

# Predicting Black-backed Woodpecker Abundance

## A decision support tool for post-fire forest management in California

This tutorial provides a worked example with suggested uses for the Black-backed Woodpecker decision support tool. The tool uses the best available science to predict the potential abundance and density of Black-backed Woodpeckers (*Picoides arcticus*) that could be supported by existing habitat after forest fire within the species' range in California. Our aim in developing this model is to provide a tool to allow managers to make post-fire forest management decisions that account for the potential effects on Black-backed Woodpeckers.

[https://bird-populations.shinyapps.io/Black-backed\\_Woodpecker\\_Portal/](https://bird-populations.shinyapps.io/Black-backed_Woodpecker_Portal/)

Version 1.0 2021. Built using RShiny.

Stillman, A.N., D.R. Kaschube, R.L. Wilkerson, R.B. Siegel, S.C. Sawyer, and M.W. Tingley. (*in prep*). Incorporating pyrodiversity into wildlife habitat assessments for post-fire management.

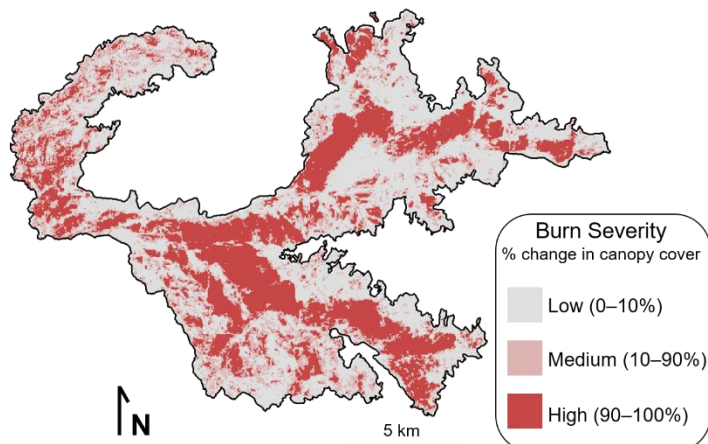
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This app supports two related approaches to produce management-oriented results. The two approaches differ only in the characteristics of the uploaded polygon shapefile, but they result in different ways of using the outputs.

Approach 1: Upload a polygon shapefile for the entire fire perimeter to predict Black-backed Woodpecker density (pairs per pixel) potentially supported across the fire as well as total potential abundance for the entire fire area. The output .tif files can then be loaded into a Geographic Information System such as ArcMap to extract density and abundance estimates across intended management areas.

Approach 2: Upload a polygon shapefile for one or more areas of interest within the burned area. The app will then produce predictions for the area contained within each polygon rather than the entire fire area.

In this tutorial, we will conduct a case study using the Donnell Fire (right) to illustrate both approaches. The Donnell fire burned in Stanislaus National Forest beginning August 1<sup>st</sup>, 2018 and burned ~36,151 acres.



## Get started: Gather and upload the data inputs

You will need to upload two files and provide some additional information under the “Upload Data” tab to begin.

- (1) A 30x30 m raster file giving the percent change in canopy cover from before to after fire. For each grid cell, the expected data have values ranging from 0 (i.e., no change in canopy cover) to 100 (i.e., total loss of canopy cover).

These data are generally available for free from the Rapid Assessment of Vegetation Condition after Wildfire (RAVG) program: <https://fsapps.nwcg.gov/ravg/>. Navigate to the “Data Access” tab and select the fire of interest using the “Query Builder”. In our case, we can search for the Donnell Fire by typing “Donnell” into the search box. After clicking “Submit Query” a summary table will appear. As multiple fires may have the same name, ensure you select the correct fire. Use the “Download Data” link on the summary table to download the zipped data folder. This folder will contain a series of spatial files (e.g., .tif, .shp), summary files, and metadata. All files use a naming convention to denote the fire ID and the file type. The raster file giving the percent change in canopy cover from before to after fire is denoted by “rdnbr\_cc.tif” at the end of the file name: ca3834911992920180801\_20171013\_20181016\_rdnbr\_cc.

