

# THE CRAYFISH INVASIVENESS RISK ASSESSMENT MODEL (CIRAM): A BAYESIAN BELIEF NETWORK FOR ASSESSING RISK POSED BY NONNATIVE CRAYFISH

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# pathogens and commensals



Andrew C., CC BY 2.0

# competition



Roger Tabor, USFWS

# habitat and trophic impacts



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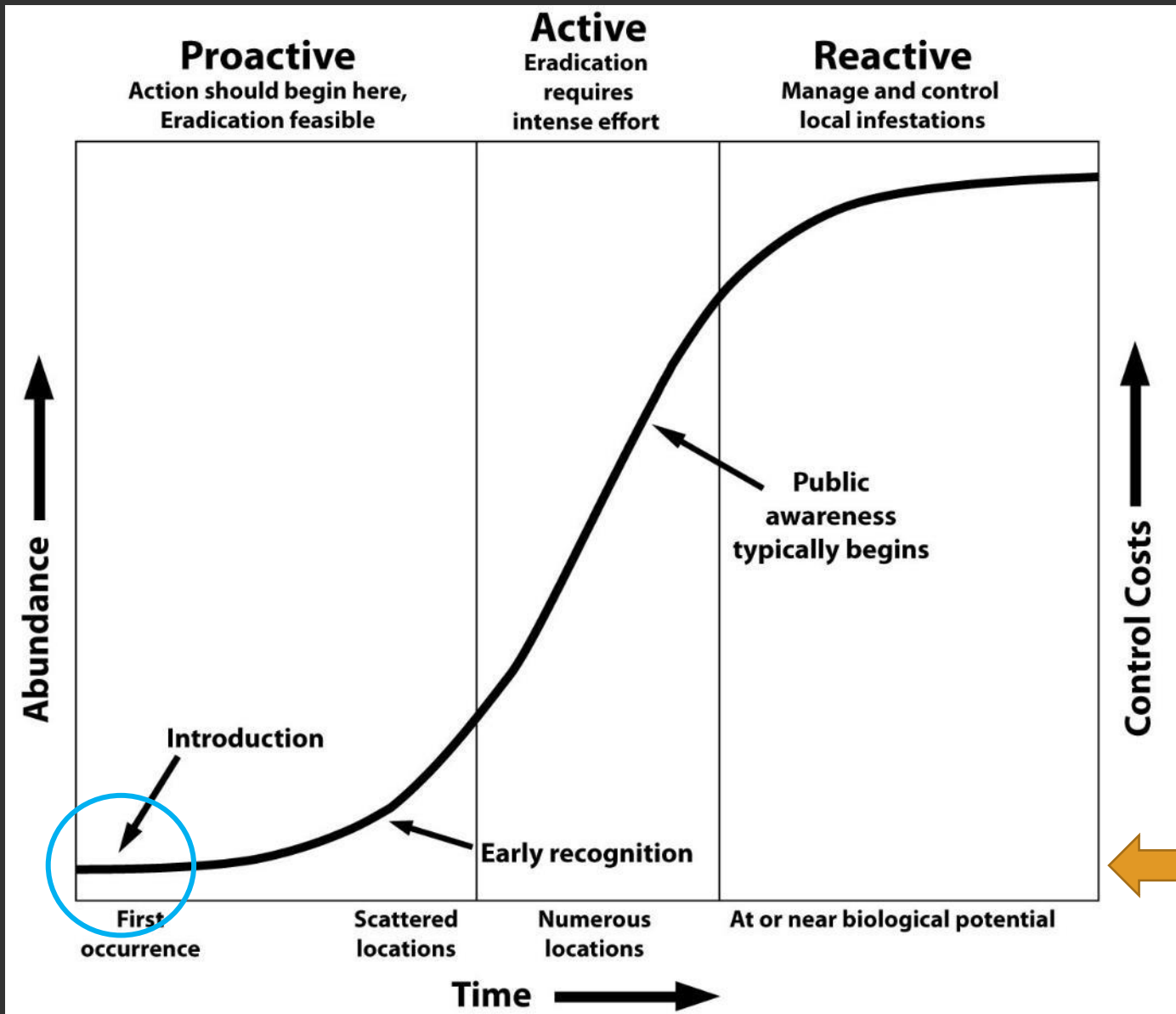


