On-Farm Food Safety and Conservation

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www.wildfarmalliance.org

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Overview

- Why Co-management of Food Safety and Conservation is Necessary
- Pathogen Routes and Prevalence on the Farm
- Factors that Influence Pathogen Reduction
- Persistence of Pathogens in Soils
- Conservation Practices that Influence the Reduction of Pathogens
- Multi-Barrier Approach to Minimizing Food Safety Concerns
- Converting Knowledge to Action

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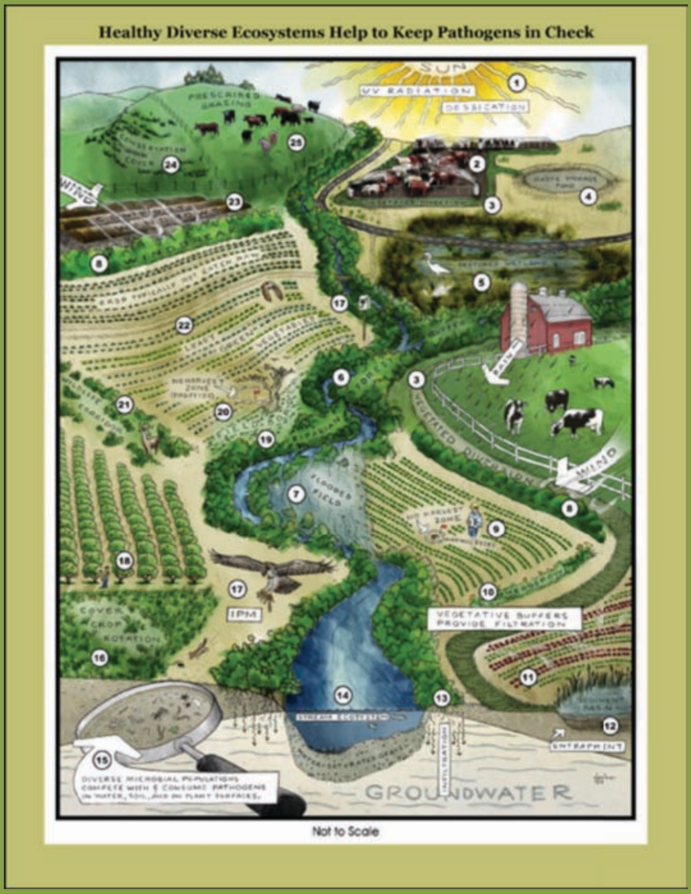
Why Co-managing Food Safety and Conservation is Necessary

Healthy Diverse Ecosystems Help to Keep Pathogens in Check



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Food Safety Plans and GAPs

Good Agricultural Practices GAPs Address:

a) water quality,

b) soil amendments,

c) wild and domestic animals,

d) the surrounding environment, and

e) worker health and hygiene

Food-Borne Illness Attributed to Produce

- From 1998-2008, 46% of the illnesses documented by the CDC were attributed to produce.
- Causes include the farm, processing, storage or shipping; handling by a store, or preparation in a restaurant or home.

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Food-Borne Illness Attributed to Produce from the Farm

- CDC can only identify 40% of the causes. Of those identified:
  - From 1998-2008, 5% might come from the farm.
  - From 2009-2010, 0.5% might come from the farm.

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Crops More at Risk

- Raw vs. cooked
- Fresh cut ready-to-eat leafy greens
- Netted melons
- Tomatoes

Bacteria in Us Would Fill a Half Gallon Jug

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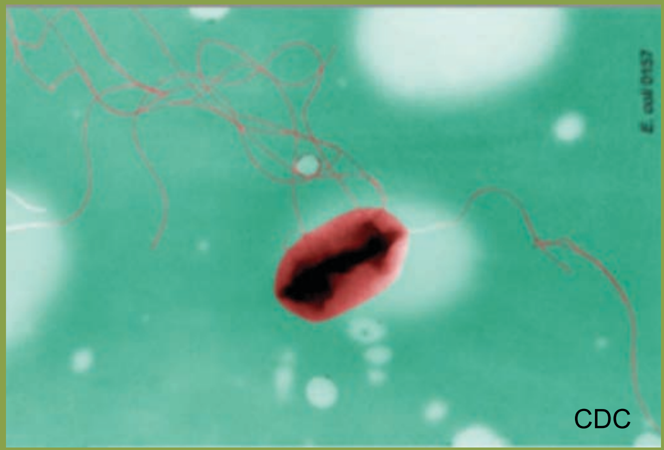
Pathogens of Concern for Specialty Crops

- Bacterial Pathogens
  - Shiga toxin-producing *Escherichia coli*’
  - *Salmonella* spp.
  - *Campylobacter* spp.
  - *Listeria* spp.
- Protozoan Pathogens
  - *Cryptosporidium* spp.
- Pathogens with Antimicrobial Resistance



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Conflicts with Conservation Goals

Before

After

After

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Conflicts with Conservation Goals

- In 2006, spinach contaminated with *E. coli* O157:H 7 caused the death of five people.
- In 2007, 89% percent of growers managing 140,000 acres on California's Central Coast reported that they had actively discouraged or eliminated wildlife from crop areas.
- Over a 5 year period after the contamination, about 13% of the remaining riparian habitat in the region had been eliminated or degraded.

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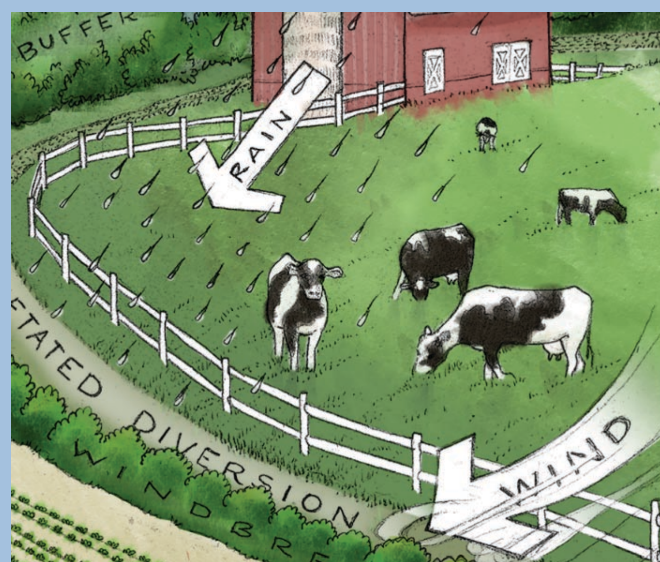
Co-management of Food Safety and Conservation

Co-management means farm system management approaches that respond to site-specific conditions by integrating cultural, biological, and mechanical practices that promote ecological balance and public health by conserving biodiversity, soil, water, air, energy and other natural resources, while also reducing pathogen hazards associated with food production (National Sustainable Agriculture Coalition).

