Tahoe Science Research Update: Predictive modeling of cheatgrass invasion risk for the Lake Tahoe Basin

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Management Implications

- For areas identified as high-risk for cheatgrass invasion based on current climatic suitability, managers should take steps to prevent the introduction and spread of cheatgrass during activities that remove canopy cover or disturb soils.
- If temperatures continue to increase to levels predicted by many of the climate change models, managers will need to pay even greater attention to the risks of cheatgrass invasion in higher elevation areas of the basin.

Fig. 1: Sam Veloz sampling soils underneath cheatgrass. Photo by Jonathan Long.

Background and Purpose

Cheatgrass (*Bromus tectorum*) is an exotic species of major concern that is increasingly detected in Sierran meadows. This notorious annual grass is a driver of ecosystem change in the intermountain west due to its tendency to dramatically alter historic fire regimes, typically increasing the frequency of early season fires. While cheatgrass is present in some meadows in the Lake Tahoe Basin (LTB), especially in drier, disturbed sites in the Carson Range, it is at a relatively early stage of invasion. There is concern that fire and fuels treatment restoration efforts in the LTB may act as a disturbance that may facilitate cheatgrass invasion into meadows and subsequently into adjacent conifer stands, with serious consequences for forest and fire management. There is also concern that warming temperatures due to climate change may lead to more suitable environmental conditions for cheatgrass invasion within the LTB.

Methods

To investigate the risk of cheatgrass invasion in the LTB, we developed a spatially explicit model of invasion risk based on the climatic niche of cheatgrass. This model was used to predict which areas within the LTB contain climactically suitable conditions for cheatgrass invasion. We parameterized this model based on the 212 field sites we surveyed for cheatgrass in 2008-09. We used this model to forecast future invasion risk based on 15 different scenarios of climate change.

Summary of Findings to Date

The model of the current distribution of cheatgrass within the basin **accurately discriminates presence sites from absence sites 92% of the time.** Many large areas at lower elevations along the east and south shores, corresponding to drier areas, were predicted to be highly suitable. In total, 6676.5 hectares had a predicted probability of occurrence >0.7 given current climate conditions (Fig. 2a). However, 48% of the land area within the basin was predicted as climatically unsuitable (probability of occurrence <0.2). A second model indicated that disturbance and dispersal variables are limiting establishment of cheatgrass in some areas that are climatically suitable.

Relatively high average monthly minimum November-December temperatures were very important for predicting the distribution of cheatgrass, which normally lives from late fall until late spring. Given climate warming, our results predict an increase in average climatic suitability for cheatgrass invasion throughout the

basin (8101.5 hectares >0.7 in the worst case scenario, a 20% increase from current predictions; Fig. 2b. Warming temperatures would leave areas at higher elevation, particularly on the west shore, more vulnerable to invasion. However, future predictions are very sensitive to future climate predictions with four out of 15 future climate models showing a decline in cheatgrass suitability (Fig.2c); in part because some of these models also predict an increase in soil moisture.

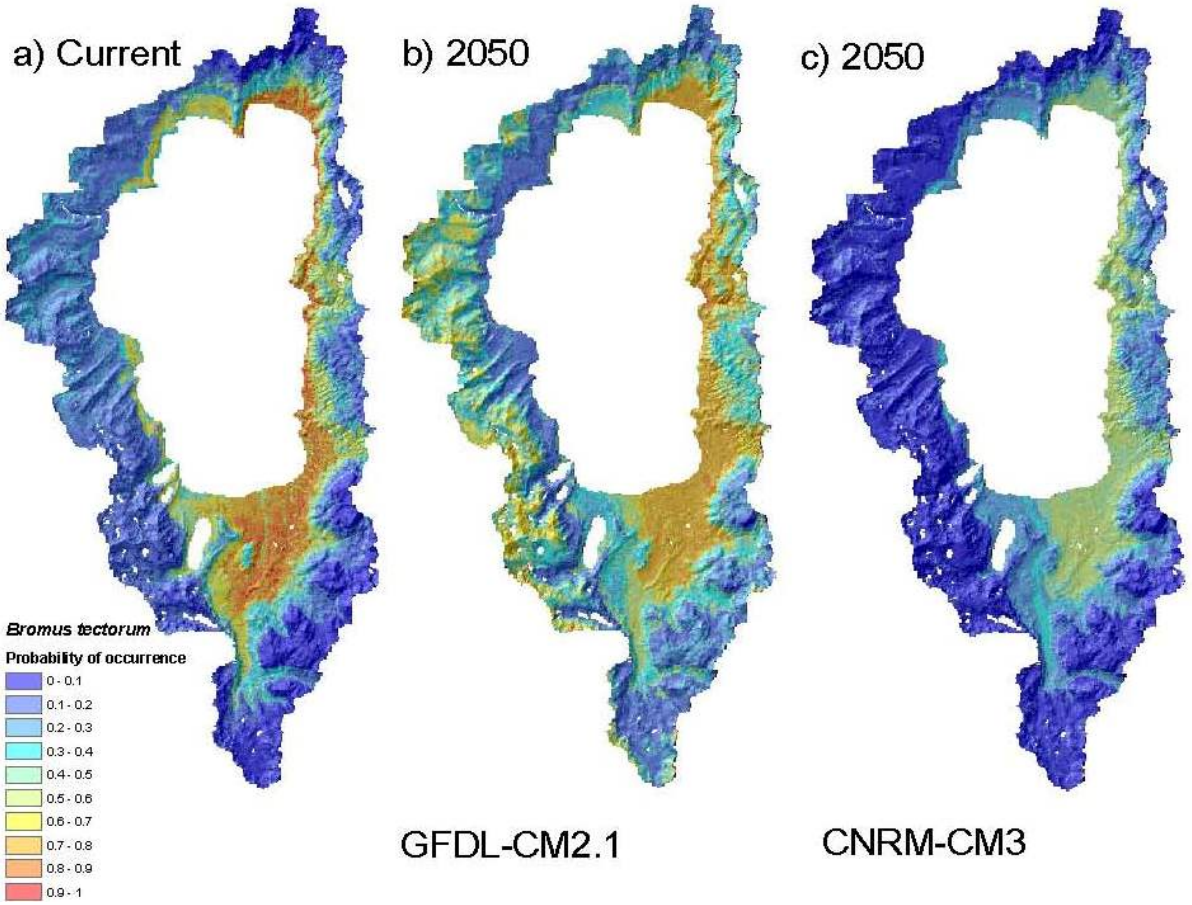

Fig. 2. The predicted probability of occurrence of *Bromus tectorum* in the Lake Tahoe Basin under (a) current climate conditions and (b-c) two future climate change general circulation models for 2050. The Geophysical Fluid Dynamics Laboratory model (GDFL-CM2.1) predicts increasing climatic suitability, particularly at higher elevations along the west shore. The Centre National de Recherches Meteorologiques model (CNRM-CM3) shows a decline in average probability of occurrence throughout the basin but the spatial pattern of highest invasion potential is more similar to the current conditions than the GFDL-CM2.1 model.

For more information about this project, please visit this webpage:
http://www.fs.fed.us/psw/partnerships/tahoescience/modeling_cheatgrass.shtml

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