

Causal Modeling of Macro- invertebrate Data

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September 20, 2002
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STARMAP

Project 2: Local Inferences from Aquatic Studies.

Objective 3: Causal Inferences in Ecological Data.

- Bayesian Belief Networks
- The MAHA-MAIA Data
- Some Open Issues

Bayesian Belief Networks (BBN)

A BBN is a **D**irected **A**cyclic **G**raph or DAG
(Lauritzen 1982, Pearl 1985, 1988).

- Express conditional independence relationships between random variables
- Allow for (simplified) factorization of joint probability distributions
- Links between variables are “causal” (really, “influential”)

- Intuitive structure for thinking about ecological systems (e.g., Lee, 2000; Haas, Mowrer & Shepperd 1994)
- Expert opinion incorporated
 - inclusion/exclusion of nodes
 - connections between nodes
 - specification of conditional probabilities
- Strength of evidence considered probabilistically (Lauritzen, 1995).
- Software for discrete node BBN (Hugin Expert ©; <http://www.hugin.com/>).

The MAHA-MAIA Data

Macro-invertebrate index of biotic integrity:
BUGIBI

Variable	Description	Levels
AGRIC	% Agriculture	Low, Med, High
URBAN	% Urban	Low, Med, High
MINE	% Mining	Low, Med, High
RPCON	Riparian Condition	Poor, Med, Good
CHSED	Channel Sediment	Poor, Med, Good
NUTRIENT	Nutrient Quality	Low, Med, High
ACIDDEP	Acid Rain	Low, Med, High
ACIDMINE	Mine Drainage	Low, Med, High
BUGIBI	Benthic IBI	Poor, Fair, Good

Several directed acyclic graphs inserted here.

“AGBAN”—a combination of percent agricultural and percent urban:

Level	Description
LL	Low Ag, Low Urban
LH	Low Ag, Med/High Urban
ML	Med Ag, Low Urban
MH	Med Ag, Med/High Urban
HL	High Ag, Low Urban
HH	High Ag, Med/High Urban

Another DAG inserted here.

Some Open Issues

- “Independent” root nodes
- Dealing with differences in scale
- Dealing with spatial and serial correlations
- Assessing software

Thanks To:

- Alan Herlihy
- John Van Sickle
- Steve Jensen