FOREST MANAGEMENT ON NATIONAL WILDLIFE REFUGES

8-10 August 2006
Big Oaks NWR, Madison, Indiana

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Fact Sheet
Managing the Forest and the Trees:
A Forest Management Workshop for National Wildlife Refuges

If you could design a research project to address the most pressing forest management issue on National Wildlife Refuges (NWR) in the midwestern and northeastern U.S., what would it look like? That was the question that 39 biologists, managers, and scientists from the Midwest and Northeast Regions of the FWS struggled with for three warm August days at Big Oaks NWR in southern Indiana (2006). The meeting was planned by refuge staff from the two Regions to provide information to USGS about pressing forest management needs in hopes that USGS would initiate new adaptive management research focused on those needs. (USGS plans to issue a call for research proposals on several topics; forest management is one of the topics.) The workshop was part symposium (eight invited speakers provided updates on forest research and management) and part discussions designed to elicit specific information about forest problems and management objectives shared by refuges.

Small group exercises were used to elicit information from Refuge staff about their forest management research needs.

The workshop was preceded by a survey issued to all Refuge System stations in the Midwest and Northeastern Regions. The survey indicated that 68% of refuges responding (63 of 92 stations reporting) own forests; among those, 86% are actively managing their forests. A large proportion of those refuges (41%) manage more than 5,000 acres of forest and 65% manage more than 1000 acres. Refuges are concerned with the overall ecological integrity of their forests as well as with providing habitat for specific focal species. However, almost half (47%) consider their forests to be below average or in poor ecological condition. Clearly, the NWR System is justified in focusing effort on improving the ecological health of its forests and welcomes help from the wider scientific community.

What forest management issues do refuge staff identify as the most challenging? One major issue was a lack of information about how their forests used to function before they were heavily exploited and manipulated. This is a need common to many forest managers! Another was putting the refuge in the context of the surrounding landscape. What should our restoration targets be, based on what we know about the site conditions, how our neighbors and partners are managing their lands, and the priority species identified by both the Service and the wider conservation community? Forests are not static; they proceed through successional cycles. How do you set benchmarks for restoration in a dynamic system? Any long-term management strategies need to consider both natural and human-induced disturbances and how to work with these disturbances to support a multi-aged, diverse forest community. Another difficulty forest managers face is that they rarely live long enough to see the full results of their management actions! Therefore, forest managers need a solid scientific basis for making management decisions and they need to use models to link management actions with desired future conditions. Fortunately, society has invested heavily in silvicultural research, so a lot of information is available to guide management actions. Ferreting out the needed information from this large literature base is usually the biggest problem!

Dr. Joe Robb, project leader at Big Oaks NWR, describes invasive species problems in forests on the refuge.

The biggest potential threats to the forests are invasive species that seem to be growing in number and aggressiveness each year along with more subtle, but significant issues, like subdivision of land

ownership in the northern parts of the Regions where large blocks of forest were once owned and managed by a few timber companies. The issues faced by managers of floodplain forests were somewhat unique. Forest regeneration is a serious problem in floodplain forests because of abnormal hydrological cycles often outside the control of refuge managers (rivers diked and levied for navigation or flood control).

A refuge tour and social held in the evening at Big Oaks NWR allowed workshop participants to share ideas in a relaxed atmosphere. Wayne Brininger is pointing out a Henslow's Sparrow, a high priority bird species that nests at Big Oaks NWR.

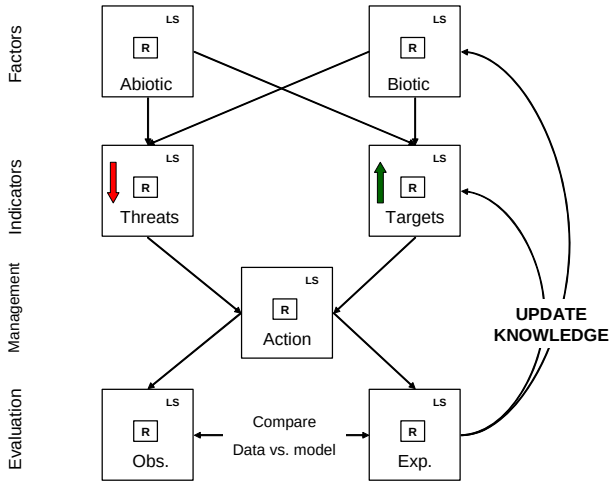
At the end of the workshop, we reviewed our three days of conversations and tried to define what type of research project would help refuges address some of the issues above. Three statements captured our main ideas. Refuges wanted a:

1. Multi-scaled, context-derived project to assess and evaluate landcover and landscape indices, providing a context for an adaptive management study addressing regeneration and invasive species.

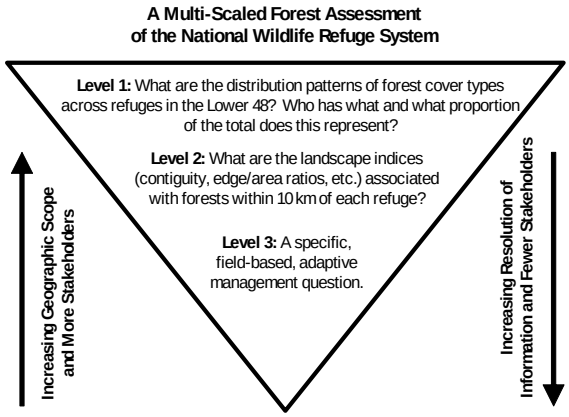
2. Process for maintaining a forest sustainability cycle to achieve ecological integrity, scaled for refuges within a landscape context.

3. Decision-support model to assess a variety of factors for conversion of open areas to desired forest condition (predictive model that leads to forest type and spatial location).

Eric Lonsdorf and Greg Corace offered conceptual models that illustrate how these comprehensive needs can be broken into elements to be worked on separately and then brought together in a synthetic framework:



Londsorf conceptual model of the elements of decision-making for setting land management objectives, at two spatial scales, landscape (LS) and refuge (R). First, map biotic and abiotic factors at the landscape and refuge scales. Then, identify threats and conservation targets at both spatial scales and model how those factors may influence them. From this analysis, several possible management actions are derived. Using adaptive management, implement the preferred action (or decision), compare observed results with expected results, and update knowledge and probabilities of success for future actions or decisions.



Corace conceptual model illustrating a multi-scaled, stepwise approach to addressing forest information needs on refuges. Levels 1 and 2 provide the context; an adaptive management project is Level 3. Level 1 and 2 information is needed first; this information will help to define Level 3 (adaptive management) research projects.

In summary, there was general agreement that just having a conversation about forest management among Refuges and between refuge managers and the scientific community was enormously helpful as a starting point for future collaboration. This was the first multi-Region, multi-disciplinary workshop ever held in the Midwest and Northeast that focused on identifying research needs for forest management on National Wildlife Refuges. We have some work to do; the first step was clarifying the issues and building resolve within the Service and USGS to address them.

WORKSHOP:
FOREST MANAGEMENT ON NATIONAL WILDLIFE REFUGES
Objectives and Agenda

8-10 August 2006
Big Oaks NWR, Madison, Indiana

Workshop Steering Committee Members: Jennifer Casey/R5, Jason Lewis/R3, Karen Westphall/R3, Greg Corace/R3, Timothy Yager/R3, Kathleen Burchett/R3, Thomas LaPointe/R5, Thomas Palmer/R3, Wedge Watkins/R3, Harold Laskowski/R5, Wayne Brininger/R3, Andrew Weik/R5, Stacy Seamans/BRD/USGS, Melinda Knutson/R3, Joe Robb/R3, Richard Speer/R3.

Goal of the Workshop: To clarify forest management research needs that could be incorporated into a multi-refuge adaptive management project, a collaborative project between USGS and FWS (see Appendix A).

Objectives of the Workshop:

1. Gain an understanding of the current status of forest management on refuges.
2. Review the science of forest management on conservation lands.
3. Increase understanding of how adaptive management and modeling can be applied to improve forest management on refuges.
4. Inform the call for proposals from USGS and set the stage for designing an adaptive management research project.
    a. Define problem(s) and identify threats with regard to forest management on refuges.
    b. Identify information needs for setting or achieving forest management objectives on refuges; identify obstacles that make it difficult to set or achieve management objectives.
    c. Use Refuge Management Scenarios to share ideas and explore the thought process that is required for setting measurable forest management objectives (desired future conditions) and identify metrics that could be monitored by refuges.
    d. Use a Regional Forest Management scenario to share ideas for setting measurable *Regional* forest management objectives (desired future conditions) for the Refuge System.
    e. Explore possible themes for a multi-refuge project to work on with USGS, with a focus on forest management, including identifying metrics that could be monitored by multiple refuges.

WORKSHOP AGENDA

Day 1 – Status of Forest Management & Defining Problems (Tuesday)

Times: Workshop will begin at 8:00 AM and end at 4:30 PM

Location: Venture Out Business Center**,** 975 Industrial Drive, Madison, IN 47250
Objectives Addressed: 1, 2, 4a

8:00 – 8:20	Introductions/welcome/housekeeping (Joe Robb/Jason Lewis)
8:20 – 8:40	Comments by Tony Léger, FWS Region 5, Chief of Refuges and Dan James, USGS Status and Trends Program
8:40 – 9:00	Workshop Overview: Expected Outcomes/Products (Hal Laskowski, Regional Refuge Biologist, R5 and Biological Monitoring Team Leader) Clarify that funding is for adaptive management research, so projects must conform to those principles. What do we expect to get from an adaptive management approach that we haven't achieved with standard research?
9:00 – 9:45	Forest management on National Wildlife Refuges: Local Perspectives Each refuge/office will report about their current or planned forest management activities and issues (each will submit *.ppt slides prior to workshop). Moderator: Tom LaPointe
9:45 – 10:00	**BREAK**
10:00 – 10:30	Summary of Forest Management Survey (Thomas LaPointe) (handout: survey summary)
10:30 - 11:00	Small Group Exercise – Defining Problems and Identifying Threats Work in groups of 3-4. These groups will be assigned by habitat/latitude. Groups will use results of survey as a reference and define a problem statement for forest management in their area. In addition, groups will identify threats to the integrity of forested ecosystems on refuges.
11:00 –11:30	Small Groups Report
11:30 – 12:30	**LUNCH**
12:30 - 1:00	*Ecological and social factors affecting historical and modern fire regimes: assessing fire risk, landscape ecosystems and fire* (David Cleland, USFS)
1:00 – 1:30	*Ecosystem classification: evaluating site conditions using soil, physiography, and vegetation* (Benjamin Dolan, Purdue University)
1:30 – 2:00	*Ecological restoration in forested ecosystems: silviculture, forest composition and structure* (Linda Nagel, Michigan Tech)
2:00 – 2:30	*Silviculture, forest ecology and landscape context* (Mitschka [Mitch] Hartley, USFWS)

2:30 - 2:45	**BREAK**
2:45 – 3:15	*Distribution, composition, and health of bottomland hardwood forests* (Mikey Heitmeyer, University of Missouri-Columbia)
3:15 – 3:45	*Forest bioindicators* (Andrew Whitman, Manomet) (Presentation via powerpoint)
3:45 – 4:30	Panel Discussion (Cleland, Dolan, Nagel, Hartley, Heitmeyer, Whitman) Question and answer period for the guest speakers

OPTIONAL EVENING SESSION

6:00 -9:00	Tour Big Oaks NWR (Vans will pick you up at hotel at 6:00 pm)

Day 2 – Adaptive Management, Modeling & Objectives (Wednesday)

Times: Workshop will begin at 8:00 AM and end at 4:30 PM
Location: Venture Out Business Center**,** 975 Industrial Drive, Madison, IN 47250
Objectives Addressed: 3, 4b, 4c, 4d

8:00 – 8:30	Review of Day 1 (Sutherland) Facilitator asks for participant insights from Day 1
8:30 – 9:15	*Principles of adaptive management* (Clint Moore, USGS) Basic elements of adaptive management, how is it different than standard approach to research? How models are used. Give some real examples of how adaptive management has been used in management agencies.
9:15 – 10:00	*Role of modeling in adaptive management* (Eric Lonsdorf, Lincoln Park Zoo) Basic principles of modeling, how modeling is connected to adaptive management. Emphasize rapid prototyping, inputs (monitoring data) and outputs, etc. Demo some examples of models.
10:00 – 10:15	**BREAK**
10:15 – 10:45	*Overview of Strategic Habitat Conservation* (Jan Taylor, Regional Refuge Biologist, R5, USFWS) How is SHC related to adaptive management, regional habitat goals and objectives, etc.?
10:45 – 11:30	Small Group Exercise – Information Needs, Barriers and Limiting Factors for Setting or Achieving Management Objectives

	Work in groups of 3-4. These groups will be assigned randomly.
11:30 – 12:00	Small Groups Report
12:00 – 1:00	**LUNCH**
1:00 – 1:30	Panel Discussion (Moore, Lonsdorf, Taylor) Question and answer session
1:30 – 2:15	Small Group Exercise – Refuge Forest Management Scenarios Work in groups of 3-4. These groups will be assigned randomly. Each group is given a different hypothetical scenario and will answer several questions.
2:15 – 2:45	Small Group Reports
2:45 – 3:00	**BREAK**
3:00 – 3:45	Small Group Exercise – Regional Forest Management Objectives Work in new groups of 3-4. These groups will be assigned randomly and given the same scenario. Each group will identify 3-5 regional management objectives.
3:45 – 4:30	Small Group Reports, Wrap-up

OPTIONAL EVENING SESSION

6:00 -9:00	Social at Big Oaks NWR (Vans will pick you up at hotel at 6:00 pm)

Day 3 – Informing the Call for Proposals (Thursday)

Times: Workshop will begin at 8:00 AM and end at 11:00 AM
Location: Big Oaks NWR, lodge
Objective Addressed: 4e

8:00 – 8:30	Review of Day 2 (Sutherland) Facilitator asks for participant insights from Day 2
8:30 – 9:30	Small Group Exercise – Possible Themes for Multi-Refuge Project Work in groups of 3-4. Groups will be assigned randomly. Each group will answer several questions related to a multi-refuge adaptive management research project in collaboration with the USGS. One of the primary questions is related to monitoring metrics that could be performed by participating Refuges.

