THE CRAYFISH INVASIVENESS RISK ASSESSMENT MODEL (CIRAM):

A BAYESIAN BELIEF NETWORK FOR ASSESSING RISK POSED BY NONNATIVE CRAYFISH

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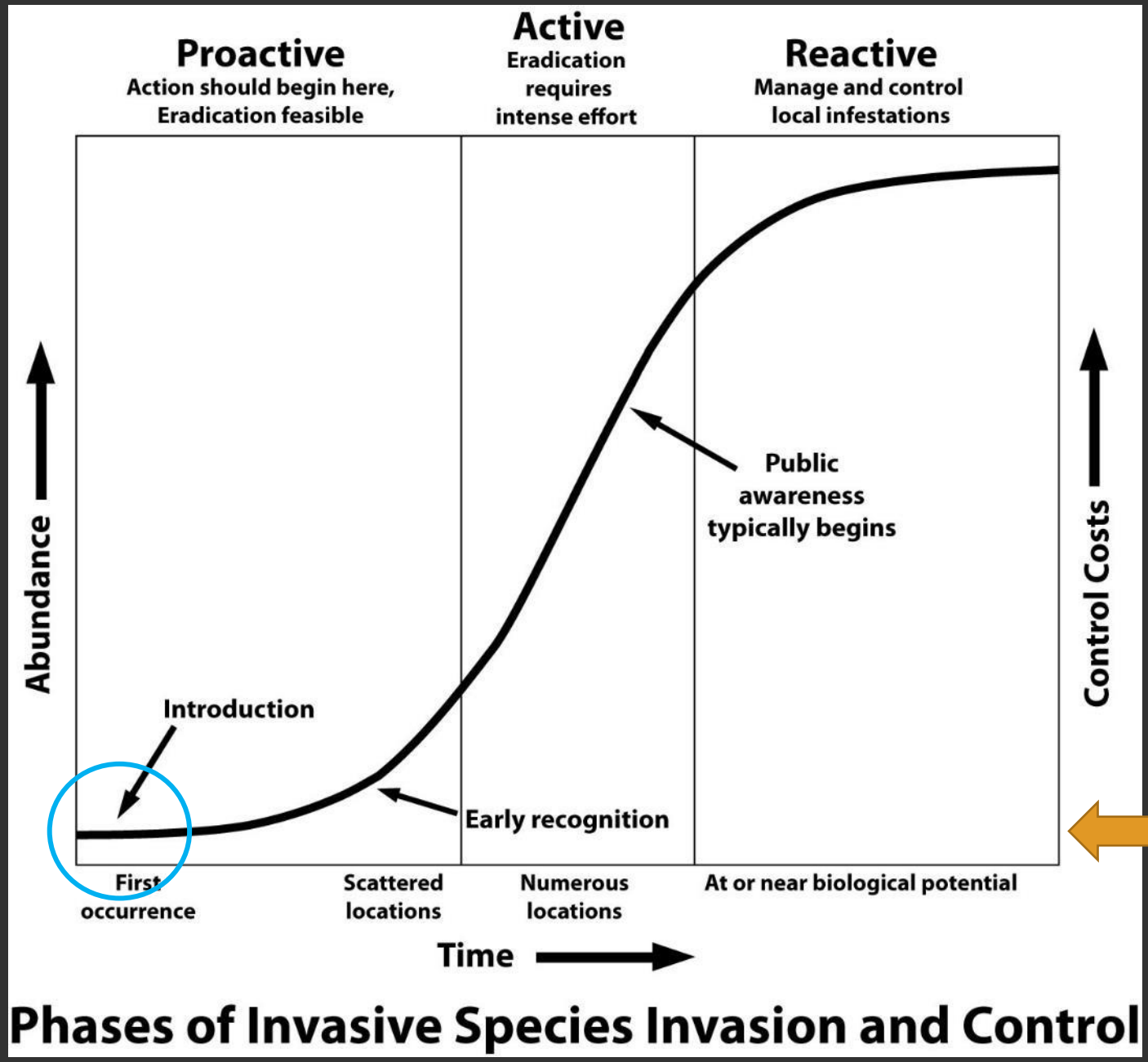
competition

