unit, find these points and write the UTM coordinates (NAD83) on the Habitat Evaluation Form.

Point-Center Quarter: Each vegetation point represents the center of the measurement area. From the center point, use a compass or GPS to define the four quadrants or quarters (northeast, southeast, southwest and northwest; see below). In each of these quarters, identify and measure the distance (in 0.1 meter increments) to the closest plant from the center point. Please measure to the main trunk (for single-stemmed trees) or to the center of a multi-stemmed tree or shrub.



Cholla and Woody Desert Plant Density and Structure: describes the density, diversity and vertical complexity of the vegetation. For each quarter (within a 50 m radius), measure the distance in 0.1 m increments from the sampling point to the closest cholla (>0.5 m in height). Similarly, measure the distance to the closest woody shrub or tree in the following three vertical structure categories: <0.5 m, 0.5-3 m, and >3m. For distant plants use a laser rangefinder or pace out the distance and record in one-meter increments. It is critical to obtain accurate distance measurements to plants because accurate plant density estimates are dependent upon it. This manual includes a list of common Sonoran Desert plants and their 4-letter code (Appendix 1) to use when completing the Habitat Evaluation Form

Mistletoe Present/Absent: describes the presence or absence of desert mistletoe. *For each quarter (within a 200 m radius)*, use binoculars (if necessary) to determine if at least one mistletoe clump is present. Record “1” if mistletoe is present, record “0” if mistletoe is absent.

Saguaro Count: describes the abundance and basic age-class of saguaros. From the sampling point, use binoculars and laser rangefinder (if necessary) to count the number of saguaros within a 50 m radius (360 degrees) and place them into two categories: with arms and without arms.

Grass/Forbs, Ground Cover and Substrate Composition: describes the amount of ground covered by non-woody plants (grasses and forbs), soil and gravel, and other materials such as clay, woody debris and biotic crust. Note that a forb is a non-woody plant, such as low-growing desert perennials and annuals. From the sampling point in the *Northeast quarter only and within a 5 m radius*, estimate the percentage of the ground that is covered by sand, gravel, rock, grasses & forbs (combined), and any other substrates (please specify). The total ground cover must equal 100%.

Use the following size classes:

Sand	(smaller than “BB”)
Gravel	(“BB” to tennis ball)
Rock	(>tennis ball, incl. cobble, boulder, bedrock sheet)

Dominant tree/shrubs: For the entire plot, document in descending order the four most dominant woody plants and/or cacti in the open desert. Similarly, if one or more washes are present on the plot, document the four most dominant woody plants in the wash habitat.

Invasive Plants presence: documents the distribution of several invasive plant species which potentially threaten Sonoran Desert habitats. For the *entire plot*, please place an “X” on the line to the right of any of the listed invasive species you detected. To assist in proper identification of the following species, images of them can be found in Appendix 8:

Sahara mustard (*Brassica tournefortii*)
Buffelgrass (*Cenchrus ciliaris* or *Pennisetum ciliare*)
Red brome (*Bromus rubens* var. *madritensis*)
Arabian or Mediterranean grass (*Schismus arabicus*)
Bermuda grass (*Cynodon dactylon*)
Fountain grass (*Pennisetum setaceum*)
Russian thistle (*Salsola iberica*)

Appendix 7. Example of a completed Sonoran Desert Plot Habitat Evaluation Form.

Arizona Coordinated Bird Monitoring

Arizona Bird Conservation Initiative

Plot# 80816

Sonoran Desert Plot Habitat Evaluation Form

Date: 20 April 2012

Plot Vegetation Points (4 points on Upper Sonoran plots or 6 points on Lower Sonoran plots)

Point-Centered Quarter: within each quarter around a vegetation sampling point, measure distance to nearest cholla (>0.5 m height), and any other tree/shrub (within each height category)]
 Only consider those plant species within a **50 m** radius of vegetation sampling point

