

To Be or Not to Be: The Fate of Ten Amphibians in the Sierra Nevada in a Warming Climate

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Environmental Science, Class of 2019





Amphibians

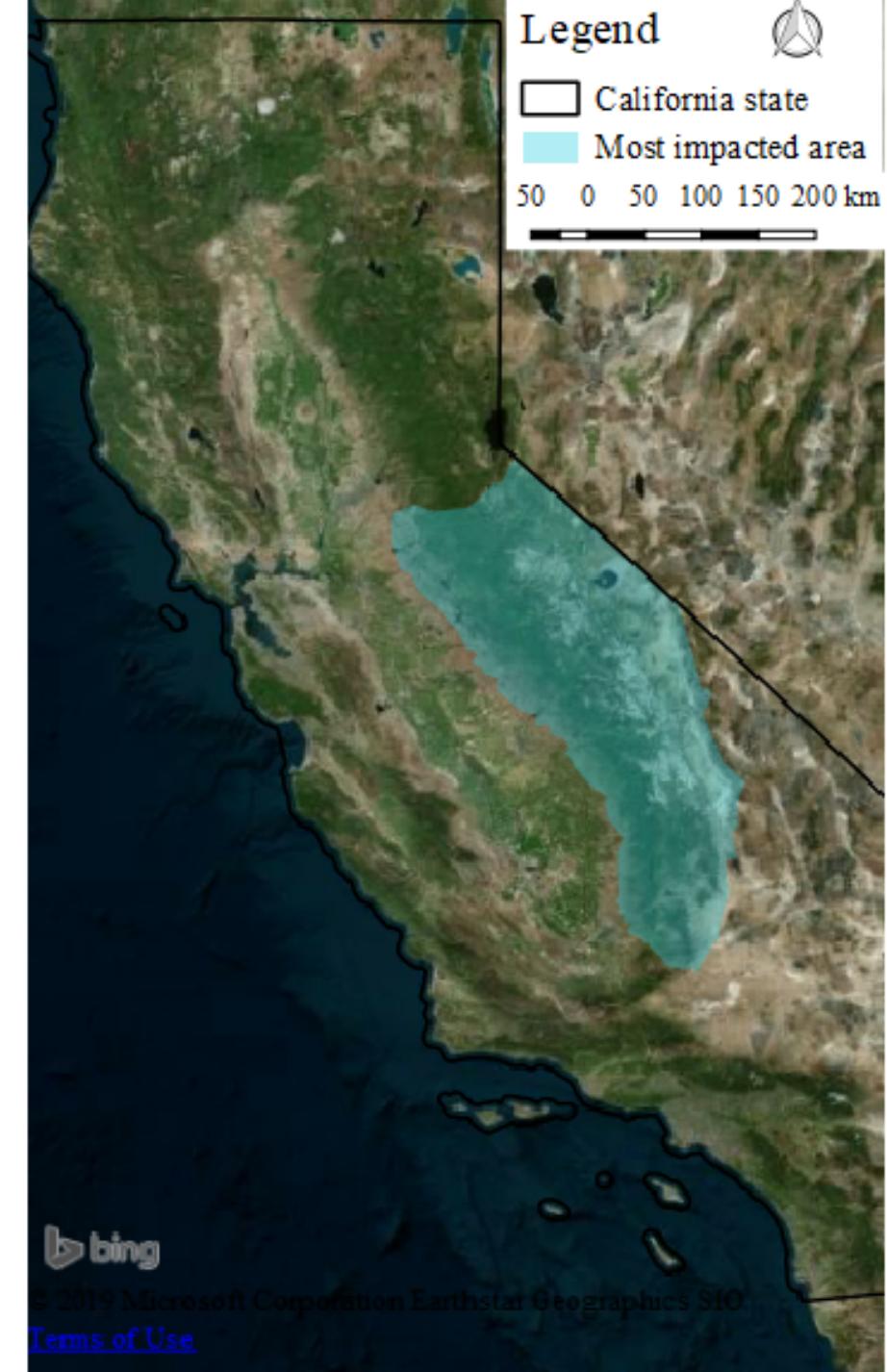


Amphibians in California

In California



At Risk



Legend



California state

Most impacted area

50 0 50 100 150 200 km

Amphibians in California



What might drive the factors for *Rana sierrae*'s decline?