pathogens and commensals

habitat and trophic impacts

socioeconomic effects



University of Georgia Center for Invasive Species and Ecosystem Health 2017

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

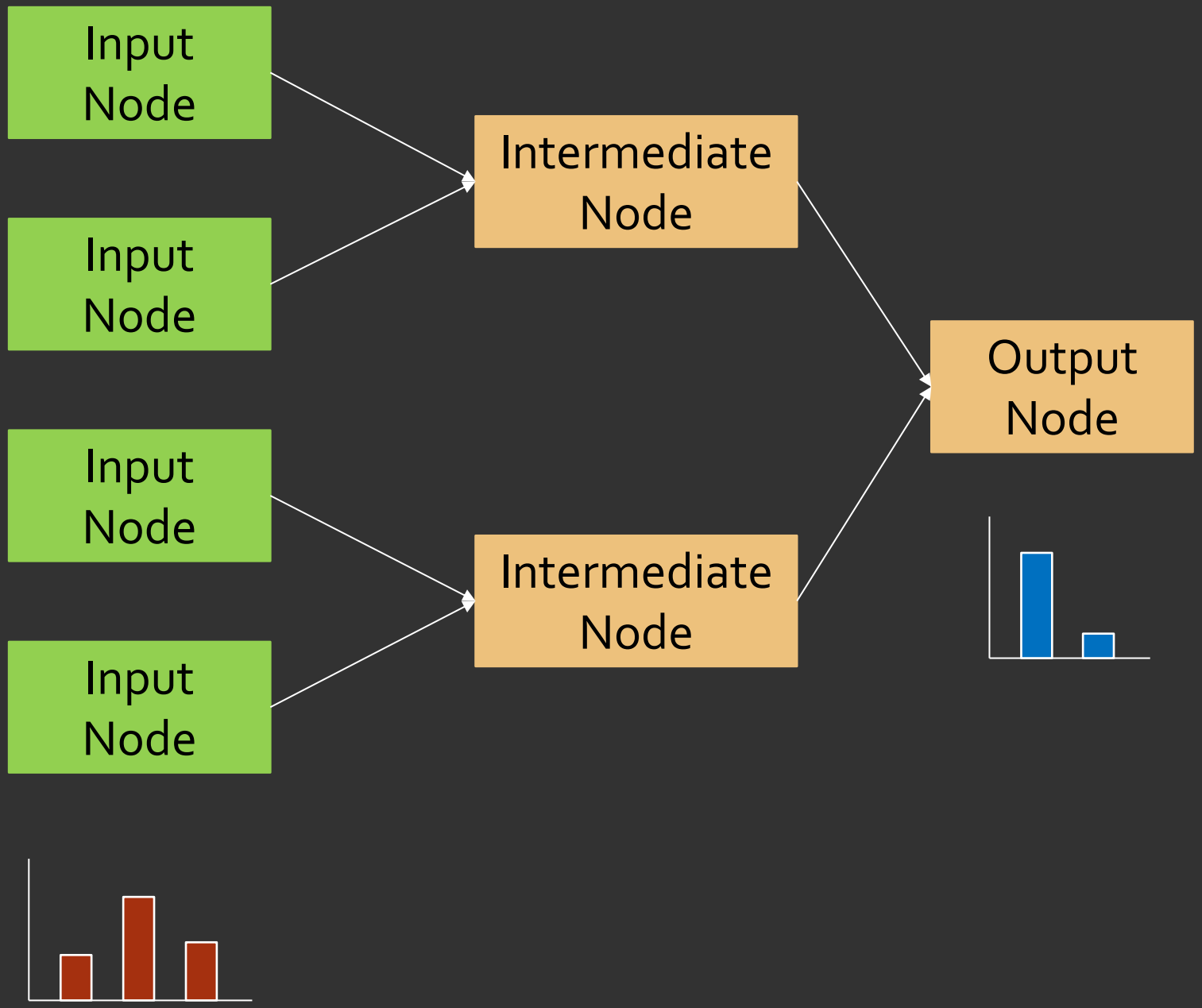
3. Offer flexibility in the target region for assessment

