Bird's Eye View Habitat Tool Manual

Draft updated 04.13.2021

Link:

https://aknw.shinyapps.io/birdseyehabitat/

Overview

This data exploration tool is intended to allow resource managers to view graphical summaries of predicted bird habitat at multiple scales (HUC12, NPLSS Section, and NPLSS Quarter section). Multi-species habitat indices and species habitat values are based on species-centered distribution models (SDMs) for 32 focal species in the Klamath Mountains Ecoregion of southern Oregon and northern California. Habitat objective descriptions for the 32 focal species provide context for the graphical outputs.

To begin: Suggested user preparation

- Location information for watersheds (HUC12, HUC8, and/or HUC6 watersheds) and/or Public Land Survey System (PLSS) Township and Range IDs to help locate project area
- Knowledge of current and desired vegetation conditions, as well as possible management actions to achieve desired conditions
- Location of an analog area to desired condition for purposes of comparison

Navigation

- Use the toggle options on the map to display a basemap of either "Topo" or "Imagery". Select "Township" and/or "HUC" to display these map layers (Note: these will only display at a certain zoom level).
- Zoom in manually (using mouse or +/- on map) or by using the dropdown menus on the right to zoom to a watershed or township and range near the project area. Locate project area at a finer resolution by using landmarks on the basemaps, and information from the "Township" and/or "HUC" layers
- Below the map, select a dataset scale to display from the drop-down list (HUC12, Section, or Quarter Section) and click the "Load data" button to load the Habitat Index and Habitat Value data for that scale. If you would like to change your selection, select a different scale from the drop-down list, and click the "Load data" button again. You can clear your selection from the map at any time by clicking the "Clear points" button.
- Markers will appear on the map, either as clusters (displayed as a highlighted number) or as individual blue marker. If clusters appear, use mouse or +/- on map to zoom in further until blue markers appear.
- Locate the marker that best represents the location of your project area at the scale of interest, and click on it.

- Click on the “Multi-species Habitat Index” and/or the “Species Habitat Value” tabs to view the associated data (in graphical format) and relevant links.
- Generate a full report and save as a PDF if desired
    - Click on the “Generate Bird’s Eye Habitat report” button in the upper right of the main tool window. This will load the report into your downloads folder as an HTML file. Click on this file to open it in a new tab in your browser.
    - Save report as PDF by right clicking within the report window, selecting “Print”, and then selecting “Save as PDF” from the drop-down options under “Printer”.
    - <u>Note</u>: Due to the technical constraints of our modeling process, not all potential focal bird species for a particular set of forest ecosystem attributes could be included within the associated Index group. To provide context on other bird species that may be associated with the conditions represented by each Habitat Index, a list of Additional Focal Species for each Index is included. Additionally, priority species according to regional conservation plans are noted with an asterisk (*) within the report.
- <u>Note:</u> Due to historical circumstances related to the Public Land Survey System, Section and Quarter section grids are not available for some of the areas covered by the Bird’s Eye Tool. Where possible, we have added Section markers and associated Habitat Index and Habitat Value data for in the missing areas of the red Township grid displayed on the Tool map. However, Quarter Section data are not available in these areas. Quarter section data are also not available for some additional areas covered by the red Township grid.

Multi-species Habitat Index Tab

This tab displays data for each individual Multi-species Habitat Index at the chosen marker location. Habitat Indices are calculated by summing the probability of occurrence of all focal species across the Klamath Mountains Ecoregion, and averaging across each HUC12 watershed, PLSS Section, and PLSS Quarter Section.

- Outputs:
    - Each bar represents the mean and standard deviation of each Multi-Species Habitat Index for the site at the scale you selected (HUC12, Section, or Quarter Section).
    - A total of nine Indices are grouped within three main categories: Early Seral Coniferous, Late Seral Coniferous, and Oak
    - Each Multi-species Habitat Index is calculated by summing the modeled probability of occurrence from Species Distribution Models (SDMs) from all of the focal species in the index, and then scaled from 0-1 to allow comparison among habitat indices. Focal species for each Index share affinities for particular structural and compositional attributes of forest vegetation, and were chosen on the basis of expert option and several regional conservation plans (detailed in the report - see “Generate Bird’s Eye Habitat Report” above).
    - Note: while the Multi-species Habitat Index values may be similar in different locations, the probability of occurrence values for the species that define the index may be different. For information about how each species model contributed to the habitat index, click the “Species Habitat Value” tab.
- Vegetation descriptions:

  - For each Multi-species Habitat Index, see the description of vegetation structure and composition typical of that vegetation type below the bar graphs within the Habitat Index tab.

Species Habitat Value Tab

This tab displays the probability of occurrence for each of 32 bird Focal Species that makes up each Multi-Species Habitat Index at the chosen marker location. The probability of occurrence is on a scale of 0 to 1 from species distribution models for each species, averaged across each HUC12 watershed, PLSS Section, and PLSS Quarter Section.

- Outputs:
  - Each graph contains the mean and standard deviation of the Probability of Occurrence (y-axis) for each Focal Species (x-axis), organized by Multi-species Habitat Index groups. Use the toggle buttons to view the species for each of the three Habitat Index groups: Early Seral Coniferous, Late Seral Coniferous, and Oak
  - The species along the x-axis are labeled using standard codes. Species codes are defined within the list of links below the graphs.
  - Use the graphs to assess which species are contributing to the Habitat Indices for your site. Identifying the birds with the highest probability of occurrence provides a clue to the vegetation conditions that are currently most likely to occur at the site.
- Species information:
  - It is important to understand the habitat requirements of each species within the Habitat Indices to interpret the meaning of each Index value for your project area. For more information about each species' habitat needs, click on the links below the graph to view information summarized from conservation plans.

Applications

- Examine current stand conditions from bird habitat perspective
- Inform/augment biological opinion in a variety of applications, e.g. in:
  - Shaping management objectives to retain current value for focal species and others under the umbrella of each Habitat Index's vegetation structure and composition
  - Crafting prescriptions to move toward alternate desired future conditions

Appendix I: Species Distribution Model (SDM) Methods

Recently, advances in using high-resolution unclassified Landsat imagery have resulted in species distribution modeling approaches that provide an effective measure of species habitat (Betts et al. 2014; Halstead 2019). Using bird monitoring data and unclassified remote sensing imagery data in species distribution models (i.e., the "species-centered approach"; Betts et al. 2014) can avoid some uncertainty associated with classified vegetation data, and allows researchers to predict subtle changes in habitat at relatively fine scales (Shirley et al. 2013). Species distribution models (SDMs) produced from unclassified Landsat imagery have successfully been applied to predict the distribution of western forest birds in Southern Oregon (Betts et al. 2014; Halstead 2019; Shirley et al. 2013). Using continuous surface maps from SDMs as a proxy for a species' habitat - or stacked SDMs for habitat of multiple species - can thus provide a reliable index of habitat for individual species or suites of bird species.

Survey data

We used point count bird monitoring data collected from 2000 to 2015 at 6,052 survey locations as part of the Klamath Bird Monitoring Network (Alexander 2011; Alexander et al. 2004) to model species distributions for a series of bird species that occur within the study region (Table 1). Counts were conducted within four hours of sunrise between mid-May and early-July to coincide with hours of peak forest bird activity during the main portion of the breeding season, using 5-minute variable radius point count methodology (Ralph et al. 1993; Stephens et al. 2010). We truncated survey data to detections within a 75m radius of each survey location summarized point count surveys, and converted all observations to presence/absence. If locations were surveyed more than once, we selected one survey randomly to include in the model training dataset. We then calculated frequency of occurrence for each species and developed models for all species that were detected in at least 5% of surveys, and for all focal species from regional conservation plans (Altman 2000; Altman and Alexander 2012) that were detected in at least 1% of all surveys.

Predictor variables

We used temporal median composites (Ruefenacht 2016) of unclassified Landsat 5 Thematic Mapper (L5 TM), Landsat 7 Enhanced Thematic Mapper (L7 EMT+), and Landsat 8 Operational Land Imager (L8 OLI) imagery as land cover predictor in focal species SDMs (following Shirley et al. 2013). All Landsat images were acquired from USGS (http://landsat7.usgs.gov/index.php). Landsat images are taken globally on a 16-day cycle, and are collected in the form of 170 km x 183 km overlapping scenes with a 30 m^2 pixel resolution. Because each Landsat scene contains a certain percentage of pixels that may unusable due to cloud cover or some other disturbance, composites of all available Landsat scenes in a given area across a given time period have the benefit of providing a more spatially continuous, cloud-free, and overall more robust image for ecological modeling than the image from any one date could provide (White et al. 2014; Ruefenacht 2016).

For compositing, we selected all available Landsat scenes that directly covered the study area or overlapped with scenes covering the study area, and which fell within the greenup-to-senescence period of June 1 to October 15 (identified with an NDVI profile) for each of the years in which point count training data were collected (2000 through 2015). All scenes were atmospherically corrected using LEDAPS (Ruefenacht 2016, Masek et al 2012) and cloudy pixels were removed using CFMask (USGS 2016). Finally, for all non-infrared Landsat bands (1, 2, 3, 4, 5 and 7) the median value of each pixel from the available images (minus the pixels excluded by the cloud mask) was found, and used as the final pixel values in the composite images (Ruefenacht 2016). The performance of median composites has been shown to be comparable to other compositing methods for use in ecological modeling (Ruefenacht 2016). L5 TM data were used in composites for years 2000 through 2011. L7 ETM+ data were used for 2012, as L5 was decommissioned in 2011. Because L7 used a similar sensor to that used in L5, reflectance data from these two Landsat missions are compatible. The 2012 L7 data were impacted by the failure of the Scan Line Correcter (SLC), which left regular 'no data' gaps in 22% of each scene collected by L7; this issue is referred to as 'SLC-off'. SLC-off-impacted (i.e., 'no data') pixels were excluded from the calculation of the median pixel values. The compositing took advantage of overlapping L7 scenes to fill in some of the missing pixel values. However, due to the large proportion of each image affected by SLC-off, a very small proportion of pixels in the final composite may have had no valid observation. While it is possible to interpolate values from surrounding valid pixels to fill in SLC-off data gaps, we chose not to do this to avoid the potential model error associated with creating synthetic pixel values. Additionally, many SLC-off areas filled in by overlapping adjacent scenes have values appreciably different than surrounding pixels, creating visible stripes in the final composite. Due to the relatively small number of L7 scenes available from which to create composites for 2012, any great phenological differences between images used to calculate medians for areas affected versus not affected by SLC-off are apparent. To validate the use of L7 composites in distribution models, we visually inspected images where the SLC-off pixels reduced the data available in the composite to ensure there were no apparent data gaps, and further verified the relative negligible impact of the SLC-off images by running a series of test models with and without the 2012 data, verifying that the model performance and relative weight of the predictor variables did not differ as a result of variance introduced by the SLC-off pixels.

For years 2013-2016, data from Landsat 8 Operational Land Imager (L8 OLI), which launched in 2013, were used to create composites to avoid SLC-off L7 images from this period. Because L8 uses a different sensor than previous Landsat missions, it was necessary to 'harmonize' the L8 reflectance data to make it compatible with that from L5 and L7. For each L8 image in the study area, using the closest least cloudy L7 image as a reference, pseudo invariant pixels between the two images were found, a reduced major axis regression model was developed band-by-band between each L8 image and L7 reference pair. Finally, the regression coefficient was applied to reflectance values of each band in each L8 image to harmonize them to the L7 values (Roy et al. 2016). Buyantuyev et al. (2007) suggested that because reduced major axis regression does not assume that the independent variable was measured without error (unlikely in the case of remote sensing of ecological systems), it may be preferred to ordinary least squares regression for harmonizing of remote sensing products.

For all non-infrared bands (1, 2, 3, 4, 5 and 7) we calculated means and standard deviation of reflectance values from the composite Landsat images at radii of 150, 500, 1,000, and 2,000 m using a moving window analysis in GIS to capture the influence of land cover at multiple scales relevant to bird habitat use and life-history (following Shirley et al. 2013). We associated mean and SD values to each point count location corresponding to the year the data at each location were collected.

