Major Crises Facing the Planet

- Climate change
- Pollution
- Human health
- Civil unrest
- Declines in biodiversity
Biodiversity is in Decline

Birds
Meehan et al. 2010. PNAS 107: 18533

Butterflies
Pleasants and Oberhauser 2013. Insect Conserv Divers 6: 134

Grassland habitats
Wright and Wimberley. 2013. PNAS 110: 4134
Johnston. 2014. Landscape Ecol 29: 81

Insect communities
Landis et al. 2008. PNAS 105: 20552

Wetland habitats
Wright and Wimberley. 2013. PNAS 110: 4134

Potts et al. 2010. TREE 25: 345
Frick et al 2010. Science 329: 682
Newton 2004. Ibis 146: 579
Monoculture Production Schemes

The only way to maintain these systems is with agrichemicals.

Agrichemicals are an addiction.
Solution to the Problem

Change agriculture

Anything less, and bees will continue to die.
How to Promote Soil Health and Biodiversity

Reduce disturbance
(tillage, agrichemicals)

Increase diversity
(Plants, microbes, animals, revenue streams, etc)
Biodiversity on Farms

Corn
482 species
Welch and Lundgren 2016 Food Webs 9:46

Wheat
103 species (predators)
Choate and Lundgren 2015 Crop Prot 77:110

Soybean
126 species (predators)
Lundgren et al 2013. Crop Prot 43: 110

Cattle Dung
172 species
Pecenka and Lundgren  Rangld Ecol Mgmt in press
Diversity and Function

A healthy system needs species

Redundancy is crucial
Tilled cornfields had 24% of species found in prairies.

Perceptions of Biological Networks

Our understanding of species networks primarily comes from simplified systems.

Tylianakis et al. 2010. Biol Conserv. 143: 2270

But simplified systems ignore the complexity of biological communities and their unforeseen interactions.
Community Network in Agroecosystems

Maize arthropod community
Biodiversity on Farms Reduce Pest Pressure in Corn

Network Topology and Pest Abundance

High Pest Abundance
Network Topology Affects Pest Abundance

Fewer linkages between species increases pests

Four Principles

1) Stop tilling (or reduce it)
2) Never leave bare soil
3) Some plant diversity is better than none, and more is better than less
4) Integrate crops and livestock
A Better Way to Farm

Best management practices
Regional focus
Systems level

Claire LaCanne, MSc

Regenerative
No insecticides

Conventional
Insecticides

LaCanne and Lundgren. 2018. PeerJ 6: e4428
Approach

Full bioinventory of corn community

Yields and profit
Pest Populations

Regenerative systems had 10-fold fewer pests than insecticide-treated systems.
Yield

Yields were reduced by 22%
Profits

Regenerative systems were twice as profitable.

\[ F_{1,70} = 12.80, \ P = 0.001 \]
Soil Health and Profit

Field profitability was NOT RELATED TO YIELD

Corn profitability is directly related to particulate organic matter of the soil
California Agriculture

Characterized by

Heavy tillage

Heavy pesticide use

Very little plant diversity in cropland

Is there a better way?
Regenerative Almond Production

Are regenerative almond systems superior to conventional systems?

Tommy Fenster, MSc candidate
Regenerative

No till
No pesticides
Perennial ground cover
Compost
Compost teas
Livestock integration

Conventional

Tillage
Bare soil
Multiple pesticide applications annually
Soil Organic Matter (0-15cm)

Mean Soil Organic Matter Percentage

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Soil Organic Matter Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>2.3875</td>
</tr>
<tr>
<td>Regenerative</td>
<td>3.875</td>
</tr>
</tbody>
</table>

P-Value = 0.029  N per treatment = 8
Soil Bulk Density

Chart of Mean (Dry Bulk Density)

- Conventional: Mean = 1.36739
- Regenerative: Mean = 1.19924

P-Value = 0.000
N for conv = 24
N for regen = 25
Water Infiltration Rate

Chart of Mean (water_infiltration_rate(secs))

- Conventional: 3855.17 seconds
- Regenerative: 608.786 seconds

P-Value = 0.007  
N per treatment = 8
Invertebrate Biomass

Chart of Mean (Invertebrate Biomass (grams))

- **P-Value** = 0.000
- **N per treatment** = 96
Pest Populations

Chart of Mean (No Pest Damage)

- Conventional: Mean of No Pest Damage = 200.65
- Regenerative: Mean of No Pest Damage = 204.2

P-Value = 0.932
N per treatment = 20
Regenerative Systems had Higher:

- 30% higher soil organic matter
- Equivalent pest populations
- Higher soil microbial communities
- 6 times higher water infiltration rates
Study is Ongoing

- Economics
- Food borne pathogens
- Almond quality and nutrition
Problems with Avermectins

Most of the treatment comes out in the dung

Campbell 1985. Science 221: 823

A half-life of 240 days


Avermectins kill the 98% of insects (non-pests) found in dung
What Causes Pests?

- Not enough diversity
- Too much disturbance
Effects of Regenerative Ranching on Maggots

How does high intensity grazing, and long rest periods affect pests of cattle?
The Ranches

16 ranches eastern SD

A range of conditions and management practices

**Regenerative ranches**

- >10 AU per ha
- Moved within 10 d
- No avermectins

**Conventional ranches**

- <5 AU per ha
- Moved after 30 d
- Avermectins twice per year
Intensively surveyed the insect communities in the dung
Insect Community

116,000 insects identified to species level

Roughly 400 insects per pat

172 species identified

Pecenka and Lundgren. 2019. Basic Appl Ecol 40: 19
Species diversity was encouraged by regenerative herd management.

Pecenka and Lundgren. 2019. Basic Appl Ecol 40: 19
Predators in dung were favored by regenerative herd management.
Insecticides are an addiction

Pests are not the problem!

Change the system
Combatting Pests Without Pesticides

- Abandon pesticides
- High intensity grazing
- Frequent movement of animals
- Integrate herds
Four Principles

1) Stop tilling (or reduce it)
2) Never leave bare soil
3) Some plant diversity is better than none, and more is better than less
4) Integrate crops and livestock
Why isn’t Regenerative Farming Mainstream?

Paradigm shifts take time

Science has been misdirected
Thanks!

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www.ecdysis.bio

www.bluedasher.farm

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