Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Multi-Species Pest Risk Analysis of Climate Impacts on Field Crop Pests in Canada

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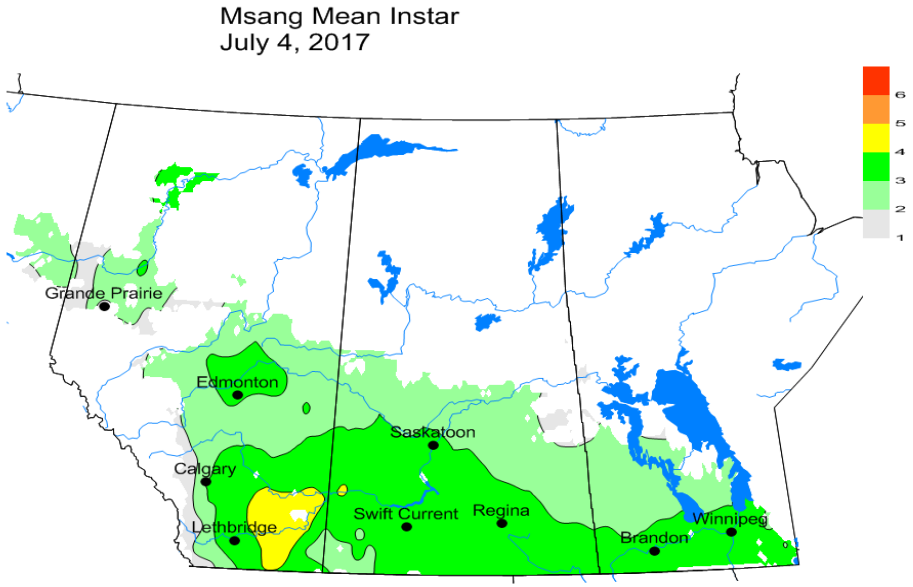
AAFC - Saskatoon Research and Development Centre

Canada

Considerations

- In agricultural ecosystems we often only consider one pest species at a time.
- Crop production decisions are based on three time frames. Pest risk analysis and decision support should permit analysis across these periods
  - Upcoming growing season
  - Within season
  - Long term (decades)
- Develop a modelling framework to address these issues.

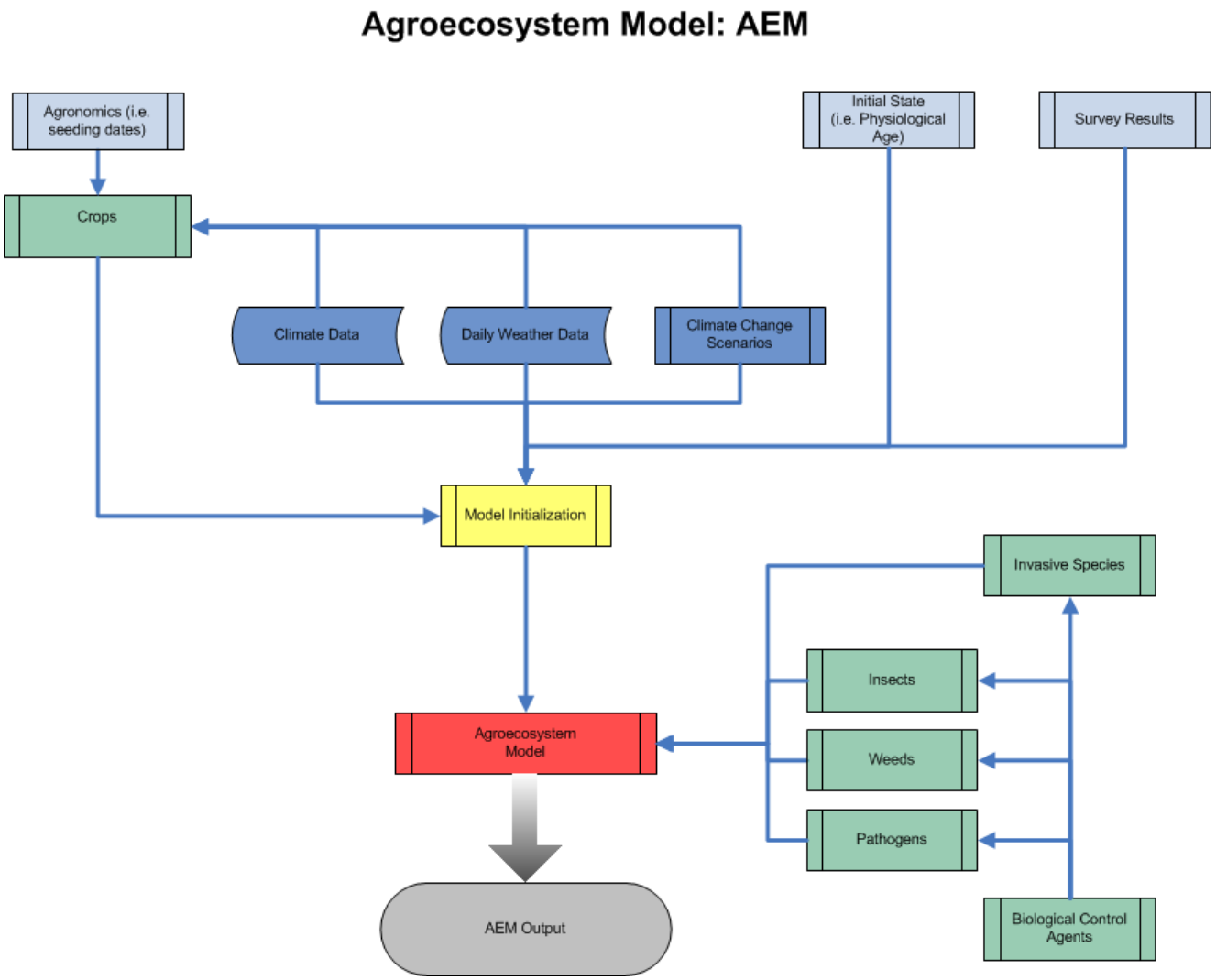


Olfert and Weiss (AAFC) 2017

Objectives

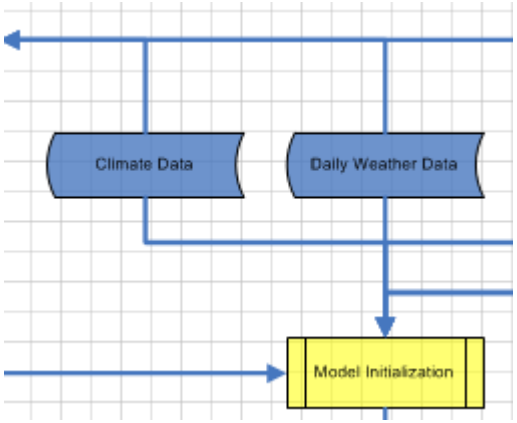
- Develop a framework to permit researchers to develop multiple species decision support systems.
- Quantify the changes in regional crop risk due to overlap of the three pest species across different time intervals.