VOTE BELOW

Climate Change:
|||||

Pesticide and Agricultural Chemical Use:
|||

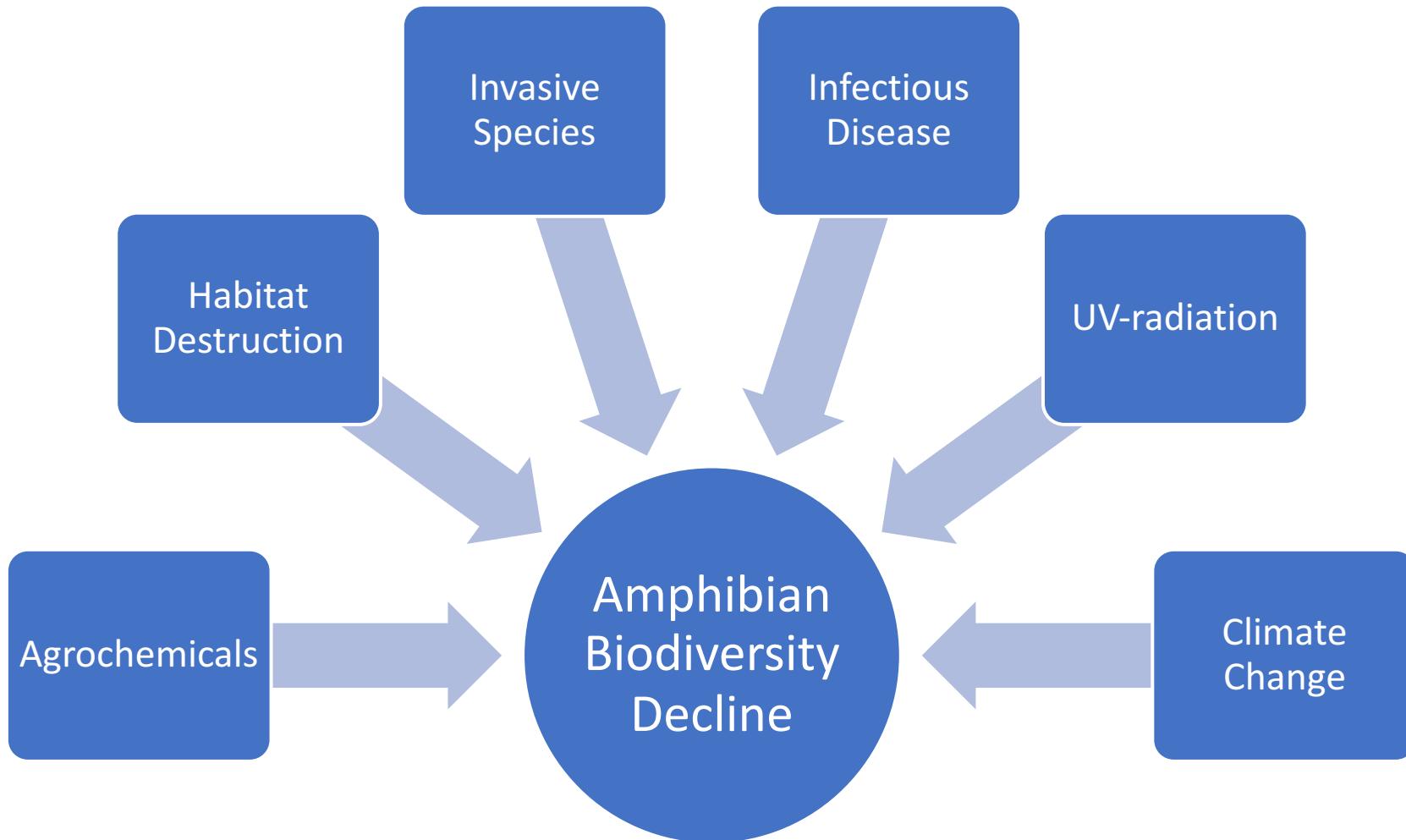
Introduced Species:
||

UV-radiation Exposure:
|||

Habitat Destruction:
|||

STAPLES 200

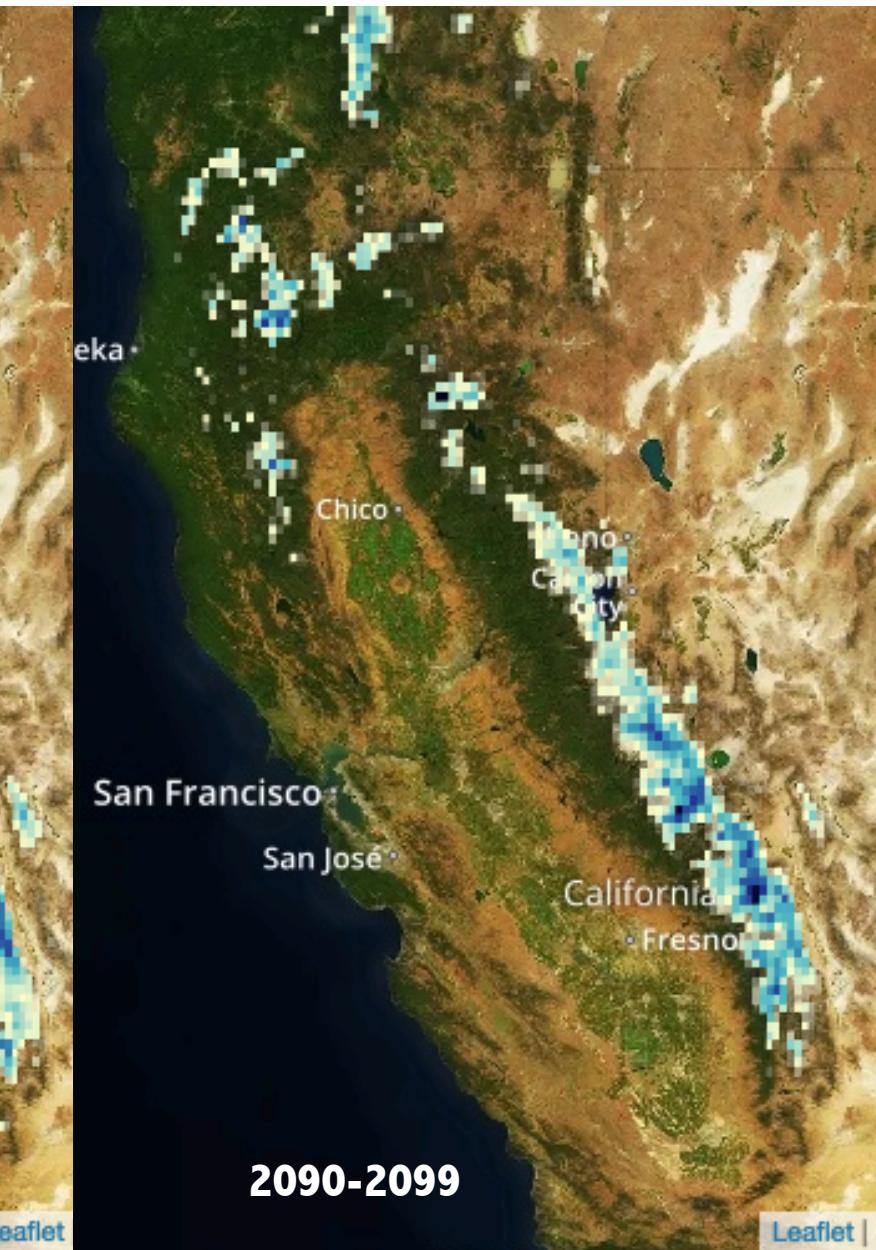
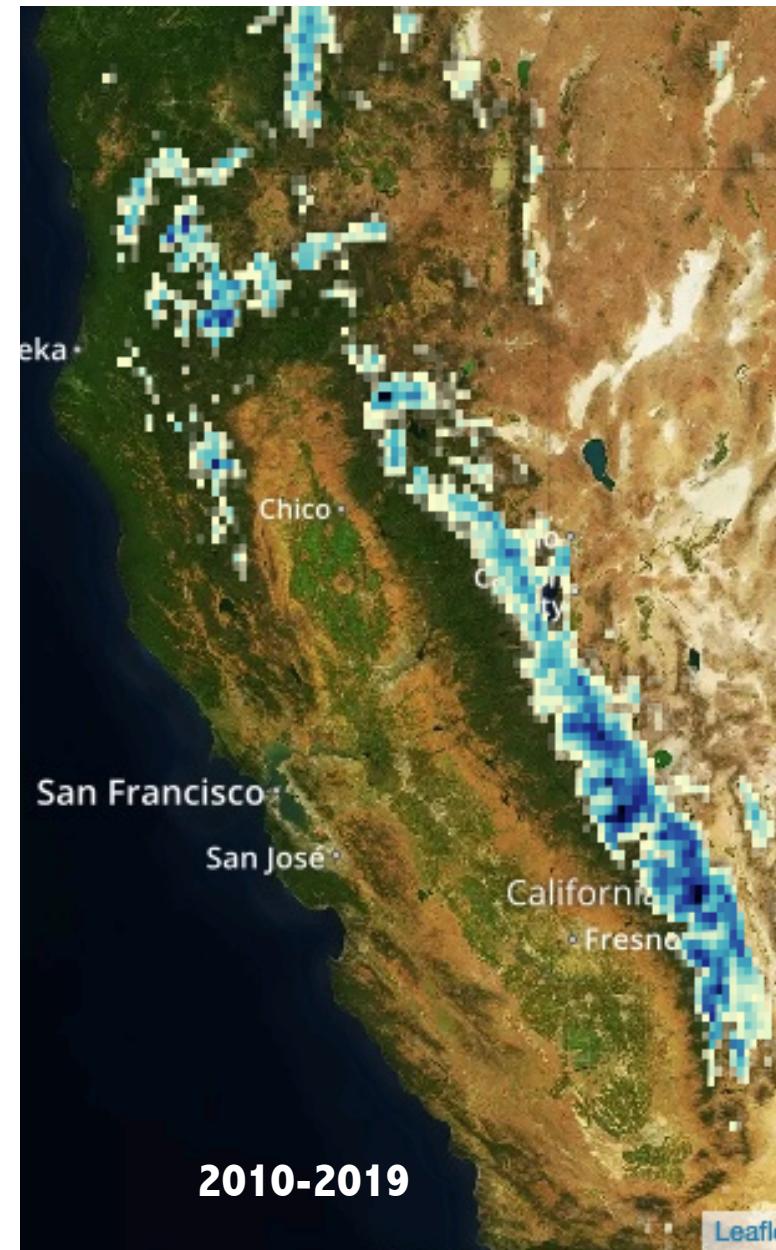
Amphibian in California



Climate Change and Snowpack

- Relation to amphibians
 - Water supply of temporary pools
 - Breeding
 - Metamorphosis

