Holistic management and systems thinking in organic agriculture

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Becky Weed 13 Mile Farm

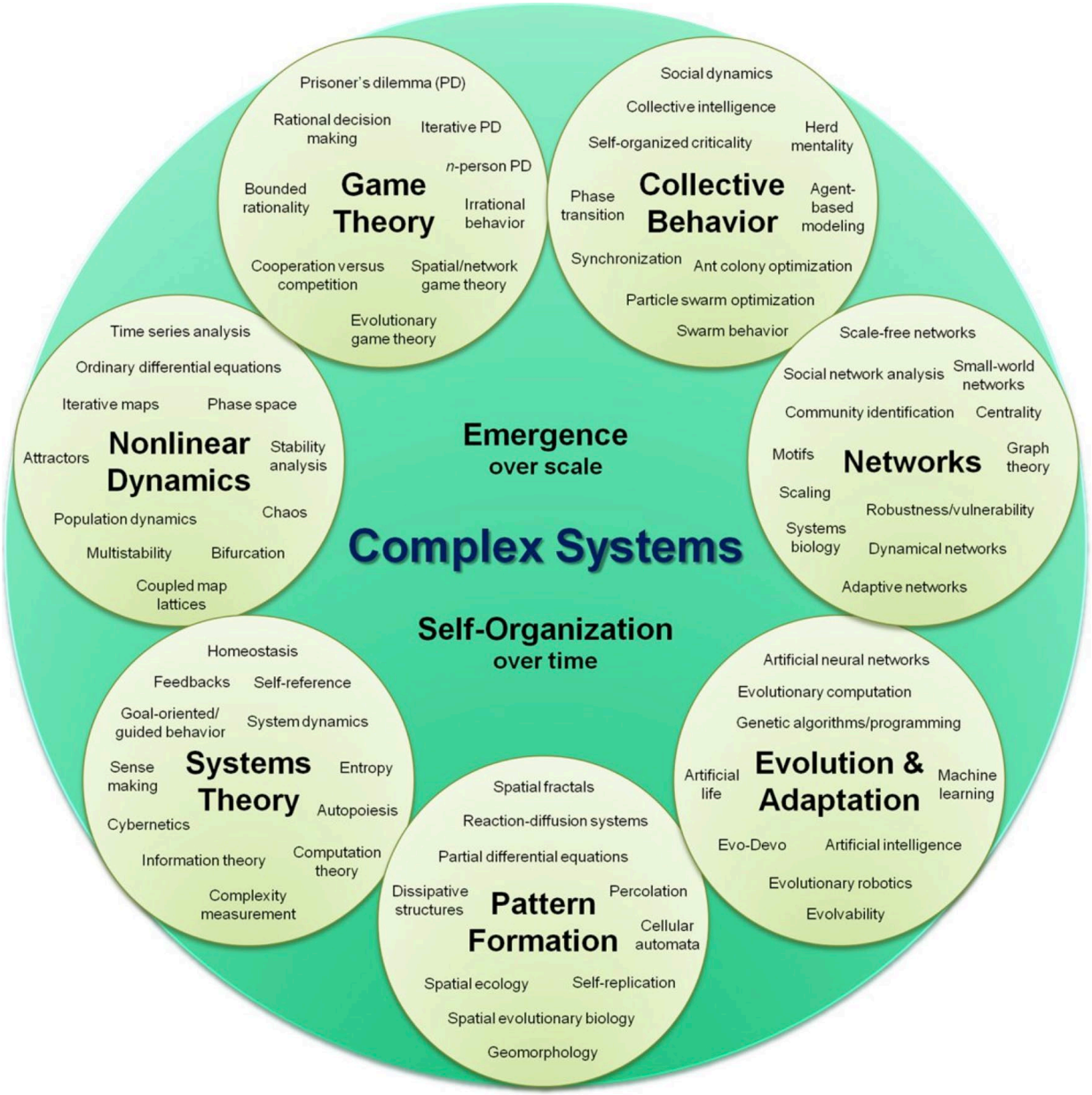
Holistic management

- Made famous by Alan Savory
- Holistic management describes a **systems thinking** approach to managing resources
- Focuses grazing management on
  - Water cycle
  - Carbon cycle
  - Energy flow
  - Community dynamics (ecosystems)