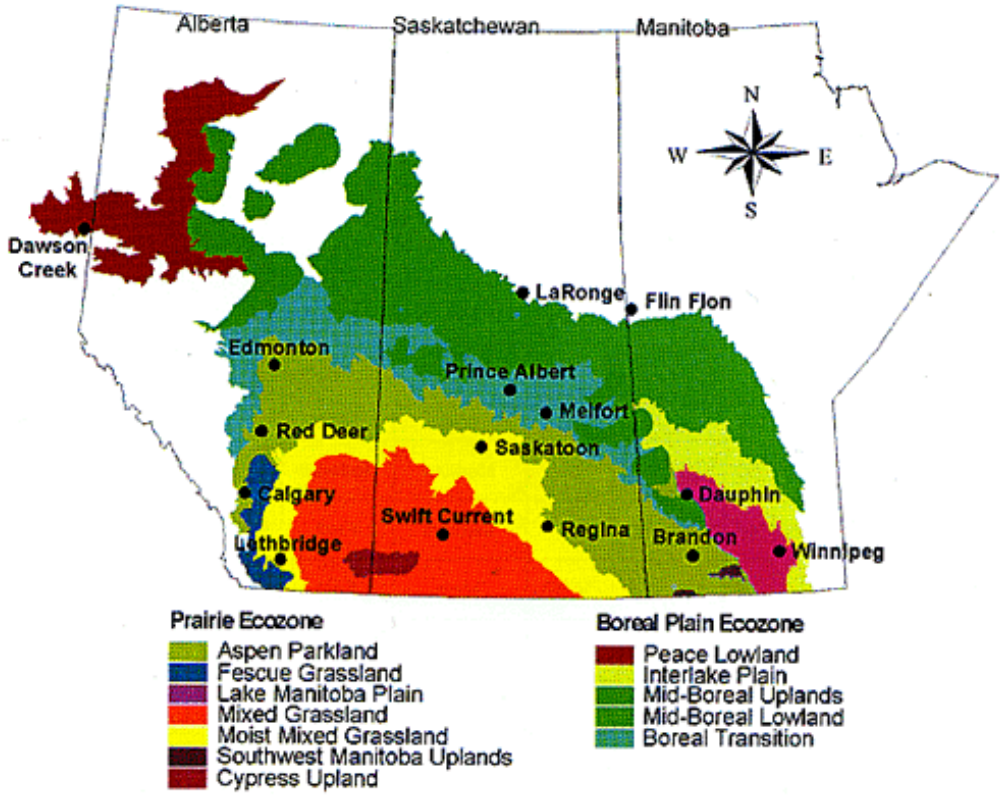
Agroecosystem Model: AEM



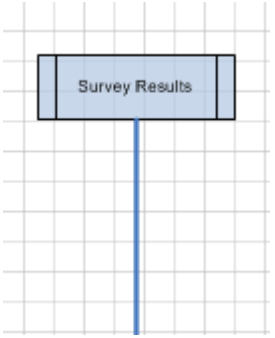
Prairies ecozone

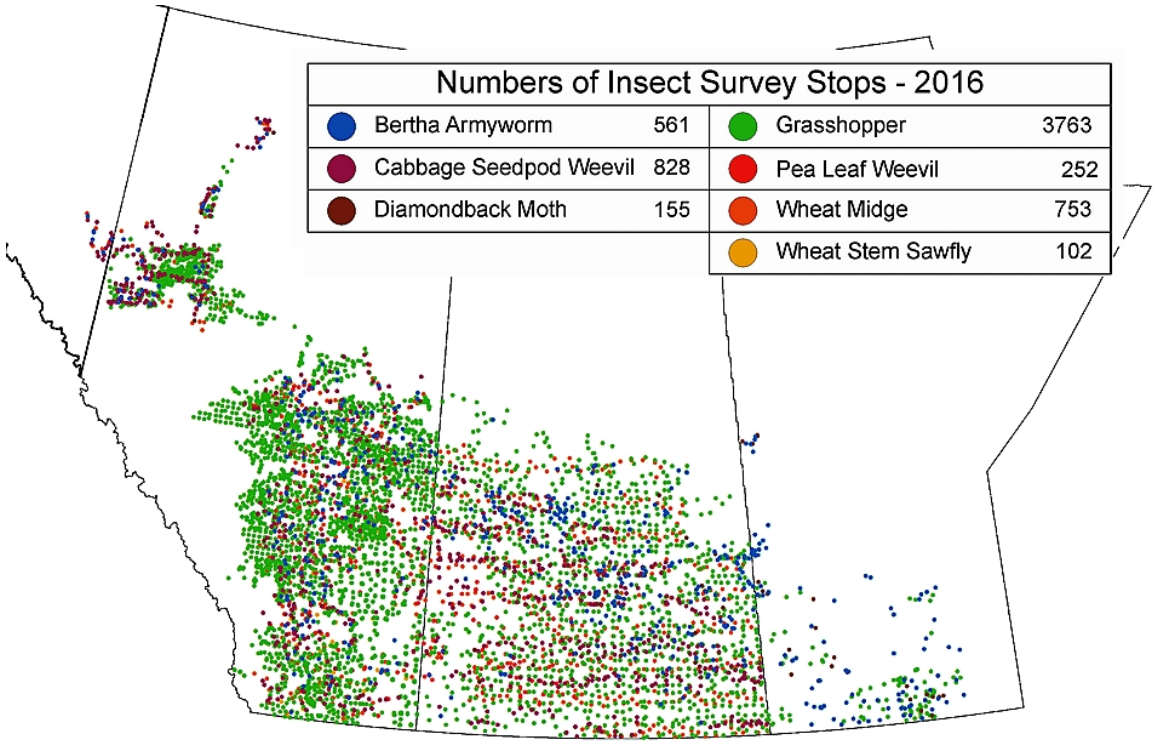
- Northern extension of Great Plains of North America.
- 95% of the region is farmland
- Semi-arid climate that is highly variable
  - Winters – Cold
  - Summers – Short and warm





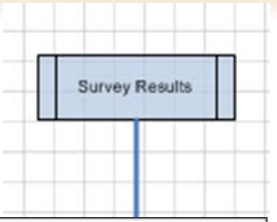
Prairie insect surveys: PPMN

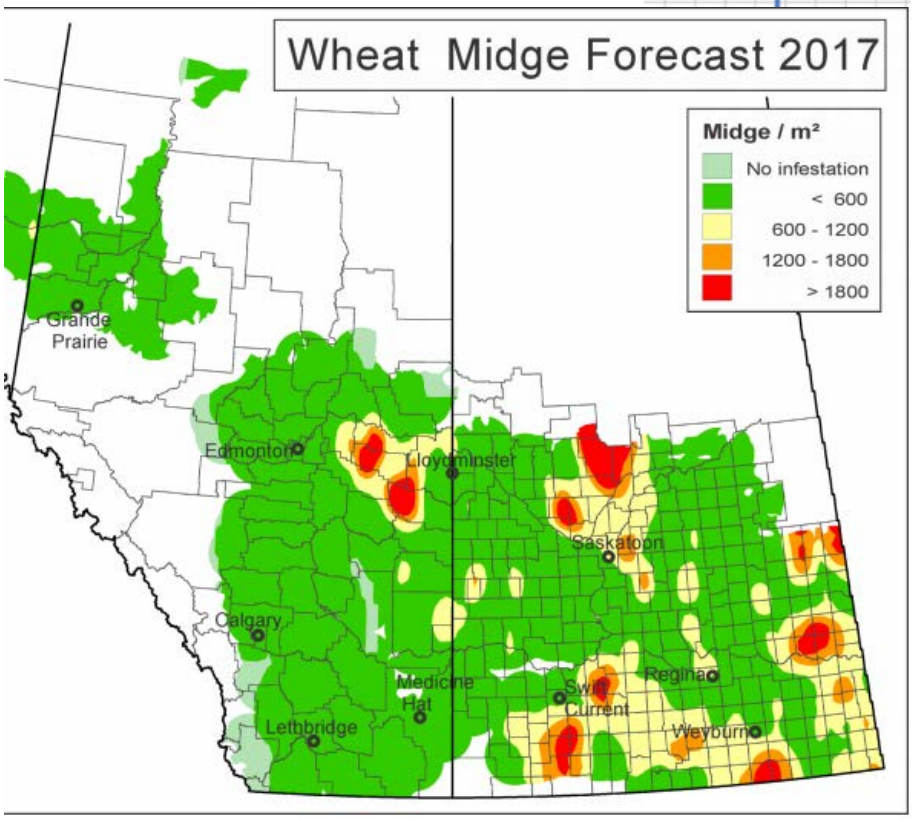




http://prairiepestmonitoring.blogspot.ca/

Historical surveys: Forecasts





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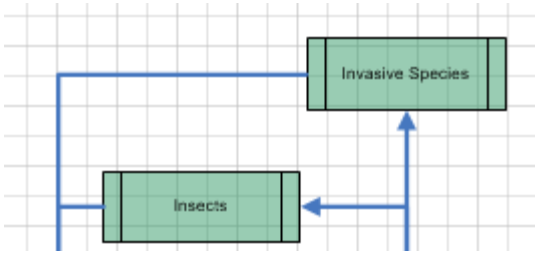
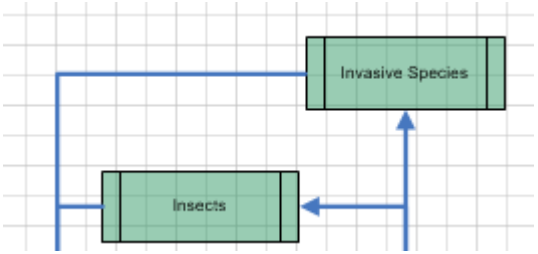
Models