Snow Water Equivalence
April



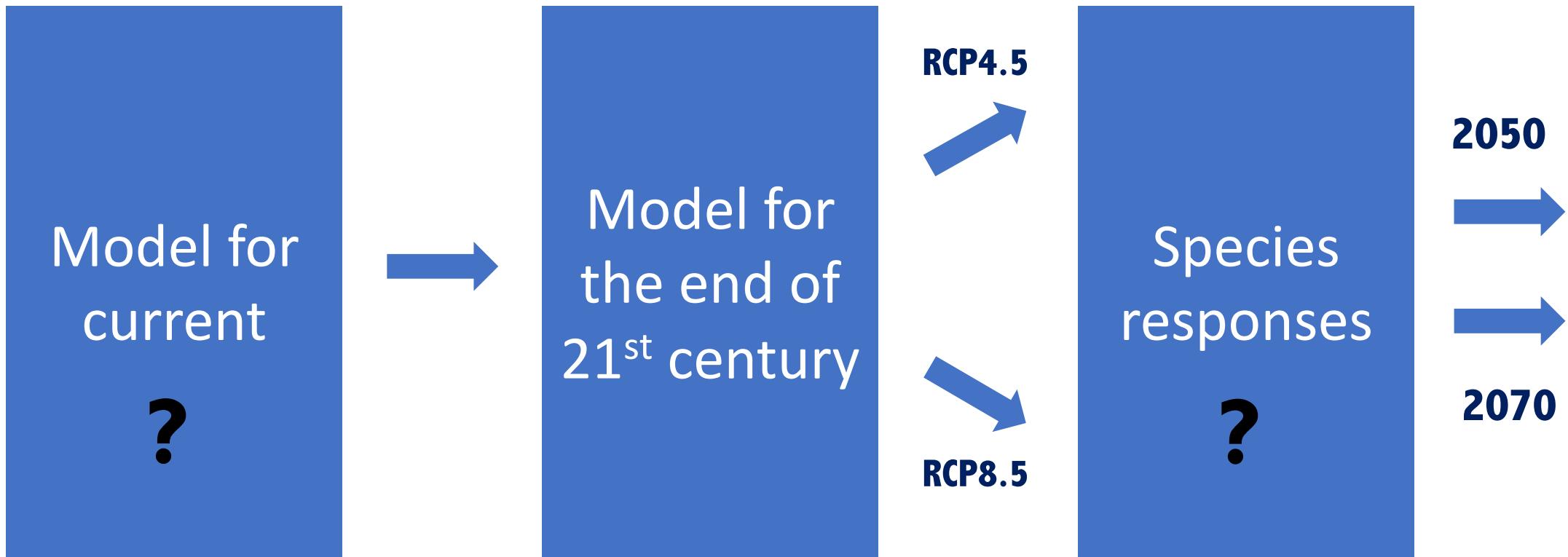
RESEARCH QUESTION

How might the distribution of ten Sierra Nevada
amphibians change under two climate change scenarios?

Model for
current
?

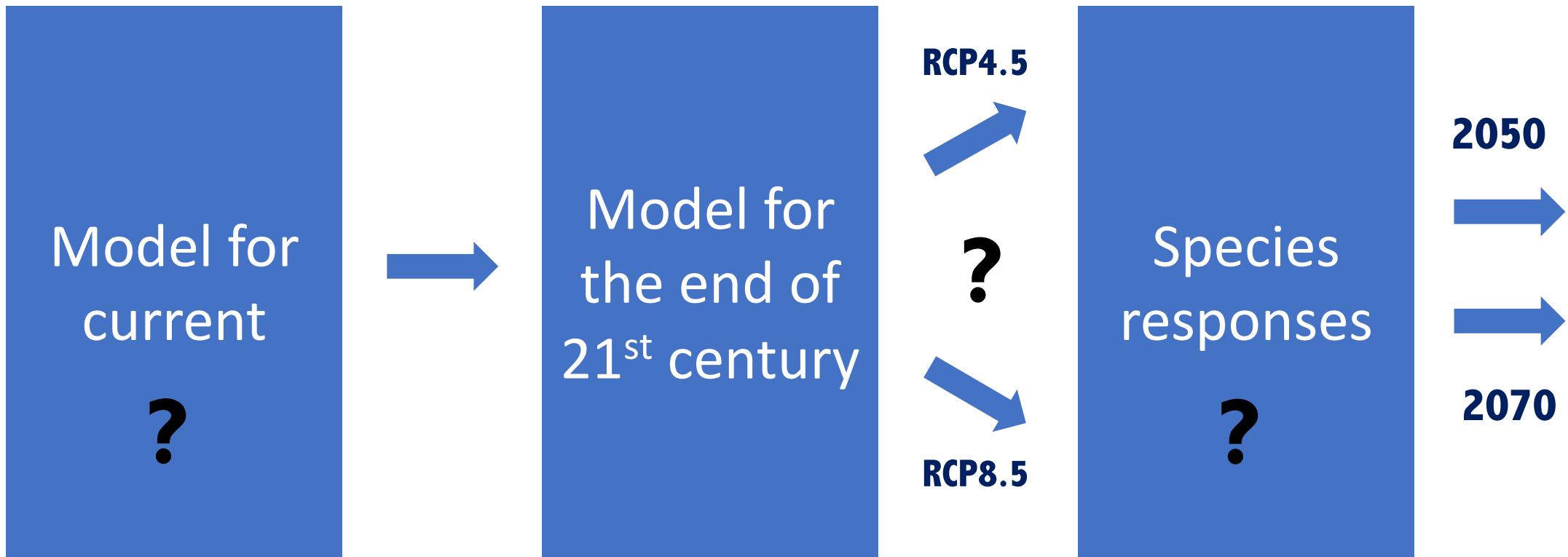
RESEARCH QUESTION

How might the distribution of ten Sierra Nevada
amphibians change under two climate change scenarios?



RESEARCH QUESTION

How might the distribution of ten Sierra Nevada amphibians change under two climate change scenarios?



Study Species

<i>A. macrodactylum</i>	<i>T. sierae</i>	<i>B. gregarius</i>	<i>H. platycephalus</i>	<i>A. boreas</i>
Least Concern	Least Concern	Least Concern	Least Concern	Least Concern
				

<i>R. cascadae</i>	<i>R. boylii</i>	<i>R. muscosa</i>	<i>R. sierrae</i>	<i>A. canorus</i>
Near Threatened	Near Threatened	Endangered	Endangered	Endangered
				

Species Distribution Modeling



Sierra Nevada
Conservancy
(SNC)