Climate predictors consisted of monthly 30-year mean minimum and mean maximum precipitation (July and December, respectively); mean minimum and mean maximum temperature (December and July, respectively); mean precipitation, mean minimum and mean maximum temperature for June (corresponding to mid-avian breeding season for the Rogue Basin); and elevation. We obtained all climate variables from interpolated 800 m rasters derived from years 1981 to 2010 (PRISM Climate Group, https://prism.oregonstate.edu/). We obtained elevation for all survey locations from a 30 m digital elevation model (U.S. Geological Survey 2016).

Species distribution model development

We used boosted regression trees (BRT) to develop a series of individual predictive species distribution models for bird species within the study area (Elith et al. 2008). BRTs have been increasingly used and tested in ecological applications (Elith and Graham 2009; Benito et al. 2013), and are powerful in that they model both non-linear relationships and interactions among predictors, can be used with a variety of response distribution types, and allow for a large number of predictor variables without overfitting. We fit all BRT models using the package 'dismo' in R (R Core Team 2015), with additional source code from Elith et al (2008). For first runs, the user-controlled model parameters of 'learning rate' (lr), 'tree complexity' (tc), and 'bag fraction', were those suggested in Elith et al. (2008). When necessary, lr was adjusted slightly for some species to optimize the number of trees produced (with a goal of at least 1000 trees, as recommended by Elith et al 2008.

We evaluated the predictive success for each model by examining the area under the receiver operator curve (AUC) created by the internal ten-fold cross validation procedure in package 'dismo' (Elith et al 2008). AUC >0.70 is considered the threshold for good discriminatory power; >0.80 is considered excellent, and ~0.70 is considered adequate (Lobo et al. 2008; Elith and Graham 2009; Hosmer and Lemeshow 2005). All of our species models performed at or above AUC 0.7 with the exception of those for Bullock's Oriole, Downy Woodpecker, Northern Flicker, and Pileated Woodpecker.

In a separate analysis, we used presence data from independent point count surveys to evaluate the predictive ability of the SDMs (Gillespie et al. 2018). We found mixed results from this analysis; for example, Hermit Thrush and Lazuli Bunting both had relatively high AUC scores in the independent model evaluation (0.742 and 0.841 respectively), while Nashville Warbler and Rufous Hummingbird had low evaluation AUC scores (0.338 and 0.321 respectively). These results may suggest 1) that our modeling approach may have been more successful in correctly predicting the presence of some species than others, or 2) that for some species the number of detections in the independent evaluation dataset to accurately assess model performance.

Literature Cited

Alexander, J. D. 2011. Integrating Partners in Flight Bird Conservation and Priority Land Management Objectives. In Informing Ecosystem Management: Science and Process for Landbird Conservation in the Western United States. Biological Technical Publication FWS/BTP-R1014-2011, edited by J. L. Stephens, K. Kreitinger, C. J. Ralph, and M. T. Green, 3–5. Portland, OR: U.S. Department of Interior, Fish and Wildlife Service. http://library.fws.gov/BTP/information-ecosystem-management-2011.pdf.

Alexander, J. D., C. J. Ralph, K. Hollinger, and B. Hogoboom. 2004. Using a Wide-Scale Landbird Monitoring Network to Determine Landbird Distribution and Productivity in the Klamath Bioregion. In Proceedings of the Second Conference on Klamath-Siskiyou Ecology., edited by K. L. Mergenthaler, J. E. Williams, and J. Jules, 33–41. Cave Junction, OR: Siskiyou Field Institute.

Altman, B. 2000. Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington. Oregon-Washington Partners in Flight and American Bird Conservancy.

Altman, B., and J. D. Alexander. 2012. Habitat Conservation for Landbirds in Coniferous Forests of Western Oregon and Washington. Version 2.0. Ashland, Oregon: Oregon- Washington Partners in Flight, American Bird Conservancy and Klamath Bird Observatory. http://www.orwapif.org/.

Buyantuyev, A., J. Wu, and C. Gries. 2007. Estimating Vegetation Cover in an Urban Environment Based on Landsat ETM+ Imagery: A Case Study in Phoenix, USA. International Journal of Remote Sensing 28 (2): 269–91. https://doi.org/10.1080/01431160600658149.

Benito, Blas M., Luis Cayuela, and Fabio S. Albuquerque. 2013. The Impact of Modelling Choices in the Predictive Performance of Richness Maps Derived from Species- Distribution Models: Guidelines to Build Better Diversity Models. Methods in Ecology and Evolution 4 (4): 327–35. https://doi.org/10.1111/2041-210x.12022.

Betts, M. G., L. Fahrig, A. S. Hadley, K. E. Halstead, J. Bowman, W. D. Robinson, J. A. Wiens, and D. B. Lindenmayer. 2014. A Species-Centered Approach for Uncovering Generalities in Organism Responses to Habitat Loss and Fragmentation. Ecography 7: 517–527.

Elith, J., J. R. Leathwick, and T. Hastie. 2008. A Working Guide to Boosted Regression Trees. Journal of Animal Ecology 77 (4): 802–13. https://doi.org/10.1111/j.1365- 2656.2008.01390.x.

Elith, Jane, and Catherine H. Graham. 2009. Do They? How Do They? WHY Do They Differ? On Finding Reasons for Differing Performances of Species Distribution Models. Ecography 32 (1): 66–77. https://doi.org/10.1111/j.1600-0587.2008.05505.x.

Gillespie, Caitlyn R., John D. Alexander, and Jaime L. Stephens. 2018. Evaluating region-wide species distribution models using independent data collected on private timberlands in the Klamath Mountains Ecoregion: A report to the American Bird Conservancy, Sustainable Forestry Initiative (SFI), and SFI Partners.

Halstead, Katherine E., John D. Alexander, Adam S. Hadley, Jaime L. Stephens, Zhiqiang Yang, Matthew G. Betts. 2019. Using a species-centered approach to predict bird community responses to habitat fragmentation. Landscape Ecology 34:1919-1935. https://doi.org/10.1007/s10980-019-00860-5.

Hosmer, David W., and Stanley Lemeshow. 2005. Logistic Regression for Matched Case-Control Studies. Applied Logistic Regression, Second Edition, 223–259.

Lobo, Jorge M., Alberto Jiménez-Valverde, and Raimundo Real. 2008. AUC: A Misleading Measure of the Performance of Predictive Distribution Models. Global Ecology and Biogeography 17 (2): 145–51. https://doi.org/10.1111/j.1466-8238.2007.00358.x.

Masek, J. G., E. F. Vermote, N. Saleous, R. Wolfe, F. G. Hall, K. F. Huemmrich, F. Gao, J. Kutler, and T. K. Lim. 2012. LEDAPS Landsat Calibration, Reflectance, Atmospheric Correction Preprocessing Code. ORNL DAAC.

PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created 4 Feb 2004.

R Core Team. 2015. R: A Language and Environment for Statistical Computing (version 3.2.2). Vienna, Austria: R Foundation for Statistical Computing. www.R-project.org/.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. Handbook of Field Methods for Monitoring Landbirds. General Technical Report PSW-GTR-144. Albany, California: Pacific Southwest Research Station, U.S. Department of Agriculture, Forest Service.

Roy, D. P., V. Kovalskyy, H. K. Zhang, E. F. Vermote, L. Yan, S. S. Kumar, and A. Egorov. 2016. Characterization of Landsat-7 to Landsat-8 Reflective Wavelength and Normalized Difference Vegetation Index Continuity. Remote Sensing of Environment, Landsat 8 Science Results, 185 (November): 57–70. https://doi.org/10.1016/j.rse.2015.12.024.

Ruefenacht, Bonnie. 2016. Comparison of Three Landsat TM Compositing Methods: A Case Study Using Modeled Tree Canopy Cover. Photogrammetric Engineering & Remote Sensing 82 (3): 199–211. https://doi.org/10.14358/PERS.82.3.199.

Shirley, S. M., Z. Yang, R. A. Hutchinson, J. D. Alexander, K. McGarigal, and M. G. Betts. 2013. Species Distribution Modelling for the People: Unclassified Landsat TM Imagery Predicts Bird Occurrence at Fine Resolutions. Diversity and Distributions 19 (7): 855–66.

Stephens, J. L., S. R. Morhen, J. D. Alexander, D. A. Sarr, and K. M. Irvine. 2010. Klamath Network Landbird Monitoring Protocol. KBO-2010-0033. Fort Collins, Colorado: U.S. Department of Interior, National Park Service, Natural Resource Report NPS/KLMN/NRR- 2010/187.

U.S. Geological Survey. 2016. USGS 1 arc second (30 m) DEM. https://apps.nationalmap.gov/downloader/#/

White, J. C., M. A. Wulder, G. W. Hobart, J. E. Luther, T. Hermosilla, P. Griffiths, N. C. Coops, et al. 2014. Pixel-Based Image Compositing for Large-Area Dense Time Series Applications and Science. Canadian Journal of Remote Sensing 40 (3): 192–212. https://doi.org/10.1080/07038992.2014.945827.

Table 1. Summary of within-model cross-validation results for all species-centered habitat models, in terms of AUC score.

Species	**AUC cross-validation score**
Acorn Woodpecker	0.858
American Robin	0.711
Ash-throated Flycatcher	0.919
Bewick's Wren	0.899
Black headed Grosbeak	0.752
Black-capped Chickadee	0.863
Black-throated Gray Warbler	0.838
Blue-Gray Gnatcatcher	0.922
Brown Creeper	0.748
Brown-headed Cowbird	0.812
Bullock's Oriole	0.308
Bushtit	0.709
California Towhee	0.905

Species	AUC cross-validation score
Cassin’s Vireo	0.725
Chestnut-backed Chickadee	0.791
Chipping Sparrow	0.877
Dark-eyed Junco	0.767
Downy Woodpecker	0.691
Dusky Flycatcher	0.874
Fox Sparrow	0.951
Golden crowned Kinglet	0.886
Hammond’s Flycatcher	0.886
Hermit Thrush	0.888
Hermit Warbler	0.894
House Wren	0.828
Lazuli Bunting	0.84
Lesser Goldfinch	0.857
Magnolia Warbler	0.773
Mountain Quail	0.805
Nashville Warbler	0.818
Northern Flicker	0.633
Oak Titmouse	0.938
Olive-sided Flycatcher	0.835
Orange-crowned Warbler	0.851
Pacific slope Flycatcher	0.787
Pacific Wren	0.847
Pileated Woodpecker	0.681
Purple Finch	0.741
Red breasted Nuthatch	0.809
Rufus Hummingbird	0.807
Song Sparrow	0.968
Spotted Towhee	0.773
Steller’s Jay	0.705
Swainson’s Thrush	0.871
Tree Swallow	0.952
Warbling Vireo	0.767
Western Scrub Jay	0.87
Western Tanager	0.735
Western Wood pewee	0.821
White-breasted Nuthatch	0.849
Wilson’s Warbler	0.78
Wrentit	0.835
Yellow Warbler	0.964
Yellow-breasted Chat	0.949
Yellow-rumped warbler	0.851

Appendix II: Relative importance of model predictors

Fig 1. Mean (±SE) relative influence (%) of Landsat (grouped by band number) and environmental predictors across all BRT models for 30 species in the Bird's Eye Habitat tool.