Systems thinking (theory)

- System is interrelated and interdependent parts
- Complex arrangement of elements
- Changes can affect parts or whole system

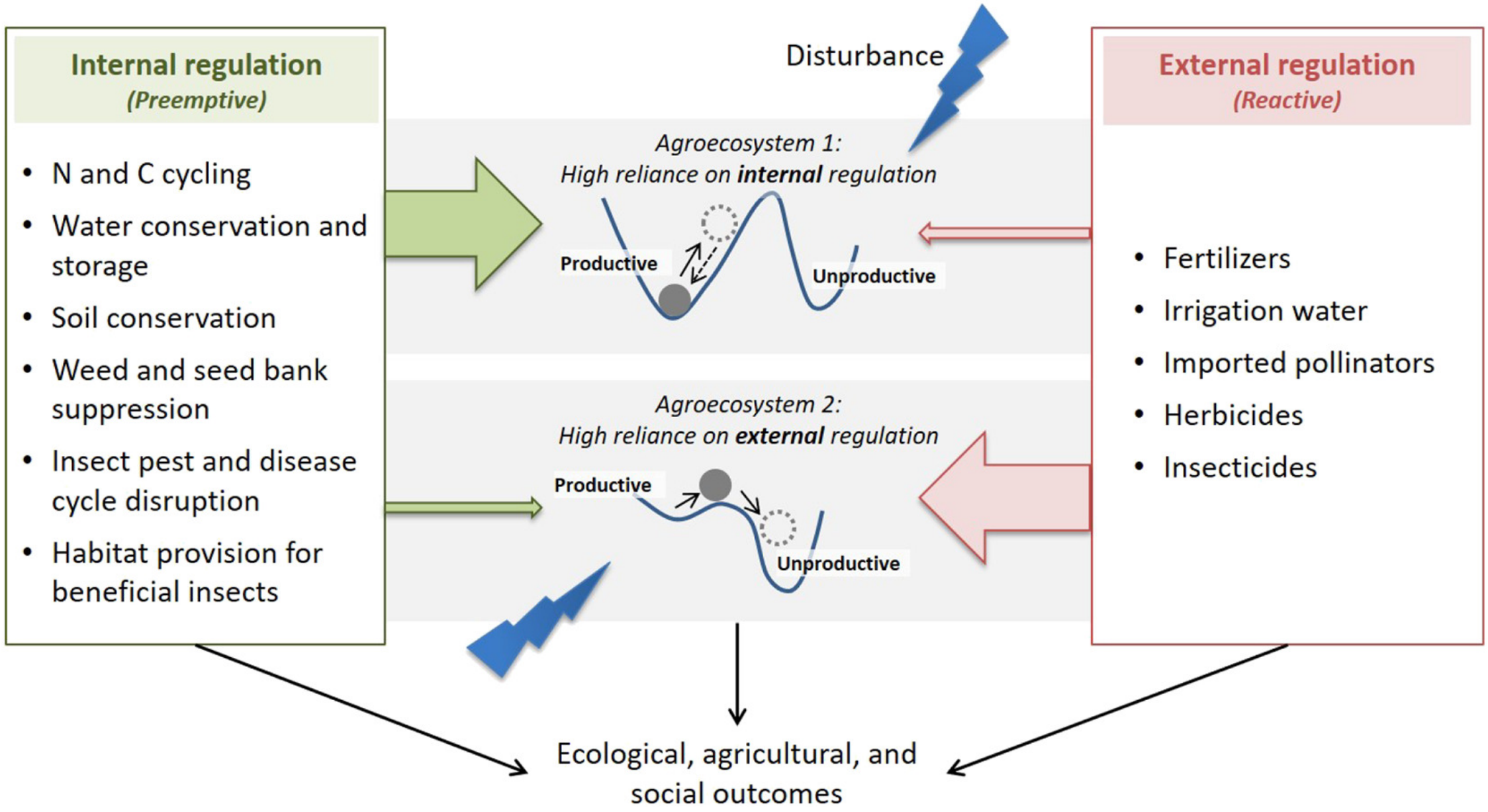
- Systems ecology focuses on interactions and transactions within and between biological and ecological systems.