Surveyor(s): Seymore Burds
 Average Elevation (m): 622

	1	2	3	4	5	6
Northeast (identify species and record distance)						
(height in meters)						
Cholla(>0.5m)	CHCH 4.6	CHCH 11		CHCA 1.3		CHTE 32
Shrub(≤0.5m)	BUTR 5.2	BUTR 3.4	RACA 2.8	BUTR 0.8	SEDE 3.5	BUTR 4.1
Shrub/tree(>0.5 to 3m)	CREO 8.2	JOJO 1.4	CREO 18	CREO 6.5	CREO 12	JOJO 4.4
Tree (>3 m)	PAFO 22.2	PAFO 10.5	PAFO 30			PAFO 24
Southeast (identify species and record distance)						
Cholla(>0.5m)	CHCH 31					CHCH 6.4
Shrub(≤0.5m)	BUTR 0.8	BUTR 3.1	BUTR 2.2	JOJO 6.8	RACA 10	BUTR 1.2
Shrub/tree(>0.5 to 3m)	CREO 4.2	CREO 14		GRAY	ACCA	CREO
Tree (>3 m)			PABL	IRON	MEVE	PAFO
Southwest (identify species and record distance)						
Cholla(>0.5m)	CHTE 12.2				CHTE 24	
Shrub(≤0.5m)	BUTR 0.9	BRIT 0.5	EPHE 6.2	BRIT 3.8	BUTR 1.1	BRIT 3.3
Shrub/tree(>0.5 to 3m)	CREO 1.2	ACCA 11.1	GRAY 21.3	HADE 14.1	CREO 25	WOLF 11.2
Tree (>3 m)		IRON 6.2	PABL 34	PABL 21		MEVE 43
Northwest (identify species and record distance)						
Cholla(>0.5m)	CHTE 45	CHTE 10.2		CHCA 1.6		
Shrub(≤0.5m)	WOLF 3.1	BUTR 0.6	BUTR 1.2	BUTR 4.4	SEDE 9.1	BUTR 1.2
Shrub/tree(>0.5 to 3m)	DEBR 7.2	CREO 14.2	CREO 23	CREO 31	JOJO 3.4	CREO 2.2
Tree (>3 m)	MEVE 16	PAFO 24		PAFO 40	MEVE 16	

UTM, NAD83	
268219	mE 1
375310	mN
268420	mE 2
3753109	mN
268819	mE 3
3752910	mN
268419	mE 4
3752909	mN
268620	mE 5
375309	mN
268819	mE 6
3752910	mN

Dominant trees/shrubs/cacti (within entire plot)		
	Desert Sp.	Wash Sp.
Tree/shrub 1	CREO	PABL
Tree/shrub 2	BUTR	IRON
Tree/shrub 3	CHCH	MEVE
Tree/shrub 4	PAFO	ACCA

Record the **top 4** most abundant tree/shrub sp. in decreasing order

Invasive Plants (within entire plot)	
Sahara mustard	_____
Red brome	X
Buffelgrass	X
Arabian Mediterranean grass	_____
Bermuda grass	_____
Fountain grass	_____
Russian thistle	X

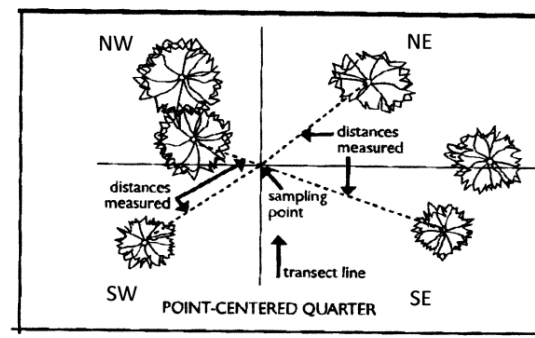
Place an X to indicate presence of invasive

Mistletoe [while standing at veg. pt., record a 1 if mistletoe present, 0 if absent (within a 200 m radius)]						
Northeast	1	0	0	0	1	1
Southeast	1	1	1	0	0	1
Southwest	0	1	1	0	1	1
Northwest	0	1	0	1	1	0

Saguaro Count (while standing at veg. pt., count all saguaros within a 50 m radius; 360°)						
Armed	6	15	34	12	18	9
Unarmed	8	9	12	10	5	6

(all sum 100%) % Ground composition (within a 5 m radius of the Northeast quarter of veg. pt.)						
Sand			10		25	55
Gravel	65	45	60	40	26	
Rock	25	30	15			
grass/forbs	10	25	15	20	5	30
Other				Biotic Crust 40	Biotic Crust 50	Biotic Crust 25

Other category may include clay, biotic crust, etc; it should be identified accordingly



Appendix 8. Photos of Sonoran Desert Invasive Plant Species.