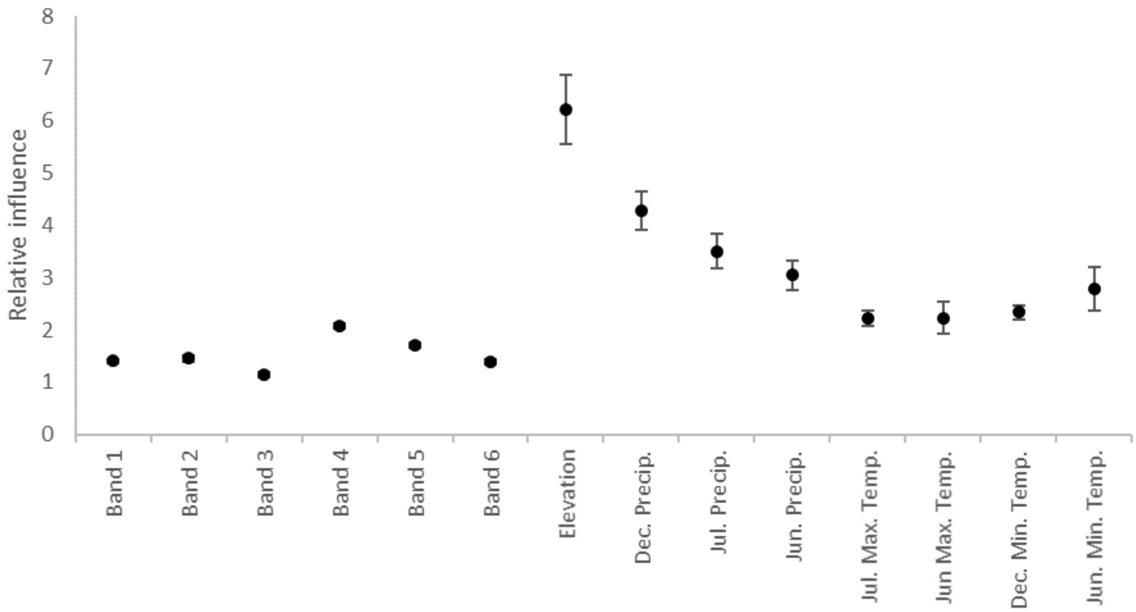


Fig 2. Mean (±SE) of relative of Landsat predictors grouped by scale across all BRT models for 30 species in the Bird's Eye Habitat tool.

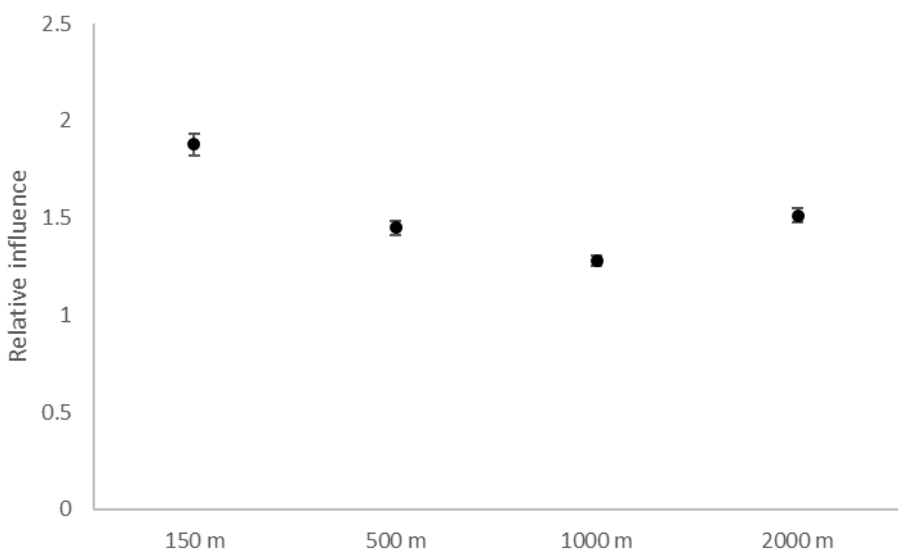
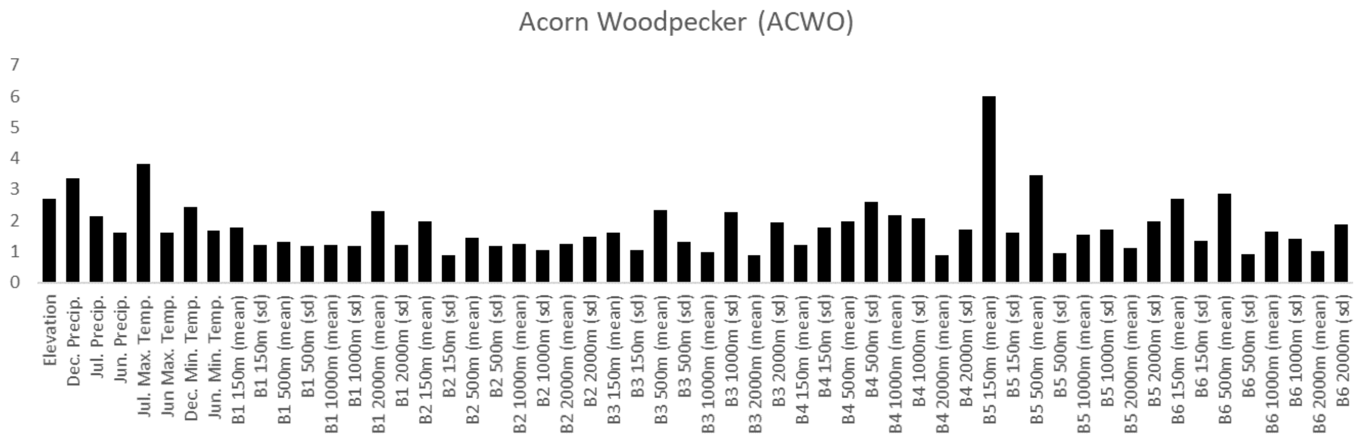
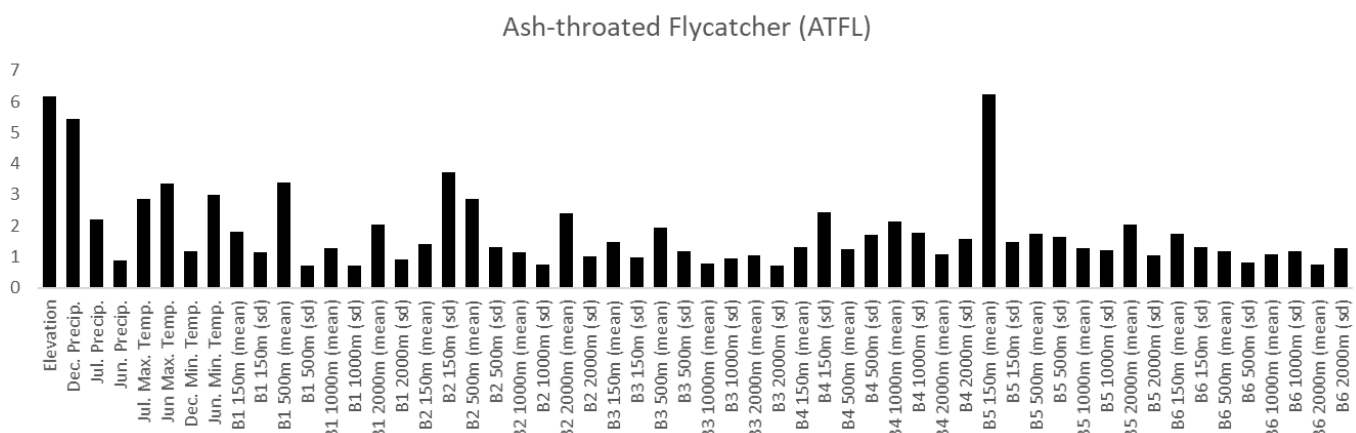
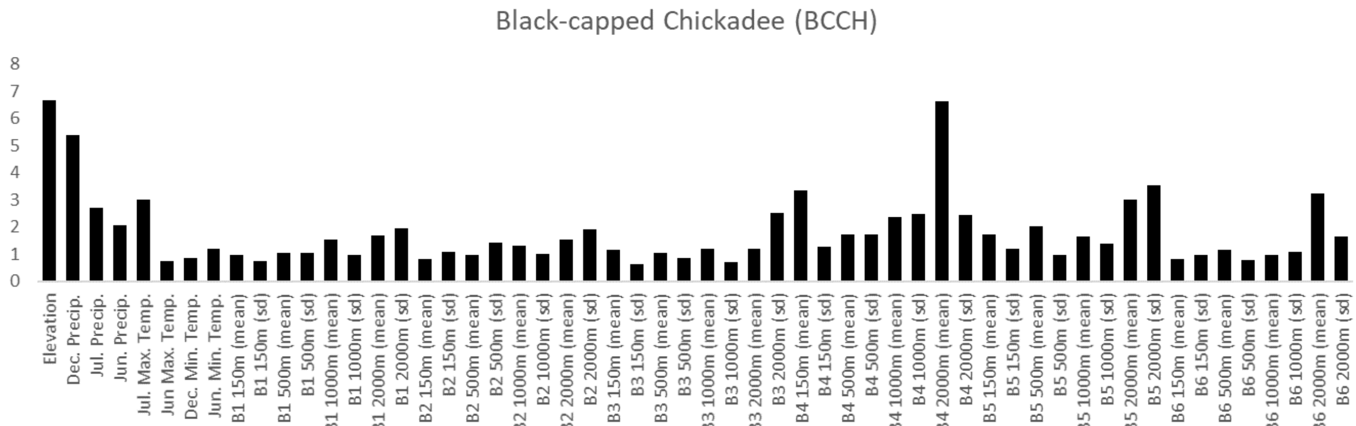
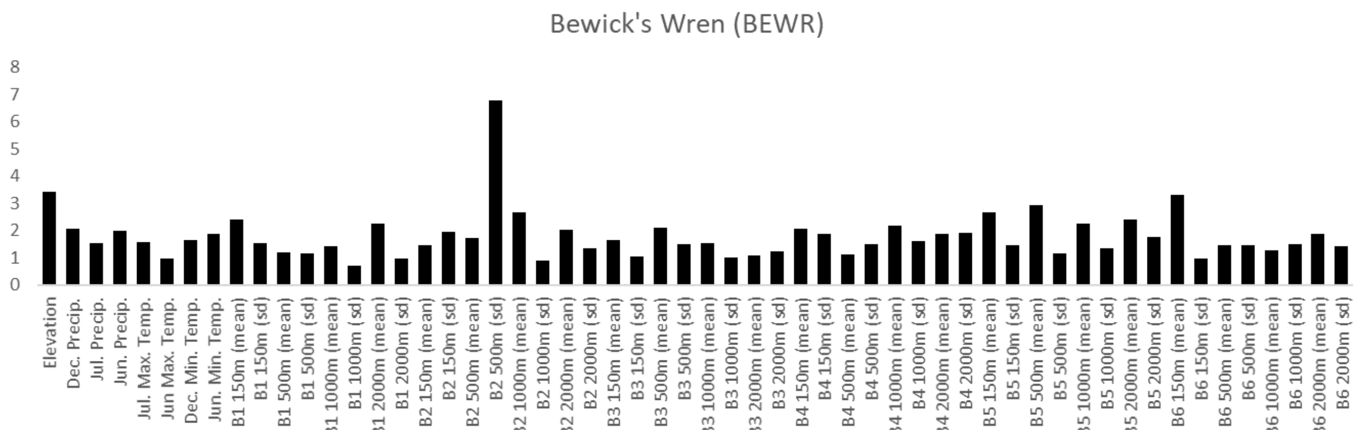


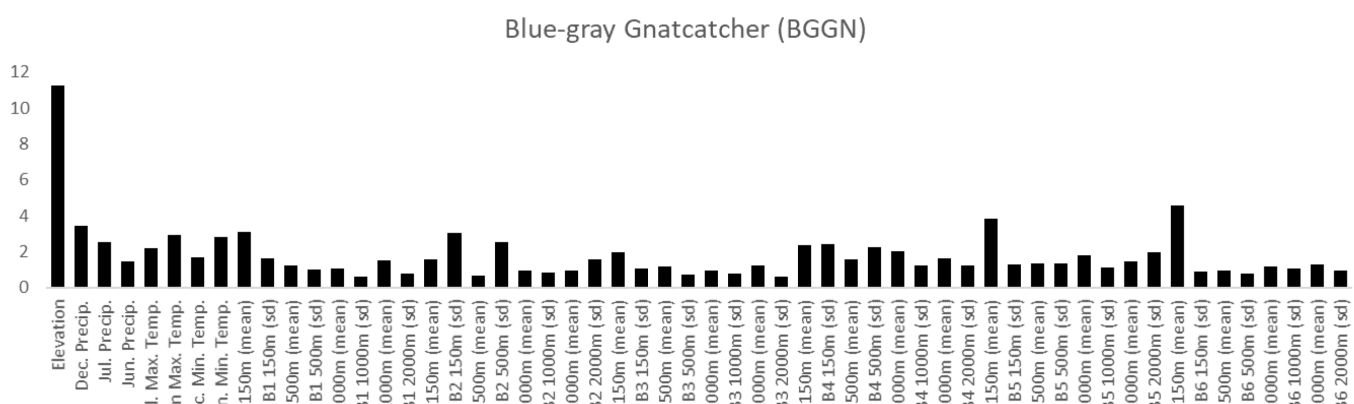
Fig 3. Relative influence (%) of all Landsat and environmental predictors in BRT models for each of 30 species used in the Bird's Eye Habitat Tool.