Environmental
Layers

Species
Occurrence

Maxent

Arctos
database

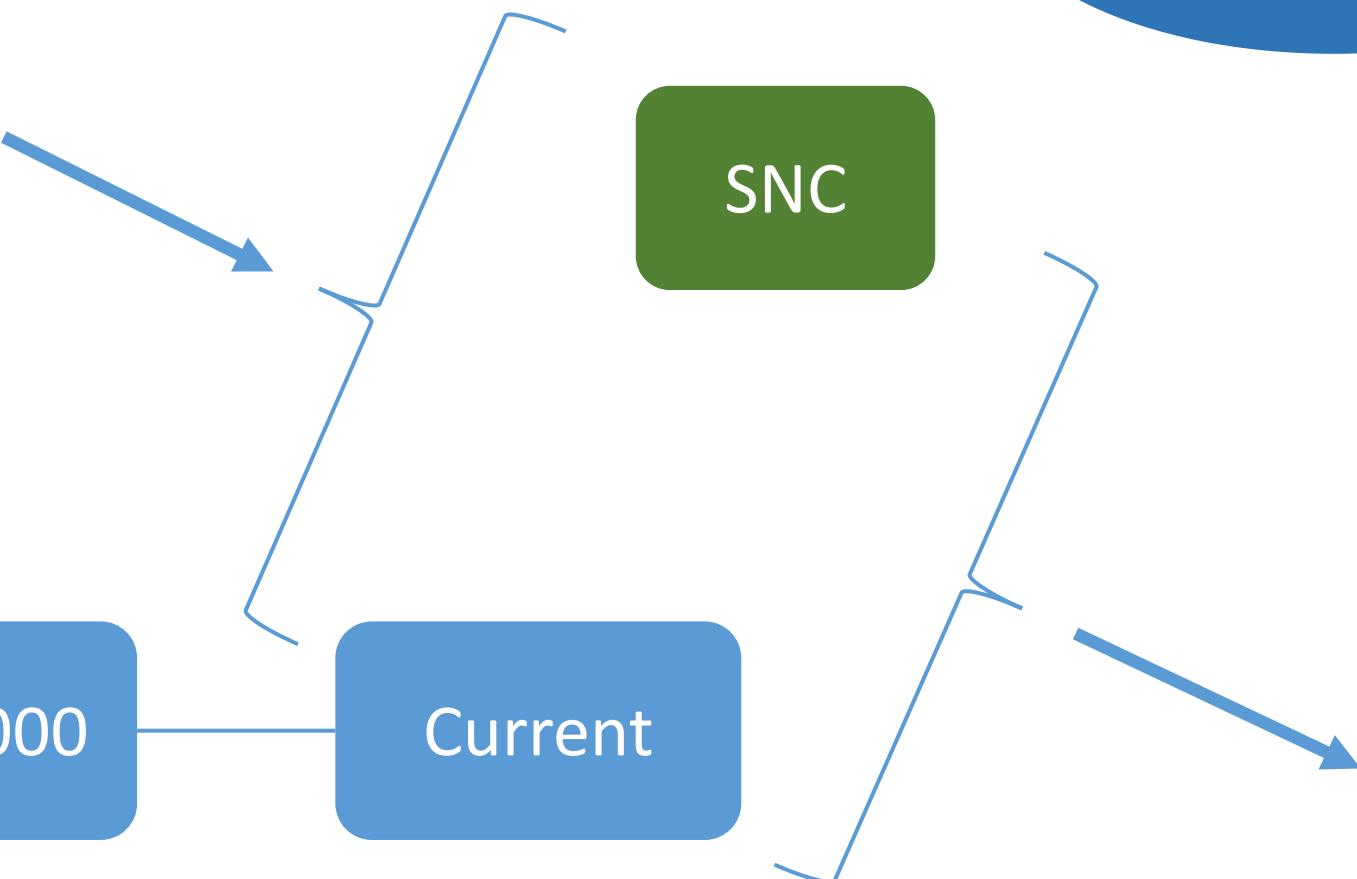
1950 - 2000

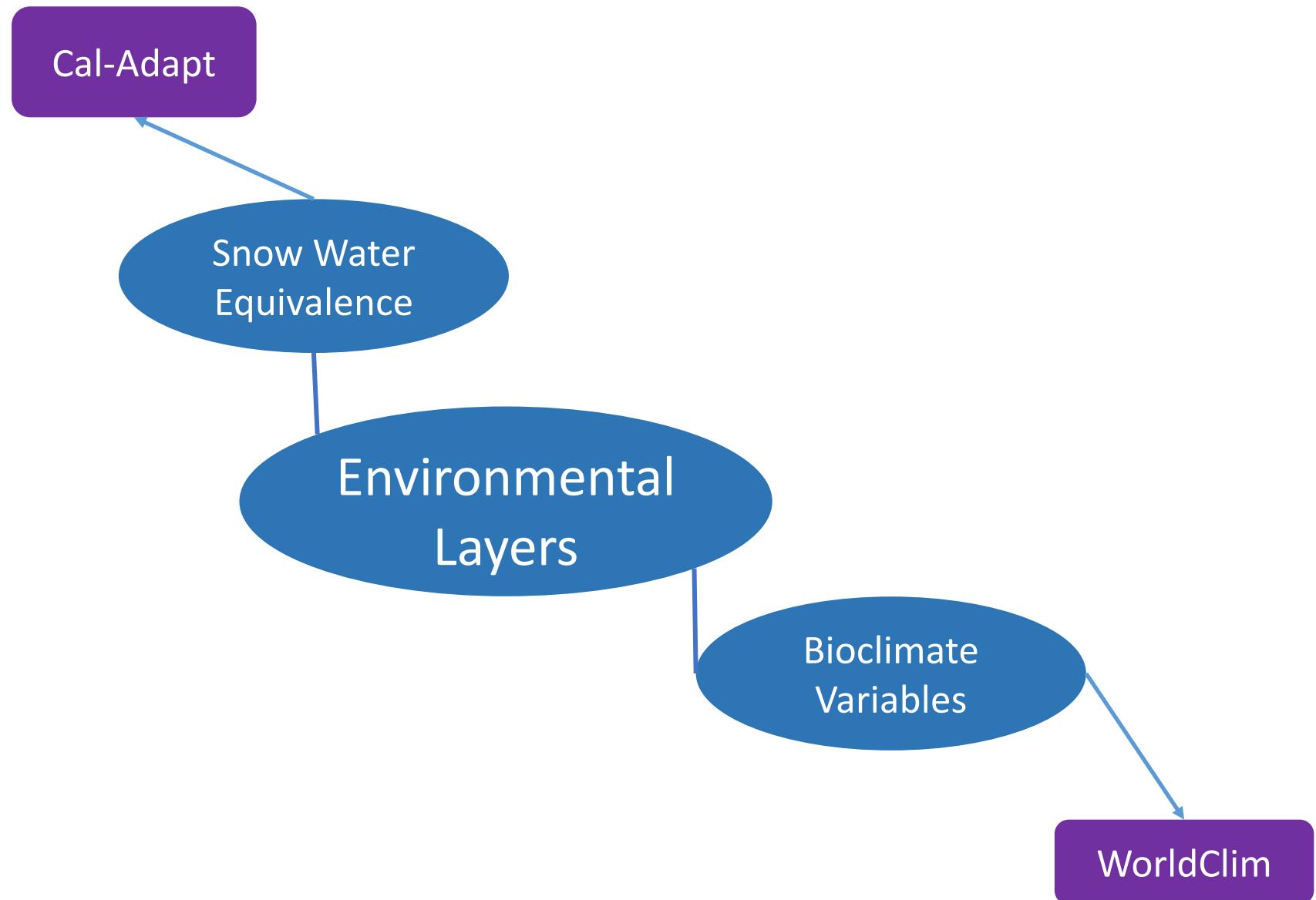
Current

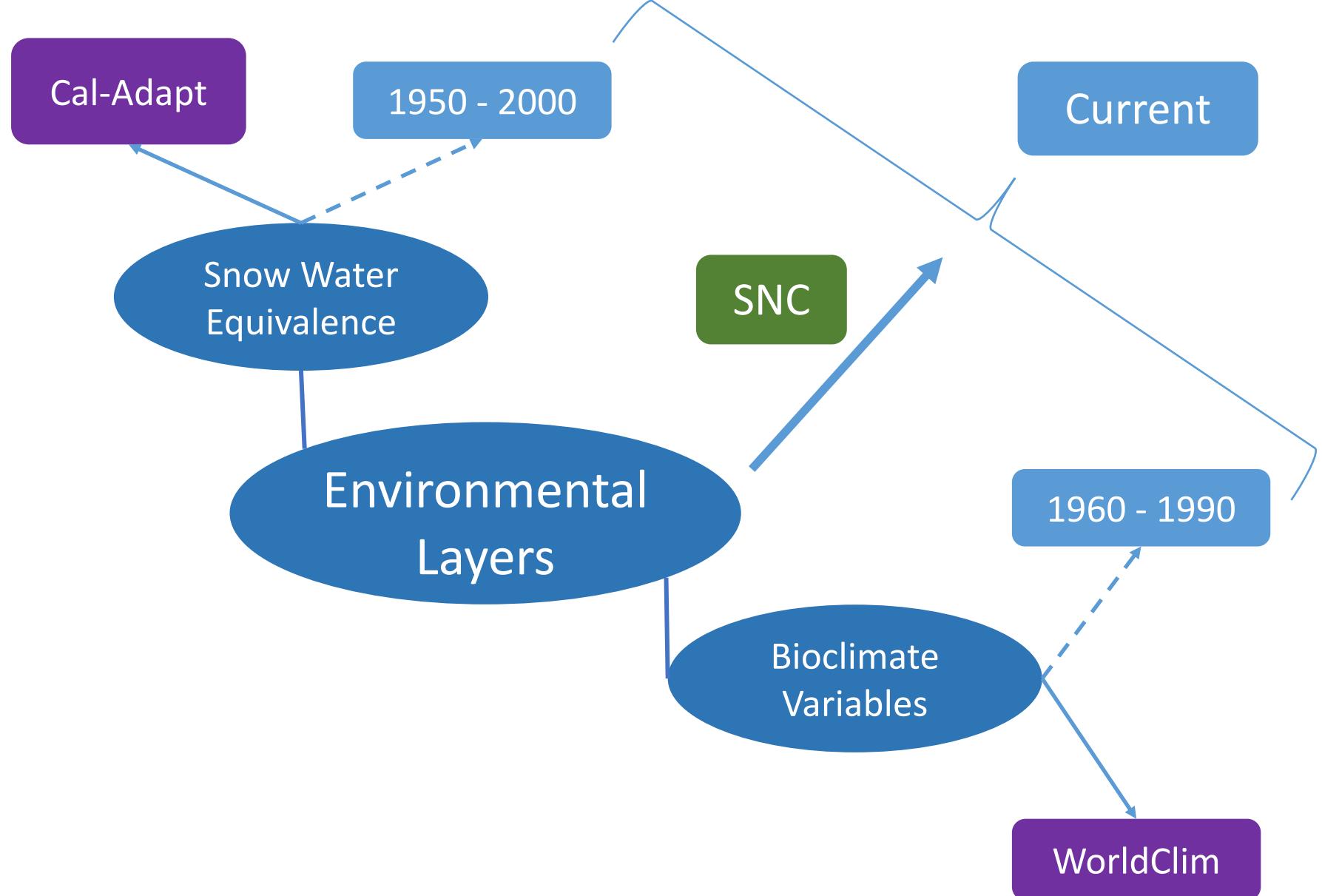
