Adaptive Management Consultancy – Chesapeake Marshlands NWR

10/23/07

Notes by L. Mitchell

Attending: Donald R Cahoon (USGS), James Lyons (FWS), Laura Mitchell (FWS), Bill Giese(FWS), Suzanne Baird (FWS), Harold Laskowski (FWS), Sean Flint (FWS), Roger Stone (FWS), Court Stevenson (UMCES), Adam Duerr (William and Mary), Melinda Knutson (BMT), Donna Brewer (NCTC), Gwen Brewer (MD DNR), Dawn Washington (FWS)

Suzanne B. intro remarks, welcome to refuge

Jim Lyons – Principles of Adaptive Management (power point presentation)

- Management involves making decisions – yet wildlife managers are often untrained in decision processes, plug for Smart Choices book
- Commonly a 2 step process – collect the info (scientist job), manager uses the info
- Problems, decision often not structured, leads to misconceptions and misdirected arguments
- We forget to id critical info needs, leads to endless "more info needed" claim
- A more integrated approach is science and managers working together to frame the decision-making process
- Info collected should focus on precisely the info most useful to management decisions
- Why are decisions difficult – uncertainty, management decisions have to be made, with imperfect knowledge
- Many sources of uncertainty – ecological (structural) (we don't fully know underlying system mechanics), environmental variation (out of our control), partial management control (management is applied indirectly, not all management actions are the same), partial observability (we have to estimate, can't measure everything perfectly)
- ARM – sequential decision making under uncertainty
- Elements – objectives, management alternatives, model of system response (predictive models), measures of model credibility (model weighting, our degree of faith in the model), monitoring program to estimate system state and other variables (1-2 based on societal values, law, politics, stakeholders, 3-5 the purview of science)
- Key element 1: Objectives – make them explicit, express them in terms that can be evaluated
- What is the object? What is the direction? What are the **fundamental** objectives? What are **means** objectives (supporting objectives)? Need to tease them out, and not just have a big jumble of objectives

- Example objective – maximize long term duck harvest; more complicated objective – maximize harvest but achieve NAWMP goal
- If you have objectives for many species, try to find common currency, or integrate the metrics, or use constraints
- Key element 2: Management Alternatives – must result in diff. benefts and costs (real choices), set of options should be limited, should be determined by everyone
- Key element 3: Predictive Models – not optional, models should be as few and simple as possible, it's either in your head or on paper, models should bound uncertainties, should differ in predicted responses to management options
- Key element 4 : Measure of model credibility
- Key element 5: Monitoring - monitoring needs to focus on data that will inform the model, only, don't attempt to measure everything out there
- What monitoring does:

1. 1 determine system state for state-dependent decisions
2. Evaluate management performance
3. Learning about system dynamics (compare observations with model based predictions)

- Learning about system dynamics – monitoring needs to constantly update the models
- Iterative nature – observe new state, learn, update, manage, observe state, learn, etc.
- We are in the set up phase, before the iterative phase, we are bringing in stakeholders, examining objectives, alternatives, developing models, setting up monitoring, once we get into monitoring part, it will be critical to break out of that cycle and get back to examination of models again

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Bill Giese (Power point presentation on fire program)

- 35 years at refuge, fire program "from the beginning"
- Passes list of multiple objectives of Fire M Plan (20 +)
- Not all but some are natural resources objectives, many are large, overarching objectives
- Reviews, operational stuff of refuge fire program: staff, complex structure, now a zone serving other refuges, coop agts/partnerships with state natural resources agencies, local timber company organizations (many defunct now)
- Biggest partner is the MD Forest Service
- Wildfire suppression – Rx burns to address suppression (remove fuels)
- Fire season Jan – April, wildfires usually associated with marsh (Rx fire coincides), this may be changing due to drought conditions
- Prescribed fire reasons – protect property and wildlife resources (e.g. eagle nest protection), maintain habitats (assume it's beneficial to the marsh, earlier regrowth following fire, prolongs growing season, strengthens root mat), species management (trapping was historically a major economic use, trappers still use the marsh), hazard fuel reduction (remove the fuels available next to roads, properties, reduce wildfire risk, WUI (marsh grasses, Phragmites in

folks' back yards), invasive species control – Rx fire following up after herbicide trt on Phrag, fire used to facilitate nutria control (used fire to congregate the animals, to facilitate access)

