

Modeling the Effects of Climate Change on Whitebark Pine
Along the Pacific Crest Trail

By

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EXT. JUNE MOUNTAIN - DAY

A close up shot of dead trees on June Mountain zooms out to reveal the entire hillside covered in dead whitebark pines. Scene fades. Music: "Interloper" downloaded from <http://www.incompetech.com>.

INT. JEEP - DAY

The team looks serious, driving up June Mountain. The title "Modeling the Effects of Climate Change on Whitebark Pine Along the Pacific Crest Trail" flashes onto the screen. Camera moves outside the window to view road as the car continues up the mountain. Scene fades. Music: "Interloper" downloaded from <http://www.incompetech.com>.

EXT. DEVIL'S POSTPILE NATIONAL MONUMENT - DAY

SOUMYA is sitting on the basalt rocks in front of Devil's Postpile, seen in the background.

SOUMYA

The Pacific Crest Trail is one of eight National Scenic Trails protected by the National Parks Service.

Shot switches to a river, and then a whitebark pine as SOUMYA continues speaking.

SOUMYA

(Voice Over)

Along this trail, the whitebark pine is a keystone species contributing to watershed hydrology, and successional processes, and providing food and shelter to animal populations along the trail. In addition, it is a candidate for the Endangered Species Act.

Shot returns to SOUMYA sitting in front of Devil's Postpile.

SOUMYA

Currently, we are beginning our fieldwork at Devil's Postpile to collect points of mortality of whitebark pine.

Slides displaying objectives bullet points.

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SOUMYA

(Voice Over)

Our project focuses on mapping the future distribution of whitebark pine and identifying current areas of whitebark pine mortality along the Pacific Crest Trail.

Shot displays the team speaking with Marc Meyer, USFS ecologist and project advisor.

SOUMYA

(Voice Over)

This project partners with the United States Forest Service, which will use our results to help with decision making in restoration efforts.

EXT. DUCK LAKE TRAIL - DAY

NATE, RYAN, SOUMYA and NEESHI are hiking up the Duck Lake Trail to Duck Pass. Camera pans across the landscape to show Skeleton Lake as ANDREW speaks.

ANDREW

(Voice Over)

Here we are, at the Duck Lake Trail, located in Inyo National Forest. We are identifying areas of whitebark pine mortality as a result of mountain pine beetle for the Forest Service, which will aid in restoration efforts. Also, since whitebark pine is an indicator species of climate change effects, understanding the key variables associated with these changes may help predict future distribution. To predict changes in stand density, we used the 3-PG model.

EXT. STREAM - DAY

NEESHI is sitting on a bridge spanning a small stream.

NEESHI

The Physiological Processes to Predict Growth model, better known as the 3-PG model, utilizes soil

(MORE)

(CONTINUED)

NEESHI (cont'd)
properties, climate data and
biological characteristics of the
whitebark pine tree to output Leaf
Area Index, biomass change and net
primary production on a monthly
basis.

EXT. DUCK LAKE - DAY

Camera pans across Duck Lake as ANDREW speaks.

ANDREW
(Voice Over)
We have just passed the Duck Lake
overpass, and are now hiking
parallel to Duck Lake. I don't
really see any ducks. We are
looking at a forest of whitebark
pine trees, and obviously it is a
very high elevation species,
growing from 7000 to 10,000 feet
here in Southern California. And
right over there, according to
LandTrendr is an area of
disturbance. So we're going to go
over there and check it out, and
see the reason for that. So let's
go!

EXT. JUNE MOUNTAIN - DAY

Scene begins with an animation of Landsat 7 flying over the
earth as NATE speaks.

NATE
(Voice Over)
Landtrendr monitors changes in
annual satellite images to identify
areas of disturbance and recovery.

NATE is standing in front of the ski lifts on June
Mountain.

NATE
We've been out taking observations
in the field to identify and
validate these areas of
disturbance.

(CONTINUED)

Switches to a shot of dead whitebark pine on June Mountain. The camera zooms in on pitch tubes of the tree as NATE speaks.

NATE

(Voice Over)

Here at June Mountain, we've been able to observe areas of mountain pine beetle outbreaks in whitebark pine forests.

EXT. PACIFIC CREST TRAIL - DAY

RYAN is sitting on the Pacific Crest Trail, with a view of the forest-covered mountains in the background. Music: "Burning World" downloaded from <http://www.jewelbeat.com>.

RYAN

Using training data that we've collected in the field, alongside a number of climatic and topographic characteristics of our sites, we are using the Random Forest algorithm to predict the current and future distribution of whitebark pine and mountain pine beetle along the Pacific Crest Trail.

Shots switches to a flyover animation of Random Forest results created in ArcScene. The underlying image is a Digital Elevation Model (DEM), and the blue polygons represent areas of whitebark pine affected by mountain pine beetle.

RYAN

(Voice Over)

The Random Forest algorithm uses the training data we've collected in the field to create hundreds to thousands of decision trees that are able to predict at any given location the probability of whitebark pine or mountain pine beetle occurring at that location. Using Random Forest, and the data that we've collected, alongside current and projected climate conditions, we are able to understand how a changing climate will affect the distribution of whitebark pine and mountain pine beetles.

INT. DEVELOP OFFICE AT AMES - DAY

ANDREW is sitting in front of a computer with the project results displayed on the screen.

ANDREW

Here we are, back in the office processing data. Within our LandTrendr outputs, we were able to detect mountain pine beetle according to disturbance magnitude and duration. As you can see here, there are 14,940 square kilometers of forest that have been adversely affected by mountain pine beetle outbreaks.

Image of whitebark pine areas affected by mountain pine beetle predicted by Random Forest.

ANDREW

(Voice Over)

Using these presence points, we were able to run the Random Forest algorithm to create a spatial representation of whitebark pine and mountain pine beetle habitat suitability, as you can see here.

Images of whitebark pine distribution through 2090 flash on the screen, ending with all four images displayed.

ANDREW

(Voice Over)

Finally, the Random Forest algorithm was used with topographic data, recent climate data and future climate forecasts for the years 2030, 2060, 2090 to predict distribution of mountain pine beetle within whitebark pine stands. Our results show that under the predicted climate scenario, whitebark pine habitat may be reduced by as much as 99.97% by the year 2090 within our study area.

EXT. JUNE MOUNTAIN - DAY

Camera zooms in on dead trees on June Mountain. Music:
"Interloper" downloaded from <http://www.incompetech.com>.

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