WI DNR



Tom Koerner, USFWS

# socioeconomic effects



## Phases of Invasive Species Invasion and Control

# EXISTING RISK ASSESSMENT TOOLS FOR CRAYFISH

- Freshwater Invertebrate Invasiveness Screening Kit (FI-ISK)
  - 👍 **takes many factors into account**
  - 👎 **time-consuming, information-intensive**
- Notre Dame's STAIR (Science-Based Tools for Assessing Invasion Risk): Crayfish
  - 👍 **easy to use (predicted probabilities available on website)**
  - 👎 **inflexible**
- USFWS Ecological Risk Screening Summary
  - 👍 **rapid, transparent (uses only two key factors)**
  - 👎 **simplistic**

👎 **uncertainty**

# INTRODUCING “CIRAM”

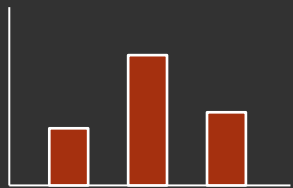
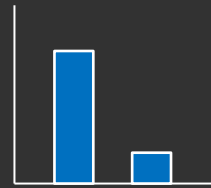
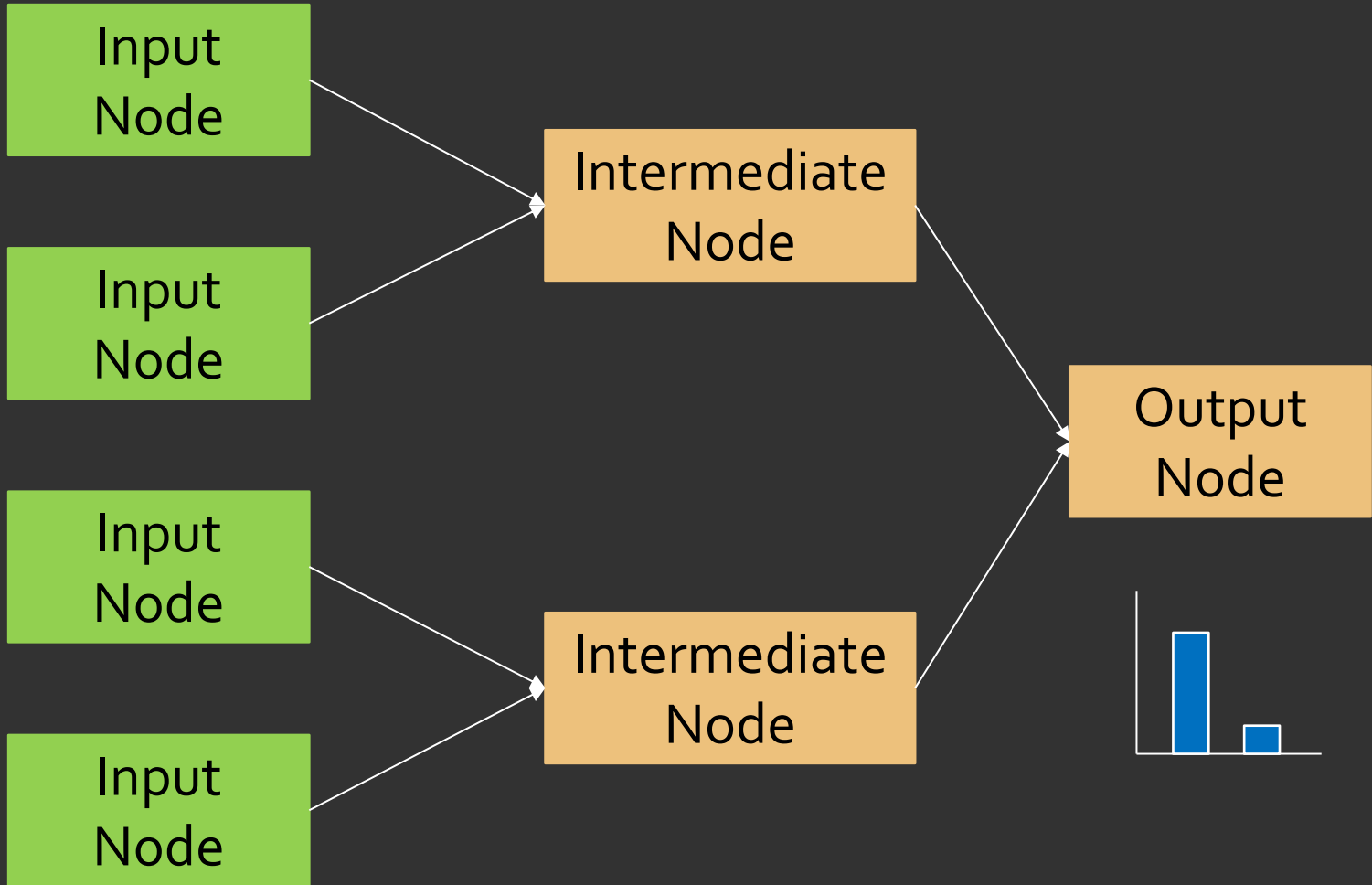
1. Treat uncertainty as a useful element of the modeling process
2. Allow explicit inputs for historical and projected impacts
3. Offer flexibility in the target region for assessment