- Fire and marsh loss? Over time, fire has been scrutinized as possible exacerbating factor? Problem is there are **many** factors causing marsh stress (herbivory, animal concentrations, hydrological changes), no definitive evidence, no conclusions made
- 1995 first panel review of affects of burn program, what were the effects? JFSP panel (field visits, general public/trappers/law enforcement, stakeholders), team was charged with developing alternatives to consider, and addressing 25 objectives
- Mentioned that Fishing Bay has 30,000 acres of marsh, FWS and MD co-manage with fire, MD was a part of this panel review
- Final report – preferred alternative was to set up study sites, various fire regimes (included marsh and upland habitats)
- Challenges – protecting the integrity of these sites, (prevent arson, etc.), challenge in setting up these compartments (chose sites that were protected by natural features, 3 on refuge, 3 on state lands)
- State situation – trappers were burning on their personal schedules on Fishing Bay, FWS assumed this responsibility, started aggressive Rx program at the same time
- Discussion of acres – we were burning about 10,000 goal, ~7K acres on state lands, 1-2K acres at Blackwater
- Could we burn less and still accomplish WUI, Hazard goals – yes, but will be more difficult and expensive, so it was much easier historically to burn the whole big compartment – easier, less expensive
- 2007- refuge had 4,308 acres of wildfires (in many cases we did not suppress, indirect attack, WFU type approach) (most if not all are arson, possibly started by trappers)
- Could the trappers trap w/o fire? Yes, but very unproductive/difficult. Is trapping an economic factor locally? Not clear answer, trappers do bid on units (20-25 units)

Q from Suzanne – is this a recreational opportunity? Is it a management action? No clear answer from Bill. He admits it is an economic use, and we hope it controls muskrat populations.

Hal L. asks – would the trappers be open to modifying the burn regime?

Bill believes that trappers will say that burning is critical to preserving the marsh – makes it easier to trap the muskrats and preserve the marsh

Court S. – points out that fire has reduced the shrub cover, which is better at holding the marsh than marsh grasses

Bill believes that fire increases chairmaker's rush, Court points out that fire has decreased shrubs, and therefore reduced sediment holding

Bill – trapping is not the primary reason we burn, believe that it keeps the marsh in place, there is disagreement

Hal – we don't know, that is why we are setting up this adaptive monitoring process

Bill – the marshes of Fishing Bay have always been burned, they are still there

Hal points out there are different marsh types at Fishing Bay WMA (hydrology, vegetation, tidal regime)

Roger Stone (Power point presentation on Connie Flores work)

- 2 Fire Review Panels, second one in 2003 – stated we need more research on this issue
- 2 main land areas subject to Rx fire: Blackwater and Fishing Bay
- 4 burn regimes set up in treatment study areas at each (A, B, C, D) (note the site integrity was not always possible due to wildfires)
- Master's Thesis – Connie Flores, focused on veg effects – plant species, composition, diversity, structural and community variables
- Ho – no differences in biomass, stem density, ht. diversity, etc among treatments

Melinda asks – each site has all four regimes, answer – yes
Bill – note the original charge from the JFSP was to cross the refuge and all veg types, not necessarily to come up with sites that were ideal replicates of each other

- Connie only no burns, annual burns, and 3-5 year burns (due to coming in early in the rotation), note all sites were burned year zero (1998), but most had already historically been burned annually, quick summary of results
- Cheryl Leonard looked at belowground biomass work, evaluating dead vs live, no results reported yet

Don Cahoon considers that setting up the regimes (no burn, 3-5 years, 7-10 years) to actually be a **release** from burning

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Sean Flint (Secretive Marsh Bird monitoring)

- Connie's research was preliminary, there are other projects that have gone on since
- Pete Marra's study was short term, did not look at burn regimes B and C, only looked at sparrows, only in Fishing Bay WMA
- Secretive Marsh bird nest search project, 2007, is an in-house "effect of prescribed burns on nesting marsh birds"