9:30 – 10:00	Small Group Reports
10:00 – 10:15	**BREAK**
10:15 – 10:30	Recap of workshop accomplishments (Knutson)
10:30 – 10:45	What is ahead, next steps (Laskowski)
10:45 – 11:00	Wrap up and close

Theme Description for Inclusion in the
USGS Call For Proposals
To Be Issued During August 2006

Theme 2. *Evaluating the ecological integrity of forest communities and developing objectives for forest habitat management on NWRS lands.*

Many refuges have forests that provide habitat for a range of wildlife species, especially birds, bats, mammals, and amphibians. However, the distribution, extent, composition, structure, and ecological integrity of these plant communities are often unknown. Thus, in many instances, if forest management occurs at all, it may be without proper assessment of forest conditions, understanding of regional and landscape contexts, comparison to historical benchmarks, or clear understanding of ecological benefits. The results of management practices in forested landscapes have long-term effects and in most places forest communities are altered from their pre-European condition. Forest restoration and conservation need to occur across the range of seral stages and cover types found in Regions 3 and 5. A clear approach to assessing and placing the forests of these NWRS units into regional and landscape contexts is needed to guide site-specific management objectives.

The Biological Monitoring Team is seeking a project that develops a framework for setting forest habitat objectives on NWRS units, and develops protocols for evaluating achievement of those objectives. The project will be informed by previous research and assessment methods already in use by agencies such as the U.S. Forest Service, TNC, universities, and the States. A set of metrics is needed to assess the status and trends of forested ecosystems on refuges, taking into account the ecological integrity of forest communities and the status of selected focal species that are a high priority for management by the Refuge System. Examples of regional scale metrics may include dominant forest types and their distribution and extent, natural disturbance regimes, ecological land unit assessment, and surrounding land ownership patterns. At the refuge scale, metrics may include pre-European cover type distribution and extent, existing cover type patch size and shape, hydrology, natural community assessments, invasive species, and current wildlife use (migratory birds and some other species, bats, amphibians, etc.).

The following are examples of likely or expected activities/products:

- Develop a model or set of models that can be used to evaluate the ecological integrity of forests on refuges at local and regional spatial scales for the purpose of setting forest management objectives at the refuge scale. Forest management objectives should address both ecological factors and USFWS policies and mandates (i.e., how should an individual refuge focus its forest management, given both local and regional factors?).

- Develop protocols and sampling designs for forest monitoring that evaluate achievement of forest management objectives and alert managers when management action is needed. The protocols and sampling designs must be practical to implement by a refuge, given the realities of budgets and staffing.

- Develop an adaptive management process flexible enough to apply on multiple refuges, in different forested ecosystems, with different target taxa, and a monitoring plan that is likely to be implemented by refuge staff long after the research phase of the project ends. The metrics identified for long-term monitoring by refuge staff should be sensitive enough to alert refuges when they need to adjust their management strategies.

Participants at the Forest Management Workshop
8-10 August, 2006

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Workshop Notes from Presentations and Discussions

Day 1: Tuesday

Opening Comments by Tony Léger, FWS Region 5, Chief of Refuges and Dan James, USGS Status and Trends Program

Tony Leger: Paradigm shift for the National Wildlife Refuge System (NWRS), goes back to Promises - vision of NWRS. Most important needs are biological databases and monitoring. Tony and Nita Fuller (FWS Region 3, Chief of Refuges) created the Biological Monitoring Team (BMT). Tough budget issues, have to make hard choices so we need to invest in new and improved management. FWS R3 and R5 - partner with premier science agency (USGS) to get our needs met for science-based management. Want to move towards a more science-based management. Need to answer questions and have credibility (with the public and other agencies), this leads to funding. Joint studies with USGS to answer questions.

Dan J. Most important thing is the partnership we're building, both agencies contributing funding and people and commitment. USGS must work closely with biologists on refuges to develop study design. Exciting to work at larger scale than just individual refuges. Info aggregated to look at larger questions. Makes economic sense too.

Workshop Overview: Expected Outcomes/Products (Hal Laskowski, Regional Refuge Biologist, R5 and Biological Monitoring Team Leader) Clarify that funding is for adaptive management research, so projects must conform to those principles. What do we expect to get from an adaptive management approach that we haven't achieved with standard research?

Hal L. Will talk about the process we're using. Adaptive management (AM) is blend of management and research to achieve better science-based mgmt. Currently NWR's often use bear model, opportunistic, solitary, hibernates, eats a lot. Promoting wolf model – group effort, specialized, efficient. Need replication over time and space and personnel changes. Refuge Cooperative Research Program (RCRP) model: FWS contributes questions, sites, coordination, data collection, management actions. USGS contributes study design, training, data analysis, report writing.

What do we want to get out of this workshop?
Trying to promote a group effort, collaboration to better define problems, bring different expertise. People work together over space within a reasonable amount of time.
This workshop is to ID questions and objectives for forest management.

Benefits are improved decision making on NWRs and NWRs working as a system. Cost effective, addresses mgmt questions. USGS likes large landscape projects, cost effective, applicable to land management agencies, large sample size.

Drawbacks to FWS – staff time, loss of some mgmt flexibility. USGS- loses some control, project incorporates actual mgmt practices, equipment breakdowns, weather problems etc.

Why the emphasis on AM? DOI emphasis- committee is defining it and making recommendations on implementation. Funding sources are coming with AM theme to them. It meets NWRS needs for objectives, predictions (modeling), mgmt strategy, monitoring and evaluation/adjustment. AM is an in-depth process involving modeling and consistent monitoring throughout all refuges involved.

Next steps
Request for proposals (RFP) released in Aug 2006 to all Science Centers.
3 themes – reed canary grass, forest management, (invasive species workshop will be in Jan).
Sept 2006 – selection committee – USGS, NWRS, subject expert – will select successful proposal. Two volunteers from this workshop will also evaluate proposals to see if they meet needs outlined this week.
Develop detailed study plan Oct 06-Mar 07. USGS will work with refuges.
Study site visits – Dec 06 to Mar 07
Workshop to insure consistent methods – Mar/Apr 07
Implement beginning May 07

Outcome of workshop - Problem description, information needs, collaboration, criteria to select proposal.
USGS and NWRS both own the data – refuges can use the data for their own needs including publishing. Looking at it as public data, but all issues haven't been resolved completely yet. Hasn't been a problem to this point, though, scientists have been collaborative. But carrot for USGS is publication at the end and we don't want to compromise that. May be opportunity for details for refuge biologists to work with USGS on data analysis and co-author on publications.

One proposal will be funded through this program but alternate funding sources are also a potential.

Forest management on National Wildlife Refuges: Local Perspectives. Each refuge/office will report about their current or planned forest management activities and issues (each will submit *.ppt slides prior to workshop). Moderator: Tom LaPointe

- Big Oaks: cowbird parasitism, sink population for some migratory species like cerulean warbler, invasive species is biggest concern, burning to control hardwood encroachment into grassland, Japanese stiltgrass, privet, bush honeysuckle
- Crab Orchard: manage to favor oak hickory, silvicultural treatments, convert non-native pines, control invasive plants. Manage sugar maple (shade tolerant spp).
- Seney: Disturbance, emulate historic conditions. Research, FWS needs to take a leadership role. Kirtlands warbler wildlife management area, jack pine needs intensive management
- Upper Mississippi: floodplain forest, pools 4-13 – altered hydrology, higher water levels, wetter soils, lack of local seed source, limited info re: cost effectiveness of active vs. passive reforestation. Now a silver maple dominated forest instead of a diverse forest.

Lack of regeneration, invasives (reed canary grass), even-age stands, increased water level on floodplain forest. Are doing island restoration and stabilization (island erosion due to high water levels). Invasives control (reed canary, buckthorn, honeysuckle), forest inventory, regeneration.

- Tamarack: climate change, fragmentation, hydrological changes, development, fire suppression, deer, invasives, earthworms, invasives, climate change, public use compatability. Jack pine mostly gone, red and white pine mostly gone. Now hardwoods.
- Mark Twain: to increase forest blocks, improve structural diversity.
- Illinois River: Hydrologically altered environment. Precludes establishment and survival of historic forest veg, lack of seed source of mast trees.
- Mingo: Water's been held too high over last 40-50 years resulting in composition change. Bottomland hardwood: cypress tupelo
- Muscatatuck: 36% in floodplain, also upland deciduous, wetlands, neotropical migrants, invasive species, stiltgrass, kudzu, surveillance for emerald ash borer. Habitat for migrating waterfowl is primary goal
- Big Muddy: mostly floodplain, some associated uplands, Johnson grass,
- Umbagog: spruce/fir, northern hardwood, mixed/conifer hardwood, no management currently although plans are in the works, several thousand acres of forested wetlands too. Harvested since 1800's, which has altered landscape because hardwoods were targeted. CCP is taking focal species approach – several warblers. Structural/landscape requirement of species, effects of forest mgmt on other species. What are best measures of success? political/economic constraints
- Canaan Valley: used to be the largest red spruce forest in U.S. now northern hardwood forest, upland plus 200 acres red spruce and hemlock, forested wetlands. Still questioning direction to go. Current projects include veg mapping and forest inventory, deer exclosure (forest not regenerating), spruce planting. Acid precipitation. First stiltgrass recently found. Issues: deer, regeneration of fern cover, acid precip. and atmospheric deposition (coal fired power plants, Japanese stilt grass)
- Silvio O. Conte: Connecticut river watershed – even-aged forests, historical logging, moose browsing, no mgmt currently occurring, plan being developed, lack of late seral stage, urbanization in southern area, invasives, eg., hemlock woolly agelid.
- Back Bay: focus on watershed. Forest mgmt is new here, CCP process is helping. Cypress/tupelo, oak/magnolia, loblolly redmaple sweetgum. Loblolly assemblage is considered a weed. Plugging ditches, planting tupelo cypress oak, encourage natural regeneration, close the canopy, e.g, old farm fields. Need to reduce the flood tides, increase spp. diversity

Summary of Forest Management Survey (Thomas LaPointe) (handout: survey summary)

Open Discussion:
A need for definitions necessary: ie. Forest management. Rather than trying to figure out what benchmark or old conditions used to be, but where we are today and where do we want to go tomorrow?
Greg C: it is important to know how past ecosystem "worked" not necessarily what was there. How it produced what it produced. What can be achieved rather than what needs to be done?

Small Group Exercise – Defining Problems and Identifying Threats. Work in groups of 3-4. These groups will be assigned by habitat/latitude. Groups will use results of survey as a reference and define a problem statement for forest management in their area. In addition, groups will identify threats to the integrity of forested ecosystems on refuges.

Defining Problems & Identifying Threats

This exercise is designed to stimulate discussion about what you see as the main problems or issues facing refuges regarding management of forested ecosystems. You can use the survey results handout as a reference. There are no 'right' or 'wrong' answers to these questions. Please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

1. List some problems refuges face regarding forest management that you think USGS (or the community of scientists) could help address. Do these issues apply only to refuges or are they shared by other land owners in the region?

Bottomland #1: Siltation
exotics and invasives (willow)
deer browsing
altered hydrology
tiling

Bottomland #2: Clear targets/objectives – historic conditions
Invasive species
Altered hydrology
Regeneration – poor success
Contaminants, sedimentation
Urbanization/ag development
Lack of digital elevation info

Oak/hickory: Climate change,
invasives and how they change/impact current mgmt.
Urbanization and proximity affect mgmt (fires).
Limited forest data/staff to collect/interpret.
Potential threats (gypsy moth, EAB, sudden oak death).
Landscape issues beyond control.
Forest succession. Conflicting objectives. Habitat needs for multiple species in limited area.
Traditional mgmt techniques impacted by invasives. Beaver/wildlife impact of forest.

Northern Forest: Lack of information (refuge specific info).
Focal species (which spp?) or ecological integrity (landscape perspecitive).
Refuge system context (forest types within refuge system- priority type).
Landscape surrounding refuge.
Geographic-specific structural questions (how do you know what to do?) (what techniques/management provide the habitat you want?)
Lack of benchmarks (historical conditions). What are site capabilities?

2. Please list at least 5 major threats facing forested ecosystems on refuges?

Bottomland #1: urban sprawl and development pressure
fragmentation, isolation.

Bottomland #2: Altered hydrology
Invasives
Suppressed regeneration
Fragmentation, urbanization, agriculture
System wide human influence

Oak/hickory: urbanization, climate change, invasives/disease
Mgmt techniques facilitate invasives,
data limitations.
Deer management.

Northern forest: Invasives, climate change, fragmentation, hydrology, acid/atmospheric deposition, forest regeneration, societal issues.

3. Please write a problem statement that captures the consensus of your group with regard to the main 'problem' or issue surrounding refuge forest management that you think USGS (or the community of scientists) could help address. We're looking for ONE statement, not a list of problems. (Leave this question for last, the other questions will help you summarize here.)

Bottomland #1: What hydrologic factors would increase growth of desireable tree species. How can we manipulate hydrologic factors for desired forest conditions.

Bottomland #2: We need a landform model that incorporates topographic, hydrological and soil characteristics to predict potential forest communities, and their responses to management.

Northern forests: To what extent can you emulate natural disturbance regimes (processes thru silvicultural treatments?

Oak/hickory: How to manage threats and potential threats at multiple scales (local, regional, landscape).

4. What is the primary contribution (value) forested habitat managed by the Refuge System for wildlife?

Bottomland #1: mid-migration stop over
neo trops (breeding,migration)
Core habitat
diversity of habitats
wood ducks, raptors, endangered species.

Bottomland #2: Migrating birds. Watershed effects (water quality). Provide high quality habitat for migrating birds and other native wildlife.

Oak/hickory: community integrity

Northern forests: Unique composition and structure.
Flexible management (able to be research and mgmt/demo example connections with other landowners/partners.

5. What factors influence the integrity (value) of our forested habitats that a manager can control?

Bottomland #1: Age, stocking, composition
insect/disease exotic, invasives.

