

RESEARCH PROJECT TITLE: Seasonal and Spatial Dynamics of Rodent Damage in No-till Cropping Systems in Idaho and Washington

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PROJECT OBJECTIVES: 1) Describe seasonal and landscape dynamics of rodents causing crop damage, 2) Model the ecological factors effecting rodent distribution in the agricultural landscape, and 3) Determine the seasonal use of refugia habitats including agricultural lands and non-agricultural lands.

KEY WORDS: rodents, damage, population dynamics, habitat use

STATEMENT OF PROBLEM: Conservation tillage farming systems potentially promote resident rodent populations in agricultural fields, which may cause increased crop damage in certain ecological settings. Such damage potentially may discourage the wider adoption of no-till agriculture. Population dynamics of rodents in agricultural settings have not been extensively studied, particularly in new cropping systems utilizing no-till farming. Consequently, better information is needed on the biophysical and ecological factors influencing the seasonal and spatial dynamics of rodent damage in modern conservation tillage cropping systems.

ZONE OF INTEREST: Palouse region of WA and ID

ABSTRACT OF RESEARCH FINDINGS: We investigated the population and spatial dynamics of rodents in 2003-04 in a no-till agricultural setting at the Palouse Conservation Field Station and surrounding areas in Whitman County, Washington. Deer mice (*Peromyscus maniculatus*) currently account for >95% of rodent populations on the PCFS. We are using classification and regression trees (CART) and logistic regression to evaluate how selected ecological and environmental variables predict rodent abundance and distribution within the Palouse agricultural landscape. Preliminary analyses reveal that cover type, elevation, and weather are significant environmental variables affecting rodent trapping success along with other secondary ecological factors (e.g., distance to field edge, slope, aspect, predicted soil moisture, predicted soil radiation, edge type). We are developing simple models to predict seasonal and spatial dynamics of rodent abundance, which may help growers identify specific landscape areas to more efficiently apply control measures or alternative cropping techniques to minimize crop losses in sites of potential high rodent damage.

RESULTS AND INTERPRETATION: The majority of our research has been conducted on the USDA Palouse Conservation Field Station (PCFS) and on other sampling sites in

Whitman County. Sampling has been performed during the four major seasons of the year, beginning in fall 2003 and continuing until fall 2004. The primary sampling scheme consists of trapping 600 random locations within the boundary of the PCFS for three consecutive nights during each season, except for Fall, 2003, when trapping was only conducted over a single night. Species, sex, weight, evidence of reproductive activity, and cover type were recorded at each trap location.

Capture rates differed significantly between fall, winter, and spring ( $p < 0.0001$ ). Capture rates were lowest in fall (15%), highest in winter (51%), and intermediate during spring (31%) (Table 1). Of all captures, 98.9% were deer mice (*Peromyscus maniculatus*), 1% were voles (*Microtus montanus*), and <1% were other incidental species. The mean weight of rodents in the fall (20.8 g) was significantly lower ( $p < 0.0001$ ) than during the winter (22.9 g) and spring (23.0 g).

Table 1. Average capture rates and species composition for rodent captures during fall, winter, and spring capture seasons at the Palouse Conservation Field Station, Whitman County, Washington. 2003-04.

<b>Season</b>	<b>Number of captures</b>	<b>Average % capture</b>	<b>% Deer Mice*</b>	<b>% Voles *</b>	<b>% other capture</b>
<b>Fall</b>	75	15	96	4	0
<b>Winter</b>	800	51	99	1	0
<b>Spring</b>	596	31	99.4	0	0.6

\* *Deer mice = Peromyscus maniculatus; Voles = Microtus montanus*

We produced farm-wide rodent distribution maps for each season illustrating the probability of capture success by using a mapping and spatial analysis technique called indicator kriging. This procedure estimates values (capture probability) of all unsampled locations based upon the surrounding sample locations. From this procedure, a distribution map was created for fall capture probabilities and a series of four distribution maps were created for the winter and spring seasons to identify portions of the PCFS that had high probability of rodent captures (Fig. 1).

We evaluated ecological factors related to rodent abundance by using classification and regression tree (CART<sup>1</sup>) procedures to describe and model environmental variables related to trap success. These analyses indicated that cover type, elevation, and weather were the most influential variables predicting rodent capture success throughout the seasons. However, other topographic and landscape features, including distance to field edge, slope, aspect, predicted soil moisture, predicted soil radiation, presence of trees, and edge type were also significant in various seasonal, crop, and non-farmed habitat models. Using cross-validation methods, we estimated that CART classification models often correctly predicted from about 52 – 87% of the capture success of rodents around the farm. The classification trees provide a visual model of capture probabilities for each classification stage in the model and are readily understood by individuals even without statistical training.

For comparison with the nonparametric CART procedure, we are also utilizing stepwise logistic regression to develop predictive models of rodent capture success using the same environmental variables used in the CART procedure. The two different classification procedures frequently agree about the most influential variables affecting rodent density, although the CART analyses lend themselves better to visual interpretation of the predictive model and were generally more readily interpreted.

