

## 1. ADMINISTRATIVE:

### **Project title: Communicating and Using Uncertain Scientific Information in the Production of 'Actionable Science'**

Principal investigator (PI): Dr. Brian Irwin  
Georgia Cooperative Fish and Wildlife Research Unit  
Warnell School of Forestry and Natural Resources  
University of Georgia  
180 E. Green St.  
Athens, GA 30602  
p: 706-542-0790  
f: 706-583-0997  
e: irwin@uga.edu  
e: bjirwin@usgs.gov

#### Names/Affiliations of other cooperators and partners:

Dr. Clint Moore, Georgia Cooperative Fish and Wildlife Research Unit  
Dr. Meredith Gore, Department of Fisheries & Wildlife and School of Criminal Justice,  
Michigan State University

Agreement number: G12AC20364  
Date of report: August 2016  
Period of performance: 07/23/2012 – 12/31/2015  
Actual cost: \$38,311.76

## 2. PUBLIC SUMMARY:

Conservation practitioners must navigate many challenges to advance effective natural-resource management in the presence of multiple uncertainties. Numerous climatic and ecological changes remain on the horizon, and their eventual consequences are not completely understood. Even so, their influences are expected to impact important resources and the people that depend on them across local, regional, and sometimes global scales. Although forecasts of future conditions are almost always imperfect, decision makers are increasingly expected to communicate and use uncertain information when making policy choices that affect multiple user groups. The degree to which management objectives are met can depend on 1) how critical uncertainties are identified and accounted for, and 2) effective communication among user groups, scientists, and resource managers. The objective of this project was to help facilitate strategic decision support and synthesize the state of the science related to communicating and using uncertain information in conservation decision making. By providing a forum on the communication of scientific uncertainty, we traversed traditional disciplinary boundaries, with a focus on climate change in the southeastern United States. We hosted a workshop, which included scholars and practitioners from a variety of fields, produced numerous presentations and a fact sheet to assist resource managers in making decisions in the presence of uncertainty.

### **3. TECHNICAL SUMMARY:**

The goal of this project was to help facilitate strategic decision support and synthesize the state of the science related to communicating and using uncertain information in conservation decision making. To meet this goal, we held an interdisciplinary workshop early in the project, contributed to multiple sessions at subsequent professional conferences, and prepared a completed peer-reviewed manuscript and one draft manuscript as well as a fact sheet. These events and products are described in subsequent sections.

### **4. PURPOSE AND OBJECTIVES:**

As stated above, the overarching objective of this project was to help facilitate strategic decision support and synthesize the state of the science related to communicating and using uncertain information in conservation decision making. The objective of the project workshop was to identify research and strategic-planning needs for effective delivery of regional conservation policy, with an emphasis on providing science-based decision support in the presence of uncertainty and climate change. Registrants for the workshop were affiliated with Universities and both federal and state agencies (incl. Climate Science Centers and the Peninsular Florida LCC; see appendices).

### **5. ORGANIZATION AND APPROACH:**

List of completed tasks:

- A UGA account number was generated (Dec. 2012).
- Human-subjects training was completed by project PIs and graduate student. An application was submitted to the UGA Human-subjects office, and approval was obtained.
- A conference call (including SE CSC, LCC, and project personnel) regarding the workshop topics and potential invitees was held (Jan. 2013).
- On-campus facilities were reserved for the 1.5 day workshop.
- A workshop announcement and a workshop registration form were broadly circulated, including directed emails to multiple LCCs (including Jean Brennan, Bridgett Costanzo, Ken McDermond, Rua Mordecai, Tim Breault, Greg Wathen, and John Tirpak).
- A project workshop, titled Communicating and Using Uncertain Information in Conservation Decision Making, was held during 27-28th February 2013 on the campus of the University of Georgia. The plenary session included two presenters – Drs. J. Marshall Shepherd and Michael Runge. These presentations were open to the broader community, and both talks were recorded and uploaded to the web: <http://www.warnell.uga.edu/news/index.php/2013/02/communicating-and-using-uncertain-information-in-conservation-decision-making/>. The workshop consisted of four sessions: 1) problem scoping; 2) definitions and treatment of uncertainty; 3) the role of science in decision making; and 4) developing recommendations. Workshop activities took place at the Miller Learning Center

(<http://mlc.uga.edu>) and the UGA Hotel and Conference Center (<http://www.georgiacenter.uga.edu/uga-hotel>).