- Collected data on 3 areas: 3, 7, 2; looked at annual, not burn, and 3-5 regime; we don't have data on 7-10 regime, yet
- Collected data on 10 species, including 2 salt marsh sparrows (Seaside sparrow, Saltmarsh sharp-tailed sparrow)
- Basically followed Greg Shriver's methods (PhD salt marsh sparrow specialist at U DE), on gridded plots
- Spot mapping to id pairs, id possible nesting behavior; nest searches, seaside sparrows most frequent, Virginia rails frequent, uncommon – common moorhen and saltmarsh sharptailed sparrows, least bittern

Melinda asks - are you doing night calls? No, using Courtney Conway's methods for secretive marsh birds, call back surveys

- Black rails are now endangered – populations are dropping, searching for them, also

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Don Cahoon (impromptu power point on SETs)

- Don strongly recommends getting a standard Blackwater tide gauge set up, perhaps on Shorter's Wharf Bridge, to get standard tide elevation readings for the refuge

- Don explains Standard Elevation Table work on the refuge (and along the coast from Canada to Gulf of Mexico) – he and colleagues are now setting up SET's in burn and no burn plots at Blackwater, to evaluate how elevation (underground elevation changes) is operating separately from aboveground accretion processes; they must be surveyed each year, use a local benchmark to reference against

- This work is measuring shallow subsidence (what's happening over the top ~50 feet deep), not **deep** subsidence), what is happening in the upper soil profile (may have some of this data available for the Jan meeting)

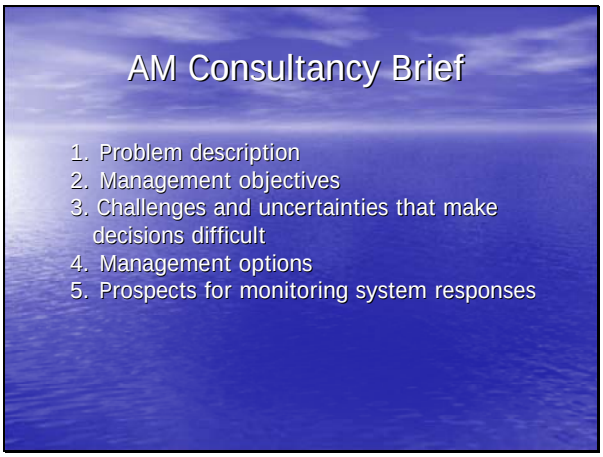
- Don provides text summary of this project (funded by Joint Fire Research Program) on a memory stick:

Land managers at Blackwater National Wildlife Refuge (BNWR) and Fishing Bay Wildlife Management Area manage ~ 11,000 acres of tidal marsh with annual prescribed fires to reduce hazardous fuel conditions, promote rare/endangered species, and enhance habitat for wildlife. Yet, using fire to improve the wildlife value of the marsh habitats may be contributing to their destruction. More than 8,000 acres of tidal marshes at BNWR and FBWMA have been lost because rates of soil organic matter accumulation are inadequate to offset sea-level rise. Fire affects the accumulation of plant organic matter in the soil, but the magnitude and direction (i.e., positive or negative) of its effects are not fully known. Understanding the relationship between fire, organic matter accumulation, and marsh sustainability is important in recognizing the limits and consequences of fire as a management tool in these coastal marshes. This proposed research addresses the following data gap identified by the land managers: *Does the annual prescribed fire regime adversely or positively affect marsh elevation, and does it contribute to marsh loss at BNWR*? We will experimentally determine how annual prescribed burns affect soil organic matter accumulation and surface elevation trends in the marshes. Accretionary processes will be measured in marshes receiving no burns and annual burns using the surface elevation table – marker horizon method and a suite of soil and plant variable measurements. Our data will be used to identify key processes controlling elevation, and how annual burning affects these processes,

and, ultimately, marsh elevation change. Also, we will assess the risk that annual burns pose to long-term marsh sustainability by integrating the accretionary processes data into an inundation model that forecasts the fate of the marsh to sea-level rise. This modeling framework will allow us to forecast ecosystem change and provide important feedback to managers; enabling adaptive shifts in burn strategies for the sustainable management of the marshes. Lastly, we will assess the effect of fire return frequency (annual, 3-5 years, and 7-10 years) on marsh fuel loads, because the managers will need to understand the fuel load and potential wildfire consequences for switching to a less frequent burn schedule if annual burns prove to be detrimental to marsh sustainability.

