Predicting Wildlife Use of Existing Highway Bridges and Culverts

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Project Objective

To develop an accessible model that DOTs could use to predict wildlife use of existing culverts and bridges and to look for cost-effective ways to increase wildlife use of existing structures

Problem Statement

Departments of Transportation (DOTs) are increasing attention to wildlife connectivity needs across highways, which is reflected in the inclusion of $350 million in new funding in the Bipartisan Infrastructure Law. There are over 600,000 bridges and likely many more culverts along US highways, approximately 75% of which are over waterways and could be useful for wildlife connectivity. There is also no current method for DOT staff to use to predict wildlife use of these existing bridges and culverts. This information is important in understanding what connectivity is already present and how it could be improved with new wildlife crossings.

Research Methodology

Using camera trap data from AZ, CA, CO, ME, NC, NM, OR, UT, VA, and WA (Fig. 1), we developed a statistical model using structure and near-landscape characteristics, and evidence of wildlife use from camera traps. Our approach relied on four types of data: individual camera trap observations of wild animals, the dimensions of existing structures, the land cover surrounding the camera trap sites, and climatic conditions at the time of observation. Model development was guided by a combination of Akaike information criterion driven stepwise regression and human-driven variable selection. Stepwise regression was used to cut models down from all possible variables to a set of significant ones. Models generally followed this structure, with variables added to the equation.

$$\text{Logit}(P) = A_o + A_T + A_{forest} + A_{length} + A_{height}$$

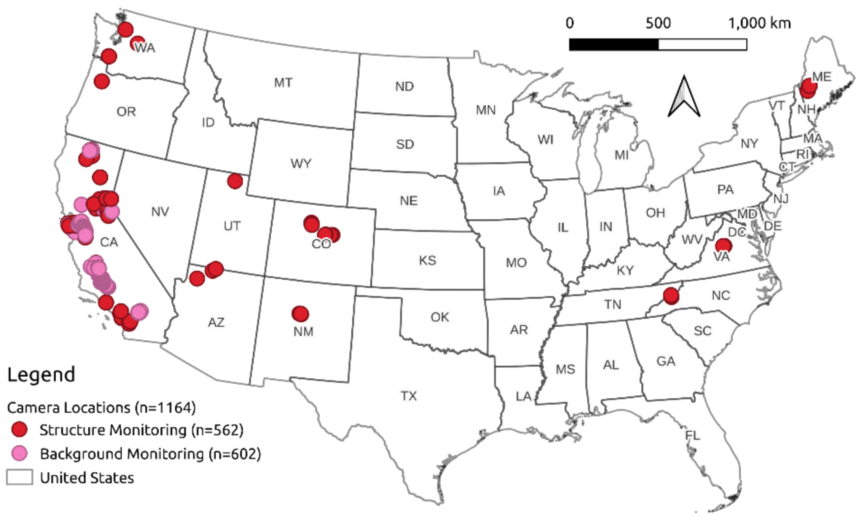

Figure 1. Locations of camera traps from which animal observation data were obtained.

Results

For each of the statistical model types (location and animal-frequency) we developed predictive models for 26 species (e.g., bobcat) and species groups (e.g., deer). Species List: Black bear, Black-tailed jackrabbit, Bobcat, Brush rabbit, California ground squirrel, Coyote, Deer, Desert cottontail, Elk, Feral pig, Foxes, Gray fox, Ground squirrel, Mountain lion, Mule deer, Mustelids, Rabbits, Raccoon, Rats, Red fox, Striped skunk, Tree squirrel, Virginia opossum, Weasel, Western gray squirrel, White-tailed deer, and Woodrats. We also combined the coefficients for all variables for each species (examples of single variable, Fig 2) to make two determinations: 1) what structural conditions (dimensions and location) do individual species prefer and 2) given certain structural conditions, what is the likelihood of species or species group use of the structure. Model (1) can be used to inform planning and siting of new wildlife crossing structures that could suit particular species, or groups of species. Model (2) can be used to informs assessment of expected wildlife use of a network of existing structures, for example, all bridges and culverts in California.