Sahara Mustard *Brassica tournefortii*



All above: <http://cabezaprieta.org> by Hank Jorgensen

Buffelgrass *Pennisetum ciliare* or *Cenchrus ciliaris*



<http://www.buffelgrass.org> by Christine Hannum



Photo - Chris Gardiner ©

www.tropicalforages.info/key/Forages/Media/Html/ by Chris Gardiner



© Larry Allain

Larry Allain @ USDA-NRCS PLANTS Database

Fountain grass *Pennisetum setaceum*



Both above: <http://cabezaprieta.org> By Hank Jorgensen

Red Brome *Bromus rubens* var. *madritensis*



© Patrick J. Alexander

Patrick J. Alexander @ USDA-NRCS PLANTS Database



www.blm.gov/pgdata Stephen Laymon



www.arizonensis.org Michael J. Plagens 2008

Arabian or Mediterranean Grass *Schismus arabicus*



Dale A. Zimmerman Herbarium, Western New Mexico University



CalPhotos.berkeley.edu © Steve Matson 2011



CalPhotos.berkeley.edu © Joe DiTomaso 2001

Bermuda Grass *Cynodon dactylon*

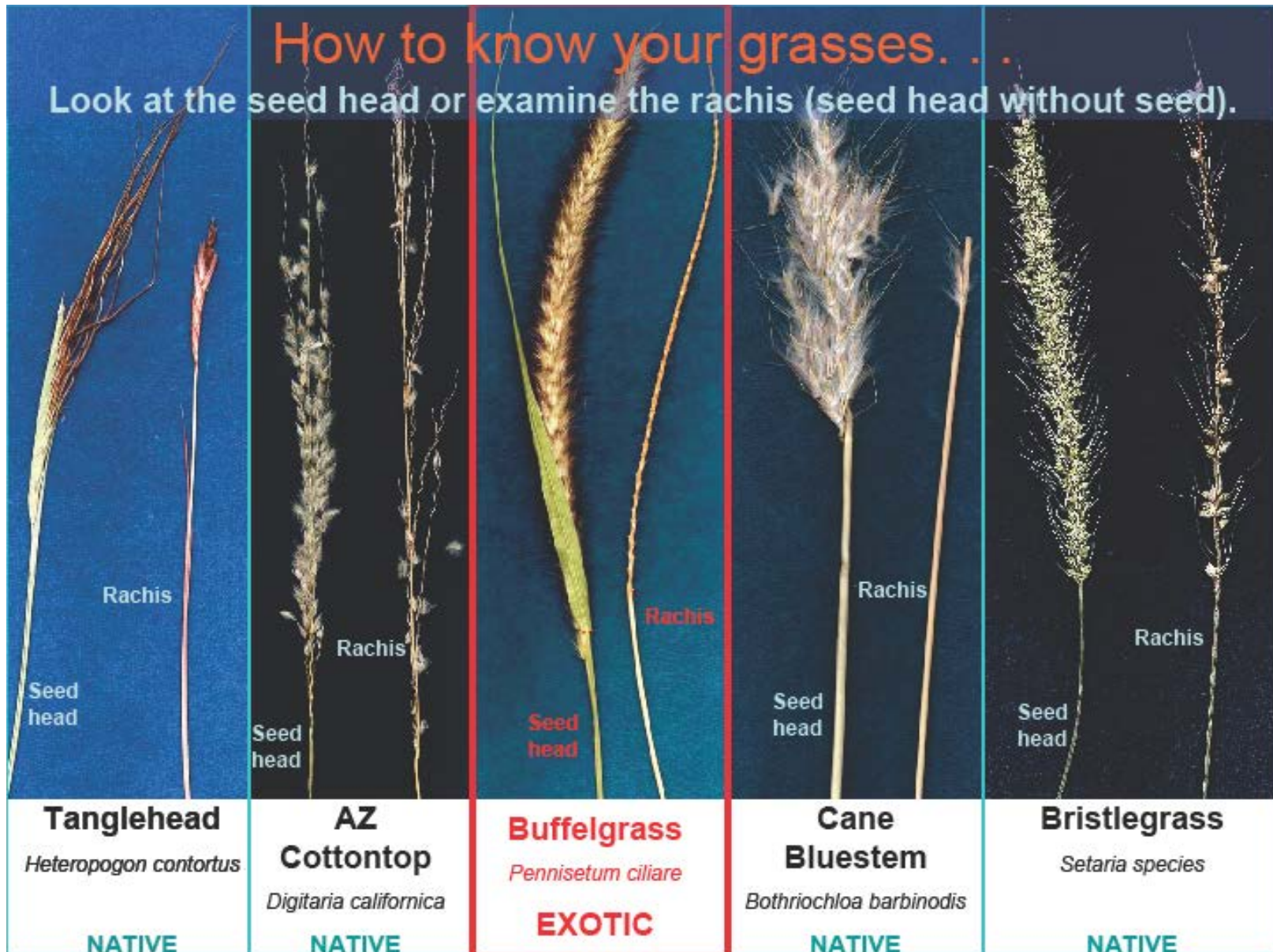


Both above: http://www.saguaro-juniper.com/i_and_i/invasive_spp/bermuda_grass.html

