**Multi-objective Conservation Planning: Prototyping a strategic decision framework for aquatic species conservation**

**PRINCIPAL INVESTIGATORS:**

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**BACKGROUND:**

Planning conservation to address landscape and climate change has been impeded by the complexity of the decisions planners must make. There is more than just the decision of conservation or management actions (e.g., restoring habitat, protecting areas, reducing anthropogenic mortality) – although, these decisions on their own are complex problems (e.g., Bonnot et al. 2013). Rather, a quick reflection of additional questions planners likely ask includes: how can a single strategy be identified when there are multiple possible future outcomes? How do we decide which management action or portfolio of actions is the best for all species when different species will likely have conflicting responses to each action?

To answer these questions in aquatic systems, the Gulf Coastal Plains & Ozarks (GCPO) Landscape Conservation Cooperative needs bring together the elements of conservation decisions into a framework that allows adaptive learning and strategic action. The decision elements include: a defined problem, a clearly stated set of fundamental and mean objectives, and evaluation of conequences and tradeoffs. Successful natural resource decision making processes also incorporate an assessment of baseline conditions; current and future stressors; a set of potential management actions (i.e., decisions); and formal linkages between conditions, actions and biological responses (i.e. a model). Structured decision making (SDM) offers a formal framework for combining these elements in a way that allows decision makers to make choices based on a clear understanding of uncertainties and tradeoffs (Gregory et al. 2012, Gregory and Long 2009, Conroy and Peterson 2013). The SDM framework has 3 elements: 1) an objective, 2) decision alternatives that can achieve the objective, and 3) a model that represents how decision actions will or will not achieve obejctives (Conroy and Peterson 2013). This framework has proved useful for simplifying the complexity of conservation decision making by providing planners a structured way to compare the alternative conservation scenarios or management decisions on multiple species given landscape change uncertainty and stakeholder objectives and values, while being confident that the important ecological and population processes are captured in each outcome.

**APPROACH:**

The general approach of this project will be to coordinate with GCPO staff and partners to prototype an adaptive decision framework that incorporates potential future changes into current aquatic management decisions. Key to development of this prototype will be identification of stakeholders to create a core technical advisory team made up of a mix of planners, managers and researchers to represent the diversity within the GCPO. The core team will fill the role of the decision makers by helping to frame the problem, constrain the spatial extent and grain, define objectives and measures of performance, and identify a set of competing conservation strategies for evaluation. The PI will hire a postdoc and together will facilitate meetings of the core team and develop a set of analytical tools (e.g. species distribution models) that estimate the likelihood of success of potential conservation strategies.

Specific objectives are to:

1. Identify 2-5 species for each inland freshwater aquatic system system listed in the Integrated Science Agenda (6-15 total). Species will be selected based on a set of criteria identified by the core team that includes how well the species represents the habitat system, data availability and other factors.
2. Adapt existing or develop new models for selected species that link objectives and performance measures (response variables) to current & potential future habitat conditions.
3. Identify current conservation strategies intended to meet desired endpoints for focal wildlife species in the GCPO.
4. Facilitate the identification of additional new conservation strategy alternatives intended to meet desired endpoints for focal wildlife species in the Gulf Coastal Plains & Ozarks region under land use change. Scenarios will likely be habitat based, but could include other approaches (e.g. policy).
5. Identify tradeoffs among strategy alternatives in terms of likelihood of success (or risk reduction) and stakeholder values.

**TIMELINE:**

We will begin work January, 2017, and proceed for at least 2 years depending on available funding.

Year 1 milestones:

1. Stakeholder anlaysis
2. Initial stakeholder workshop (2 days) to frame problem, spatial extent and grain, fundamental and means objectives, and alternative conservation strategies
3. Progress towards objectives 1-4 above
4. Development of prototype decision support framework
5. 1-2 additional Stakeholder meetings to refine framework and objectives
6. Documentation of process and objectives for future publication

Year 2 milestones:

1. Continued documentation of process and objective
2. Continued progress towards objectives 1-4 above
3. Analyses to meet objective 5, evaluation of strategy alternatives
4. Final documentation report and drafts of scientific publications

**POTENTIAL PRODUCTS:**

* A scientific publication detailing the pros and cons of various modeling approaches being used in the GCPO region to link species to habitat conditions, and a set of recommended modeling approaches or discussion about using multiple models to incorporate system uncertainty, if apporpriate.
* A report describing:
  + A revised list of aquatic species/guilds/communities for the GCPO’s Integrated Science Agenda that prioritizes them for modeling (i.e. which do we include in the framework first).
  + A set of biological objectives (habitat + species) for the aquatic systems of the GCPO.
  + A set of potential adaptation strategies for managers in the GCPO to consider implementing.
* A set of spatially explicit maps of projected climate- and landscape change, simulated conservation activities, and resulting biological response of the aquatic system. This output will vary in spatial resolution, most likely providing predicted aquatic system responses at the watershed level, but also providing predictions at the steam and stream reach level if reasonable predictions can be made at finer spatial scale. A prototype modeling framework that the GCPO and its partners can use to evaluate decisions moving forward. It is envisioned that the prototype can be built upon by adding additional aquatic species/guilds/communities &/or other objectives (e.g. water quality).
* A scientific publication documenting the approach, results, and synthesis that provide strong scientific support for management decisions based on the results. The publication will also serve to demonstrate this approach to other regional partnerships so that they may consider it in the future.

**BUDGET:**

Total budget for this work is $160,000 over 2 years ($80,000 per year).

**Budget Justification:**

* Salaries, wages, and fringe benefits:

Postdoctoral student salary ($47,500 x 2 years) $95,000.00

Fringe benefits (35.96%) $34,162.00 ***Total $129,162.00***

* Travel: 572 miles to Columbia, MO 4/year

Mileage 1150 miles x 0.23/mile x 3 trips in 2016, 2 in 2017 $1322.50

Hotel (91 x 2 people x 2 nights x 5 trips) $1230.00

Meals (41/day x 2 people x 3 day x 5 trips) $1820.00  
 ***Total $4372.50***

* Supplies:

Computer and software $1200.00

* Contractual

Publication costs $1500.00

* Project costs

Project cost $136,234.50

Indirect cost(17.5% CESU) $23,841.04

***Total cost $160,075.54***

**LITERATURE CITED:**

Bonnot, T. W., F. R. Thompson III, J. J. Millspaugh, and D. T. Jones-Farrand. 2013. Landscape-based population viability models demonstrate importance of strategic conservation planning for birds. Biological Conservation 165:104-114.

Conroy, M. J., and J. T. Peterson. 2013. Decision making in natural resource management: a structured, adaptive approach. Wiley-Blackwell, West Sussex, UK..

Gregory, R. D., L. Failing, M. Harstone, G. Long, T. McDaniels, and D. Ohlson. 2012. Structured decision making: a practical guide to environmental management choices. Wiley-Blackwell, West Sussex, UK.

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