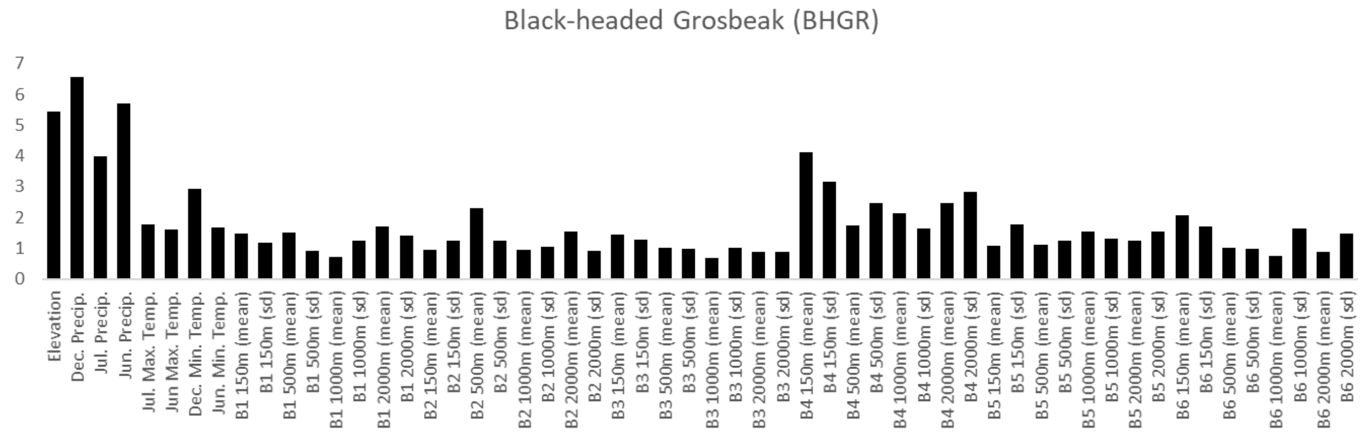


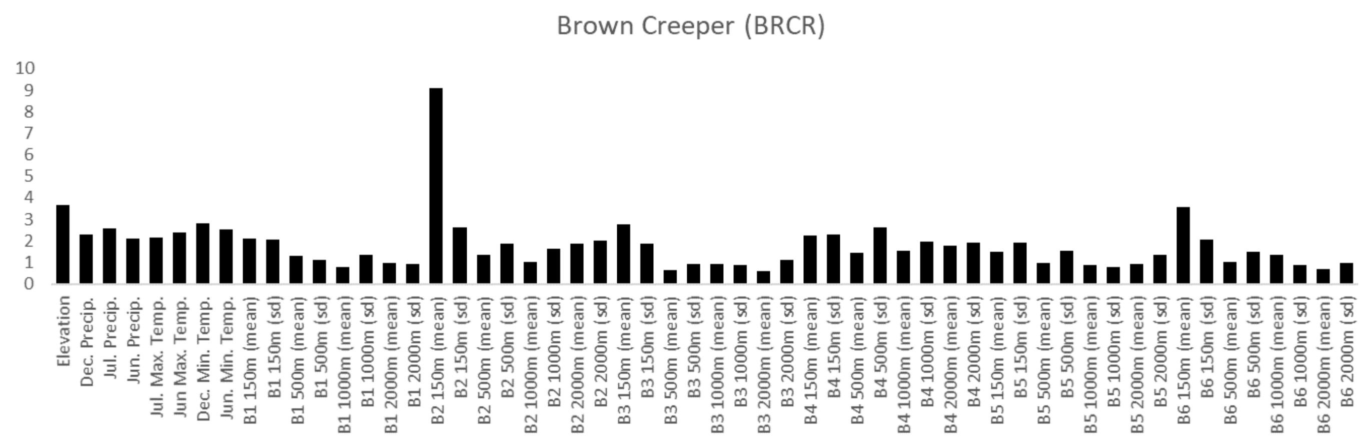


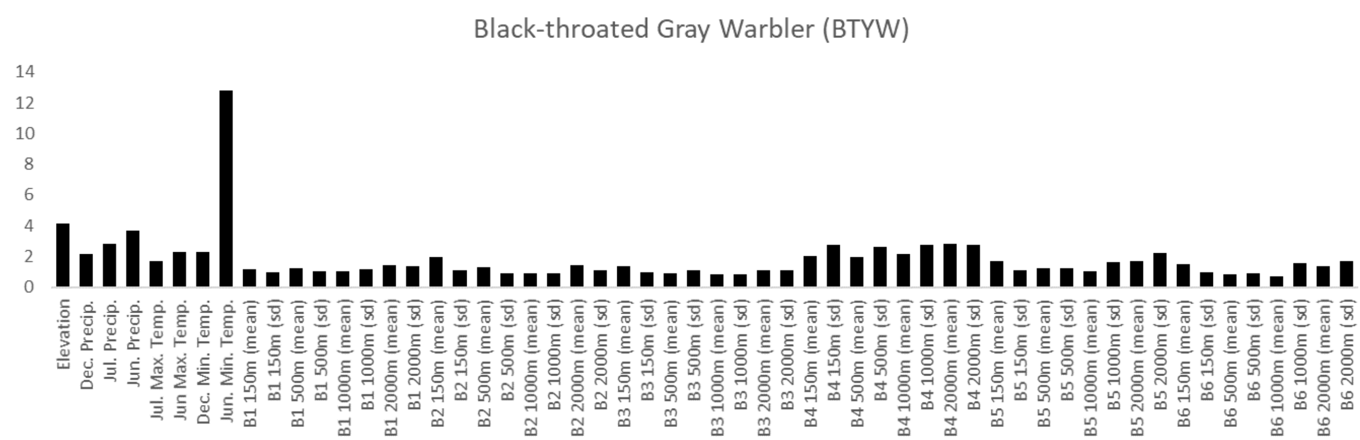

Black-capped Chickadee (BCCH)
0
1
2
3
4
5
6
7
8
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Bewick's Wren (BEWR)
0
1
2
3
4
5
6
7
8
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

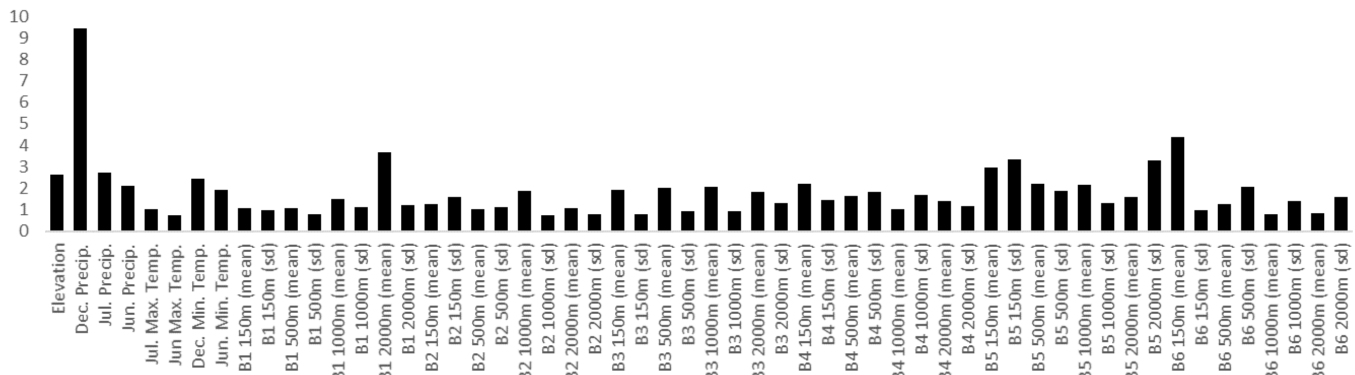

Blue-gray Gnatcatcher (BGGN)
0
2
4
6
8
10
12
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Black-headed Grosbeak (BHGR)
7
6
5
4
3
2
1
0
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

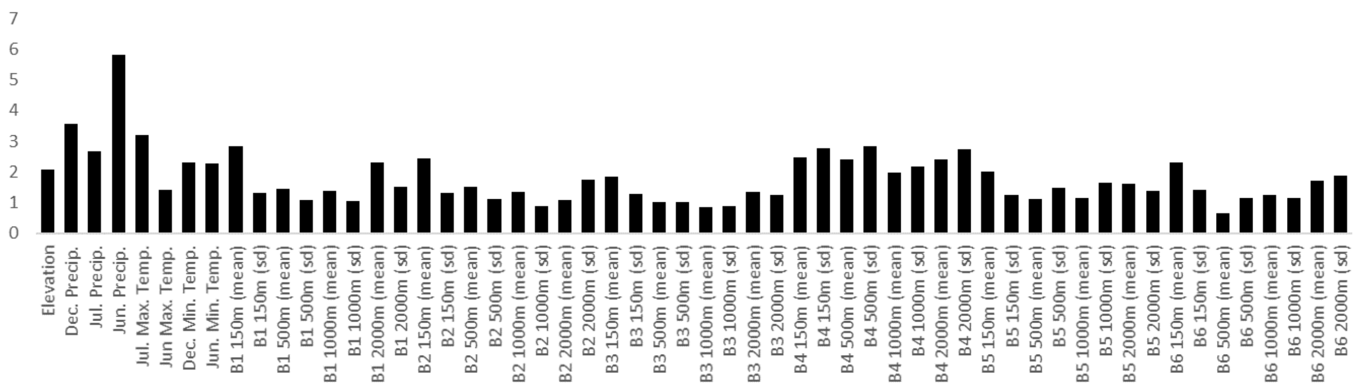

Brown Creeper (BRCR)
10
9
8
7
6
5
4
3
2
1
0
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Black-throated Gray Warbler (BTYW)
14
12
10
8
6
4
2
0
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

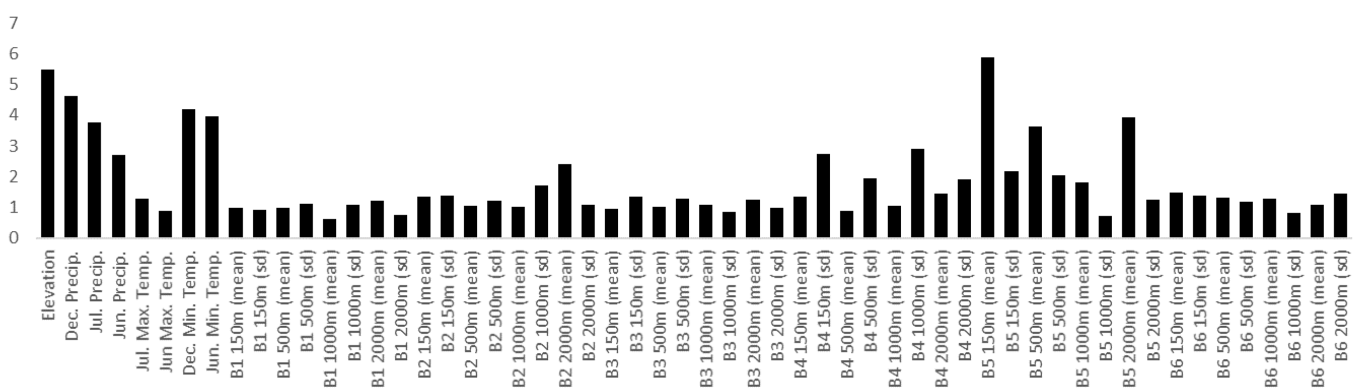
California Towhee (CALT)