In addition to large-scale rodent sampling over the entire farm, we also conducted “hotspot” sampling in areas of high rodent densities. We retrapped areas with >55% trap success from the fall farm-wide sampling period using smaller 5-m census grids in areas of apparent high rodent density. A total of 648 live traps were set in this manner in a series of small sampling grids for one night, yielding an overall capture rate of 20%, which is intermediate between the overall fall and winter capture rates. About 74% of these hotspots occurred in non-agricultural areas (comprised of 73% grasslands and 1% road surface), while croplands accounted for 27% of the trap locations (14% wheat stubble, 7% corn, 4% experimental plots and 2% peas). Species diversity was low with deer mice (*Peromyscus maniculatus*) accounting for 93% of the captures and montane voles (*Microtus montanus*) the other 7%.

We have also conducted sampling of representative off-farm habitats to determine whether rodent populations were in relative synchrony in abundance and species composition in comparison to no-till and non-agricultural habitats on the farm. These results are currently being analyzed. When completed, this project will help describe the ecological factors influencing the population abundance of rodents in a no-till agricultural setting and will provide simple and practical predictive modeling of rodent abundance to identify areas with greater potential for crop damage.

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<sup>1</sup> Breiman, L., J. Friedman, R. Olshen, and C. Stone. Classification and Regression Trees. Pacific Grove: Wadsworth, 1984. CART is a registered trademark of California Statistical Software, Inc.

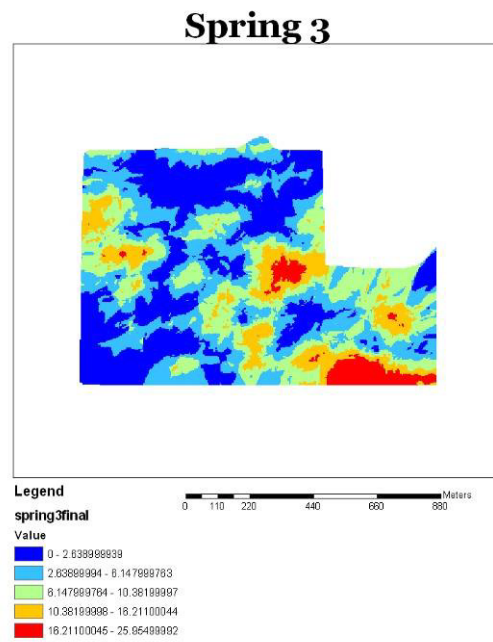
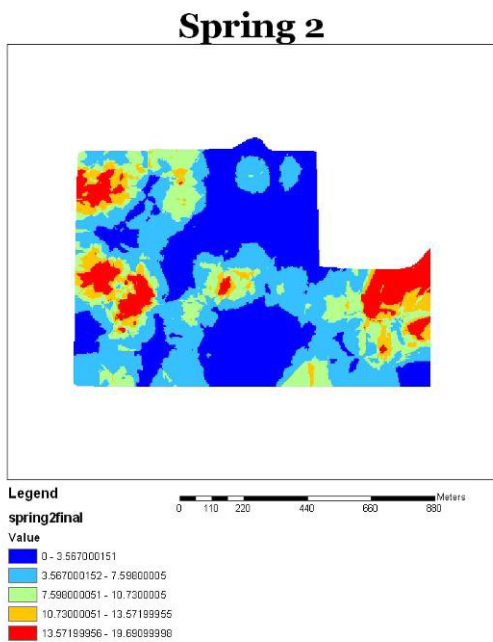
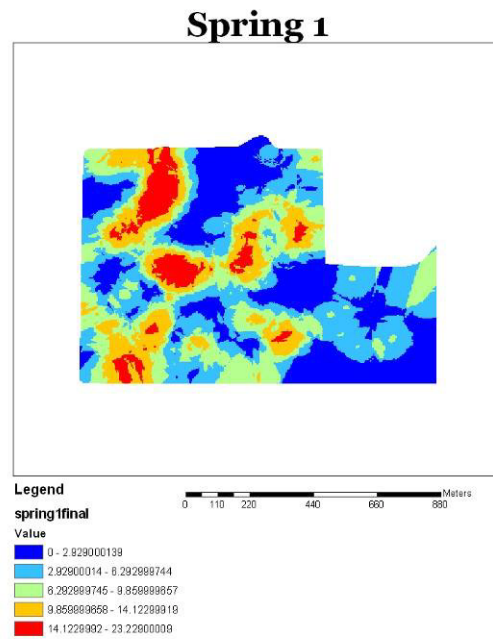
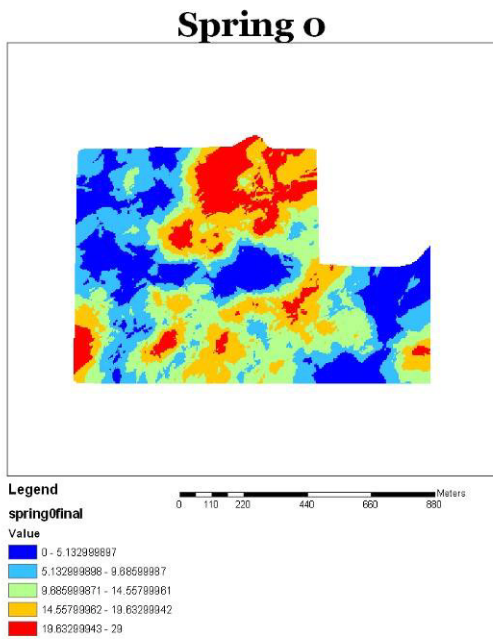


Figure 1. Probability of rodent captures (0, 1, 2, or 3 captures over 3 trap nights) at the Palouse Conservation Field Station, Whitman County, Washington, Spring (Feb./March) 2004.