Charina bottae umbratica

Southern Rubber Boa

California Department of Fish and Wildlife
Range and Distribution Mapping and Analysis Project (RADMAP)
Species Habitat Model (SHM) assessment metrics and metadata Star Rating: 5 out of 5

Date: 2026-05-04

This metadata describes the SHM results for this one taxon. Methods were developed by the RADMAP team and implemented with Maxent. Evan Greenspan was the primary modeler for this species.

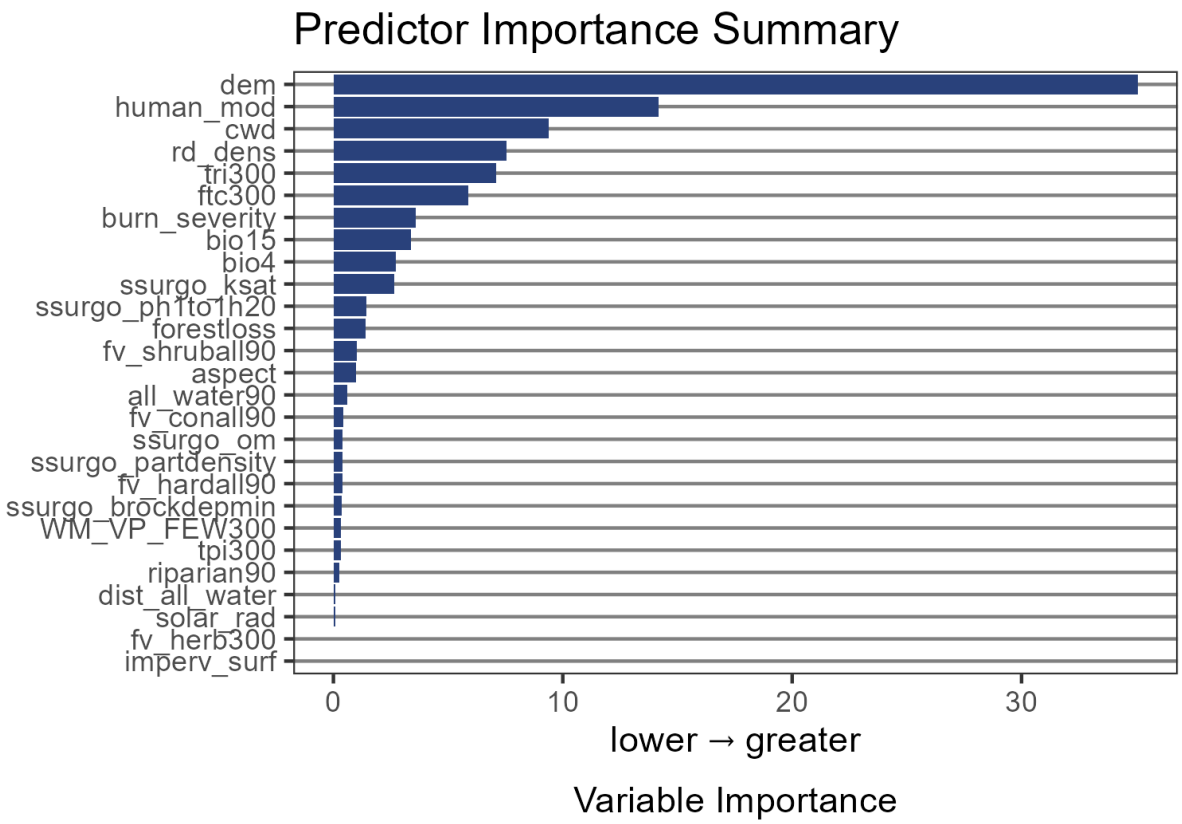
Model Results

Table 1. Maxent model testing results, including the number of filtered presence locations used (Presence), regularization multiplier (RM), feature class (FC), p0 test omission error rate (OER), test area under the curve (AUC), difference between AUC test and AUC training values (AUCdiff), p0 threshold (Threshold) distinguishing habitat from non-habitat, and max(se+sp) test True Skill Statistic (TSS).

Presence	RM	FC	AUC	AUCdiff	Threshold	TSS	OER
201	5	lqh	0.8517609	0.1110667	P0	0.63005	0

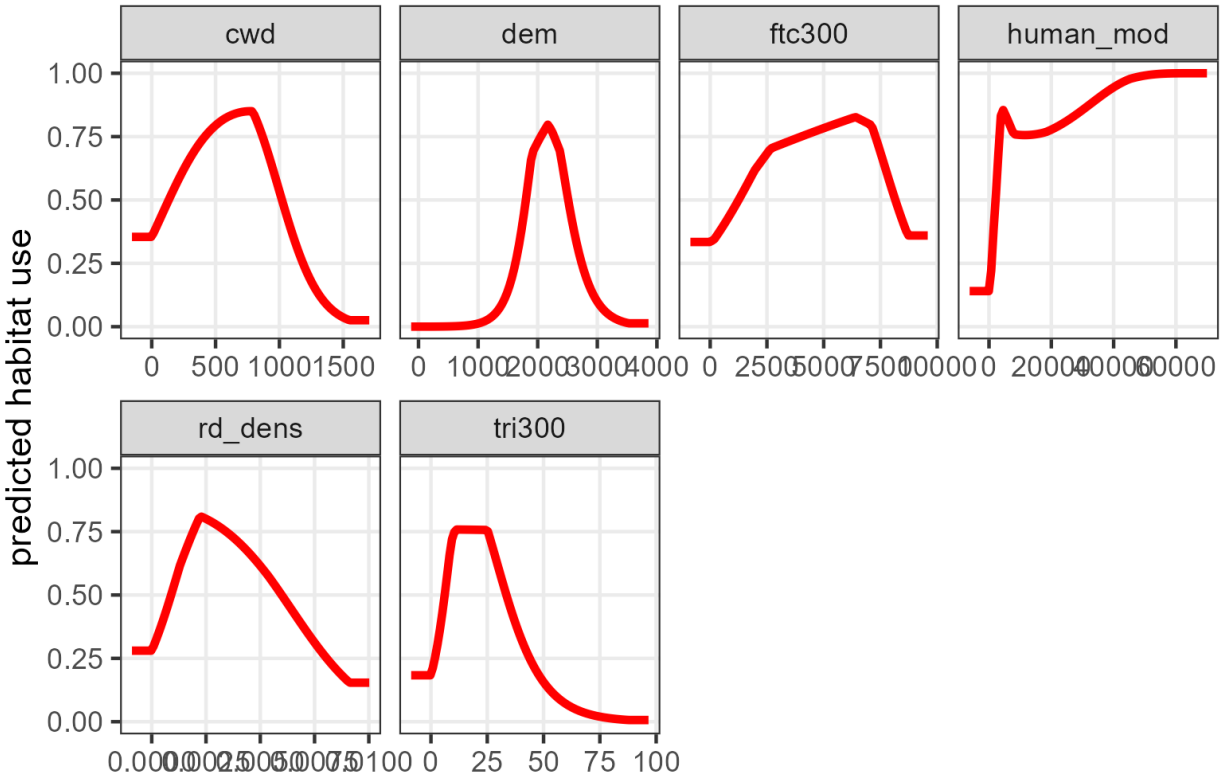
Percent Contribution of Covariates

Figure 1. Estimates of the relative percent of contributions (variable importance %) of covariate inputs to the top Maxent model. Covariates are defined in Table 4.



