

A spatially explicit model of the presence of English  
Holly (*Ilex Aquifolium*): Spatial relationships and  
implications for management

Santiago Lopez, PhD

David Stokes, PhD

University of Washington Bothell

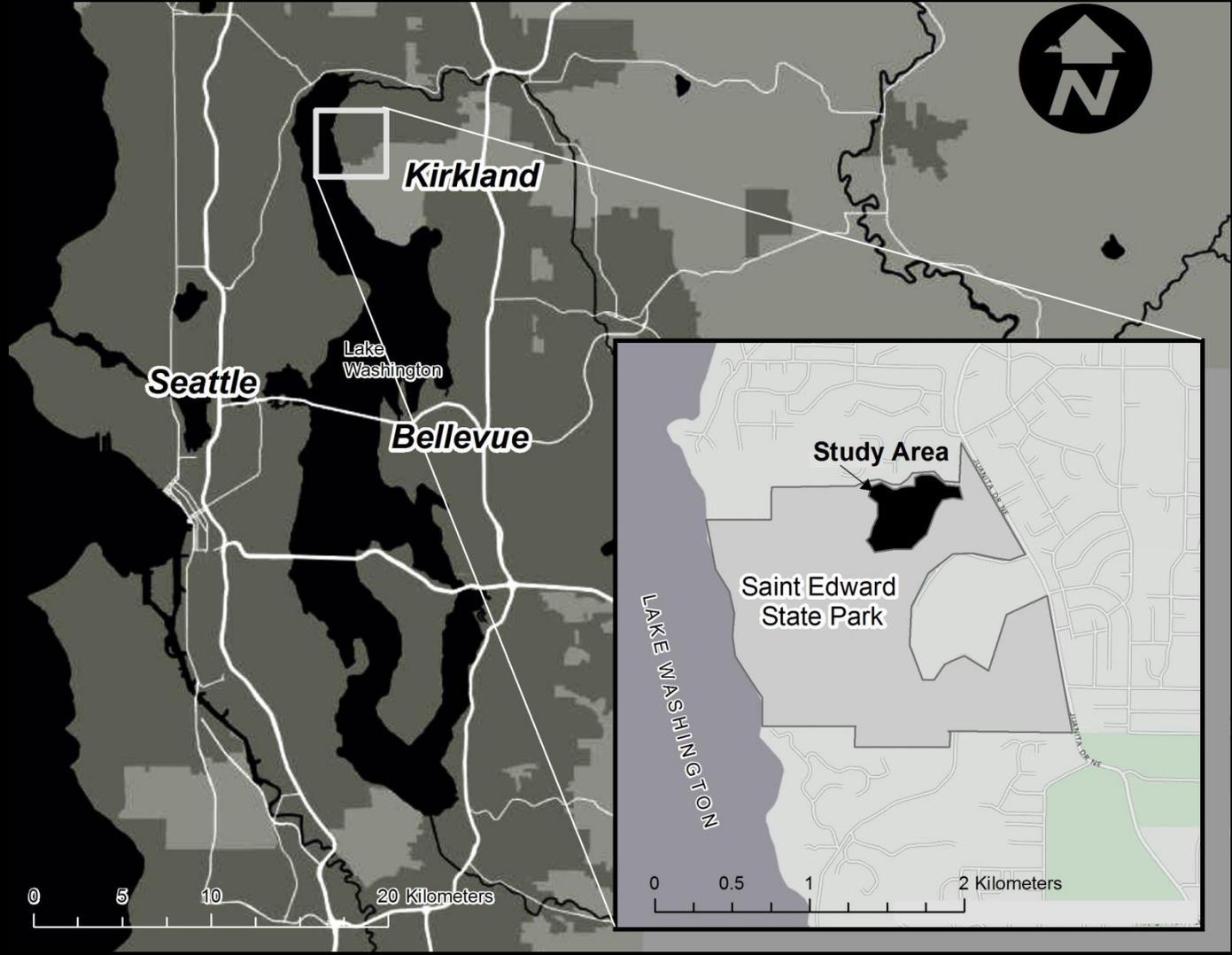
# Background

- ❑ Research on invasive alien species has been motivated by the need to mitigate their negative influence on natural systems (management) (Higgins and Richardson 1996)
- ❑ From a theoretical perspective, invasions provide natural experiments that offer insights into issues that are fundamental to ecological and spatial theory.
- ❑ The literature on invasive species modeling has concentrated on the analysis of:
  - Types of environments and environmental conditions that allow a successful establishment of a particular species
  - Life histories attributes (e.g. demographic conditions) of invasive species in particular environments

