Mental Modeler:
Incorporating individual and group stakeholder understanding into natural resource decision-making through a fuzzy-logic cognitive mapping software tool

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Outline

Tell you about it:

• Participatory methods and modeling
• Mental models
• Fuzzy-logic Cognitive Mapping (FCM)
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Pilot Study
• Understanding the production and consumption systems of bush meat in villages near Serengeti National Park
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Seeking feedback
- Your recommendations on changes/additions
- Use in your programs or research?
- Research partnerships
Integrating stakeholder knowledge into decision-making is good!
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A ladder of citizen participation

(Arnstein 1969) citations 6235
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Citizen participation and environmental risk: A survey of institutional mechanisms (Fiorino 1990) citations 669
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Public participation in environmental assessment and decision-making  
(Dietz and Stern 2009) citations 125 National Research Council (NAP)
Two types of participatory tools have emerged to integrate stakeholder knowledge

1. Procedural Tools:
Two types of participatory tools have emerged to integrate stakeholder knowledge

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Stakeholder workshops to collect data that prioritizes values, knowledge, qualitative models (Lynam et al. 2007)
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Examples:

Spider Diagram (Lynam 1999; 2001)
4 Rs framework (Dubois 1998)
Discourse-based valuation (Wilson and Howarth 2002)
Pebble Distribution method (Colfer et al. 1999)
Two types of participatory tools have emerged to integrate stakeholder knowledge

1. Procedural Tools:
Stakeholder workshops to collect data that prioritizes values, knowledge, qualitative models (Lynam et al. 2007) (generally easy to use, capture values and knowledge, flexible, stand-alone data)

Examples:

**Spider Diagram** (Lynam 1999; 2001)

**4 Rs framework** (Dubois 1998)

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**Pebble Distribution method** (Colfer et al. 1999)
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2. Software Tools:
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Stakeholder workshops and individual data collection that represents knowledge, establishes model parameters, and promotes learning (Vionov and Bousquet 2010)
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Examples:

* **Bayesian Belief Networks** (Analytica, Netica, Hugin)
* **System Dynamics** (Stella, Venism, Powerism)
* **Agent-based Models** (NetLogo, StarLogo)
Two types of participatory tools have emerged to integrate stakeholder knowledge

2. Software Tools:

Stakeholder workshops and individual data collection that represents knowledge, establishes model parameters, and promotes learning (Vionov and Bousquet 2010)

(more difficult to use, captures knowledge, but not values, data can be integrated into other datasets)

Examples:

**Bayesian Belief Networks** (Analytica, Netica, Hugin)
**System Dynamics** (Stella, Venism, Powerism)
**Agent-based Models** (NetLogo, StarLogo)
Goals:

- **Represent and standardize** stakeholder knowledge and values in resource decision-making
- **Provide flexibility and ease in** the modeling process
- **Create datasets which can compare and combine** stakeholder understanding and values
- Create datasets which can be integrated with expert knowledge, scientific datasets, and used to test co-developed hypotheses
- **Increase understanding of the structure and function of social-ecological systems**
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Mental Models

Individual perception of complex, dynamic relationships, which are the basis of human understanding and decision-making (incorporate knowledge, values and beliefs) (Craik, 1943; Johnson-Laird, 1983)
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Interviews
Surveys
Discourse Analysis
Concept Mapping
Draw Conclusions about Stakeholder Understanding

**Structural:**
Quantitative measures that determine:
- System composition and important connections
- Most important components
- Driving components and vulnerable components
- Complexity

**Functional:**
Scenario analysis to determine:
- How stakeholders may react to policy options or environmental changes
- How various stakeholder preferences can be met simultaneously
- How groups differ in their anticipated reaction to a proposed policy
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Define relationships between variables in qualitative terms
Hypothetical Example

How will increased gas prices impact recreational fishery systems?
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1. Stakeholders model the resource system
Hypothetical Example

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1. Stakeholders model the resource system
2. Analyze structure

Infer about perceptions of resource systems (Structural Metrics)
Hypothetical Example

How will increased gas prices impact recreational fishery systems?

