**The HABPOPS Decision Support Tool: A look inside the “Black Box”**

**Introduction.** The IWJV HABPOPS web tool is build from a Microsoft Access database, originally based on the successful Heirarchical All-Bird Strategy (HABS) database of the Playa Lakes JV. It combines estimates of current habitat extent and condition with the best available data describing focal species occupancy rates and density to derive *population estimates at the BCR/State polygon scale*. Because these estimates are based on vegetative association and condition, it is possible to calculate the predicted population response to habitat changes (as defined by dominant vegetation and condition class).

The basic building blocks of the HABPOPS database are:

* **Acreage.** The acreage each habitat (vegetative association) within each BCR-State polygon. These were calculated from analysis of NW ReGAP (2009), SWReGAP (2007) and California WHR (2002) layers, with the latter reclassified to 30-m pixels for consistency with the other layers;
* **Condition Classes**. The percentage of each habitat in defined condition classes (e.g. poor,/fair/good as defined variably by canopy coverage, structure or vegetative composition; young/mature/old growth). Our assumptions of the percentages of any given vegetative association in each condition class came from the summaries in PIF and previous IWJV state plans, or from the literature. Little is available in the way of regional spatial datasets that specify habitat condition at the association level. For the interior Columbia Basin, we extrapolated from “Range Integrity Ratings” in the support documents for the muti-agency planning documents for the region (Quigley et al. 1996).
* **Predicted Occurrence**. The amount of potential habitat for each focal species in each BCR-State polygon, based on predictive models combining deductive habitat associations with the mapped known range of the species. We used shapefiles of the mapped ranges (from Nature Serve) of each focal species to clip raster files of the habitats assigned as suitable for each species. Species habitat relationships were provided by PIF state plans, review by the IWJV Landbird Science Team, and ReGAP vertebrate modeling.
* **Occupancy, Density.**  Occupancy rates and breeding density values for each condition class of each predicted habitat type for each focal species, locally-derived when available, or the best available information, were used for population estimation. Because of voluminous data sets that included “0” values for density were available (e.g. sagebrush obligates in the northern Great Basin), we used a default value of 1.0 for occupancy for those species (average density included unoccupied habitats). Density values came either directly from published and unplublished field research, with weighted averages used when sample sizes were high, or extrapolated using documented assumptions when sample sizes were low (see **Assumptions** section, below).
* **Population Estimate.** The current population estimate for any given region was calculated by multiplying the area of habitat assumed to be suitable for the species times the occupancy rate, times the appropriate density value, and then summed across association/condition classes for the geography (e.g. BCR9 in Utah). By using using the polygons formed by overlaying BCRs and states, we developed estimates that could be rolled up by state or by BCR.

The HABOPS database can used as a strategic tool for the development of habitat projects and programs, by predicting the change in breeding populations that will result from changes in the extent and condition of one or more habitats in a specified geographic area. It also allows us to develop “bottom-up” habitat objectives by providing a tool to examine the overall potential to change carrying capacity on the landscape and testing various scenarios to see how (or if) we can meet trend-based goals.

**Limitations.** The HABPOPS tool was created for five priority bird species dependent on grassland and sagebrush habitats, the highest priority terrestrial habitats identified in the IWJV 2013 Implementation Plan. These are the Brewer’s Sparrow, Grasshopper Sparrow, Long-billed Curlew, Sage Thrasher, and Sagebrush Sparrow (Note that the desktop and web tool were completed prior taxonomic changes in the Sage Sparrow, and it is listed as such in the tool). The tool was also developed for the three largest BCRs that overlap the IWJV: the Great Basin (BCR 9), Northern Rockies (BCR 10), and the Colorado Plateau/Southern Rockies (BCR 16). It covers only the U.S. portion of these three BCRs.