# Background

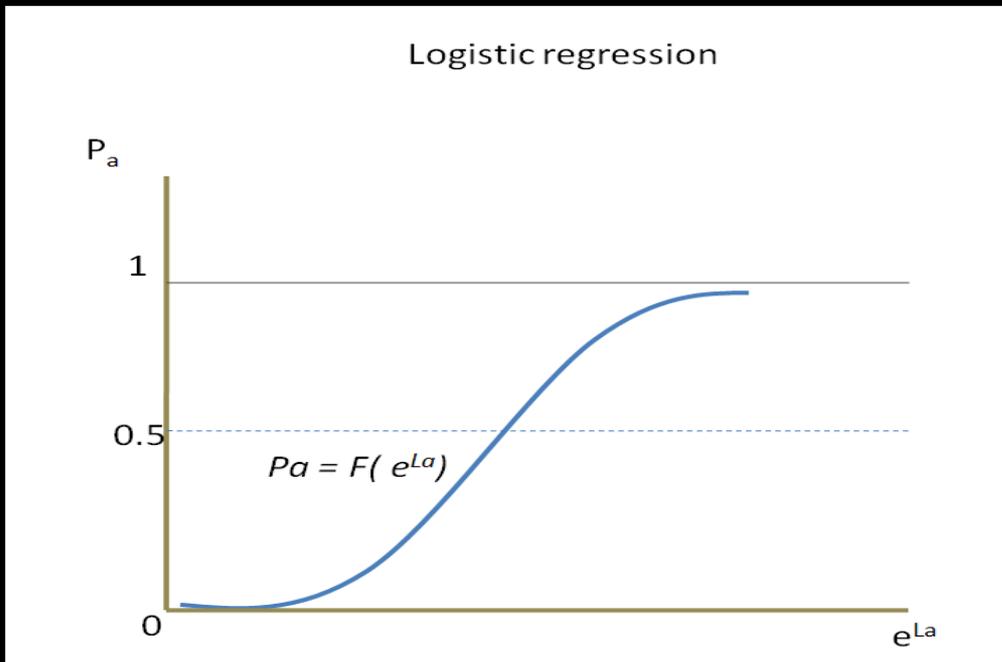
- ❑ When modeling invasive species dispersion, it is useful to consider the environment as a series of filters which prevent unsuited plants from establishing, maturing, reproducing, and dispersing (Keddy, 1992).
- ❑ The selection of the appropriate environmental and spatial filters requires a basic *a-priori* understanding of how the system functions.
- ❑ In this study, we hypothesize that the occurrence of holly is explained by topographic conditions, vegetation composition, and edge effects

# Study Site



# Methods

- Multiple Logistic Regression is designed to estimate the parameters of a multivariate explanatory model in situations in which the dependent variable is categorical, and the independent variables are continuous or categorical.