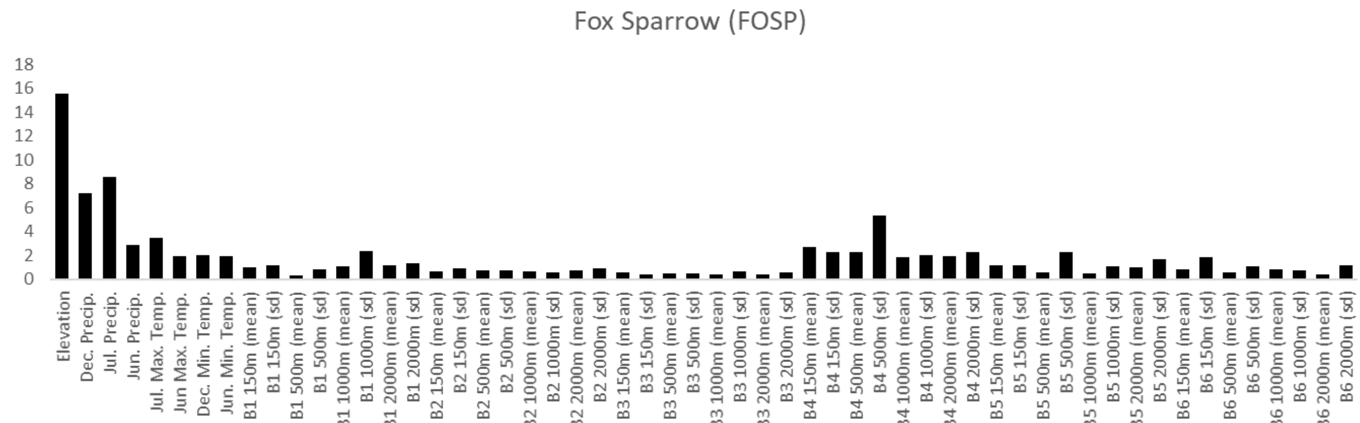


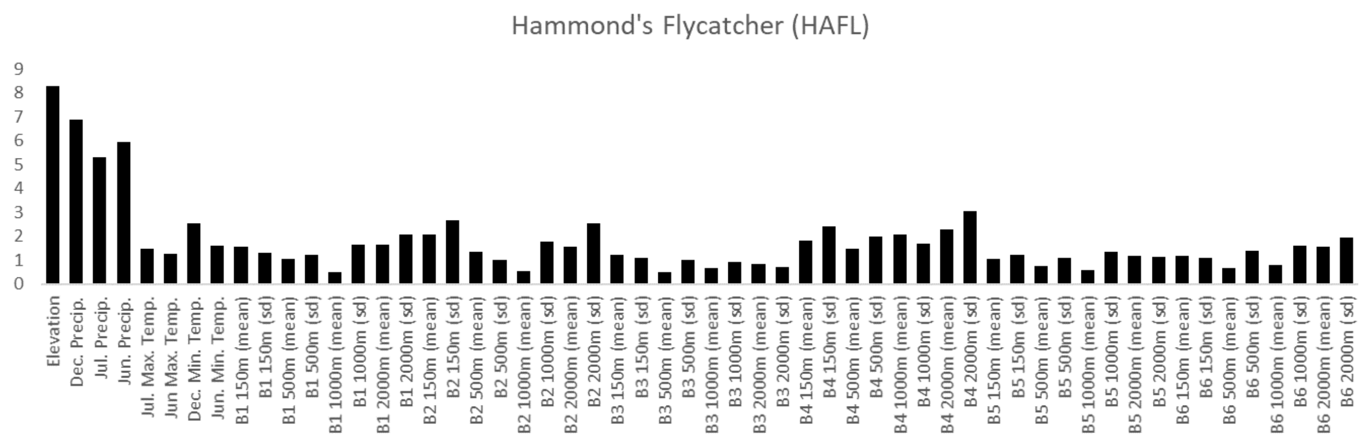
Cassin's Vireo (CAVI)

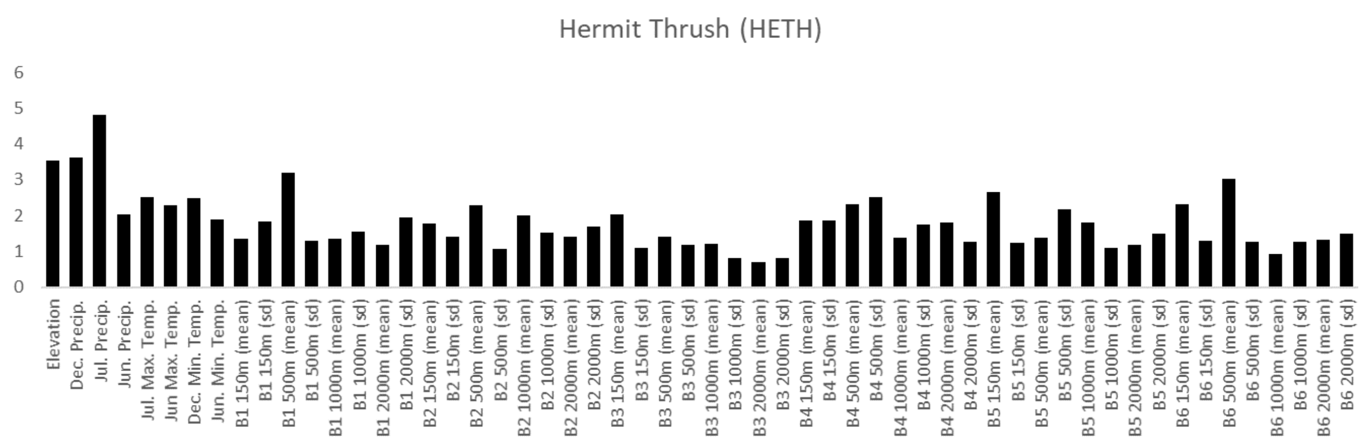


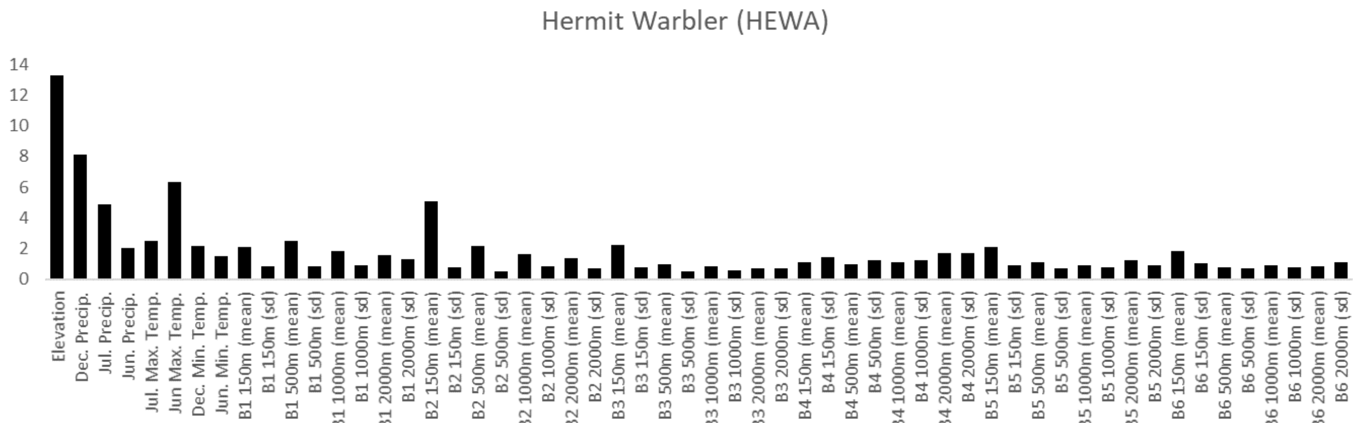
Chipping Sparrow (CHSP)

