Managing Chronic Wasting Disease with System Dynamics

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VentanaSystems.com & MetaSD.com

Related Paper:
https://www.biorxiv.org/content/10.1101/2025.09.22.677405v1

With

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Team

- **USGS National Wildlife Health Center**
  - LeAnn White
  - Bryan Richards
  - Richard Berl
  - Daniel Walsh (now at UofM)
- **Montana Cooperative Wildlife Research Unit, Wildlife Biology Program, UofM**
  - Stephanie Penk – USGS Montana Cooperative Wildlife Research Unit
  - Erica Rieder – USGS Montana Cooperative Wildlife Research Unit
- **Wisconsin Department of Natural Resources**
  - Jen Price Tack
  - Scott Hull
  - Tami Ryan
  - David MacFarland
  - Daniel Storm
  - Jasmine Batten
- **Ventana**
  - Ron Suiter
  - Ben Arthur

Chronic Wasting Disease

- Prion disease, like Mad Cow and scrapie
- Affects cervids (deer family)
- 100% fatal
- Long latent period, short clinical phase
- Environmental reservoir
- No human transmission …yet

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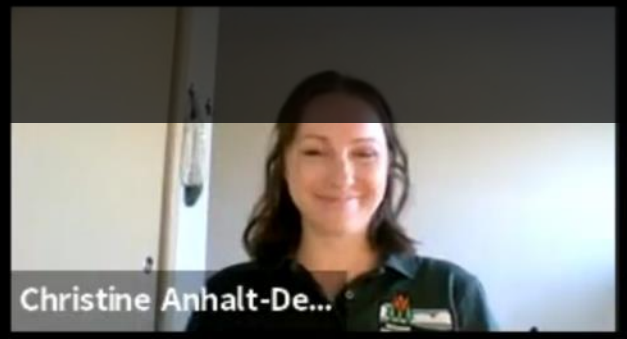
Project Goals

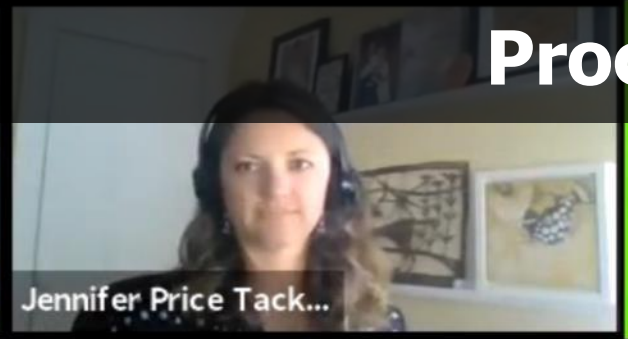
- **Support a 5-year review of Wisconsin's 15-year CWD Management Plan**
  - How best to use agency resources to reduce the prevalence and geographic spread of CWD?

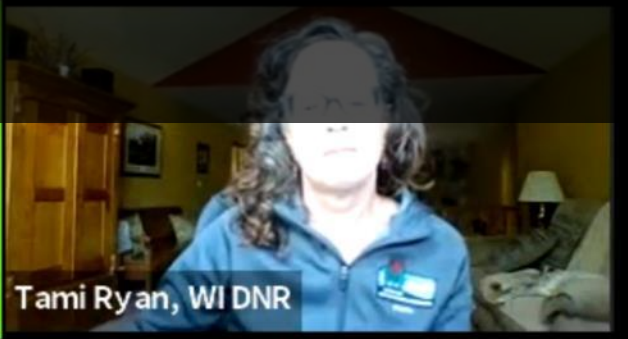
- **Find new leverage points in the CWD system**
  - Discover or create new feedback loops?
  - Engage new stakeholders?

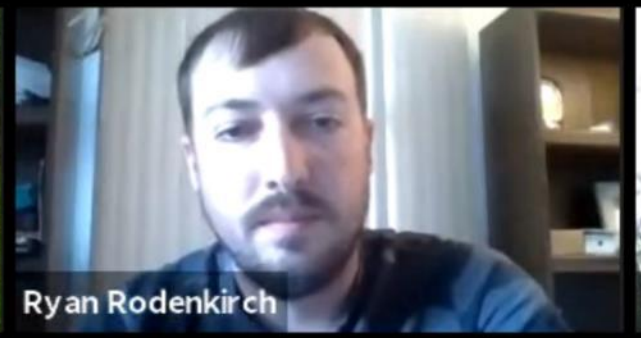
Process

- **Model Elicitation – 5 panels covering epidemiology, forest & deer health, human dimensions, regulatory structure and integration**
- **Stakeholder Review**
  - Hunting NGOs – Wisconsin Wildlife Federation, National Deer Association, Wisconsin Bowhunters, Backcountry Hunters & Anglers
  - Policy NGOs – Wisconsin Greenfire, Sporting Heritage Council, Wisconsin Conservation Congress
  - Business interests – WI Counties Solid Waste Management Assoc., WI Commercial Deer & Elk Farmers Assoc., Whitetails of Wisconsin
  - Tribal interests – Oneida Nation, Great Lakes Indian Fish & Wildlife Comm., Red Cliff Band of Lake Superior Chippewa
  - Agencies – Wisconsin DNR, DATCP, DHS & Veterinary Diagnostics Lab., USDA