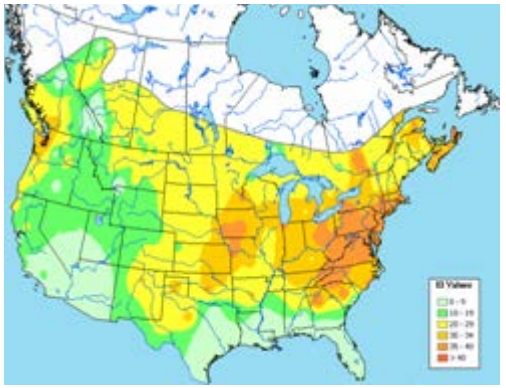


- Based on published bioclimatic models
- CLIMEX and DYMEX
- Climate/meteorological data
  - Daily – interpolated
  - Climate – CLIMOND (Kriticos et al. 2012)

Bioclimatic model: Cereal Leaf Beetle (*Oulema melanopus*)

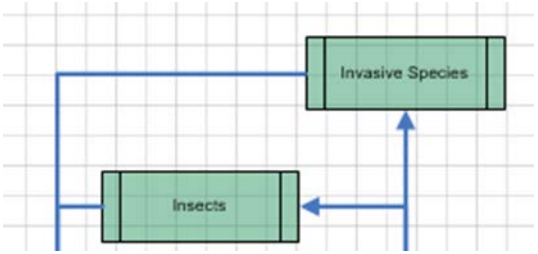


- Early season species. Adults and larvae are active in May and June.

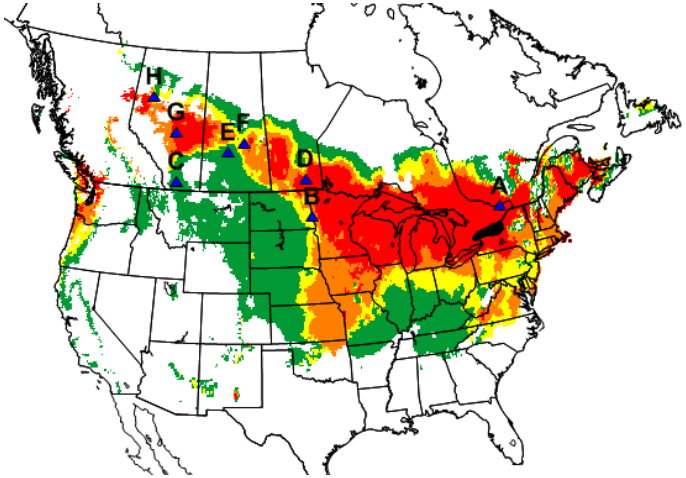


Olfert et. al. 2004. Canadian Entomologist **136**: 277-287.

Bioclimatic model: Wheat midge (*Sitodiplosis mosellana*)

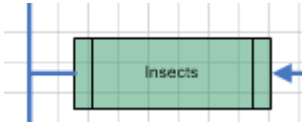


- Wheat midge – cool, wet (July)

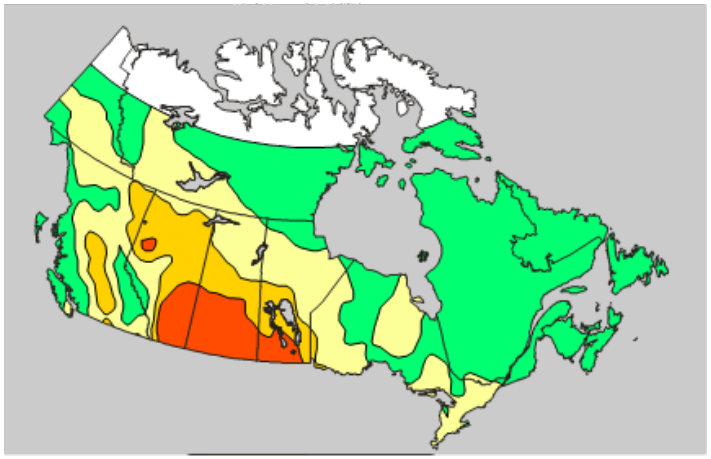


Olfert, O., Weiss, R.M., Elliott, R.H. 2016. Canadian Entomologist **148**: 52-67.

Bioclimatic model: Grasshoppers (*Melanoplus sanguinipes*)



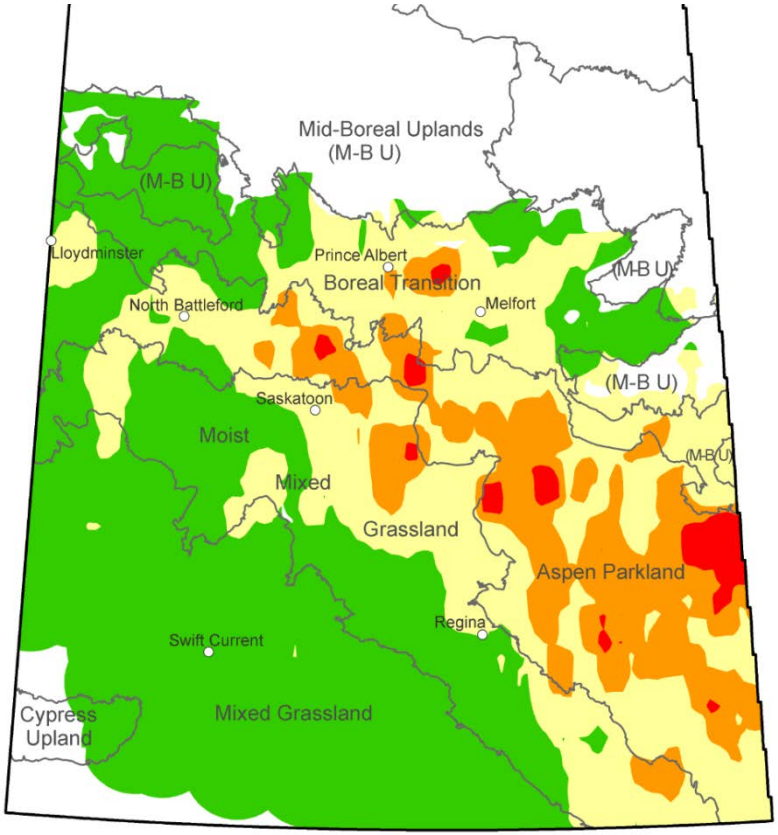
- Grasshoppers – hot, dry (May – September)

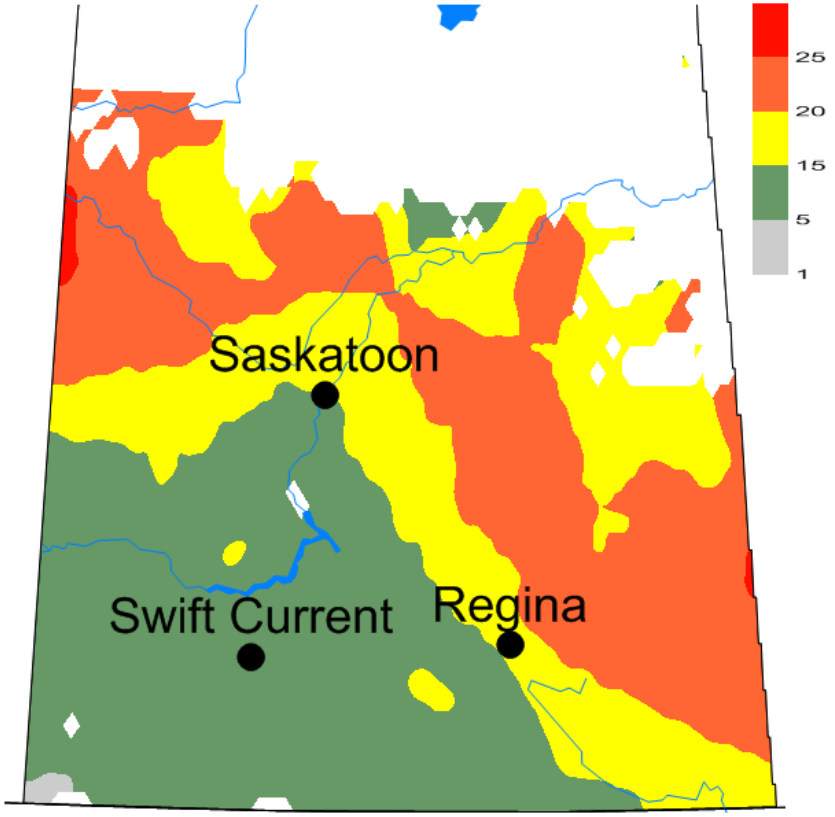


Olfert, O., Weiss, R.M. and Kriticos, D.J. 2011. Psyche **2011**: 1-9.