Laura Mitchell Problem Statement (Power Point on framing this problem in AM structure)

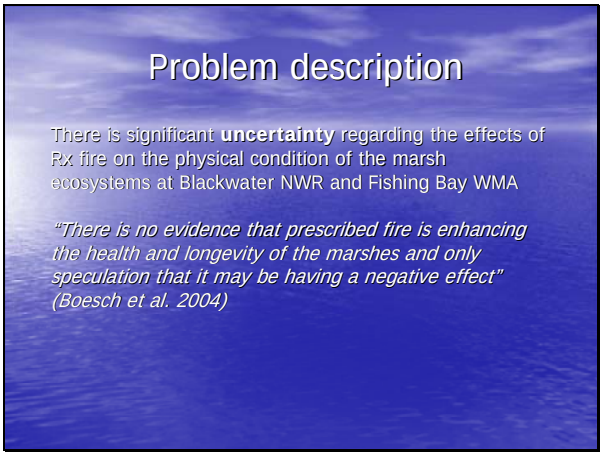
Slide 1



So we have: marshes severely under stre
a landscape-scale Rx fire program, and a
bit of historic and ongoing research activit
in these marshes

We want to use AM, to improve our
management with fire, and learn from our
management. As part of this process, the
BMT asked us to define what is our prima
problem statement, etc.

Slide 2



Slide 3

Objectives

CCP Objective 1.1.2.: "Restore emergent marsh on Blackwater NWR to 1933 coverage level by 2017…by maintaining, restoring, and enhancing marsh habitats" one strategy listed is "…the use of Rx fire to affect regrowth vigor and species composition."

Station Fire Management Plan:

- "Provide, maintain, enhance and protect habitats for State and Federal endangered and threatened species, and species of special concern
- Provide, maintain, enhance, and protect feeding, resting, nesting and brood habitat that meets the requirements of migratory waterfowl, other migratory birds, and resident wildlife
- Facilitate the control of resident and non-native furbearers
- Maintain health and vigor of marsh vegetation, maintain current marshland acreage and species composition, and reduce brush invasion into marshland"

Slide 4

Objectives

Maximize the ability of brackish and salt marshes to sustain themselves in the face of numerous system stressors, ensuring that the quality and natural function of the marshes are sustained. Ideally, prescribed fire should either: a) augment the rate of vertical accretion, if possible, thereby assisting the marsh in keeping pace with apparent sea-level rise, or b) contribute to slowing the rate of vertical loss.

Also ensure that marsh vegetation communities provide quality breeding habitat for species of special conservation concern (e.g. wintering waterfowl, other migratory species of concern such as saltmarsh sharp-tailed sparrow and seaside sparrow).

In plain English, we boiled these objective down to 2 habitat management objectives use a fire regime that does the most to he the marsh maintain itself.

We also want to ensure it is compatible w species of conservation concern

This was written for this AM consultancy; might, of course, be subject to modificatio but I think the basic essence is there

Slide 5

Challenges and uncertainties

- *Schoenoplectus americanus* (chairmaker's bulrush) productivity was historically enhanced by winter fire at Blackwater NWR (Pendleton and Stevenson); the plant is fire-adapted
- Productivity of other tidal marsh plants (*D. spicata, S. alterniflora* and *S. patens*) historically reported to be reduced by winter fire; these species are considered non-fire adapted (Nyman and Chabreck, Gabrey et al.)
- Winter fire at Blackwater NWR increased cover and stem density for *D. spicata, S. alterniflora* and *S. patens, S. americanus* was not increased, fire enhanced aboveground live biomass, reduced accumulated litter, and increased aboveground stem density (Flores and Bounds)
- On a preliminary basis, subsidence appears to prevail at both marsh sites annually burned, and not burned, location seems to be a controlling factor for the rate of elevation change (J. Rooth)