→ **Bayesian belief network**

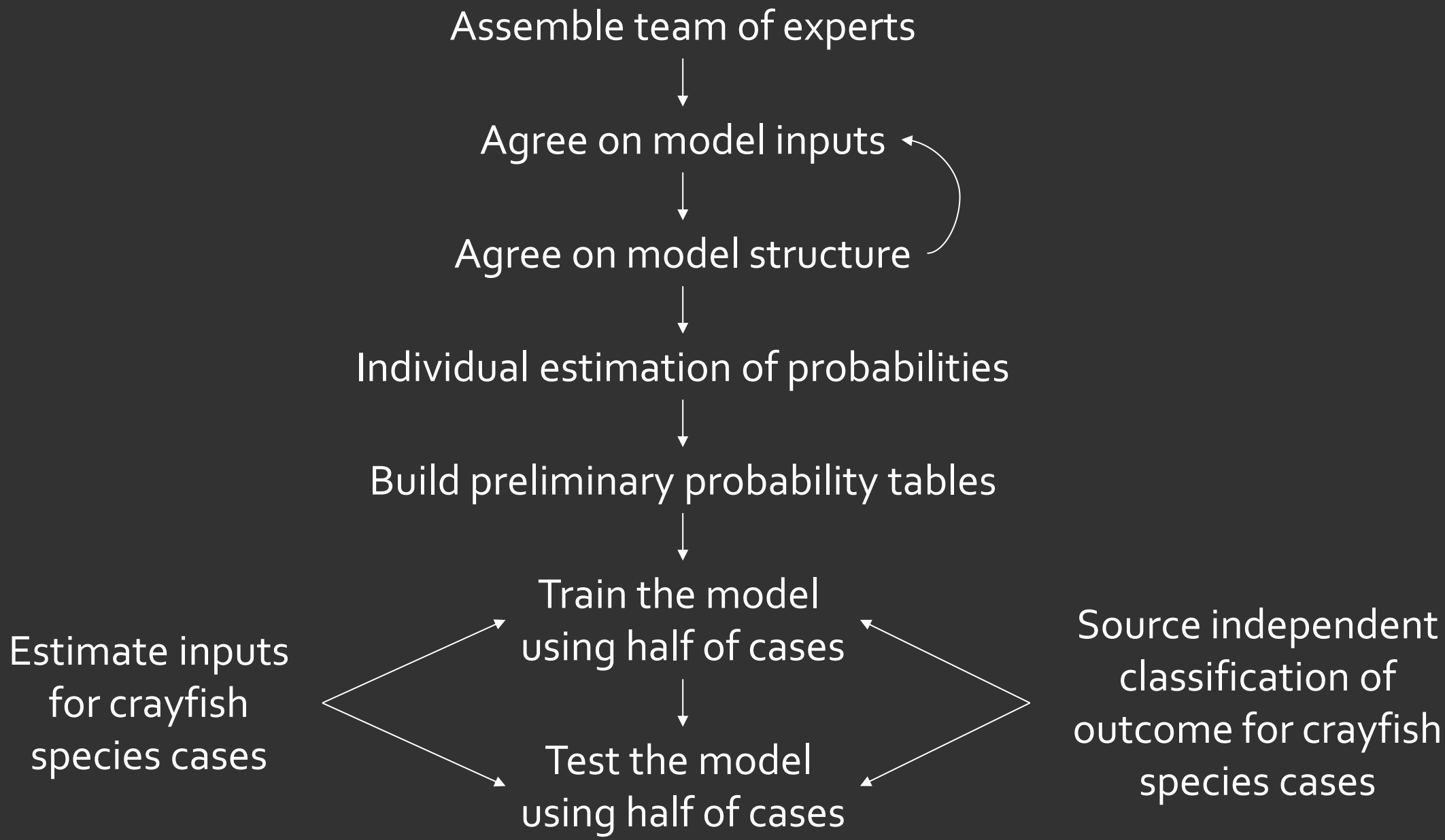
DEFINING INVASIVENESS

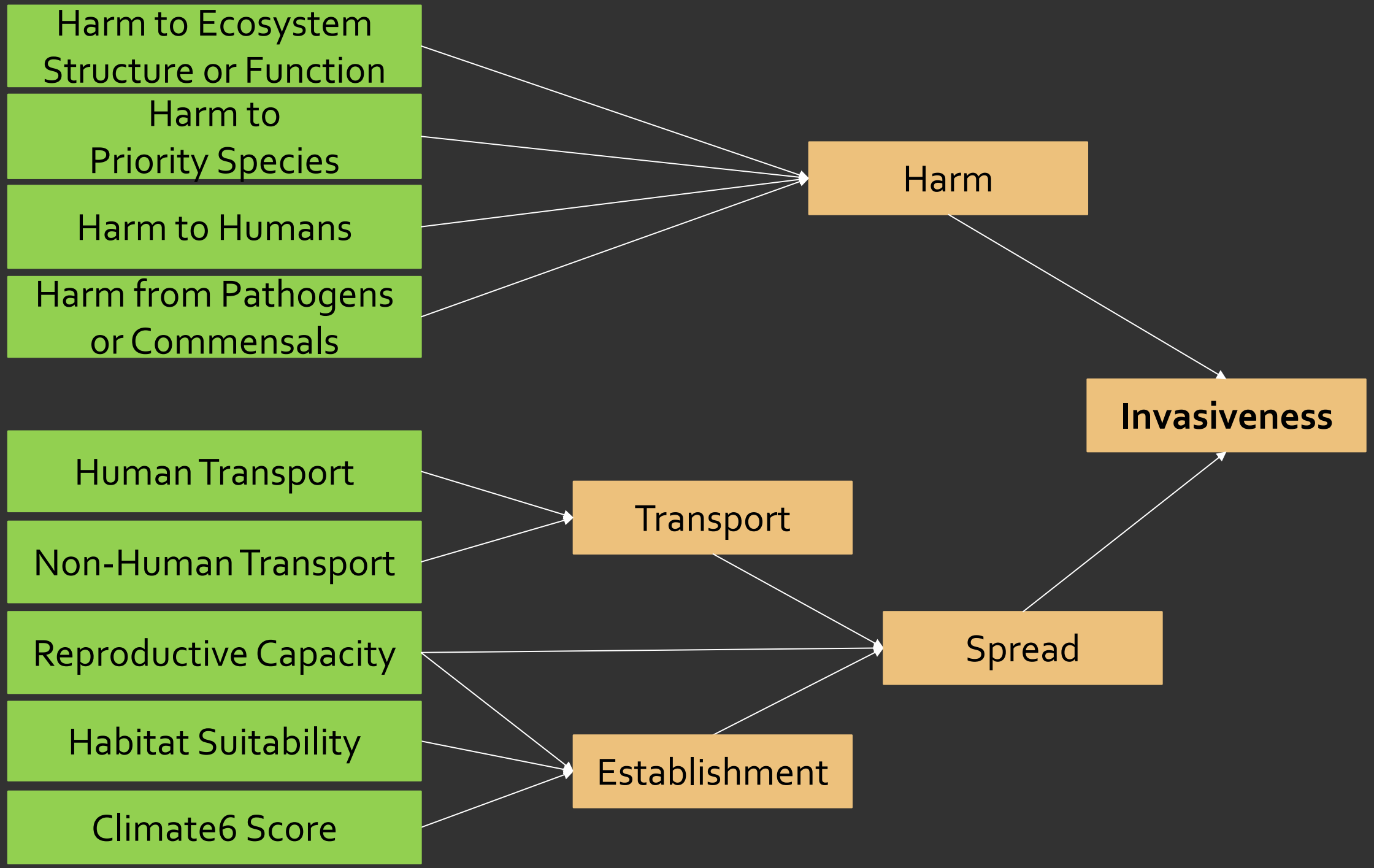
"the species has sufficient capacity for harm and establishes and spreads to a degree that priority species, ecosystems, or humans experience negative effects of its presence in more than isolated cases"