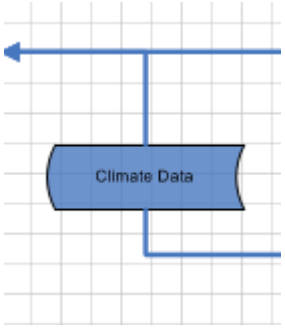
Bridge the gap: Relate survey and model output

- Relate insect survey results and EI/GI values

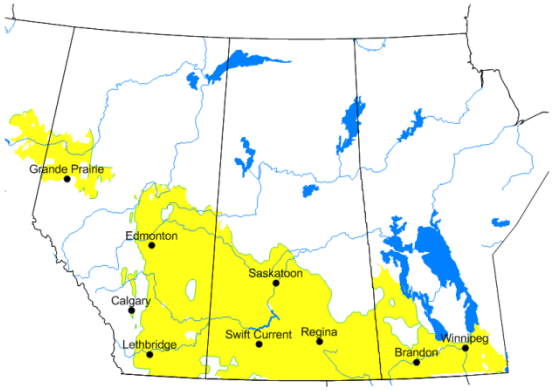




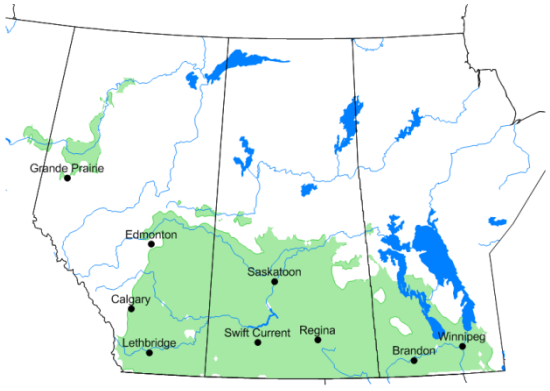
Current and Future Climate: Single vs Multiple species