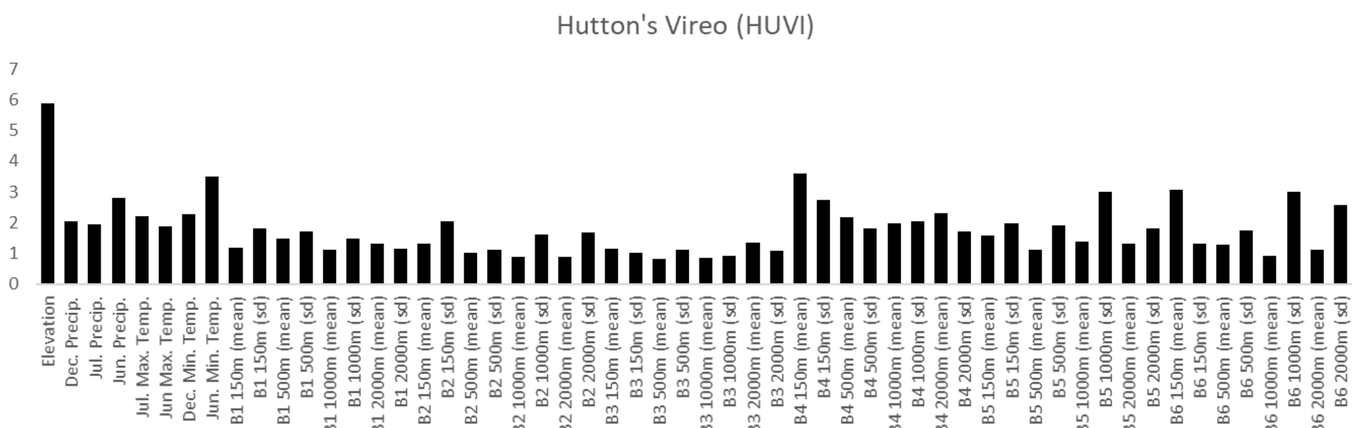


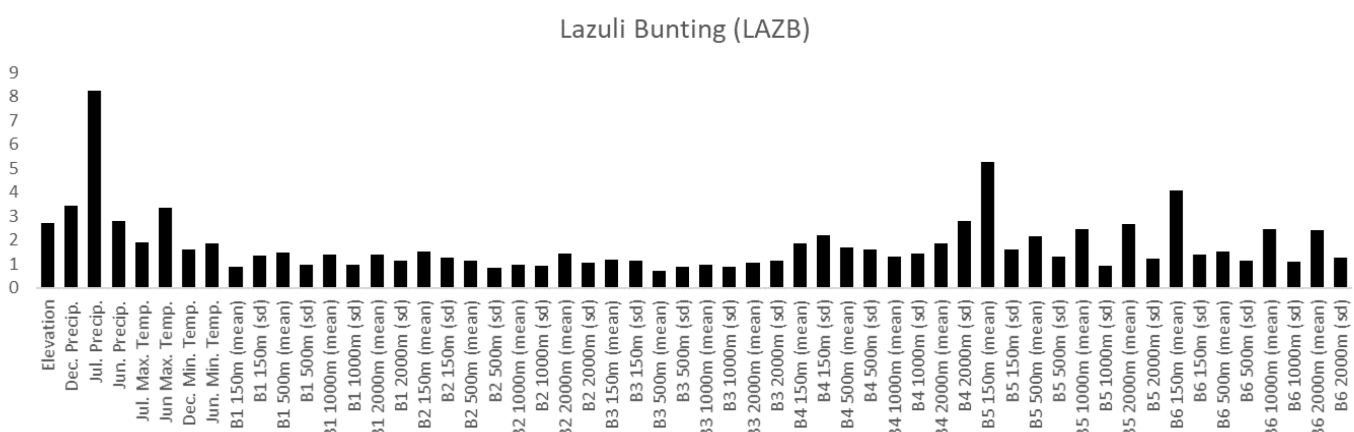

Fox Sparrow (FOSP)
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

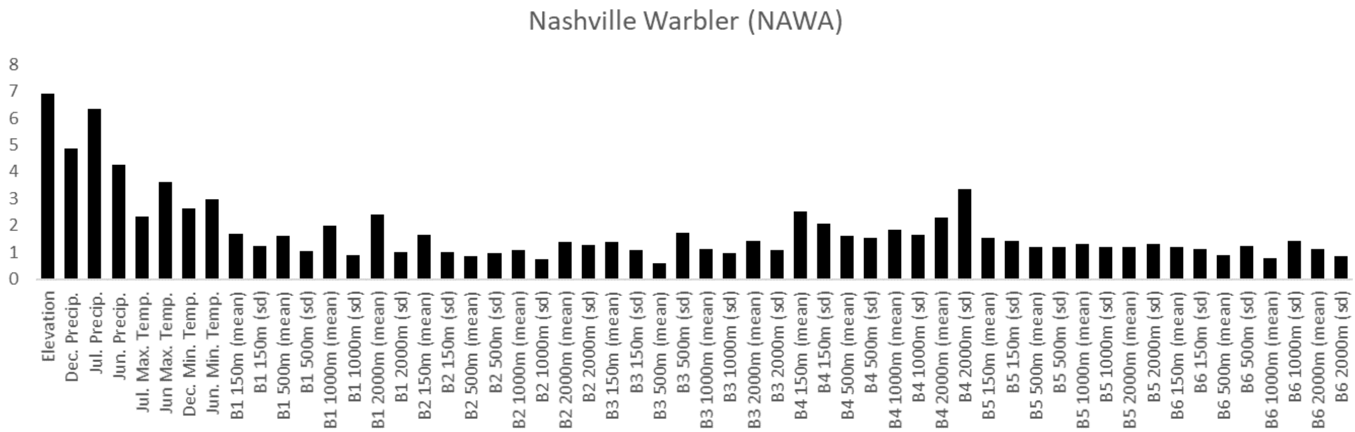

Hammond's Flycatcher (HAFL)
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

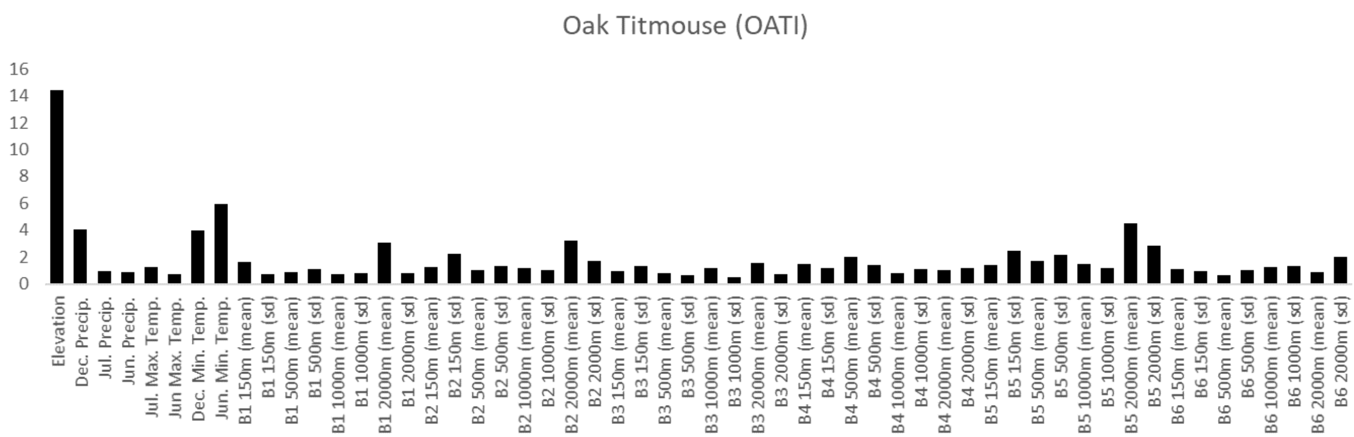

Hermit Thrush (HETH)
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

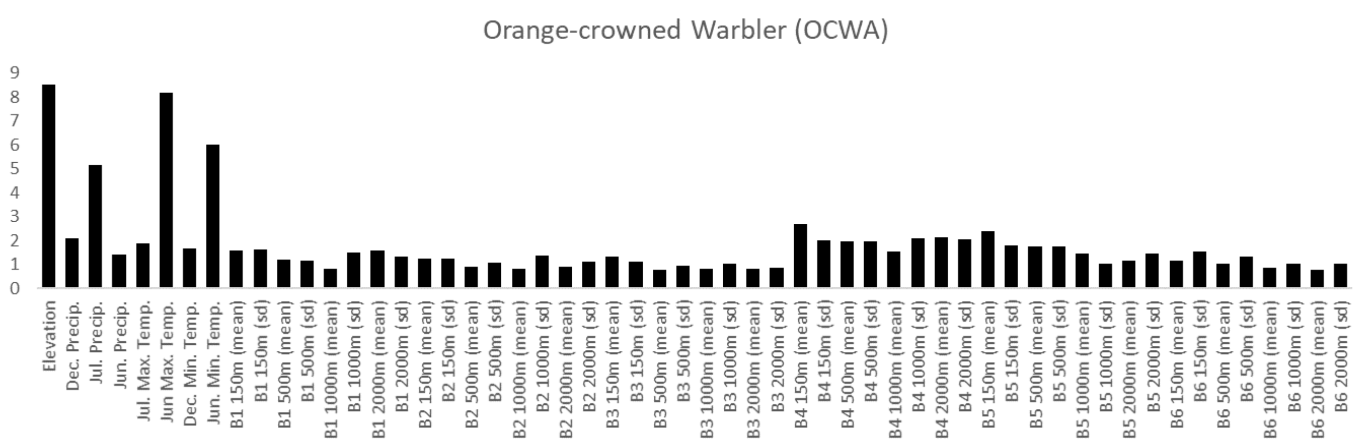

Hermit Warbler (HEWA)
0
2
4
6
8
10
12
14
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

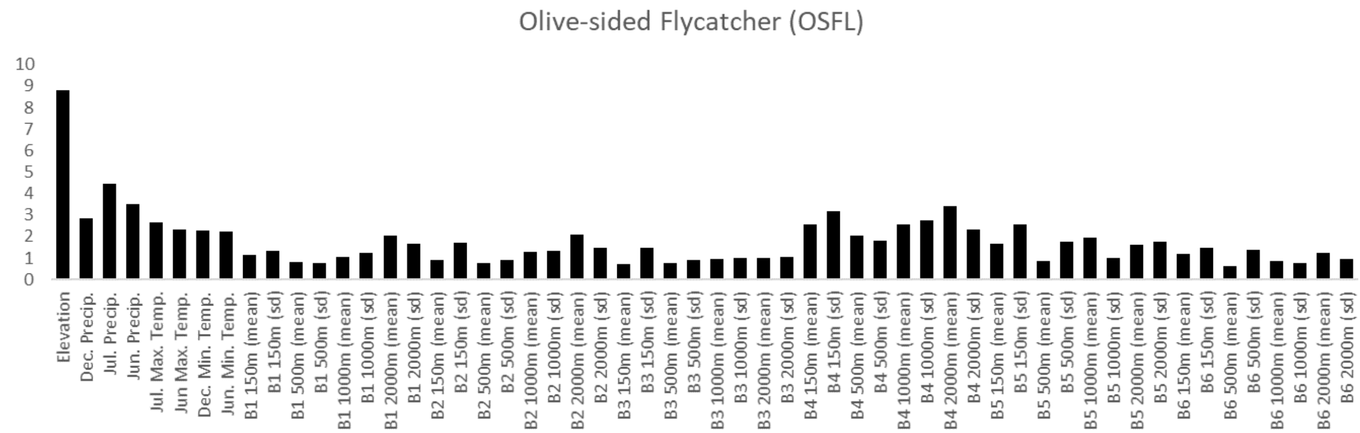

Hutton's Vireo (HUVI)
0
1
2
3
4
5
6
7
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

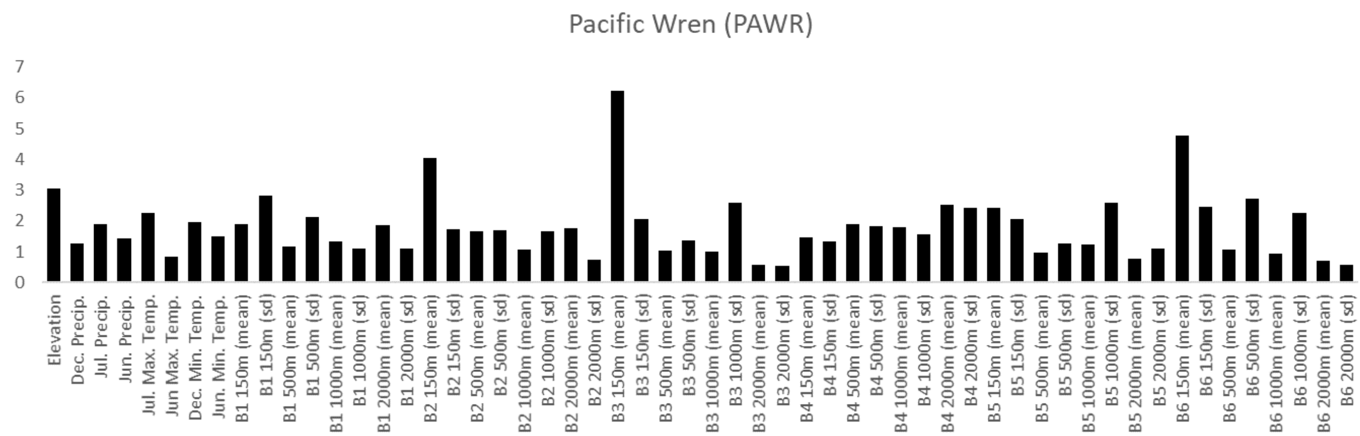

Lazuli Bunting (LAZB)
0
1
2
3
4
5
6
7
8
9
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

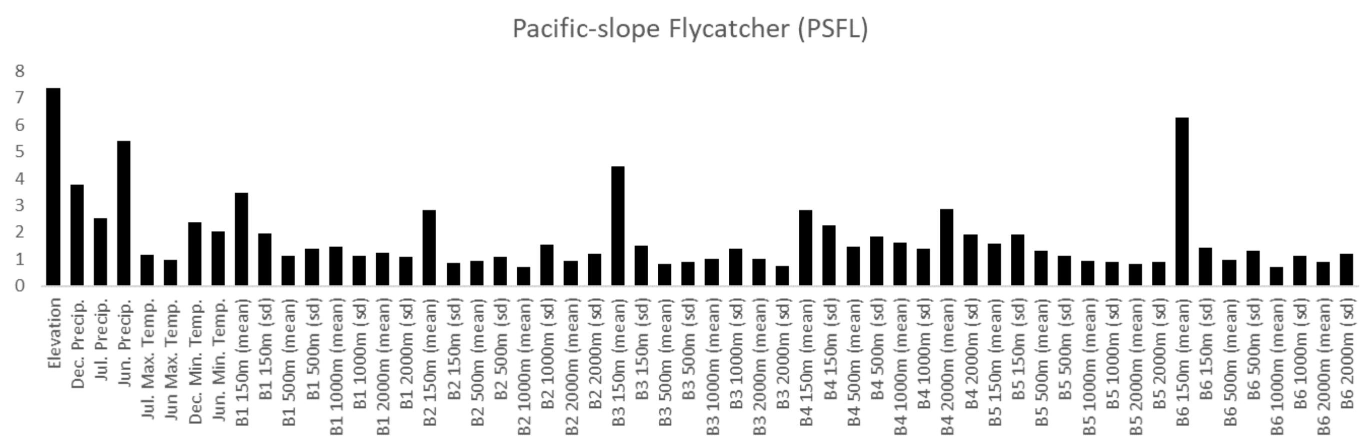

Nashville Warbler (NAWA)
0
1
2
3
4
5
6
7
8
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