- Travel reimbursements were processed for workshop attendees and thank-you letters sent to plenary presenters.
- A final summary of the workshop was produced and included contact information for the registrants, abbreviated interests for the attendees, and a compiled list of relevant references.
- In addition to the workshop and plenary sessions, we attempted to circulate information related to this project through publications and multiple presentations (detailed in section 10 below).

Graduate education:

In total, 3 graduate students received partial support from this project during their PhD studies at the University of Georgia.

- Aneela Qureshi, Department of Geography (Advisor: J. Knox); assisted with workshop
- Tara Gancos Crawford, Warnell School of Forestry and Natural Resources (Advisor: C. Moore); assisted with fact sheet
- Brian Crawford, Warnell School of Forestry and Natural Resources (Advisor: J. Maerz); assisted with fact sheet

## **6. PROJECT RESULTS:**

Overall, we believe that we were successful at advancing a decision-analytic perspective within the conservation community to support delivery of effective conservation in the face of uncertainty, thus meeting the overarching objective of this project. However, challenges were encountered during this effort, largely due to the 2013 U.S. Government Sequestration (and the subsequent federal government shut-down), which interfered with the travel ability of multiple workshop participants, just prior to the workshop. Also, Dr. Irwin was not able to provide an invited conference presentation due to the sequestration.

## **7. ANALYSIS AND FINDINGS:**

This project did not include a formal analytical component.

## **8. CONCLUSIONS AND RECOMMENDATIONS:**

We find that uncertainty is always present in conservation and other socio-ecological decisions, which can make choices uncomfortable and challenging. Yet, all choices have consequences – including the choice to do nothing. Decision makers appear interested in tools that can formally account for known uncertainties when evaluating management alternatives. We have produced a fact sheet that discusses the pervasiveness of uncertainty, the importance of understanding varying perceptions of uncertainty, and avenues for progress in the presence of uncertainty and differing risk tolerances. Although the focus of the project workshop was not manuscript development, we were able to coordinate and produce a multi-authored draft

manuscript after the workshop, which included involvement from several of the attendees.

In terms of future recommendations, a potential organizational approach to use in other synthesis-style projects could be to base group interactions around co-development of simultaneous contributions to a journal special issue, particularly if manuscript development is a primary objective and the scientific literature has the appropriate audience for disseminating findings and interpretations. For instance, during this project, PI Irwin was able to contribute to a special issue for the American Fisheries Society's *Fisheries* magazine about the effects of climate change on North American inland fishes:

<http://fisheries.org/special-issue-on-climate-change-and-inland-fisheries-july-2016/>

<http://www.tandfonline.com/doi/abs/10.1080/03632415.2016.1187011>

<https://www.usgs.gov/news/hot-water-climate-change-affecting-north-american-fish-1>

His contributions to this special issue were related to the topics of this project. In order to produce this special issue, an expert panel was invited to Bozeman, MT, with an expectation to prepare draft manuscripts by the completion of the workshop.

## **9. MANAGEMENT APPLICATIONS AND PRODUCTS:**

See included appendices for the workshop announcement, an advertisement for the plenary session, a list of workshop participants and their affiliations, and a handout copy of a project poster. Presentations and publication products are listed below.