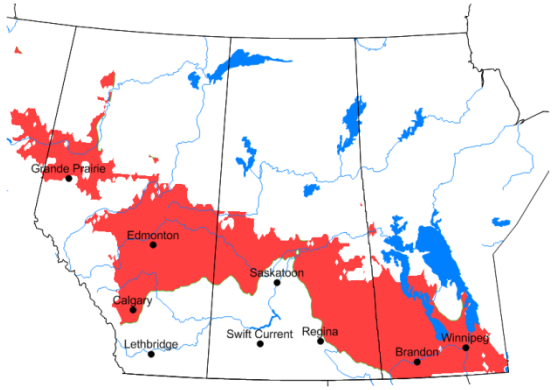
CLB - 1975



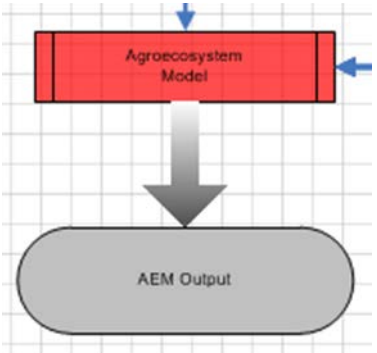
Msang - 1975



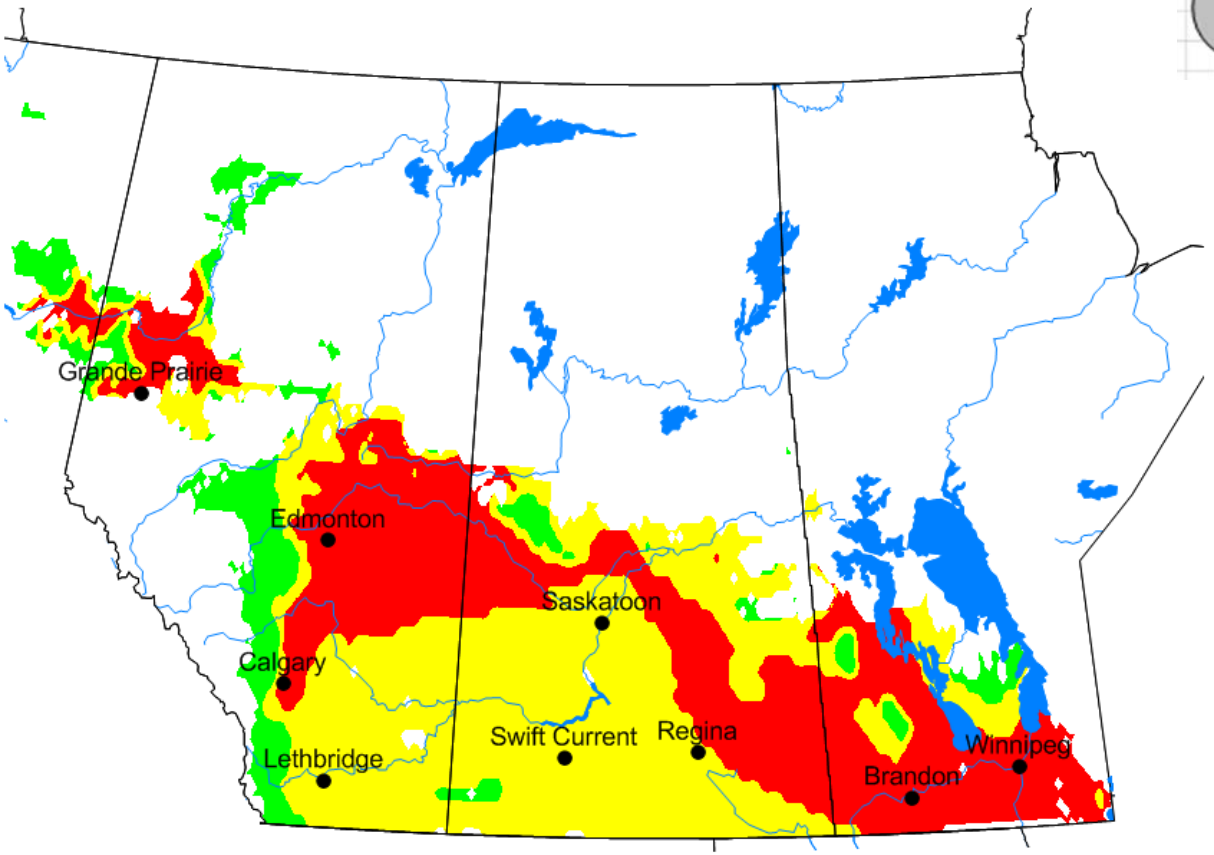
Wm - 1975



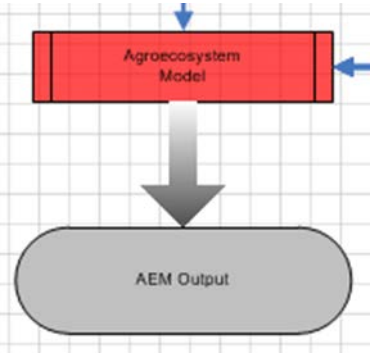
Current climate



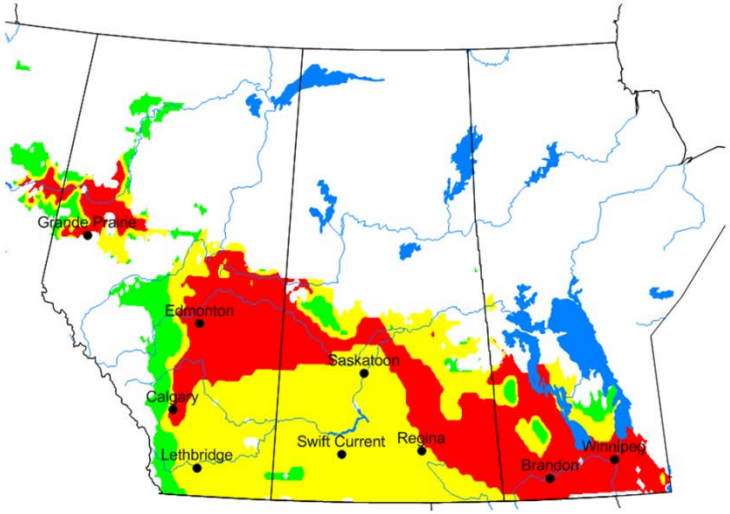
Mult species - 1975



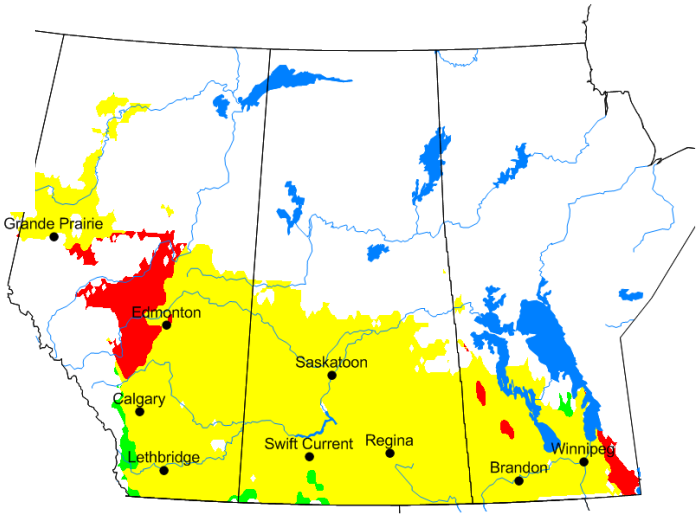
Current Climate – Incremental Scenarios (+2C, -20%): Multiple species



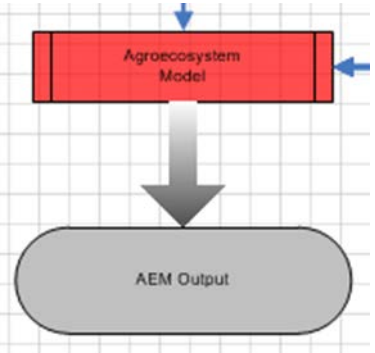
Mult species - 1975



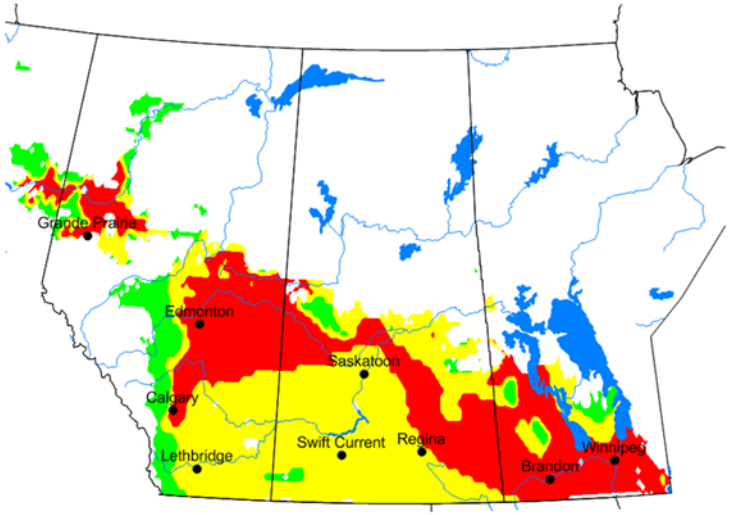
Mult species - 1975
+2C, -20%



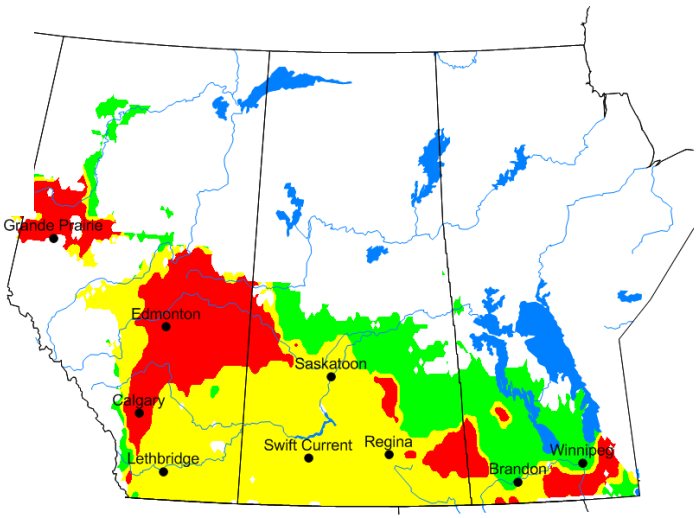
Current Climate – Incremental Scenarios (-2C, +20%): Multiple species



Mult species - 1975



Mult species - 1975
-2C, +20%



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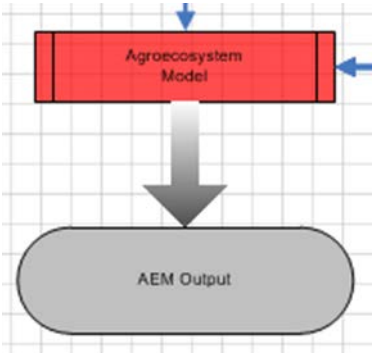
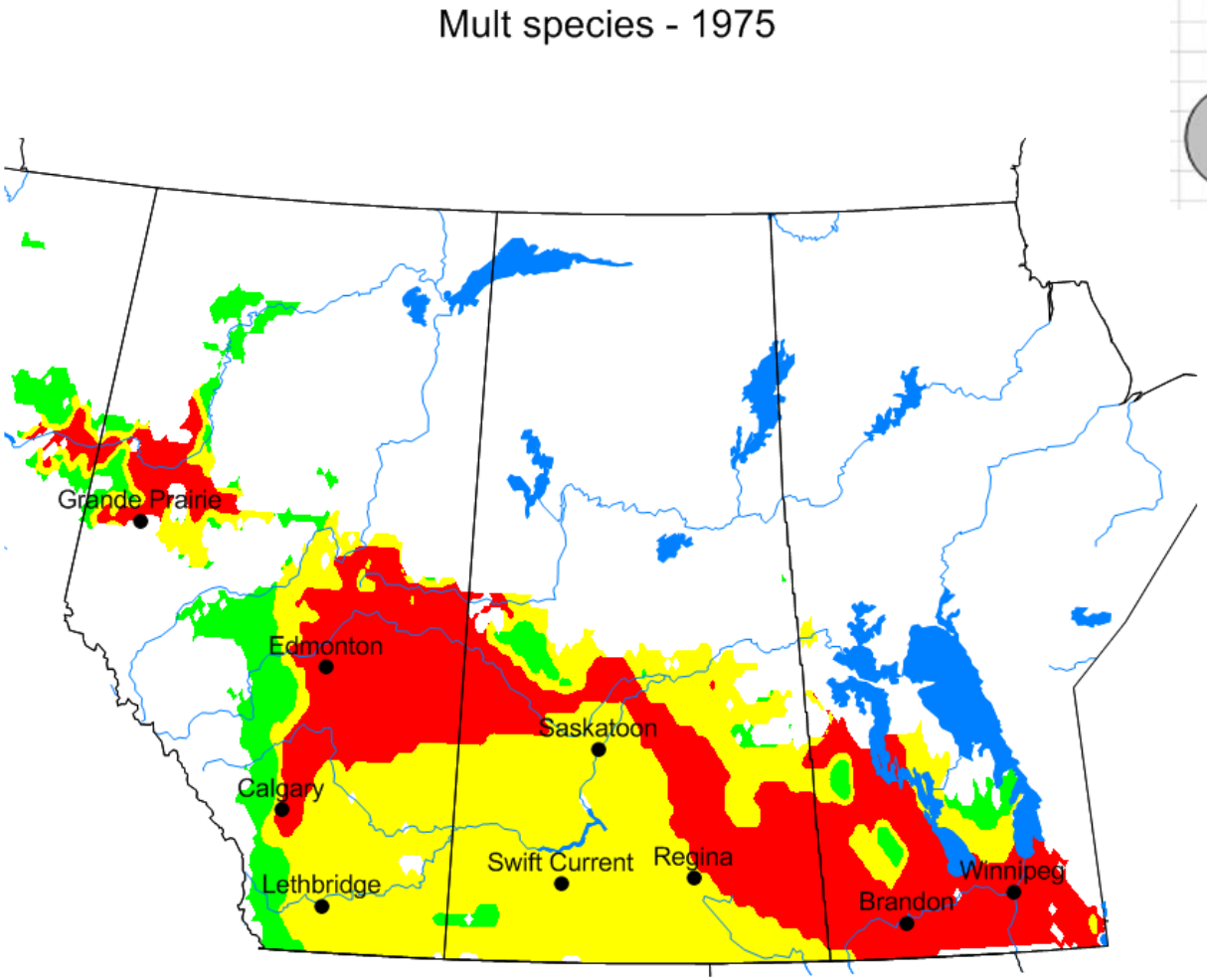
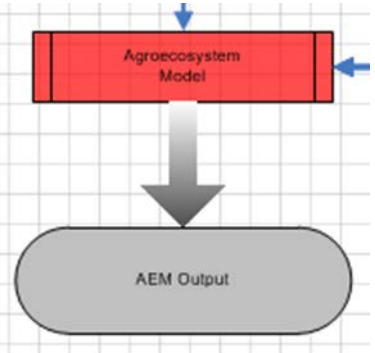