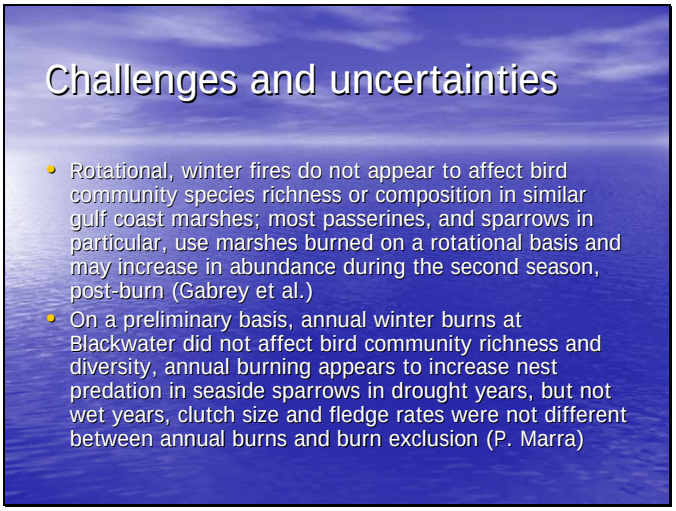
Uncertainty when trying to meet these management objectives

What we thought we knew – some plants enhanced by fire, other not
Waterfowl food preference, but also snow goose and muskrat/nutria food, some plar better at holding substrate So what's goin on – can we actually predict plant commu response to fire (can we tweak the plant species composition? Should we?)
Note – other plant community studies may have been marshes less stressed by flooding, SLR,
Don Cahoon found belowground productiv enhanced in *S. patens* marshes, stressed flooding
Stem density – may add structural diversi accumulate sediment

May be increasing aboveground live mate

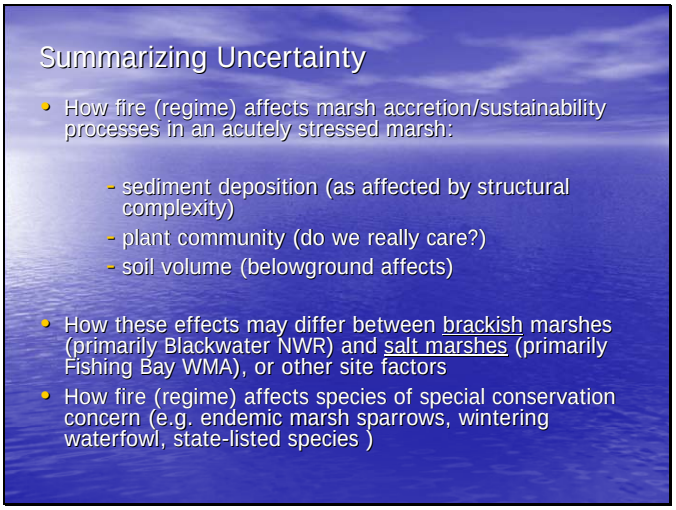
but losing dead material but does this eve
matter to accretion? Rooth seemed to thi
not

Slide 6



No studies on annually burned marshes. Most studies are short-term, including at Blackwater.

Slide 7



How to divide up this uncertainty into piec
that can be investigated through AM – ea
piece, if solved, can contribute to greater
management certainty

Slide 8

System Stressors

- **sea-level rise** in the lower Chesapeake Bay region
- **land subsidence** attributed to water removal from the aquifer and/or forebulge collapse due to glacial retreat
- **salt water intrusion** following sea-level rise and subsidence
- **increased wave energy** causing shoreline erosion
- **wildlife damage** – excessive herbivory by native (e.g. muskrats, migratory waterfowl) and non-native (e.g. nutria, resident geese) wildlife
- **altered hydrology and salinity** – human modifications to the Blackwater watershed have altered the hydrology resulting in saltwater intrusion and freshwater inundation (e.g. Stewart's Canal, roads, ditches, and Shorters Wharf Road)

I suppose this falls under "challenges" in t AM framework – what external influences have to be built into our models

Slide 9

Management Options

Study areas: 4 at Blackwater (*1, 2, 3, 7*) and 4 at Fishing Bay WMA (*4, 5, 6, 8*), each divided into 4 management regimes:

- annual burn
- 3-5 year rotation
- 7-10 year rotation
- burn exclusion

(note, these treatments have been in place for 7 years at sites *1, 2, 3, 4, 5, 6*, and 2 years at sites *7* and *8*)

Slide 10

Management Options

The rest of Blackwater NWR and Fishing Bay WMA…

Similar options?

