Impact of climate change on potential distribution and relative abundance of the migratory grasshopper (Orthoptera: Acrididae) in the prairie ecosystem of Canada

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Introduction Climate is the dominant force determining the distribution and abundance of most insect pest species. There has been considerable concern in recent years about climatic warming caused by human activities and the affects of these changes on agriculture in North America. Warming conditions may affect insect populations by altering timing of emergence, increased growth and development rates, shorter generation times and reduced overwintering mortality (McCarthy *et al*. 2001). Given that the magnitude of predicted temperature change associated with global warming is beyond the historical experience of modern agriculture computer models are one method by which researchers can study the possible impacts of climate change.

Materials and methods Model output was generated with CLIMEX^{TM} 2.0, based on climate data derived from splined data. A 0.5 ^{0} world grid dataset was used for input into the models. Models were run with the North American dataset (n=12452 grids). Incremental scenarios were created for all possible combinations for temperature (0, +1, +2, +3, +4, +5, +6, +7^0 of climate normal temperature for each grid) and precipitation (-20%, -10%, 0%, +10%, +20% of climate normal precipitation for each grid). Contour maps were generated by importing Ecoclimatic Indices into ArcView ^{TM} 8.1 (ESRI Inc 2001). Ecoclimatic Index values weree used to identify locations where climatic conditions are conducive to the development of pest populations.

Results Prior to utilizing the bioclimatic model for *M. sangunipes* (Gage *et al*. 1976) to predict the potential impact*s* of climate change in the grasslands of Canada, the model was validated by comparing predictions to known distributions of grasshoppers using approximately 50 years of population data. The results of the analysis indicated that potential grasshopper abundance and distribution varied with different combinations of predicted precipitation and temperature changes. Figure 1a, representing current Canadian conditions, provides a baseline for comparison against each of the climate change scenarios. For example, even a two degree increase in mean temperature and a 20% decrease in precipitation can potentially have a significant increase in risk to grasslands productivity due to the increase in grasshopper population density and distribution (Figure 1b).

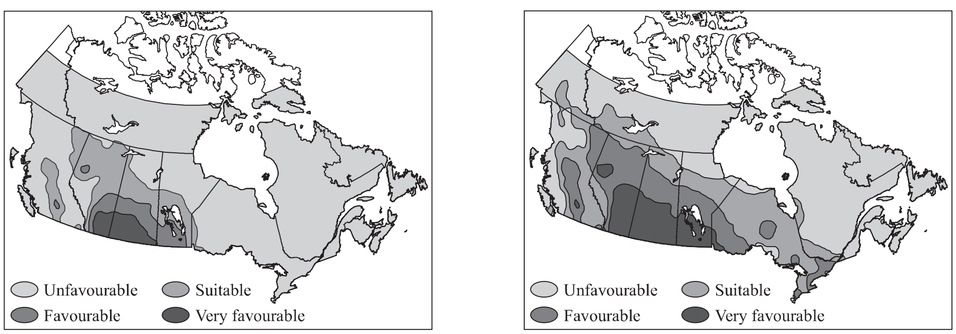

Figure 1 (a) Map on the left represents the grasshopper density and distribution under current conditions; (b) Map on the right predicts the density and distribution of grasshoppers with a two degree increase in mean temperature and a 20% decrease in precipitation

Conclusions The results of the present study showed that grasshopper range and distribution are positively and negatively affected based on specific combinations of temperature and precipitation. The model predicted that increased temperatures would result in the northward extension of *M. sanguinipes*. The study demonstrates that grasshopper populations, associated with observed meteorological conditions, can be used as analogues to estimate risk to grasslands of North America from climate change.

References

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