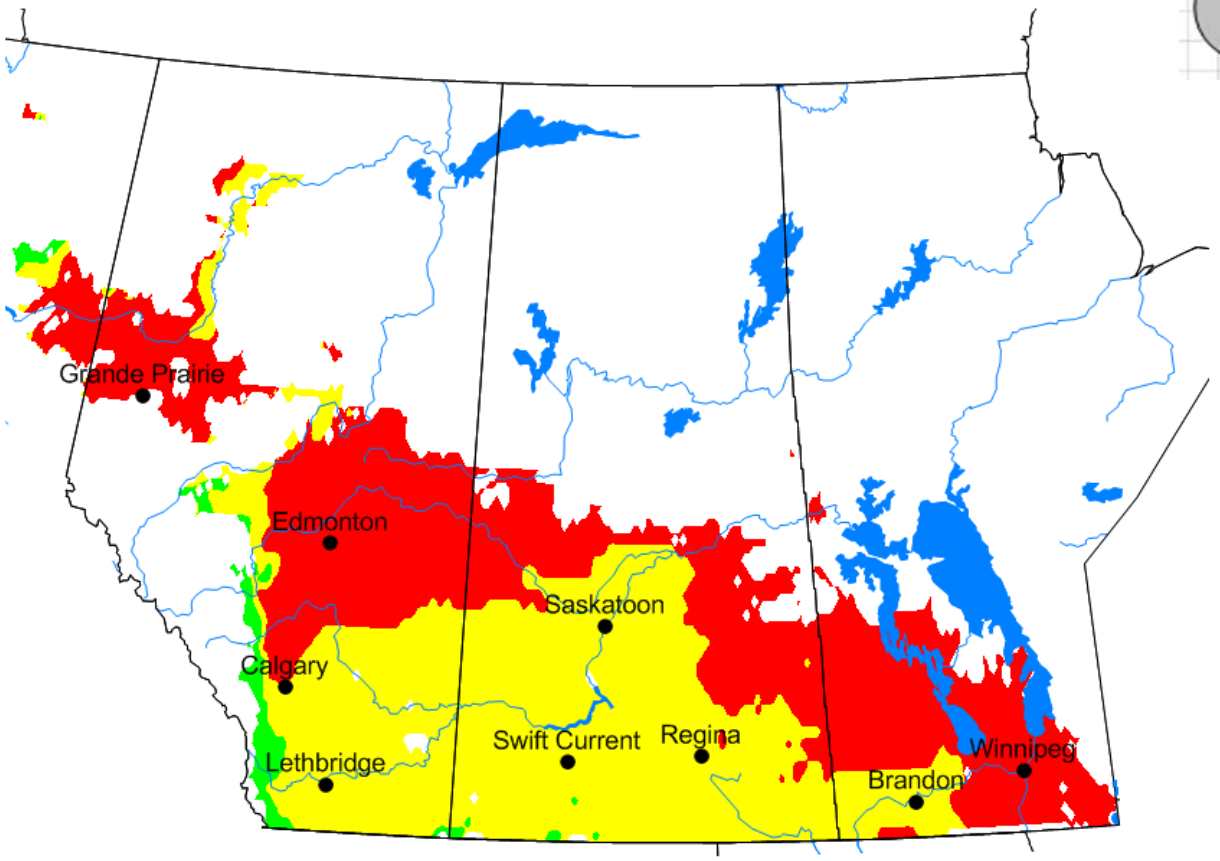


Kriticos, D. J., et al. (2012). "CliMond: global high-resolution historical and future scenario climate surfaces for bioclimatic modelling." Methods in Ecology and Evolution **3**: 53-64.