**The HABPOPS Dataset.** All of the numerical data used in the calculations run by the HABPOPS tool are housed in a single spreadsheet within the Access database. An Excel copy of that spreadsheet is available [here](E:\\HABPOPS-CEAP\\HABPOPS\\HABPOPS NOTES\\HABPOPS NOTES\\here). It includes the following variables:

|  |  |
| --- | --- |
| ID | Record identifier; each record has a unique value |
| SPECIES | Four-letter species code |
| SpeciesName | AOU Common Name (at the time the tool was built) |
| STATE | Two-letter postal code |
| StateName | State name |
| BCR | Bird Conservation Region number |
| ASSOCIATION | Vegetative Association (ReGap or California WHR) |
| Condition | Condition name/description |
| MasterConditionCode | Unique (MCC) numeric code combining state, BCR, Association and Condition |
| DefaultPercent | Proportion of an association assigned to a condition class |
| MCCAcres | Calculated Field: (MCC percent) x (area of Association in a state/BCR polygon) |
| DensityPerAcre | Birds/ac value for each unique MCC code |
| Occupancy | Proportion of MCCAcres occupied by the species (0.0 – 1.0) |
| ObjectiveMultiplier | Multiplier to establish population objectives (1.0 – 2.0) |
| Link Field | Combined codes for species, BCR and state used for summing calculations |

**Assumptions**

The development of any quantitative decision support tool requires a wide range of assumptions regarding inputs, calculations and outputs. The following is not meant to be a comprehensive listing off all the assumptions built into the HABPOPS tool, but does include the major assumptions driving input values and calculations, by data category and by species.

**Associations.** We assumed that the vegetation association level of habitat classification would have the greatest relevance to conservation planning partners, being fine enough to distinguish communities and dominant species, available across the entire planning area, and based on a nationwide nomenclature. We also assumed that the timing of the ReGap effort across the West meant that these layers would adequately represent habitat distribution and extent at the time the tool was built. Some reclassification was done to cature recently burned areas and to takes human infrastructure (most notably roads) out of our calculations.

**Conditions.** Lacking any spatial layers that displayed habitat condition classes (e.g. successional stages, invasives, structural components) at the full IWJV scale, assigning proportions of the areal extent of vegetative associations within our assigned condition classes was, by necessity, somewhat arbitrary. For example, in agricultural types where we had two assigned conditions (e.g. irrigated vs. dryland), we arbitrarily apportioned them at 50% each. In most cases, we assigned three condition classes (Poor/Fair/Good), and in these cases we assumed a “bell-shaped curve”, with 20% Poor, 60% Fair, and 20% Good. These broad categories were deemed appropriate for comparative purposes, especially considering that conditions can fluctuate rather widely from year to year in response to management, drought cycles, fire and other influences.

In the interior Columbia Basin in OR and WA, we were able to modify our estimates by extrapolating from “Rangeland Ecological Integrity” (REI) ratings for watersheds, from multi-agency planning documents for the region (Quigley et al. 1996). We assumed the 60:20:20 rule, assigning the majority to the designated REI condition rating for the watershed. For example, if the REI condition rating for the watershed was “poor,” we assumed that 60% of rangeland habitat was in poor condition, with 20% in fair condition and 20% in good condition. Conversely, we assumed that even where the REI condition rating for the entire watershed was good, 20% of the habitat would be in poor condition and 20% in fair condition. Where the REI rating was not provided (no data), we treated the watershed as being in fair condition (20% poor, 60% fair, 20% good). We then rolled up these estimates to the BCR/State polygon level. So across BCR 9 in OR, for example, this resulted in estimates that for Columbia Plateau Low Sagebrush Steppe, 41% was in poor condition, 39% in fair condition, and 20% in good condition (and so on).

**Density.** The initial effort to compile densities for sagebrush obligate species came from an analysis conducted by the American Bird Conservancy for sagebrush habitats on BLM lands in Oregon and Washington (Altman and Casey 2008). Hundreds of density values for our three sagebrush obligates were compiled from the lieterature and from additional contracted survey work; they included variable circular plot, transect and plot data. Absences of a species at a particular site in a study (density estimate equals 0) were included in the database and in calculations of mean density estimates. Thus, we did not correct for occupancy in our analyses and assumed the use of density values of zero in the database allowed us to account for variations in occupancy rates.

We assigned the density estimate from each study to one or more habitat types based on expert opinion and/or our comparison of the association descriptions with those provided in the study. Each density estimate was further characterized as being associated with good, fair, or poor quality habitat based on an assessment provided by the study (only a couple studies reported this) or our interpretation of the vegetation data as presented in the report. We primarily used characteristics of shrub or sagebrush cover supplemented by assessments of grass, forb or native versus non-native herbaceous cover; and bare ground or cryptogamic crust cover. In general, sagebrush cover >20% was considered good, 10-20% fair, and <10% poor quality habitat. The other vegetation characteristics were subjectively evaluated in terms of supporting or refuting that categorization.