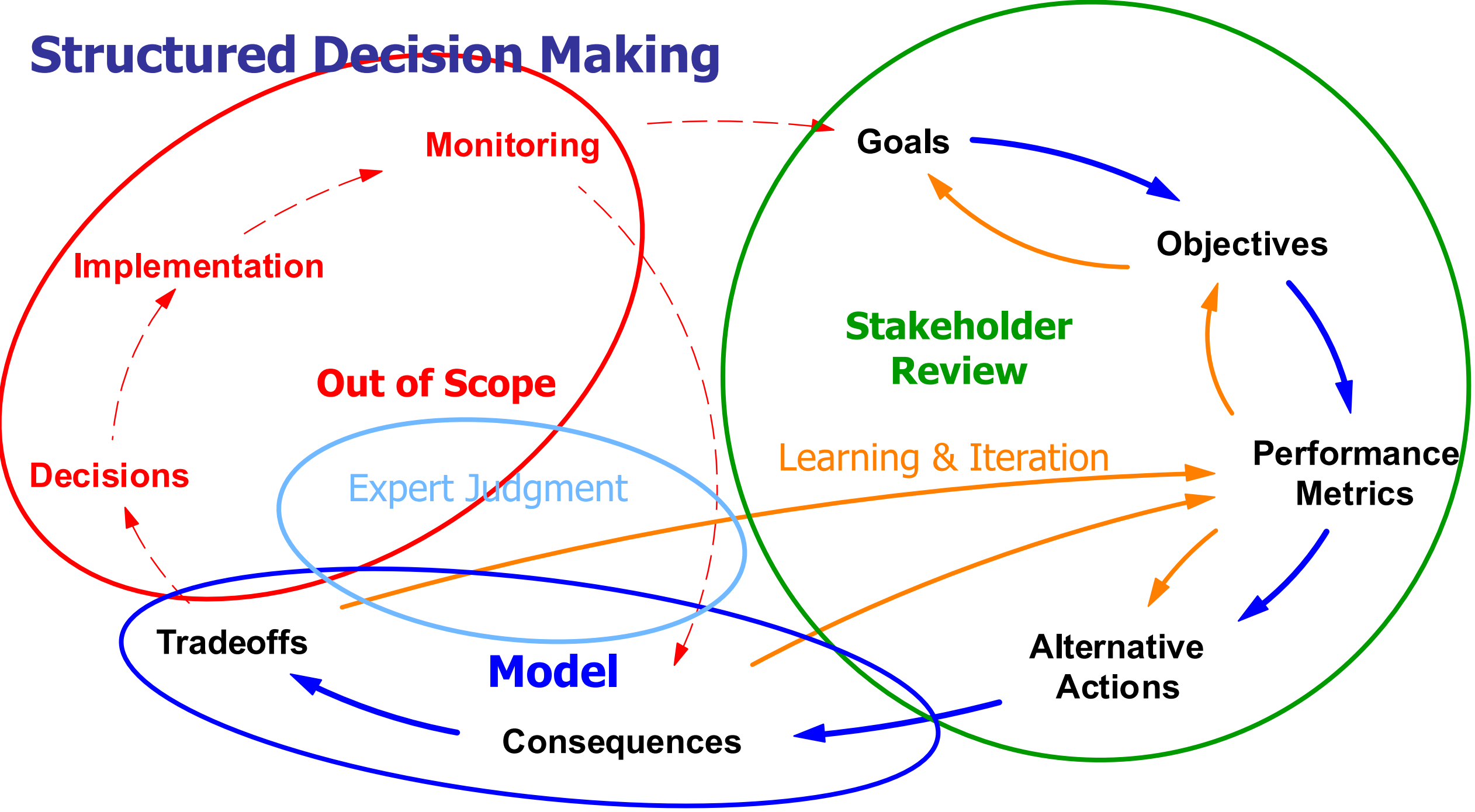




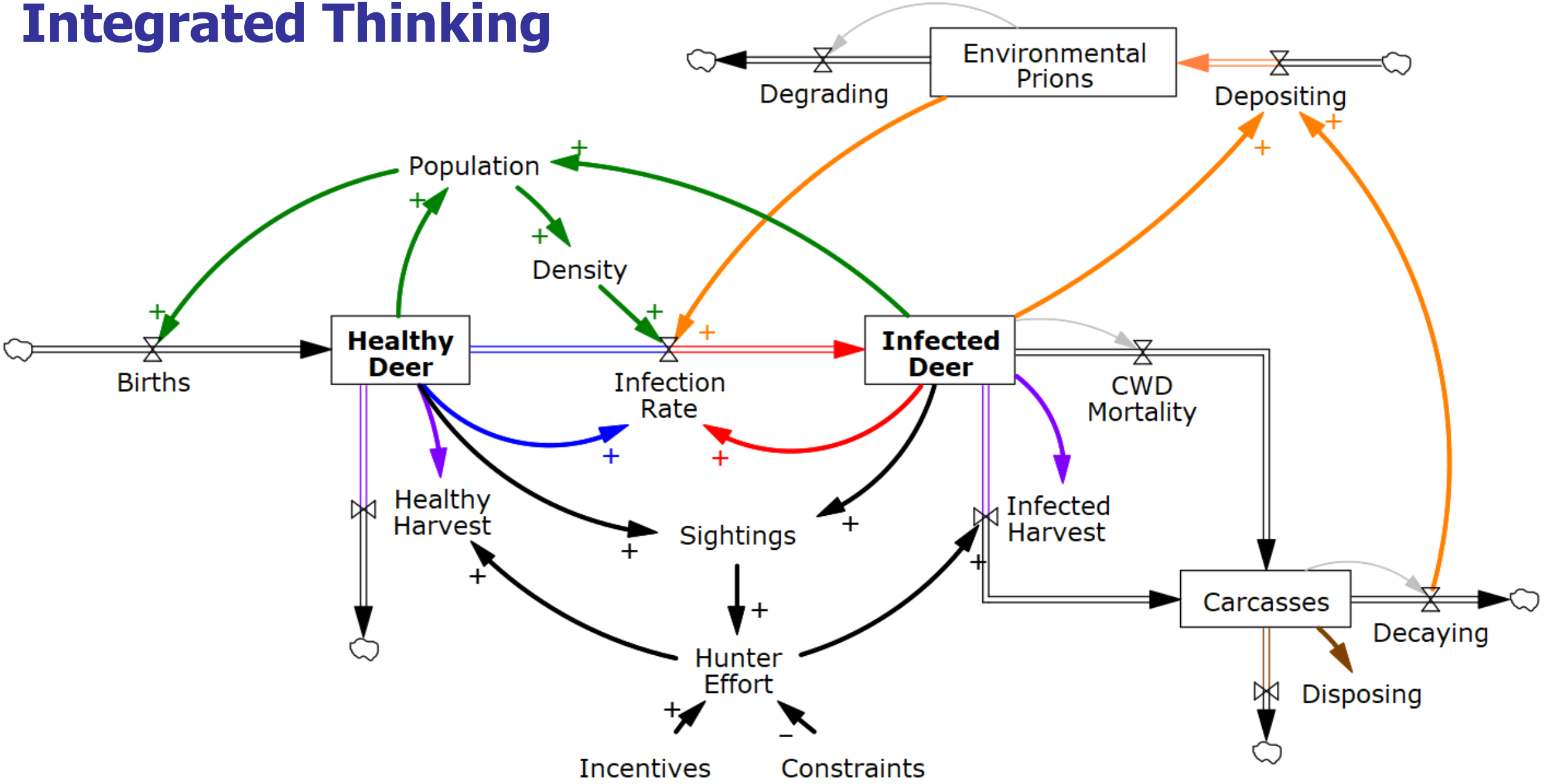




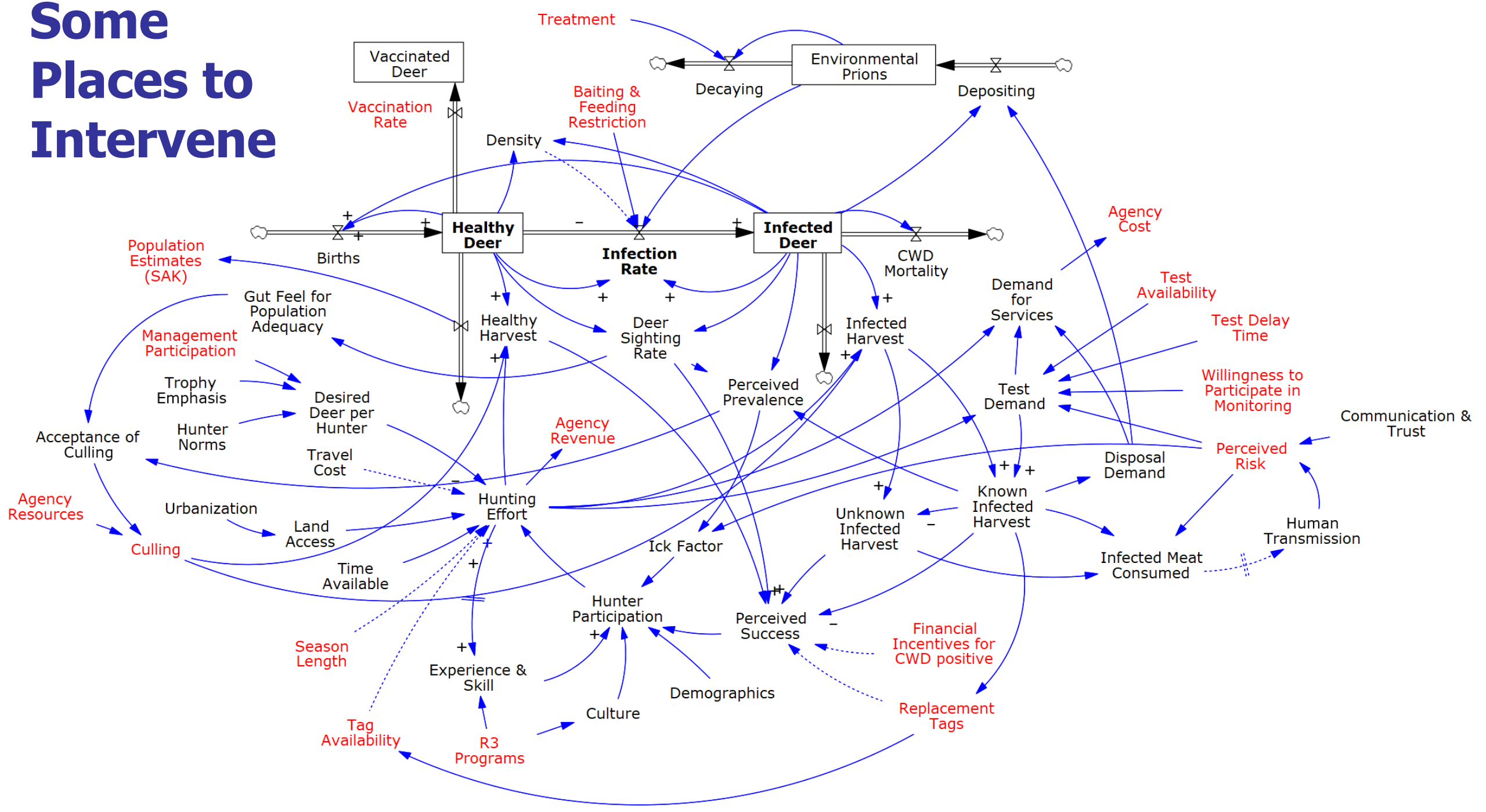
Structured Decision Making



Diagrams Facilitate Integrated Thinking



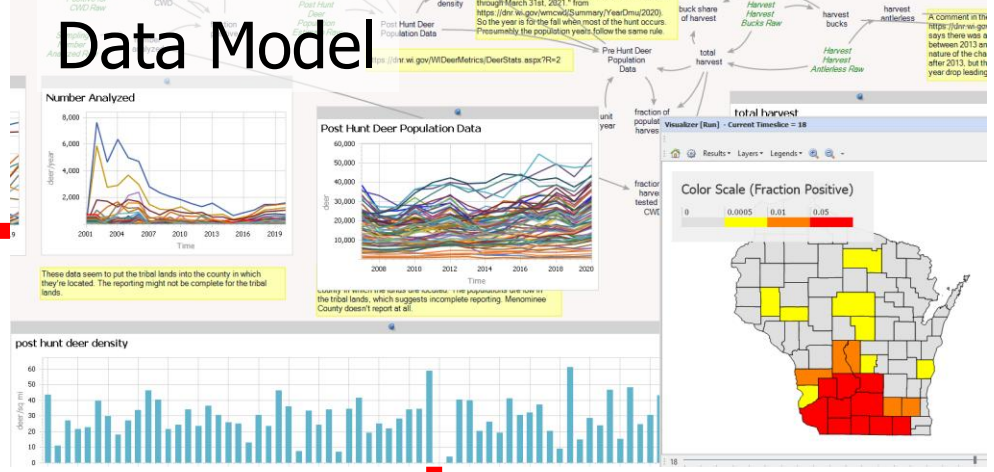
Some Places to Intervene



Architecture

Driving Data

Data Model



Parameters

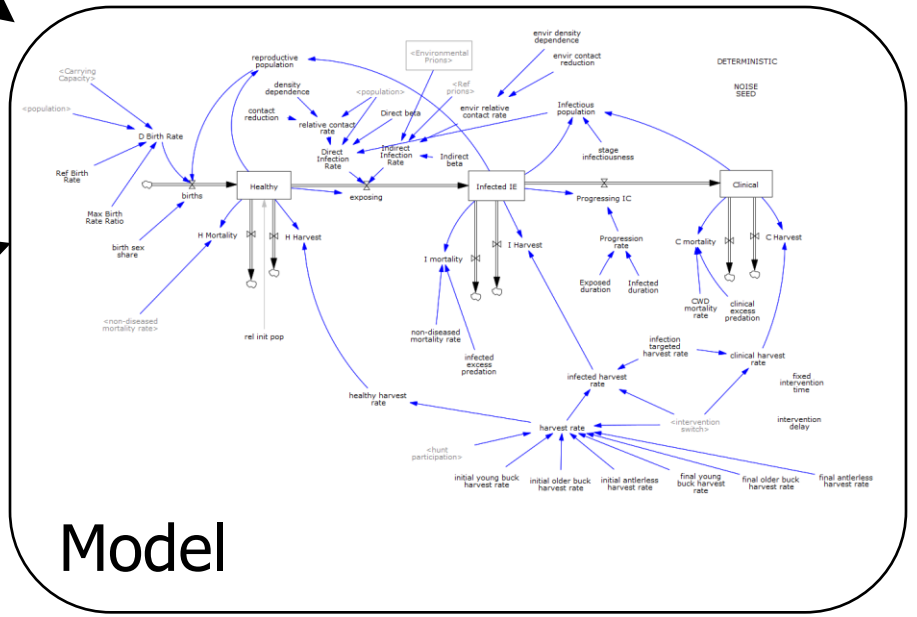
- CWD transmission
- Environmental prions
- Deer fertility & mortality

+ Uncertainty

Decisions

- Hunting
- Baiting & feeding
- Surveillance
- Carcass management
- Safe practices
- Timing

Comparisons



Model

Outcomes

- Prevalence
- Fraction positive
- Population
- Age, sex structure
- Harvest
- Surveillance results
- Hunt effort
- Human exposure

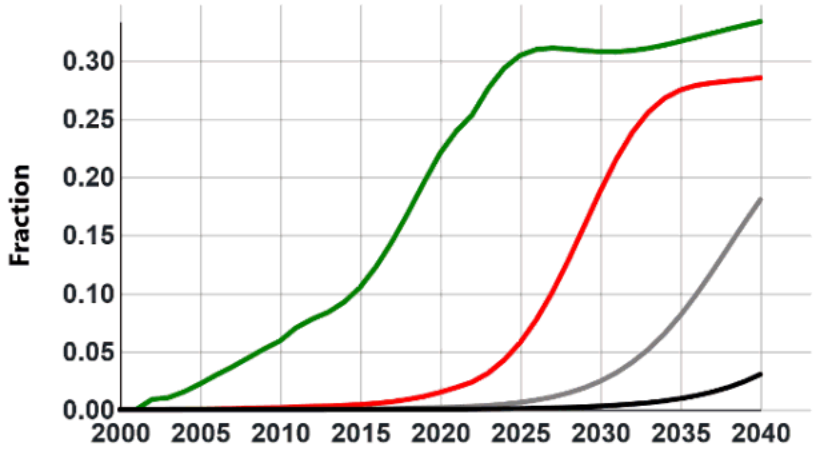
+ Uncertainty

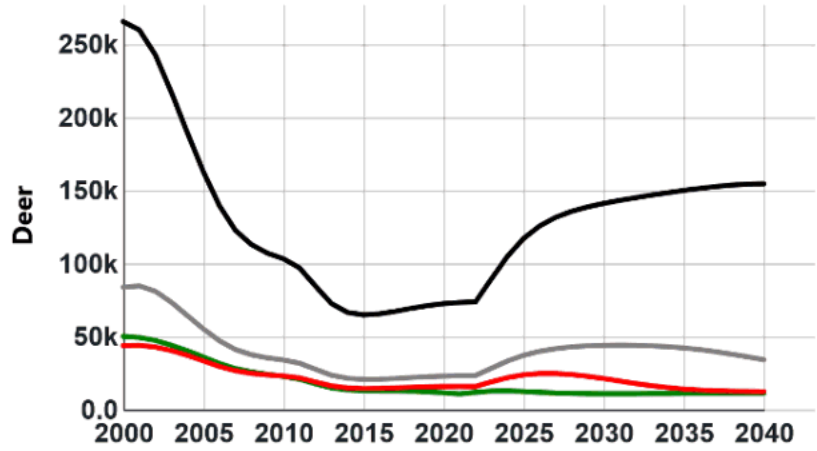
Consequence Tables Summarize Outcomes for Multiple Strategies

Metrics	Harvest Actions					
	Base	Uniform	Antlerless	Older Bucks	All Bucks	Perfect Targeting
population	871	376	379	875	879	778
older buck population	154	53	86	117	98	118
healthy population	456	269	214	505	554	569
prevalence	0.48	0.29	0.44	0.42	0.37	0.27
harvest fraction positive	0.46	0.28	0.39	0.44	0.38	0.37
positive harvest consumed	74	31	36	76	74	61
clinical prevalence	0.02	0.02	0.02	0.02	0.02	0.02
total harvest	255	185	150	280	314	271
trophy harvest	46	26	26	58	49	47
relative harvest effort	0.96	1.60	1.38	1.09	1.24	1.19
Vegetation Index	1.02	1.09	1.08	1.02	1.02	1.04

CWD Sandbox

Reset | Documentation | Share | Output





Baseline | Baseline-Endemic | Baseline-Leading | Baseline-New | Baseline-Undetected | User | User-Endemic | User-Leading | User-New | User-Undetected

