An Overview of the Southeastern Adaptive Management Group (SEAMG)

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Southeastern Adaptive Management Group (SEAMG)

Origin: Created in 2001 as part of an interagency cooperative agreement (USGS, USFWS, Florida FWCC)

Mission: To better integrate research and management to improve natural resource management decisions

Staff: Fred Johnson (USFWS), Franklin Percival (USGS), Bob Dorazio (USGS)

Collaborators:

- Patuxent Wildlife Research Center
- Cooperative Research Units (Univ. Georgia, North Carolina State Univ.)
- Florida Fish and Wildlife Conservation Commission

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This includes development of

- ecological and statistical theory
- analytical and decision-support tools
- institutional arrangements between research and management

Why Integrate?

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- Is inefficient
- May fail to satisfy management objectives if extrapolations between experimental and managed areas are inappropriate

True Integration Between Research and Management

- Management actions themselves provide an opportunity to learn through experimentation
- Management objectives include a compromise between the (possibly) long-term value of learning and the short-term value of achieving more immediate rewards
  - thus, random selection of management actions (purely for the sake of learning) is not always optimal
- Adaptive selection of management actions is based on experience and monitoring (adaptive decision making)

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4. **Repeat** 1–3

There is an iterative updating of beliefs that includes learning from data and making decisions in the presence of uncertainty to achieve the overall management objectives.

An Example: Adaptive Management of Waterfowl Habitat

Year 1: Observe Responses to Management

burn	chop	graze
graze	burn	chop
chop	burn	graze

$\longrightarrow$

y_{11}	y_{21}	y_{31}
y_{41}	y_{51}	y_{61}
y_{71}	y_{81}	y_{91}

Management Actions

$\boldsymbol{X}_1 = (\boldsymbol{x}_{11}, \ldots, \boldsymbol{x}_{91})^T$

Vegetation Responses, $\boldsymbol{y}_1$

Year 2: Use modeling and prediction to evaluate alternative management actions

?	?	?
?	?	?
?	?	?

$\longrightarrow$

Proposed Management Actions

$\tilde{\boldsymbol{X}}_2 = (\tilde{\boldsymbol{x}}_{12}, \ldots, \tilde{\boldsymbol{x}}_{92})^T$

Adaptive Management of Waterfowl Habitat (continued)

Learning (in conjunction with monitoring and modeling)

$$p(\boldsymbol{\beta}, \sigma^2, \rho \mid \boldsymbol{y}_1, \boldsymbol{X}_1) = \frac{f(\boldsymbol{y}_1 \mid \boldsymbol{X}_1, \boldsymbol{\beta}, \sigma^2, \rho)\ \pi(\boldsymbol{\beta}, \sigma^2, \rho)}{\int f(\boldsymbol{y}_1 \mid \boldsymbol{X}_1, \boldsymbol{\theta})\ \pi(\boldsymbol{\theta})\, d\boldsymbol{\theta}}.$$

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Prediction (given what we've learned)

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Optimization (select management actions most likely to achieve objectives)

$$\tilde{\boldsymbol{X}}_2^* = \arg\min_{\tilde{\boldsymbol{X}}_2} \left[\bar{l}(\tilde{\boldsymbol{X}}_2 \mid \boldsymbol{y}_1, \boldsymbol{X}_1) \right]$$

$$\text{where } \bar{l}(\tilde{\boldsymbol{X}}_2 \mid \boldsymbol{y}_1, \boldsymbol{X}_1) = \mathrm{E}_{(\tilde{\boldsymbol{y}}_2 \mid \tilde{\boldsymbol{X}}_2, \boldsymbol{y}_1, \boldsymbol{X}_1)} \left[l(\tilde{\boldsymbol{y}}_2, c) \right]$$

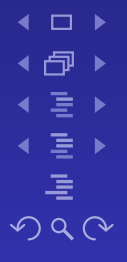
Benefits to Managers

A more systematic/formal approach to decision making

- Finite set of alternative management actions
- Objective function – values the consequences of alternative management actions
  - unambiguously defined
  - may include multiple, competing objectives
- Predictive model(s) – formulate dynamics of the system in terms of quantities relevant to management objectives
- Monitoring program – follows evolution of the system and responses to management

An explicit recognition of uncertainties

A direct linkage between monitoring and research programs



Benefits to Researchers

"Experiments" are conducted over more appropriate temporal/spatial scales by taking advantage of manager's abilities to provide the manipulations

Results are more likely to be relevant

- No extrapolation from experimental to managed areas
- All areas acquire immediate benefits during the experiment

Potential Rewards of Integration are Great, but so is Cost!

Front-end investment and infrastructure

- Assembly of existing information (literature review, databases)
- Analysis of existing data
- Elicitation and valuation of management objectives
  - identification of stakeholders, spatial/temporal scales, etc.
- Development of monitoring and database-management programs

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Adaptive decision making

- Development of models of system dynamics
- Development of analytical and decision-support tools

Close Interaction Between Researchers and Managers is Essential!

Which problems are best suited to a high level of integration between research and management?

Potential criteria:

- Decision making is hampered by lack of information, as opposed to just disagreements or ambiguities in the management objectives
- Ability to develop explicit and measurable set of objectives
- Institutional arrangements exist for decision making
  - especially needed in cases where jurisdictions and authorities overlap
- Number management actions is sufficiently small (relative to number of managed areas) so that learning is feasible
- Reasonable control over management actions

Contributions to the Theory and Practice of Adaptive Resource Management

(http://cars.er.usgs.gov/SEAMG/seamg.html)

Publications

- Johnson, F. A., Kendall, W. L., and Dubovsky, J. A. 2002. Conditions and limitations on learning in the adaptive management of mallard harvests. Wildlife Society Bulletin 30, 176–185.
- Runge, M. C. and Johnson, F. A. 2002. The importance of functional form in optimal control solutions of problems in population dynamics. Ecology 83, 1357–1371.
- Dorazio, R. M. and Johnson, F. A. 2003. Bayesian inference and decision theory – a framework for decision making in natural resource management. Ecological Applications 13, 556–563.

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Work in progress

- Adaptive management of shorebirds in the Atlantic flyway
- Adaptive management of scrub jays in Merritt Island, Florida
- Objective-based vegetation management
- Simulation-based approaches for computing an optimal sequence of adaptive management decisions
- Adaptive decision-making in the conservation of endangered species (Okaloosa darter, Florida manatee)