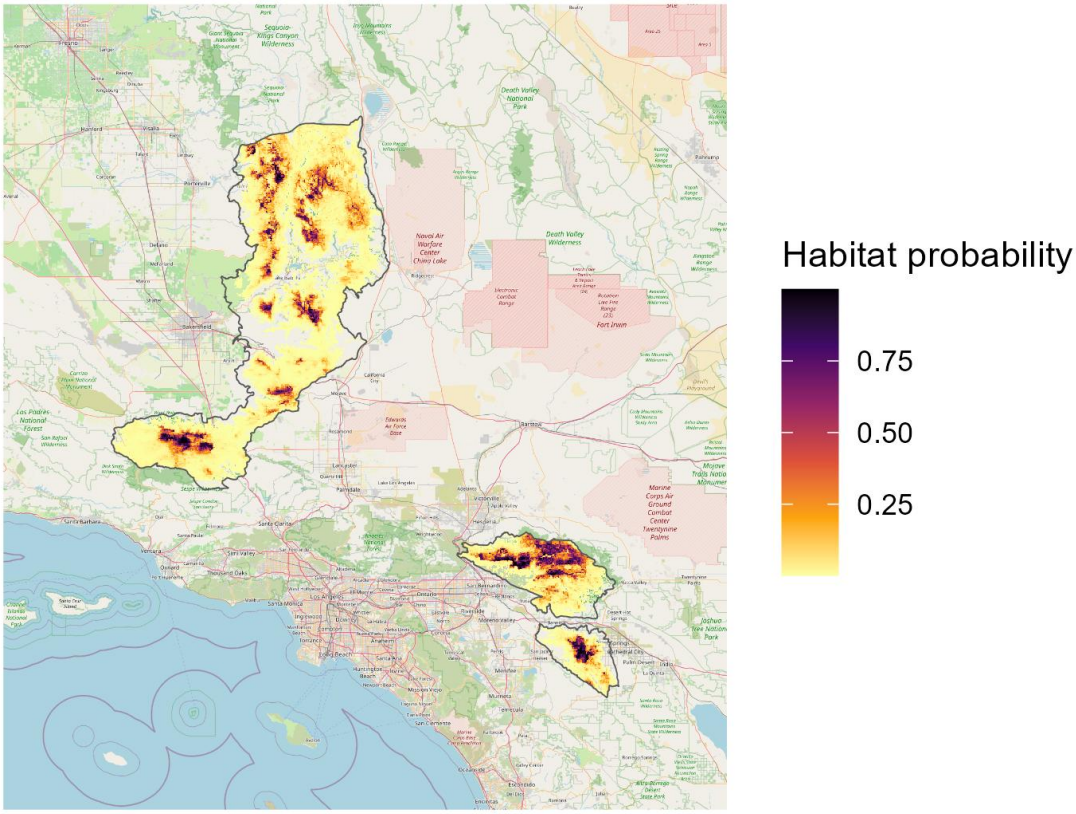
Response Curves

Figure 2. Response curves reveal how the predicted habitat use (0–1 on the y-axis) changes as each variable is altered while all other predictors remain constant. The x-axis represents the covariate's range of values while the y-axis represents the effect between the variable and the model response. Covariates are defined in Table 4.



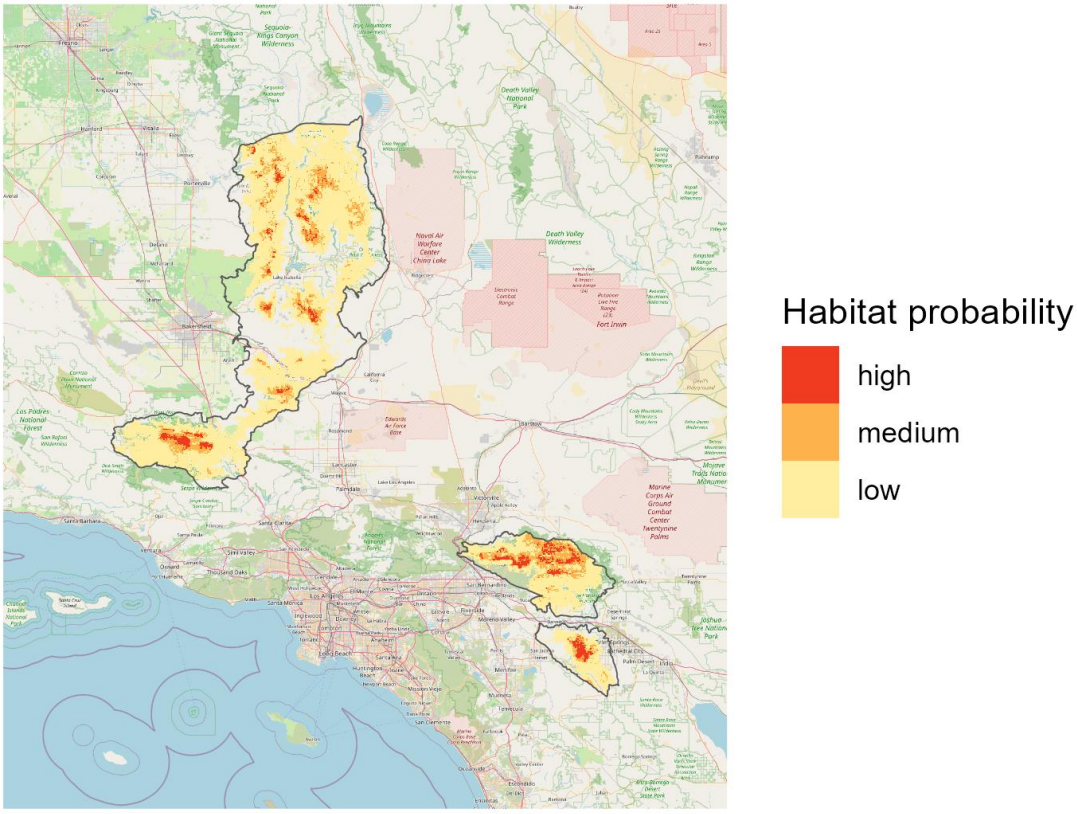
Model Output – Species Habitat Model (continuous)

Figure 3. SHMs depict a species' predicted habitat associations within each cell, represented as a continuous value between 0 and 1, and masked to the species' range. Values closer to 1 depict a higher relative probability of habitat use within that cell.



Model Output – Species Habitat Model (categorical)

Figure 4. The categorical SHM is based on the continuous SHM output. It splits the model output into predicted habitat and non-habitat based on a statistical threshold (p0). Within the area marked as predicted habitat in the output, this map displays the categories of high, medium, and low relative probability of habitat use. Medium and high relative probability of habitat use categories were distinguished based on expert chosen statistical thresholds.



Categorical SHM Thresholds

Table 2. Statistical thresholds chosen to represent the categorical SHM.

Category	Threshold Selected	Threshold Value
low	Minimum Training Presence	0.0032500
medium	Maximum Sensitivity Plus Specificity	0.1374000
high	Top 25% of habitat probability values above medium threshold	0.5539669

Model Evaluation

Table 3. The final model evaluation score, represented as a star rating (1-5) is presented at the top of this metadata. Star ratings are comprised of three distinct components, including an expert review, a modeler review, and an AUC score. Experts review models based on predictor relevance and the overall accuracy of the continuous and categorical SHM outputs. Modelers provide a review of presence data, predictor relevance, performance evaluation, spatio-temporal data alignment, model review status, and the overall accuracy of the continuous and categorical SHM outputs. Along with the AUC score, these three inputs are normalized and given an equal weight before being converted into a categorical star rating. The table below provides a basic descriptive meaning of the star rating provided for this model, taking into account the subjective expert and modeler review scores as well as the objective AUC evaluation.