Russian thistle (tumbleweed) *Salsola tragus* or *iberica*



Both above: www.delange.org/ThistleRussian
Images Copyright [George & Audrey DeLange](#)



<http://www.buffelgrass.org/sites/default/files/grasscomparison.pdf>; Prepared by Bethany Hontz/Saguaro National Park

Appendix 9. Blank Data Forms

Plot# _____

Sonoran Desert Plot Habitat Evaluation Form

Date: _____

Plot Vegetation Points (4 points on Upper Sonoran plots or 6 points on Lower Sonoran plots)

Point-Centered Quarter: within each quarter around a vegetation sampling point, measure distance to nearest cholla (>0.5 m height), and any other tree/shrub (within each height category)]

Only consider those plant species within a **50 m** radius of vegetation sampling point

Surveyor(s): _____

Average Elevation (m): _____

1	2	3	4	5	6
---	---	---	---	---	---

(height in meters)

Northeast (identify species and record distance)

Cholla(>0.5m)
Shrub(≤0.5m)
Shrub/tree(>0.5 to 3m)
Tree (>3 m)

UTM, NAD83

mE	1
mN	

Dominant trees/shrubs/cacti

(within entire plot)

	Desert Sp.	Wash Sp.
Tree/shrub 1		
Tree/shrub 2		
Tree/shrub 3		
Tree/shrub 4		

Southeast (identify species and record distance)

Cholla(>0.5m)
Shrub(≤0.5m)
Shrub/tree(>0.5 to 3m)
Tree (>3 m)

mE	2
mN	

Record the **top 4** most abundant tree/shrub sp. in decreasing order

Southwest (identify species and record distance)

Cholla(>0.5m)
Shrub(≤0.5m)
Shrub/tree(>0.5 to 3m)
Tree (>3 m)

mE	3
mN	

Invasive Plants (within entire plot)

Sahara mustard	_____
Red brome	_____
Buffelgrass	_____
Arabian Mediterranean grass	_____
Bermuda grass	_____
Fountain grass	_____
Russian thistle	_____

Northwest (identify species and record distance)

Cholla(>0.5m)
Shrub(≤0.5m)
Shrub/tree(>0.5 to 3m)
Tree (>3 m)

mE	4
mN	

mE	5
mN	

mE	6
mN	

Place an **X** to indicate presence of invasive

Mistletoe [while standing at veg. pt., record a **1** if mistletoe present, **0** if absent (within a **200 m** radius)]

Northeast					
Southeast					
Southwest					
Northwest					

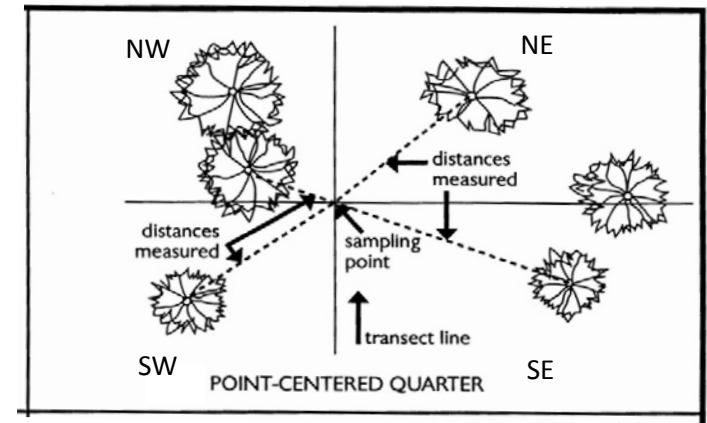
Saguaro Count (while standing at veg. pt., count all saguaros within a **50 m** radius; 360°)