- (2) An ESRI shapefile giving the outline of the fire or area of interest within the fire. When uploading these data to the app, use the multiple highlight option (Windows: shift + click, Mac: command + click) to highlight all file components, including: .dbf, .prj, .shp, and .shx.

If you wish to use Approach 1 to predict across the entire fire area, these files are contained within the RAVG data package. Burn boundary files are denoted by “burn\_bndy” at the end of the file name. For the Donnell fire, the files to select are as follows:

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ca3834911992920180801_20171013_20181016_burn_bndy.dbf
ca3834911992920180801_20171013_20181016_burn_bndy.prj
ca3834911992920180801_20171013_20181016_burn_bndy.sbn
ca3834911992920180801_20171013_20181016_burn_bndy.sbx
ca3834911992920180801_20171013_20181016_burn_bndy.shp
ca3834911992920180801_20171013_20181016_burn_bndy.shx
```

- (3) Last, you will need to provide additional information about the fire. Use the sliding bar to select a single post-fire year (e.g., 2 years after the burn) for output predictions. Select the year that the fire burned, and select the approximate fire ignition date. Last, enter the size of the total fire area in acres, without commas. If you are unsure of the

exact fire size, you can find a close estimate in the file that ends with “\_ravg\_table”. The estimate of the total number of acres burned occurs in the row labeled “Grand Total”.

To make predictions for 1 year after the Donnell fire, which was ignited August 1, 2018 and burned ~36,151 acres, we will enter the following values:

For which post-fire year do you wish to make a prediction? Model predictions are specific to whole numbers of years after fire. Black-backed Woodpeckers generally begin breeding in the first spring following fire (i.e., 1 year after fire).

1  2  3  4  5  6  7  8  9  10

In what year did the fire burn? This information helps the model use the correct landscape variables when making predictions.

2012 to 2017  
 2018+

What was the approximate fire ignition date?

January 1 to August 15  
 August 16 to December 31

What is the size of the total fire area, in acres? Please enter the number without commas (e.g., 5000 not 5,000).

36151