Star Rating	Brief Description
1	Poor representation of habitat. Habitat for this species is unlikely to be successfully mapped using standard habitat modeling approaches given unique species traits.
2	Significant concerns. A large proportion of the map shows habitat in areas where the species is unlikely to occur or does not predict habitat where the species is known. Revisions are needed before the model is used for any formal application or decision, with the possible exception of guiding inventory.
3	Some concerns about model performance in specific areas. The model would benefit from additional refinement, but the general pattern of mapped habitat is consistent with expert expectations
4	Model generally good. Potential for further improvement through additional iteration but provides a good approximation of likely habitat.
5	Modeled habitat is a very good representation of likely habitat. Further iteration is unlikely to result in significant improvements.

Covariate Descriptions

Table 4. Descriptions of environmental variables included in model. Covariates were chosen for inclusion in the model based on a literature review, their potential for ecological relevance to the focal taxon, and advice from applicable experts. Focal statistics were calculated for certain habitat covariates at the 90, 300, 900, 3,000, and 6,000-m radii scales to assess species' scale dependency. Only one covariate per set of scales were included in the covariate candidate set. Other covariates were extracted at the raster cell's resolution (30-m) unless otherwise specified.

The entire covariate library including full citations is available here: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=232517

Covariate Name	Covariate Description	Source
aspect	Aspect	Digital Elevation Model, USGS Earth Explorer
bio4	Temperature seasonality	USGS Basin Characterization Model
bio15	Precipitation seasonality (coefficient of variation)	USGS Basin Characterization Model
dem	Digital elevation model	USGS Earth Explorer
imperv_surf	Impervious surfaces	NLCD-MRLC
cwd	Climatic water deficit	USGS Basin Characterization Model
rd_dens	Road density within a 3 km radius	US Census TIGER/Line data
tpi300	Topographic position index at a 300 m radius	USGS Earth Explorer
tri300	Terrain ruggedness index at a 300 m radius	USGS Earth Explorer
ftc300	Fractional tree cover at a 300 m radius	Center for Ecosystem Climate Solutions
fv_herb300	FVEG herbaceous prevalence at a 300 m radius	Cal Fire FVEG 2022
ssurgo_partdensity	Soil density	NRCS SSURGO
ssurgo_om	The amount by weight of decomposed plant and animal residue	NRCS SSURGO

Covariate Name	Covariate Description	Source
ssurgo_ksat	Amount of water that would move vertically through soil	NRCS SSURGO
human_mod	Human modification of terrestrial lands	Theobald et al., 2020
solar_rad	Solar radiation	Digital Elevation Model, USGS Earth Explorer
dist_all_water	Distance to all water	USGS National Hydrography Dataset Plus Version 2, CDFW, Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CARI 2024, CropScape 2022, Cal Fire FRAP 2025
all_water90	Water prevalence at a 90 m radius	USGS National Hydrography Dataset Plus Version 2, CDFW, Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CARI 2024, CropScape 2022, Cal Fire FRAP 2025
riparian90	Riparian habitat prevalence at a 90 m radius	Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CDFW, Cal Fire FRAP 2025
fv_hardall90	FVEG all hardwood prevalence at a 90 m radius	Cal Fire FVEG 2022
fv_conall90	FVEG all conifer prevalence at a 90 m radius	Cal Fire FVEG 2022
fv_shruball90	FVEG all shrub prevalence at a 90 m radius	Cal Fire FVEG 2022
forestloss	Forest loss during the period 2000-2024	Global Forest Change 2024
burn_severity	Burn severity from 1984-2024 at a 90 m radius	MTBS

The categorical species habitat model map constructed for *Charina bottae bottae* was created from a composite of three separate models based on the general geographic locations of genetic clades. *C. b. bottae* is likely to be separated into three distinct species based on recent genetic work by Jesse Grismer at La Sierra University. However, until the official publication is accepted, CDFW has elected to post all three *C. b. bottae* models together as a single map file. The metadata below represents these three distinct models separately, including coast, Sierra, and northern California.

Charina bottae bottae

Northern Rubber Boa (coast)

California Department of Fish and Wildlife
Range and Distribution Mapping and Analysis Project (RADMAP)
Species Habitat Model (SHM) assessment metrics and metadata Star Rating: 4 out of 5

Date: 2026-04-29

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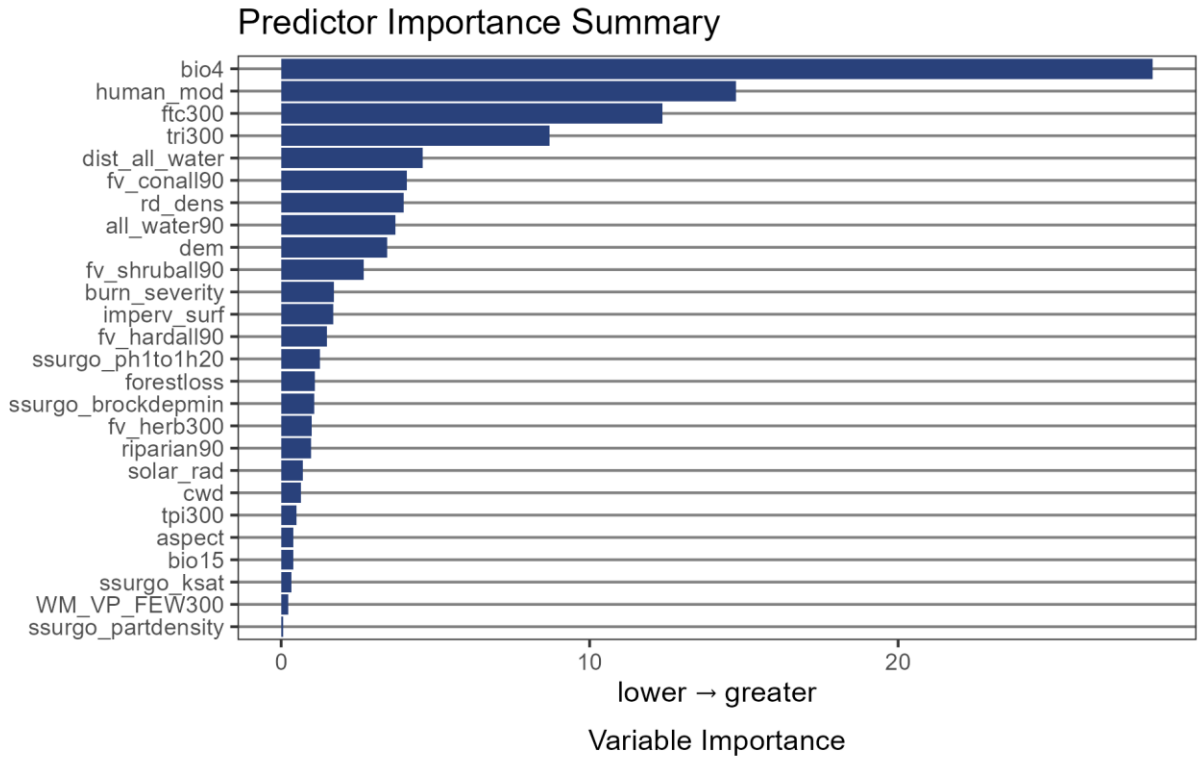
Model Results

Table 1. Maxent model testing results, including the number of filtered presence locations used (Presence), regularization multiplier (RM), feature class (FC), p0 test omission error rate (OER), test area under the curve (AUC), difference between AUC test and AUC training values (AUCdiff), p0 threshold (Threshold) distinguishing habitat from non-habitat, and max(se+sp) test True Skill Statistic (TSS).