Systems thinking

- Complex interactions
- Complex decision making
- Dynamic
- No prescriptive cure

Agricultural systems are complex systems



Peterson et al 2017, Agricultural systems

Understand the ecology of the system

- An example of cropping systems from Havre (Northern Ag Research Center)

Cover crop trade-offs: evaluating soil moisture, weed suppression, and soil microbial communities

Montana Ag Experiment Stations
Virtual field day 2020

Tim Seipel, Maryse Bourgault, Darrin Boss, Mary Ellyn DuPre, Tindall Overson, David Weaver, and Fabian Menalled

Project Design

- Began in 2012
- Wheat – cover crop rotation
  - With different mixtures of cover crops
  - Different phenologies and divesity of mixtures

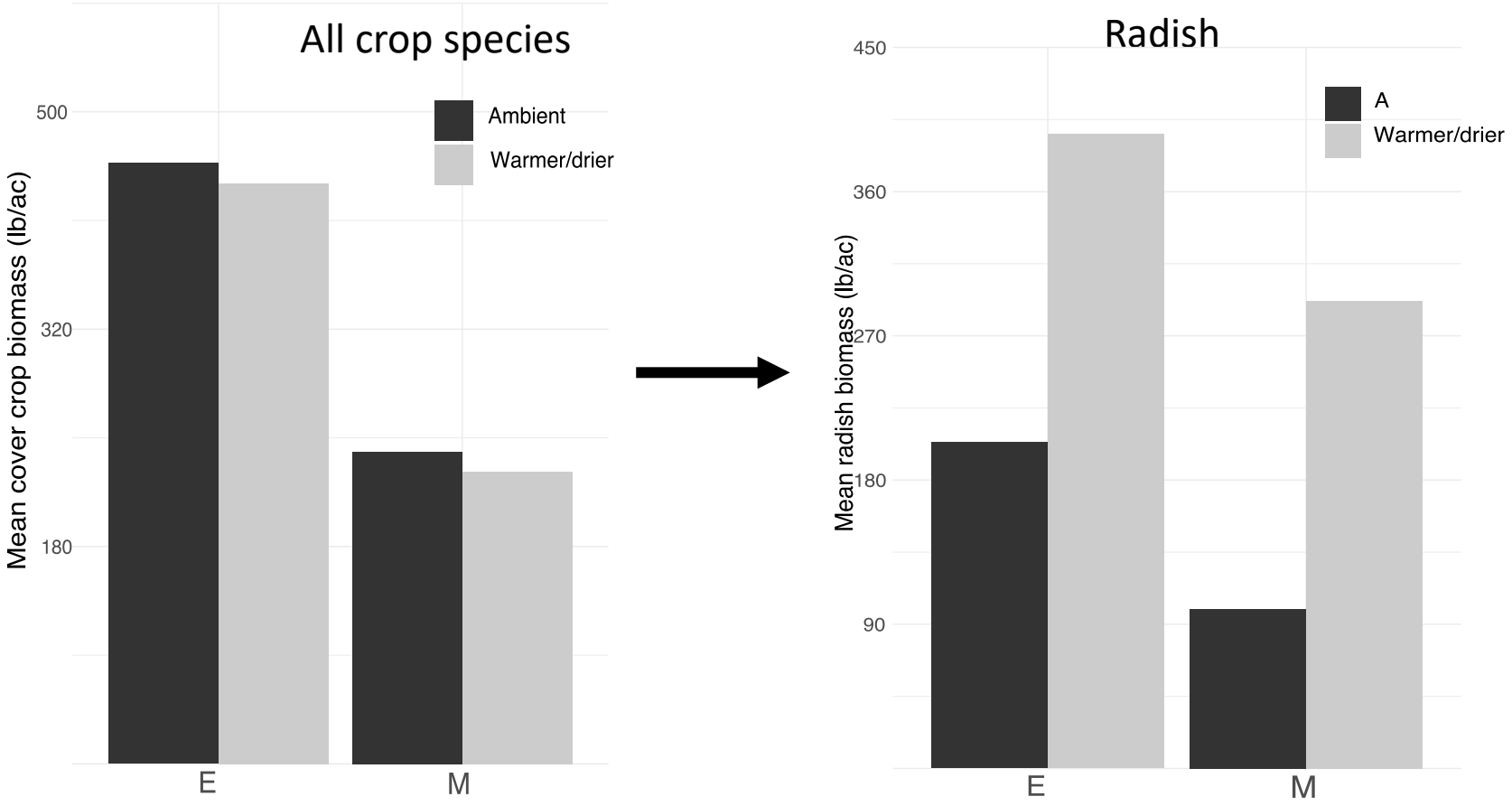
- We also compared the outcomes under warmer and drier conditions

