

RESEARCH PROJECT TITLE: Examination of Tillage Factors, Crop Type, Soils and Non-crop Habitat upon Soil Fauna and Ground Dwelling Predators in a Small Inland PNW Watershed.

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INTERIM REPORT

PROJECT OBJECTIVES:

1. Determine the ground dwelling predator fauna of spring wheat and pea grown under conventional-till and reduced-till, and the overlap of such fauna with that found on natural habitats.
2. Ascertain the ground dwelling predator fauna of specific natural habitats within the Palouse.
3. Determine the spatial relationship between soil macrofauna, soil type, crop rotation, and soil fertility across two sub-watersheds under different tillage regimes.

KEY WORDS: spring wheat, pea, biodiversity

STATEMENT OF PROBLEM:

Reducing tillage generally increases the population density of earthworms and ground-dwelling predators such as ground beetles, rove beetles, and spiders. Increasing the densities of these species may have beneficial effects in a field. Earthworms may improve soil fertility, while predators may improve the biological control of pest insects. However, little information on the relationship between tillage practices and the invertebrate animal community is known that is specific to the Palouse. Our research examines invertebrate communities on working farms in the Palouse. Understanding how tillage affects invertebrates will enhance integrated farm management within the region.

ZONE OF INTEREST: High rainfall, Palouse

ABSTRACT OF RESEARCH FINDINGS:

We sampled invertebrate communities in spring wheat and pea crops on farms in Latah county and Nez Perce county, ID. Three conventional-till and three reduced-till fields of each crop were sampled for a total of 12 fields. We used pitfall traps and bulk soil collection to sample invertebrates. Although our study is ongoing, our current data suggest that both crop type and tillage affect the density of certain species. In the species we have currently analyzed, various responses were seen. The most abundant ground beetle, *Poecilus scitulus* was more common in conventional-till fields of both wheat and pea. In the other three species of ground beetles, the effect of tillage changed with crop. Finally, earthworms were more abundant in reduced-till fields of both wheat and pea. Ongoing work will extend our analyses to other species in the invertebrate community.

RESULTS AND INTERPRETATION:

We sampled invertebrate communities in 12 fields during the summer of 2002. We worked on two crops, spring wheat and pea, sampling six fields of each. For each crop, three fields were conventional-till and three were reduced-till. To focus on the effects of tillage and crop type, we selected fields with similar cropping history and soils. In addition, only spring wheat and pea crops that were farmed in a 3-year crop rotation (or longer) were selected for this study. We narrowed the selection further by choosing only pea crops that followed a cereal crop in the rotation, and only cereal crops that followed another cereal crop in the rotation. We then installed 2 transects within each field for a total of 24 transects (see Figures 1 and 2). Efforts were made to place transects only in well-drained soils. We are using two complementary sampling procedures in our study, pitfall traps and bulk soil collection. Pitfall traps are plastic cups sunk into the ground, flush with the soil surface, which collect organisms that fall into them.

Pitfall trap sampling

To capture the ground-dwelling arthropods, 5 pitfall traps were placed equidistantly along each transect (see Figures 1 and 2). Each trap location was recorded with an ETREX GPS unit. This location data was later imported into ARC VIEW 3.2 to produce the maps in Figures 1 and 2, and will further be used to examine relationships between geographical features and macrofauna abundance. The sample period extended for 8 weeks during June and July of 2002. Thus far, 4 sample weeks have been processed, and only the ground beetles (Coleoptera: Carabidae) have been sorted. A total of 17 morphospecies have been found. Of these, 4 common species – *Poecilus scitulus*, *Pterostichus melanarius*, *Poecilus lucublandus* and *Calosoma cancellatum* - account for 85% of all beetles collected. Very importantly, these same species were identified as the most common (dominant) ground beetles collected at the University of Idaho Kambitsch Research Farm, enabling a comparison of tillage and crop effects upon the most dominant species found at these sites.