SNC

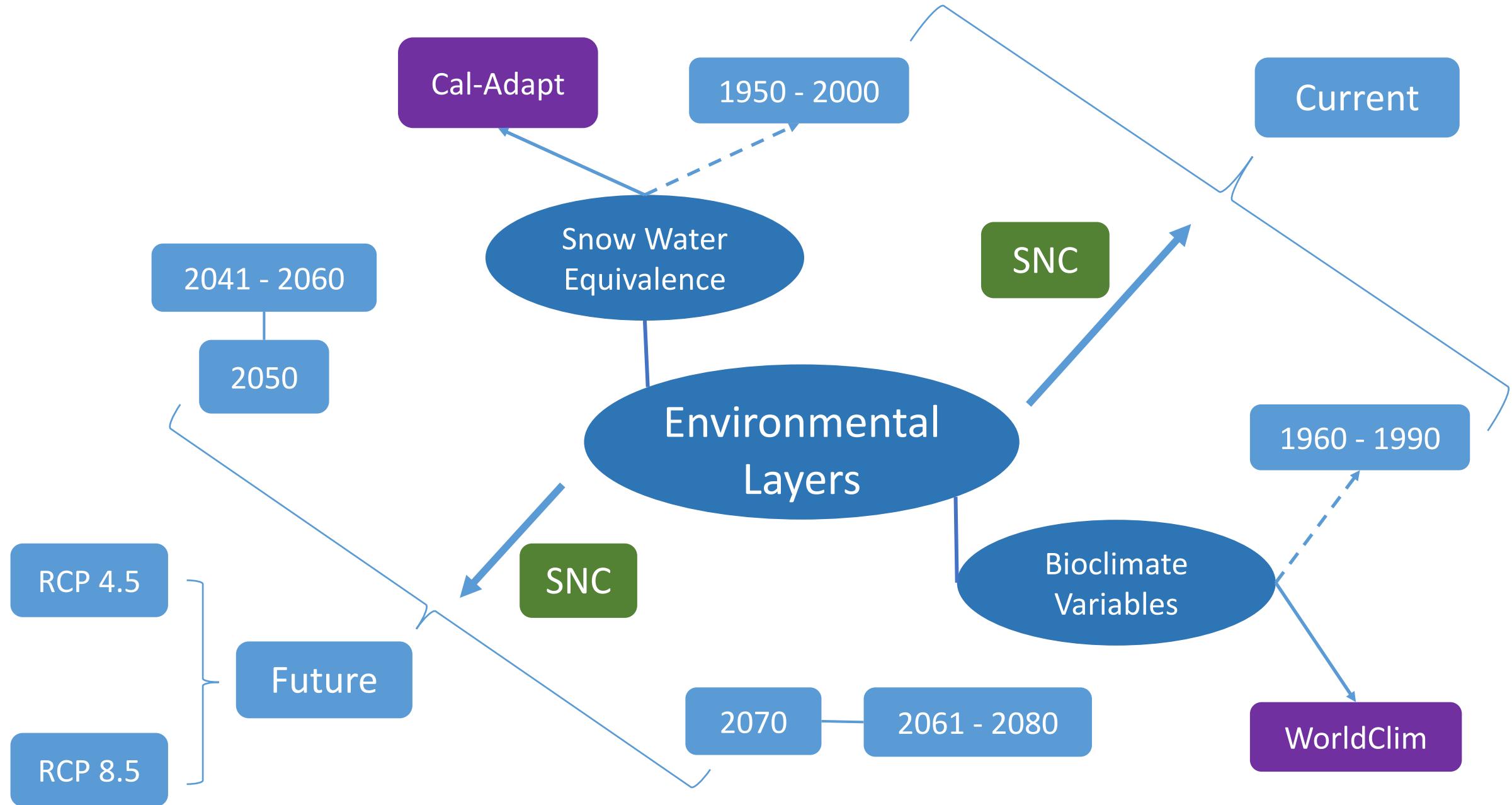
Species
Occurrence

remove
outliers or
errors







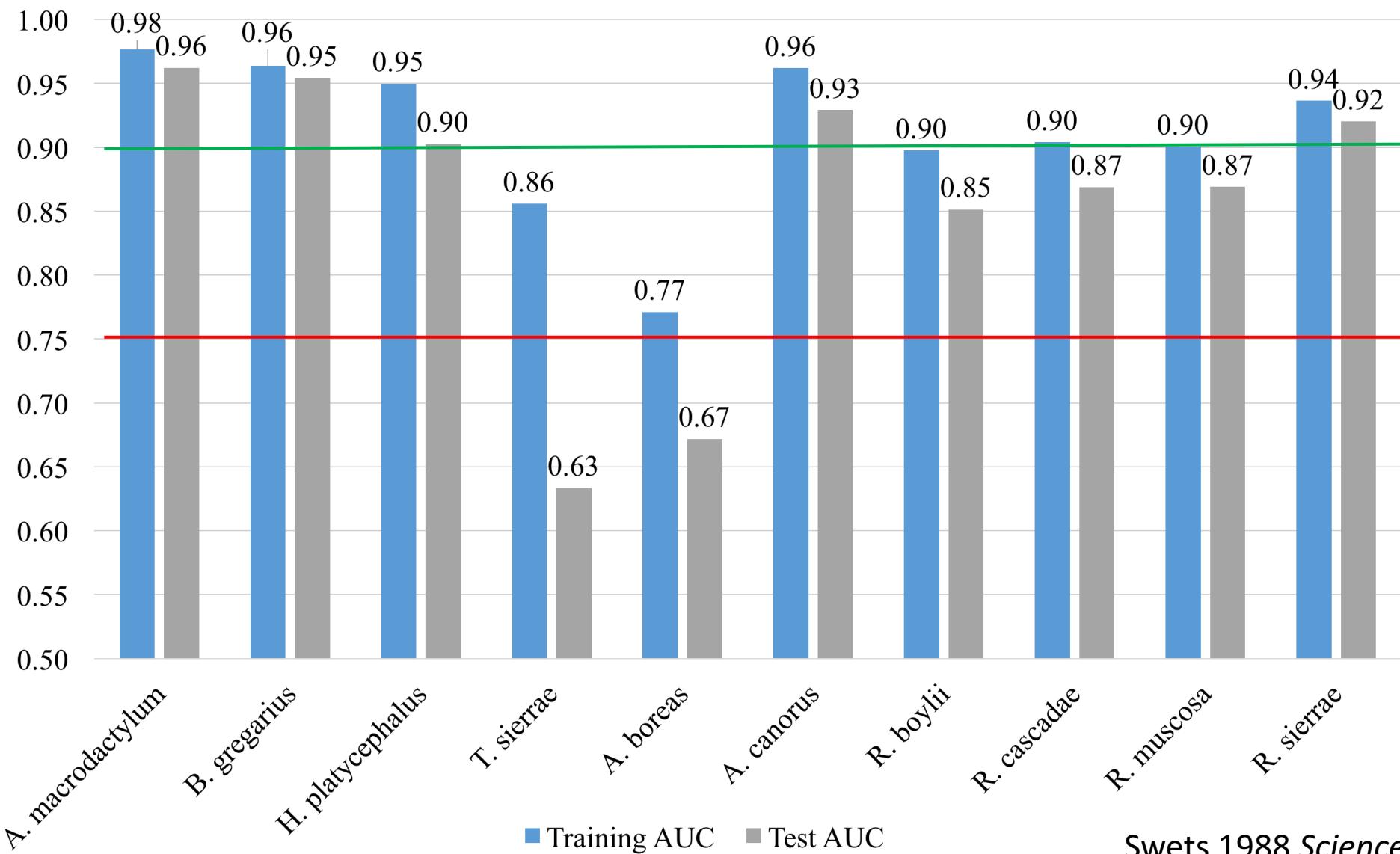


Results

Model for
current

?