- annual burn
- 3-5 year rotation
- 7-10 year rotation
- burn exclusion

Slide 11

Potential Monitoring Metrics

1. "*Maximize the ability of brackish and salt marshes to sustain themselves in the face of numerous system stressors, ensuring that the quality and natural function of the marshes are sustained*"

(Macro-scale measurements)

- Marsh Surface Condition Index - use satellite imagery to track net change in acreages in various marsh surface condition categories, e.g. degraded, restored

(Micro-scale measurements)

- Index of Plant Community Integrity, perhaps relying on plant health indicators – productivity, root/shoot ratios, rhizome integrity/mortality, root mass volume

Slide 12

Potential Monitoring Metrics

2. "*Ideally, prescribed fire should either: a) augment the rate of vertical accretion, if possible, thereby assisting the marsh in keeping pace with apparent sea-level rise, or b) contribute to slowing the rate of vertical loss*"

- SET measurements – track marsh elevation changes (changes in surface and subsurface processes), including organic material at the marsh surface and mineral sediment deposition
- Belowground plant production – track changes in root zone organic material volume
- Aboveground plant production – track changes in aboveground organic material deposition

Slide 13

Potential Monitoring Metrics

3. "*Provide quality breeding habitat for species of special conservation concern*"

- Population parameters for species of concern – presence/absence, abundance, productivity, sex ratios, survival
- Population parameters for indicator species
- Index of Marsh Bird Community Integrity (IMBCI) (a more general point-based survey of the entire bird community, as described by DeLuca et al. 2004, Smithsonian Environmental Research Center)

Follow up comments on presentation –

Suzanne – please understand that cultural history, community opinion, political pressures will also be factored into our decisions; this is my job as a manager

Also, typically a 2-3 year burn rotation is what I'm used to, understand its not just science, we will need to expand on this objectives a bit

Adam – we are here to help with this process, we might need to include more objectives to make this more useful to the manager

Jim – we need to also explicitly state the external factors – political, monetary, also need to list all objectives, all primary objectives

Bill G. – expresses concern about where are we going with this whole thing?

Hal – the outcome of this meeting is draft recommendations for refuge staff to put together an adaptive management plan, **not management recommendations,** we are here to develop competing models to monitor for (This explanation appears to clear up some confusion among refuge staff)

Melinda Knutson– Adaptive Updating

- presents explanation of developing competing models, inserting values, weights, probabilities, expected utilities;
- shows how this process (thru an example spreadsheet) can be used to set up competing models, incorporating various utilities, values, that can then be updated over time, as monitoring data comes in from the management action
- *see attached excel spreadsheet example*

Jim – this is intended as an objective, transparent decision making process, the optimization machinery gives you the "smartest" decision to make

Hal – in this case, we may just be focusing AM on the study sites as a starter, and not necessarily apply this to the rest of the refuge

Adam – what we should learn from this – if you get a probability of something like 90% - this should jump out at you as being a really smart decision

Jim – doesn't want to necessarily constrain adaptive management to just the study areas, wants to collect info from all areas, and apply it to all areas

Bill – if we have a strong indicator that shows one factor, that would help push us to a different regime, but he just doesn't see it right now

Jim – hears that there is lack of learning from this process up to now (there is agreement from the group)

The group considers the problem description – do we need to change it? The group rewrites the problem description, slightly.