Pathogen Routes and Prevalence on the Farm

- **Waterborne Pathways**
- **Airborne Particulate Matter Pathways**
- **Wildlife Prevalence and Pathways**
- **Livestock Prevalence and Pathways**



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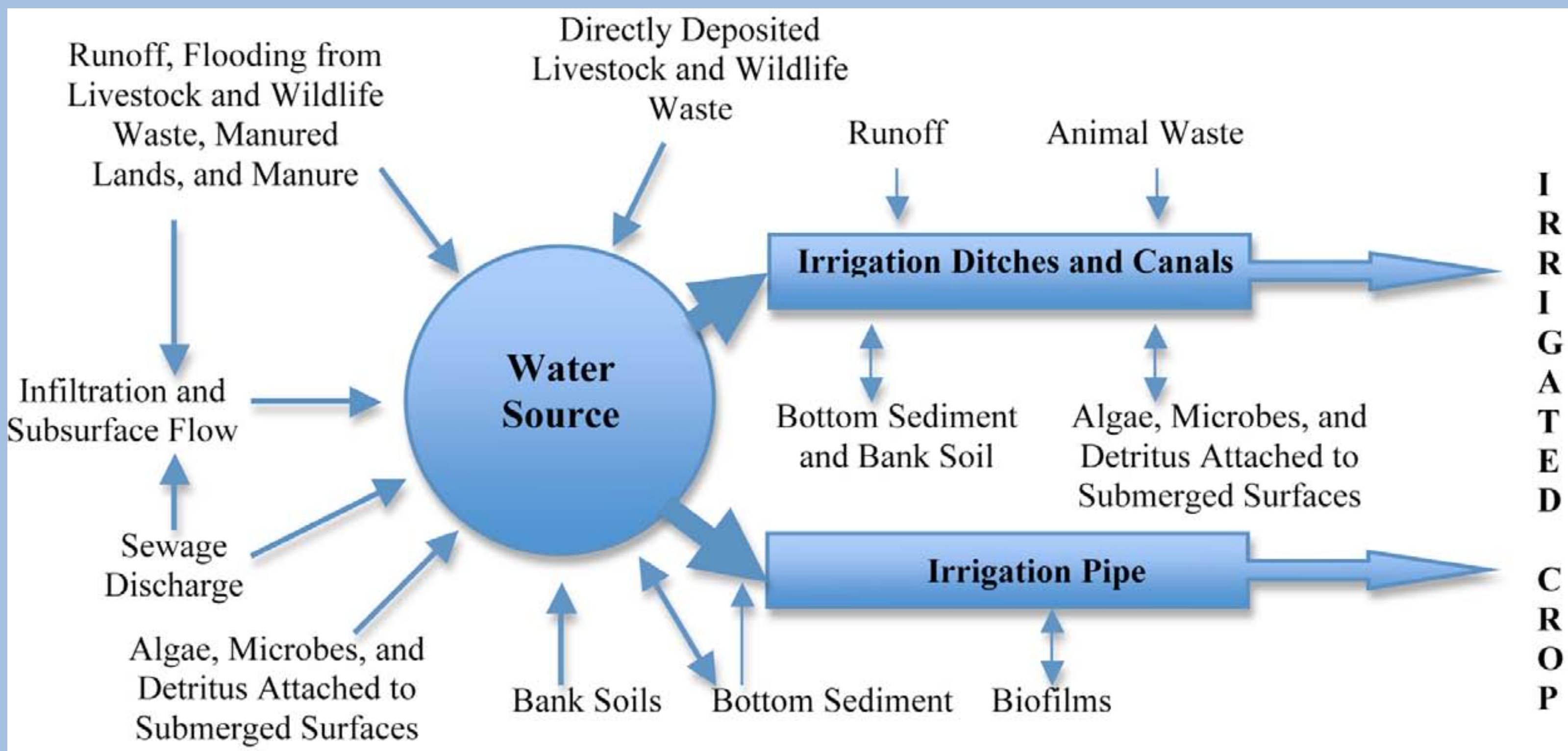
Waterborne Pathways

Processes Affecting Microbial Quality of Irrigation Water



Adapted from : Pachepsky et al. 2011

Waterborne Pathways

Table 1

Confirmed Outbreaks Associated with Irrigation Water

Crop	Pathogen	Irrigation Source	Farm Location
Tomatoes (a)	*Salmonella* Newport	pond	Virginia
Lettuce (b)	*E. coli* O157:H7	small stream	Sweden
Shredded lettuce (c)	*E. coli* O157:H7	well water accidentally mixed with dairy lagoon water	California
Hot peppers (d)	*Salmonella* SaintPaul	holding pond used for irrigation water	Mexico

From (a) Greene et al. 2008; (b) Soderstrom et al. 2008; (c) US FDA and CA Food Emergency Response Team 2008; and (d) CDC 2008.

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Airborne Particulate Matter Pathways

Table 2

Selected Cases of Airborne Pathogen Contamination

Types of Airborne Pathogens	Location	What the Research Examined
E. coli O157:H7 (a)	Colorado 6,000-head cattle feedlot	Airborne transport of *E. coli* O157:H7 from feedlot to various distances of leafy green crops.
Newcastle disease virus (b)	Pennsylvania poultry farms	Vegetative buffers in Pennsylvania reduced dust and respiratory virus transmission from commercial poultry farms.
Larynogtracheitis virus (c)	Delaware poultry farms	A four-fold increase in risk of poultry developing the disease if a farm was located within the downwind plume of the farm with contaminated poultry.
E. coli O157:H7 (d)	Ohio fairgrounds	One hundred people were sickened when a dance was held in the same building that had earlier exhibited animals.
Many pathogenic *E. coli* strains (e)	Mexico City household and street dust	Intestinal infections caused by dust collected from indoor and outdoor environments was greater than thought.
E. coli O157 and *Salmonella* (f)	Texas cattle feed yards	Exposure to dust in the cattle load-out area of feed yards increased pathogen contamination of cattle hides.
Salmonella enteritidis (g)	Chicken houses	Infected hens in houses transferred disease to healthy hens via the air.