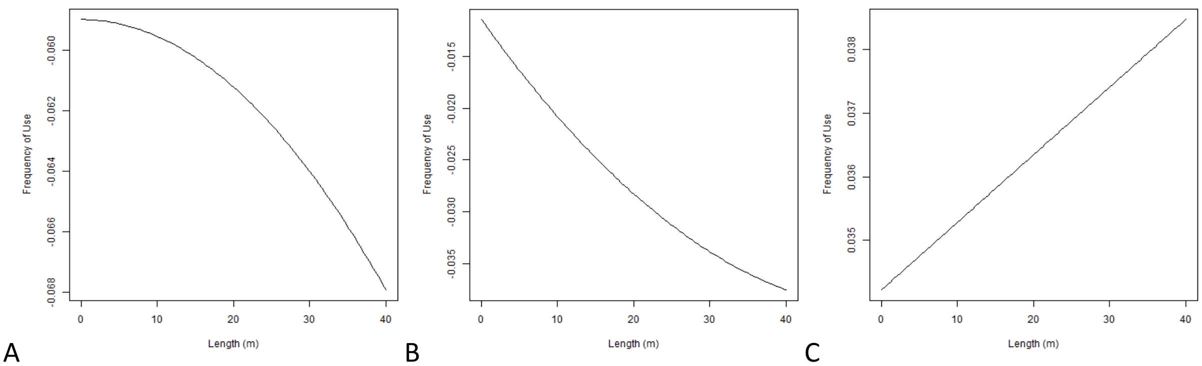

Figure 3. Relationship between frequency of use of structures and structure length for (A) mule deer, (B) bobcat, and (C) California ground squirrel.

Next Steps

We are using the model coefficients for each species to develop a website that anyone can use to plan new wildlife crossings (Fig. 3), or to assess predicted wildlife use of existing structures. The website will combine the predictions of wildlife use of existing structures with the features of an existing web tool to plan new wildlife crossings).

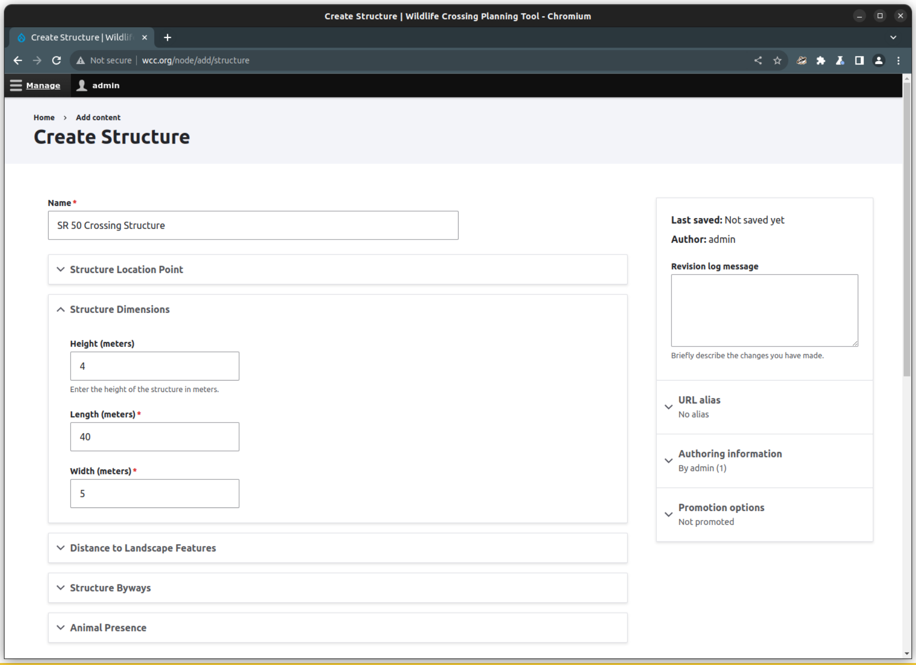

Figure 3. Draft web-system for any user to predict wildlife use of existing structures, based on structure location and dimensions.