Rephrased Problem Statement (from the group) -
If and when to use fire on the marsh

Objectives Exercise

The group expanded the objectives of Rx fire into the following list:

1. maximize extent and health of the marsh (must further define "health")
2. support key species (waterbirds, species of concern, T&E species)
3. cost? Maximize $ for refuge management (to be revisited)
4. minimize CO2 emissions
5. minimize invasives (Phragmites)
6. support traditional uses in the marsh to the extent that these activities support mash management goals (e.g. muskrat trapping)
7. engender public support for refuge management
8. maximize public safety
9. minimize critical natural resources damage

Management alternatives:
No burn, annual, 3-5, 7-10, mechanical treatments

Suzanne –focusing on the resource is number one, it should be the overarching thing we are addressing with this

The group highlighted the "key" objectives, agreed to table the others for now

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Exercise: Developing "Sub-objectives"

1. Objective: Maximize extent and health of marsh

What does this mean? What is the definition of a healthy marsh? Expand on "health"

- Maintain Shrubs, % cover
- Decrease in invasives
- Gross acreage veg communities versus open water
- Detritivores
- Marsh surface condition index (density of veg/satellite interp) (this is existing data)
- Accretion
- Elevation with respect to tidal range – possibly using LIDAR data (this is existing data for the model)

October 24, 2007

Melinda:
Research at refuge is ongoing, but the function of this meeting is now to extract a small set of key monitoring metrics to institute

Hal: We need to make sure that monitoring metrics are very repeatable
Bill: Also need to make sure metrics are robust to weather variation, if possible, and need to ensure monitoring takes place often enough to deal with annual weather variation
Donna: some metrics might not be able to be measured every year, but perhaps not sediment accumulation
Don: SET usually takes about 3 years for a trend, and is measured often

Q posed to the group - What is the spatial extent of this AM project?
What is the area mostly burned? Not clearly answered in group discussion.

Hal - #1 metric should be measuring marsh conversion to open water in varies trt scenarios
Don and others – we also need to collect covariates/other info to feed into the model, to then start to explain the underlying *mechanisms*
Hal – disagrees. This info is good, it informs us about the *why* of the results of a management action, but the *first* priority of AM is to tell us what the management action is doing, why it is doing it falls in to the realm of research

Discussion of what is AM, and what is research

Discussion of looking at historical photography analysis of burned/unburned areas

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Exercise to choose appropriate metrics for each objective

The group filled out the following tables:
(highlighted metrics were picked as the "best")
Adaptive management – Blackwater
Monitoring metrics

Units = management units

Note For "priority", 1= high, practical for refuge to implement, 2=medium, not as practical for refuge to implement, 3=low, not likely for refuge to be able to implement

Which metrics?

Objectives	Metric	Priority	Currently Feasible ?	Protocol?	Timely?	Repeatable?
Max. extent & health of marsh						
	Veg community (category) change/time	3	Expensive ($10ks of dollars), possible, labor intensive	YES	YES	YES
	MSCI (Marsh Surface Condition Index) (reflectivity and "brokenness")	1	Need $, intern	YES	Time series possible	YES
	Marsh elevation & Accretion /time	1	Yes ($500 per new station)	Yes	Yes	Yes
	Detritivores					
	Soil volume covariates?	3	Secondary importance – maybe thru collaborative research			
	Water level and Salinity	1	(need 2) $1k per datalogger/probe + downloading time (maybe)	Yes	Yes	Yes
	Muskrat/Nutria populations	1	Yes	Yes	Yes	Yes
Support key spp.						
	Marsh breeding bird success (possibly an index? Possibly modified to include rare)	1	YES, on a larger scale will need more $, personnel	Yes	Yes	Yes
Protect public safety and critical resources						
	Property damage $	1	Yes	Yes	Yes	Yes
	Critical habitat damage Y/N	1	Yes	Yes	Yes	Yes

What is success?