Statewide | Endemic | Leading Edge | New Foci | Undetected

Harvest

Young Buck Harvest Rate

Older Buck Harvest Rate

Antlerless Harvest Rate

Sharpshooting

Sharpshooting Rate

Geographic Targeting Enrichment

Age/Sex Targeting Enrichment

Baiting & Feeding

Contact Reduction

Safe Practices

Consumption of Positive Meat

Risk Reduction from Best Practices

Carcass Safe Disposal

Carcass Transport Reduction

Surveillance

Future Sampling

Intervention Delay

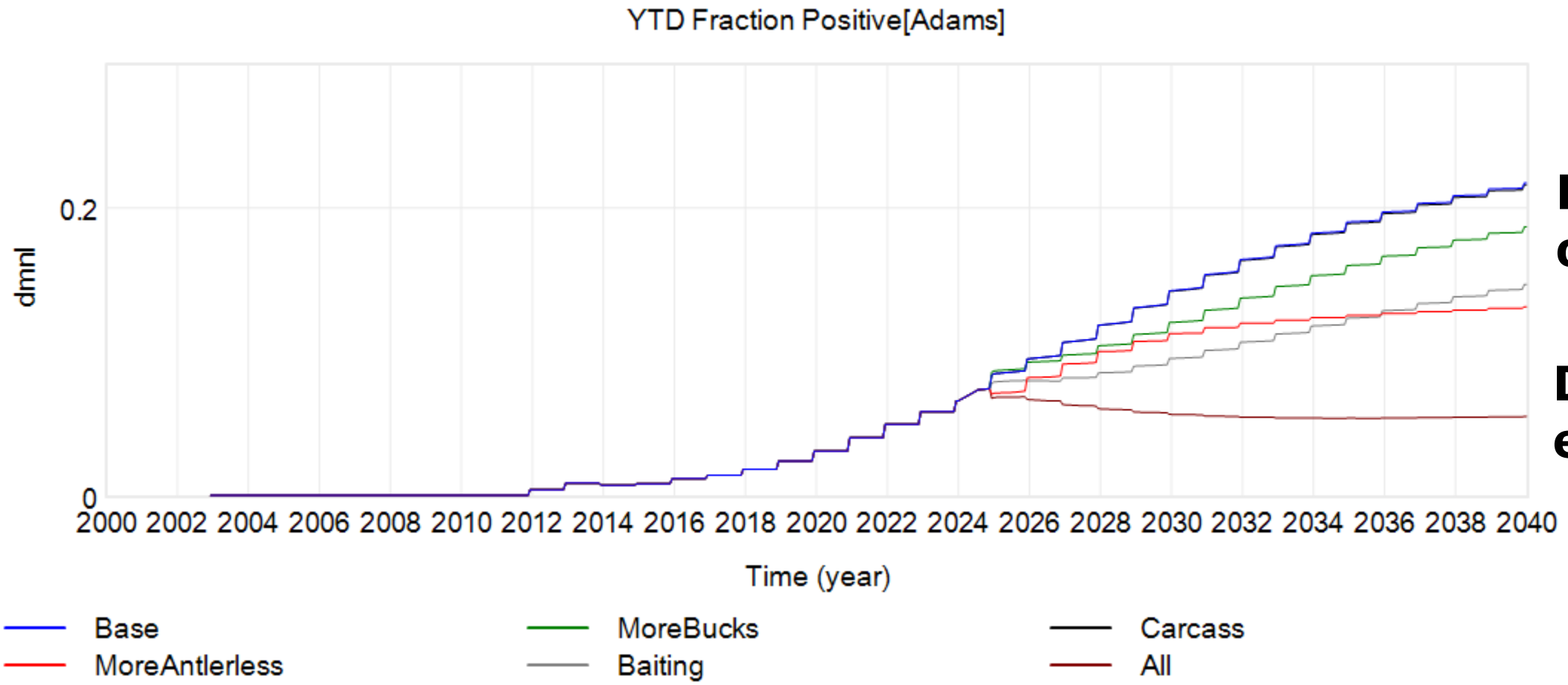
Fixed Intervention Time

Intervention Duration

Interactivity Allows Stakeholders to Suggest Experiments

The problem is hard, but not impossible

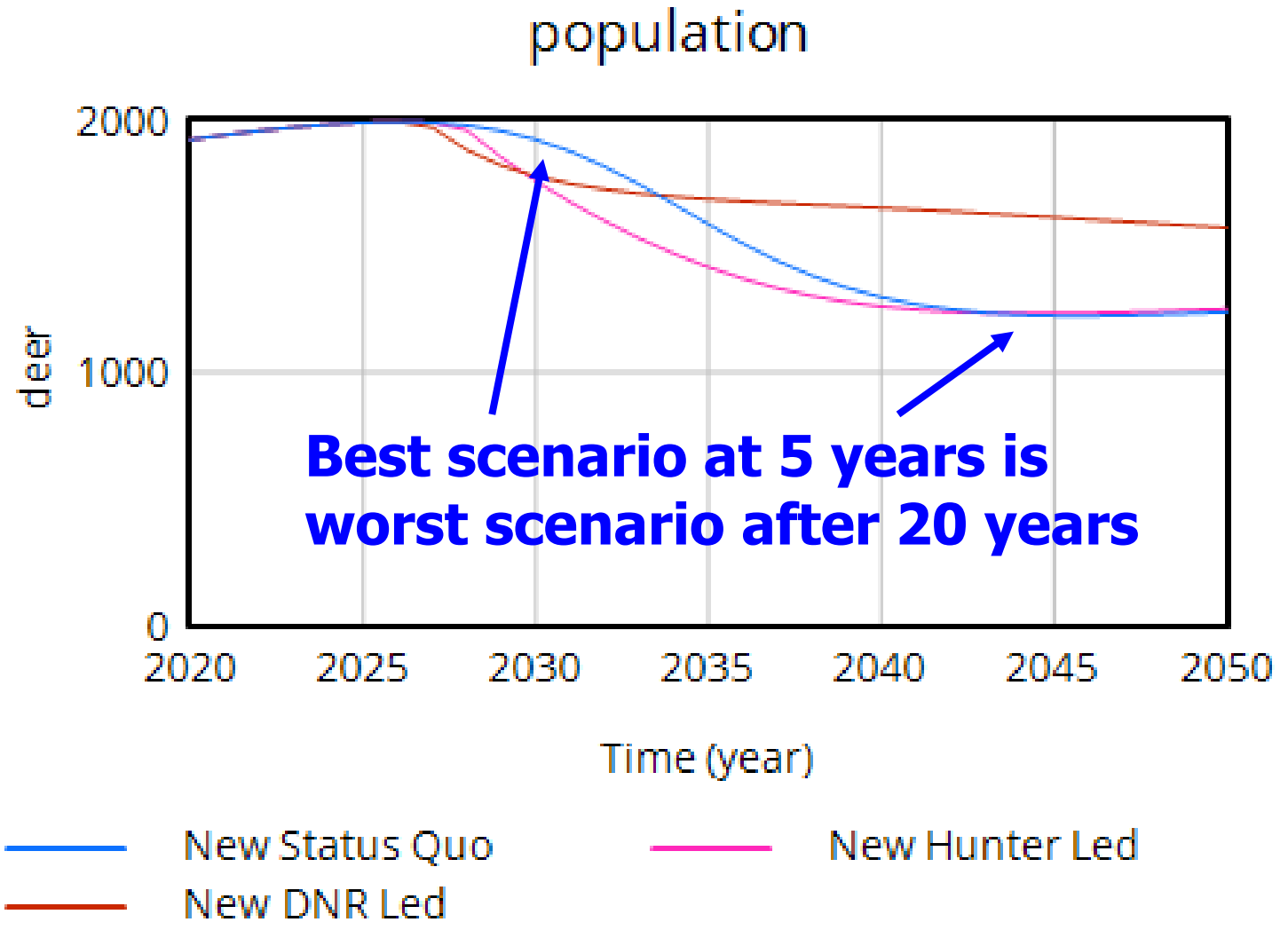
- **Transmission must be reduced 50-80% to arrest growth.**
- **No single policy is likely to achieve the needed reduction.**