Invasive = Establishment & Spread + **Harm**

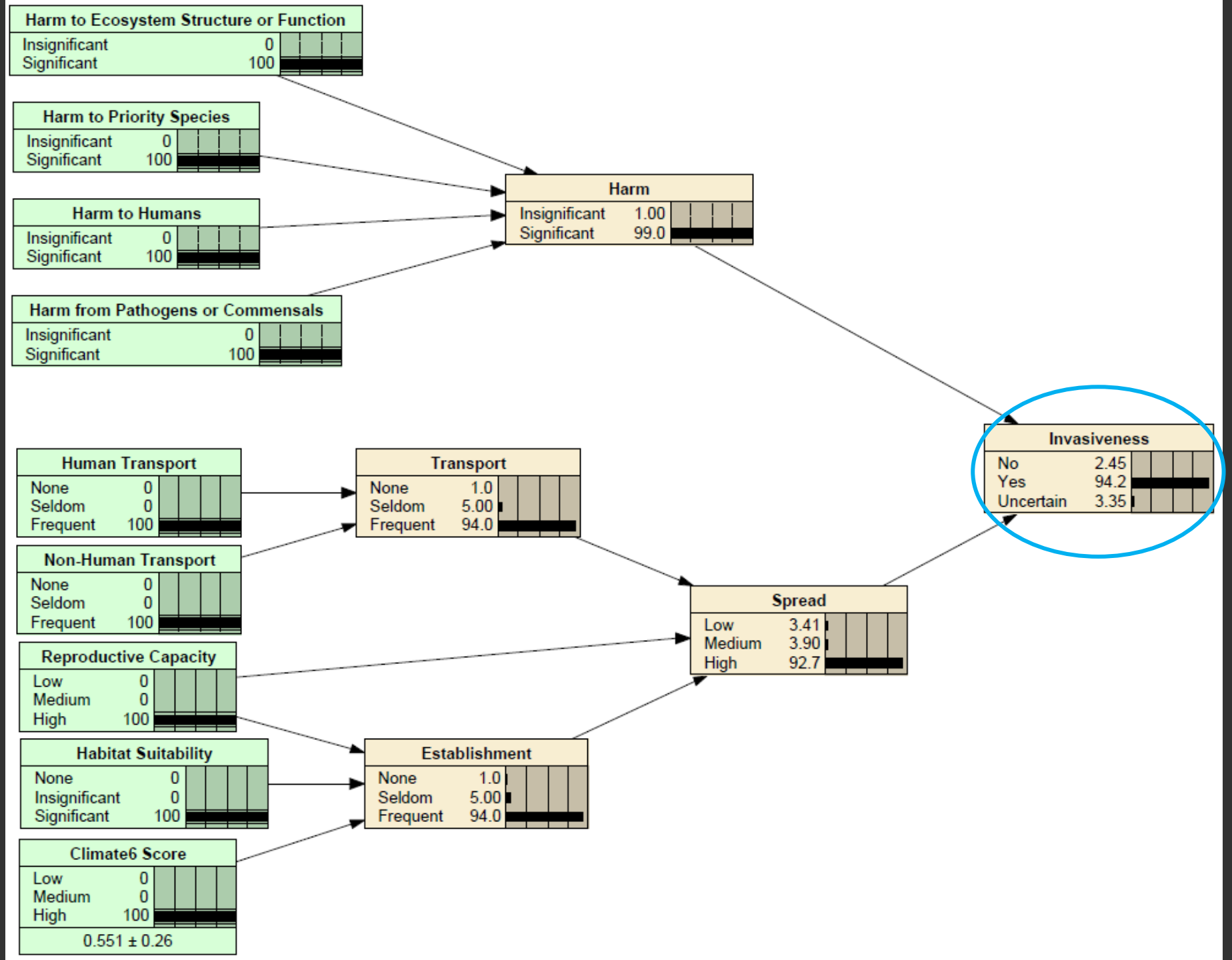


- What nodes are included in the model?
- How are the nodes connected?
- What are the probability distributions behind each node?