Recorded Outbreaks Associated with Wildlife

Table 3

Recorded Outbreaks Associated with Wildlife

Crop	**Pathogen**	**Wildlife**	**Location**
Spinach (a)	*E. coli* O157:H7	non-native feral pigs*	California
Strawberries (b)	*E. coli* O157:H7	deer	Oregon
Peas (c)	*Campylobacter jejuni*	sandhill cranes	Alaska
Carrots (d)	*Yersinia pseudotuberculosis*	shrews	Finland

* While feral pigs were found with the same DNA pattern of *E. coli* O157:H7 as the spinach, so were nearby cattle and pasture soil, and water/sediments from a creek that may have contaminated the irrigation well.

From (a) Jay 2007; (b) Laidler and Keene 2012; (c) McLaughlin 2008; (d) Kangas 2008.

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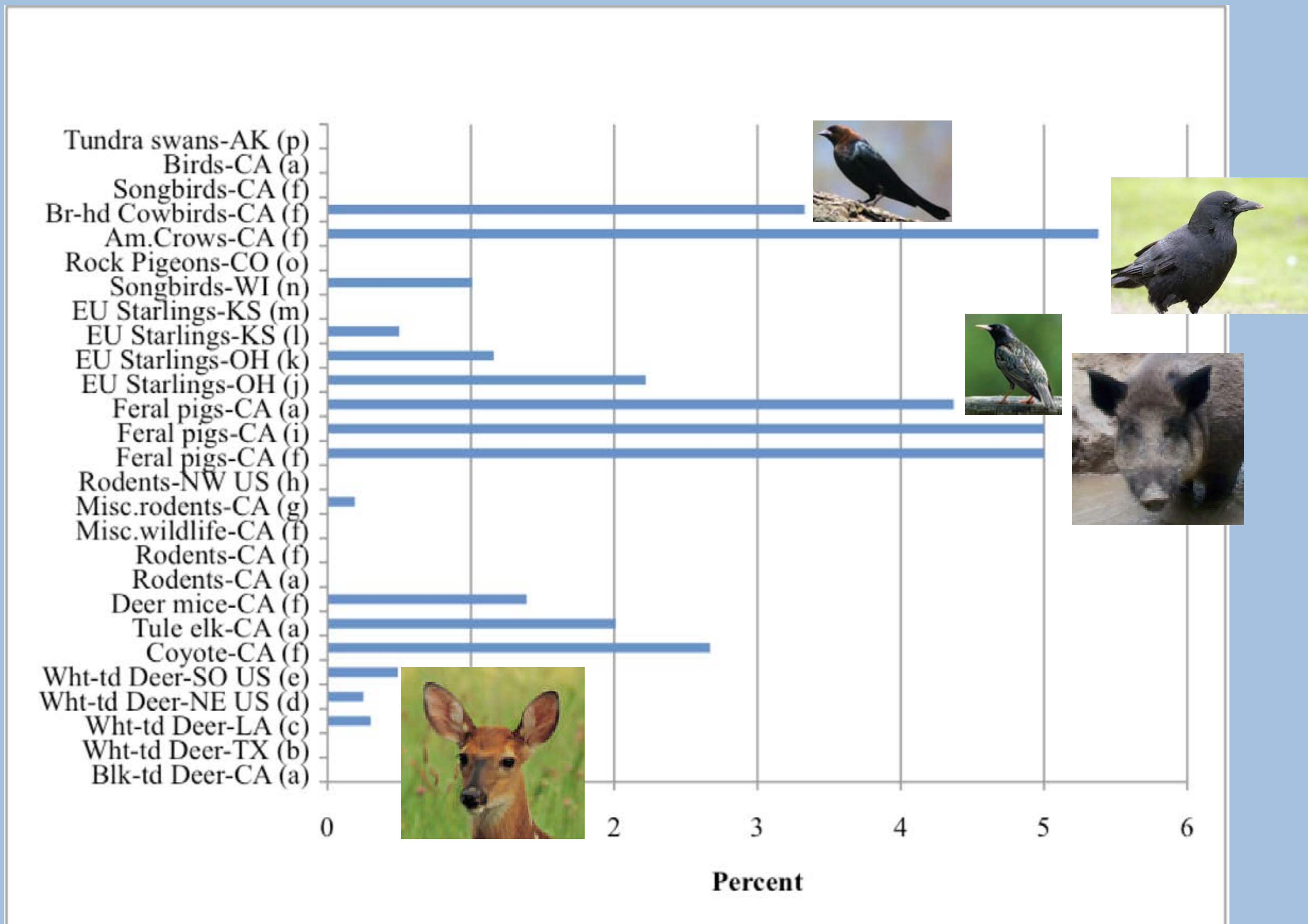
E. coli 0157:H7 Prevalence in US Native and Non-Native Mammal and Avian Species