## **10. OUTREACH:**

Funding was acknowledged in the following presentations:

- Irwin, B. J. 2013. Virtual-world management strategy evaluation and real-world conservation. Center for Integrative Conservation Research / Interdisciplinary Conservation Seminar Series, University of Georgia, Athens, GA.
- Qureshi, A. L., B. J. Irwin, and M. L. Gore. 2014. Challenges and opportunities for communicating climate change information across a "consensus gap". American Meteorological Society Meeting, Atlanta, GA. [IP-049677]
- Irwin, B., C. Moore, M. Gore., and A. Qureshi. 2014. Communicating and using uncertain scientific information in the production of 'actionable science'. Grand Opening of the South East Climate Science Center, Raleigh, NC. [poster (no abstract)]
- Irwin, B. 2014. Using quantitative models to support decision making. School of Fisheries, Aquaculture and Aquatic Science. Auburn University, Auburn, AL.
- Irwin, B. 2014. Using uncertain information in conservation decision making – Great Lakes fisheries management. North Carolina State University – Southeast Climate Science Center Global Change Fellows Seminar. North Carolina State University, Raleigh, NC.
- Irwin, B., and T. Vidal. 2015. Accounting for variability & uncertainty when informing natural resource management. NE Climate Science Center webinar, University of Massachusetts, Amherst, MA.

- Irwin, B., T. Vidal, B. Crawford, T. Gancos Crawford, and C. Moore. 2016. Quantitative consideration of uncertainty and variability in decision analysis for conservation and management of ecological systems. Annual meeting of the Ecological Society of America, Fort. Lauderdale, FL. [IP-073549]

Funding support was acknowledged in the following peer-reviewed publication:

- Irwin, B. J., and M. J. Conroy. 2013. Consideration of reference points for the management of renewable resources under an adaptive management paradigm. *Environmental Conservation* 40:302-309. doi:10.1017/S0376892913000222. [IP-041381]

An additional manuscript was assembled following the workshop and submitted to *Conservation Biology*, but declined without review. It currently remains in draft form:

- Irwin, B. J., P. S. Hart, D. M. Wald, M. L. Gore, C. T. Moore, M. C. Runge, J. M. Shepherd, G. McMahon, A. Lascurain, M. Ratnaswamy, M. D. Staudinger, A. R. Holland, T. L. Morelli, P. Knox, A. L. Qureshi, and Z. Ma. Using Climate-Change Information in Conservation Decision Making.

A peer-reviewed fact sheet was completed and is available in both electronic and hard-copy forms:

- Irwin, B., B. Crawford, T. Gancos Crawford, and C. Moore. 2016. Turning uncertainty in useful information for conservation decisions. Southeast Climate Science Center Fact Sheet 2016-02. [IP-070398]

[https://globalchange.ncsu.edu/secsc/wp-content/uploads/SECSC\\_FactSheet\\_2016\\_02\\_Final.pdf](https://globalchange.ncsu.edu/secsc/wp-content/uploads/SECSC_FactSheet_2016_02_Final.pdf)

## **11. List of Appendices:**

1. Workshop announcement
2. Workshop plenary poster
3. Workshop participants
4. Project poster

# WORKSHOP ANNOUNCEMENT

## Communicating and Using Uncertain Information in Conservation Decision-Making

**Purpose:** The objective of this workshop is to identify research and strategic-planning needs for effective delivery of regional conservation policy, with an emphasis on providing science-based decision support in the presence of uncertainty and climate change. Participants may expect to interact within an interdisciplinary forum to share insights for communicating scientific uncertainty and making policy choices under a changing climate.

**Target Audience:** Natural-resource managers, decision makers, steering-committee members, outreach & extension agents, researchers, instructors, and communicators working in the areas of accounting for uncertainty within a decision-making context and conservation in the face of climate change, particularly in the southeastern United States.