→ **Bayesian belief network**

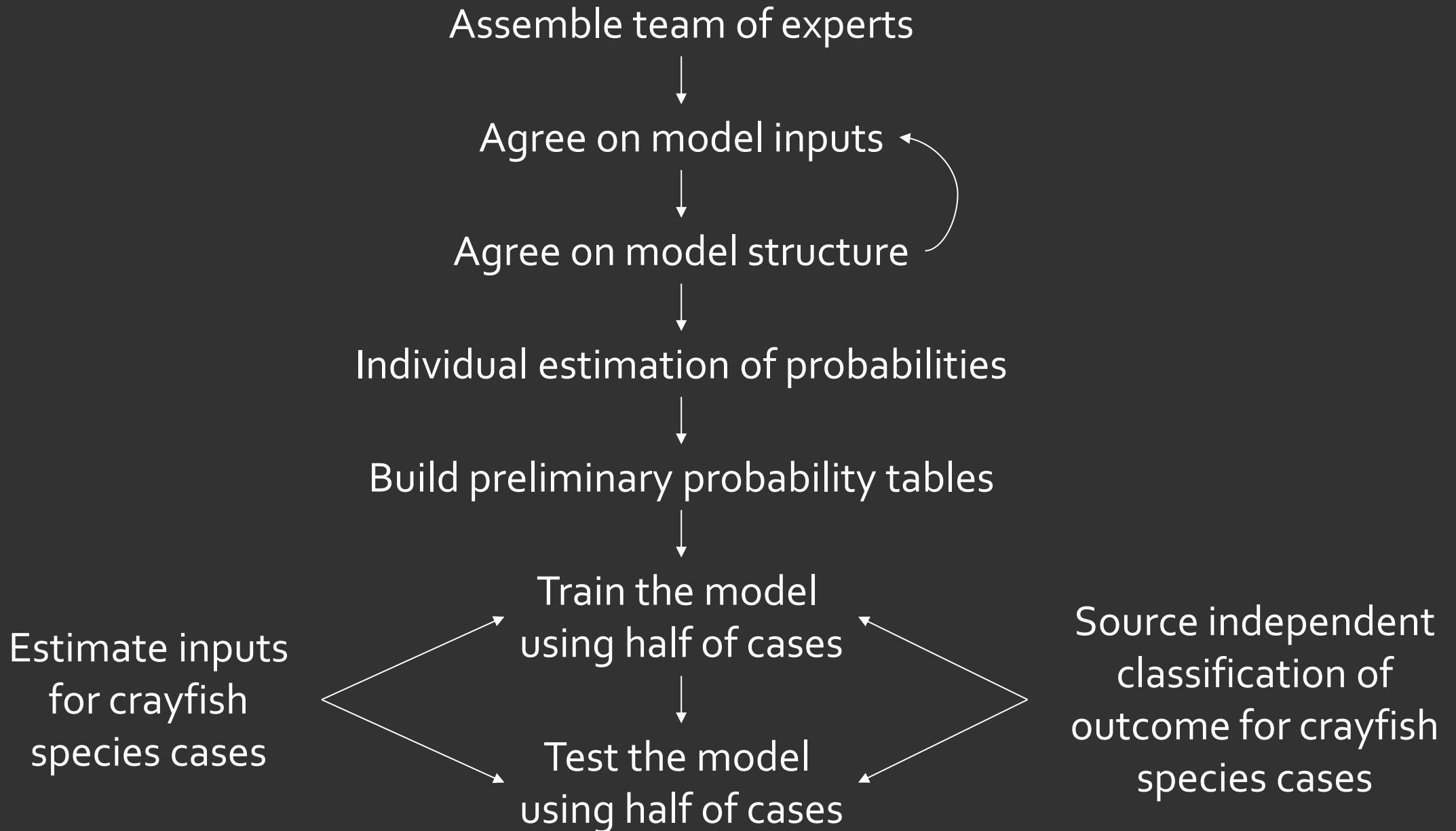
# DEFINING INVASIVENESS

“the species has sufficient capacity for harm and establishes and spreads to a degree that priority species, ecosystems, or humans experience negative effects of its presence in more than isolated cases”

Invasive = Establishment & Spread + **Harm**



- What nodes are included in the model?
- How are the nodes connected?
- What are the probability distributions behind each node?