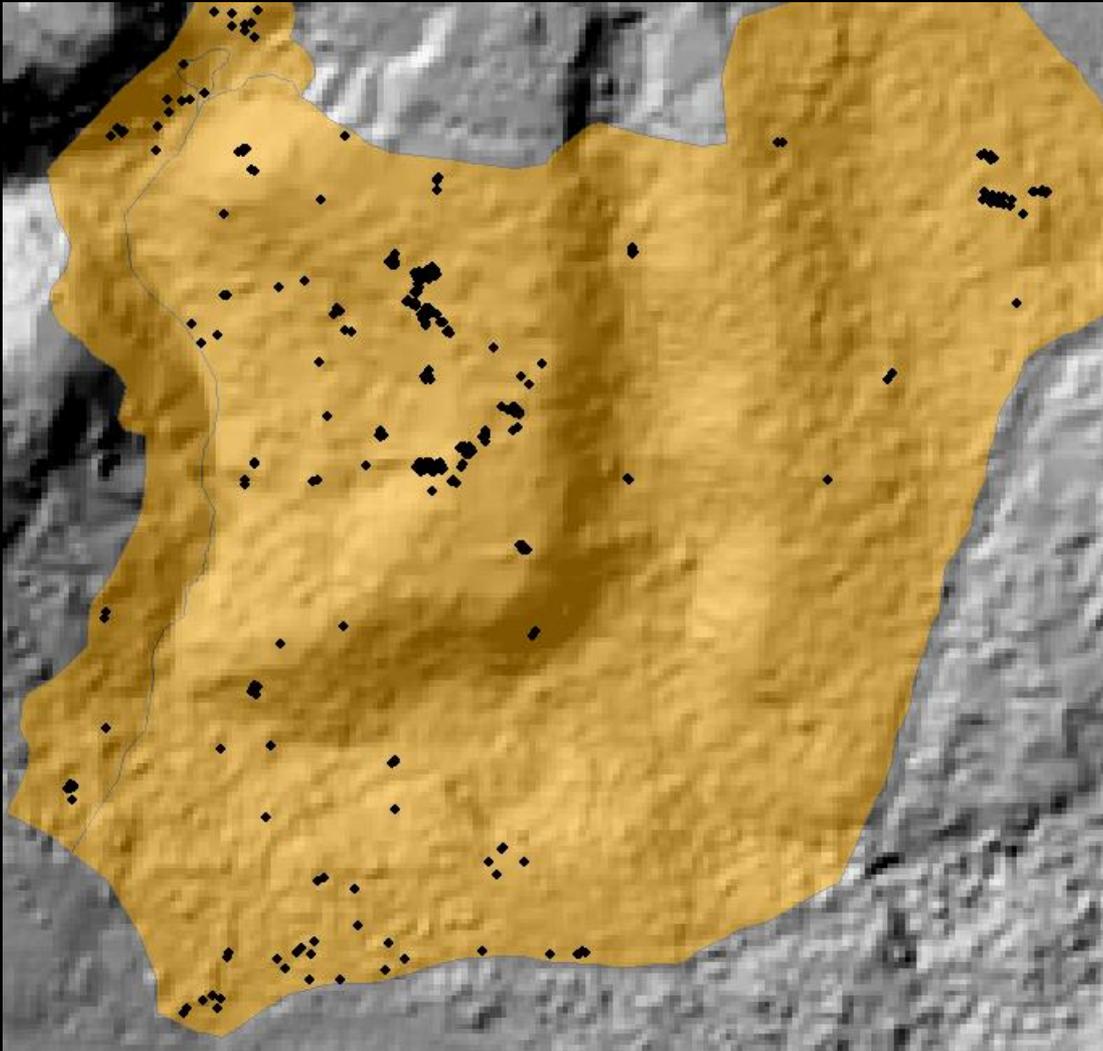


$$P_a = \frac{e^{(La)}}{1 + e^{(La)}}$$

$$La_{(x,y)} = \alpha + \beta_1 \text{Slope} + \beta_2 \text{Elevation} + \beta_3 \text{DstStreams} + \beta_4 \text{DstEdge} + \beta_4 \text{DstTrails} + \beta_5 \text{DistEvGreen} \\ + \beta_6 \text{CurPlan} + \beta_7 \text{CurvProf} + \beta_8 \text{Aspect} + \beta_9 \text{CanHeight}$$