Bottomland #2: no answer

Oak/hickory: Invasives (local site scale)
Management techniques
Disturbance (fire, harvest)

Northern forests: lack of knowledge/making "wrong" decisions.
Lack of benchmarks.
Spatial context (large patch size, juxtaposition, control and over time.

6. What factors influence our forested habitats that are outside of our control?

Bottomland #1: Development, politics, economics, hydrology
Sedimentation
weather, catastrophe, natural events

Bottomland #2: no answer

Oak/hickory: climate change
Invasives (landscape scale)
Urbanization
Pests (gypsy moth, EAB).

Northern forests: development/private ownership.
Climate change.
Atmospheric deposition.
Political pressure/interest/initiative.
Wildlife managed by other agencies (deer managed by state).

7. Identify forest management activities that may improve or maintain the value of our forested habitat.

Bottomland #1: TSI, Fire, thinning, prescribed harvest, IPM, restoration planting, corridor linkage.

Bottomland #2: no answer

Oak/hickory: Exotic control
Fire
Natural community mgmt (silvicuture)
Habitat conversion to appropriate type
Restored/modified hydrology.

Northern forests: emulating natural disturbance regimes.
Restore hydrology.
Rehabilitation of managed stands.
Land acquisition.

8. What metrics might be used to determine the extent to which the above factors influence our forest values?

Bottomland #1: Population monitoring
forest inventory
fuels

Oak/hickory: regeneration
forest growth/health
carbon sequestration
historic vs. current vegetation
fragmentation (patch sizes).

Bottomland #2: no answer

Northern forests: Extent & distribution of specific forest type.
Compare natural disturbance with management to mimic disturbance.
Vegetation structure, age class, composition.
Response variable for wildlife/taxa (choosing indicator species).

9. If you have forest management objectives for your refuge, are there hurdles you face with achieving your objectives and what are they?

Bottomland #1: Manager, RO, DOI
Funds, personnel
lack of public land
knowledge, what to do?

Bottomland #2: no answer

Oak/hickory: Lack of stand level information
public perception
urbanization
wildlife control (deer, beaver)
lack of resources (staff, funding).

Northern forests: Money, personnel with appropriate training, markets, knowledge, not receiving money from timber sales.

Small Groups Report

Differences within **bottomland forest group** due to regional differences in regional definitions of bottomland forest. Hydrological factors
Oak hickory – urbanization came up which wasn't reflected in the survey. Common theme linked scales and how to manage at different scales. Diverse problems within the group made it difficult to develop a problem statement. Invasives
Northern hardwoods – how to emulate natural disturbance regimes through silvicultural treatments. Need to know benchmark conditions you're trying to emulate.
Restore to what has been or to a more current condition? Not necessarily to understand how it "looked" but how it functioned. Need to consider what's achievable today.

Ecosystem classification: evaluating site conditions using soil, physiography, and vegetation (Benjamin Dolan, Purdue University)

Soil, vegetation (existing veg), habitat (potential and indicator plant assoc), ecological classifications (veg. related to physical features, hierarchical, mapped easily) (systems).

Ecological classification; physiography (landform, topography), soil, potential natural veg. ie. Prairie soils vs. forest soil (diff drainage) landform affect soils and natural veg.
Vegetation affects soils, etc. Relationship between veg. and environmental factors.

Scale and Environment interactions: Macro (Global) (latitude, elevation, continental position) Meso(Regional): slope, relief, plains, mountains, soil associations
Micro (local): slope-aspect, soil moisture, landform components, geologic differentiation (soil orders)

Macro scales: domain, division ie. Polar regions, tropical regions, temperate forests, deserts, etc. Macro scale: province ie hot continental division (region 3&5), humid temperate domain, Eastern broadleaf
Meso Scale: Sections and subsections Meso-Micro Scale: LTA, ELT
Micro scale:

National Heirarchical Framework of Ecological Units: Level, Name, Scale
Ecoregion. Subregion. Landscape. Land Unit – grouped into hierarchical framework of ecological units. "ecological classification systems".

Significance to mgmt (the classifications);

- Sites in context of landscape
- Understand how small differences in condition impact flora and fauna across landscape.
- Can link aquatic and terrestrial systems
- Sampling and monitoring stratification
- Helps to understand invasive species ecology

Transfer knowledge – shared across diff regions (even in diff continents), or ecoregions. Our invasives come from these same regions on different continents e.g garlic mustard in US. and Europe.

ECS Uses: mapping, resource assessment and mgmt, Environmental impact analysis, Watershed analysis, etc.
Examples of ECS in use: distribution of goldenseal in HNF, site stratification for studying silvicultural disturbances, Restoration.
Using ECS to guide restoration: ex from Ichauway Reserve, GA: reference classification, mapping, etc Reference vs. Current Vegetation.
ECS can give Priority areas for restoration.

Similar approach at sleeping bear dunes: historical, current, potential forests (all these Maps were analyzed in GIS) 78% of property should return to pre-Euro conditions after fire suppression mgmt and reintroduction of ……

Existing ECS for use as Reference: N.F.: Wayne, Hoosier, Huron-Manistee

Developing a preliminary classification: At ELT and ELTP levels: Divide landscape based on topo feature ie. Hills upland plains, bottomlands
Use soil characteristics to subdivide
Describe current vegetation

Many classification systems have been developed, not very consistent, which does cause some problems. There are a lot of classification systems out there. No umbrella class.
TNC, USFS, EPA

Ecological restoration in forested ecosystems: silviculture, forest composition and structure (Linda Nagel, Michigan Tech)

What is silviculture? The art and science of controlling ("Dictionary of Forestry") the estab, growth, compos, health and quality of forests. Changing views on desired future forest structures: taming and regulating forests

How silviculture and wildlife mgmt can mesh.
50 years ago taming and regulating forests, now creating more diversity
Contemporary Wildlife habitat objectives – species oriented mgmt. or conservation of regional diversity

Managing for wildlife Habitat: impractical to expect to understand and quantify habitat needs of all species inhabiting a forest area

The silvicultural prescription process is similar to AM process: ID objectives, inventory the stand, diagnosis, develop a target stand in relation to obj. (desired future condition), develop silv. prescription. Must define desired future conditions before deciding on management prescriptions.
Succession and disturbance are factors you're trying to modify. They interact to determine the ecological landscape of the ….

Stand Dynamics: four stages of stand development following major disturbances,
Stand structure: describe conditions, habitat elements, guide to develop future conditions
-a diameter distribution, crown classification, strata,

Vertical structure: stand initiation, interim stages, mature forests Ie. Even age stands, selection systems…

Principles of ecological forestry: manipulation of a forest ecosystem should work within the limits established. By natural disturbance patterns prior to extensive human alteration of the landscape. To maintain high degree of biodiversity across landscape. Harvest forests….
Managing for wildlife habitat: need to consider age class distribution ie. tree spp. composition….

Managing for functional groups: early successional, late successional, landscape
Early successional spp: habitat that persist only for a short time

Natural range of variability: conditions possible in ecosystem comp., structural and function considering both temporal and spatial factors.

Jack pine and Kirtlands' warbler: requires early successional JP,
Managing for Multiple obj:
Late successional Spp: old growth forest and large expanses of interior forests
Managing for old growth characteristics: retention of reserve trees, large diameter, maintain vertical structure
Managing for wildlife habitat tree spp composition: Some spp may have a disproportionate influence on wildlife
No. Hardwood mgmt: individual tree selection
Group selection for Midtolerant spp. to promote yellow birch and Eastern hemlock
Restoration Ecology: Restoration is the goal of returning an ecosystem to a desired more natural stat after human disturbance. Restoration bridges the boundary between basic…

Common Restoration Goals: single spp , mult spp, process oriented goals

Forest regeneration: Biotic chanllenges: deer, earthworms
Invasive plants: Pennsylvania sedge, garlic mustard

Target Invasive plant spp.: model development

Silviculture, forest ecology and landscape context (Mitschka [Mitch] Hartley, USFWS)

Roles and goals of forested refuges
Importance of landscape context
Effects of timber harvests on wildlife
Birds as a metric of biological integrity

Potential Roles and Goals:
1. Conserve all wildlife and habitats: manage for all representative forest types and full continuum of age classes (i.e., a comprehensive shifting mosaic)
2. Focus on management for rare/declining habitats
3. Preserve or create pre-colonial condition:
4. Complement landscape matrix (i.e., achieve Goal #1 above by identifying and addressing the set of conditions least likely to exist on future landscape.

Shifting mosaic requires careful planning on a landscape scale, due to long-term nature of forests. Some conditions harder to create. Natural disturbances are unpredictable like fire, wind, pest outbreaks

Shifting mosaic requires careful planning on a landscape scale, due to long-term nature of forests. Some conditions (e.g., very old forests) take a long time and are thus harder to create. Also have to plan for unpredictable natural disturbances like fire, wind, pest outbreaks

Complementarity. What habitats dominate the matrix? What disturbance factors are operating? What conditions unlikely in the future? Bottlenecks? What wildlife likely to be affected by bottlenecks. Spp that requires certain conditions. NWRs are uniquely suited to tackle "high maintenance" habitats – can and should. E.g early successional and fire dependent mgmt. invasives mgmt. Refuges lack economic constraints of private/industrial lands and therefore can manage for uneconomical conditions (e.g., very old forests or frequently repeated disturbances). Refuges have professional, conservation oriented staff.

Landscape context. Landscape composition directly affects habitat quality. Same patch in different landscapes can mean very different wildlife habitat. Landscape composition affects wildlife population dynamics eg occupancy, density, productivity, survival, use during annual cycle, and movements of individual birds.

Patch size – importance can depend on landscape. Larger blocks considered better habitat but need not be homogeneous or unharvested. more spp, forest interior spp, increased productivity, large home range (forest raptors).

Landscape context should inform refuge goals and shape management plan eg. urbanization, agriculture.

Research from a Maine mixed-wood forest showed virtually no community-level effects from low-intensity timber harvests (e.g., 10-20% removals in small gaps with retention trees) that emulate typical natural disturbances, nor measurable effects on most individual bird species.

Research from northern hardwood forests in upstate New York showed that different suites of birds preferred different forest conditions. A diverse suite of birds strongly preferred harvested or disturbed forests, and experienced a large magnitude of change in response to the creation of those conditions by logging. However, the suite of birds associated with mature and less disturbed forests was largely unaffected by timber harvesting that removed 25-50% of timber; most species experienced dramatic changes in density only in response to the heaviest cuts (e.g., 75-100% of timber removed). Some species in the mature-forest suite actually increased in response to intermediate-leves of harvesting (e.g., 25-50% removals). Likewise, carrion beetles as a group preferred more disturbed forest habitats, but some species strongly preferred undisturbed or heavily disturbed conditions. However, terrestrial amphibians (dominated by red-back salamander and similar species) strongly preferred mature forests, and their abundance decreased in direct proportion to logging intensity. These results illustrate why conservation of all native wildlife species will require maintaining a diversity of conditions across the landscape over time (i.e., a shifting mosaic).

Distribution, composition, and health of bottomland hardwood forests (Mikey Heitmeyer, University of Missouri-Columbia)

Benchmark or baseline doesn't need to be 100 years ago or even 40 years ago. Also what can it be now. Condition may be so altered but you can't go back. Difference on geographical spatial and temporal scales.
Bottomland hardwood have some seasonal inundation typically in dormant season.

What is it you are trying to restore/manage?
Structure, function, ecological processes. What was present where? What were basic functions. What processes sustained the system short and long term?
Understand abiotic factors eg geomorphology, topography, soils, flood frequency zone.
What's below and above the surface. Make map. Must compare apples to apples. Can adapt it to any scale. Model can tell you what vegetation types were where.

Monitoring criteria: Ability to determine landscape level effects. Baseline monitoring including hydrology, forest composition and health. Direct application to adaptive management.

Leading indicators of BLH health: Basal swelling, tip die-back, leaf chlorosis, mortality of red oaks, herbaceous ground cover, regeneration, growth rates

Composition BLH : Once general community type is determined (by geomorphic/topo/hydrological), what are ranges of species presence? What size classes present? What regeneration is occurring? Compare across sites. Trees will tell you what's happening, don't even need to measure water.

Growth rates. Plot over time, look for anomalies

Must understand flooding – depth duration etc.
Flood Stress and Recovery Potential: Conditions, causes, Recovery. Ie: Canopy thining, Cholorosis, basal swelling,

Depth, duration, and timing of flooding- have to know hydrology to manage bottomland forests

Better to measure physical characteristics rather than birds.

Forest bioindicators (Andrew Whitman, Manomet) (Presentation via powerpoint)

Sustainability: to meet the needs and aspirations of the present generation without compromising the ability to meet those of future generations.
Indicators: a measurable variable used to report….. provides valuable info about the condition of other measurable elements
Something that is not measured cannot be managed for.

Selecting indicators is procedural not technical or scientific

1. Know scale at which you want to make decisions about ecological integrity. Don't confuse measurement scale with decision-making scale.
2. Know who your stakeholders are. Who has a stake in the forest? Pick indicators
3. that represent stakeholder values and create a clear indicator selection process.
4. Link indicators to decision making framework (and have a framework!). set target levels if you can.
5. Put right amount of energy into selecting indicators – 12 months or less.
6. Know your capacity to measure (don't end up with long lists).
7. Indicators are only a means to an end, the end being sustainability. Just because you're measuring indicators doesn't mean you're doing adaptive management.
8. Have a well thought out process for selecting indicators and implementing indicators and using the info in decision making. These should all be integrated

Stepwise process for selecting indicators

1. Know what you care about. Ecological integrity – lack of consensus on definition. Break down what we care about into manageable bits.
2. Select indicators that measure what you care about. 3 types: Condition level of an ecological component, value or criteria. Pressure indicator: level of a factor that affects the condition of a component of interest. Policy response indicator: a policy or the capacity to affect the condition of a component of interest.
3. Evaluate indicators by scientific merit, ecological breadth, practicality, utility, relevance

What is eocological integrity: caveats…… lack of consensus on definition (30 web sites)

Condition Indicators: indicates the level or condition of a specific component to be sustained; ie spotted owl density, Karr's stream macroinvert index of biotic integrity
Pressure indicators: level of a factor that affects the condition of a component of interest; ie natural or human
Policy Response indicators: a policy or the capacity to affect the condition of a component of interest. ie. policy approaches,
3 types of indicators

Relationship between condition, pressure, and policy response indicators:

5 critieria for evaluating indicators:
Reducing your list of indicators: look for duplication among indicators

Panel Discussion (Dolan, Nagel, Hartley, Heitmeyer, Whitman)

Heitmeyer mapping site characteristics to vegetation. How did you determine appropriate vegetation communities? Start with reference site where you have understanding of the characteristics of it. Test hypothesis going back in time eg. GLO notes, historic data, national archives, old aerial photos, old soils maps.