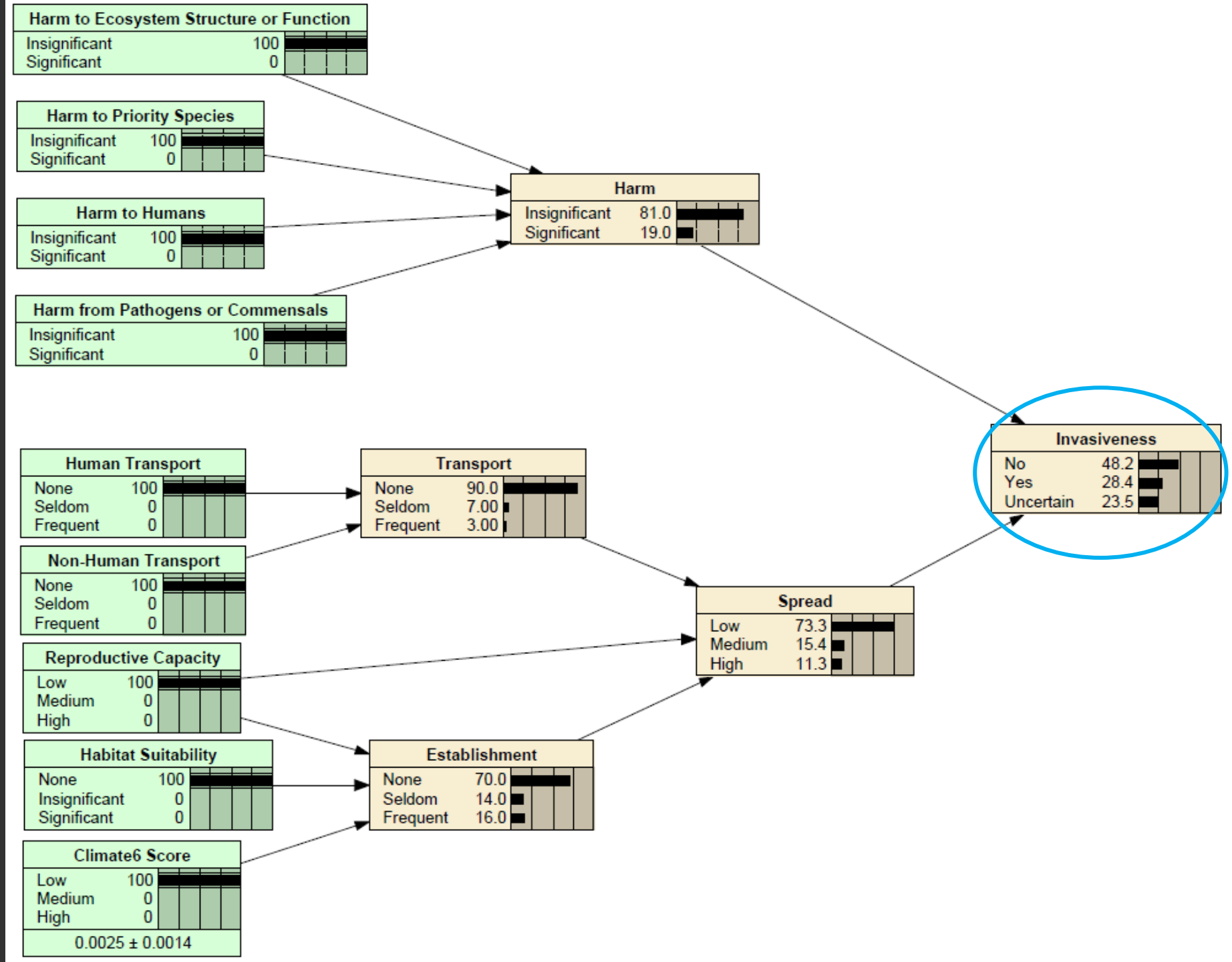

Assemble team of experts
Agree on model inputs
Agree on model structure
Individual estimation of probabilities
Build preliminary probability tables
Train the model using half of cases
Test the model using half of cases
Estimate inputs for crayfish species cases
Source independent classification of outcome for crayfish species cases