## Run the model and download results

After uploading the data and selecting the correct options for your fire, navigate to the “Run the Model” tab and select which analyses you wish to run. Click the button “Click here to run the model(s)” to run the analyses and produce predictions. Please be patient while the model runs. Under the hood, the app uses your inputs to extract and calculate a series of predictor variables across the area of interest. It then uses these predictors to produce estimates of Black-backed Woodpecker density and abundance, along with associated uncertainty.

Finally, click the “Download results as a zip file” button to download a zipped folder with results from the selected analyses.

## Approach 1: Predict Black-backed Woodpecker abundance across an entire fire area

With this approach, the user uploads a spatial file giving the entire fire perimeter (Step 2 in the list of data inputs, above). Thus, the model makes predictions across the entire fire area. Users can then load the .tif file outputs from the app into a Geographic Information System such as ArcMap to extract density and abundance estimates across intended management areas.

For the Donnell fire, we will upload the following spatial files to the app, both available from the RAVG database:

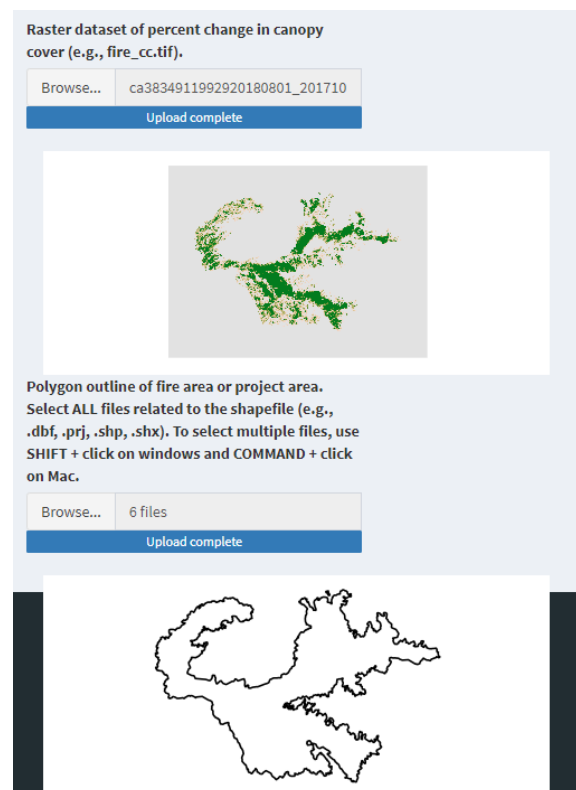
Burn severity raster:

ca3834911992920180801\_20171013\_20181016\_rdnbr\_cc

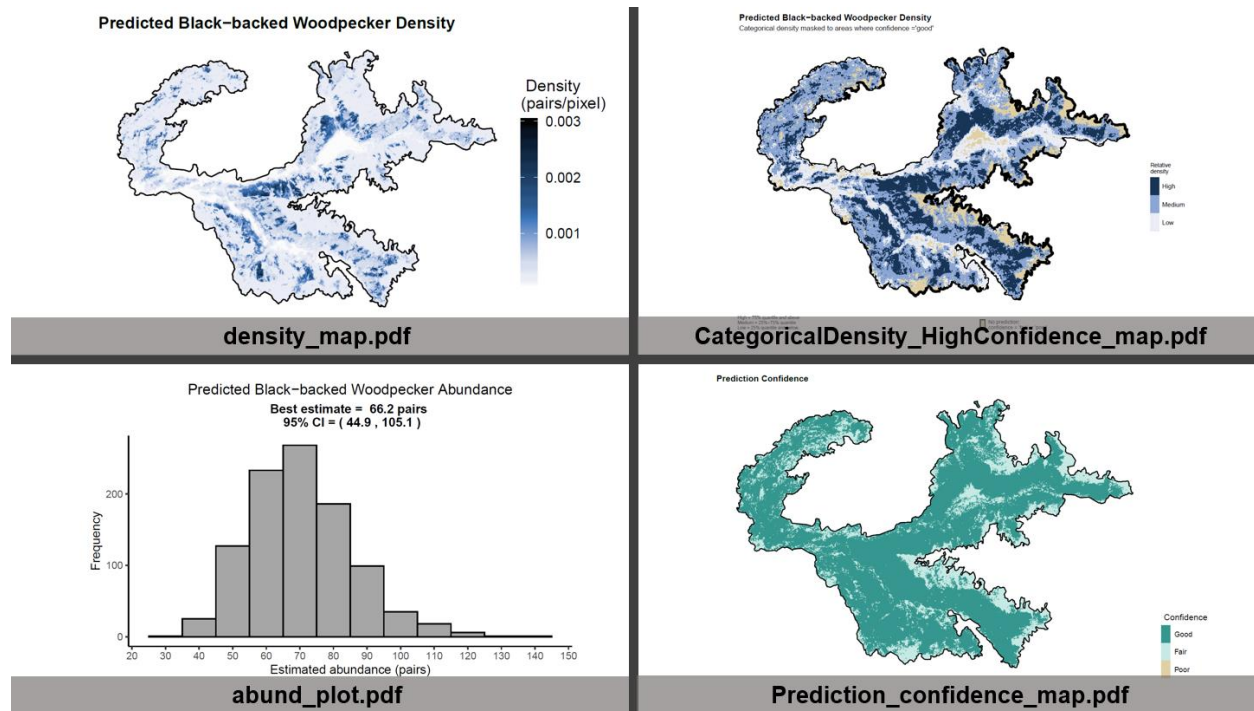
Burn perimeter files:

ca3834911992920180801\_20171013\_20181016\_burn\_bndy.dbf  
ca3834911992920180801\_20171013\_20181016\_burn\_bndy.prj  
ca3834911992920180801\_20171013\_20181016\_burn\_bndy.sbn  
ca3834911992920180801\_20171013\_20181016\_burn\_bndy.sbx  
ca3834911992920180801\_20171013\_20181016\_burn\_bndy.shp  
ca3834911992920180801\_20171013\_20181016\_burn\_bndy.shx

After uploading the files, the app will provide rough plots of the spatial data. Next, use the “Run the Model” tab to select the desired analyses, run the model, and download the outputs! For our example, we will use the “1. Select All” option to produce the full set of results.



Results will download as a zipped folder starting with the name “BBWO\_download\_...”. In addition, the date is provided in the folder name using the format “yyyy-mm-dd”. Let’s take a look at the four pdf plots provided in this folder:



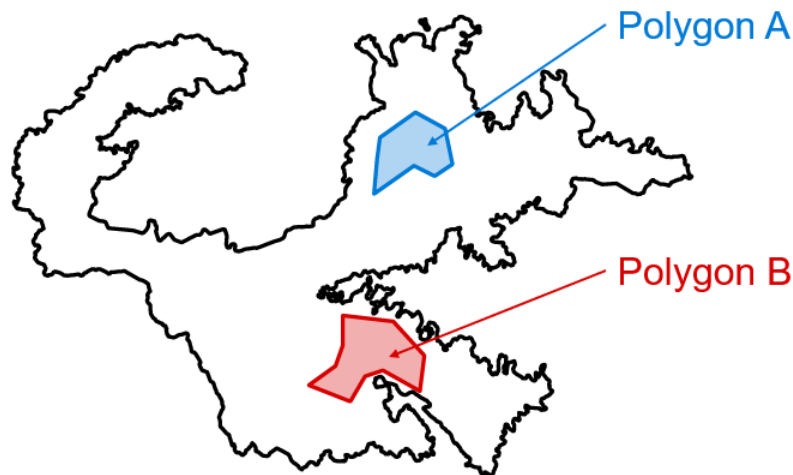
The user now has the option to load the .tif file outputs into a Geographic Information System to conduct additional analyses. For example, users may wish to compare the expected number of woodpecker pairs potentially supported by habitat in two separate areas of interest within the fire. The output “Mean\_predicted\_density.tif” gives the expected number of woodpecker pairs *per pixel*, so potential abundance supported by a given area can be calculated for any area within the fire by simply summing the pixels contained within the area of interest and multiplying by the number of acres/pixel. Results can be extracted for a particular area of interest and dealt with individually (e.g., using the “Extract by Mask” tool in ArcMap).

## Approach 2: Predict Black-backed Woodpecker abundance across an area of interest within the fire

As an alternative to making predictions across an entire fire area, users may choose to upload a custom polygon shapefile showing a specific area of interest. This shapefile may include one or multiple polygons of any shape. However, we strongly recommend that the polygons fit within the spatial extent of the percent change in canopy cover raster. Portions of the polygon outside of this extent will generate empty (i.e., “NA”) cell values.

The benefit of this approach is that it allows users to generate predictions of abundance for particular areas within a fire, with associated uncertainty, without loading the raster file into a Geographic Information System. The downside of this approach is that each area of interest (i.e., shapefile) requires a separate model run in order to compare results for multiple areas.

Let's consider two areas of interest within the Donnell Fire. We'll use these two polygons as an example moving forward\*.



\*These two polygons are not meant to represent true management options. Rather, they are arbitrary areas selected for the sake of example.

To produce results for each of these two polygons, we will need to run the model twice. For the first run, we will load the following spatial files:

Burn severity raster:

ca3834911992920180801\_20171013\_20181016\_rdnbr\_cc