Do any one thing

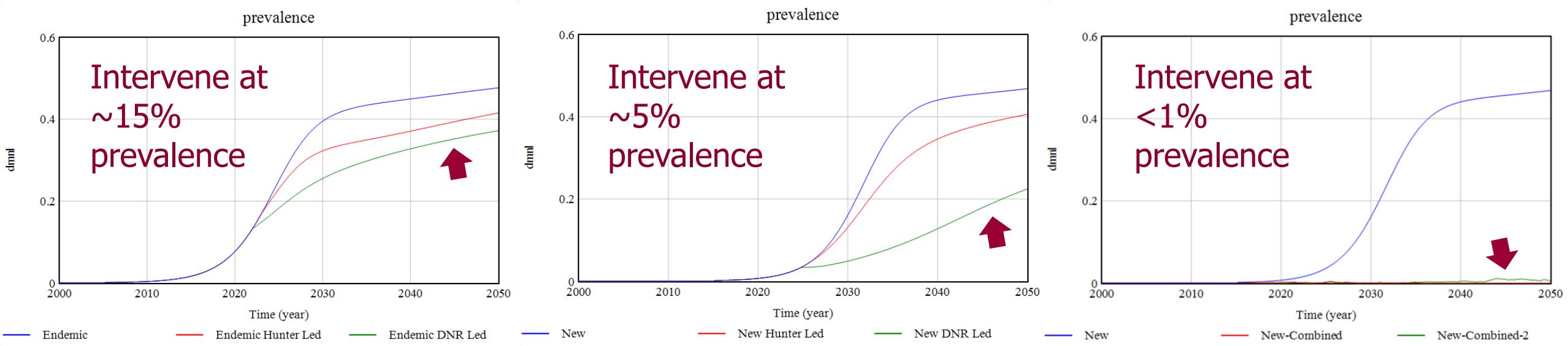
Do everything

The effectiveness of options depends on your time horizon

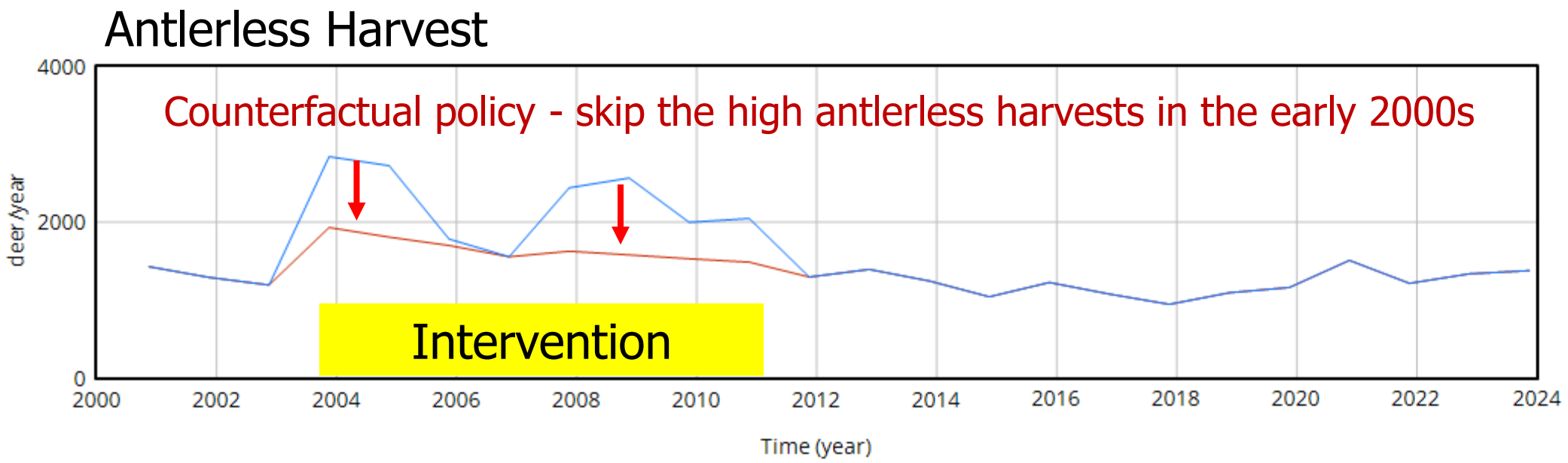


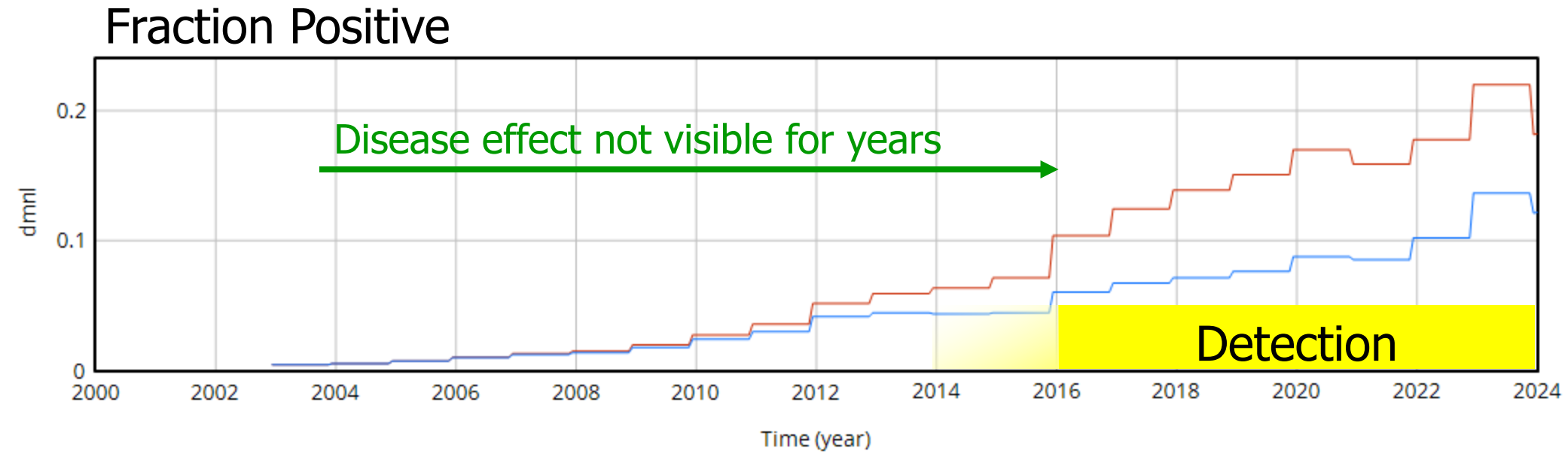
Timing is Important

- **Early intervention is more successful – fewer positives, smaller geography, less environmental contamination**
- **Sufficient surveillance is a key enabler…**
- **But surveillance only helps if it is followed by action.**
- **At low levels, eradication may be possible.**



Deer age structure, population dynamics and metrics confound detection of changes in CWD prevalence