**N = 218 (30% → 1 ; 70% → 0)**

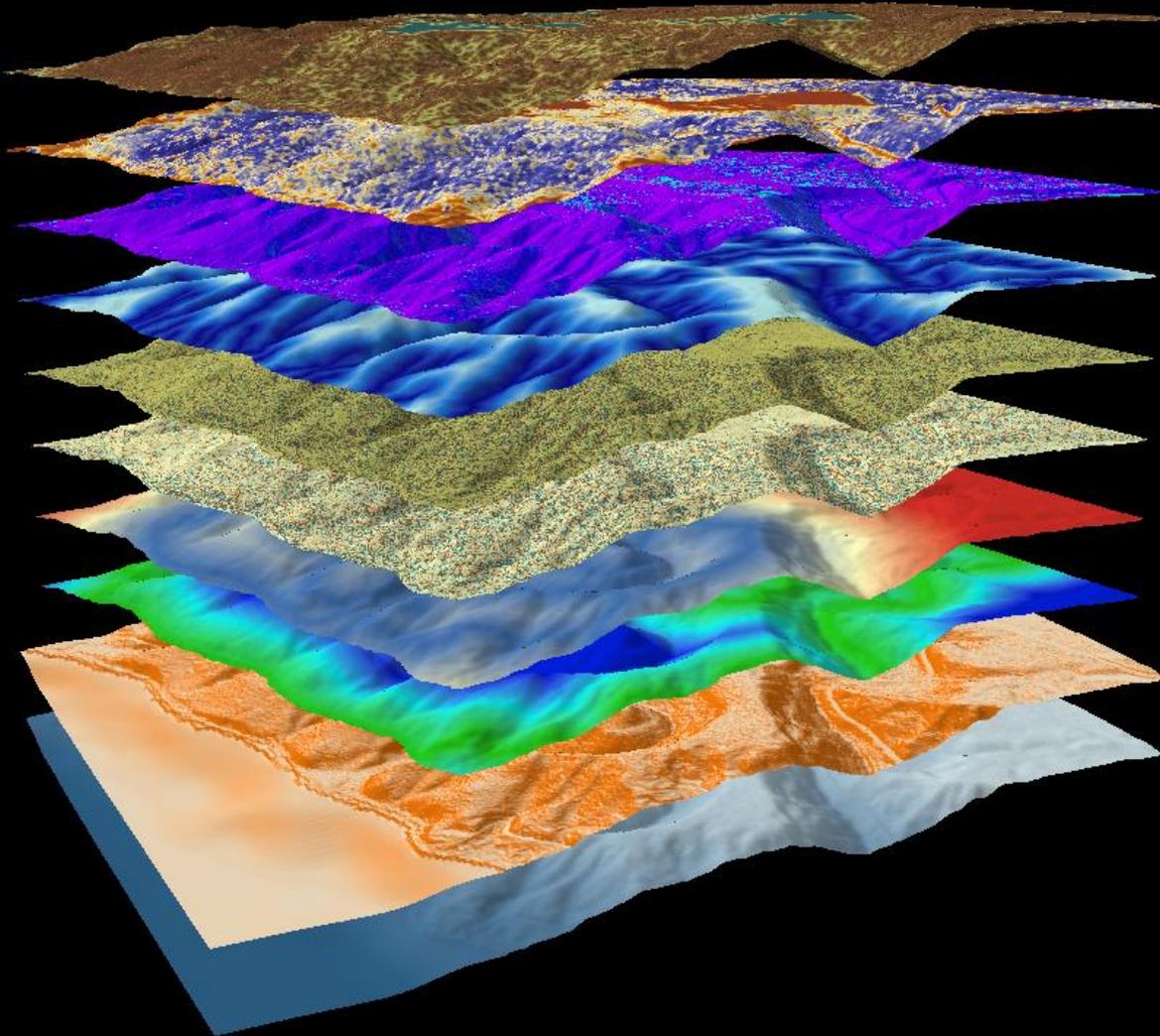
# Dependent Variable



HOLLY LOCATIONS (presence and absence)

- Differentially corrected GPS measurements and vegetation surveys (2011 and 2013) (Stokes et al. 2014; 2013; 2012)

# Independent Variables



## ELEVATION

- LIDAR data (2003) – Puget Sound Lidar Consortium – 2 meter resolution

## LAND COVER

- National Agriculture Imagery Program (NAIP) Orthoimagery (4 Band) – 1 meter resolution

## TRAILS

- GPS data

# PRELIMINARY RESULTS

TABLE 1: RESULTS OF THE MULTIVARIATE LOGISTIC MODEL

	B	S.E.	Wald	df	Sig.	Exp(B)
SLOPE	.007	.025	.077	1	.782	1.007
ELEVATION	-.030	.016	3.743	1	.053	.970
DISTANCE TO STREAMS	.014	.004	9.943	1	.002 *	1.014
DISTANCE TO EDGE	.019	.005	12.186	1	.000 *	.981
DISTANCE TO TRAILS	-.045	.019	5.323	1	.021 *	.956
FLOW ACCELERATION	.062	.086	.519	1	.471	1.064
FLOW DISACCELERATION	.030	.094	.104	1	.747	1.031
CANOPY HEIGHT	.017	.011	2.414	1	.120	1.017
DISTANCE TO EVGREEN.	.064	.030	4.549	1	.033 *	.938
SLOPE DIRECTION (N/S)	-1.458	.414	12.434	1	.000 *	.233
SLOPE DIRECTION (W/E)	-.381	.839	.206	1	.650	.683
Constant	10.354	5.397	3.680	1	.055	31367.497