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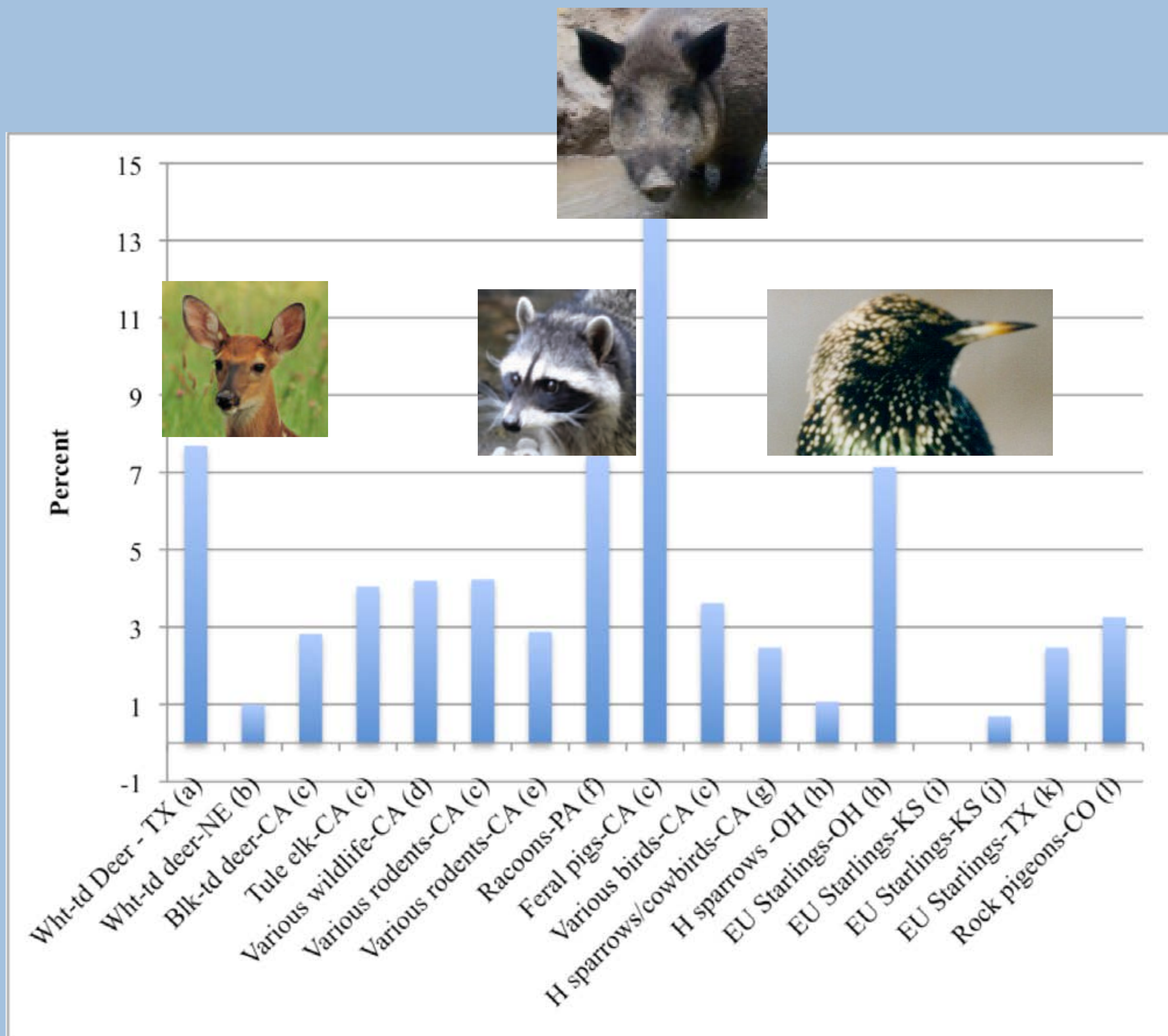
Salmonella Prevalence in US Native and Non-Native Mammal and Avian Species