Nagel. John Kotar habitat typing in Great Lakes Region. Series of veg plots related to cover type and understory, related loosely to physiography and climate. Probablistic. Good for planning purposes. Used at stand level.

Melinda: Setting objectives, wait till find out land cover? Refuges struggling because they don't have baseline information needed. Should they wait to set their objectives until they have baseline information in place?
Manomet – helpful to first ID baseline components i.e. elements of concern and out of that you can select indicators and then set objectives if you can. Important to have a feeling for the context. Nothing will ever be quite right and so learning how to set objectives may be as important as having specific objectives. Realize you may not do a very good job the first time around. Get out there and start to learn.
Linda: The more info you have (tangible) the better to set objectives. Understand the ecology of the system and set your objectives maybe on a modest level to start. Habitat typing can help too.
Ben: Focus on processes over time and space. Never be able to remedy all issues. E.g. removing ditches, restoring fire.
Mikey: Managers need to make decisions every day and have a general idea what you want to do. Can't let the world stand still until you get this information. Can begin to move forward intuitively and not wait for someone to help you or consult. Use ARM to go to the next step.

Hal: Is it better to ID focal bird species or ecological integrity of forests assuming wildlife will use those forests? Regarding ecological integrity, at what scale should we set our objectives based on surrounding landscape?
John G: Do objectives have to tie into a wildlife species or not? They almost felt guilty not including wildlife in their forest management objectives. Depends on where you are in your

forest management process – they're just beginning and will learn more as they go, maybe tie in real wildlife objectives in their next CCP.
Mitch: There is no simple procedure. What are spp needs? What is cost effective? What landscape am I in? There are many questions to ask. Take different levels of info to make your decision. ie. Its not worth it to manage a small unit.
Look at big picture ideally. How important is your BCR to the bird's needs? Don't try to be all things to all people. If your refuge is in Maine, forget about those grassland birds.
Eric: This is where modeling can come into play. Keep track of what you want to do, can have multiple objectives and incorporate them into the model are different (are important or not) to many people. More on that tomorrow.
Heitmeyer: Preference to be habitat based rather than species based. Do evaluation of options properly and that will tell you what's best for your site. Maybe had 90% of a component historically but now only have 40%. That's obviously an important component, maybe not possible to restore on your refuge but can then look at other sites e.g. private land. what belongs there? What is management capability? each site has to be looked at with scale because each refuge is different. What role can it best play (the refuge)? Every refuge has to be looked at different and looking at what is around it. Mitch: Don't forget about public opinions ie. deer and turkeys. That is what most people consider wildlife.
Tom La Pointe: Is it reasonable to expect individual refuges to do all of this, developing indicators, disturbance regimes, etc…… Or would be better to ….?
Ben: That is USGS's role.
Mikey: Never going to be enough resources. You have to prioritize. There'll never be enough resources. This workshop bubbled up from below, not from above which is a good thing. Have to have a sense of priorities and that must be considered in the proposal selection process. "Brains not bulldozers"…can make good decisions and move forward based on the knowledge in this room.
Folks think ecological classification is complex and needs data we don't' have but we do informal classification on a day to day basis. Maybe very simple, just 3 or 4 types.
Jim: A lot of you managers already use veg. types (ecological conditions) anyway, so you can do this.
Tony : we're weak on what the refuge role is the larger landscape. Need to explore this some more. Strategic habitat conservation talks a lot about how we fit. What do our partners want?
Heitmeyer: Yes, Refuges can't be looked at in isolation. Looked at different scales up to a million acres. Refuge may have a key piece of the landscape that can't be met anywhere else, but others may be similar to surrounding area
Mitch: Partner influence might be for turkey or deer which could be better met by state areas for example.
Tony: Just because the task is daunting, doesn't' mean we can't do this. Only good comes from this (discussion). We have admin tasks but the conversation and expert advice has been missing from the refuge system. We are setting a priority and trying to do the right thing, this is cause for celebration. Let's not be worried about how hard this is going to be. We are making progress.

Day 2: Wednesday

Review of Day 1 (Sutherland) Facilitator asks for participant insights from Day 1

Discussion
Discussion on whether or not to restore to pre-settlement conditions, then going out on the refuge which was historically all forest, and seeing grassland management for Henslow's sparrow. Pre-settlement management depends—you must have objectives.
John G: Many concerned about site conditions we should be restoring. Mickey's presentation was illuminating – provided us with a tool to use – geomorphic surfaces.
Vinny: Setting objectives. Sometimes we get so focused on critters that we don't think about the habitat needs and objectives. Good to get a good overall focus instead of smaller focus.
Matt: All refuges had similar issues and came up with similar veg types therefore similar issues on their lands. How few forest types most people were significantly concerned with and how simple people were able to make their issues on their refuges. Often three and no more than five issues. That simplicity will bode well for the modeling process we'll be discussing over the rest of the workshop.
Jim D: Had problems with regeneration on their forest – during the break learned about larger size trees being used elsewhere. Will go back and develop a nursery on refuge.
Wedge: In the floodplain it's not as important to know what was present on every acre presettlement, but to know generally what was present. Sites on floodplain have changed so much that conditions aren't the same.

Problem statements. Comment - Too many questions on the group discussion sheet for the time allowed. One group just focused on the most relevant ones.

Review of yesterday.
Jan: Yesterday was a good foundation day to set the stage for second day. Great review of current issues on refuges. Presentations set the table for today.
Greg: Saw range of conditions that we all work in which can be very different. Saw search for silver bullet and there is none, so can only manage
Rick: Mickey's presentation brought home that any project developed must compare apples to apples via abiotic factors. Just comparing vegetation across regions wouldn't work well.
Eric and Ben got a better understanding of forests on refuges, but forest types are so diverse that there are a lot of ways they must be managed, good to focus on multiple refuge, but it'll be challenging. There is so much diversity in the refuges that there has to be different mgmt techniques. How do you combine all of these different issues and manage for them?
Hal: Yesterday was really good. There is a commonality on how to manage for forest and what to manage for. There is a higher level needed. Some kind of process on how to manage each indiv. Forest and then evaluate each of those processes. Agrees that each refuge is dealing with many different issues. We won't be comparing bottomland forest to spruce but there was commonality on need to develop a process by which we determine what to do on each refuge.
Dan USGS: Three hours on Big Oaks last night and just scratched the surface of management issues. If we do such workshops in the future we must find a way to get more USGS scientists here…many scientists who will be submitting proposals would have benefited from the day yesterday.

Principles of adaptive management (Clint Moore, USGS)

Basic elements of adaptive management, how is it different than standard approach to research? How models are used. Give some real examples of how adaptive management has been used in management agencies.

Adaptive Mgmt: Iterated decision making in the face of structural uncertainty, w/a focus on its reduction. Many different definitions, we need to get on the same page.

Structured decision making. Choosing a course of action in consideration of expected outcome of the action, value of the outcome resulting from the action (utility). These values are subjective so people don't like to deal with them, but it's important. Choose decision that gives you the greatest expected value. Basically you choose the decision with the best expected outcome based on weighting the different outcome choices.

A rational decision is one that considers the value of an outcome in light of its chance of occurrence. E.g. do I manage a forest by single-tree or group selection?
Best decision is affected by 1) choice of values placed on outcomes. Values reflect societal preferences. 2) probabilities assigned to outcomes. Probabilities are informed by science (data, models, expert opinion). What if we're totally ignorant about the outcomes? Then probabilities are equal, 0.5 vs 0.5

Why is this important?: Anyone can make a decision using any criteria, but a rational decision is one that considers the value of an outcome in light of its chance of occurrence .e.g. do I… carry an umbrella today or not? (sufficiently small chance of rain offsets cost of carrying it) Or; invest in a corporate stock (cost of a bad outcome times chance of occurrence).

Uncertainty
Uncertainty attends all natural resource management decision making. Risk of ignoring it results in management loss eg. cost overruns, population collapse, foregone harvest. Responsible management must address uncertainty.
Forms of uncertainty: partial observability (inability to clearly see the resource you are managing), environmental stochasticity (unpredictable random response around a mean), partial controllability (action taken is not action intended), (expected outcomes are known, but exact outcomes aren't), Ecological or structural uncertainty (uncertainty about operative biological mechanisms). Ecological uncertainty implies 2 or more hypotheses about expected outcomes. How do we tackle this?

Stochastic uncertainty - uncertainty about the degree to which a specific outcome differs from the expected mean outcome. Structural uncertainty is uncertainty about the expected outcome itself. AM can accommodate both forms, but isn't needed if decision making is not affected by structural uncertainty.

Adaptive management (AM) setting

- Where decisions are made in sequence through time
- Where structural uncertainty hinders management

- Where stakeholders can agree on objectives. , if not the science. (Is stakeholder disagreement over uncertainty about science, or "I'm just not into your values"?: Hidden agendas)
- Where institutions are committed to monitoring and transparency.

Elements of AM

1. Management decisions & objectives – attaches a value to each decision and outcome combination. (obj. reflect mgmt desires).
2. Set of candidate decisions – menu of feasible actions. (each feasible kind of action that leads to diff. response in the obj). (Unconventional actions should not be dismissed if high uncertainty calls into question conventional wisdom.) Few and highly distinct actions increase learning faster than do a larger # of subtly distinct actions.
3. Set of predictive decision models to portray structural uncertainty, to guide the decision under uncertainty, to improve decision making by reducing the uncertainty (provides a prediction of response to compare with monitoring data).
4. Measure of relative confidence on each model. Reflects influence of model on current decision. Model weights are updated on basis of model predictive performance over time. (Dynamic "information state" of system).
5. Monitoring program- (to assess current system conditions) (to track progress toward mgmt objectives) (to provide data for challenging model predictions and updating model influence)

General sequence in adaptive mgmt;

1. assess current level of uncertainty
2. measure current physical conditions of system
3. choose and execute one decision alternative
4. confront model predictions with observed response
5. update model, reallocate credibility among models
6. Repeat 1-5

Example: management of waterfowl harvest - degree of density depenedence in survival and recruitment was in dispute. "Decision table" for adaptive harvest management is indexed to status of population and habitat and to current allocation of belief weight among predictive models.

Misconceptions

AM is not: Try something initially, that fails, and then try something else. No, AM is guided formal decision making.

AM is not defined as making a different decision when the population or environment changes.

AM is not a tool for resolving different stakeholder values. Need negotiation, scale and weighting for that.

AM focuses on achieving management objective. Experimentation is a direct focus on resolving uncertainties that hinder management

AM treatment selections are based on what provides best management return. Experimental – treatments designed to most rapidly and clearly resolve uncertainty.
AM info is used immediately in the next decision. Experimental - info applied at completion of study.
AM only collect info pertaining to mgmt objectives and model prediction. Experimental - any data yielding info on ecological processes is valued.
AM – learning valued only to improve future decision-making
Expt - learning is highly valued for clear, strong, precise inference
Increased focus on learning moves you closer to experimentation whereas AM maintains primary focus on mgmt

Role of modeling in adaptive management (Eric Lonsdorf, Lincoln Park Zoo)
Basic principles of modeling, how modeling is connected to adaptive management. Emphasize rapid prototyping, inputs (monitoring data) and outputs, etc. Demo some examples of models.

Theoretical - Greek
Modeling for management – objective-based – top down
Ecological models – bottom up, complex, too many details for our use – curiosity based

Managers and biologists have knowledge; modelers organize and synthesize this knowledge.

Modeling as a management tool to:
Organize and integrate data with knowledge and intuition
Explicitly ID and test assumptions
Perform simulation experiment that would otherwise be difficult or unethical
Promote and focus discussion of management options
Provide insight to solve problems in most efficient way.
It's cheap.

Model requirements
- Objective clearly stated
- Scale is defined and appropriate for problem
- As simple as possible
- Assumptions are clearly stated and justified
- Model output and variables represent obtainable data.
- Data collection does not occur until the last step.

Description/discussion on the 4-lunch model – keeping forests in white pine. Example using Excel.

Single frame = single forest patch
Multiple frames = look at whole forest

Most refuges have multiple objectives and operate in a stochastic environment – best to use simulation and SMART technique

Discussion

Examples of models that incorporate social values e.g. economics? Waterfowl harvest example – objective function was struggled with all stakeholders. Different harvest policies assure sustainable harvest over time, but also interested in incorporating how badly we'd feel if still harvesting lots of ducks when population was low. As pop'n fell below a certain level, value of a harvested bird fell.
In refuges we have knowledge to make models but very often we collect the wrong information or none at all. How can modeling help us collect the right monitoring information? Models are simplified and represent our best knowledge. If you're collecting data that you doesn't fit into the model, that becomes data that isn't necessary. Or if you have no data to feed into a part of the model, then you better get some data on it.
If you use an existing model that someone else has created make sure your objectives match the outcomes of those models.

Sometimes when you conduct AM variables come out that you hadn't planned for. They come out in the wash.

What's the usability of modeling on refuges? Getting into that comfort zone and getting support to get through that process isn't there. Need guidance from service re: who to contact, need experts. We need someone to help direct modeling first so no wheels are spinning because we don't know how to do it.

Tony: that's why we're working with USGS experts. We need to make the decision that we're going to be a science-based management organization. We do a lot of stuff that we don't know why we're doing it, don't evaluate it, don't explain it very well to the American people. Project leader might say "I don't have time for that." Well then, what do you have time for? Maybe as a system we haven't made that commitment yet. For us to be more science based we need to do more modeling. Are the participants being asked to create a model? That is not the purpose of the workshop. That is the job of USGS. The purpose of this workshop is to convey refuge needs. To ID needs and questions that refuge staff have to put into proposals.