Cover crop mixtures

- We assessed a 5-species (early phenology) and 7 species mixture (mid season phenology)

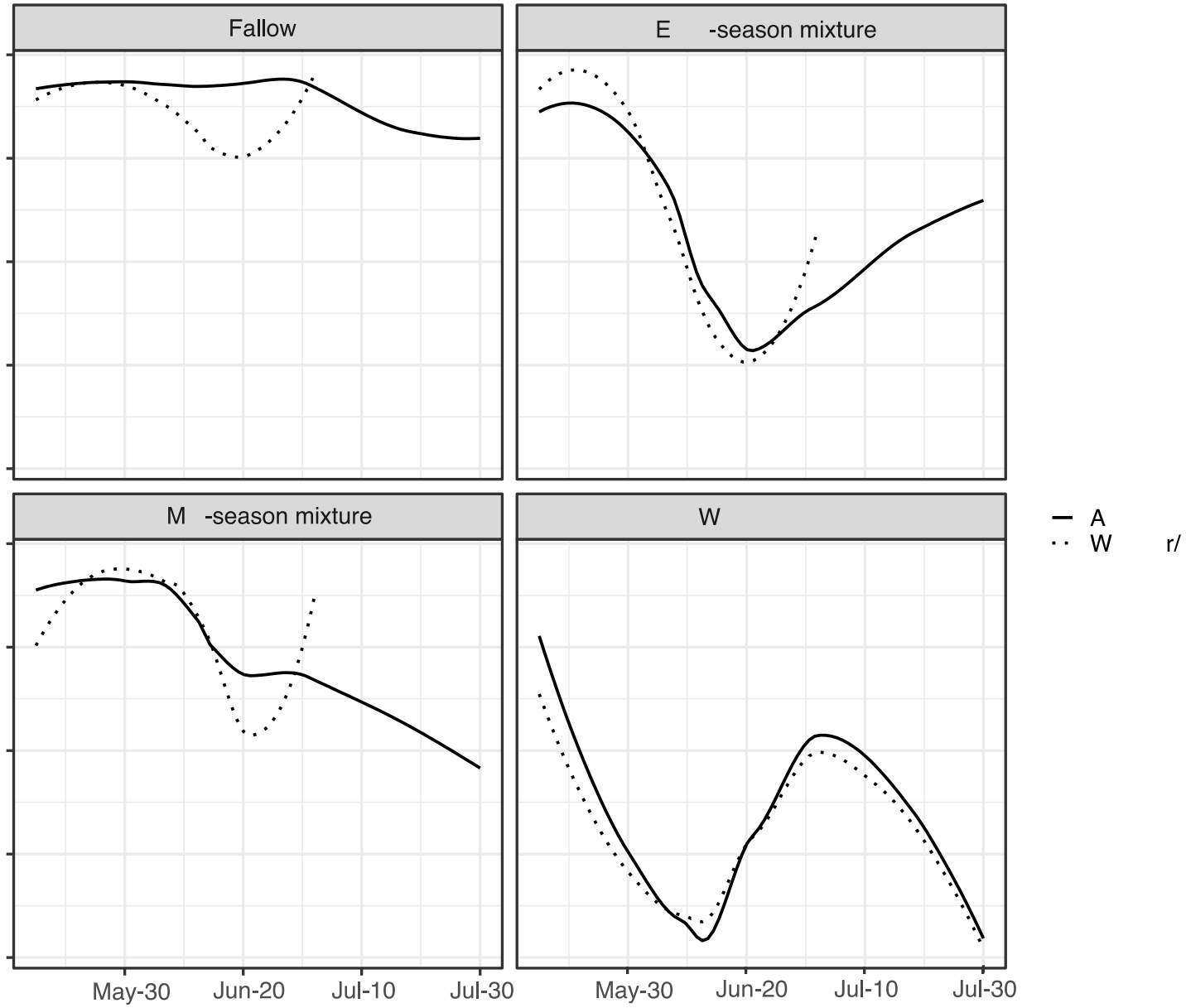
Cover crop species	2018		2019	
	early	mid	early	mid
Otana Oat (*Avena sativa*)	X	X	X	X
Purple Top Turnip (*Brassica rapa*)	X	X	X	X
Frontier Chickpea (*Cicer arietinum*)	-	-	-	X
Sheyenne Soybean (*Glycine max*)	-	X	-	-
Indian Head Lentil (*Lens culinaris*)	-	X	-	-
Arvika Pea (*Pisum sativum*)	X	X	X	X
Ground Hog Radish *(Raphanus raphanistrum)*	X	X	X	X
Golden German Millet (*Setaria italica*)	-	-	-	X
Grazex III Sorghum x sudan grass (*Sorghum x drummondii*)	-	X	-	-
Hairy Vetch (*Vicia villosa*)	X	-	X	X