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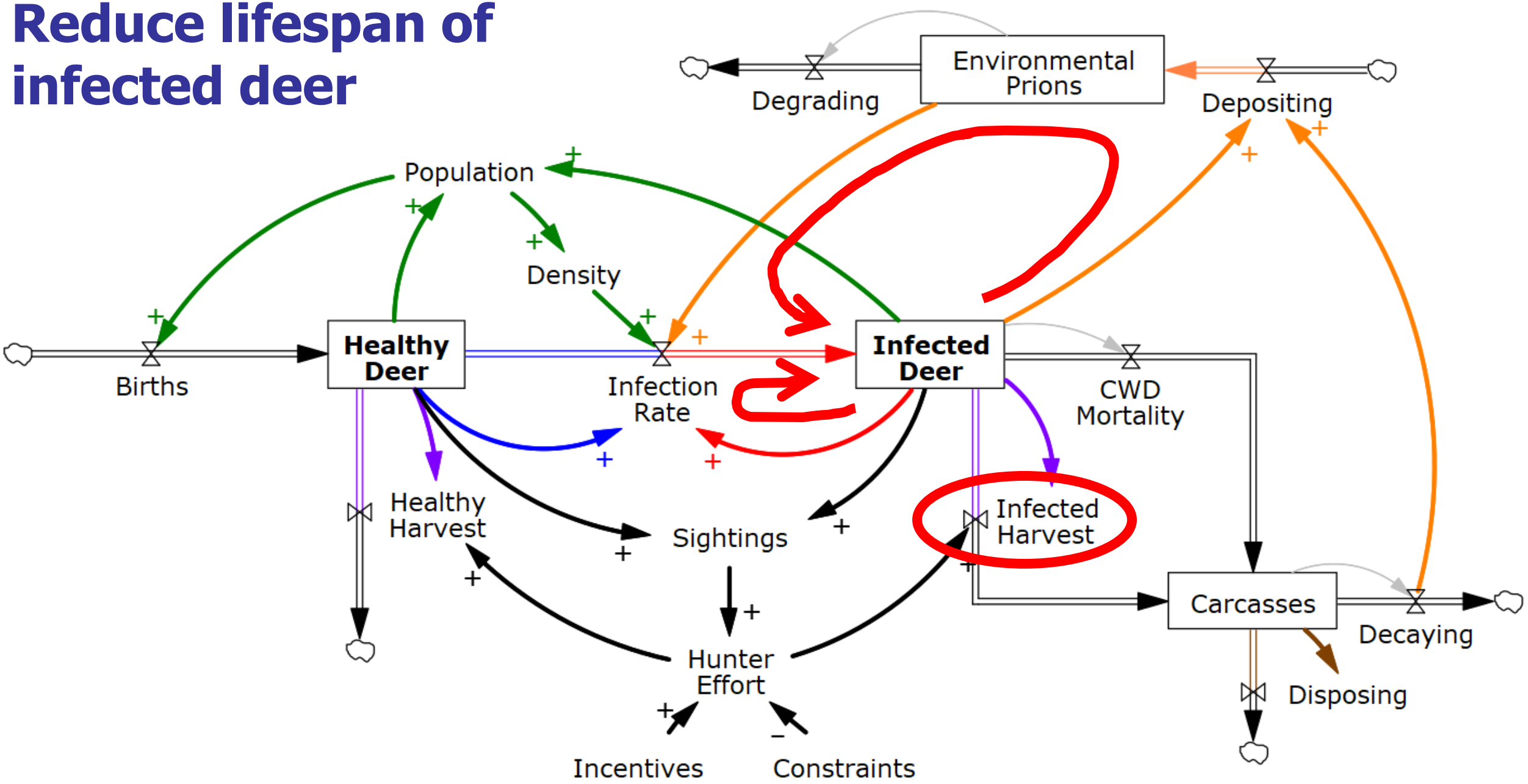
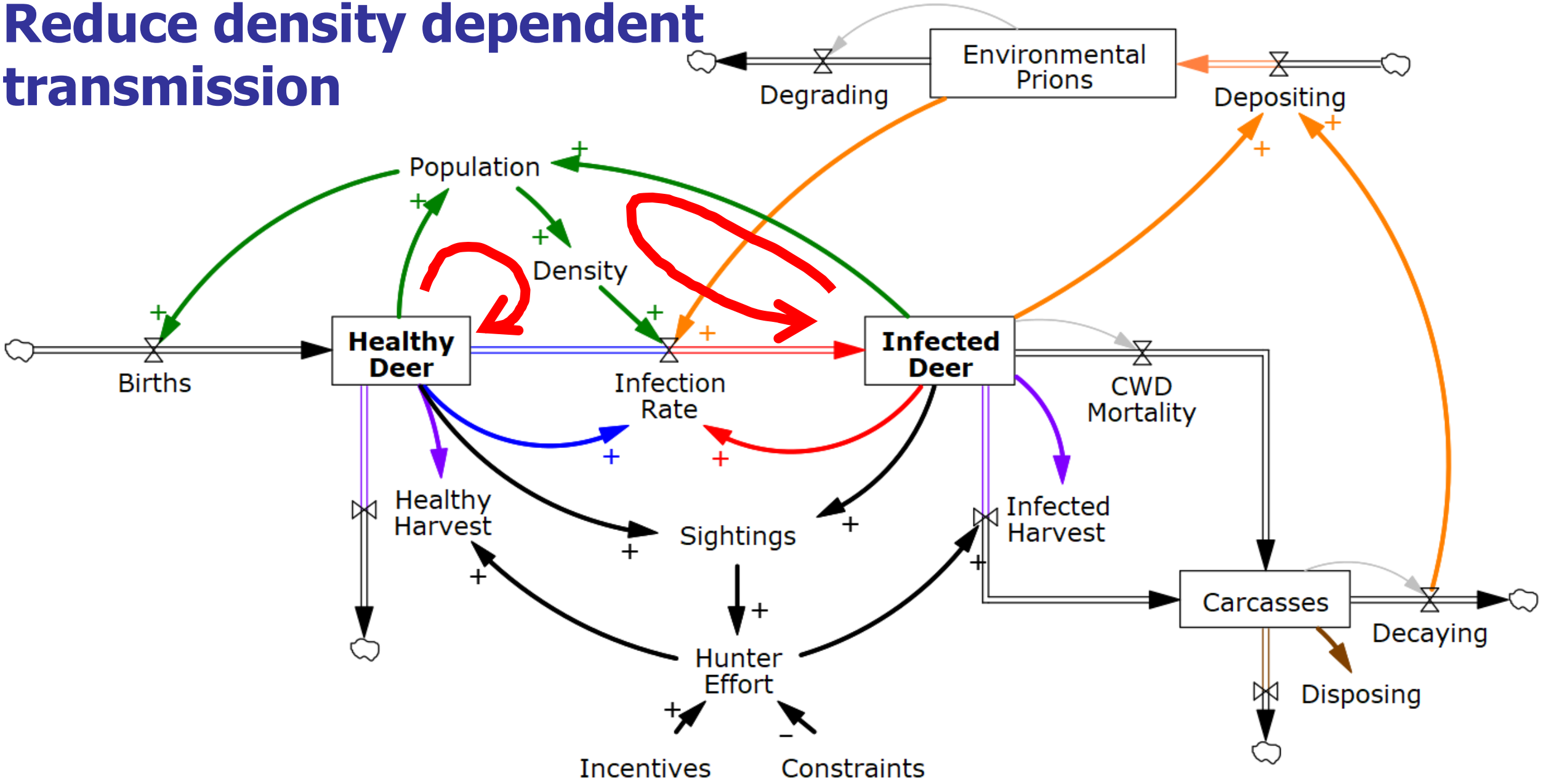
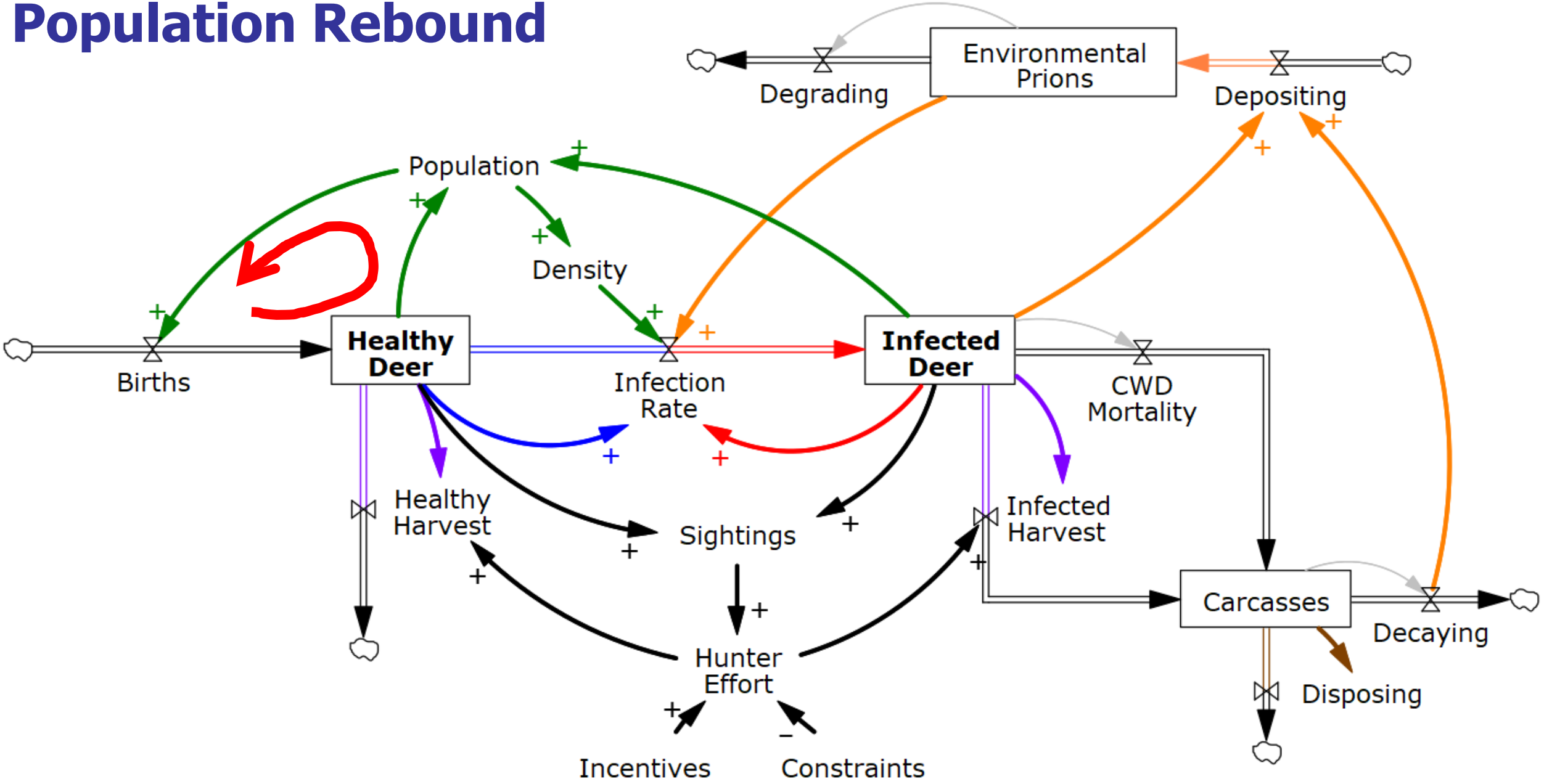
Direct Effect: Reduce lifespan of infected deer



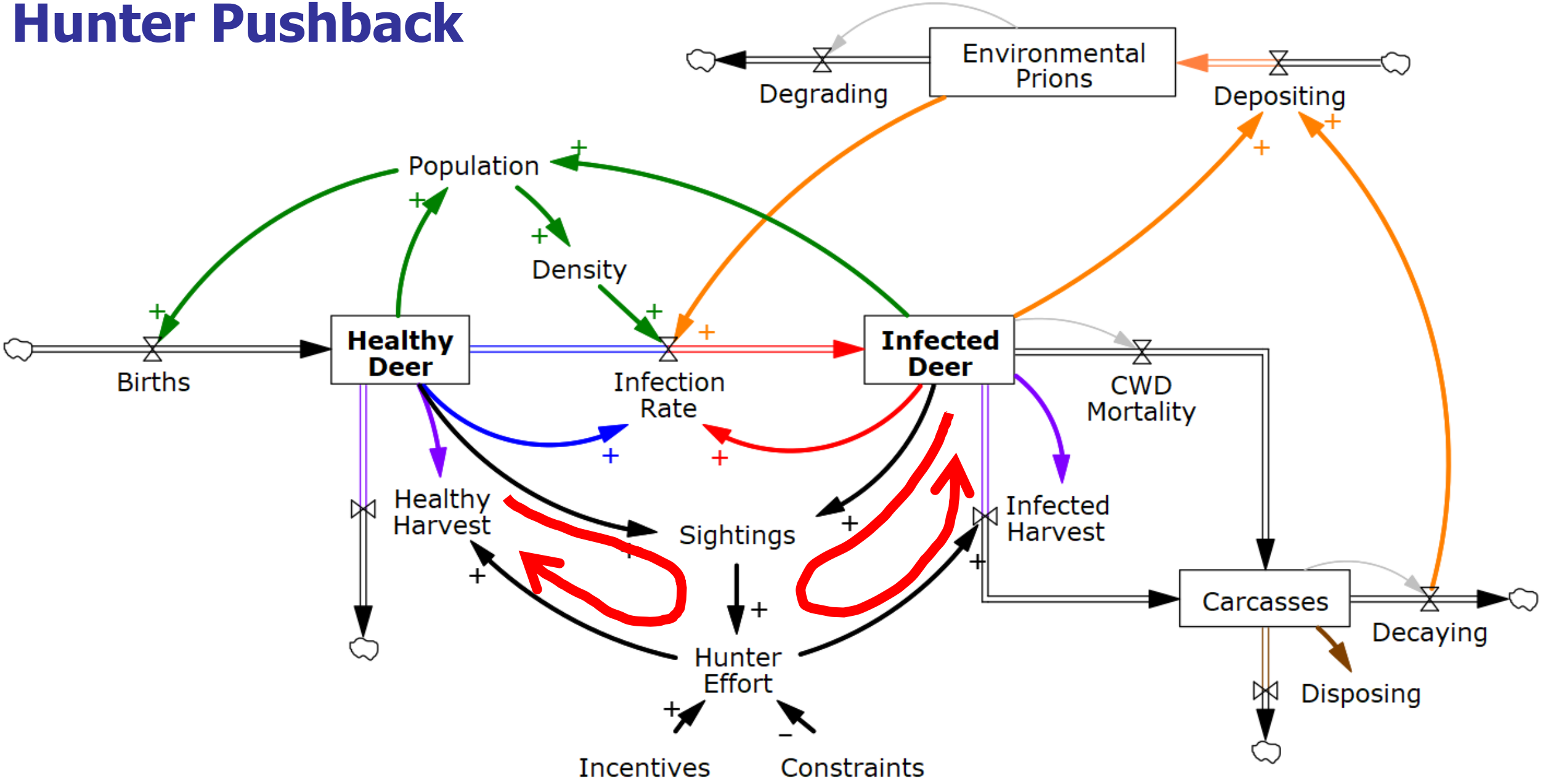
Delayed Effect: Reduce density dependent transmission