Armed					
Unarmed					

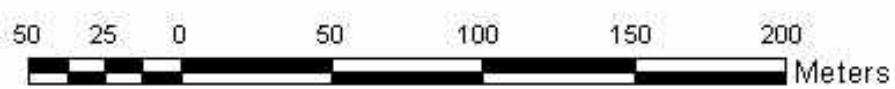
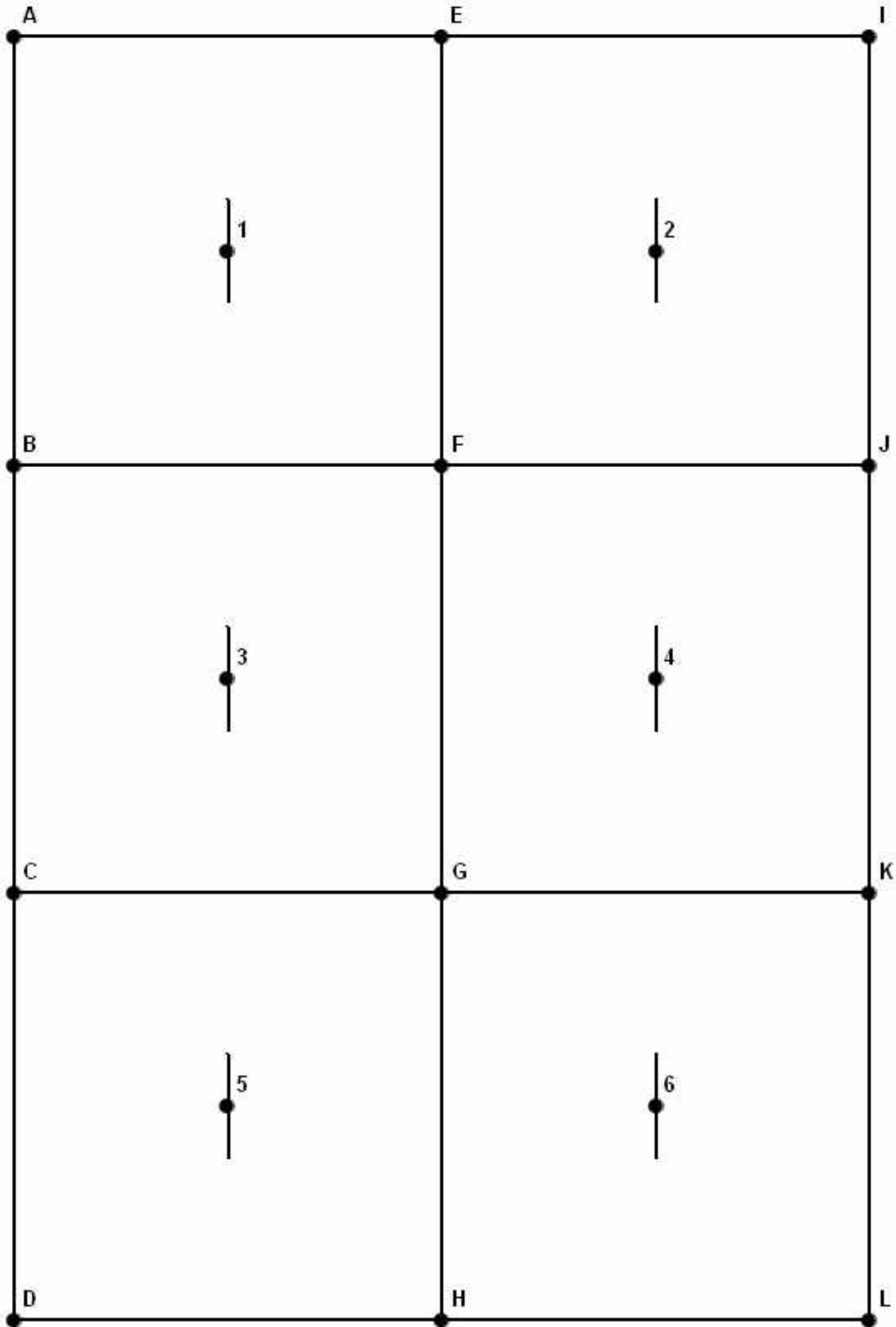
(all sum 100%) **% Ground composition** (within a **5 m** radius of the **Northeast** quarter of veg. pt.)

Sand					
Gravel					
Rock					
grass/forbs					
Other					

Other category may include clay, biotic crust, etc; it should be identified accordingly



Plot: _____



Plot _____