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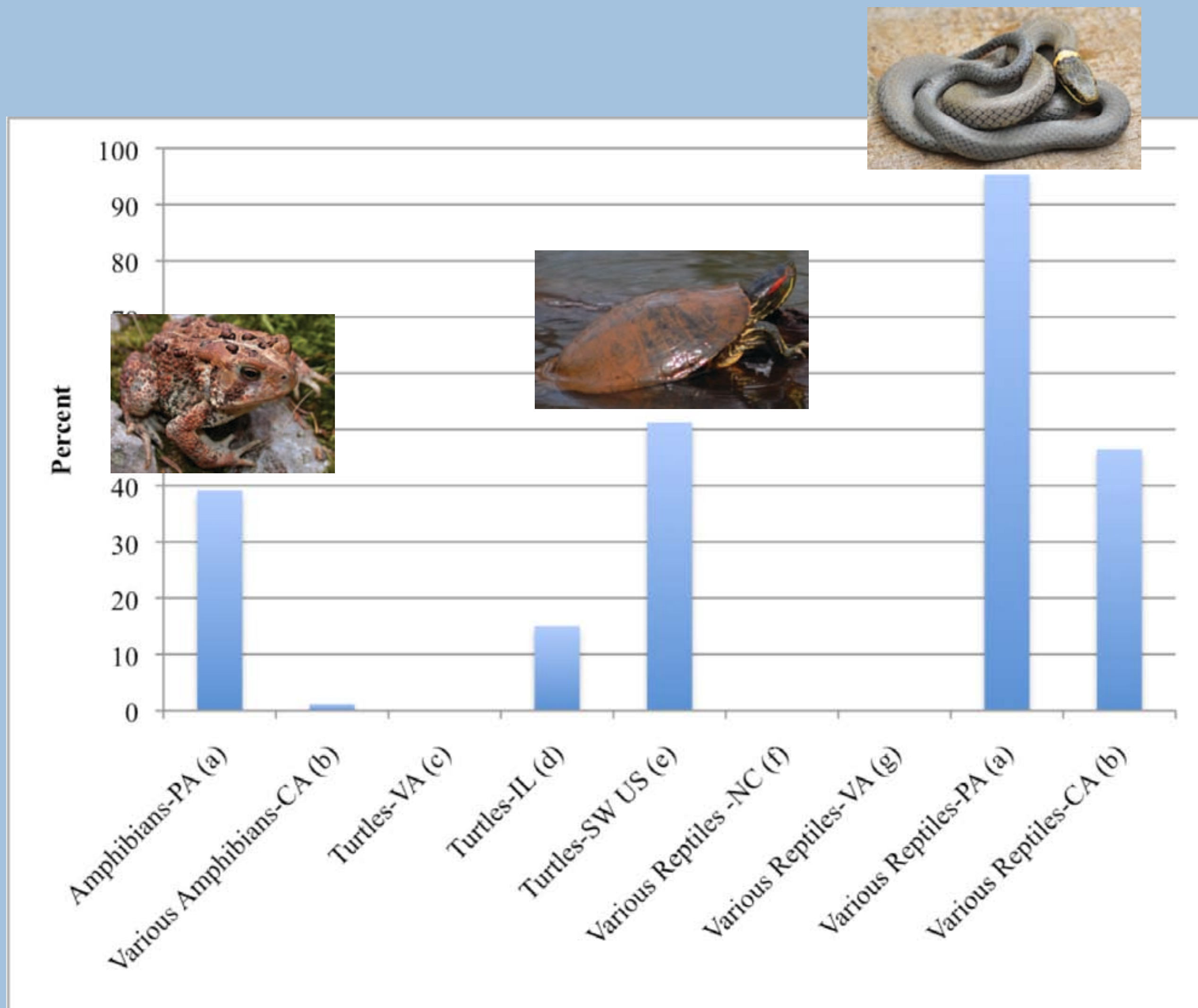
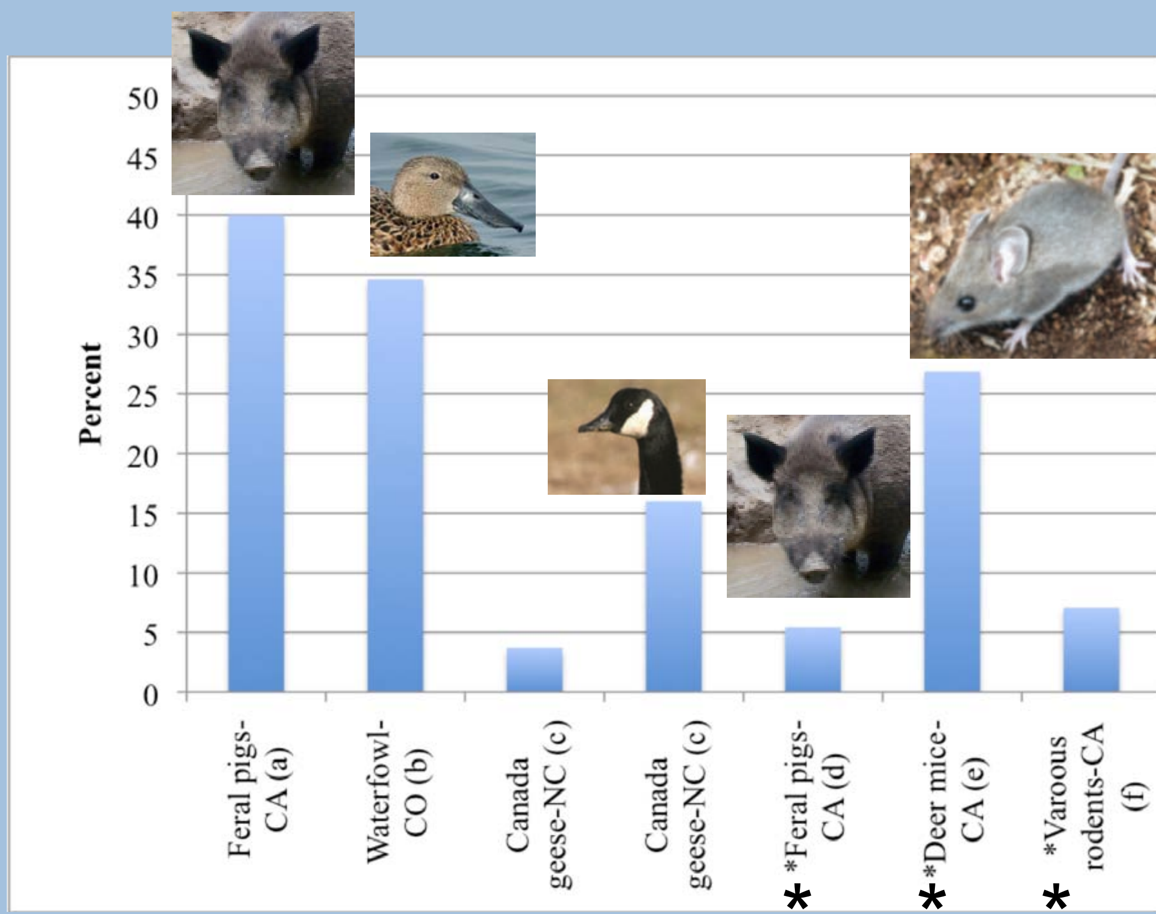
Salmonella Prevalence in US Native Amphibians and Reptiles



Campylobacter and *Cryptosporidium** Pathogen Prevalence in US Native and Non-Native Mammal and Avian Species



Pathogen Vectoring by Wildlife

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Prevalence of Pathogens in Livestock

E. coli 0157:H7

- **Widespread in cattle; higher in CAFOs than on pasture**
- **Also in pigs, dogs, poultry**
- **Higher in young than in adults**

Salmonella

- **Poultry**
- **Pigs**
- **Cattle**
- **Other livestock**

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Prevalence of Pathogens in Livestock

Campylobacter

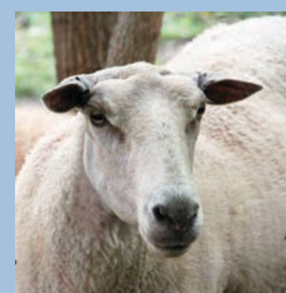
- Most common in poultry
- Cattle
- Other livestock

Cryptosporidium

- Cattle
- Sheep
- Goats
- Pigs
- Horses
- Geese
- Poultry

Listeria

- Sheep
- Goats
- Cattle
- Other livestock



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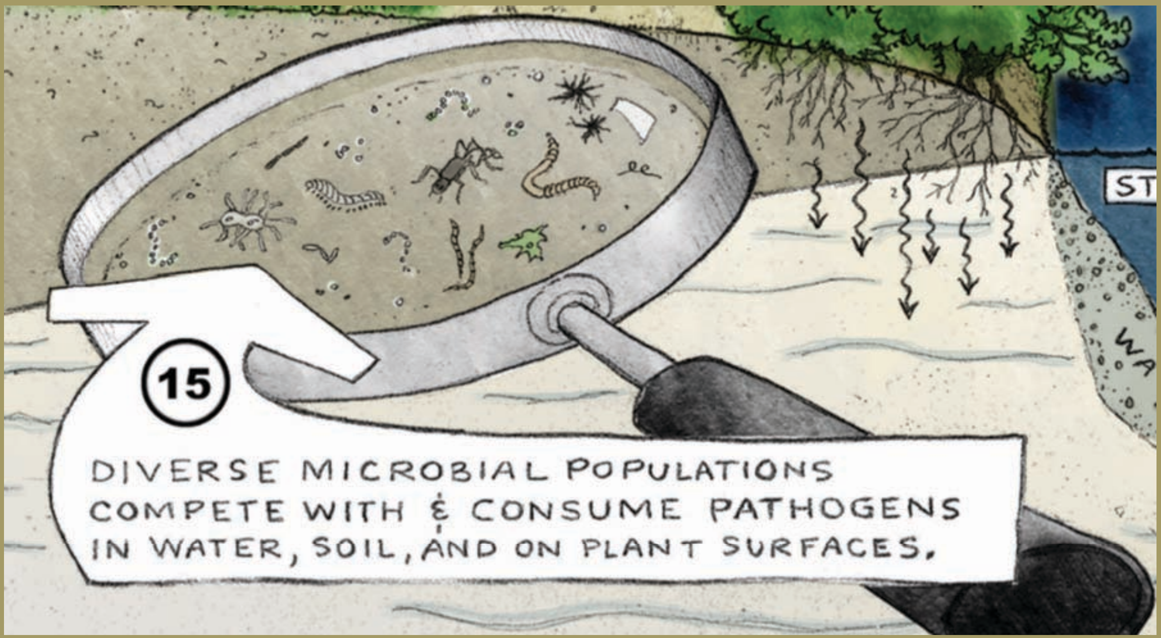
For a thorough discussion, see *Introduction to Waterborne Pathogens in Agricultural Watersheds, USDA NRSC Nutrient Management Technical Note No. 9.*