**Dates:** 27–28 February 2013 (see draft agenda)

**Location:** University of Georgia, Athens, GA 30602

**Sponsor:** Southeast Climate Science Center

**Events:** 1.5 day workshop including presentations, special-topic sessions, networking opportunities

### Session Topic Areas<sup>†</sup>

#### I. Climate-change communication at the science-policy interface

- How to identify problems/questions from the decision-maker's perspective
- Cultural attitudes, stakeholder perceptions, and behavioral changes in response to climate change
- Identifying disconnects between science and policy
- Outreach opportunities for communicating uncertainty in climate-change predictions
- Political dimensions of climate-change uncertainty

#### II. Decision-making with imperfect information

- Treatment of uncertainty & why does it matter
- Structured Decision Making; development of decision-support tools
- Methods for accounting for uncertainty in forecasting models
- Evaluating tradeoffs in an uncertain future
- Prioritizing work under uncertainty

#### To Register:

- For more information please see the workshop's registration form
- All workshop participants must register in advance
- No registration fee
- Only a limited number of spaces available

**\*\*\* We have the ability to provide some financial support for travel and lodging expenses for a few workshop participants. \*\*\***

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<sup>†</sup> Topic areas will continue to be refined as the workshop agenda is further developed

## Workshop Agenda (draft):

Day	Date	Where	Activity	Time
Tuesday	26 Feb 2013		Travel (if needed)	
Wednesday	27 Feb 2013	HCC	Workshop registration	12:00 pm -1:00pm
		MLC	Workshop begins	1:30 – 2:30 pm
		MLC	Plenary session (open to campus)	2:30 – 5:00 pm
			Dinner (provided)	6:30 – 7:30 pm
			Downtown Athens	7:30 pm –
Thursday	28 Feb 2013	HCC	Breakfast (provided)	8:00 am – 9:00 am
		HCC	Session 1	9:00 – 12:00 pm
		HCC	Lunch (provided)	12:00 – 1:00 pm
		HCC	Session 2	1:00 – 4:00 pm
		HCC	Discussion of next steps	4:00 – 5:00 pm
Friday	1 Mar 2013		Travel (if needed)	

### Contacts:

Brian Irwin  
GA Cooperative Fish and Wildlife Research Unit  
Warnell School of Forestry and Natural Resources  
University of Georgia  
Athens, GA 30602  
E: [irwin@uga.edu](mailto:irwin@uga.edu)

Aneela Qureshi  
Department of Geography  
University of Georgia  
Athens, GA 30602  
E: [aneelag@uga.edu](mailto:aneelag@uga.edu)

Clint Moore  
GA Cooperative Fish and Wildlife Research Unit  
Warnell School of Forestry and Natural Resources  
University of Georgia  
Athens, GA 30602  
E: [cmoore@warnell.uga.edu](mailto:cmoore@warnell.uga.edu)

Meredith Gore  
Department of Fisheries & Wildlife  
School of Criminal Justice  
Michigan State University  
East Lansing, MI 48824  
E: [gorem@msu.edu](mailto:gorem@msu.edu)

### Links:

#### Travel

Hartsfield/Jackson International Airport (ATL) in Atlanta to Athens –

<http://www.georgiacenter.uga.edu/sites/default/files/uga-hotel-docs-transportation-tip-sheet.pdf>

Megabus – <http://us.megabus.com>

Groome Transportation – <http://www.groometransportation.com/>

Driving directions – <http://www.visitathensga.com/things-to-do/transportation/driving-directions/>

UGA maps – <http://www.architects.uga.edu/maps/current>

#### Other

University of Georgia (UGA) – <http://www.uga.edu>

UGA Hotel and Conference Center (HCC) – <http://www.georgiacenter.uga.edu/uga-hotel>