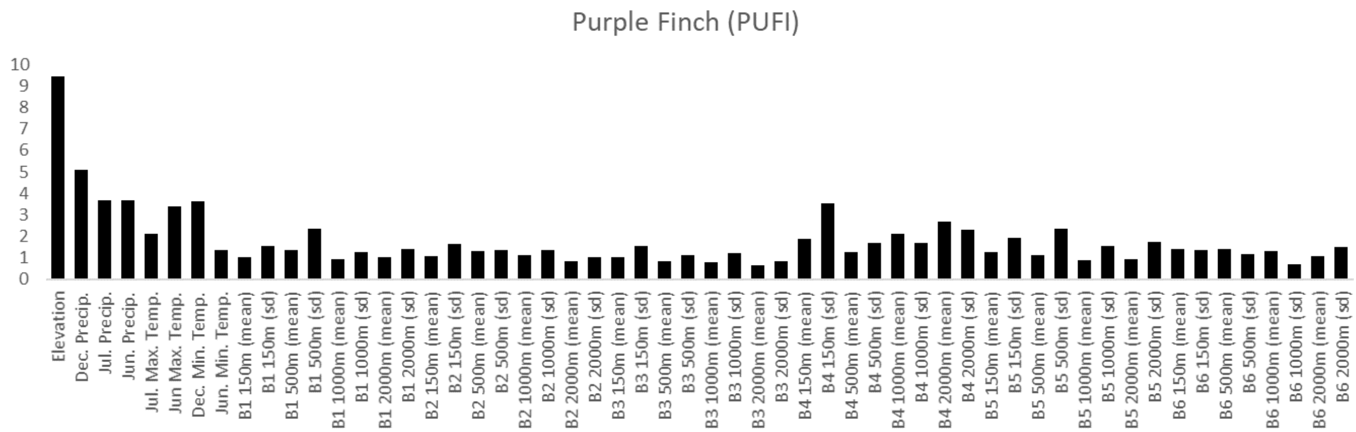

Oak Titmouse (OATI)
0
2
4
6
8
10
12
14
16
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

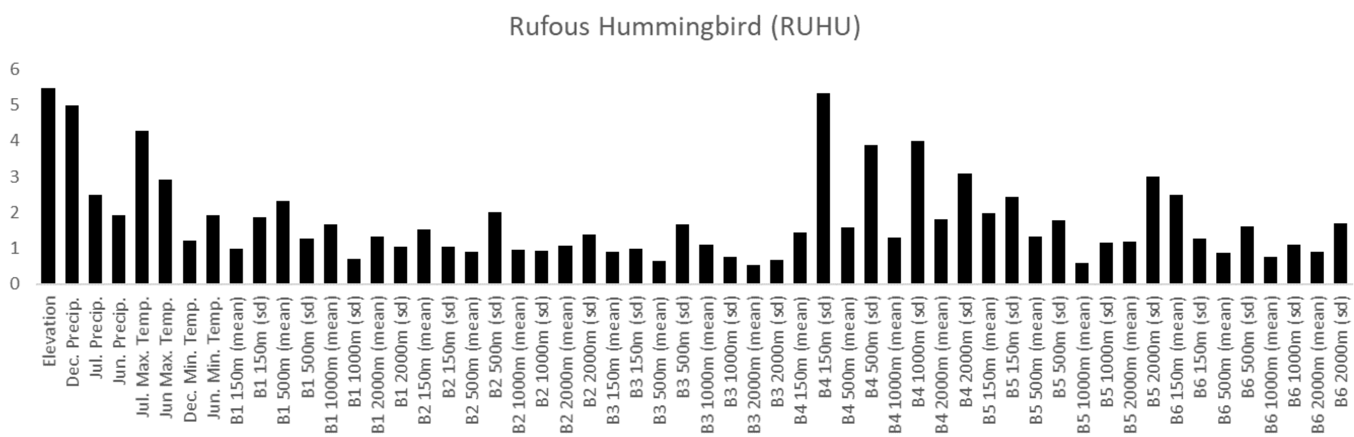

Orange-crowned Warbler (OCWA)
0
1
2
3
4
5
6
7
8
9
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

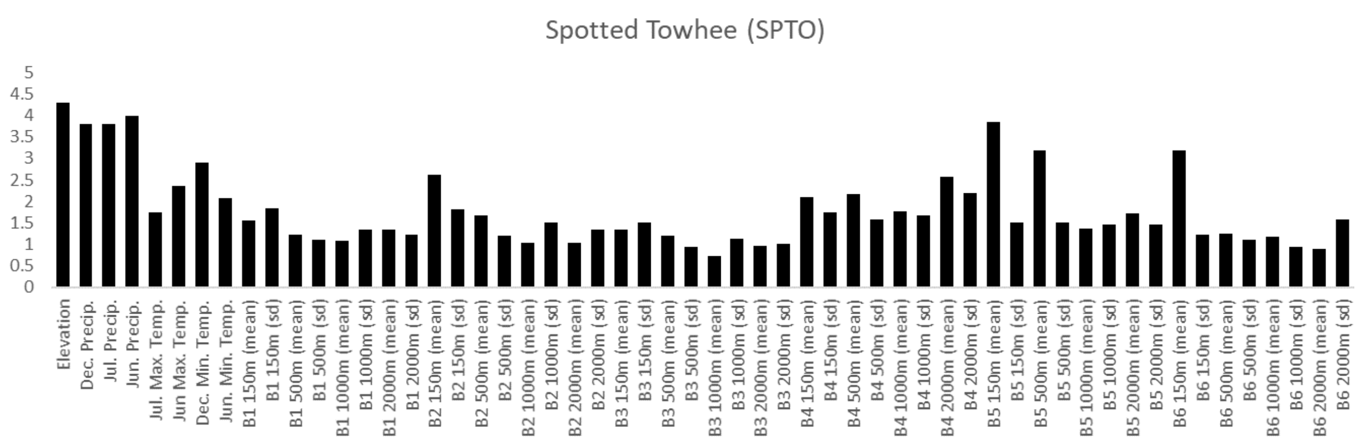

Olive-sided Flycatcher (OSFL)
0
1
2
3
4
5
6
7
8
9
10
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

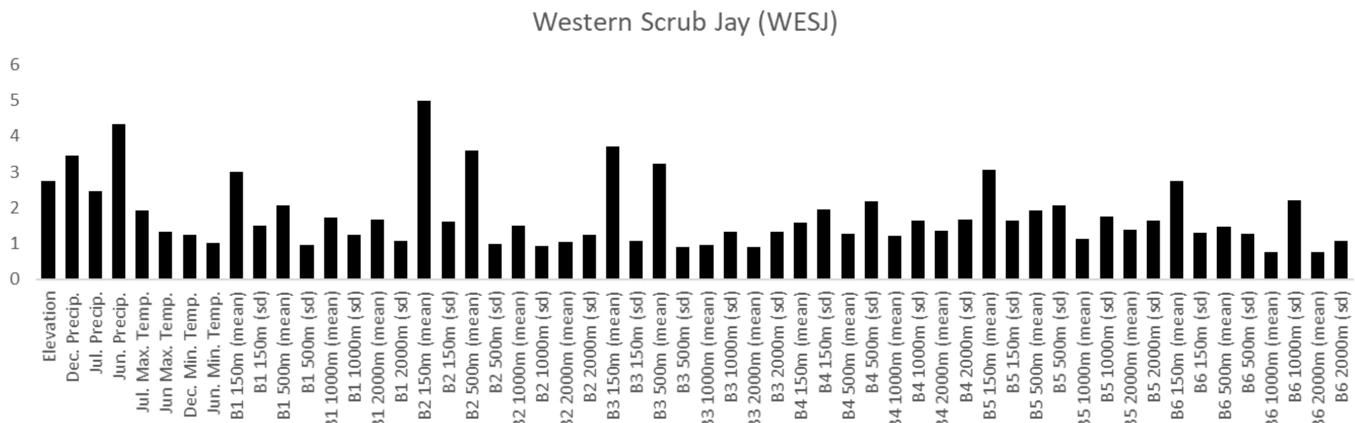

Pacific Wren (PAWR)
0
1
2
3
4
5
6
7
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

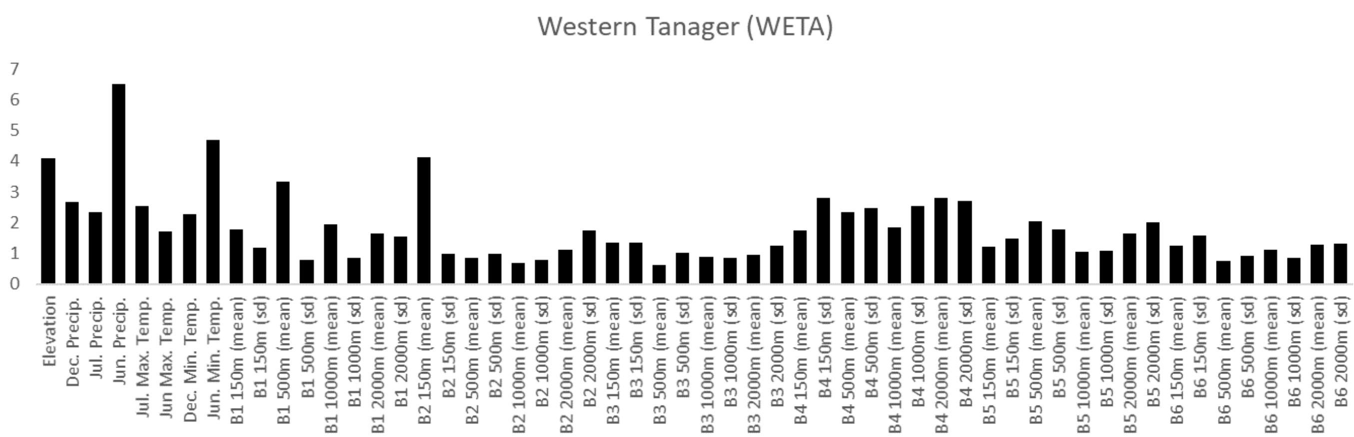

Pacific-slope Flycatcher (PSFL)
0
1
2
3
4
5
6
7
8
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

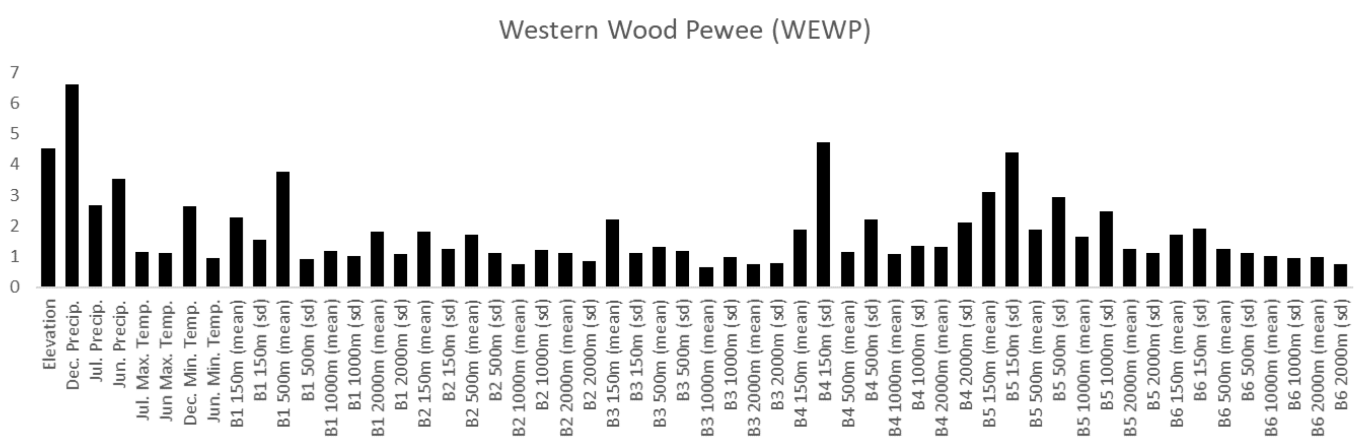

Purple Finch (PUFI)
10
9
8
7
6
5
4
3
2
1
0
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)