Factors that Influence Pathogen Reduction

- **Biotic**
- **Abiotic**

Biotic Factors - Microbial Interactions

- Predation
- Competition
- Antagonism



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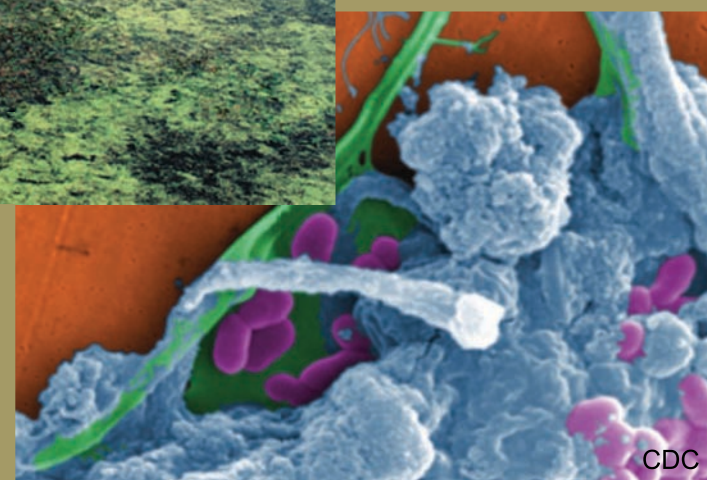
Biotic Factors - Harborage

- Biofilms
- Amoebas
- Algae

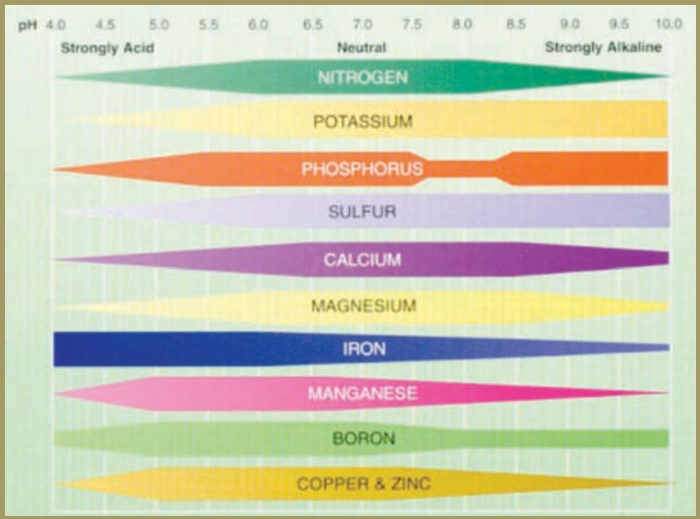


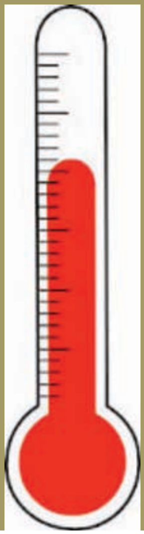
Biofilm

Abiotic Factors – Sunlight/UV Exposure

More Abiotic Factors

- Salinity
- pH
- Nutrient Sources
- Temperature
- Moisture and
- Microscopic Niches





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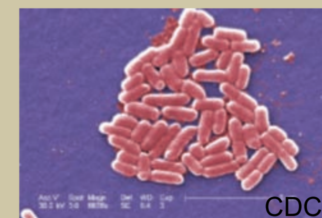
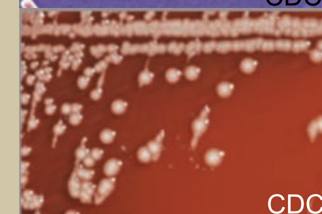
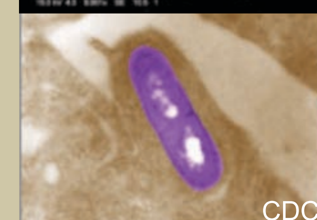
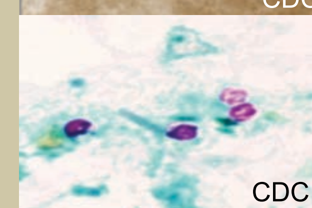
Persistence of Soil Pathogens

- Examples of Pathogen Persistence
  - *E. coli* O157:H7 (25 - 226 days)
  - *Salmonella* (7 - 332 days)
  - *Campylobacter* (31 – 64 days)
  - *Listeria* (43 - 128 days)
  - *Cryptosporidium* (<1 year)