Harm to Ecosystem Structure or Function
Harm to Priority Species
Harm to Humans
Harm from Pathogens or Commensals
Harm
Invasiveness
Human Transport
Non-Human Transport
Reproductive Capacity
Habitat Suitability
Climate6 Score
Transport
Establishment
Spread

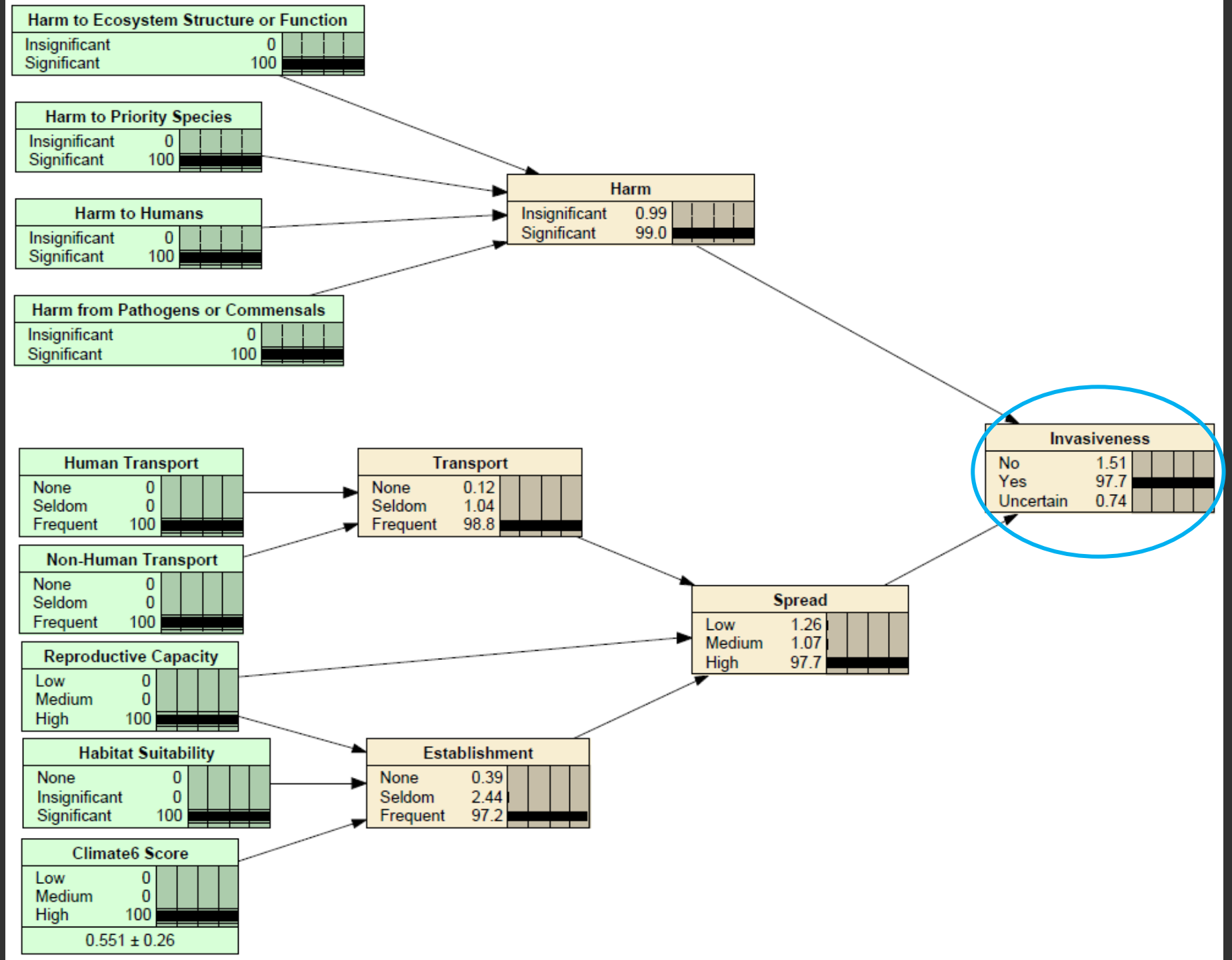
preliminary probability tables



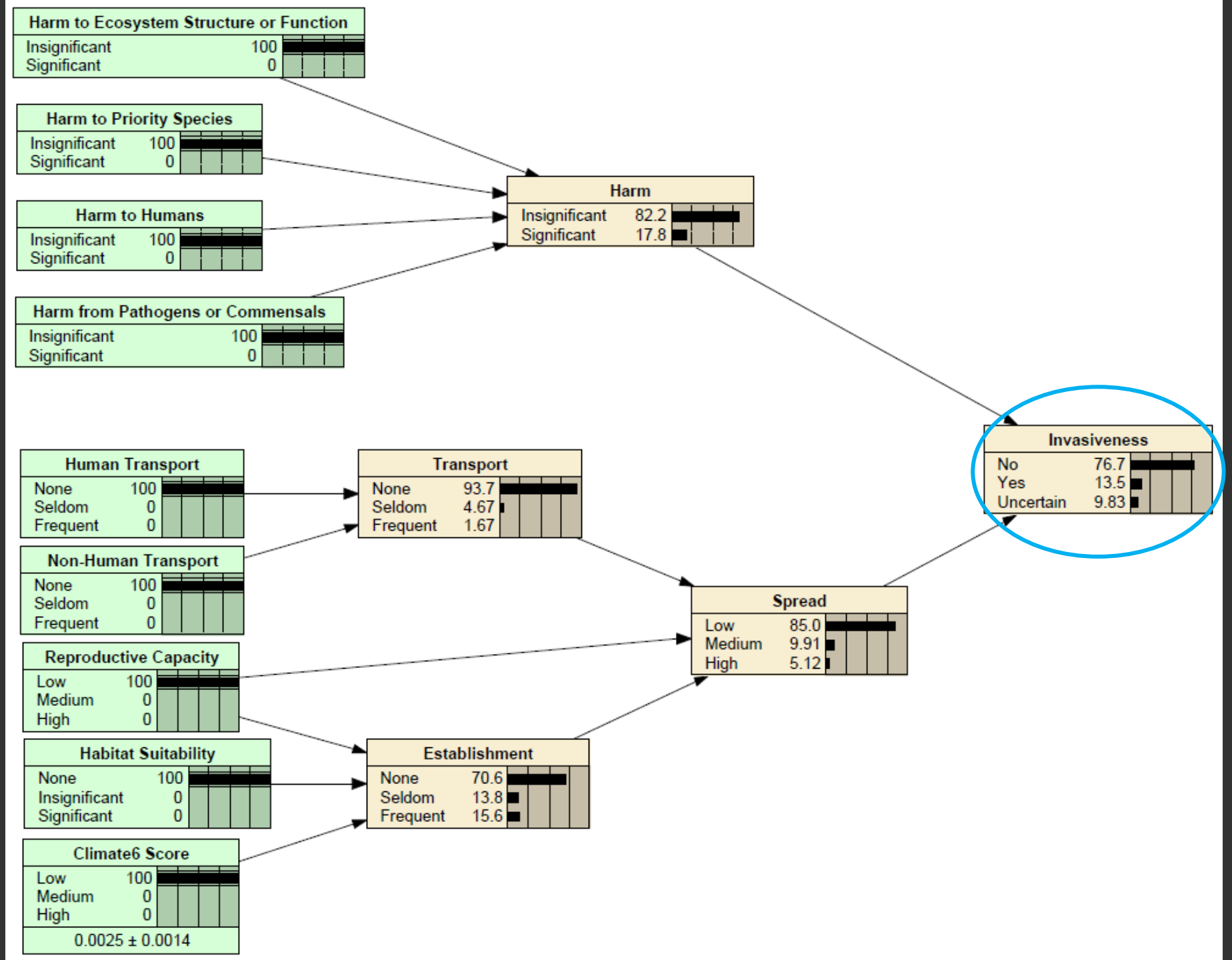
preliminary probability tables



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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