Miller Learning Center (MLC) – <http://mlc.uga.edu>

Downtown Athens – <http://www.downtownathensga.com>

Southeast Climate Science Center – <http://www.doi.gov/csc/southeast/index.cfm>

# Seminar Announcement

When: **February 27<sup>th</sup>**

Where: **0171 MLC**

University of Georgia

## Communicating and Using Uncertain Information in Conservation Decision Making

**Dr. J. Marshall Shepherd**

**3:00 PM**

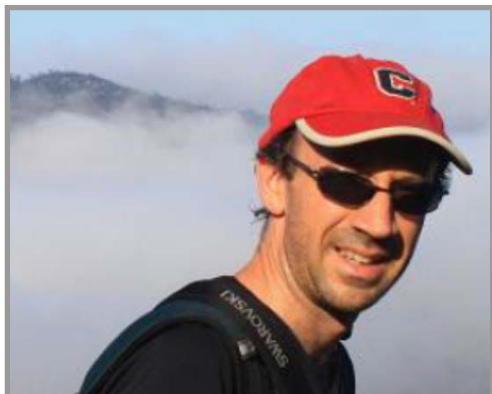


*“Challenges of Communicating  
Uncertainty in Climate Sciences:  
Perspectives from the President  
of the American Meteorological  
Society”*

UGA Department of Geography/Atmospheric Sciences

**Dr. Michael C. Runge**

**4:00 PM**



*“Making Decisions in the Face of  
Uncertainty: Managing Risk  
and Information”*

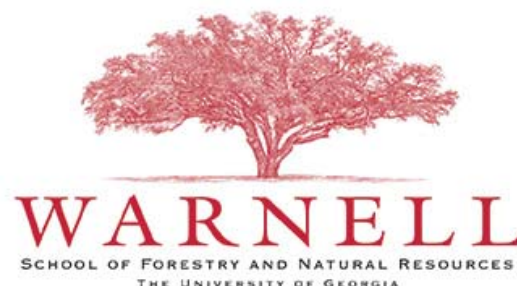
USGS Patuxent Wildlife Research Center

**Sponsored by:**

Southeast Climate Science Center

<http://theglobalchangeforum.org/se-csc>

Georgia Cooperative Fish and Wildlife Research Unit





## Registrant / Participant List

<u>Name</u>	<u>Affiliation</u>	<u>Email</u>
Merryl Alber	UGA (Marine Science)	malber@uga.edu
Jon Ambrose	GA DNR	jon.ambrose@dnr.state.ga.us
Leslie Boby	Southern Regional Extension Forestry	lboby@sref.info
Timothy Breault	Peninsular Florida LCC	timothy_breault@fws.gov
Brian Crawford	UGA (Warnell)	bcrawfor@uga.edu
Eric Darracq	GA DNR	eric.darracq@dnr.state.ga.us
Janice Flory	UGA (Marine Science)	jefflory@uga.edu
Andrea Goijman	UGA (Warnell)	andreapg@uga.edu
Meredith Gore	Michigan State University	gorem@msu.edu
Suzanne Hagell	University of Wisconsin/US FWS	hagell@wisc.edu
Sol Hart	American University	solhart@gmail.com
Addie Rose Holland	NE CSC/UMass Amherst	aholland@geo.umass.edu
Brian Irwin	GA Cooperative Research Unit	irwin@uga.edu
Cassandra Jansch	UGA (Warnell)	cjansch@uga.edu
Pam Knox	UGA (Crop & Soil Science)	pknox@uga.edu
Aranzazu Lascurain	SE CSC/NC State University	alascur@ncsu.edu
Khalil Lezzaik	UGA (Geology)	lezzaikk@uga.edu
Zhao Ma	Utah State University	Zhao.Ma@usu.edu
Jerry McMahan	SE Climate Science Center	gmcmahon@usgs.gov
Clint Moore	GA Cooperative Research Unit	cmoore@warnell.uga.edu
Aneela Qureshi	UGA (Geography)	aneelaq@uga.edu
Ken Reckhow	Cardno Entrix	kenneth.reckhow@cardno.com
Angela Romito	UGA (Warnell)	aromito@uga.edu
Mike Runge	USGS, Patuxent	mrunge@usgs.gov
Colin Shea	Tennessee Tech University	cshea@tntech.edu
Marshall Shepherd	UGA (Geography)	marshgeo@uga.edu
Bruno Takahashi	Michigan State University	btakahas@msu.edu
Adam Terando	NCSU/SE Climate Science Center	ajterand@ncsu.edu
Dara Wald	University of Florida	dwald@ufl.edu

