

ECOSENTINEL™: A DECISION SUPPORT TOOL FOR PEST MONITORING IN SIBERIA AND THE RUSSIAN FAR EAST

Bruce J. Miller¹, Yuri A. Baranchikov² and Max W. McFadden¹

¹The Heron Group, LLC, PO Box 741, Georgetown, DE 19947

²V.N. Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences, Akademgorodok, Krasnoyarsk 660036, Russia

Abstract

A new decision support software tool, EcoSentinel™—a proprietary software application—can help decision makers address and respond to complex social, natural resource, and environmental problems including famine onset, human health hotspots, insect pest outbreaks that affect important forest or agricultural resources, and status of threatened and endangered species or whole ecosystems such as forests. EcoSentinel™ can process both satellite imagery and geographically referenced data (e.g., identified with longitude and latitude) into maps designed to predict potential outcomes in the overall problem context (e.g., forest loss, insect outbreaks, forest fire, slash and burn, agricultural extensification).

EcoSentinel™ uses a knowledge base (i.e., a formalized articulation of a model's logic). The knowledge base can process any type of data including geographically referenced data which can be used to create maps showing predicted outcomes of the problem articulated in the model, including input data collected from specific points or places. EcoSentinel™ then processes these data into suitable two-dimensional geographically referenced (map) format. These maps are suitable for use in all geographic information systems (GIS).

One example of an EcoSentinel™ model is EcoSentinel/SM developed for the USAID/Russia-funded FOREST project. EcoSentinel/SM, The Siberian Moth Outbreak Prediction Model, is a knowledge base that captures the equations and logic of Dr. Yuri Kondakov's career-long

research on forest defoliation and outbreak prediction of Siberian moth in the Taiga Forests of Siberia. This model consists of two predictive models: a defoliation prediction model based on Siberian moth larvae observations, and a potential outbreak prediction model based on measured changes in Siberian moth adult populations and factors related to reproduction. The Siberian Moth Outbreak Prediction Model uses Kriging to smooth both moth capture and larvae sampling data from a monitoring system with a grid of points or sampling plots across seven geographic regions. The software then analyses moth captures and larvae counts from the monitoring grid and creates input maps. The knowledge base then processes these data into a new map displaying "Hazard Potential" as its output, showing areas on the grid where moth captures indicate increasing populations and where a potential for high-level outbreaks may occur and become a hazard. The Siberian Moth Outbreak Prediction Model also uses kriging to analyze sampled larvae data. The Kondakov model predicts defoliation on a single tree, so EcoSentinel/SM processes sample data, tree by tree. Then, EcoSentinel/SM uses kriging to build the map designating "Control Indicated". This provides decisionmakers with timely and useful information that helps guide their decisions about the kind and magnitude of control actions (e.g., use of environmentally sensitive biocontrols, cutting, or other forest management practices) they might take or whether to continue monitoring, based on input from the statistical analysis and map outputs of the model.