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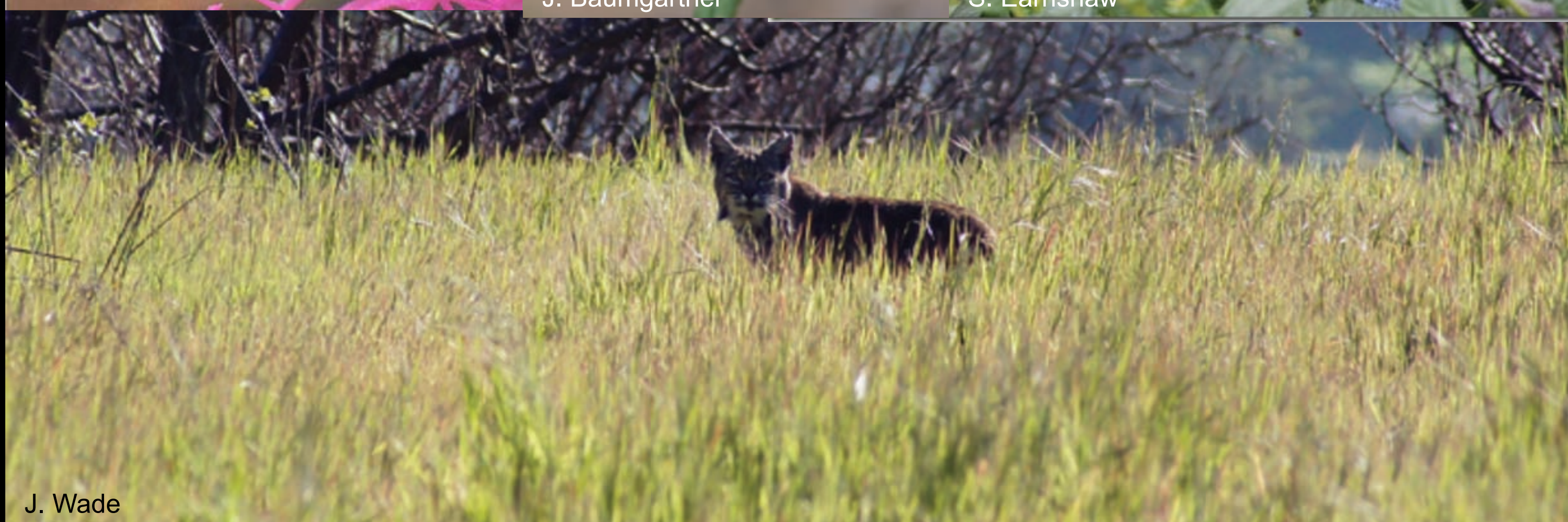
Five Minute Break for Questions



Conservation Practices that Influence the Reduction of Pathogens in Specialty Crops

- Soil Conservation Practices
- Water Movement and Storage Practices
- Vegetative Conservation Practices
- Animal Management Practices

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Soil Conservation Practices that Influence Pathogen Reduction

- **Manure Management**
  - – Nutrient Management (590)
  - – Composting Facility (317)
- **Dust Mitigation Practices**
  - – Air Filtration and Scrubbing (375)
  - – Dust Control for Animals (371)

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Soil Conservation Practices that Influence Pathogen Reduction

- Cover Crops (340)
- Conservation Crop Rotation (328)


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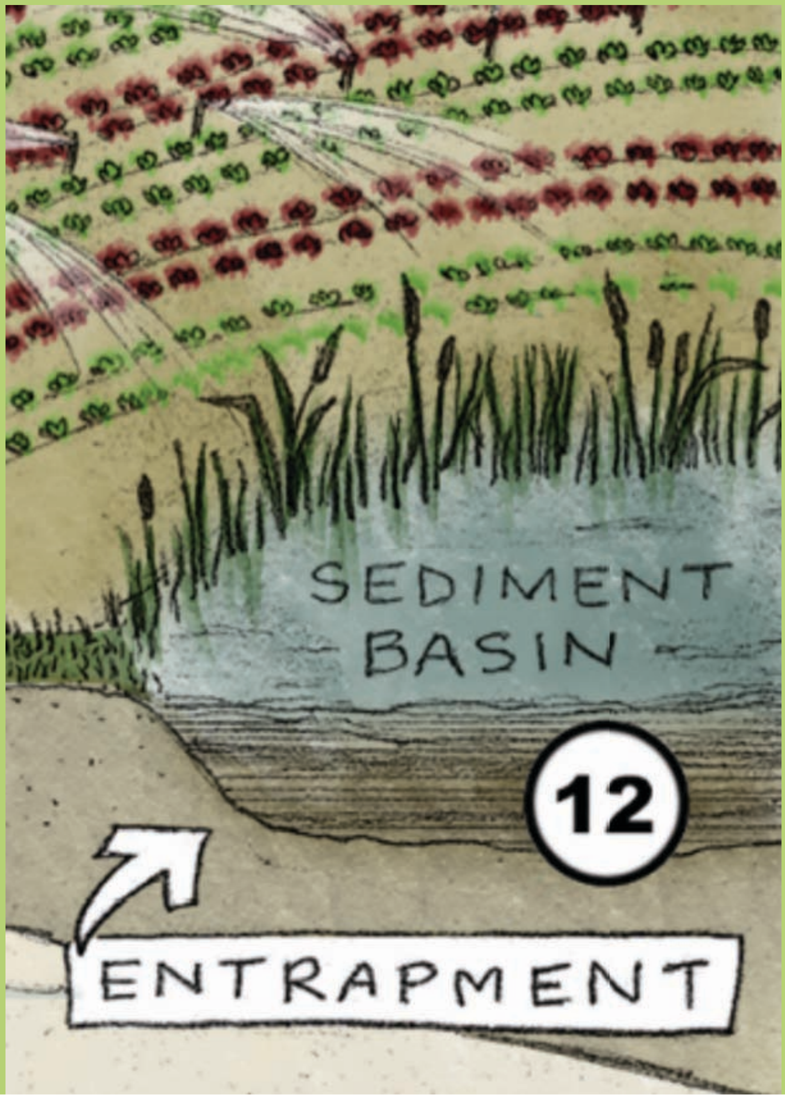
Water Movement and Storage Practices for Pathogen Management

- Irrigation Water Management (449)
- Diversion (362)
- Waste Storage Facility (313)

Water Movement and Storage Practices for Pathogen Management



Vegetation that Intercepts Waterborne Pathogens

- **Wetlands**
  - Constructed (656)
  - Created Wetlands (658)
  - Enhanced Wetlands (659)
  - Restored Wetlands (657)

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Vegetation that Intercepts Waterborne Pathogens

- **Vegetative Buffers**
  - Field Borders (386)
  - Filter Strips (393)
  - Critical Area Plantings (342)
  - Grassed Waterways (412)
  - Vegetative Barriers (601)
  - Tree and Shrub Establishments (612)
  - Conservation Cover (327)
  - Riparian Forest Buffer (391)
  - Riparian Herbaceous Buffer (390)