Side Effect: Population Rebound



Side Effect: Hunter Pushback



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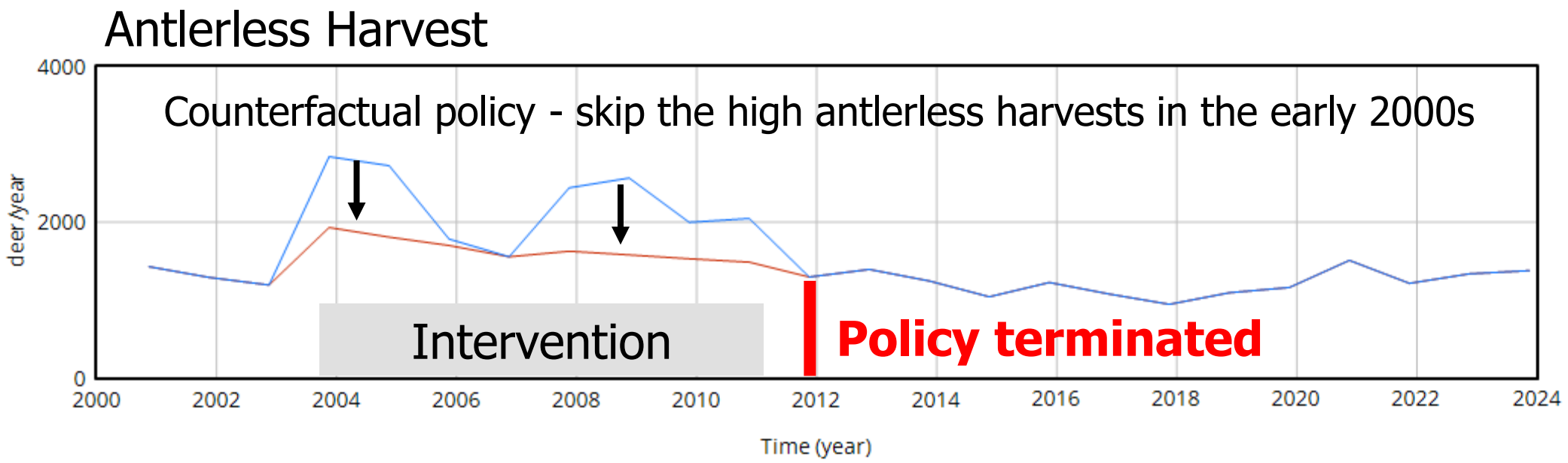

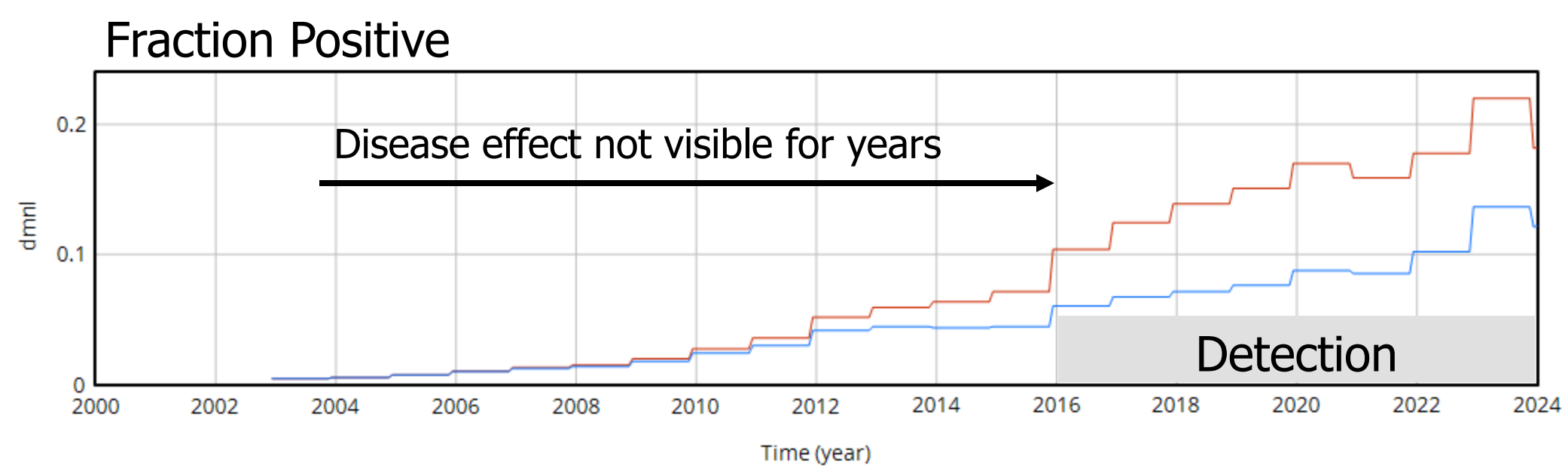

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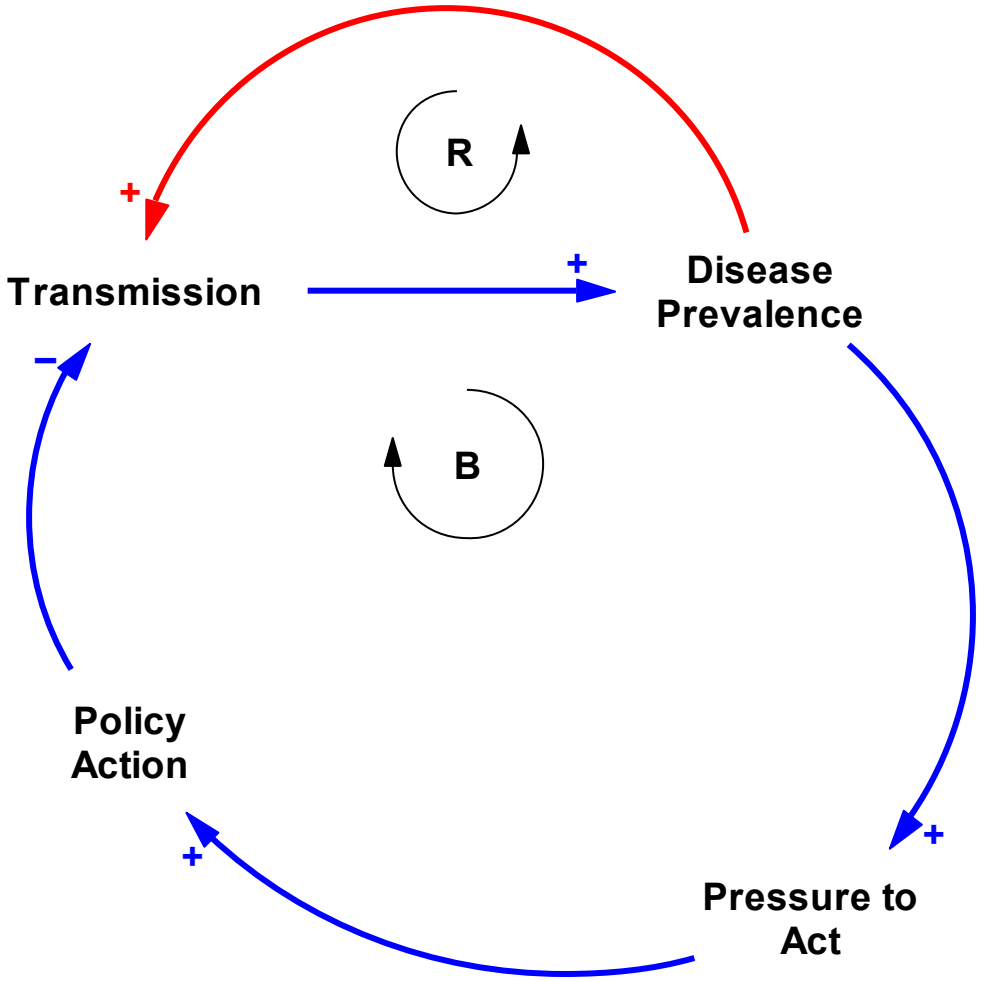
How did policy extinction happen?