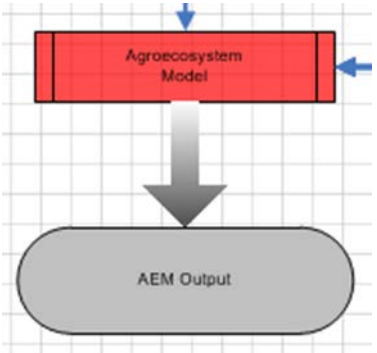
2030

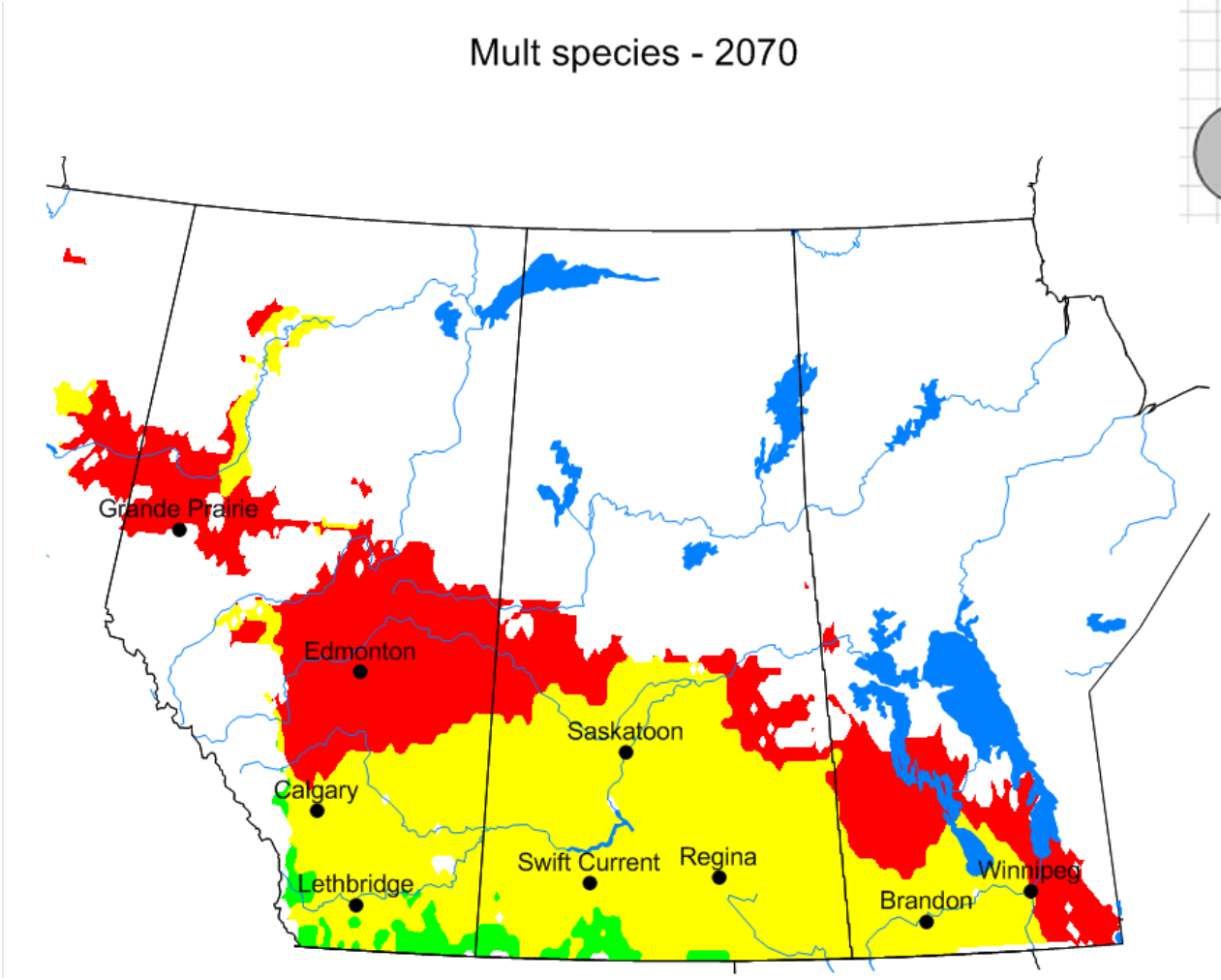


Mult species - 2030



2070


Agroecosystem Model
AEM Output

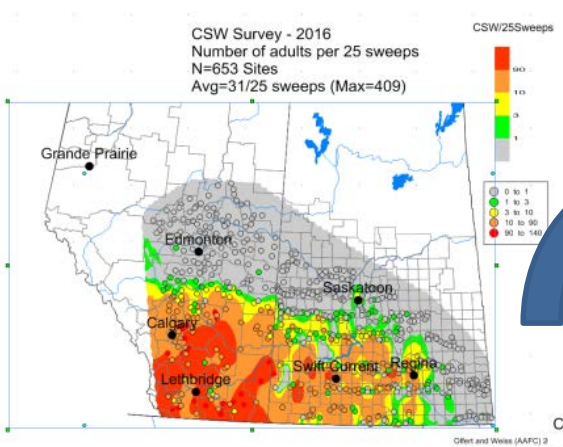

Mult species - 2070
Grande Prairie
Edmonton
Saskatoon
Calgary
Swift Current
Regina
Lethbridge
Winnipeg
Brandon

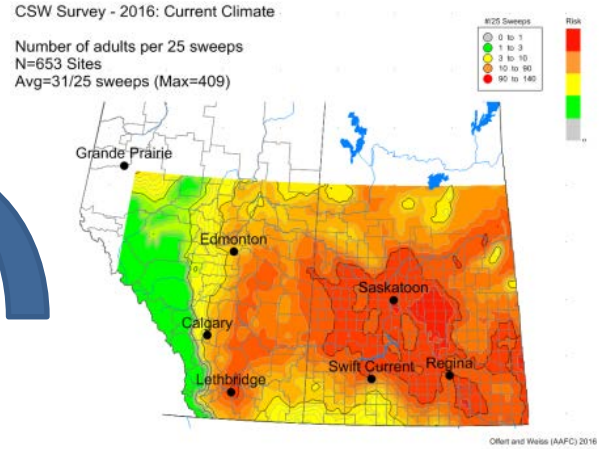
Next steps…

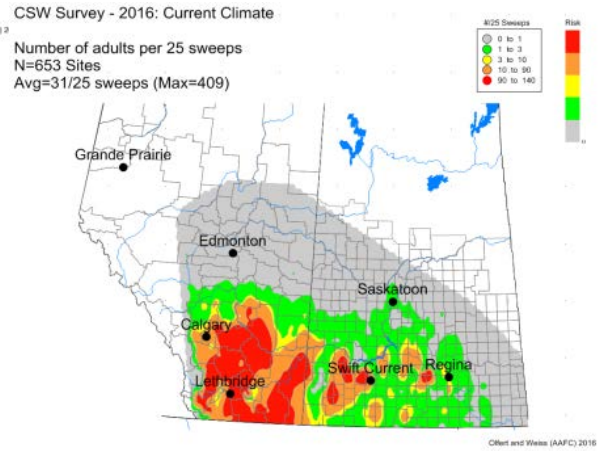
- Integrate *survey data* with model output across multiple species including biocontrol agents and weeds.

Next Steps:
Surveys and climate → risk estimates

- Survey data (2016) is combined with model output (GI values) to produce a composite surface that reflects the impact of climate on CSW populations (based on the survey from the previous year.







Summary

- The AEM is a flexible, robust framework to address issues associated with pest risk analysis and decision support.
- Large scale field surveys can be a significant component of model initialization.
- Multiple species models identified geographic areas that are at risk for establishment of economic levels of pest population density.
- *Conduct similar studies to investigate response of natural enemies, weeds and pathogens.*

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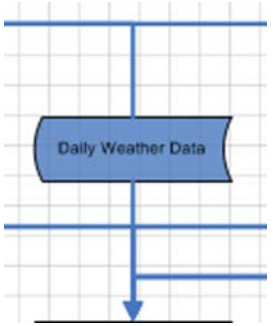
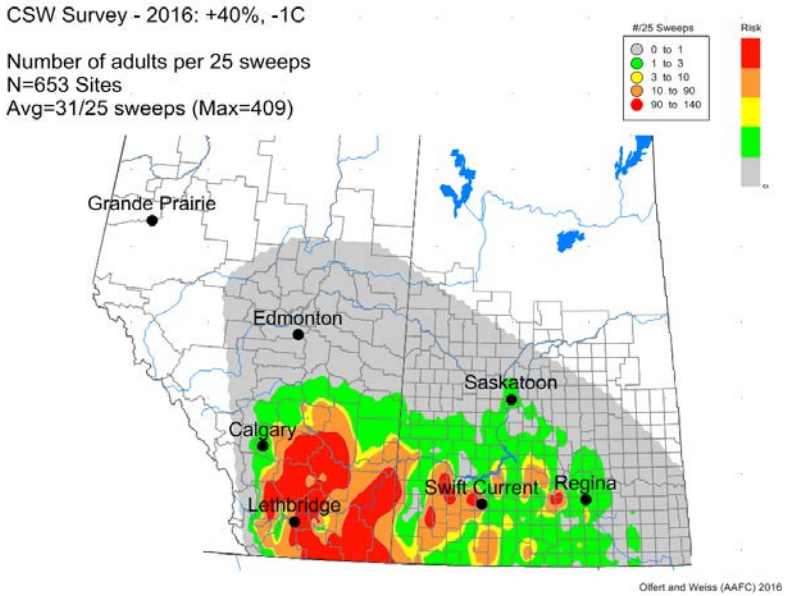
Thank you

Canada

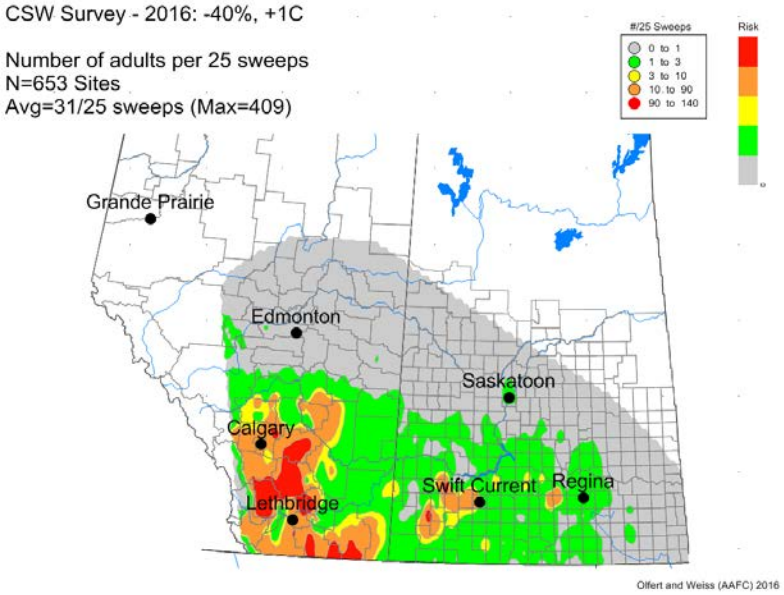
Annual Forecasts: Temperature and rain scenarios