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Vegetation that Intercepts Particulate Matter with Pathogens

- Windbreaks (380)
- Hedgerows (422)
- Riparian Forest Buffers (391)

NRCS

Animal Management Practices that Help to Reduce Pathogen Presence

- Integrated Pest Management (595)
- Wildlife Corridors
- Prescribed Grazing (528)

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Multi-Barrier Approach to Minimizing Food Safety Concerns on the Farm and in the Watershed

- **Barriers that Prevent Pathogens from:**
  - Entering the Farm
  - Contaminating Produce Crops
  - Spreading from Livestock to the Crops
  - Moving to the Wider Landscape

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1^{st} — Barriers that Prevent Pathogens From Entering the Farm

- Intercepting waterborne pathogens
- Intercepting particulate matter with pathogens

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1st— Barriers that Prevent Pathogens From Entering the Farm

- IPM of non-native feral animals

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2nd— Barriers that Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:

- Avoid nearby contamination*
- Avoid frequently flooded land or institute a waiting period after flooding*
- For riskier areas, plant crops for livestock*
- Mitigate food safety requirements*
- Avoid overhanging vegetation*

*Food Safety GAPs

2nd—Barriers that Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

- **Monitor***
- **Conserve wildlife corridors**
- **IPM**

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*Food Safety GAPs

2nd—Barriers that Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

- ***Soil management practices that reduce pathogens***
  - Waiting period for manure*
  - Cover cropping and crop rotations
  - Nutrient management
  - Using compost as an alternative
  - Contaminated site management*
  - Pathogen desiccation in soils and sediments*

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***Food Safety GAPs**

2nd—Barriers that Reduce Likelihood of Pathogens Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

- **Intercept pathogens before they reach the crop**
- **Mitigate water quality concerns caused by food safety requirements***
- **Meet water quality standards***

***Food Safety GAPs**

3rd—Barriers that Reduce Spreading Pathogens to Crops When Livestock are on the Farm

- **Waiting period between fecal deposits and harvest***
- **Conservation practices that keep pathogens from spreading in diverse farms**
- **Restrict wild and feral animals that move between livestock areas and crop fields***

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***Food Safety GAPs**

4th—Barriers that Prevent Pathogens From Leaving the Farm

- Conservation practices that keep pathogens in check

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Converting Knowledge to Action

- Specialty Crop Food Safety Plans and Audits
- Fundamental Co-management Concerns

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Bugwood


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Specialty Crop Food Safety Plans and Audits

- USDA AMS food safety audit program does not make growers loose points for non-crop vegetation near produce fields.
- Some auditors will not allow a crop to be located near non-crop vegetation.
- Growers can effectively advocate for their farming practices by explaining their rationale for management decisions that address any food safety risks.

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Specialty Crop Food Safety Plans and Audits

- Wild Farm Alliance's *Training Scenarios for USDA and Third Party Auditors on the Co-management of Food Safety and Conservation* ***www.wildfarmalliance.org/resources/FS_Training_Scenarios.htm***

- University of California's *Introduction to Auditor Resource Materials* ***http://ucfoodsafety.ucdavis.edu/Preharvest/Co-Management_of_Food_Safety_and_Sustainability***

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Fundamental Co-management Steps to be Taken

- Develop a food safety plan that incorporates co-management of food safety* and conservation,
- Manage manure for pathogen reduction,
- Strategically select crop and field,*
- Intercept contamination before it gets to the crop,
- Encourage diverse soil microbial populations,
- Monitor for wildlife and discourage significant intrusion,* and
- Manage water to reduce runoff with possible pathogens.

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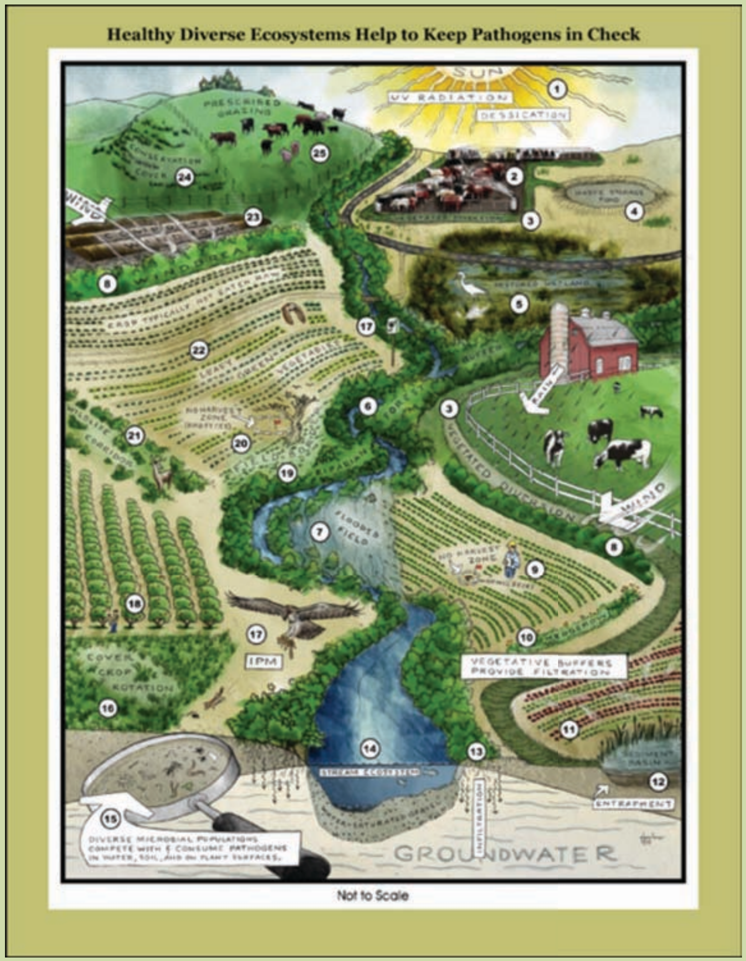
***Food Safety GAPs**

Food Safety Without Compromising Natural Resources



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Farm Organization Partners

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ALBA

CAFF
COMMUNITY ALLIANCE WITH FAMILY FARMERS

NOFA-NY
NORTHEAST ORGANIC FARMING ASSOCIATION OF NEW YORK

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