In order to provide a regional mean density estimate for all three conditions within each association, we had to make some assumptions and extrapolations. Where we only had data for one habitat condition within a habitat type, we assigned bird density estimates to the other conditions based on 50% differences from the condition we had data for. Where we only had data for two habitat conditions within a habitat type, we assigned bird density estimates to the other condition based on the same proportionate differences between the other two habitat conditions. For the Intermountain Semi-Desert Shrub-Steppe habitat type where we had no bird density data, we calculated a mean density from the three habitat types we judged most similar to it, Columbia Plateau Sagebrush Scabland, Columbia Plateau Low Sagebrush Steppe, and Intermountain Mixed Salt Desert Shrub.

A regional mean density was calculated for each species for each combination of census method, habitat type, and habitat condition based on all the individual density estimates in the database weighted by effort. For fixed-radius and variable-radius point counts (approximately 90% of the data), effort was the number of point counts conducted in the study. For spot-mapping, effort was the total number of hectares; and for transects, effort was the total number of transects conducted. The regional mean density estimate for each combination was the weighted mean (i.e., weighted by effort again) of the density estimates for each census method within each habitat type and condition.

We used the values from OR and WA, where we had the greatest sample sizes by far, for other locations in the IWJV where more local data were not available. Data from Rocky Mountain Bird Observatory and their “Monitoring Colorado Birds” were used there and in adjoing states. Further descriptions of the data and assumptions used in calculating appropriate density values are included in the **Species** sections, below.

We found fewer sources for density data for our two modeled grassland species (Grasshopper Sparrow and Long-billed Curlew). Because one of our challenges was a limited number of density estimates for such a large area, we assigned a general density estimate to each cover class for each species based on an overview of the reported densities and our professional understanding of the relative importance of each cover type as suitable habitat for each species (Altman and Casey 2006). Although we recognize that densities can vary widely within a cover type across State and BCR boundaries, the general density estimate we used for a cover type is a attempt to take in that variability. For our purposes, we assigned three density values for Grasshopper Sparrow (10, 30, and 50 ha/pair) and four density values for Long-billed Curlew (20, 50, 100, and 200 ha/pair), which were translated to birds/ac for the HABPOPS tool. Further refinement of these density values is described in the **Species** sections, below.

**Occupancy.** Lacking detailed occupancy data from across the region a the time the HABPOPS tool was built, we used a value of 1.0 for our three sagebrush obligate species (as described above), based on the inclusion of multiple studies with density values of zero.

In the case of our grassland species we took a different approach. Lacking a diversity of density information for these patchily distributed species, we had to account for the areas where bird populations are absent in a suitable cover type. To do this, we made professional judgments as to the percent of the suitable cover type that is likely currently occupied by breeding birds. We used four correction factors to account for this assumption. We assigned factors of 5%, 20%, 30%, or 60%, applying them based on our professional knowledge of the species habitat affinities and the characteristics of the cover type being considered.

Some agricultural or cropland cover types under some conditions can be suitable habitat for each species (e.g., Grasshopper Sparrow in fallow fields and CRP lands, Long-billed Curlew in grazed pasture). In lieu of specific designation of agricultural cover types, we had to assume that most of the more general agriculture types (e.g., agriculture, cropland, irrigated cropland) would not be suitable, and assigned 5% of these cover types as suitable habitat. At the other end of the scale, those habitats assumed to be the most preferred were assigned our maximum value of 60%, recognizing the patchy distribution of the species even within suitable habitat. With some exceptions, this meant that for each of these grassland specialist species, we assumed that 5% of agricultural lands were suitable/occupied; 20% of habitat types that had a woody component (e.g., shrub steppe or savanna); 30% of suboptimal grassland types (e.g. slope grasslands for Long-billed Curlew), and 60% of preferred habitats (e.g. Palouse Prairie for Long-billed Curlew, Western Mixed Grass for Grasshopper Sparrow).

**Species Notes.** The following are examples of the assumptions, calculations and adjustments were made to the species-specific density and/or occupancy values for the five species in the current (2015) version of the HABPOPS database. This is an incomplete list, presented here to represent the scope of the effort. Additional raw data and calculations are available on request from the Intermountain West Joint Venture.