Spatial data for Polygon A:

PolygonA.dbf

PolygonA.prj

PolygonA.shp

PolygonA.shx

As with Approach 1, the app will provide rough plots of the spatial data. Next, use the “Run the Model” tab to select the desired analyses, run the model, and download the outputs. As before, we will use the “1. Select All” option to produce the full set of results.

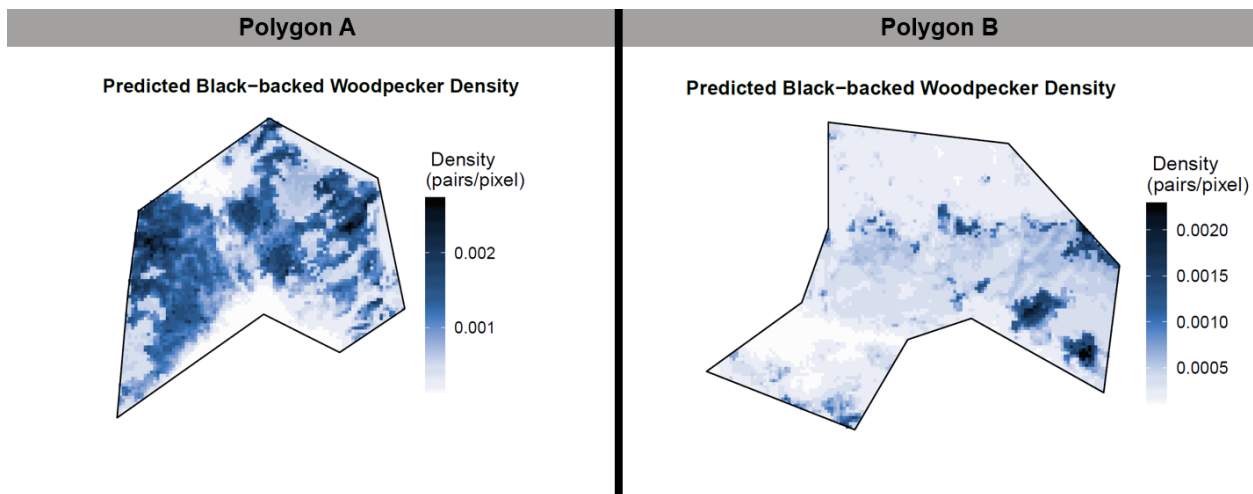
Next, we will return to the “Upload Data” tab to upload the spatial data for Polygon B. Note that the other data inputs (e.g., burn severity, years since fire) do not need to be replaced unless you choose to refresh the webpage.

Spatial data for Polygon B:

- PolygonB.dbf
- PolygonB.prj
- PolygonB.shp
- PolygonB.shx

Use the “Run the Model” tab to select the desired analyses, run the model, and download the outputs. As with Polygon A, we will use the “1. Select All” option to produce the full set of results.

With both outputs in hand, we can begin to make comparisons between the relative abundance and density of Black-backed Woodpeckers supported in each polygon. First, let’s visually compare the two plots of Black-backed Woodpecker pair density. We see that density predictions in Polygon A tend to be higher than density predictions in Polygon B. Relative to Polygon B, Polygon A likely contains higher quality habitat.



Second, we can compare abundance estimates for the two polygons, which are summarized in “abund\_plot.pdf”. While we caution against interpreting these numbers as absolute abundance, these estimates can facilitate robust comparisons between potential management options. Here, the app has estimated that the habitat in Polygon A could potentially support 4 Black-backed Woodpecker pairs (95% confidence interval: 2.8–7.0), and Polygon B could potentially support 2.7 pairs (95% confidence interval: 1.8–4.3). Thus, even though Polygon B has an area 1.4 times larger than Polygon A, we would expect it to contain habitat for ~30% fewer Black-backed Woodpecker pairs, on average. Based on these results, we can also conclude that management actions implemented across Polygon A have the



potential to effect more Black-backed Woodpecker pairs than management actions implemented across Polygon B.

## Contacts

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