Biomass and relative abundance of cover crops

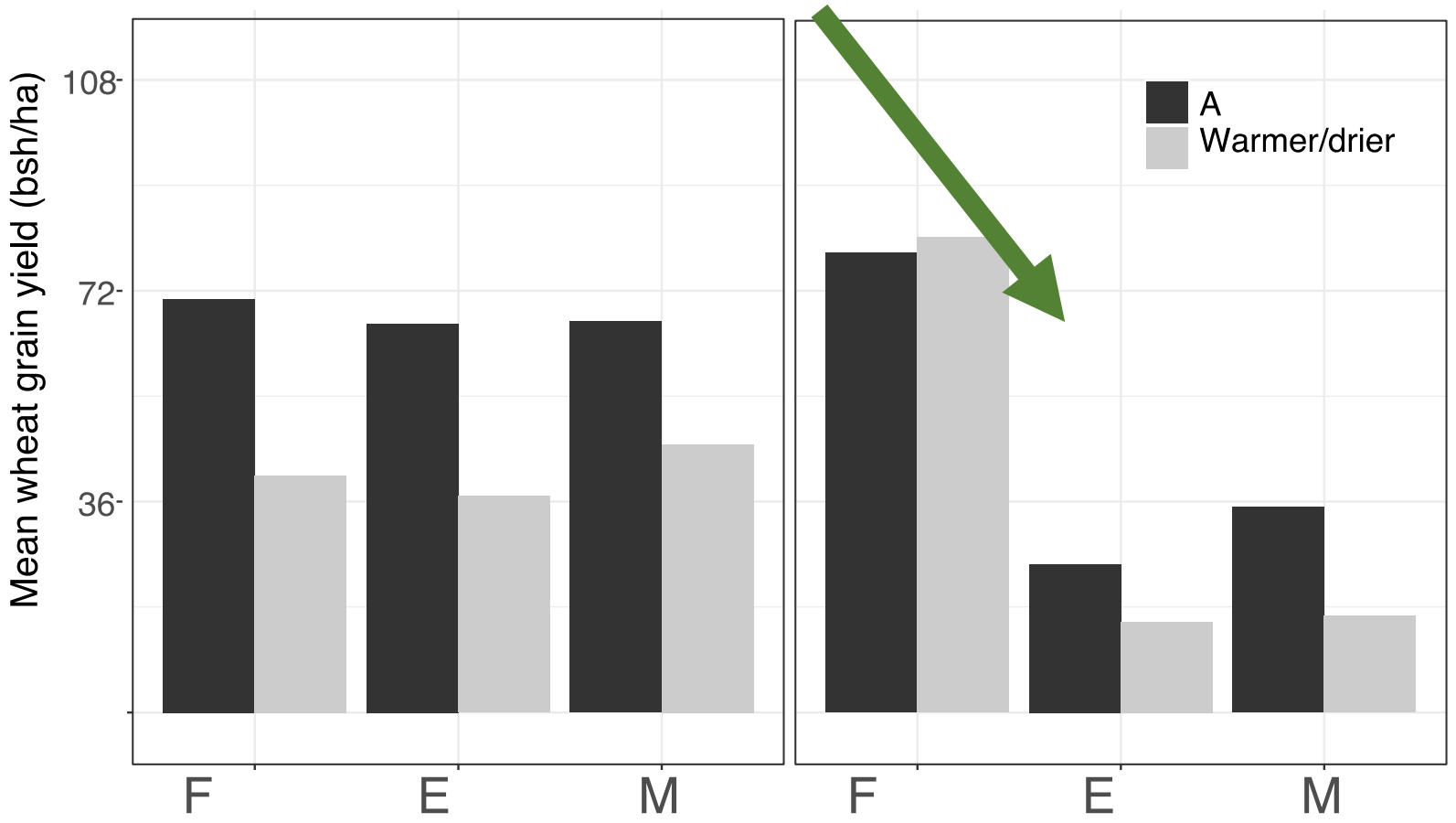


Shift to more mustard biomass in warmer and drier conditions

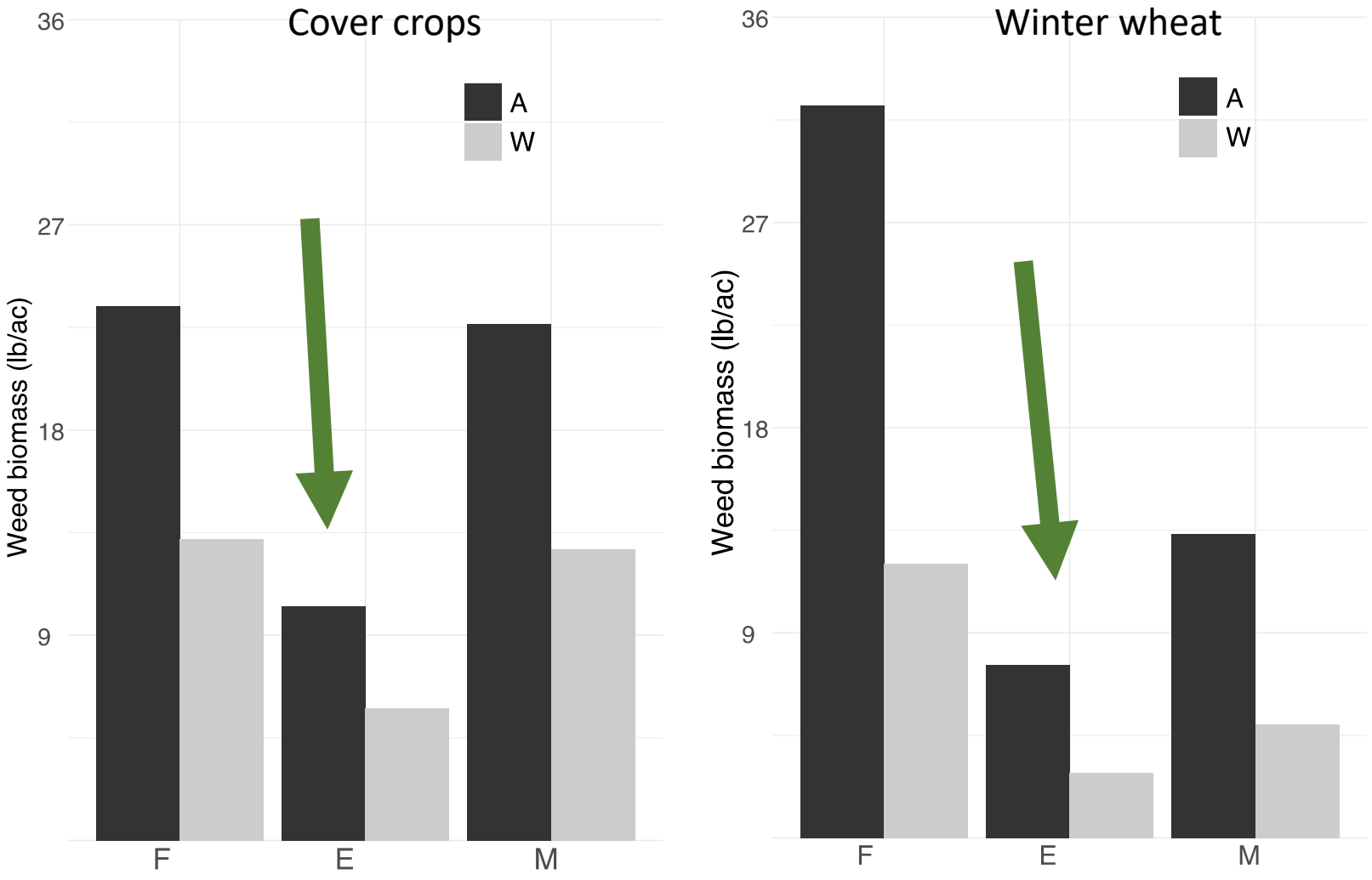
Soil moisture



Wheat yield