Presence	RM	FC	AUC	AUCdiff	Threshold	TSS	OER
420	5	lpqht	0.8699167	0.09086667	P0	0.641075	0

Percent Contribution of Covariates

Figure 1. Estimates of the relative percent of contributions (variable importance %) of covariate inputs to the top Maxent model. Covariates are defined in Table 4.



Response Curves

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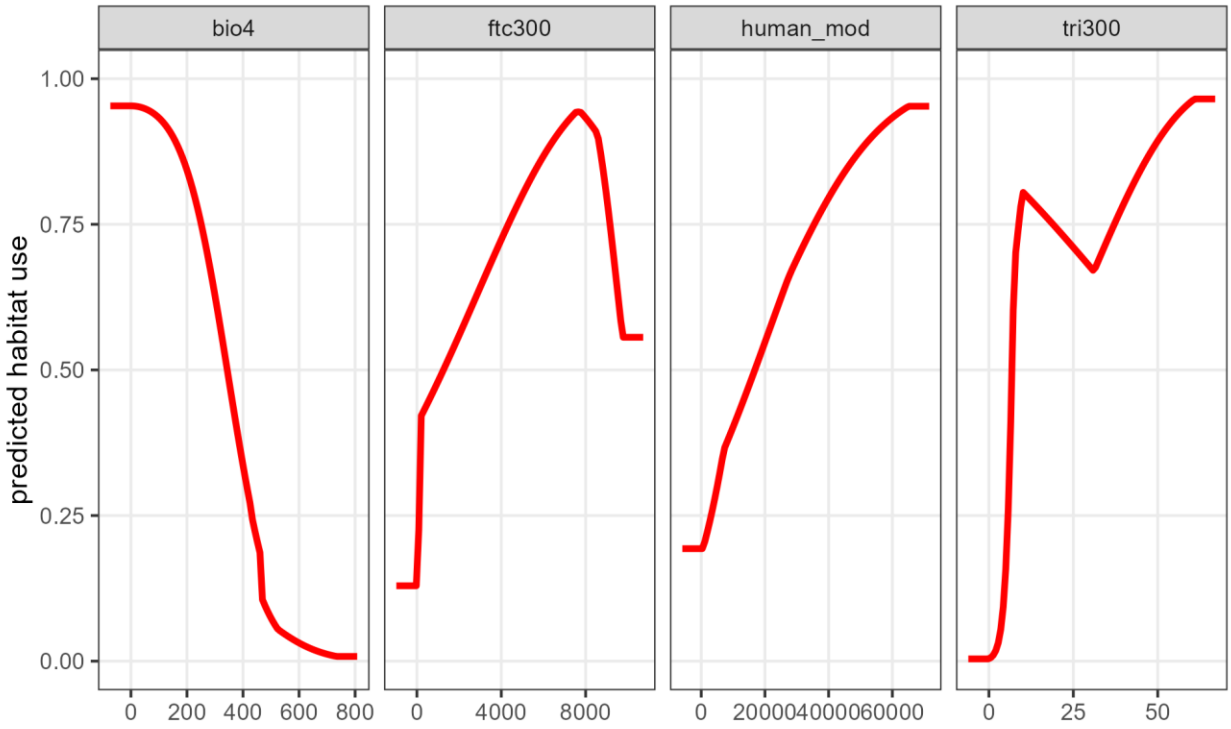

Model Output – Species Habitat Model (continuous)

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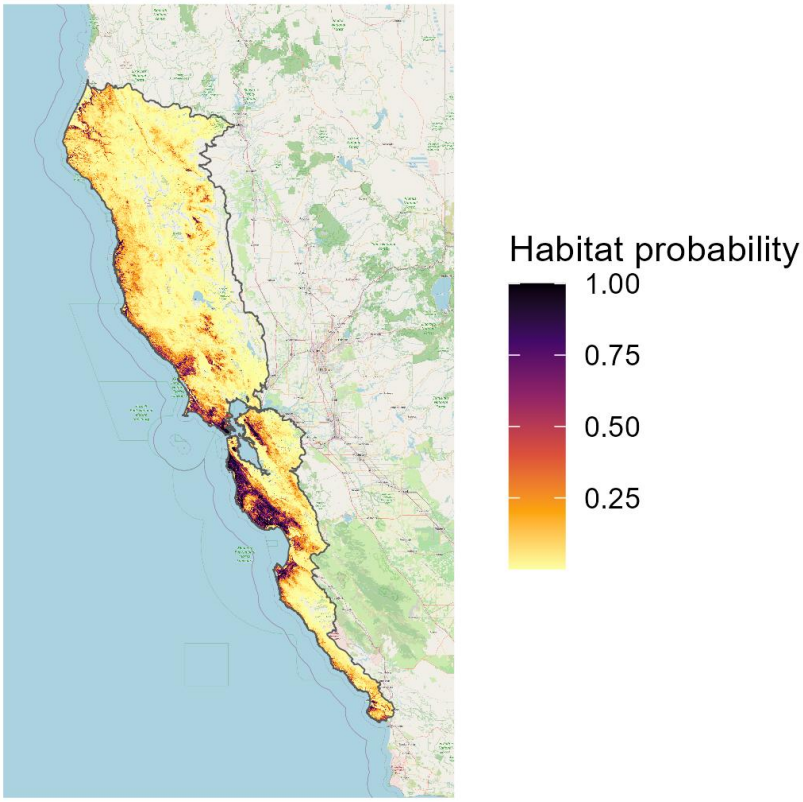

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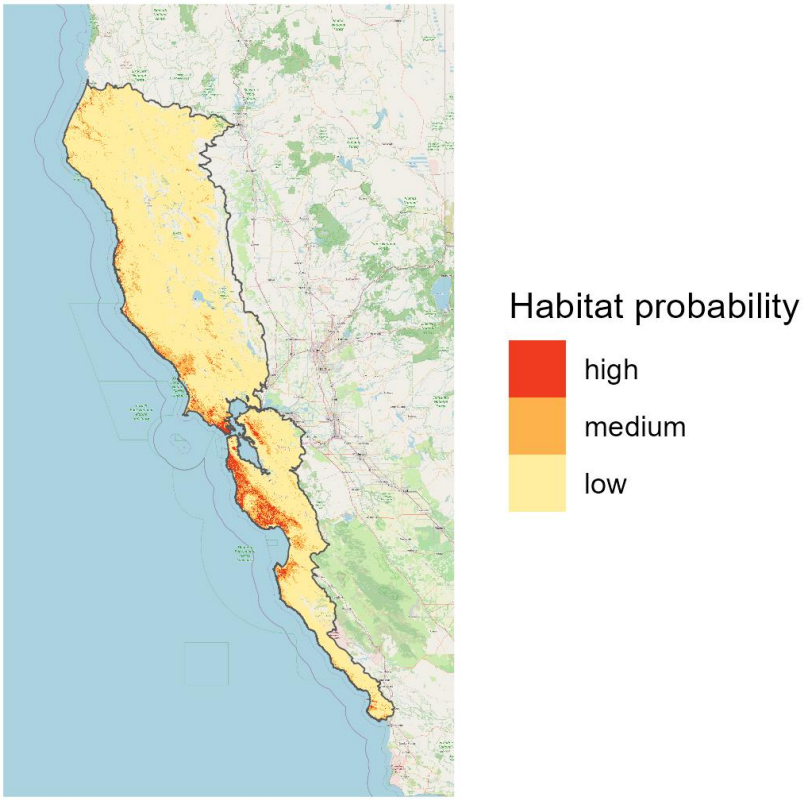