While the analysis is preliminary, patterns in the data indicate that individual species respond differently, but with some consistency, to treatment effects (Figure 3). For example, *P. scitulus*, the most abundant beetle found at both Kambitsch and on-farm, was more abundant in conventional-till crops than reduced-till crops at both locations (i.e. Kambitsch and on-farm). In contrast, the non-native *Pterostichus melanarius* was more abundant in reduced-till wheat than in conventional-till wheat, a pattern observed at Kambitsch during 2000 but not 2001. *Poecilus lucublandus*, on the other hand, was found more abundant in conventional-till peas, but in the wheat crop this species showed a clear preference for reduced-till systems, this latter pattern having been observed at Kambitsch during 2001. And lastly, *C. cancellatum* was more abundant in conventional-till than reduced-till peas, but the opposite response was observed in the wheat crop. This same pattern was observed at Kambitsch.

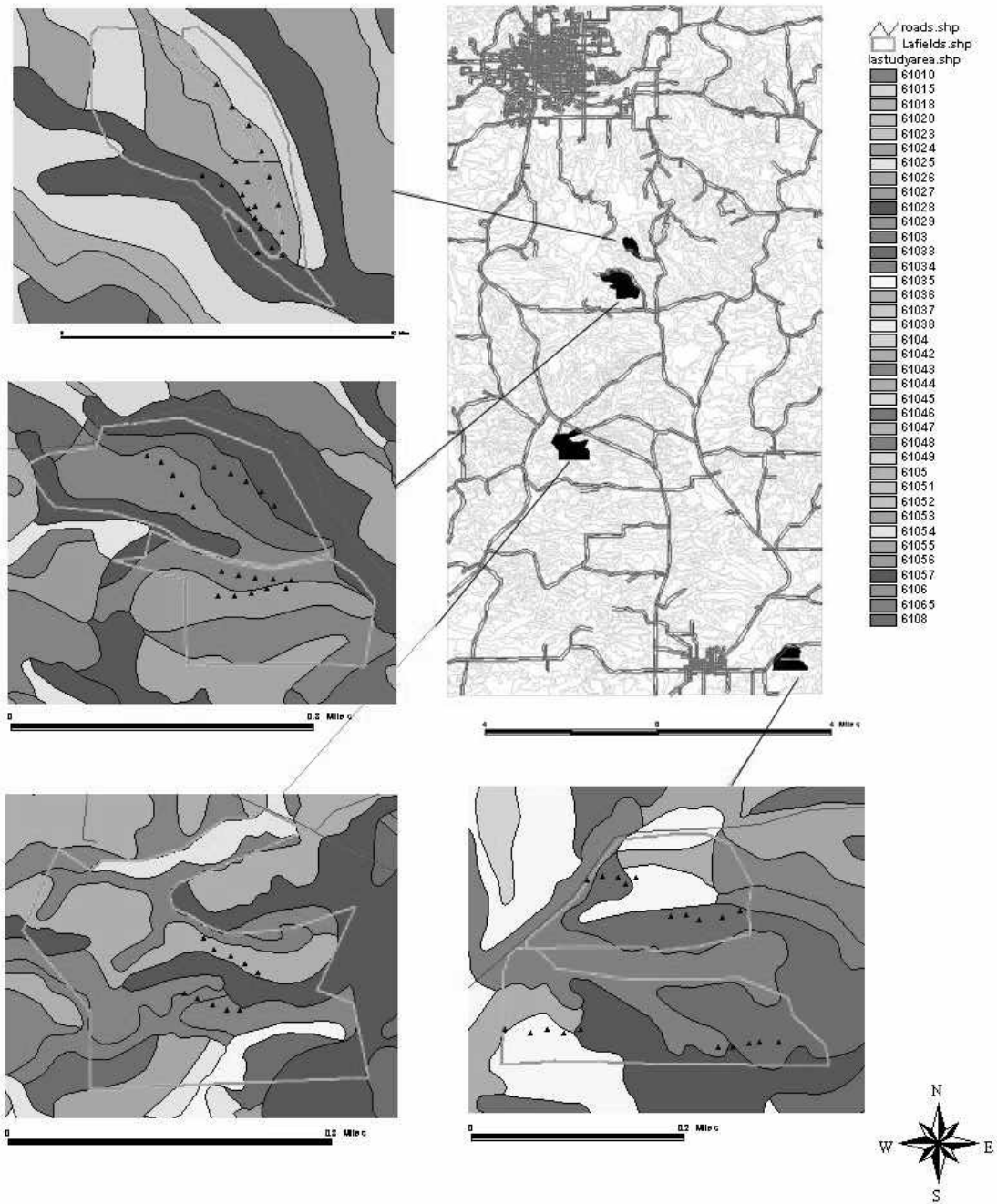


Figure 1. Latah County study area. Locations of pitfall traps along transects are denoted by triangles, the field boundaries by the light colored lines, and individual soils by the dark irregular shaped lines.