Dan: then we need to go through the process. Now focusing on large scale multiple refuges. Individual refuges need to develop models for their own use.
Purpose of workshop isn't to develop a model it's to gather information to assist development of an adaptive management project.
Need conversation on what is a biologist's role on a refuge. Are we glorified biotechs?
There's lots of institutional knowledge in FWS. FWS is looking to gain defensible scientific credibility. Biologists doing good things on the ground but we can't quantify and defend it.
We're too focused on our own individual refuges. We don't tell others what we've done e.g. ecoteams.

Overview of Strategic Habitat Conservation (Jan Taylor, Regional Refuge Biologist,

R5, USFWS) How is SHC related to adaptive management, regional habitat goals and objectives, etc.?

Strategic Habitat Conservation
FWS shift toward a more complex and sophisticated science/mgmt relationship
Mgmt – focus less on opportunities and more on outcomes
Cross-program team – 2 tasks characterize current and evolving science based spatial explicit conservation strategies, recommend unifying approaches.
In most cases FWS programs are building expertise and capacity in an isolated manner. Need greater cross-program coordination and flexibility. Coordinate better with USGS and develop in-house expertise to undertake landscape level biological planning and assessment. Manage refuges as a system. Can't do it alone, hope someday to include state and private lands. Need to be transparent and show people why individual refuges are important in the larger landscape. SHC report has been to FWS leadership and it's been endorsed by them. Will encompass all program areas, not just refuges.

Difference from ecoteams – it's about working with partners on a broader ecoregional scale, not prescribed boundaries. Broad opportunity to work with partners to do what needs to be done on whatever scale is appropriate and figure out what FWS can contribute.

Discussion:
Each refuge needs to know how much of what type of forests they have first. Each HMP says you have to know this.
Tony: The difference between ecosystem approach and strategic habitat conservation is …… there are broad opportunities for partners to work together and decide on what can be done and it empowers us to do the right thing (strategic habitat conservation).

Small Group Exercise – Information Needs, Barriers and Limiting Factors for Setting or Achieving Management Objectives. Work in groups of 3-4. These groups will be assigned randomly.

Information Needs & Objectives

This exercise is designed to stimulate discussion about what you see as information needs, barriers, or limiting factors that make it difficult to set or achieve management objectives for forested ecosystems on refuges. You can use the survey results handout as a reference. There are no 'right' or 'wrong' answers to these questions. Please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

1. What are the primary forest management decisions that you need to make at your refuge? How often do you make these decisions?

Group 1: What treatment, where, when, how often.
Habitat mission, but need to determine mix of forest types depending on biological diversity wanting to achieve.

5 year re-evaluation of plan, annual re-evaluation of annual plants.

Group 2: How to achieve and maintain less flood affect forest type. How much of each forest type is appropriate. What species can be planted and survive and where. What is potential natural veg on a site. How should habitat patches be distributed on landscape.

Group 3: Decide to regenerate desired species
Need to decide what types of forest should be managed given landscape/abiotic factors.
Need to decide when to conduct mgmt actions/sequencing
How to achieve the goals that have been set in the CCP.

Group 4: Do something or nothing; what decisions to make.
Do we want to change the habitat (soybeans to wet prime/shrub).
Do we want to change the forest composition (how to do this?).
Where do resources come from to implement management?
Decisions often made infrequently (more seasonal mgt.)

Group 5: Natural regeneration, tree planting.
Broader conservation implications.
To maintain/manage for fire while not greatly impacting wildlife.
Passive mgt, would like to be more active. What is the health of my forest (no benchmarks). Not as much as we like.

Group 6: Forest area and how much.
Decide age, structure, species. (what is forest composition?).
Forest rotation length.
What management will produce results.
CCP every 15 years.
HMP approx. every 5 years with annual updates.

2. What information, currently available to you, is used to make these decisions? If you have forest management objectives, how did you use this information to write objectives?

Group 1: aerial photos (detailed). Stand data. Natural community data – includes some soil info.
Ecological land typing (land units).
No forest objectives.

Group 2: GLO – Historical data.
Elevation data (DEM)/ 2 feet (floodplain).
Hydroligic data, soil survey (surficial).
Scientific literature on species needs.
Expert opinion.

Group 3: Soil and abiotic
TSI, Seeding, planting, stand evaluation (good techniques)
How long it will take to conduct actions and timing of actions.

Historical data
Know the biology of target species (oak).

Group 4: Historical records (GLO notes).
Land cover, soils maps.
Aerial photographs.
Local knowledge (previous land owners).
Only dismal does have objectives (mostly used historical records).

Group 5: GIS overlays and a new forest assessment/Report.
GLO notes and data.
Soils and veg covers.
Base layer and historical information.
Information from forest service (state/fed).

Group 6: Foresters/experts from other refuges.
Forest stand classification (ranges from broad to specific, and some old).
Soil information.
Population goals (some measure of habitat mgmt. needs).

3. List information, not currently available, that you think is needed to make good decisions? How would you use this information to write or revise your management objectives?

Group 1: Land use history, historical conditions.
On Upper Miss complete forest inventory.
Soil data.
Stand data on surrounding lands.

Group 2: What is potential natural vegetation on a site.
Deep soil profile.
Detailed elevation data (floodplain).
Detailed vegetation data (existing).
Species specific habitat requirements.

Group 3: More precise topographical data.
More information on invasive species – bio cycle and control, and effect on regeneration.
Response of undesired species to drying of site.
Uncertainty in response of hydro change
Oaks reaction to mgmt is known but there may be elements present that make the outcome uncertain.

Group 4: Topography data (contour data at a finer scale (detailed elevation data)(helps determine objectives).
Hydrological data.
Soil information.

Habitat conversion/regeneration potential (what species would grow on our soils).
This info would help to narrow down/focus mgt. options on objectives.

Group 5: Expertise (forester).
Tap into production forester's expertise and knowledge.
Landscape indices.

Group 6: Historical data/ GLO notes/ Benchmarks.
Geomorphology and hydrology maps and relationship of geology and soils to vegetation.
GIS specialist to help organize and understand available data (soil, current veg, geography/geomorphology).

4. Of the information needs you have identified, are there needs that are specific to your refuge or do you think all refuges need the same information?

Group 1: All refuges would need similar information.
Historical, disturbance data, forest inventory, soil.
More specific landscape data.

Group 2: Specific endangered species information (common).
Potential veg (common).
Detailed elevation in floodplains (common).

Group 3: Yes, but some site specific.

Group 4: Probably a combination of both.

Group 5: Baseline information across refuges and non-refuge lands (soil layers, hydrology, etc)

Group 6: All refuges need same information, if they don't already have it.

5. What steps should be taken to obtain the information listed in Question 3? Who should take these steps – the refuge staff, Regional Office, or the NWRS and when?

Group 1: refuge staff/RO biological staff/ RO GIS staff

Group 2: Site; existing vegetation and soil profiles.
Regional; potential vegetation/landscape modeling.

Group 3: Adaptive management model.

Group 4: Refuge staff identifies the needs. Refuge office could collect, aggregate and help determine where to go (and who) to get the data.

Group 5: Additional support from other sources.
Local oversites (ground truthing).

Refuge staff may not be knowledgeable (guidance).

Group 6: Need to have info at national level.
Organize available info and combine in accessible database (regional level).
Locate existing resources, especially base layers.
Hire staff/assign staff to apply existing resources to refuge use (refuge level) (with funding support). Use promises report to determine what is useful.

6. What is the main difficulty that refuge managers and biologists face regarding writing (or evaluating) forest management objectives?

Group 1: Lack of understanding of forest dynamics.

Group 2: Different values – internal.
Environmental uncertainties.
Tieing wildlife objectives to habitat objectives.
Social and political influence (external values).

Group 3: The length of time before you can evaluate your action.
May never see the achievement of the goal.
The unknowns of #3 made it difficult.

Group 4: Not knowing if the objectives are realistic (achievable) (uncertainty). Fear of making a mistake. System is so altered now.

Group 5: Comfort levels, communicating ideas about forest ecology mgt.
Lack of forest mgt expertise.
How we fit into the refuge system scale.

Group 6: Historical forest community information limited.
Working with partners at landscape and regional levels (NABOI).
Coordinating local goals with partners often conflicts with refuge system goals.
Local limitations, such as T&E requirements, that conflict with refuge system.
Ensuring that objectives are meaningful and realistic (what is best way to make choices concerning goals).

7. How does the landscape context surrounding the refuge influence your forest management objectives?

Group 1: Varies refuge by refuge

Group 2: Assessing the relative value of types.
Not at all due to lack of predictability of private landowners.
Informally examining neighbors activities to assess needs but less critical than site conditions.

Group 3: no answer

Group 4: Corridor conductivity with private landowners of refuges. Adjacent landscape so altered (hydrology affected by landscape).
At Canaan, more flexibility to implement mgt. than the USFS.
At Dismal, RCW reintroduction HCP needed with landowner lug-in.

Group 5: Greatly, especially if you are in an urban setting.
Managing in a already altered environment.
Structural and spatial elements.

Group 6: Refuge property is limited by what it can provide. Need to understand landscape context is important to determine what a refuge can accomplish.
There are sometimes tradeoffs and agreements with other stakeholders that affect the type of mgmt used.
Surrounding urbanization and development eliminate forests; makes maximizing this habitat on refuge more important. Makes remaining habitat more critical.
Landscape directly influences some species needs, so refuge may never be able to provide appropriate habitat. Lack of control over landscape and other properties.

Discussion:

Leah: thought it was a local issue
Greg: There are too few foresters within USFWS, biologists don't get forestry/silvic. background
John: Refuge biologists are focusing now on woodland bird biology, but now is the start of focusing on forest mgmt
Susan K: you can have both, wildlife habitat and forest production. But we don't because it seems as if there is a negative connotation with "forest production"
Rick: Forest mgmt is a slow process. Bottomland forests/ trees are dying and now all of a sudden noticing it. Because it is a slow process. It creeps up on you.
Tom L: This is new ground for USFWS, there was very little resources within USFWS to help him. Also, new forests on refuges recently. Using expertise from other agencies, even long-term, is a positive direction.
Tony: We did what we did back then because that was the era, but we can change these things thru AM
Matt: Everyone here puts a priority on forest magmt. That is why you are here. We need people to commit to this effort especially since this is a long term process.

Panel Discussion (Moore, Lonsdorf, Taylor) Question and answer session

Hal: He feels people still think biologists want to manage for focal species.
Jan: We are not putting ecosystems first. Or thinking at that level first. Even though we have priority species (birds) that is what the CCPs say that's what we should focus on.
Eric: Yes that is a goal put we have a partner and is there
Jan: we don't have pop goals at a landscape scale.
Greg: Refuge improvement act, talks about ecological integrity as a principle on refuges, it gives us direction on that.

Jan: but you also have legislation on each refuge that supersedes that. Mostly for Migratory birds. We look at that first, then start incorporating other species
Laurie: Yes CCP says primary focus is usually migratory birds but then I thought of Mitch's talk about how birds don't really have specific forest requirements other than patch size. SO where does that leave us in terms of forest mgmt.
Mitch: There are a small # of birds that are really in trouble. They haven't really lost that much habitat. Birds a fairly catholic in terms of their habitat.
Eric: Migratory birds is a national objective, then there are more region goals, then refuge specific goals like ecological integrity. Try to organize the obj this way. Some have constraints, some don't and balance your objectives.
Wayne: golden winged warbler mgmt now
Mitch: problems with forming objectives like bird pop is dynamic. Changes happen more frequently than like trees. How do you set objectives given moving targets of bird pop changes and Clint how do you incorporate that into AM?
Clint: That is the heart of setting objectives. If you go with a pop abundance based measure objective than the models have to be forgiving in terms of meeting objectives and stuff outside of your control as it plays out on the land. SO maybe if you are honest about the stochasitic elements then there may not be a lot you can do. Maybe there are other things can be done like if you focus on diversity bird community. Am I doing better than the land around me. Or if I want to maintain the area as a source and never becomes a sink.
Eric: maybe monitor an indicator that is sensitive. When should I be concerned? Or a range of observation is set.
Jan: we are not setting pop objectives or even a range (an index). We are setting habitat structure. Species habitat relationship is looked at but not measuring birds.
Eric: All you can do is maximize the potential for birds it doesn't matter wa
Don: They have been doing songbird surveys for 30 years. Basically the structure of the forest…..the birds they have are associated with certain types of trees. You have to look at each situation. It is the structure of the forest not the majority of the species.
Laurie: Maybe we don't' need to worry about spp requirements because the birds will do OK regardless of structure.
Melinda: We are still carrying along the tradition of both magmt for species and …..
The needs of the animals that are not doing well elsewhere we have a duty to deal with it. But if you don't have a spp than ecological integrity should be the focus.
Jim: We should be focusing on a larger scale, and bigger issues because if you follow this it will trickle down to benefit all the spp.
Matt: proper metrics, in an ideal world you can manage for whatever you want and measure it. Maybe a using a bird is not the right metric, or something that is more resilient.
Joe: you have different scales, it is silly just to look at birds because they can be missed when they are there. There should be a national plan. There needs to be a diversity to support a diverse population. Protecting a genetic pop of a spp. A refuge can be good at it, or contribute to the health of a population. Metric at different scales is good use.
Laurie: T&E species on refuge should be focus. But with ecological integrity, birds should be the metric, maybe a mammal or forest floor animals. Maybe amphibians, like salamanders would be appropriate because some are tied to ecological characteristics.
Jan: That is a good idea because a lot of refuges have vernal pools.

Clint: The challenges will be scaling the objectives. Scales affects. Refuges are in very diff landscapes needs to be taken into account.
Melinda: must monitor a metric that is politically correct because public expects us to do that. But other metrics can be followed that are more scientific based, robust, and sensitive for feedback about mgmt. I don't think birds are appropriate but the public.
Eric: birds have a much larger scale than herps. Your scale at a particular scale would be for a herp. But if birds are measured at all refuges, a national level, the population moves and is a larger scale vs herps because they don't move. The model has to have appropriate scale.
Wedge: Pacific Northwest work, its important not to get hung up on one animal and to be more open.
Jennifer: Birds as trust resources. Once we decide what kind of forest we want then look at a more indicative, has that habitat becoming what we want. We need birds to determine how a property sits but herps to make sure we are going where we need to go.