Harm to Ecosystem  
Structure or Function

Harm to  
Priority Species

Harm to Humans

Harm from Pathogens  
or Commensals

Human Transport

Non-Human Transport

Reproductive Capacity

Habitat Suitability

Climate6 Score

Harm

**Invasiveness**

Transport

Spread

Establishment

# preliminary probability tables

Harm to Ecosystem Structure or Function	
Insignificant	0
Significant	100

Harm to Priority Species	
Insignificant	0
Significant	100

Harm to Humans	
Insignificant	0
Significant	100

Harm from Pathogens or Commensals	
Insignificant	0
Significant	100

Harm	
Insignificant	1.00
Significant	99.0

Human Transport	
None	0
Seldom	0
Frequent	100

Transport	
None	1.0
Seldom	5.00
Frequent	94.0

Non-Human Transport	
None	0
Seldom	0
Frequent	100

Reproductive Capacity	
Low	0
Medium	0
High	100

Spread	
Low	3.41
Medium	3.90
High	92.7

Habitat Suitability	
None	0
Insignificant	0
Significant	100

Establishment	
None	1.0
Seldom	5.00
Frequent	94.0

Climate6 Score	
Low	0
Medium	0
High	100
0.551 ± 0.26	

Invasiveness	
No	2.45
Yes	94.2
Uncertain	3.35

# preliminary probability tables

Harm to Ecosystem Structure or Function		
Insignificant	100	
Significant	0	

Harm to Priority Species		
Insignificant	100	
Significant	0	

Harm to Humans		
Insignificant	100	
Significant	0	

Harm from Pathogens or Commensals		
Insignificant	100	
Significant	0	

Harm		
Insignificant	81.0	
Significant	19.0	

Human Transport		
None	100	
Seldom	0	
Frequent	0	

Transport		
None	90.0	
Seldom	7.00	
Frequent	3.00	

Non-Human Transport		
None	100	
Seldom	0	
Frequent	0	

Reproductive Capacity		
Low	100	
Medium	0	
High	0	

Spread		
Low	73.3	
Medium	15.4	
High	11.3	

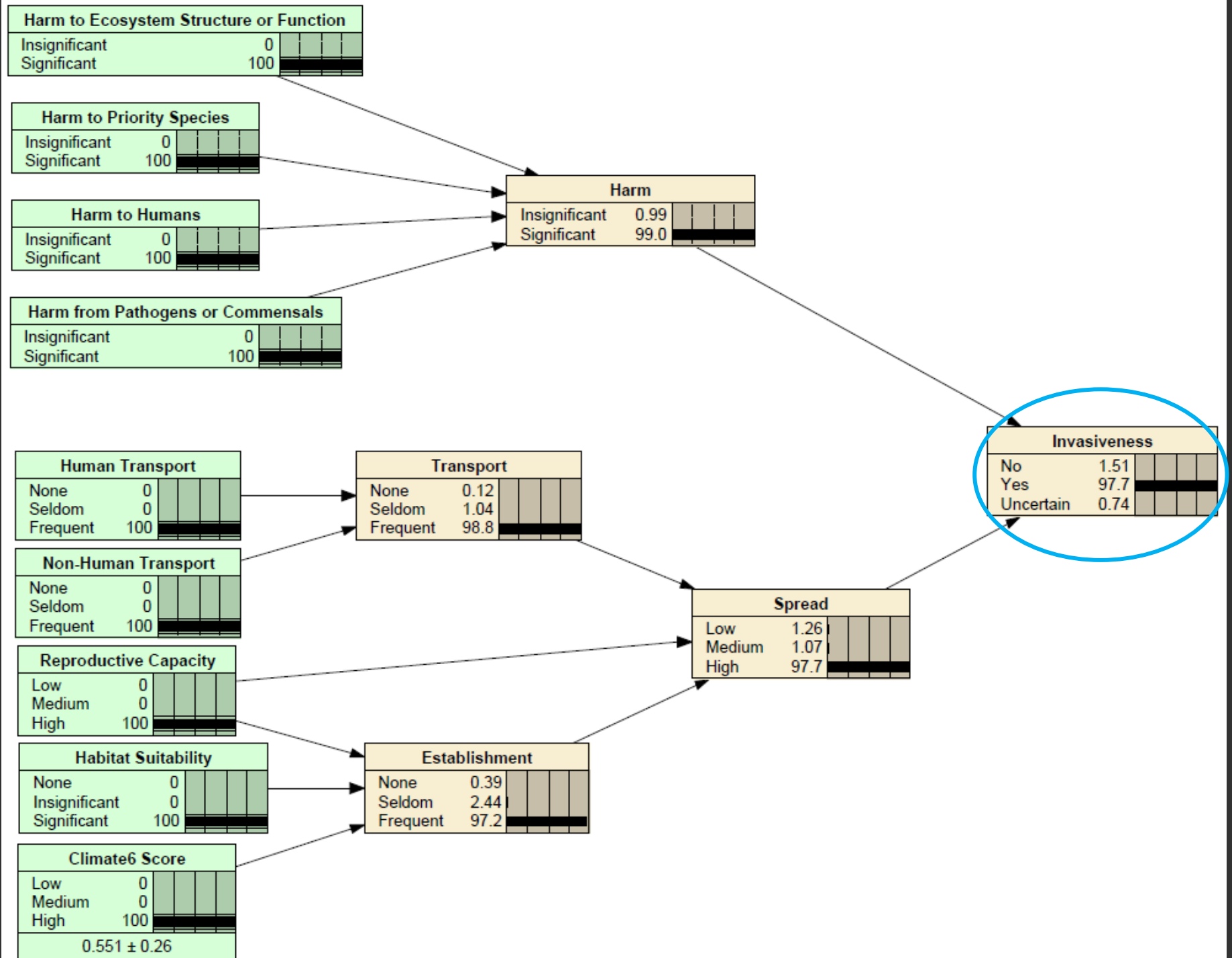
Habitat Suitability		
None	100	
Insignificant	0	
Significant	0	