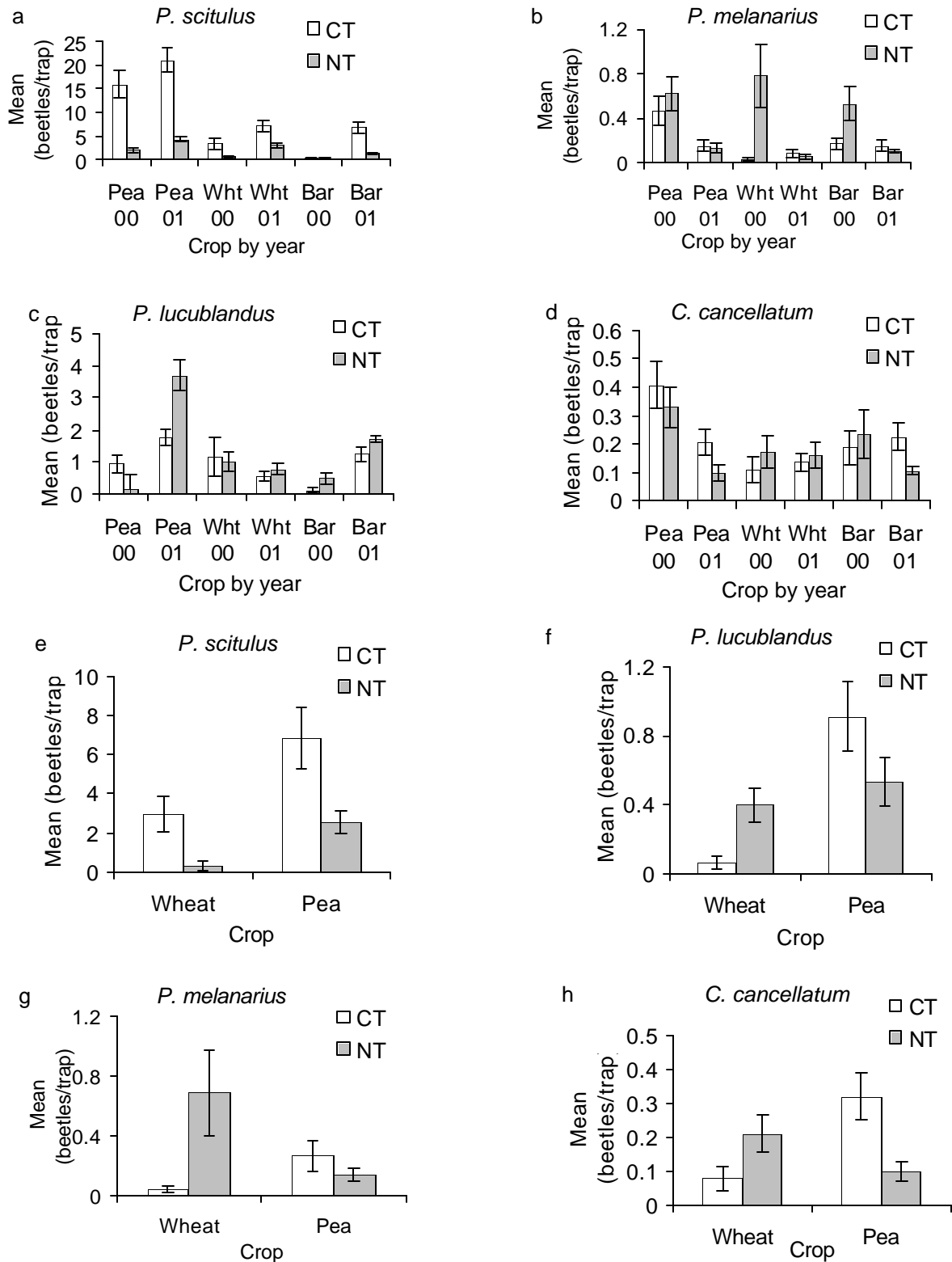


Figure 3. Response of the dominant ground beetles to crop and tillage in experimental plots located at the Kambitsch Research farm (a-d) and in large-scale commercial fields located on farms across Latah and Nez Perce counties (e-h). “CT” = conventional tillage, “NT” = reduced tillage.

Clearly, the remaining pitfall samples need to be analyzed before any conclusions concerning these data can be made. However, it appears that the response of ground beetles to crop and tillage differ for individual species, and that such responses are somewhat consistent. It also appears that the response of dominant ground beetles to tillage in the small plots at Kambitsch is similar to that observed in the large-scale commercial fields. This suggests that the abundance patterns observed at Kambitsch realistically reflect the effects of crop and tillage upon ground beetles across the broader Palouse, or at least on beetles associated with well-drained soils in the high rainfall zone of the Palouse.

We now need to pose questions concerning the behavior, diet, phenology and pesticide tolerance of these species. Placing emphasis on such questions, and on these dominant species, will provide the best opportunity for maximizing the pest control potential of these important biological control agents.

Bulk soil sampling

Soils and macrofauna were sampled at the end and central points of each of the 24 transects. Bulk soil samples were collected in 10-cm increments to a depth of 100 cm. Soil samples were returned to the laboratory, air dried, and gently ground and sieved to obtain the less than 2-mm size fraction. These samples are currently being analyzed for total C, N, and inorganic (available N). Earthworm and other macrofauna collected in each sample were returned to the laboratory, counted, and weighed to get total biomass.

Although there was significant variability, probably due to slight differences in aspect, slope, and time since conversion to reduced-till, earthworm numbers were generally higher in reduced-till as compared to conventionally tilled fields (Figure 4). Tillage had little influence on the distribution of other macrofauna (Figure 5), which included weevils, centipedes, and spiders. In general, numbers of other macrofauna were higher in pea fields where weevils were the dominant species. Crop type, therefore, influenced the number and type of other macrofauna to a higher degree than did tillage.