Model Performance under Current Climate and Snowpack Levels

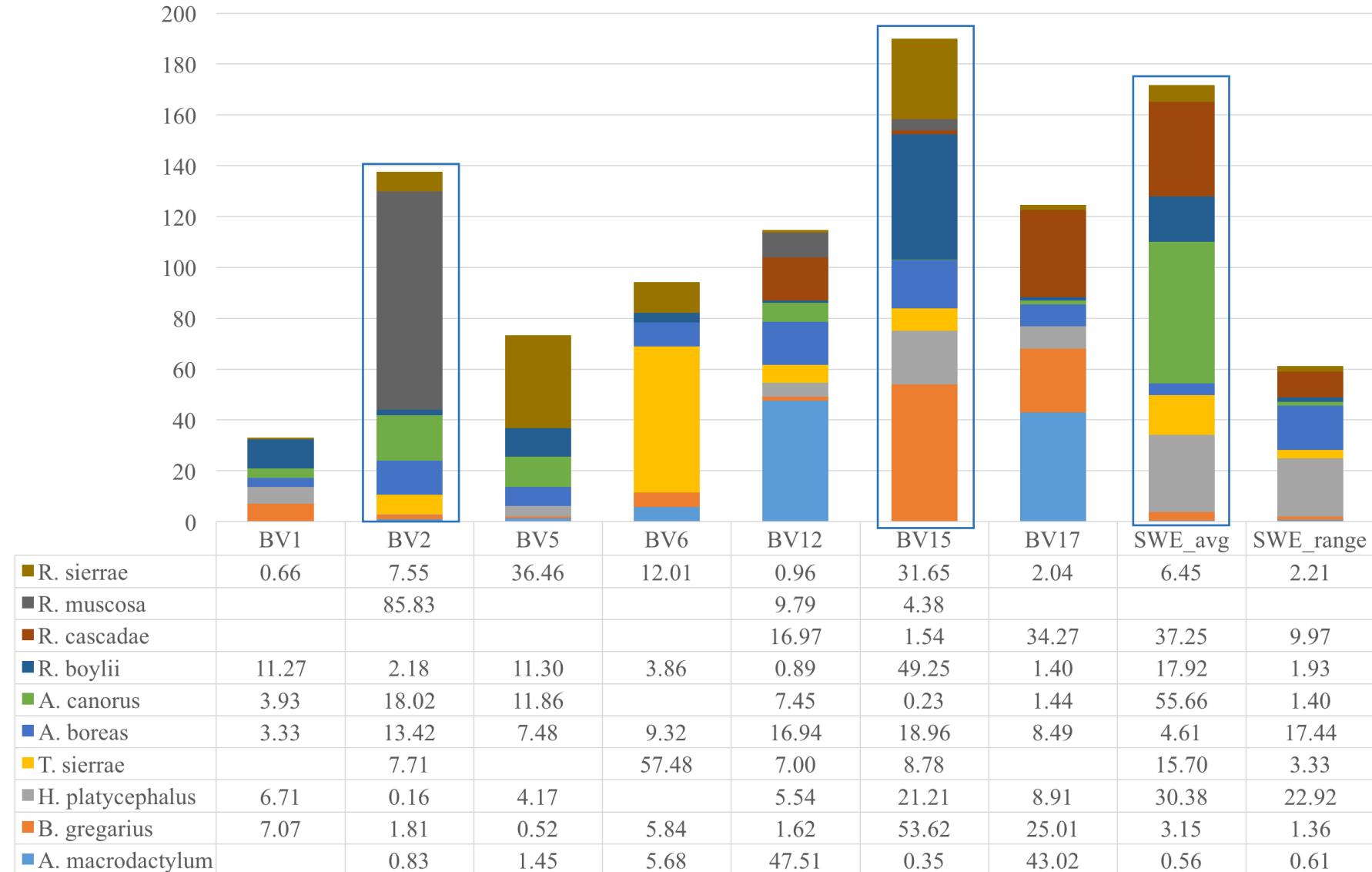


Results

Model for
current

?

