CCSF Lunch Summary – 27 August, 2008

Adaptively Managing for Sustainable Resource Use: Challenges and Opportunities

Attending:

Evan Cooch (Host)
Jon Conrad
Richard Stedman
David Dieterich
Jery Stedinger
Anurag Agrawal
Ani Guerdjikova
David Shmoys
Dan Decker
Paul Curtis
Cliff Kraft
Bernd Blossey
Mark Lewis
Frank DiSalvo
Chris Barrett

Regrets

Steven Wolf
Alexander Schied
Carla Gomes
Joe Halpern

I would like to thank the CCSF for sponsoring the 'lunch' series – the informal setting for presenting and discussing several ideas was very enjoyable, and I appreciated the opportunity to engage old and new colleagues alike in a very interesting discussion.

Following a short presentation which outlined the basic paradigm of 'adaptive management' (optimal structured decision making under uncertainty), we had a lengthy group discussion concerning both the technical challenges of implementing adaptive management, and the clear opportunities for cross-disciplinary work, especially with the recently funded initiative in 'Computational Sustainability'. The basic premise of adaptive resource management (ARM) is that it represents a science-based formalism to make optimal decisions under uncertainty, to reach one or more specific sustainability objectives, while simultaneously serving to reduce that uncertainty in the process. All sustainability 'problems' are embedded into systems – typically dynamic and complex – which are subject to various sources of uncertainty. ARM proposes a sequential series of steps which allow us to explicitly account for these uncertainties, and make the best decisions we can under those circumstances. Thus, there is perhaps a reasonable argument to make that ARM might be a general framework for addressing actions intended to lead to sustainable resource use over some specified time horizon. While this might suggest the ARM should be fairly widely adopted as a starting point for a lot of sustainability initiatives, implementation in practice has been somewhat sporadic. In large part, that is because fully specifying the uncertainty in many cases is very complicated, as is the optimization of the decision space under whatever specification is used. The bounds of the uncertainty problem bridge multiple disciplines – statistical and mathematical, computational, operations research, social science, economics – the participants in the lunch represented this diversity.

Our initial interests in the larger problem of how to usefully and efficiently implement ARM in a sustainability context focused on 3 points: 1. the characterization of uncertainty for a high-dimensional system state, where one or more states may be at best only partially observable (in

particular), and how to accommodate 'surprise' (in the information theory context), and dynamically changing parameterization for the model(s) used in the decision-making process. 2. given the specification of the objective, and the state of the system, how to derive the optimal or near-optimal solution to the problem. 3. the very difficult problem of uncertainty in implementation of management decisions (optimal or not) via human agents (the problem of partial controllability). However, the 'arrival' of the new program in 'Computational Sustainability' in fact (i) eliminated the need for our project to focus any energy and funds explicitly on the technical optimization problems (2), since that is what that program is intended to address, at a very high level. In fact, this creates an exceptional opportunity for us, since the presence of the 'Computational Sustainability' program allows us to expand our focus on the specification of the uncertainty, and creates a natural synergy, and indeed a 'critical mass', whereby we work on the uncertainty side of the problem, and partner with the 'Computational Sustainability' program to fully explore the optimization problems under those uncertainties. A significant proportion of our discussion was focused on delineating this natural partnership, and specifying the elements of the larger 'ARM' initiative which would be the focus of our research proposal. The lunch precipitated several follow-up meetings between some of the principals from our group and several of the PI's of the 'Computational Sustainability' program – some of whom have agreed to serve as co-PIs on this project, if it is supported (in point, indicating the clear connections between the two groups). In addition, it was clear that there were natural avenues for collaboration with a number of other Departments – in particular, Sociology, and Economics.

We also had a good discussion concerning empirical 'test' opportunities. While the exploration of various ideas 'in theory' is not without some intellectual appeal, the larger intent of sustainability research achieves some extra 'gravitas' via 'proof on concept' – meaning, empirical testing and demonstration. Several individuals representing field programs that are subject to active management were represented at the lunch. We had useful discussions about the different attributes of each study, and time-frames under which actual field experiments could be considered (although we acknowledge that adaptive management is implemented on a time scale well beyond possible CCSF funding cycles – our objective is to lay the groundwork for some empirical tests, which would likely commence after the CCSF funding cycle was completed).

We concluded with some discussion of subsequent funding opportunities. CCSF funding is clearly intended as 'seed' funding. We discussed leveraging CCSF funding to pursue two primary funding opportunities: (i) *Federal & State – agency based*: To date, Federal and State agency funding for research on adaptive management has been minimal, and sporadic (at best). However, the DOI and its subordinate agencies, specifically the USGS and USFWS, have explicitly identified structured decision making under uncertainty as a priority research and policy initiative for all future management and research programs under its auspices. Federal funding will initially occur via matching support funds through the state-based Fish & Wildlife Cooperative Research Units (the NY Unit is based in the Department of Natural Resources at Cornell). A key element of this plan involves a partnering arrangement between Federal and State agencies, and specific research universities. The CCSF and the 'Computational Sustainability' initiatives will place Cornell in a very strong position to be one of the partnering institutions. (ii) *Federal Funding – sponsored programs*: USDA, EPA and NOAA provide a number of competitive research grant opportunities in this area. Our prior applications have been generally well-received (excellent reviews, all positive except final recommendations), but were ultimately not funded, primarily because of lack of a strong empirical component to the research (proposals focused on technical, conceptual problems) – this is an area we will specifically target in the current proposal, with the explicit intent to leverage identification and (in some instances) preliminary empirical analysis with revised proposals.