**Brewer’s Sparrow**

* Extensive review, fieldwork from BCR 9 & 10 in OR, WA, (including adjoining areas in CA, NV, ID, but hereafter called the OR/WA data set); also monitoring data from Rocky Mountain Bird Observatory from CO, NM, adjoining states.
* Total of 477 recorded density values used as the baseline values for calculations (CA, CO, ID, MT, NM, NV, WA, WY)
* Included multiple zero density values – hence 1.0 used for occupancy.
* Did not include Timberline Sparrow (e.g. Alpine Dwarf Shrubfield)
* Used density ratios from analagous habitat types and conditions for other states where condition was unknown, used ratios from analogous types in OR/WA data set.
* Applied OR/WA values for “Inter-Mountain Basins Mixed Salt Desert Scrub” to “Mojave Mid-Elevation Mixed Desert Scrub” in CA.
* Used CA/NV data for all Wyoming sagebrush types (Barton and Holmes 2004a) to establish mean sagebrush values by condition class for “Sagebrush” in CA.
* For those sage/shrub habitats w/ unknown density/condition (e.g. the statewide density values from RMBO for CO), assumed the value presented represented “fair” condition, and used ratios from the OR/WA set, n=8 types, plus NV data (L. Neel) n=2, so N=10. Density values in “fair” condition habitats averaged 74% of those in “good” habitat, and those in “poor” condition averaged 64% of the density in “fair” condition.
* Above done for CO data from RMBO for sagebrush types in BCR 10 and BCR 16.
* Certain sagebrush types had 0.0 density values when in poor condition (e.g. “Columbia Plateau Low Sagebrus Steppe”, “Great Basin Xeric Mixed Sagebrush Shrubland”).
* For “Intermountain Basins Juniper Savanna” and “Colorado Plateau Pinyon-Juniper Shrubland” habitats in CO BCR 16, we started with the RMBO dataset, which showed a statewide density of 0.04375 birds/ac in Pinyon-Juniper. We assumed that the conditions in each were 20% grass 60% shrub, and 20% woodland. The density ratio in our detailed OR/WA dataset showed that BRSP densities was highest in the “shrub” stage, 85% of that value in the “grass” stage, and 0.0 in the “woodland” stage. We therefore assigned densities for CO Juniper types in the following way:

10,000 ac of habitat would support 437.5 birds at the measured statewide density.

If we let *x* represent BRSP density in stands in shrub condition, then 0.85*x* is the density in grass stands (with density = 0 in woodland stands).

Then: 437.5 = 6000(*x*) + 2000(.85)(*x*) + 2000(0)

437.5 = 7700*x*

7700/437.5 = *x*

So: *x* = 0.05681, BRSP density in CO Pinyon-Juniper, shrub condition

.85*x* = 0.04830, BRSP density in CO Pinyon-Juniper, grass condition

* Note: Our original summaries for OR/WA assumed that density in “fair” condition = 50% of “good” condition densities, and that those in “poor” condition = 50% of “fair” in those cases where we had data from just one condition class.
* We applied CO values for “Lower Montane Foothill Shrub” to the same habitat in MT.
* In NV, the values presented by L. Neel fall well within the range we calculated for BCR 9 in OR/WA, although his were within a tighter range (e.g. .14 - .64/ac in “Sagebrush”, .25 - .65 in Mountain Sage; our “Montane” was .42 – 1.17/ac.)
* We applied the OR/WA values to the same associations in UT BCR 9 and BCR 10.
* For UT BCR16 we used analogous CO BCR 16 values except for “Great Basin Xeric Mixed Sagebrush Shrubland”, “Mojave Mid-Elevation Mixed Desert Scrub”, and “Sonora-Mojave Creosotebush-White Bursage Desert Scrub”, for which we applied the OR/WA/ID values for analogous types (e.g. “Inter-Mountain Basins Mixed Salt Desert Scrub”).
* We used the OR/WA values for WY BCR 9; all other WY values (BCRs 10 and 16) came from the CO data.
* Sagebrush and Pinyon-Juniper types in NM used the values from the same habitats in CO – average values prorated accordingly for ‘sagebrush’ types.
* AZ values all from NM (CO) values
* WY 16 all from CO; BCR9 + 10 from OR/ WA set except “Inter-Mountain Basins Juniper Savanna” values from CO.

**Sage(brush) Sparrow**

* 417 unique density values compiled (CA, CO, ID, MT, NM, NV, OR, WA, WY).
* Assumptions and extrapolations similar to those described for Brewer’s Sparrow
* No data for the limited population in BCR 10 in MT, as this local population is not included in the Nature Serve mapped range for the species.