Categorical SHM Thresholds

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Category	Threshold Selected	Threshold Value
low	Minimum Training Presence	0.0009400
medium	Maximum Sensitivity Plus Specificity	0.1670300
high	Top 25% of habitat probability values above medium threshold	0.5990599

Model Evaluation

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dist_all_water	Distance to all water	USGS National Hydrography Dataset Plus Version 2, CDFW, Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CARI 2024, CropScape 2022, Cal Fire FRAP 2025
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Charina bottae bottae

Northern Rubber Boa (Northern CA)

California Department of Fish and Wildlife
Range and Distribution Mapping and Analysis Project (RADMAP)
Species Habitat Model (SHM) assessment metrics and metadata Star Rating: 4 out of 5

Date: 2026-04-29

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Presence	RM	FC	AUC	AUCdiff	Threshold	TSS	OER
121	5	lpqht	0.7618007	0.1421268	P0	0.4682	0

Percent Contribution of Covariates

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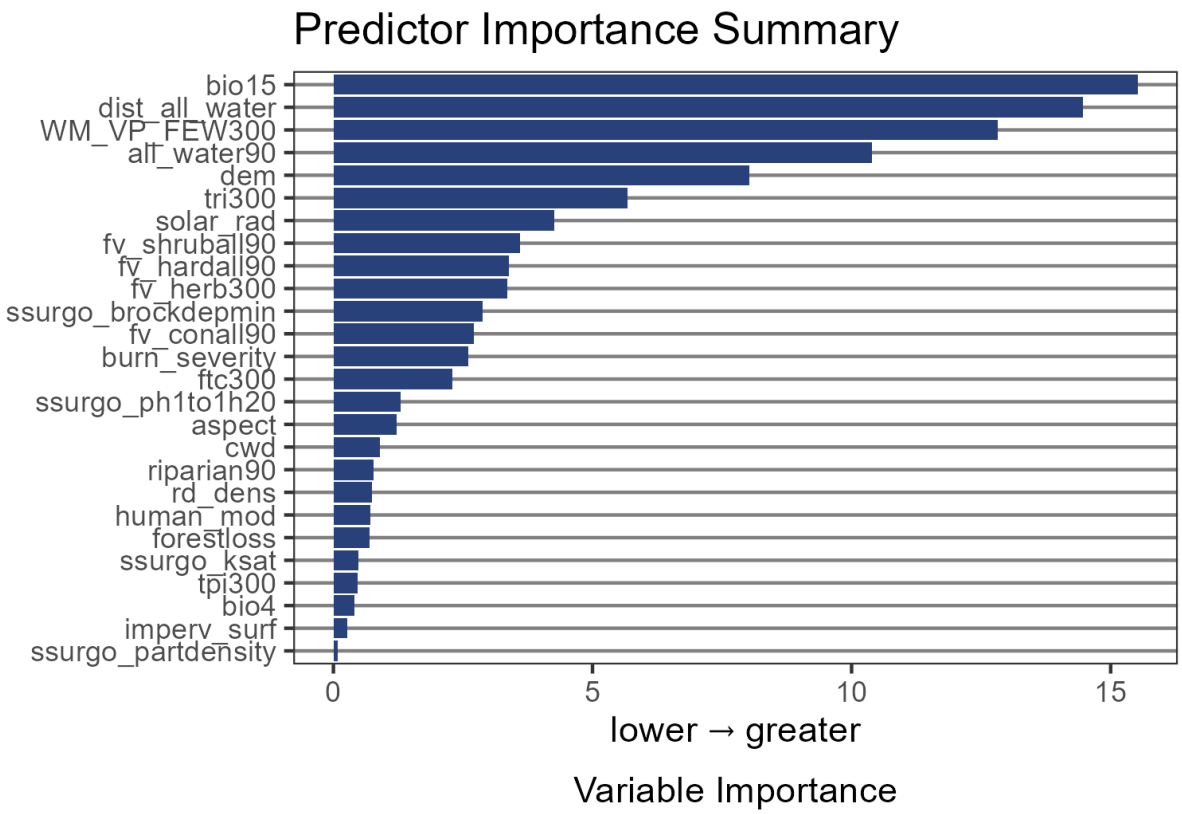

Response Curves

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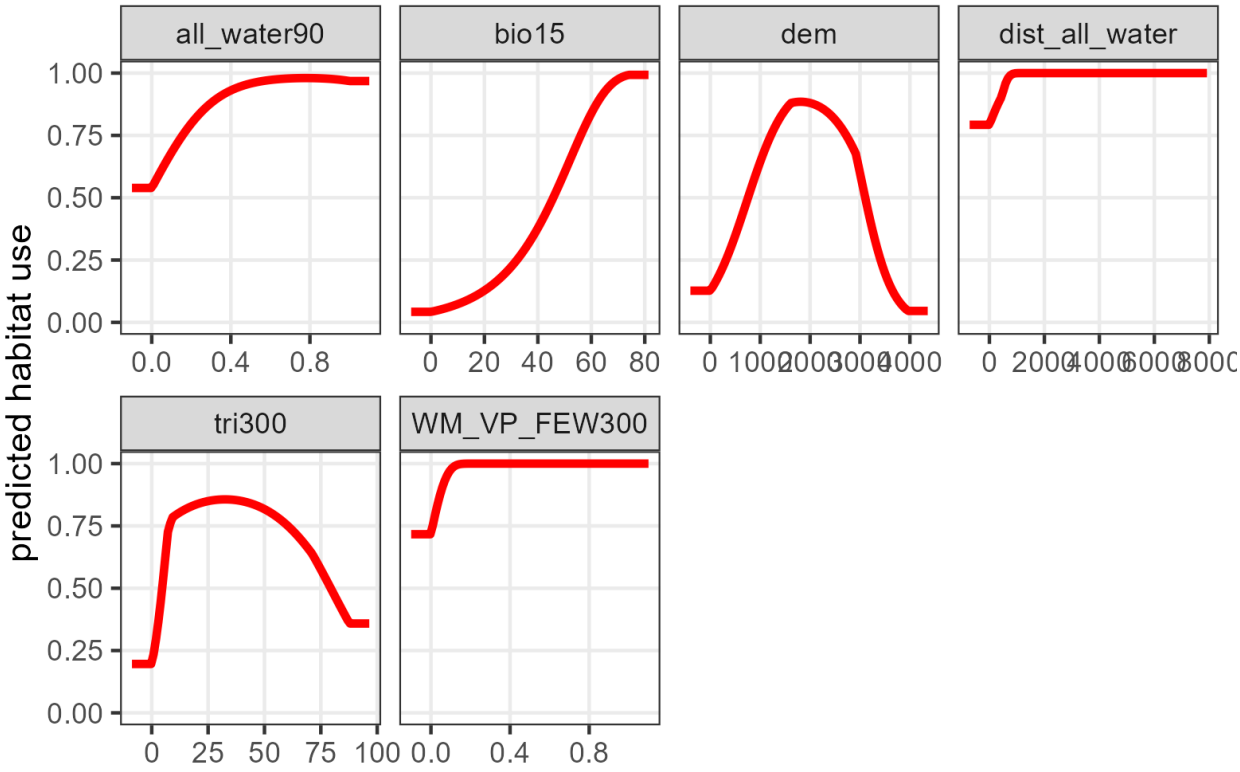