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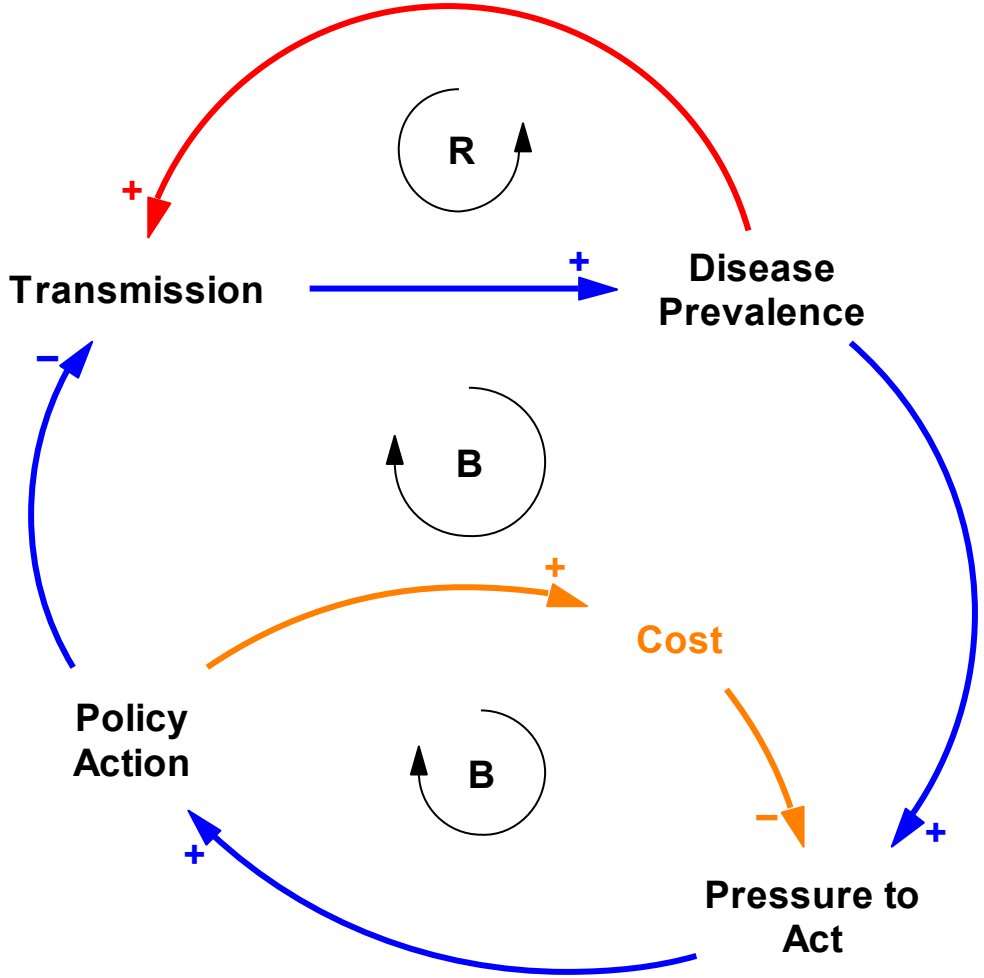

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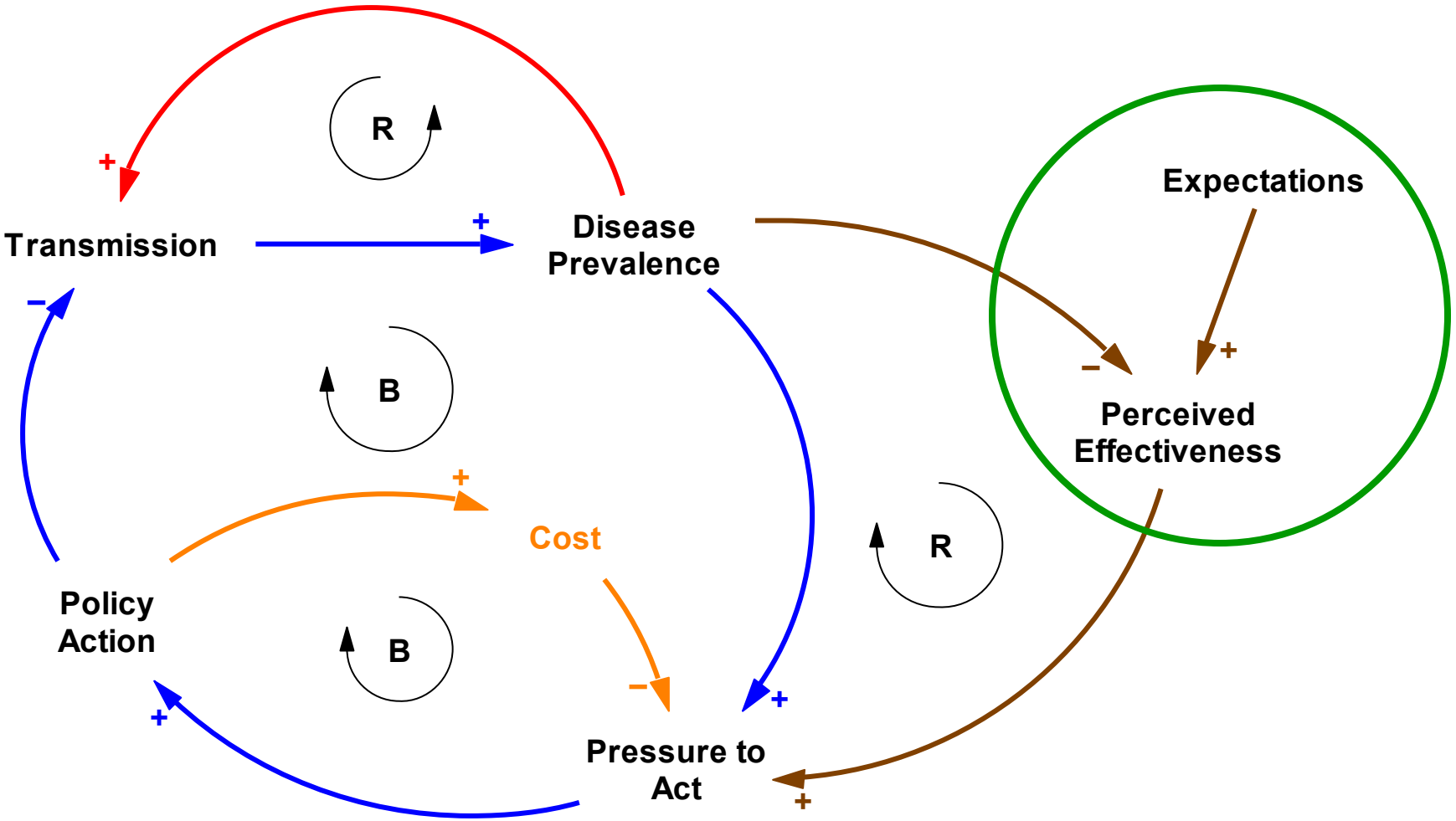

Project Wins

Products

- Integration of Structured Decision Making and System Dynamics Models
- Evaluated management alternatives to inform planning
- Illuminating key CWD processes affected by proposed management– including feedbacks, system delays, social "short-circuiting"

Insights

- Arresting CWD growth requires large reductions in CWD transmission (~50-80%)
- Success unlikely to be achieved by a single intervention
- Modest reallocation of current resources will not have a large effect
- Historical policies discontinued may have had substantial benefits

Buy-in

- Participatory workshops created buy-in from stakeholders and increased credibility for the agency
- Productive conversations with stakeholders, because the model served as a focal point for discussion and resolved conflicts
- Enhanced WDNR's current processes

Questions?

bit.ly/sdspolls

Thanks!