1. Stakeholders model the resource system
2. Analyze structure
3. Analyze function

Infer about perceptions of resource systems (Structural Metrics)
How will increased gas prices impact recreational fishery systems?
Case Study
Understanding the production and consumption systems of bush meat in villages near Serengeti National Park
Case Study

Understanding the production and consumption systems of bush meat in villages near Serengeti National Park

Ecologically Vulnerable:
- Zebra and wildebeest poaching is illegal
- The relationship between migration and hunting pressure is uncertain and depends on bushmeat trade and environmental conditions

Socially Vulnerable:
- Bush meat consumption is a culturally important source of protein and profit
- No knowledge of how bushmeat travels from food to table
- Social drivers of poaching pressure are unclear
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How can we better understand bush meat consumption and production as a social-ecological issue?
Workshops

11 focus groups with villages ($N = 109$) comprised of former/current poachers, suppliers, bushmeat consumers

- Modeling prod and consumption system
- Mapping hunting areas
- Mapping markets
- Economic contributions
- Hunting behaviors/gear selection
Linking ecological dynamics...
Linking ecological dynamics... ....with social dynamics
Nyamburi Workshop
(9 consumers, 4 hunters, 1 meat/gear supplier)
Structural Analysis:

Social Drivers:
• Low capital to run small business projects
• Unaware/complicated legal hunting procedures
• Lack of employment opportunities in tourism
• Lack of food crops
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Ecological Drivers:
• Flooding
• Sufficient rain fall
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• Low capital to run small business projects
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Ecological Drivers:
• Flooding
• Sufficient rain fall

**Most important variables:**
• Poaching income
• Income generating activities/employment
• Climate change
• Availability of wildebeest and zebra
Functional Analysis:
Increase family-size, village populations,

Data from World Bank 2011
Functional Analysis:
Increase family-size, village populations, and status quo of farmable land

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Functional Analysis:
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Increase family-size, village populations, and status quo of farmable land

- Increase Population
- Increase Family-size
- Maintain agricultural production
Outcomes

Understanding of the linkages between these communities and wildebeest and zebra populations
Understanding social drivers and benefits associated with poaching
Measured variation in understanding across communities
Linking the social-model to expert-based ecological models to understand how communities will be affected by different ecological and policy scenarios
Available Spring 2013
Available Spring 2013

[insert cool looking website here]
Questions for you

Could you use MM in your research projects?

Could you use MM in your applied management projects?

What changes/edits/additions can we make?
Thanks for listening

stevenallangray@gmail.com
Case Study 1
Promoting Community-based coastal storm & climate change adaptation in Hawaiʻi
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*Promoting Community-based coastal storm & climate change adaptation in Hawai‘i*

**Physically Vulnerable:**
- Frequent natural hazards (tsunamis, hurricanes, flooding) expected to increase with climate change
- Infrastructure needs
- Isolated

**Socially Vulnerable:**
- Culturally fragmented:
  - Homeless, native Hawaiian, affluent, tourist, Asian communities with low levels of communication and interaction
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- Homeless, native Hawaiian, affluent, tourist, Asian communities with low levels of communication and interaction

How can we facilitate planning given varied understanding and low social cohesion?
Modeling structure of their community...
...and linking it to these tsunamis, climate change, and flooding events.
Outcomes

Through a series of workshops and model revision allow stakeholders to better anticipate unwanted outcomes
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Through a series of workshops and model revision allow stakeholders to better anticipate unwanted outcomes. Use this new knowledge to develop mitigation plans which decrease unwanted outcomes and compare mitigation plans.
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Through a series of workshops and model revision allow stakeholders to better anticipate unwanted outcomes. Use this new knowledge to develop mitigation plans which decrease unwanted outcomes and compare mitigation plans. Develop and negotiate a shared problem definition by explicitly representing diverse knowledge.