Establishment		
None	70.0	
Seldom	14.0	
Frequent	16.0	

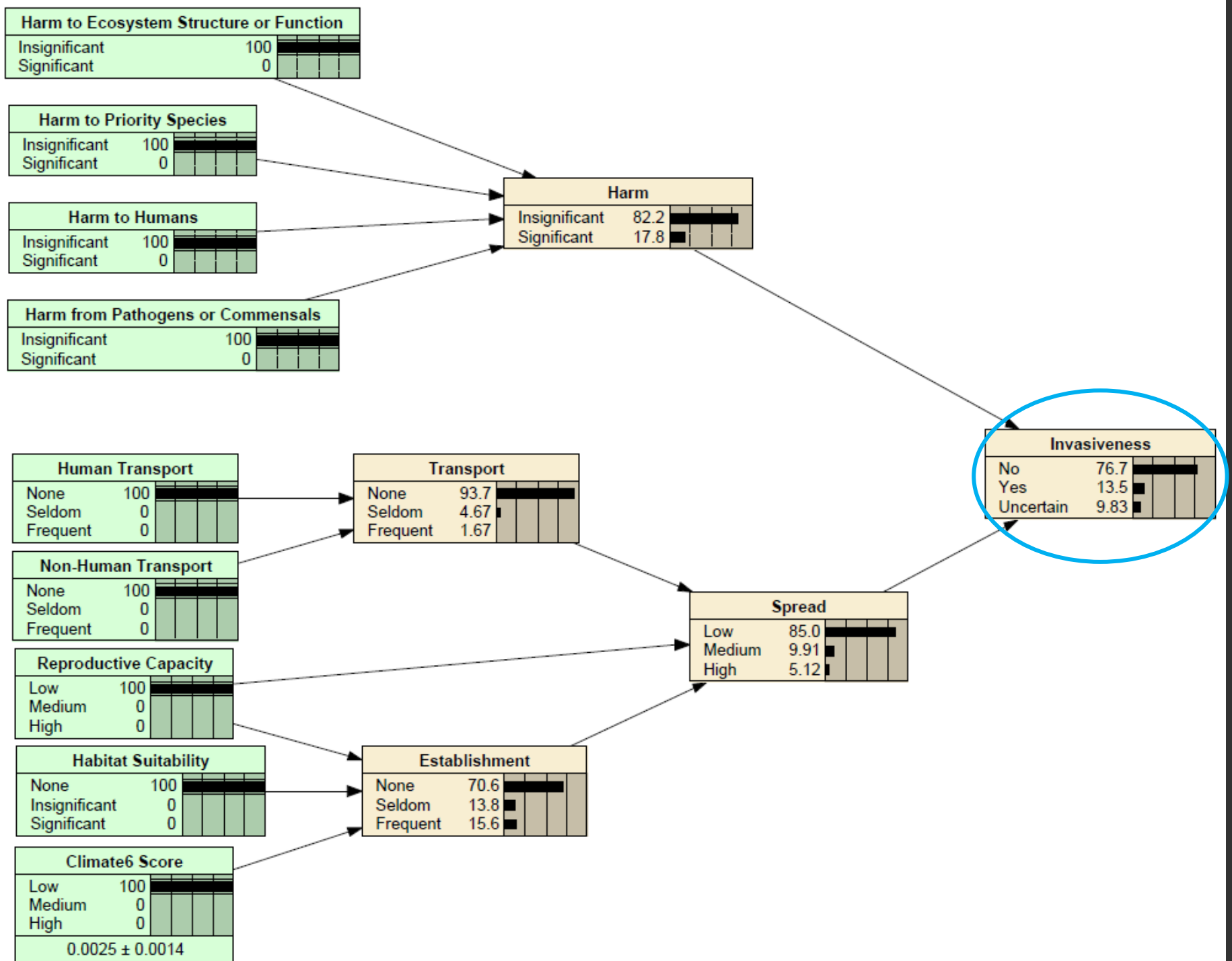
Climate6 Score		
Low	100	
Medium	0	
High	0	
0.0025 ± 0.0014		

Invasiveness		
No	48.2	
Yes	28.4	
Uncertain	23.5	

after  
training



after  
training



# PRELIMINARY TESTING RESULTS

.....Predicted.....			
No	Yes	Uncertain	Actual
3	13	0	No
0	16	0	Yes
6	0	0	Uncertain

- No false negatives!
- High rate of false positives

# REFLECTING ON OUR PROGRESS

- CIRAM strengths:
  - Treat uncertainty and disagreement as useful elements of modeling process
  - Allow explicit inputs for historical and projected impacts
  - Offer flexibility in target region for assessment
- Major challenge: lack of data on many crayfish species
- Next steps:
  - Finish remaining cases (39 species done, 53 species goal)
  - Re-train model and re-test performance
  - Assess need for further modification of model structure

**\*Ultimate goal: Work with partners to use model to inform decision-making\***

# QUESTIONS?

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