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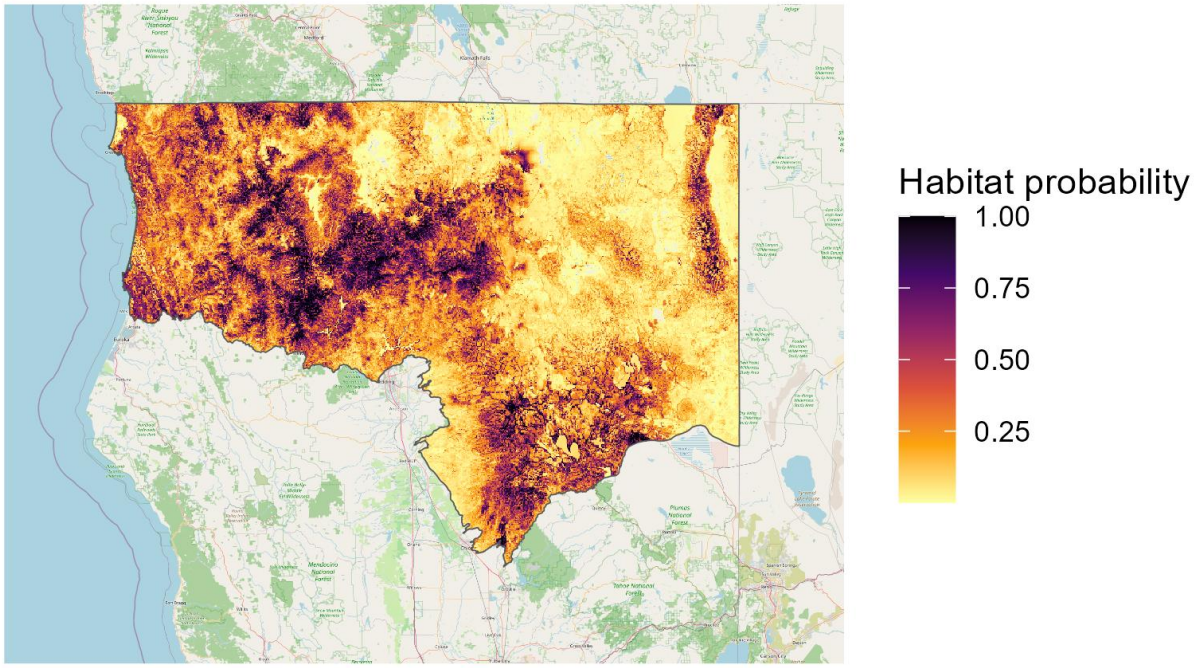

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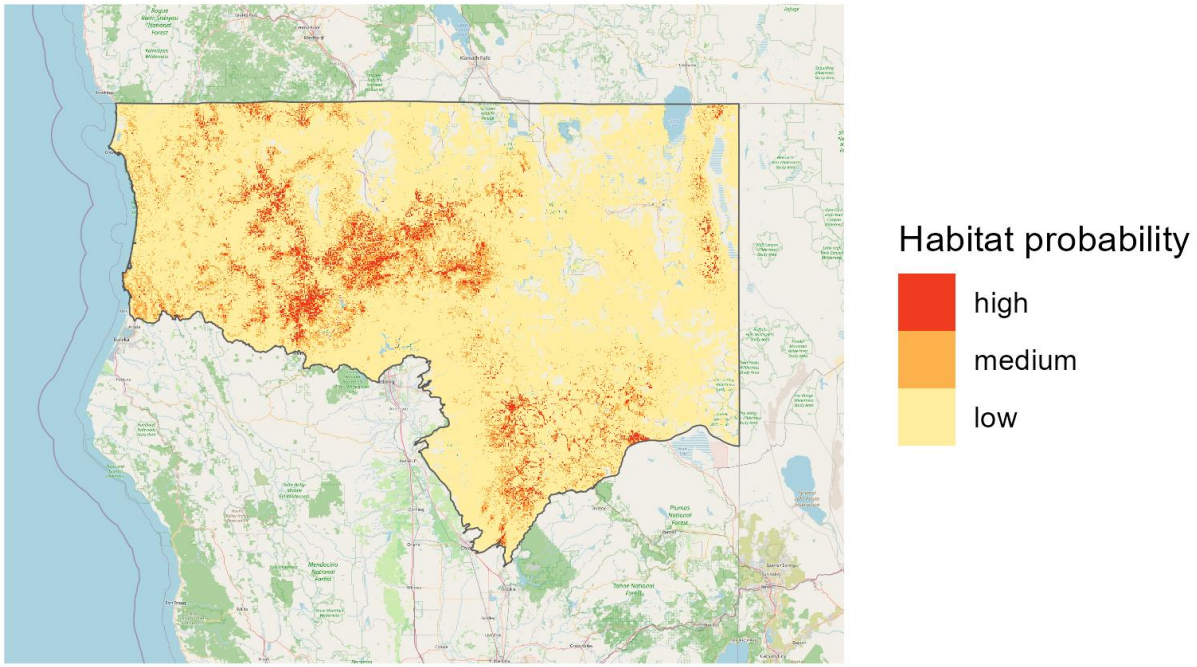

Categorical SHM Thresholds

Table 2. Statistical thresholds chosen to represent the categorical SHM.

Category	Threshold Selected	Threshold Value
low	Minimum Training Presence	0.0247800
medium	Maximum Sensitivity Plus Specificity	0.4061800
high	Top 25% of habitat probability values above medium threshold	0.7656717

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all_water90	Water prevalence at a 90 m radius	USGS National Hydrography Dataset Plus Version 2, CDFW, Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CARI 2024, CropScape 2022, Cal Fire FRAP 2025
riparian90	Riparian habitat prevalence at a 90 m radius	Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CDFW, Cal Fire FRAP 2025
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fv_conall90	FVEG all conifer prevalence at a 90 m radius	Cal Fire FVEG 2022
fv_shruball90	FVEG all shrub prevalence at a 90 m radius	Cal Fire FVEG 2022
forestloss	Forest loss during the period 2000-2024	Global Forest Change 2024
burn_severity	Burn severity from 1984-2024 at a 90 m radius	MTBS

Charina bottae bottae

Northern Rubber Boa (Sierra)

California Department of Fish and Wildlife
Range and Distribution Mapping and Analysis Project (RADMAP)
Species Habitat Model (SHM) assessment metrics and metadata Star Rating: 4 out of 5

Date: 2026-05-01

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Presence	RM	FC	AUC	AUCdiff	Threshold	TSS	OER
647	5	lpqht	0.8473419	0.05961981	P0	0.560425	0