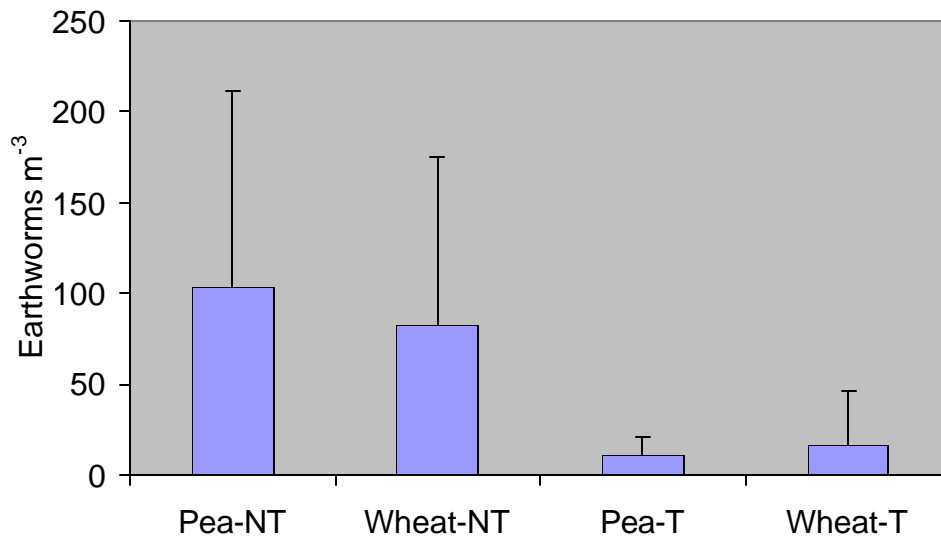


Figure 4. Average number of earthworms per cubic meter of soil in reduced-till (NT) and conventional-till (T) fields planted to either pea or wheat.

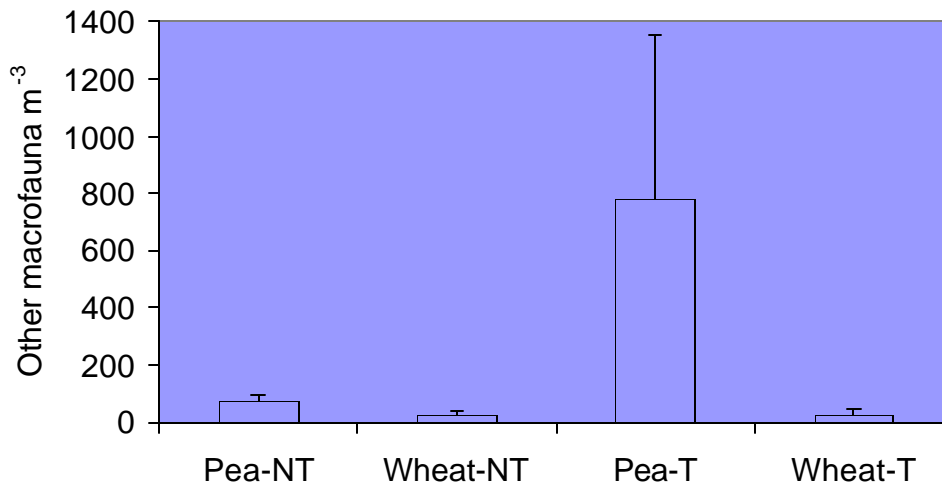


Figure 5. Average number of “other macrofauna” in reduced-till (NT) and conventional-till (T) fields planted to either pea or wheat.

INTERACTION WITH OTHER SCIENTISTS CONDUCTING RELATED ACTIVITY:

We interact with Stephen Guy, as this project is related to research under his direction being conducted at the UI Kambitsch Research Farm. We would like to thank the following individuals for allowing us to sample their fields, without which this study would not have been possible: Wayne Jensen, Nick Ogle, Mary-Jane Butters, Greg Moser, the Nelson family, John Hermann, Mike Becker, Mark Zenner and Russ Zenner.

PUBLICATIONS AND PRESENTATIONS:

Hatten, T.D., N. Bosque-Perez, S. D. Eigenbrode, and G. Chang. 2002. Examining the effects of crop and tillage on ground-dwelling arthropods found in the Palouse region of Idaho. Oral presentation, Annual Meeting of the Pacific Branch Entomological Society of America, June 16-19, South Lake Tahoe, Nevada.

Hatten, T.D., N. Bosque-Perez, S. D. Eigenbrode, S. Gebbie, and G. Chang. 2002. Richness and community structure of ground-dwelling arthropods found within cropland and remnant prairie of the palouse. Oral presentation, Annual Meeting of the Palouse Prairie Foundation, September 5, Moscow, Idaho.

Hatten, T.D., N. Bosque-Perez, S. D. Eigenbrode, and G. C. Chang. 2002. Influence of management practices on abundance and diversity of soil-surface Coleoptera in the Palouse. Poster presentation, Annual Meeting of the Entomological Society of America, November 17-20, 2002, Fort Lauderdale, Florida.