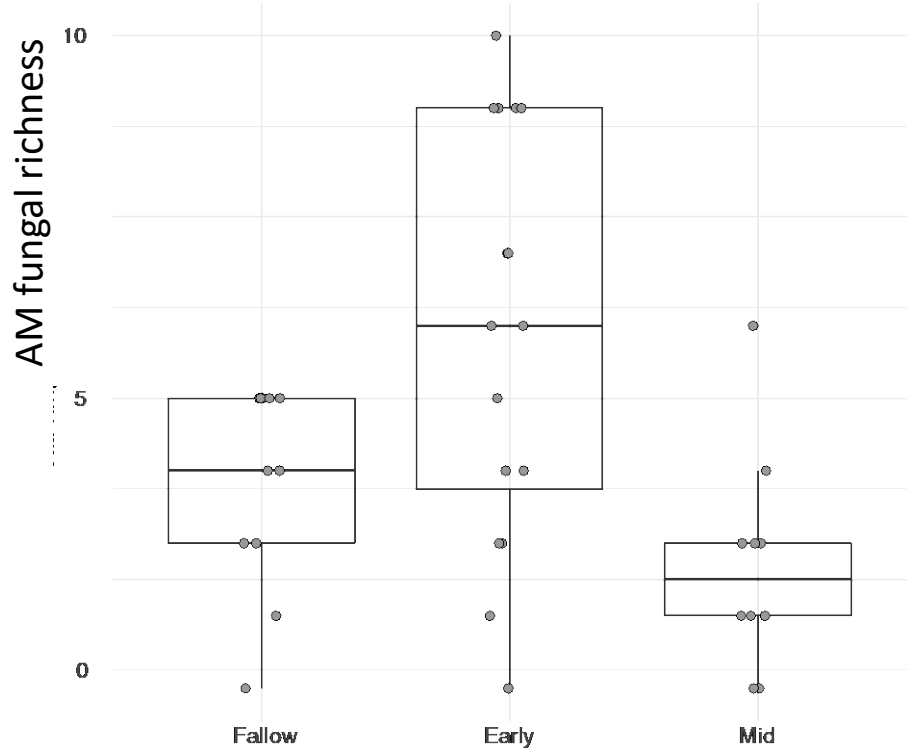


Weed biomass best supressed in early season cover crop

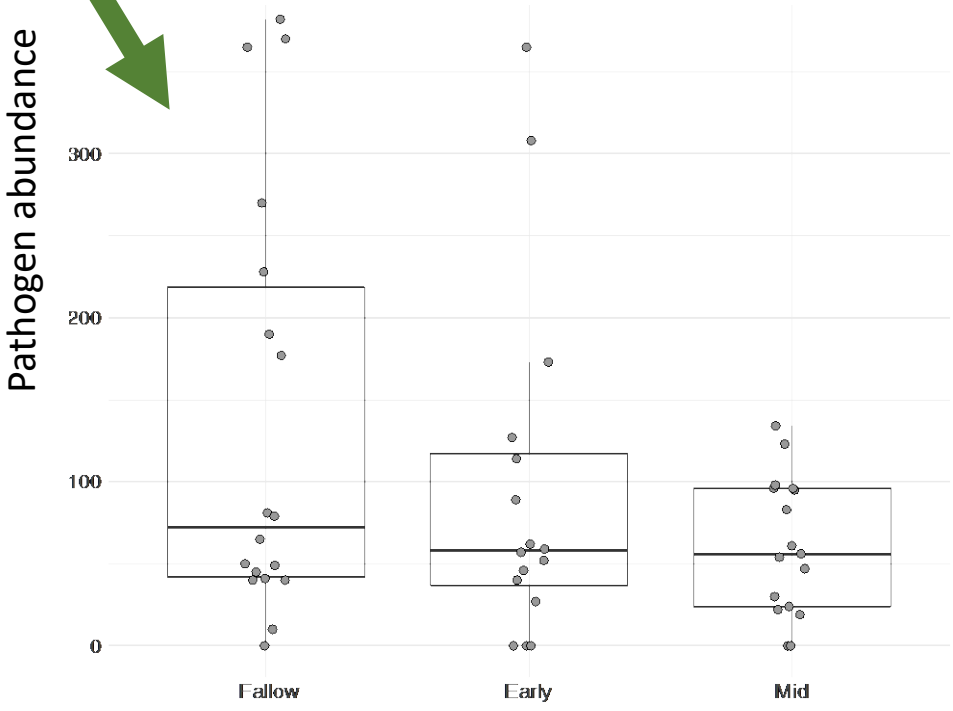


In early season cover crop more beneficial fungi species and more pathogens in fallow

Arbuscular mycorrhizal fungi (AMF)



Fungal plant pathogens



In summary

- There are trade-offs when using cover crops
  - More soil moisture usage and lower wheat yields
  - But better weed suppression
  - More beneficial fungi and fewer fungal pathogens

Requires complex systems thinking

Becky’s thoughts

Acknowledgements

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USDA NIFA

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Montana Wheat and Barley