Small Group Exercise – Refuge Forest Management Scenarios
Work in groups of 3-4. These groups will be assigned randomly. Each group is given a different hypothetical scenario and will answer several questions.

Refuge Forest Management Scenario: Central Hardwood and Bottomlands

This exercise is designed to stimulate discussion about refuge forest management objectives and monitoring metrics. The scenario describes a hypothetical FWS refuge with 'real' problems. Following the scenario, some specific discussion questions are posed. There are no 'right' or 'wrong' answers to these questions. Have fun with this and please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

Ohio Valley NWR: central hardwood and bottomlands in the lower midwest

Ohio Valley NWR is 35,000 acres in size and contains large stands of flatwoods, mesic central hardwoods on slopes, and bottomland hardwoods line the tributaries of the Ohio River within the refuge. Your refuge was created from former farm land with many woodlots. Much of the forest was regenerated within the last 60 years, creating even-aged stands of sweetgum, tuliptree, white and green ash, red maple, American sycamore and little oak component on former farmland. The older woodlots have mature (>150 years old) stands of swamp chestnut oak, white oak, red oak, shellbark hickory, American beech, sweetgum, and red maple in the flats while bottomland forest contain walnut, pin oak, swamp chestnut oak, green ash, American sycamore, shellbark hickory, red and American elm, and silver maple. Mesic ridges bordering the bottomland contain tuliptree, white and red oak, hickory sp., American beech, and sugar maple. The refuge has remotely sensed GIS layers of habitat, but no stand specific data or GIS layers exist. Emerald ash borer and gypsy moths are now within 3 counties of your refuge and dogwood and sycamore anthracnose are currently affecting your forest stands. Fire is used extensively on the refuge to maintain grassland and shrubland (forest 50%, shrubland 30 %, and grassland 20 %) and The Nature Conservancy and the Natural Heritage botanists support burning of forest (especially flatwoods and areas that are dry ridges or south facing slopes) to support unique communities of rare plant species. The grasslands and shrublands also contain rare flora (prairie species) and

fauna (Henslow's sparrows and crawfish frogs both state listed, and woodcock are abundant during nesting), but keeping these areas open is complicated due to woody intrusion (sweetgum, black locust, and sumac). Northern copperbelly watersnakes (state endangered) and Indiana bats (federally endangered) are also found on the refuge. This area was probably mostly forested pre-settlement. Extensive bird research has been done, forest bird nests are heavily impacted by cowbird parasitism and predation (because of the predominant agricultural landscape), while grassland birds do better because of very low parasitism rates. Invasive species also complicate prescribed fire; Japanese stilt grass now invades forested habitat following burns and out competes native understory and hinders tree recruitment. Also privet and bush honeysuckle are invading the understory of forests and are decreasing tree growth due to competition and perhaps alleopathic chemicals.

Landscape: The refuge is surrounded by agriculture (mostly row crops and some livestock pasture). Small scattered state and NGO areas contain forested habitats in 100 acre to 2,000 acre size range in the landscape surrounding the refuge. The landscape within 10 km of the refuge is < 40 % forested. Small towns and agricultural lands are common in the landscape, and the remaining forest is secondary growth fragments (this area of Indiana was almost totally cleared of forest by the mid 1800's). Forest and shrubland and grassland bird groups are the highest priority for the FWS in this region, because of the large populations that use these habitats within the heart of their range. Because of the cultural landscape and a paucity public land in this region, there is high demand for good hunting opportunities on all public lands within this area (deer, turkey, and quail).

1. What information do you need to set defensible habitat management objectives for the forests at Ohio Valley NWR?

Inventory – DBH, Density, snags, regeneration, ground flora (ideally)
Maps – (GIS) elevation, flooding, soils, vegetation

2. What type of assistance from USGS and the research community would be most helpful to you in setting management objectives and managing the forests at the refuge?

Same as #1

3. How would you set priorities for forest management, given the issues outlined above? (Use the FWS Biological Diversity and Environmental Health policy and other FWS policies as a guide.) What tradeoffs (incompatible management objectives) will need to be resolved?

Focal Species – Indiana bat
Invasive species
Sustain forest areas – convert to unevenaged, concentrating on flatwoods, bottomland hardwoods, mesic
Invasive species management
Focus forest and open area mgmt in context.
Reforest openings in forested areas and keep opening near ag. Edge.
Monitor emerald ash borer.

4. How would you define the role of your refuge in meeting habitat or population goals set for the region surrounding the refuge, assuming there are some regional goals?

Contribute to Indiana bats
Benefit high priority BCR species/Henslow's sparrow.
Consider land purchasing or private lands programs – work on increasing forest area or prarie/shrubland where adjacent to those communities within refuge.

5. What do you think the forests at Ohio Valley NWR should be like in 50-100 years (desired future conditions)? What should the forest plant community (trees & understory) be like, what focal species should be supported, what recreational/hunting opportunities should be available? (If you have no knowledge of central hardwood/bottomland forests, just do your best.)

Encourage development of diverse age classes using silvicultural treatments.
Increase forest block size.
Restore structure and age diversity using silvicultural treatments.

6. Let's assume that you have the information that you need (#1 above), please list one or two forest management objectives that might appear in a habitat management plan for Ohio Valley NWR.

Restore forests in areas that will increase connectivity between each habitat.
Within the next 15 years restore based on new acquired USGS data from question 1.

7. Select one of the objectives above. If you can only measure one thing, what would you monitor to evaluate achievement of that objective? Staff & resource limitations (3 field staff and budget of $5000 for field biology) prevent you from conducting a comprehensive monitoring program.

Improve Indiana Bat habitat by managing for trees/acre as recommended by the Indiana bat recovery plan.
Monitor forest condition.
Density
Basal area
Species composition

Refuge Forest Management Scenario: Floodplain Forests in Illinois

This exercise is designed to stimulate discussion about refuge forest management objectives and monitoring metrics. The scenario describes a hypothetical FWS refuge with 'real' problems. Following the scenario, some specific discussion questions are posed. There are no 'right' or 'wrong' answers to these questions. Have fun with this and please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

Handy Hill NWR: floodplain forests in Illinois

Handy Hill NWR has 1,500 acres of floodplain forest along the Wissooka River in Illinois. The Wissoka River is a large river and a tributary of the Mississippi River. The refuge is surrounded by agriculture (corn & soybeans). Small towns and some agricultural lands are leveed off from the river. Your refuge was created from farm land when levees failed in the last major flood and the owners sold the land to the FWS. The floodplain forests (cottonwood & willow) are regenerating on some, but not all of the former crop lands. The open fields are covered with invasive Johnson Grass; few native grasses have been established. The local hunting clubs want the Refuge to plant mast trees in these open fields. This has been tried elsewhere in the region, but tree recruitment has been poor due to occasional flooding (the old levees retain water long after the flood subsides) and competition with invasives. No bird surveys have been done, but the local Audubon members report large numbers of migrating landbirds are using the area in the spring. Wood ducks use the forest for nesting habitat. The state-listed crawfish frog is a special concern species in IL and is present in some adjacent floodplain forests owned by the state of Illinois. No surveys for the frog have been done on the Refuge.

Landscape: You are within a heavily agricultural region of Illinois, with few natural habitats remaining. Bird research in the region indicates that most forests are sink habitats for breeding landbirds because of the low forest cover in the region. The historical floodplain forests in the region were dominated by American elm, green ash, and cottonwood. Grassland birds as a group are the highest priority for the FWS in this region, because they historically used the extensive prairies that are now cropland. Because of the limited area of 'natural landscapes' in this region, there is high demand for good hunting opportunities on all public lands.

8. What information do you need to set defensible habitat management objectives for the forests at Handy Hill?

Landscape/regional analysis to determine if this is a priority refuge for grassland birds.
Inventory (taxa, veg)
Topographics
Better invasives info
Range of habitats can we create with a budget
Hydrology
Natural disturbance
Historical conditions

9. What type of assistance from USGS and the research community would be most helpful to you in setting management objectives and managing the forests at Handy Hill?

Geomorphology maps
Hydromorphology maps
Gaug station records (flood frequency)
More info/research on crawfish frog lifecycles
Combating invasives research if not found in lit review

10. How would you set priorities for forest management, given the issues outlined above? (Use the FWS Biological Diversity and Environmental Health policy and other FWS policies as a guide.) What tradeoffs (incompatible management objectives) will need to be resolved?

Use info such as hydromorphology/topography to determine if/where forest restoration could occur. Rank or further prioritize species. Refuge contribution to; the service, the region, the ecosystem.

11. How would you define the role of your refuge in meeting habitat or population goals set for the region surrounding the refuge, assuming there are some regional goals?

How important is our refuge? Team approach
Use available info such as PIF physiographic regions/ BCR info, state wildlife action plans, etc.

12. What do you think the forests at Handy Hill should be like in 50-100 years (desired future conditions)? What should the forest plant community (trees & understory) be like, what focal species should be supported, what recreational/hunting opportunities should be available? (If you have no knowledge of Midwestern floodplain forests, just do your best.)

They would be in transition to mid-stage of development
Structurally diverse and native/historic composition.
Need more info for beneficiaries
The big six- hunting, fishing, observation, photo, interp., education
Those ID as threatened or through PIF/BCR assessment.

13. Let's assume that you have the information that you need (#1 above), please list one or two forest management objectives that might appear in a habitat management plan for Handy Hill NWR.

Establish historic vegetation floodplain forest type in areas determined to be most suitable.
Maintain suitable conditions (flooding) in low elevation areas for crawfish frog and grassland species.

14. Select one of the objectives above. If you can only measure one thing, what would you monitor to evaluate achievement of that objective? Staff & resource limitations prevent you from conducting a comprehensive monitoring program.

Structural/age variability of forest community composition.

Refuge Forest Management Scenario: Mixture of Forest Types

This exercise is designed to stimulate discussion about refuge forest management objectives and monitoring metrics. The scenario describes a hypothetical FWS refuge with 'real' problems. Following the scenario, some specific discussion questions are posed. There are no 'right' or 'wrong' answers to these questions. Have fun with this and please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

Sudo Creek National Wildlife Refuge: mixture of different forest types

Sudo Creek NWR contains a total of 60,000 acres. Habitat types include upland hardwood forest, bottomland hardwood forest, pine forest, agricultural fields, grasslands and open water of roughly equal area coverage. The various habitat types are interspersed with each other resulting in an abundance of edge and fragmentation. The upland forest has oak-hickory on ridges and south-facing slopes and a mixture of mesic hardwoods on north-facing slopes and in valleys. The bottomland forest is mainly mature and old-growth pin oak with a profusion of red maple, ash and elm regeneration, and little else. It appears that the beaver population is growing based on expanding flooded, dead timber areas, which are colonized by cattail and *Phragmites*. All of the southern pine plantations were established in the 1930s by the Civilian Conservation Corps on old farm fields. Pine is not native to this area where the pre-settlement cover was 90 percent hardwood forest and 10 percent prairie. About half of the pine stands have been thinned in the past and hardwood regeneration is becoming established there, but not in the unthinned stands. The grassland cover is mostly fescue with small patches of native, warm-season grasses; autumn-olive, multi-flora rose and Johnsongrass are also present throughout the grasslands. The refuge devotes a great deal of resources to control the invasion of trees in the grasslands. The refuge allows cooperative farmers to grow corn and soybeans in the agricultural fields. Most of the water area is in artificial impoundments on the various tributaries of Sudo Creek. There is a 7,000-acre Wilderness containing upland and bottomland hardwood and pine in the southern portion of the refuge.

The land north of the refuge is urbanized; to the east and west are low-density residential areas and agriculture (row crops and pasture); and the south boundary adjoins a national forest and a state park, which are mostly forested. The local hunting clubs adjacent to the east and west sides of the refuge want agricultural fields or grasslands near them; if the refuge were to convert these areas to forest, the politically powerful hunting clubs would object. An experienced forester at the adjacent national forest has forewarned the refuge manager that reforestation would be problematic because of the high deer population and competition from highly invasive autumn-olive. One maternity colony of the endangered Indiana bat has been found in the largest stand of bottomland forest. Bird research in the region indicates that most forests are sink habitats for breeding landbirds because of the fragmented forest cover. The refuge is a popular destination for hunting, fishing, hiking and wildlife observation.

The refuge has just started preparing its CCP and identified some preliminary wildlife habitat management goals:

1. Reduce habitat fragmentation in forest and grassland types
2. Convert all non-native pine plantations to native hardwoods
3. Minimize agricultural fields and convert these to forest
4. Control non-native, invasive plants

1. What information do you need to set defensible habitat management objectives for the forests at Sudo Creek NWR?

Current cover and soils to determine historic/potential veg.
Bat locations and habitat info.
Landscape context of ag and open fields for deer hunting issue.
Confirmation that pine removal will have no adverse affect.
Scientific data to suggest that field removal will improve or have no negative effect on hunting.
Coarse physical features map.
Specific habitat needs for other target species/invasive ecol. And control.
Biological inventory with focus on protected plants.

2. What type of assistance from USGS and the research community would be most helpful to you in setting management objectives and managing the forests at Sudo Creek NWR?

Bio inventory.
Landscape analysis
Habitat information for target species
Beaver impacts (historic vs present)
Why are pin oaks not being replaced and is this OK?

3. How would you set priorities for forest management, given the issues outlined above? (Use the FWS Biological Diversity and Environmental Health policy and other FWS policies as a guide.) What tradeoffs (incompatible management objectives) will need to be resolved?

Refuge purpose.
Trust resources.
Time sensitivity analysis (ie. Are there critical short-term issues).
Pine removal and potential good effects.
Political fall out vs biology driven mgmt.
Ag conversion to forest vs invasive species.
Forest vs. grassland species.

4. How would you define the role of your refuge in meeting habitat or population goals set for the region surrounding the refuge, assuming there are some regional goals?

Maintain habitat needs for Indiana Bat.
Maintain Pin oak quantities by replacing conversion areas with planted pin oak.
Reduction of fragmentation by eliminating isolated ag fields.