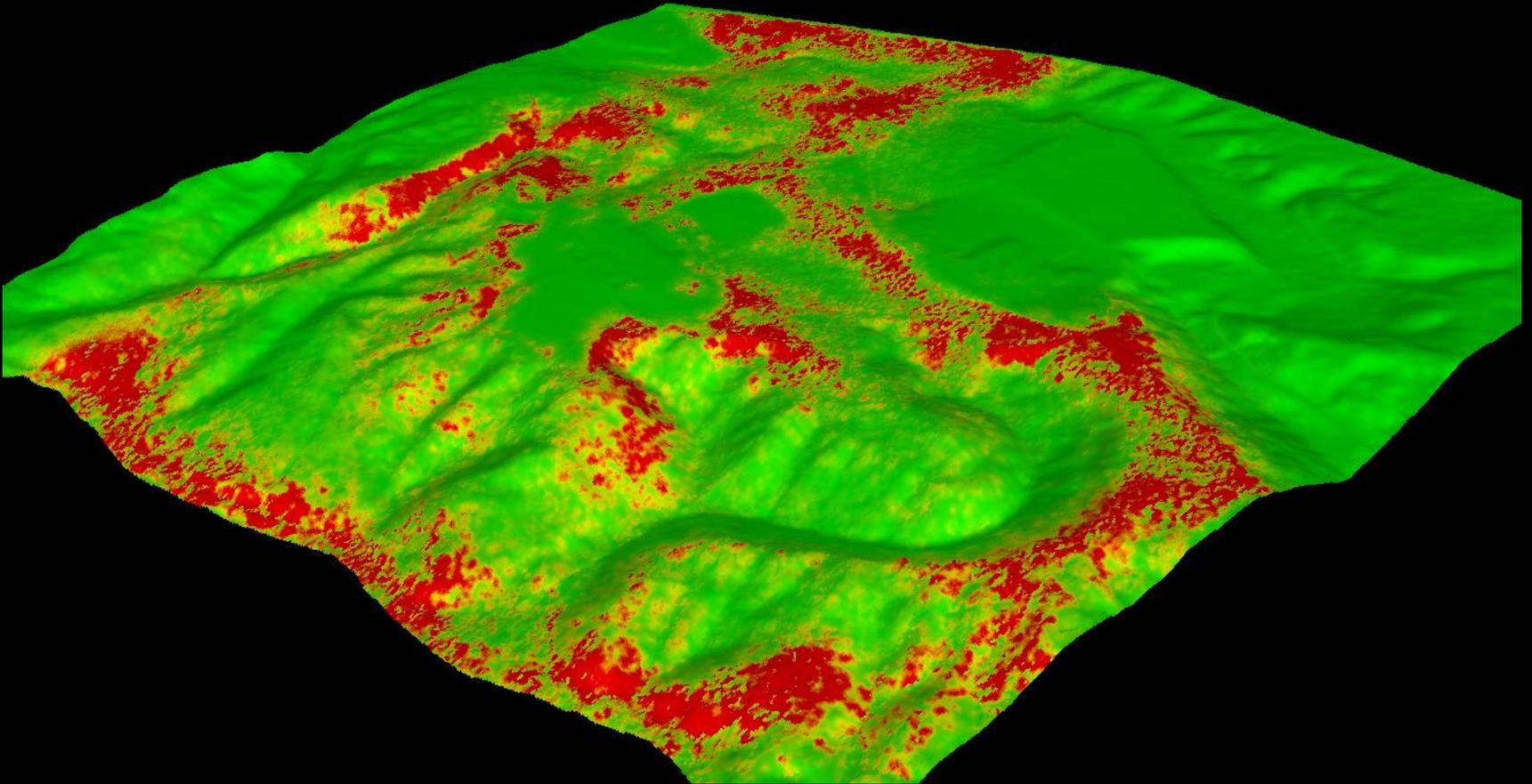
**N = 218 (30% → 1 ; 70% → 0)**

## Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	181.504 <sup>a</sup>	.291	.421

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

# Probability of the Presence of Holly in St. Edward Park



# Conclusions

- Environmental conditions play an important role in explaining the occurrence of holly.
- Slope and edge effects are the most important spatial factors associated with the presence of holly.
- Actions that could reduce the negative impact of edges (e.g. modifying edge shapes, re-vegetation, careful monitoring) could also help address problems associated with holly invasion.

# Future research

- Is it possible to extrapolate trends into the future?
- Based on the data collected, the combination of MLR and other techniques such as cellular automata could help understand the process of invasion in the long term