Percent Contribution of Covariates

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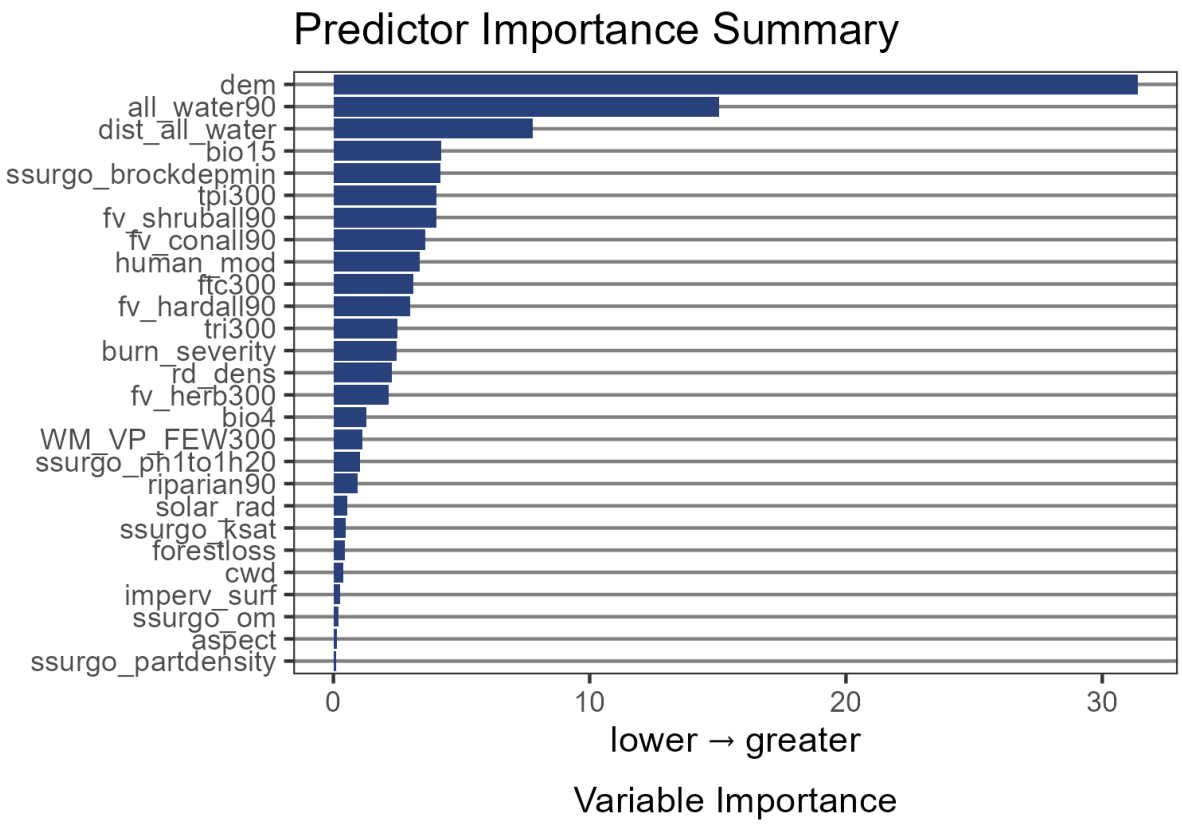

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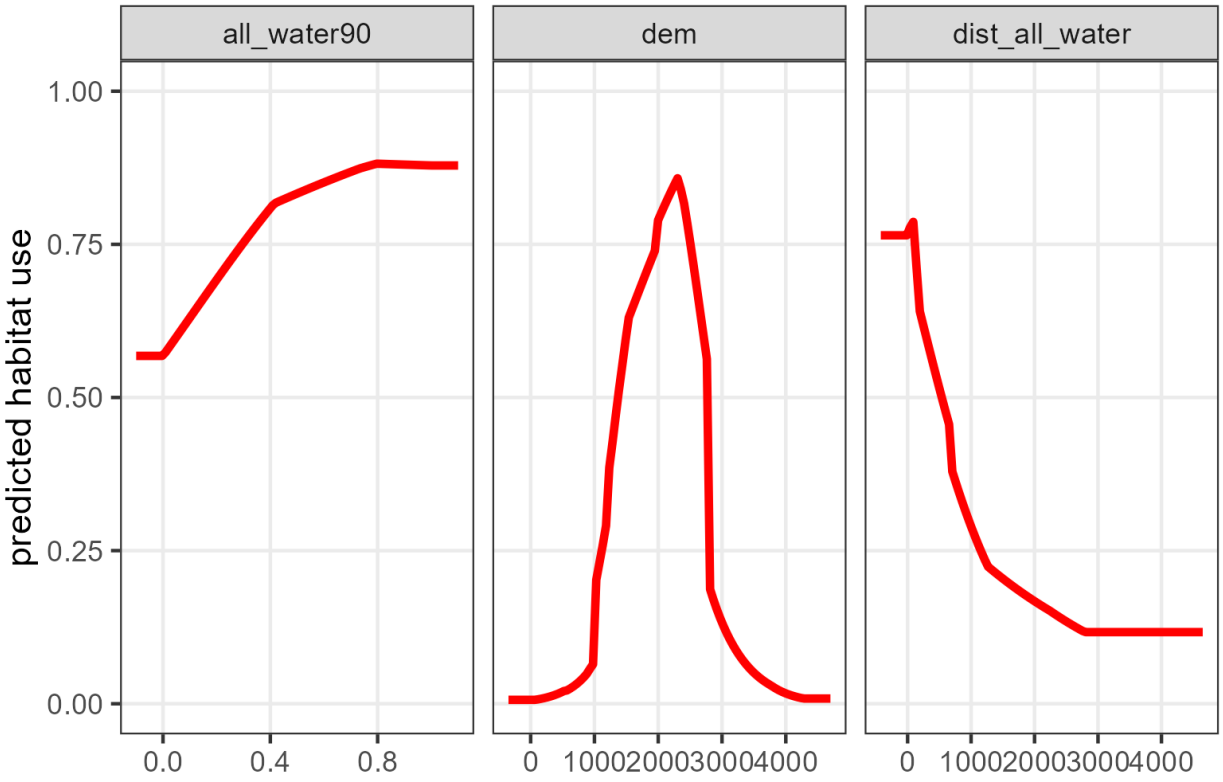

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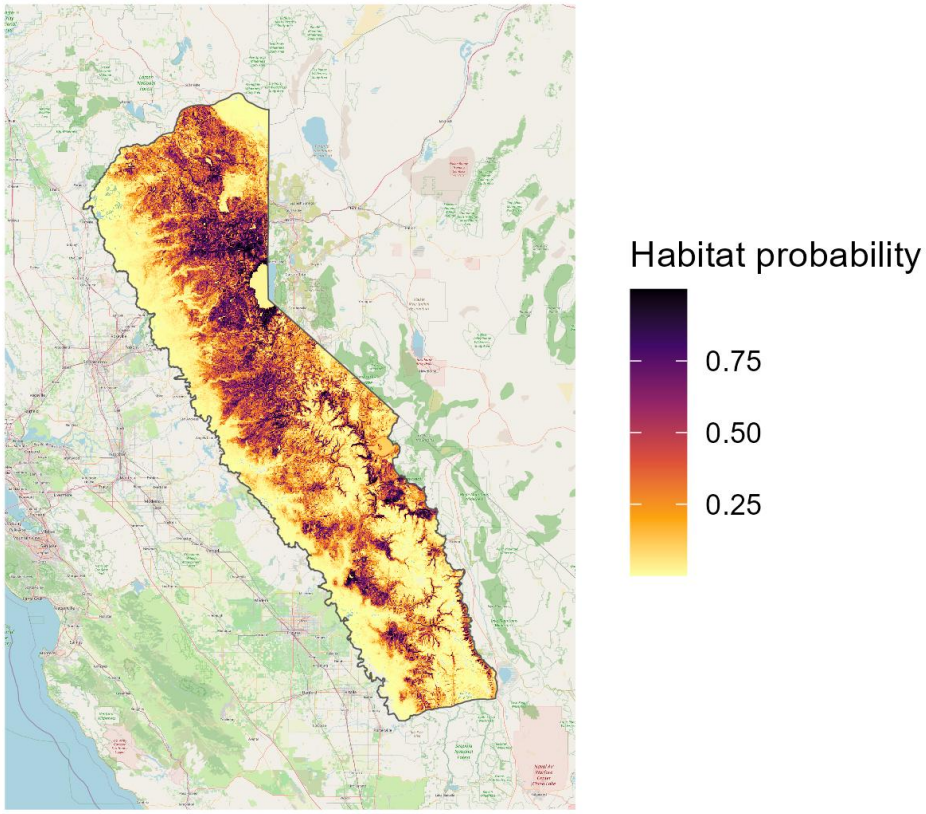