5. What do you think the forests at Sudo Creek NWR should be like in 50-100 years (desired future conditions)? What should the forest plant community (trees & understory) be like, what focal species should be supported, what recreational/hunting opportunities should be available?

Relatively open forest (but not structurally homogenous) with pine eliminated and prairie limited to areas where it was documented historically with a variety of forest types that would have naturally occurred there. (90%/10% ratio).

6. Let's assume that you have the information that you need (#1 above), please list one or two forest management objectives that might appear in a habitat management plan for Sudo Creek NWR.

Work with other agencies and hunt club (same as #4)

7. Select one of the objectives above. If you can only measure one thing, what would you monitor to evaluate achievement of that objective? Staff & resource limitations prevent you from conducting a comprehensive monitoring program.

Indiana Bat
Stem density in conversion areas by height class

Refuge Forest Management Scenario: Northern Hardwoods and Spruce-Fir

This exercise is designed to stimulate discussion about refuge forest management objectives and monitoring metrics. The scenario describes a hypothetical FWS refuge with 'real' problems. Following the scenario, some specific discussion questions are posed. There are no 'right' or 'wrong' answers to these questions. Have fun with this and please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

Smokey Hollow NWR: northern hardwood and spruce-fir forests in the northern and central Appalachians.

Smokey Hollow NWR has 15,000 acres of northern hardwood and mixed coniferous forest in the Appalachian Mountains of West Virginia. The refuge is surrounded by private, state and national forests as well as agriculture (livestock pasture). Small towns and some agricultural lands are common in the landscape, however secondary forest predominates. Your refuge was created from former farm land with many woodlots. Much of the forest was harvested within the last 50-70 years, creating even-aged stands of American beech, black cherry, and birch. Beech is a dominant species, however beech bark disease has recently infected many stands and mortality is occurring. Deer numbers are high and inhibit regeneration of many native tree species, favoring an understory (where one exists) of beech. The riparian forests and shrublands (black spruce & black ash, alder & willow) are regenerating on some, but not all of the former pasture lands. The open fields are covered with Spirea spp, multi-flora rose, Japanese barberry, and black locust saplings. No bird surveys have been done, but the local Audubon members report large numbers of migrating landbirds are using the area in the spring. Oven birds and hermit thrushes use the forest for nesting habitat, and woodcock use the riparian alder stands and forest edges particularly during migration. The state-listed crawfish salamander is a special concern species in WV and is present in some adjacent forests owned by the local water district. No surveys for the salamander have been done on the Refuge.

Landscape: You are within a moderately forested region of West Virginia, with few natural habitats remaining. Bird research in the region indicates that most forests support habitats for breeding and migrating landbirds, several of which are of conservation concern in the region. The historical riparian forests in the vicinity were dominated by black spruce, balsam fir, black ash, and speckled alder. Forest and shrubland bird groups are the highest priority for the FWS in this region, because they historically used the extensive forests that now agricultural land farther north. Because of the cultural landscape and a paucity of early successional forest in this region, there is high demand for good hunting opportunities on all public lands.

1. What information do you need to set defensible habitat management objectives for the forests at Smokey Hollow?

Stand structure/inventory baseline data
Basic habitat map
Soil mapping
Historical land use data
Historic forest processes/site capibilities

2. What type of assistance from USGS and the research community would be most helpful to you in setting management objectives and managing the forests at Smokey Hollow?

More information on adjacent land use
Geomorphological data
Hydrological
Refer to USDA for additional regional forest cover types
Impact of invasives and deer on regeneration

3. How would you set priorities for forest management, given the issues outlined above? (Use the FWS Biological Diversity and Environmental Health policy and other FWS policies as a guide.) What tradeoffs (incompatible management objectives) will need to be resolved?

Realistic forest stand composition
Is beech bark disease a disease we are going to battle or establish another dominant community?
Consult forest deer management/harvest. (can't read entire comment)

4. How would you define the role of your refuge in meeting habitat or population goals set for the region surrounding the refuge, assuming there are some regional goals?

Regional population goals for individual focal species or communities.

5. What do you think the forests at Smokey Hollow should be like in 50-100 years (desired future conditions)? What should the forest plant community (trees & understory) be like, what focal species should be supported, what recreational/hunting opportunities should be available? (If you have no knowledge of northern hardwood forests, just do your best.)

Beech/hemlock as dominant with early successional habitat in areas inflicted with beech bark.

6. Let's assume that you have the information that you need (#1 above), please list one or two forest management objectives that might appear in a habitat management plan for Smokey Hollow NWR.

Restore, enhance & protect 5,000 acre riparian forest for a representative of that community.
Create 500 acre early successional habitat each year over the next 20 years (for woodcock).

7. Select one of the objectives above. If you can only measure one thing, what would you monitor to evaluate achievement of that objective? Staff & resource limitations prevent you from conducting a comprehensive monitoring program.

Measure total acres of early successional habitat <3 meters tall.

Day 3: Thursday

Review of Day 2 (Sutherland) Facilitator asks for participant insights from Day 2

John: He likes AM. It has more merit than ecosystem team did. So he is optimistic for the future.
Hal: The field of wildlife mgmt is going thru a changing process. So there is an evolution, so is the refuge system, we are trying to learn new things. The refuges are purchased for very specific sites because of what they contain. So now we are broadening our scope. So we should criticize

ourselves that we haven't done forest man so we should be happy that we are sitting here now trying to incorporate forest mgmt needs.
Wedge: We shouldn't have a huge expectation. Lets think outside of USFWS for help, like w/ USFS. There is no need to reinvent the wheel the USFWS. We should ask other agencies to help.
Greg: That is a great idea. Those people would jump at the opportunity.
Dave R: We do go for fiber but that is not the only thing concentrate on. We jump on opportunities to cooperate with other agencies for goals other than fiber production. He sees a lack of clarity in the workshop. Don't let the fact that you don't know or don't have the budget stop you. You can get help and a little imagination. HE hasn't heard what happens beyond the refuge borders/fence. He says that what you do on the inside has a huge effect on the outside of the fence. For instance, you can take away the resources from local people. People look toward gov. land managers as the best resource experts. So people assume that what you are doing is right.
Greg: The idea of mgmt in late successional communities is hard to do vs. early successional which is easy to do.
John: All of the agencies have different policies. Land acquisition. Politically it pays off to communicate with the public and when it comes to land acquisitions letting locals continue using the refuge.

Leah: We need so much information. Data needs first and then AM part. But maybe we don't need all those things. Maybe we should just take what we need now and start the model from where we all rather than getting all the info about the land.
Todd: if you keep waiting for all the info/technology, you will never get anywhere.
John: talking about the decision circle to get objectives. With research you don't get anywhere, but with AM you can progress and get somewhere.
Todd: AM is good because you have so much uncertainty. You could have all the info in the world but if you don't have objectives, your not going to get anywhere.
Matt: It seems like most people don't even know what the have so that can't start and characterize and to know how they interact with each other to create a model. It seems you can't have a model development without baseline info. Maybe the RFP should say both of those. The Reed canary grass issue is more focused, but here we are trying to find themes about upland and bottomland veg. We might leave a lot of people out in the cold if we can't incorporate all types of forests.
Tony: I don't think we should feel constrained to deal with only certain types of forests. We need to come up with something we can get our head around. We can't get hung up and trying to find something for everyone. We just need to come up with issues whether they relate to all or not.
Eric: There are models that can be used. Get the structured decision process in use. Organize what you have and focus on objectives. There can be an overall approach that you can use and be modified for different issues.
Joe: You can put different themes in the landscape scale. Then other metrics would come in after that.
John: we need structured guidelines to incorporate these AM.
Hal: modeling is just another tool. We often think of modeling as too complex. If they could attempt modeling and then call Eric to help.
Susan: Forest successional stages seems to be the common theme. Comparing the stages.

Dan: stay focused on goals and objectives and don't worry on prescriptions.
Jim: There are so many variable and responses in refuges that we need to find a technique that will move your forest in a positive direction.
Leah: Is one use of model to help create obj. than to use the obj
Eric: You could use modeling to help establish objectives then go on to more specific refuge objectives so there are separate modeling approaches.
Todd: planning sucks. It is hard for people to come up with objectives even for simple things.

Hal talks about upcoming exercise:

You all represent a lot of other folks. We are trying to do is design a wolf project that meets the needs of a lot of other people. Identify what is our info needs.
We could use USGS just help us come up with our objectives! A higher level project.
Try to think of higher level projects.

Small Group Exercise – Possible Themes for Multi-Refuge Project. Work in groups of 3-4. Groups will be assigned randomly. Each group will answer several questions related to a multi-refuge adaptive management research project in collaboration with the USGS. One of the primary questions is related to monitoring metrics that could be performed by participating Refuges.

Group Exercise – Possible Themes for Multi-Refuge Project

This exercise is designed to solicit your ideas for a multi-refuge research project in collaboration with USGS. There are no 'right' or 'wrong' answers to these questions. Please record your group answers on a single scenario worksheet that you will use to report to the full group. Please turn the (legible!) summary sheet in to Todd Sutherland.

The USGS may have funding to conduct research to help refuges improve their management of forests. If a forest project is selected, the requirements for this project will be:

1) Research must be based in the principles of adaptive management.
2) Multiple refuges with different habitat types will likely be involved.
3) Forest management treatments (if appropriate) will be conducted by FWS (refuge) staff.
4) The data for the research will be collected by the FWS (refuge) staff at participating refuges.
5) The research study design, analysis, models…etc. will be designed by the USGS with consultation and collaboration by refuge staff.

<u>In small groups, please discuss and answer the following questions</u>:

1) What should be the primary focus of a multi-Refuge research project that meets the above requirements?

Group 1: What variables are most important to conduct landscape analysis and develop GIS process. Develop quantitative analysis process/software.

Establish indicators that can be used to monitor success of reforestation/even-aged rehabilitation specific to habitat variables (shrub density).

Group 2: How to maintain forest health (regeneration, processes) in the face of invasive plants or exotic insect pests.

Group 3: Multi-scale
layers of information (3 or so),
top-down,
context derived,
with AM project the 3rd tier linking landscape metrics (2nd tier),
deer browse, regeneration, alluvial sedimentation, or other.

Group 4: Develop a model to assess a variety of factors for conversions of open areas to desired forest conditions.
Factors include: soil, aspect, topography, hydrology, surrounding vegetation.

Group 5: Commonality- invasives, ecological integrity, fire,
Ecological integrity, scaled to the size of your forest
Regeneration
Sustainability cycle

2) Is there a research approach or unifying theme that would encompass multiple forest types in a research project that meets the above requirements? If yes, please list and describe.

Group 1: Prioritize level of importance of potential goals/objectives.

Group 2: Monitoring forest response after treatments.

Group 3: certain levels/data are provide for uniformly across R3/R5 refuges.
Regeneration (planting) (or other).

Group 4: Yes, both regions have similar questions that need to be answered in a variety of landscape and forest types (ie. What happens to this open area if we do nothing? If we burn? If we plant/seed?).

Group 5: Forest sustainability cycle scaled to the refuge within the context of the landscape to achieve ecological integrity.

3) Identify <u>one product</u> your group feels would be most useful as a result of a research project that meets the above requirements. Please be as specific as possible.

Group 1: Landscape model/decision model, product would query user/manager and identify important data variables.

Something that would provide recommendation relating to structural/composition landscape distribution of refuges based on surrounding conditions and previously prioritized species of importance.

Group 2: Dichotomous key or cookbook that allows refuge specific input/of conditions (invasive species, forest type, hydrology, mgmt tools available) to help choose best mgmt strategy over time.

Group 3: Landscape metrics (ex. 10 km buffer)
NLCD, fragstats (or other)
must pick suite of metrics (e.g. mean patch size, connectivity, isolation, patch shape, etc.).

Group 4: A prediction model for predicting results of various treatments including no action.

Group 5:Determine the treatments needed to obtain sustainability, given a specific situation (a process).

4) List 3-5 types of monitoring activities that could be conducted by Refuge staff to help inform forest management decisions in regards to identifying priority objectives and evaluating achievement of objectives. Please consider that your station may be compensated approximately $6000 per year to conduct this monitoring.

Group 1: Permanent plot inventory (veg/wildlife), remote sensing (satellite imagery, aerial interp), indicators/collection protocol.

Group 2: Pretreatment condition- invasive density, extent, forest type (tree spp, density, size class, regeneration), disturbance/land use history, soils, hydrology, slope, aspect.
Response of invasive- density, extent
Response of forest trees and other taxa (indicators/indicator species).

Group 3: Tpa/spa
mortality (browse)
growth rates, deer density (continuous or categorical)
invasive competition, hydrology
Results could be mapped/ spatially presented.

Group 4: Veg surveys/plots, stem counts
Invasives
Point or transect counts to monitor bird use
Site specific abiotic factors, slope, aspect, soil, hydrology, surrounding vegetation (seed source)
Herbivore density

Group 5: Determine acreages and successional stages
Collect plot data within treatment areas – map invasives, regeneration, species composition and numbers.

The entire group focused on # 1 above (What should be the primary focus of a multi-Refuge research project?) **to try to synthesize the ideas across groups. We came up with the three statements below. We did not prioritize among the three statements.**

1. **Multi-scaled, context-derived project to assess and evaluate landcover and landscape indices, providing a context for an Adaptive Management study linking regeneration and invasive species (such as deer browse).**

2. **Develop a process for maintaining a forest sustainability cycle to achieve ecological integrity, scaled to the refuges within a landscape context.**

3. **Develop a model to assess a variety of factors for conversion of open areas to desired forest condition (predictive model that leads to forest type and spatial location).**

Comments on the above exercise:
Leah: They (three statements) are all similar. Ask USGS to develop of model that does everything and incorporates everything. That is a huge task.