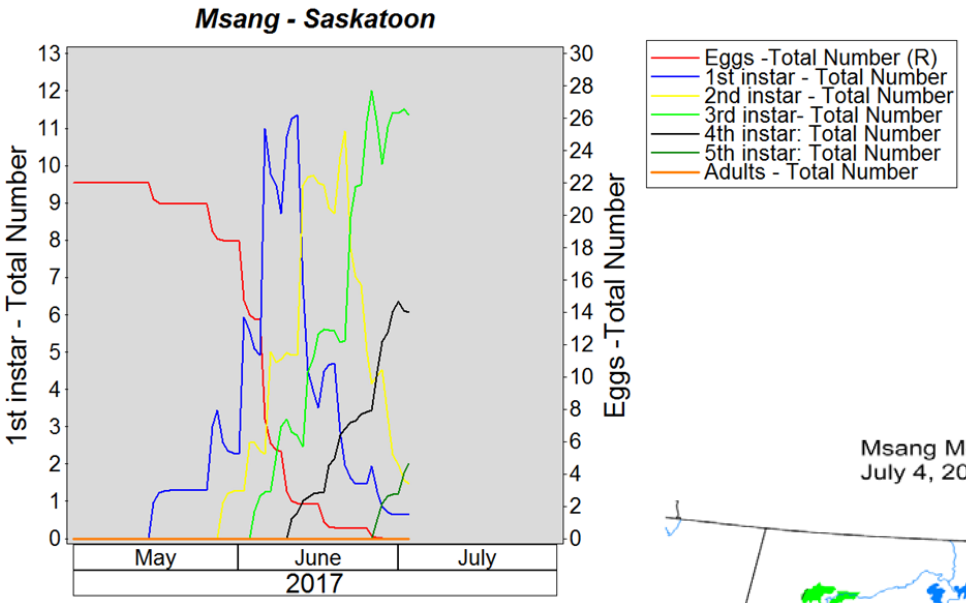
Cool/Wet

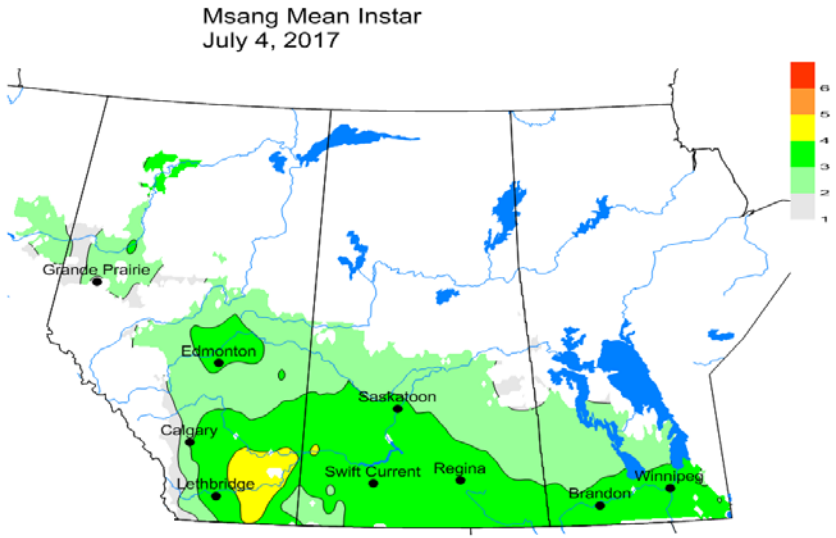


Warm/Dry



Within growing season

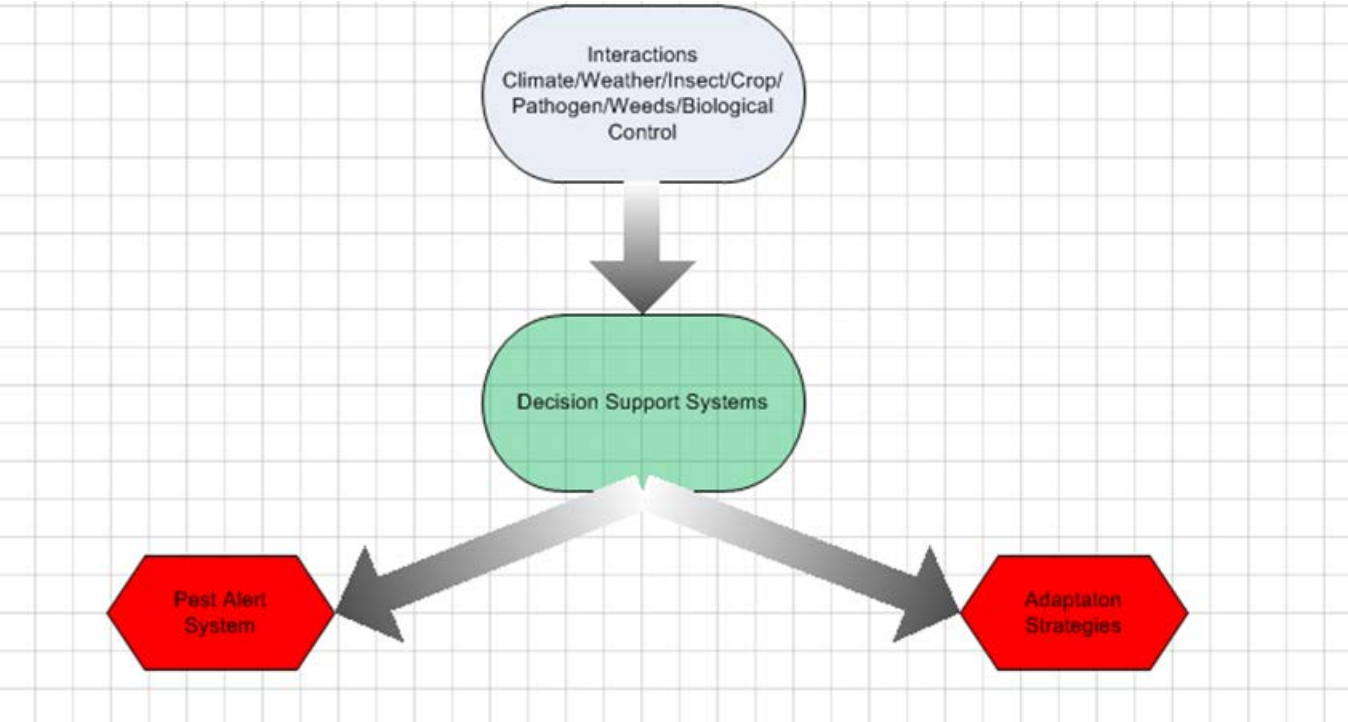




Olfert and Weiss (AAFC) 2017

Raison d'être

Through increased awareness, farmers and land managers in potentially high-risk areas can be more proactive when needed, utilizing integrated pest management practices to combat the establishment or spread of pests.



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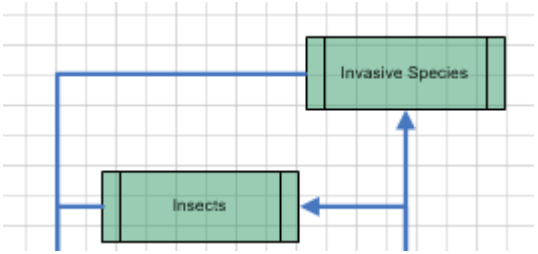

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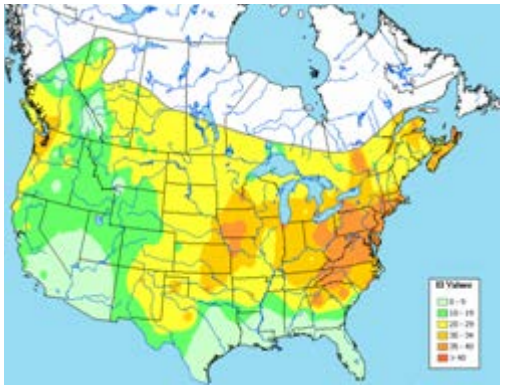

Olfert et. al. 2004. Canadian Entomologist **136**: 277-287.