Contribution of Environmental Predictors to Current Species Distribution

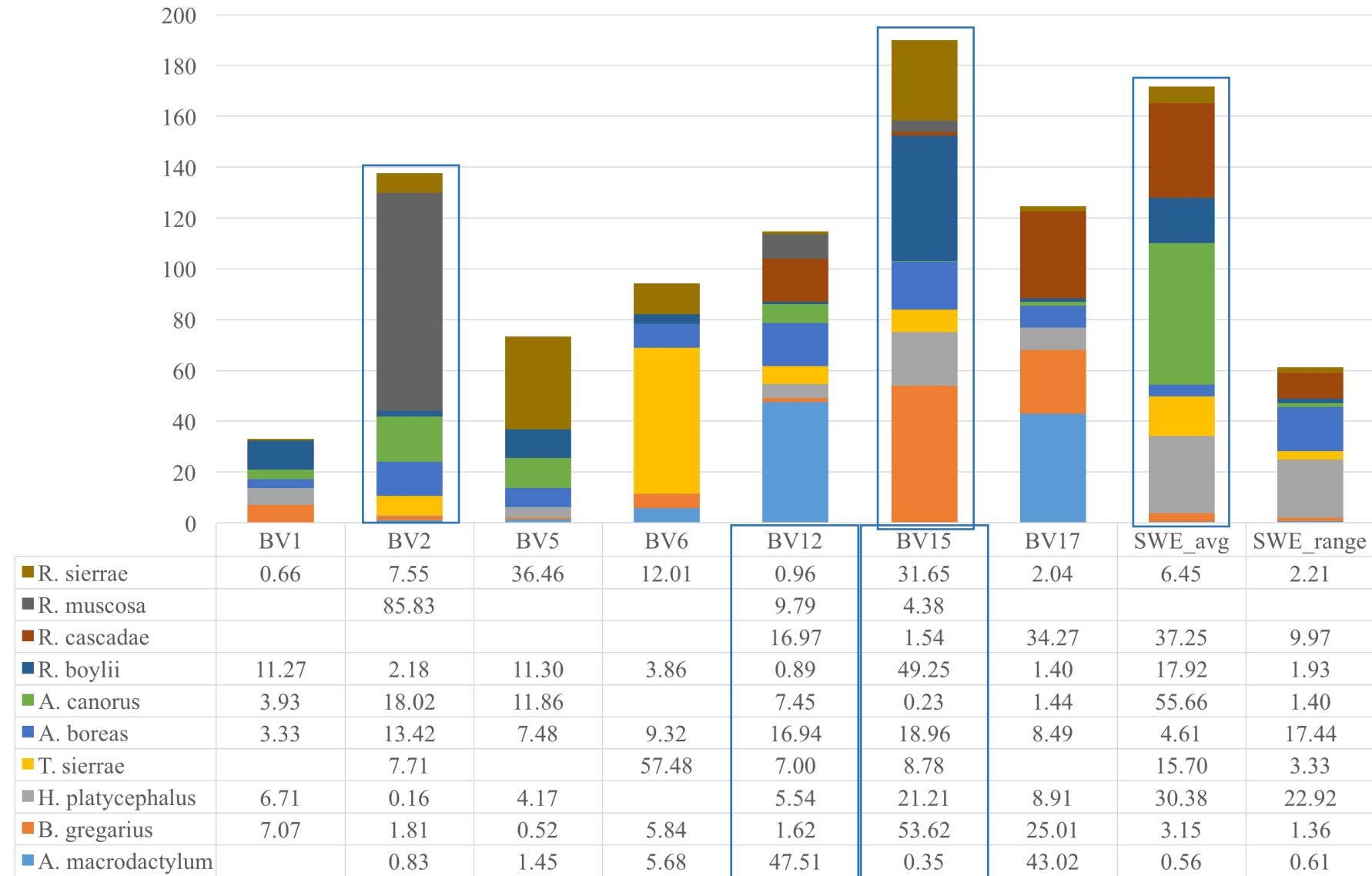


Results

Model for
current

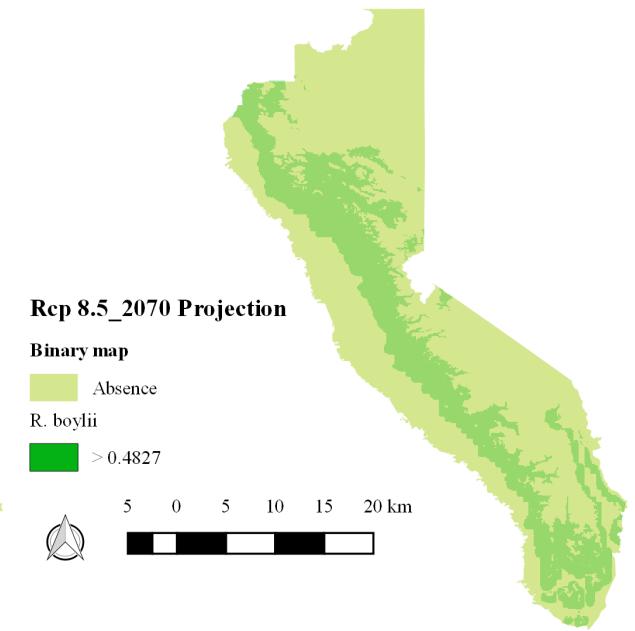
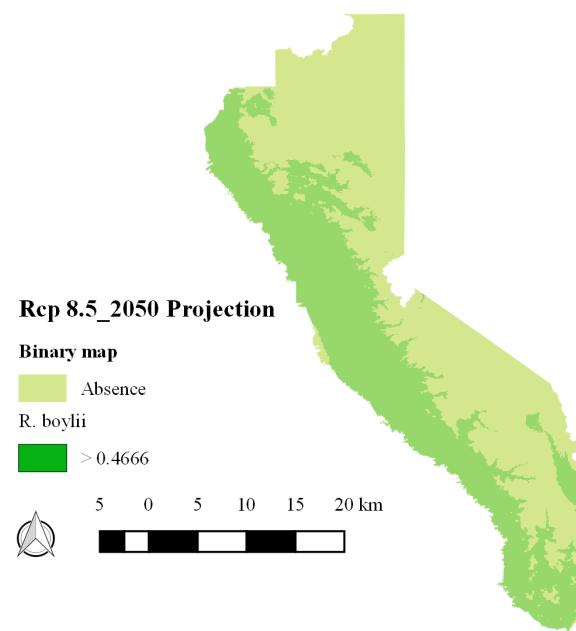
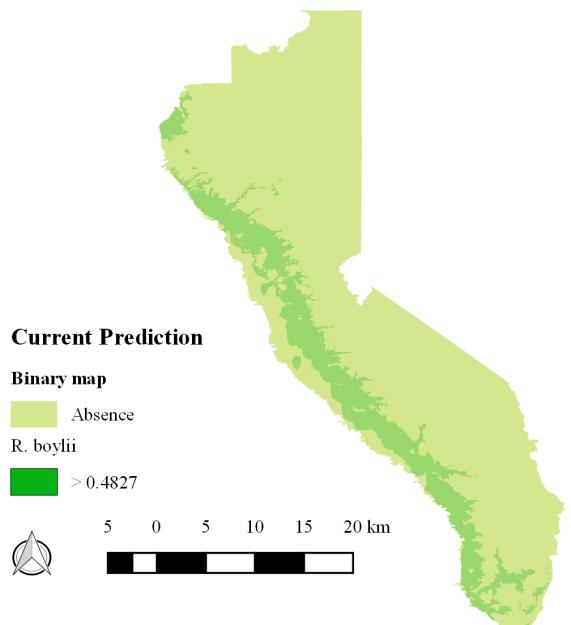
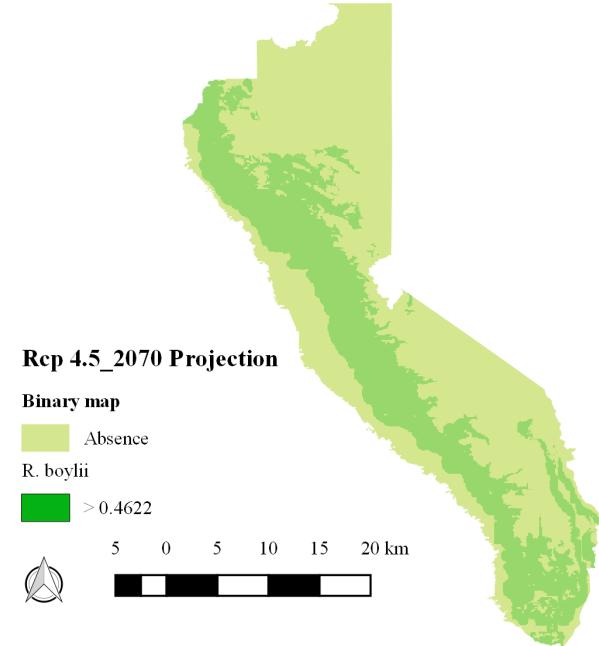
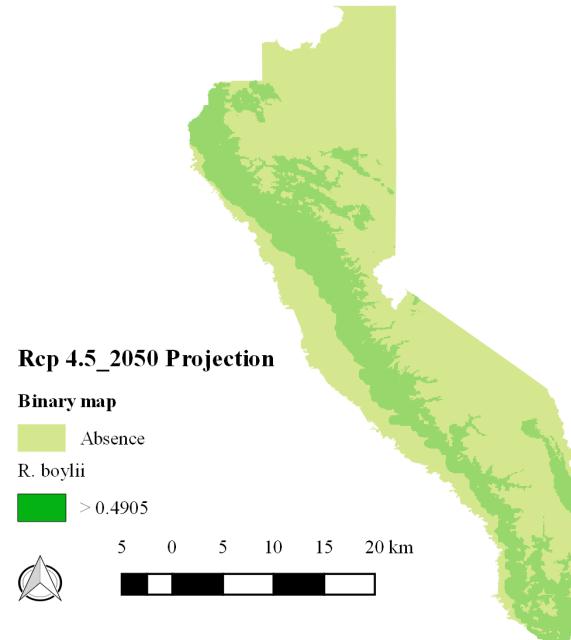
?