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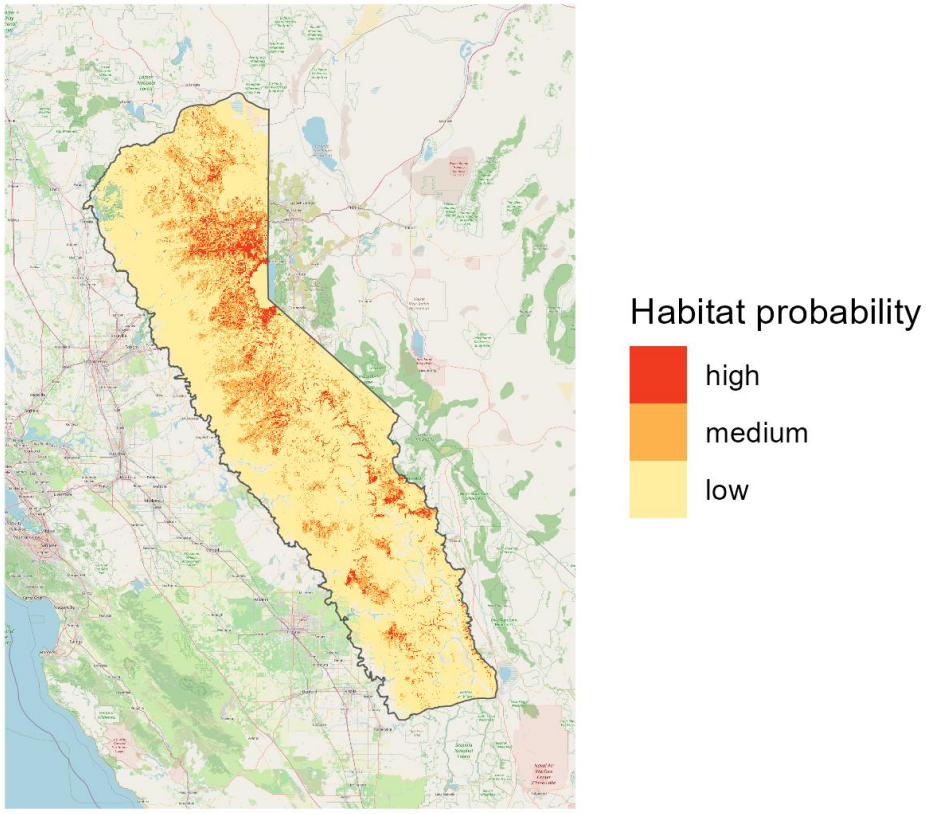

Categorical SHM Thresholds

Table 2. Statistical thresholds chosen to represent the categorical SHM.

Category	Threshold Selected	Threshold Value
low	Minimum Training Presence	0.0036300
medium	Maximum Sensitivity Plus Specificity	0.3021900
high	Top 25% of habitat probability values above medium threshold	0.6527728

Model Evaluation

Table 3. The final model evaluation score, represented as a star rating (1-5) is presented at the top of this metadata. Star ratings are comprised of three distinct components, including an expert review, a modeler review, and an AUC score. Experts review models based on predictor relevance and the overall accuracy of the continuous and categorical SHM outputs. Modelers provide a review of presence data, predictor relevance, performance evaluation, spatio-temporal data alignment, model review status, and the overall accuracy of the continuous and categorical SHM outputs. Along with the AUC score, these three inputs are normalized and given an equal weight before being converted into a categorical star rating. The table below provides a basic descriptive meaning of the star rating provided for this model, taking into account the subjective expert and modeler review scores as well as the objective AUC evaluation.

Star Rating	Brief Description
1	Poor representation of habitat. Habitat for this species is unlikely to be successfully mapped using standard habitat modeling approaches given unique species traits.
2	Significant concerns. A large proportion of the map shows habitat in areas where the species is unlikely to occur or does not predict habitat where the species is known. Revisions are needed before the model is used for any formal application or decision, with the possible exception of guiding inventory.
3	Some concerns about model performance in specific areas. The model would benefit from additional refinement, but the general pattern of mapped habitat is consistent with expert expectations
4	Model generally good. Potential for further improvement through additional iteration but provides a good approximation of likely habitat.
5	Modeled habitat is a very good representation of likely habitat. Further iteration is unlikely to result in significant improvements.

Covariate Descriptions

Table 4. Descriptions of environmental variables included in model. Covariates were chosen for inclusion in the model based on a literature review, their potential for ecological relevance to the focal taxon, and advice from applicable experts. Focal statistics were calculated for certain habitat covariates at the 90, 300, 900, 3,000, and 6,000-m radii scales to assess species' scale dependency. Only one covariate per set of scales were included in the covariate candidate set. Other covariates were extracted at the raster cell's resolution (30-m) unless otherwise specified.

The entire covariate library including full citations is available here: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=232517

Covariate Name	Covariate Description	Source
aspect	Aspect	Digital Elevation Model, USGS Earth Explorer
bio4	Temperature seasonality	USGS Basin Characterization Model
bio15	Precipitation seasonality (coefficient of variation)	USGS Basin Characterization Model
dem	Digital elevation model	USGS Earth Explorer
imperv_surf	Impervious surfaces	NLCD-MRLC
cwd	Climatic water deficit	USGS Basin Characterization Model
rd_dens	Road density within a 3 km radius	US Census TIGER/Line data
tpi300	Topographic position index at a 300 m radius	USGS Earth Explorer
tri300	Terrain ruggedness index at a 300 m radius	USGS Earth Explorer
ftc300	Fractional tree cover at a 300 m radius	Center for Ecosystem Climate Solutions
fv_herb300	FVEG herbaceous prevalence at a 300 m radius	Cal Fire FVEG 2022
ssurgo_partdensity	Soil density	NRCS SSURGO
ssurgo_om	The amount by weight of decomposed plant and animal residue	NRCS SSURGO

Covariate Name	Covariate Description	Source
ssurgo_ksat	Amount of water that would move vertically through soil	NRCS SSURGO
human_mod	Human modification of terrestrial lands	Theobald et al., 2020
solar_rad	Solar radiation	Digital Elevation Model, USGS Earth Explorer
dist_all_water	Distance to all water	USGS National Hydrography Dataset Plus Version 2, CDFW, Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CARI 2024, CropScape 2022, Cal Fire FRAP 2025
all_water90	Water prevalence at a 90 m radius	USGS National Hydrography Dataset Plus Version 2, CDFW, Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CARI 2024, CropScape 2022, Cal Fire FRAP 2025
riparian90	Riparian habitat prevalence at a 90 m radius	Cal Fire FVEG 2022, USFWS National Wetlands Inventory 2024, CDFW, Cal Fire FRAP 2025
fv_hardall90	FVEG all hardwood prevalence at a 90 m radius	Cal Fire FVEG 2022
fv_conall90	FVEG all conifer prevalence at a 90 m radius	Cal Fire FVEG 2022
fv_shruball90	FVEG all shrub prevalence at a 90 m radius	Cal Fire FVEG 2022
forestloss	Forest loss during the period 2000-2024	Global Forest Change 2024
burn_severity	Burn severity from 1984-2024 at a 90 m radius	MTBS