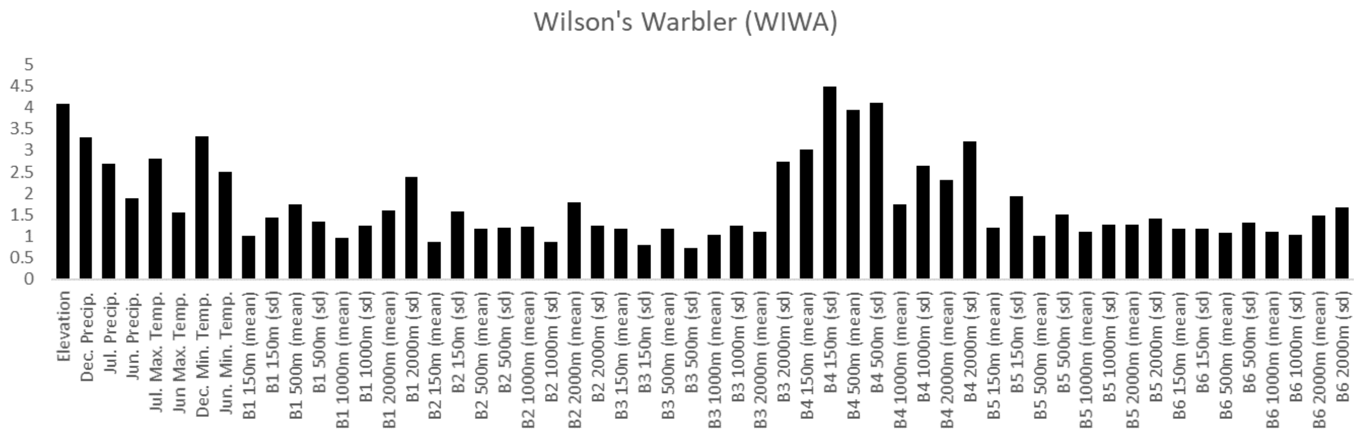

Rufous Hummingbird (RUHU)
6
5
4
3
2
1
0
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Spotted Towhee (SPTO)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Western Scrub Jay (WESJ)
0
1
2
3
4
5
6
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Western Tanager (WETA)
0
1
2
3
4
5
6
7
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)


Western Wood Pewee (WEWP)
0
1
2
3
4
5
6
7
Elevation
Dec. Precip.
Jul. Precip.
Jun. Precip.
Jul. Max. Temp.
Jun Max. Temp.
Dec. Min. Temp.
Jun. Min. Temp.
B1 150m (mean)
B1 150m (sd)
B1 500m (mean)
B1 500m (sd)
B1 1000m (mean)
B1 1000m (sd)
B1 2000m (mean)
B1 2000m (sd)
B2 150m (mean)
B2 150m (sd)
B2 500m (mean)
B2 500m (sd)
B2 1000m (mean)
B2 1000m (sd)
B2 2000m (mean)
B2 2000m (sd)
B3 150m (mean)
B3 150m (sd)
B3 500m (mean)
B3 500m (sd)
B3 1000m (mean)
B3 1000m (sd)
B3 2000m (mean)
B3 2000m (sd)
B4 150m (mean)
B4 150m (sd)
B4 500m (mean)
B4 500m (sd)
B4 1000m (mean)
B4 1000m (sd)
B4 2000m (mean)
B4 2000m (sd)
B5 150m (mean)
B5 150m (sd)
B5 500m (mean)
B5 500m (sd)
B5 1000m (mean)
B5 1000m (sd)
B5 2000m (mean)
B5 2000m (sd)
B6 150m (mean)
B6 150m (sd)
B6 500m (mean)
B6 500m (sd)
B6 1000m (mean)
B6 1000m (sd)
B6 2000m (mean)
B6 2000m (sd)



Appendix III: Use case from Bear Country Project, Klamath National Forest

From Bear Country Prescription Matrix Report:

"The overall goal of the prescriptions for the project area are focused on fire risk reduction for communities and habitat. Wildfire is single most damaging agent which threatens both human and animal communities, and current conditions would likely trigger a high severity burn. As such, the primary considerations for this area revolve around wildfire mitigation. Some other considerations exist due to cultural use of some oak and hardwood species and the desires of the public, including: Retain and promote hardwoods where operations allow – especially culturally important species such as black oak and tanoak; Retain all white pine where operations allow. Populations are stressed due to white pine blister rust; Maintain shade intolerant species in the stand over shade tolerant species. These species are harder to maintain without creating regeneration gaps and are critical for stand diversity."

Note: An asterisk (*) indicates a "Priority" bird species according to Oregon-Washington Partners in Flight Habitat Conservation for Landbirds in the Coniferous Forests of Western Oregon and Washington (OR/WA PIF Coniferous Forest Plan) or Land Manager's Guide to Bird Habitat and Populations in Oak Ecosystems of the Pacific Northwest

- Watershed analysis: Provides context for overall project goals and prescriptions, as well as context for comparison and interpretation of smaller-scale HUC12, Section, and Quarter section analyses Habitat Indices & Species Habitat Values
    - Zoom in one of two ways
        - T10N R08E Quarter-section 21NW (is in the target watershed)
        - Klamath Basin, Salmon Sub-basin, Methodist Creek-South Fork Salmon River Sub-watershed
    - Examine Habitat Index tab values:
        - Early Seral
            - Lower in *Recently Disturbed*
            - Intermediate-to-high in *Post-disturbance* & *Areas Managed for Wildlife*
        - Late Seral

        - Low-to-intermediate in both *Conifer Dominated* and *Conifer with Hardwood*
    - Oak
        - Low in *Oak Savannah* and *Oak Woodland*
        - Intermediate -to-high in *Oak Chaparral*
        - High in *Oak Conifer*
  - Examine Habitat Values tab:
    - Early Seral
        - LAZB, NAWA, WETA* highest
        - RUHU*, WIWA, HAFL very low or absent
    - Late Seral
        - PSFL*, BHGR* highest
        - RUHU*, WIWA, HAFL very low or absent
    - Oak
        - LAZB, SPTO*, NAWA, WETA*, BHGR* highest
        - A number of species (including CHSP*, BGGN*, ACWO*, WBNU*) are very low or absent particularly in the *Oak Savannah*, *Oak Woodland*, and *Oak Chaparral* categories. Oak values are relatively low overall.
  - Based on SDMs, the Methodist Creek Watershed appears to contain a diverse mix of vegetation types, including a relatively even mix of early seral and late seral types, some oak chaparral, and a relatively high amount of oak conifer.
  - See Attachment 1 (Watershed Report) for complete tool output
- <u>Area 1 (Plantation Stand) analysis</u>: Pine-dominated plantation with a history of stand-replacing fire (1979 & 1987). Goal is to move stand toward late seral conditions, by facilitating increased dominant tree growth and improving vertical structure and other late seral characteristics over the long-term. Prescriptions include retaining the healthiest dominant and co-dominant trees, skips on on 15-25% of the unit, 40-100% canopy closure mix, and openings of <0.25 - 2 acres on 15-25% of the unit
  - Zoom in one of two ways
    - T10N R08E Quarter-section 21NW
    - Klamath Basin, Salmon Sub-basin, Methodist Creek-South Fork Salmon River Sub-watershed
  - Examine Habitat Index tab values:
    - Early Seral
        - Low in *Recently Disturbed*
        - Intermediate in *Post-disturbance* & *Areas Managed for Wildlife*
    - Late Seral
        - Low to intermediate in *Conifer Dominated*
        - Intermediate in *Conifer with Hardwood*
    - Oak
        - Low in *Oak Savannah* and *Oak Woodland*
        - Intermediate in *Oak Chaparral*
        - High in *Oak Conifer*
  - Examine Habitat Values tab:

            - Early Seral
                - OCWA*, BTYW*, WETA* high
                - A number of species (including RUHU*, OSFL*, HAFL) are very low or absent
                - Consider how prescriptions may be used to maintain/improve some habitat for early seral species (priority species in particular) as the stand is moving toward late seral conditions
            - Late Seral
                - PSFL*, BHGR* highest
                - RUHU*, HEWA*, PAWR* very low or absent
                - Clear opportunity to increase heterogeneity (e.g., to support hardwood & shrub-associated birds, nectar-producing plants) and promote structures that are associated with late seral dependent species (dense, multi-layered canopy; large decadent trees & snags; large contiguous area of late seral vegetation)
                - NOTE: As this is pre-dominantly a plantation and unlikely to provide much PSFL habitat, it is possible that the high values for PSFL are due to either 1) model mis-attribution, or 2) influence of high levels of PSFL habitat at the watershed scale (as models took landscape scale vegetation conditions into account). A good example of importance of taking biological expertise into account when interpreting the tool results.
            - Oak
                - SPTO*, WETA*, BHGR* highest
                - With the exception of SPTO* in *Oak Chaparral*, most species are very low or absent in the *Oak Savannah*, *Oak Woodland*, and *Oak Chaparral* categories
                - *Oak Conifer* is the only category with any real representation in the Oak species group. This may not be the right landscape to promote the other oak vegetation types, so focus on maintaining Oak Conifer vegetation where it exists, as well as the shrub components represented by SPTO*
    - See Attachment 2 (Area 1 Plantation Report) for complete tool output
- Area 2 (Late Seral Stand) analysis: Heterogeneous stand, characteristic of Klamath Knot, with good late seral component. Goal is to maintain late and improve seral conditions already present, e.g., dominant and co-dominant tree growth, vertical structure, and other late seral characteristics. Additional goal to reduce risk of and resilience to wildfire by reducing fuel loading (including downed wood debris and ladder fuels) while creating canopy openings.
    - Zoom in one of two ways
        - T38N R12W Section 11
        - Klamath Basin, Salmon Sub-basin, Methodist Creek-South Fork Salmon River Sub-watershed
    - Examine Habitat Index tab values:
        - Early Seral
            - Low in *Recently Disturbed*

        - Intermediate to high in *Post-disturbance*
        - High in *Areas Managed for Wildlife*
    - Late Seral
        - Intermediate in *Conifer Dominated*
        - High in *Conifer with Hardwood*
    - Oak
        - Low in *Oak Savannah* and *Oak Woodland*
        - Low to intermediate in *Oak Chaparral*
        - Very high in *Oak Conifer*
- Examine Habitat Values tab:
    - Early Seral
        - NAWA, BTYW*, LAZB highest
        - A number of species (including RUHU*, OSFL*, HAFL, PUFI*) are low or absent
        - Consider how prescriptions may be used to maintain/improve some habitat for early seral species (priority species in particular) while promoting late seral conditions - e.g., by maintaining shrubs and hardwoods
    - Late Seral
        - PSFL*, BHGR* highest
        - Many late seral species present at some abundance (in contrast with Area 1 and the watershed scale with few species present and lower predicted abundances respectively)
        - RUHU*, HAFL, WIWA very low or absent
        - Stand appears to support a number of late seral focal bird species; work to maintain and promote important vegetative characteristics (see Habitat Objectives for details)
        - Additional opportunity to increase heterogeneity (e.g., to support hardwood & shrub-associated birds, nectar-producing plants)
    - Oak
        - SPTO*, WETA*, BHGR*, NAWA highest
        - Many species are very low or absent in the *Oak Savannah*, *Oak Woodland*, and *Oak Chaparral* categories
        - There appears to be slightly more oak vegetative diversity in the Area 2 as compared with Area 2. Work to maintain and improve hardwood components where the exist to promote heterogeneity within the late seral complex
- See Attachment 3 (Area 2 Late Seral Report) for complete tool output