Contribution of Environmental Predictors to Current Species Distribution



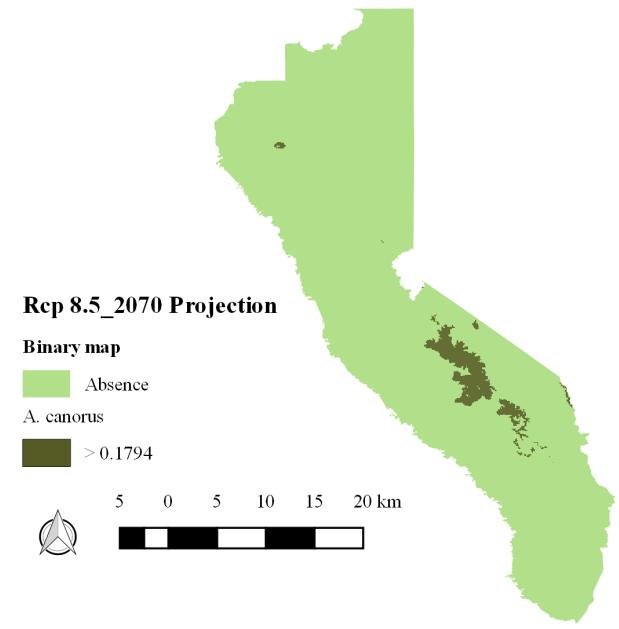
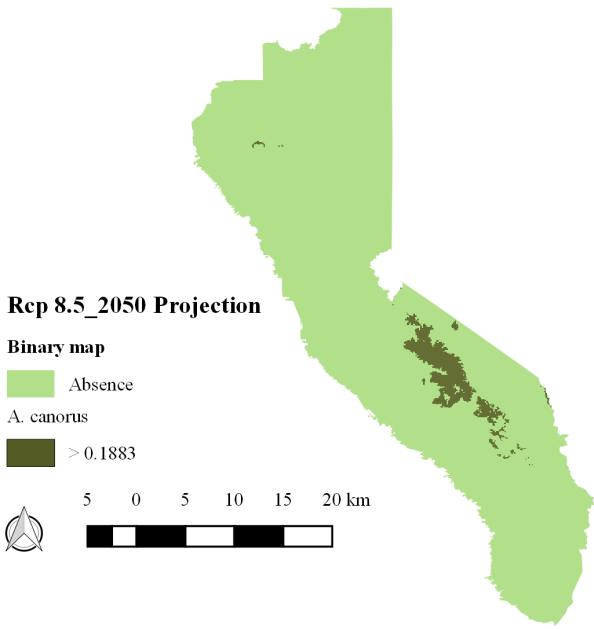
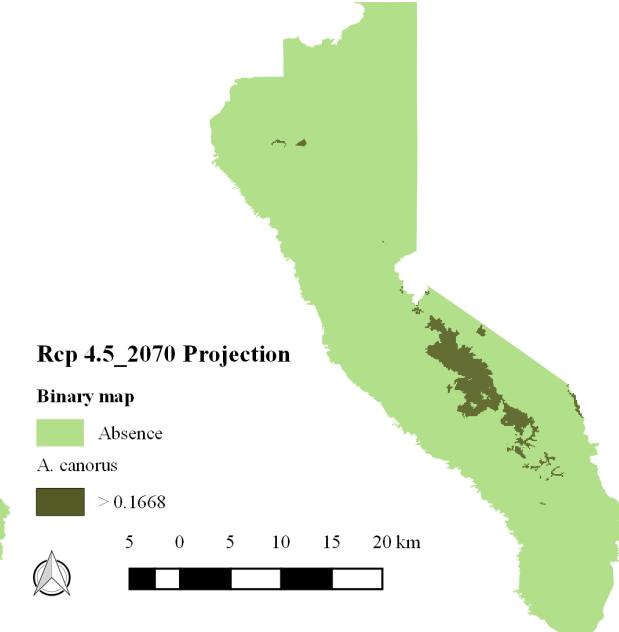
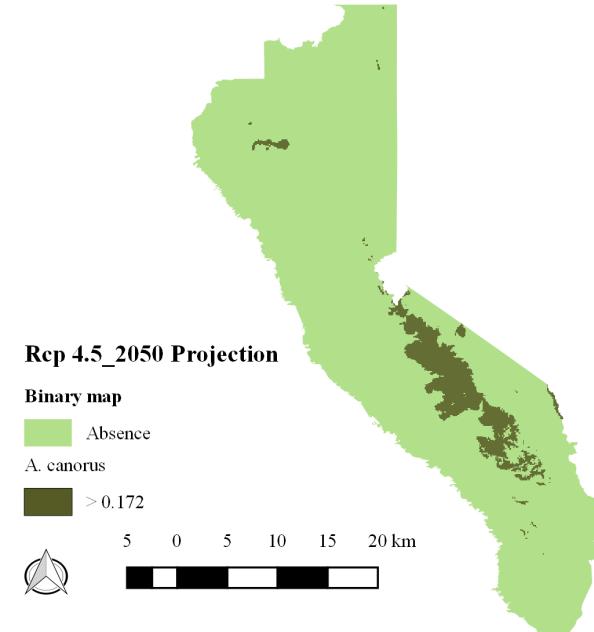
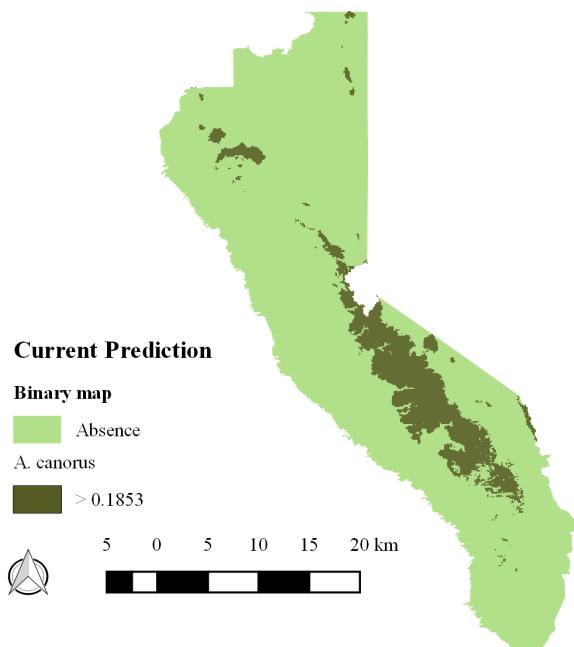
Results

Rana boylii



Results

Anaxyrus canorus



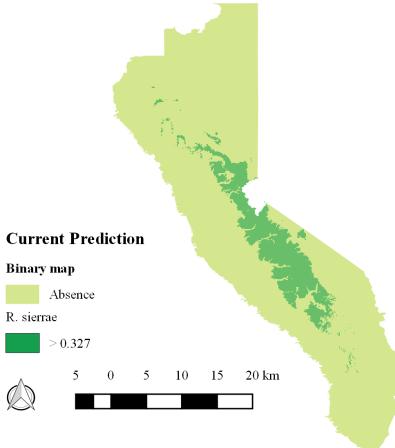
Results

high elevation endemic species

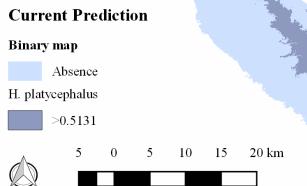
Species
responses

?

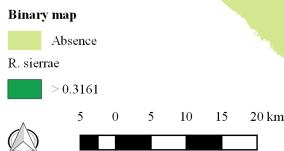
Rana sierrae



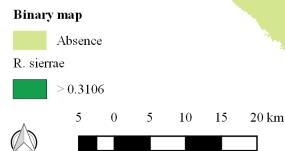
Hydromantes platycephalus



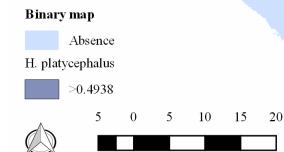
Rep 4.5_2050 Projection



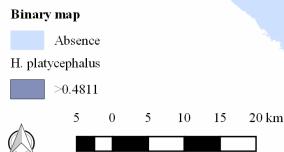
Rep 4.5_2070 Projection



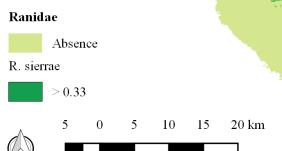
Rep 4.5_2050 Projection



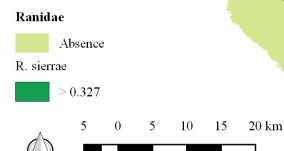
Rep 4.5_2070 Projection



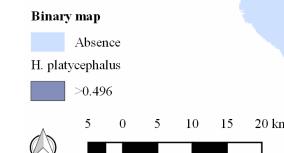
Rep 8.5_2050 Projection



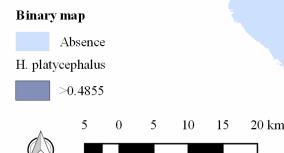
Rep 8.5_2070 Projection



Rep 8.5_2050 Projection



Rep 8.5_2070 Projection

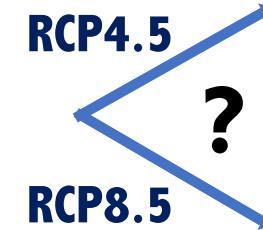


Results

Species	RCP 4.5		RCP 8.5	
	2050	2070	2050	2070
<i>A. macrodactylum</i>				
<i>T. sierrae</i>				
<i>B. gregarius</i>				
<i>H. platycephalus</i>				
<i>A. boreas</i>				
<i>A. canorus</i>				
<i>R. boylii</i>				
<i>R. muscosa</i>				
<i>R. cascadae</i>				
<i>R. sierrae</i>				

Results

Model for the end of
21st century



Species responses

Species	RCP 4.5		RCP 8.5	
	2050	2070	2050	2070
<i>A. macrodactylum</i>	Red	Red	Red	Red
<i>T. sierrae</i>	Blue	Blue	Blue	Blue
<i>B. gregarius</i>	Red	Red	Blue	Light Red
<i>H. platycephalus</i>	Red	Red	Red	Red
<i>A. boreas</i>	Light Red	Light Red	Red	Light Red
<i>A. canorus</i>	Red	Red	Red	Red
<i>R. boylii</i>	Blue	Blue	Blue	Blue
<i>R. muscosa</i>	Light Blue	Light Blue	Light Blue	Light Blue
<i>R. cascadae</i>	Light Red	Light Red	Red	Red
<i>R. sierrae</i>	Blue	Light Red	Red	Red

Take Home Message

- Key environmental variables:
 - Average snow water equivalence from January to April
 - Precipitation seasonality
 - Annual precipitation
 - Mean diurnal temperature range
- Two groups that need conservation attention:
 - High-elevation endemic species
 - Species from the family of Plethodontidae
- New species interaction due to change of range.
- RCP4.5 is more bearable than RCP8.5 for most species.

Acknowledgements

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