**Sage Thrasher**

* 426 unique density values compiled (CA, CO, ID, NV, OR, WA).
* Assumptions and extrapolations similar to those described for Brewer’s Sparrow

**Grasshopper Sparrow**

* 41 unique density values compiled (CO, MT, NE, KS, OR, WA)
* Database estimates derived from combination of % Occupancy classes (5-60%) and density classes (10-50 ha/pr = 0.0162-0.081 birds/ac), with certain assumptions made to distinquish condition habitat conditions. Here are those assumptions, by habitat category:



**Long-billed Curlew**

* 30 unique density values compiled (AB, BC, CO, ID, KS, NE, NM, OK, OR, UT, WA)
* Database estimates derived from combination of % Occupancy classes (5-60%) and density classes (20-200 ha/pr = 0.04 -0.004 birds/ac), with certain assumptions made to distinquish condition habitat conditions. Examples, in ascending order of suitability:

|  |  |  |  |
| --- | --- | --- | --- |
| **Association** | **Occ.** | **ha/pair** | **Comments on % predicted suitable** |
| Cultivated Cropland | 0.05 | 200 | most tilled cropland unsuitable |
| Inter-Mountain Basins Juniper Savanna | 0.20 | 200 | trees reduce suitability compared to other steppe |
| Pasture/Hay | 0.30 | 200 | more consistent suitability than other ag types |
| Columbia Plateau Low Sagebrush Steppe | 0.20 | 100 | prefer sites with fewest shrubs |
| Wyoming Basins Low Sagebrush Shrubland | 0.20 | 100 | shrub component reduces suitability |
| Columbia Basin Foothill and Canyon Dry Grassland | 0.30 | 100 | slopes lowers suitability than other grasslands |
| Inter-Mountain Basins Semi-Desert Grassland | 0.60 | 100 | high occupancy but lower density |
| Western Great Plains Shortgrass Prairie | 0.60 | 50 | high occupancy, relatively high density |
| Great Plains Prairie Pothole | 0.20 | 20 | pothole itself supports birds when dry |
| Invasive Annual Grassland | 0.60 | 20 | cheatgrass can support high densities |
| Columbia Plateau Steppe and Grassland | 0.60 | 20 | highest suitability |
| Northwestern Great Plains Mixedgrass Prairie | 0.60 | 20 | highest suitability |
| Columbia Basin Palouse Prairie | 0.60 | 20 | highest suitability |

* Lacking detailed density information under various conditions, we used a series of assumptions to adjust density values based on condition classes. It is important to note that our assigned condition classes of “poor”, “fair” and “good” related to vegetative and structural components of various associations, not their value to our focal species. So in some cases, the best habitat condition for a species might be counterintuitive, and this is the case for Long-billed Curlews, which prefer short-to mid-structure, some open ground and even show high densities in some disturbed habitats (e.g. cheatgrass). So often we considered Fair>Poor>Good from a nesting density standpoint.
* For cultivated agriculture associations, we assumed that (nesting) density in irrigated crops was 50% that of dryland crops (many irrigated crops are unsuitable).
* For pasture and hayland, we assumed that densities in irrigated sites were 80% of those in upland pasture (overall). We acknowledge that some high densities of nesting curlews can occur in irrigated meadows (e.g. in eastern ID), but at the regional scale of classification, many irrigated haylands are alfalfa that is less suitable.
* For most grassland and shrub-steppe habitats, we considered that the highest densities would occur under “fair” conditions, with “poor” conditions (generally shorter structure, more open soil) supporting 80% that of “fair”; and “good” conditions (higher residual cover, often with woody inclusions) at 80% of “poor”. Exceptions were “Annual Grassland”, “Inter-Mountain Basins Semi-Desert Grassland”, and “Western Great Plains Shortgrass Prairie”, where we ranked Fair>Good>Poor based on the very limited cover in these types in poor condition.
* For a few grasslands, we included “grazed” and “ungrazed” as our condition classes; in these cases we considered that ungrazed lands supported 80% of the densities of grazed lands.
* In juniper savanna association, we assumed that stands in the “shrub” condition supported densities at 80% of those in the “grass” condition, and that “woodland” conditions did not support curlews.
* Several ephemeral/playa wetland types were included in the curlew model. We assumed that nesitng densities would be low, but highest when the sites were dry, reduced to 80% under “wet” conditions.

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