Development of Establishment Masks

We generated two establishment layers to mask the risk model output to locations where gypsy moth would be more likely to establish: climate suitability and host availability. This additional step was applied prior to survey design, but not for model validation. We used BioSim, a multiple life-stage phenology model for gypsy moth, to generate a climate suitability surface [118]. The phenology model [61,63,119-121] evaluates the multiple stages of life cycle development for gypsy moth concurrently with timing of local ambient air temperatures, and evaluates whether successive generations could survive, mate, and reproduce. This ability was termed “adaptive seasonality” [62], and is equivalent to establishment potential. The spatial output of this model is a 0-100% likelihood of establishment given stochastic replications on a 30-year climatic dataset (1990-2010). The mean climatic suitability for northern Maine underestimated potential establishment as detection data clearly showed high population levels detected there. A two-year deterministic model was run on weather data from 2011-2012, which were very warm years and would have coincided with years of high detection for gypsy moth in northern Maine. The maximum likelihood was taken between these two models, so that climatic suitability would not be underestimated for years considerably warmer than the climate norm. We converted the continuous risk map to a binary climatic suitability mask by applying a threshold probability value of 0.075. This threshold was derived by intersecting the historical positive detections against the continuous climatic suitability map and finding the 5th percentile suitability value at those locations. Climatic suitability values under 0.075 were classified as “unsuitable”, resulting in a masking of those areas from the gypsy moth risk assessment. The resulting risk surface was termed the “detection likelihood” map and represents the likelihood to detect gypsy moth using lure traps, given different pathways for introduction across space, and subject to climatic limitations. We applied a host area mask to the detection likelihood surface by re-classifying National Land Cover Dataset (NLCD) 2001 percent tree cover [122] (>0%) into a binary mask. Initial efforts were made to create a primary host species layer as part of an establishment mask [75], but analyses of detection data with the host mask showed great underestimation of where gypsy moths were found. Therefore, we assumed any tree was a potential host for models starting in 2015.