John: we want to keep it as practical as possible.
Hal: I agree. There are related but there are 3 chunks.
Wedge & Rick: we are all converting open areas to forest and we think it is manageable to do.
Keith: A proposal could come out of this easily.
Jim: There is already a program that sustains forests.
Joe: You measure all these things and you relate them at all these levels. You have diff influences on planting a tree. You have altered hydrology. There are some unified things, like reforestation.
Matt: The methods you use to manage your forests are not going to be new. But what is going to be new is the results put into decision making. The primary focus should be regionally important. The methods
John: The Starfield method has sooo many variables and can get complicated so maybe we should think more simply.
Joe: You figure out which tool is best to use
Tony: He is worried about what we are really going to study. We don't need to develop techniques for reforestation. We need to ecosystem health or as simple as Henslow's sparrow. He is concerned none of the 3 things go far enough to try to learn how things work. We need to bridge from looking at these 3 things to look at what we want to influence, he is concerned.
Tom: Plugging variables into a decision model.
John: He thinks all the 3 things can be incorporated into a bigger picture (umbrella objective)

Eric: You have maps of each of abiotic (USGS can do), biotic, threats, targets, action (lit review), expectation and observed (can be matched up with expectation)
Then you decide what your actions are.
At this point, Eric presented a model that captured many of the elements of the three statements above describing the focus of a future USGS research study. The model suggests how this very

large endeavor could be broken down into steps that could be worked on separately and brought together in a synthetic framework.

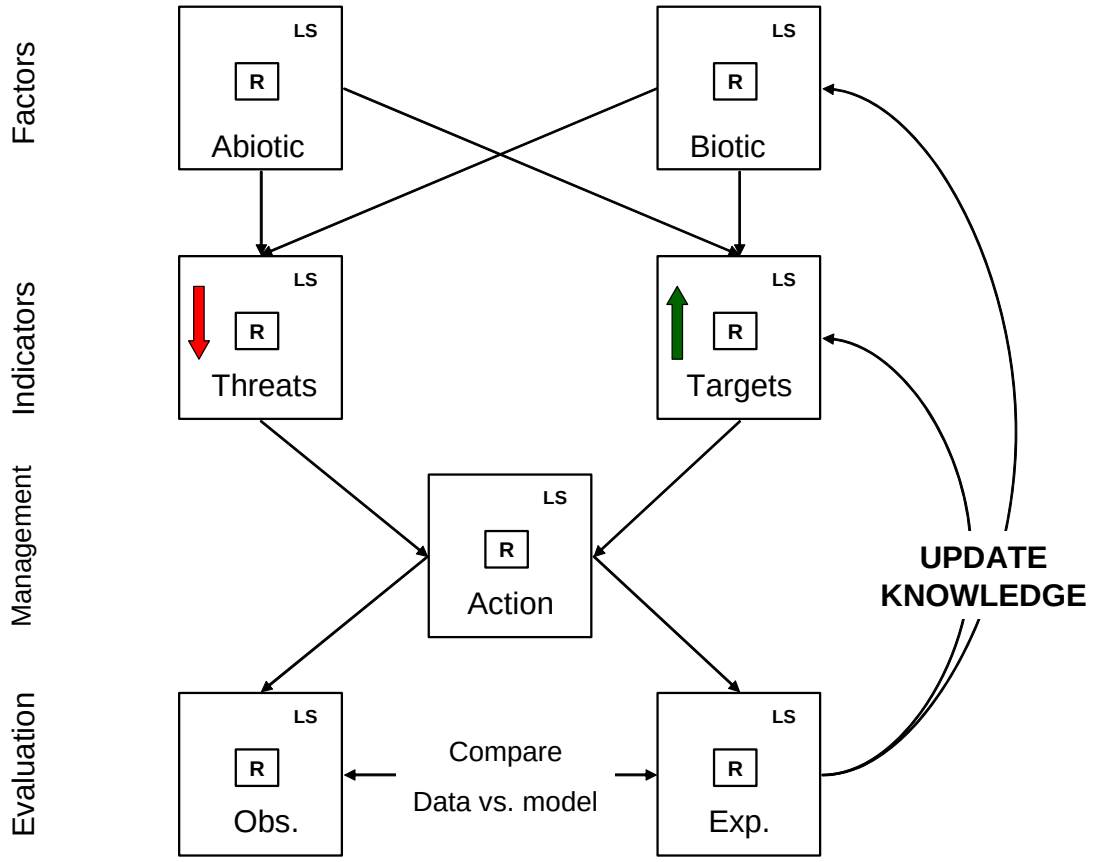


Figure 1. Conceptual model of the elements of decision-making for setting land management objectives, at two spatial scales, landscape (LS) and refuge (R). Adaptive management (Fig. 2 below), fits into the lower half of this model, after objectives have been set.

The outer box represents a spatial map at the landscape scale (LS) and the inner box represents the refuge (R) within this landscape context. Abiotic factors include, soil, topography, moisture, flooding potential, nutrients, etc. Biotic factors include seed sources, land cover, disease prevalence, etc. The USGS is particularly well-suited to provide these maps since their strength is geographic inventory of geomorphology and physiography, as well as Biology.

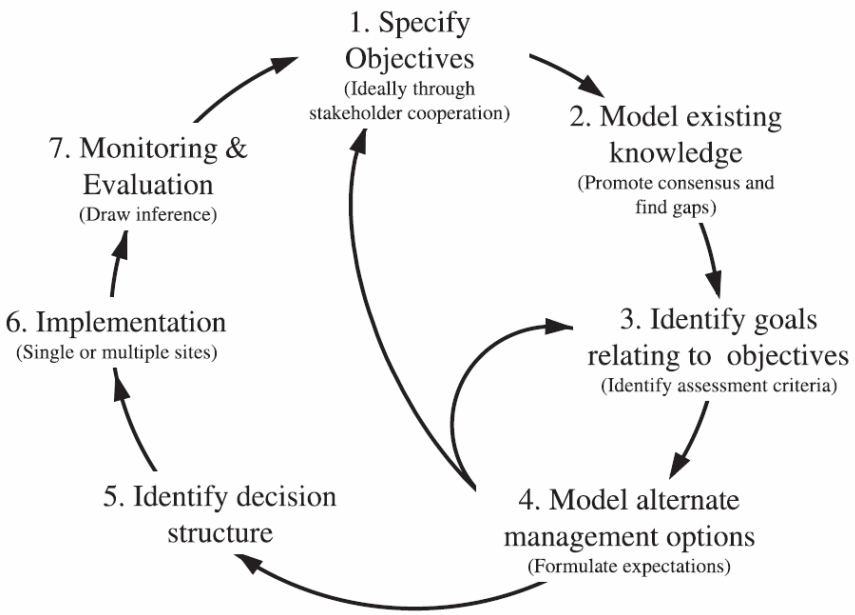
Based on the factors, a predictive framework is needed to determine how those factors affect where the threats are (e.g. RCG, disease) or their potential to get somewhere (predictive model) and where our management targets (what we want instead) are now or their potential to be there.

The step from factors to indicators helps determine what a refuge's objectives should be for management. Whether it should be threat-focused, target-focused or both and where these

objectives are most relevant. These objectives also take into consideration landscape context and potential federal or state mandates – things you cannot ignore (constraints). This is also the step where guidance at the regional level is most needed since this basically part of an eco-regional plan. Reed canary grass (the focus of a previous workshop) makes this step an one easy because it is such a dominant threat. The refuges with forests do not have such a clear threat or target and thus are having trouble identifying their objectives.

Once objectives for targets and threats are agreed upon, adaptive management can occur at full-speed. This will involve modeling, management options, decision analysis, etc. Once action has been carried out, compare the observed outcome of action with the predicted outcome you're your model and see how well your logic works, then update your logic accordingly and redo the steps.

Adaptive management



From Schreiber et al. 2004

Figure 2. Conceptual model of the Adaptive Management process, from Schreiber et al. 2004. This model fits into the lower half of Figure 1 and illustrates the process, once objectives are defined.

This model helps organize thoughts and decide who can do certain jobs.
Greg: this info can be provided to all at a coarse scale regions and then filtered down to the refuges.

Melinda: structured framework is AM. Then you have a basis to make those decisions.
Joe: the cycle may be several years. Long term.
Melinda: USGS can model existing bird data to tell us how often to monitor; the time frame is what we want to get from USGS.
Joe: what works best at what level.
Eric: you have to choose the best one for you.
Matt: Existing info gives you the potential realm of what to do and a list of expectations for each mgmt activity. What is key is that if you continue monitoring you can update your info to see what works and what doesn't work. So this can work very well (Eric's model). It is not beyond everyone's ability.

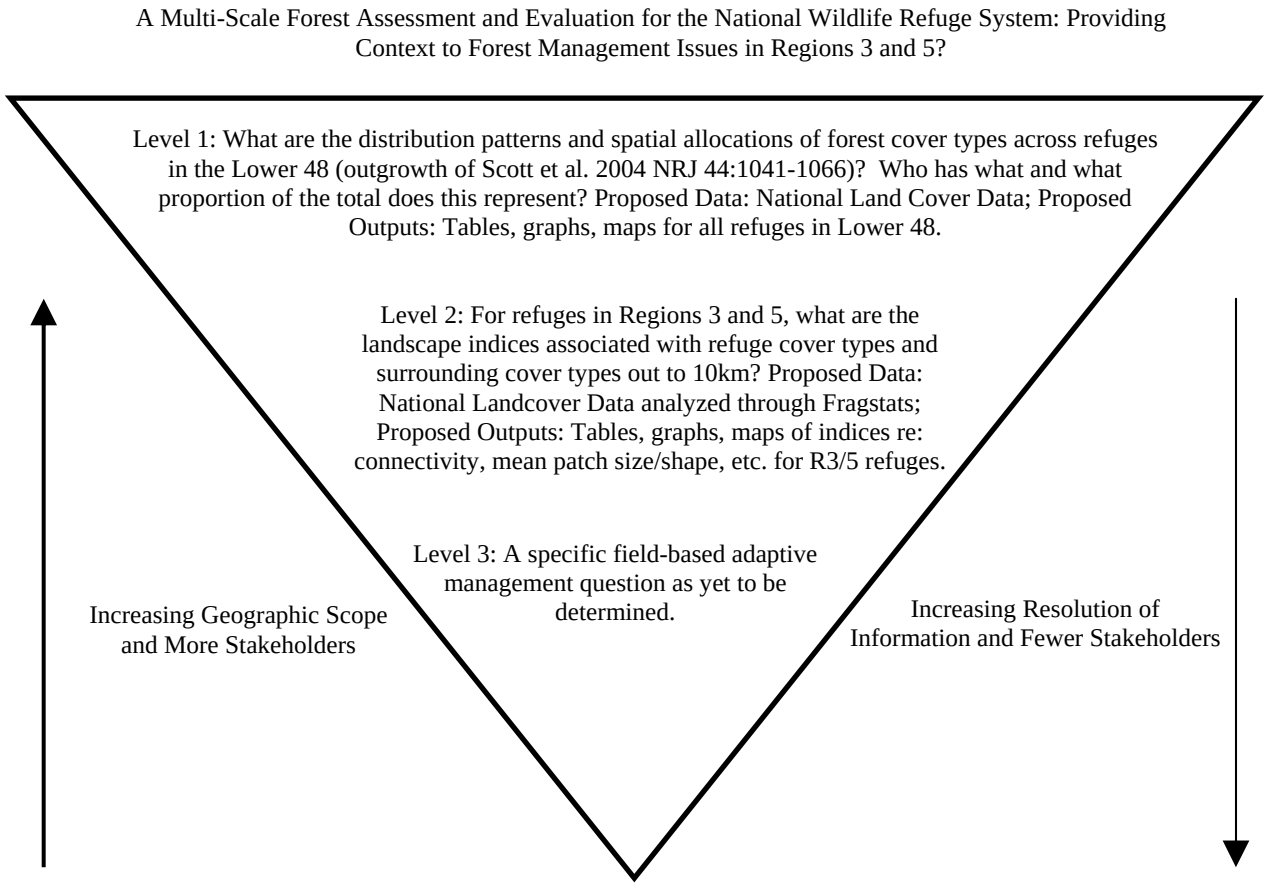


Figure 3: This simple graphic illustrates the ideas of a multi-scale, step-wise approach. The adaptive management portion of the overall project is Level 3; Levels 1 and 2 provide the context, and also provide some information of the same type to first all refuges and then more detailed information to refuges in R3/5. As many of us work with step-down plans and see the utility of the same, I here suggest a step-down research project (Greg Corace).

Recap of workshop accomplishments (Knutson)

Melinda: This whole process is new. We need a different structure. Many managers as well as scientists aren't familiar with AM, so we are talking about pioneer work here at this workshop. We have brought together people with a common interest and hopefully we stay in contact with each other and we have ID'd our research needs. That is huge.
We can use the info from this workshop to maybe get money elsewhere if USGS doesn't help.

Thank the committee.

What is ahead, next steps (Hal Laskowski)

Hal: there will be a document produced from this workshop to participants and to USGS. You will be a part of the process after a proposal is selected. Help the USGS scientists draw up methods etc.

Wrap up and close

Tony: No matter what happens we are going in a new direction. Sharing our problems is not what we have done before. This is growth even if we didn't get to where you expected us to be after this workshop. Think of the bigger picture and don't nag about the little things.

Parking lot issues
(from easel paper)

What is the appropriate restoration target?

What is the role of a refuge biologist in the evolving science-based management focus? and will there be support for learning, knowledge building?

Support for modeling on NWR's?

Day 2 Insights (from easel)

Is geomorphological surfacing a good tool?

Habitat objectives are important to see the whole picture first.

Few forest types are represented. There are 3-5 forest types on most refuges. This might help focus a project.

Information sharing during breaks is useful; ideas about tree nursery on refuge.

Floodplain- most important to know generally what was there historically, not specifically, because there has been a lot of change.

Useful to see the variability of issues on refuges. Search for "silver bullet" is futile.

Any project needs to compare "apples" to "apples" (Heitmeyer).

Problems are diverse and trying to operate as a "system".

The commonality- The refuges struggling to identify how to manage their forests. We need to define a process for managing and a way to evaluate our success.

We've only scratched the surface of the forest management issues.

We need to get more of the USGS scientists to this meeting.

Literature cited

Schreiber, E. G., A. R. Bearlin, S. J. Nicol, and C. R. Todd. 2004. Review article: Adaptive management: a synthesis of current understanding and effective application. Ecological Management & Restoration 5:177-182.