# Communicating and Using Uncertain Scientific Information in the Production of 'Actionable Science'

Project Personnel: Brian Irwin, Clint Moore, Meredith Gore, and Aneela Qureshi

## Premise & Overview:

- Conservation decision makers rely on imperfect information
- Actionable science has the potential to inform decisions, improve implementation of policy, or influence planning (Palmer 2012)
- Collaborative, interdisciplinary approaches to conservation decision making require a different support structure than do efforts traditionally aimed at first improving the state of the science followed by improving the communication of science

## Highlight #2: Decision Analysis

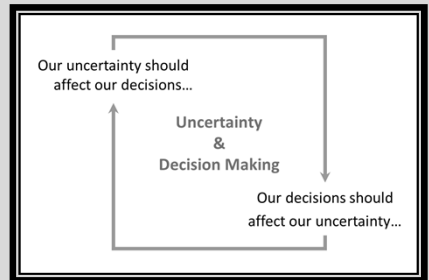
Providing Decision Support for Conservation Delivery

- Focus on objectives – what makes a decision important?
- Formally account for uncertainty
- Consider the value of information
- Proactively consider risks & tradeoffs

**Table 1.** The production of actionable science will likely require confronting several questions, but using decision-analysis tools may help.

### Important Questions to Confront & Corresponding Steps Taken Towards Making Informed Conservation Decisions

- What do we hope to achieve?**
  - Specify objectives
- What can we do about it?**
  - Identify implementable options
- What is likely to happen?**
  - Use models to make predictions
- How certain are we?**
  - Evaluate tradeoffs and risks



**Fig. 3.** Recognition that decision making and treatment of uncertainty can be integrated (Modified from Irwin & Conroy 2013).

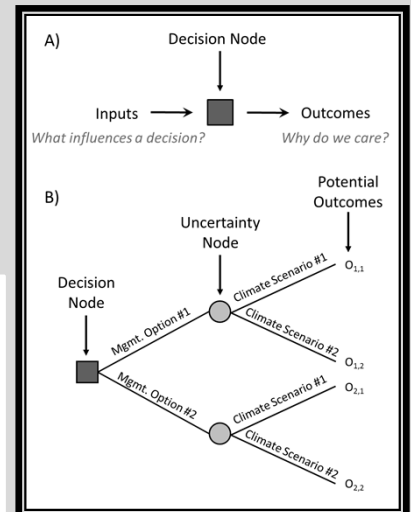
## Highlight #1: Project Workshop

### Communicating and Using Uncertain Information in Conservation Decision Making

- Emphasize interdisciplinary interactions & facilitate decision support
- Recognize that uncertainty is ubiquitous & decisions will still be made

**Fig. 1.** Announcement for plenary session.

**Fig. 2.** Affiliations of workshop registrants.



**Fig. 4.** A) A simplistic representation of how decisions convert inputs to outcomes, where a decision maker's values may determine the relative importance of various inputs, outcomes, and even decisions themselves; and B) a simplified decision tree, where an uncertain state of nature requires consideration of more than one possible outcome for a single decision. The overarching purpose of applying a formal decision-making framework is to find those management options which are likely to achieve specified management objectives.

## References

- Palmer, M.A. (2012). Socioenvironmental sustainability and actionable science. *Bioscience*, 62, 5-6.
- Irwin, B. J., & Conroy, M. J. (2013). Consideration of reference points for the management of renewable resources under an adaptive management paradigm. *Environmental Conservation*, 40(4), 302-309.

For more information see: [theglobalchangeforum.org/projects](http://theglobalchangeforum.org/projects).