Metric	Stable or improvement	Decline
MSCI (reflectivity and "brokenness")	Number stays the same or declines	If number increases
Marsh elevation & Accretion /time	Maintain or increase elevation (flat or positive slope) or slowest loss (least negative slope); same for accretion	Elevation loss (negative slope) or greatest loss (most negative slope); same for accretion
Water level and Salinity	This should be a covariate	
Muskrat populations	0-9 rat houses per acre;	10 rat houses per acre;
Nutria populations	Nutria absence	Nutria occurs
Marsh breeding bird success (possibly an index? Possibly modified to include rare)	Need further information	
Property damage $	none	any
"Critical forest habitat" damage Y/N	Need further information	

Expected change? ↓↑↔

Metric	Annual	3-5 yr	7-10 yr	No burn
(note - this table was not yet filled out)				

Comments on Key species metrics (Marsh Breeding Bird):

Melinda – may want to back off to just occupancy work, reducing intensity of work (e.g. stop attempting to measure breeding success, etc.)

Expanding this to many more units, will that be possible?

Sean – might be more feasible to expand into more of the study compartments, Fishing Bay for example

Hal – how about correlating nesting data with point counts, and just expand point counts

Adam - Suggestion to focus on a community survey – like IMBCI (Index of Marsh Bird Community Integrity) technique (DeLuca et al. 2004, *Wetlands*)

Selecting metrics was deferred to a "subcommittee" on community survey techniques (Dixie, Melinda, Adam, Gwen, Sean)

Comments on "Muskrat Population" metric:

This metric was exceedingly seat-of-the-pants.

Further refining this metric was deferred to a "subcommittee" on muskrats: (Roger, Court, unnamed state representative)

Comments on "Critical forest habitat" damage metric:

Group went round and round about:

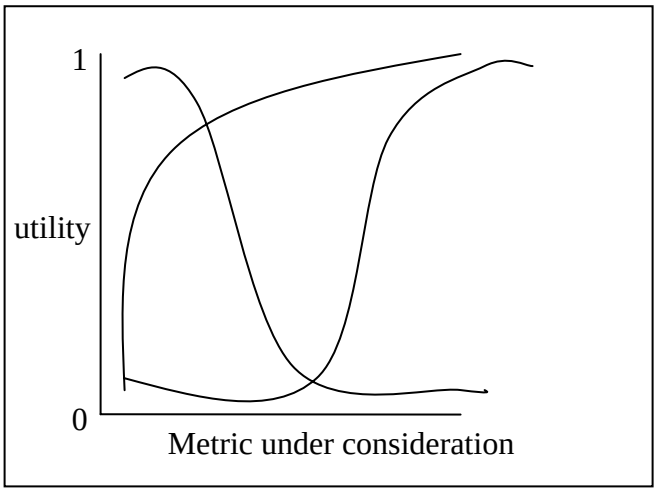
Whether this is only measuring damage to Bald Eagle nesting trees, whether this is actually a population issue or just a public perception problem, whether this also includes damage to DFS woods, if so, what kind of "damage". Should other species be considered?

Selecting metrics was deferred to a "subcommittee" (Gwen, Bill, Dawn, Dixie)

Discussion about should we categorize burn types? Depth of water, intensity, heat, etc. Tabled to another day's discussion. This could rapidly get very complex.

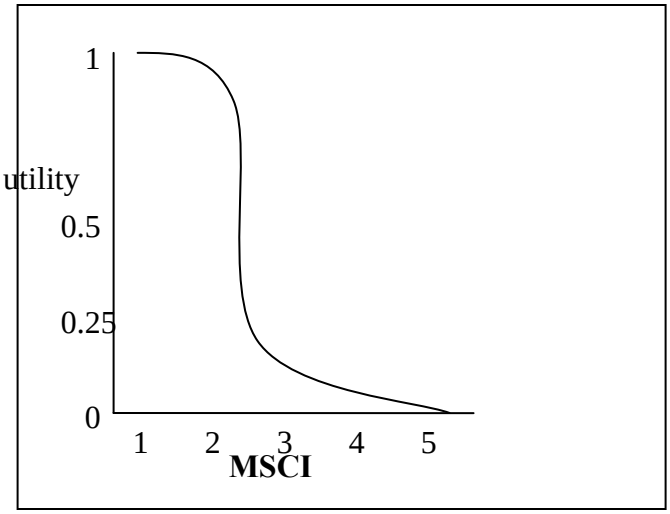
Exercise to graph utility measurements for each metric

Jim Lyons explained that utility graphs for each metric show our expectations, and could take various forms:

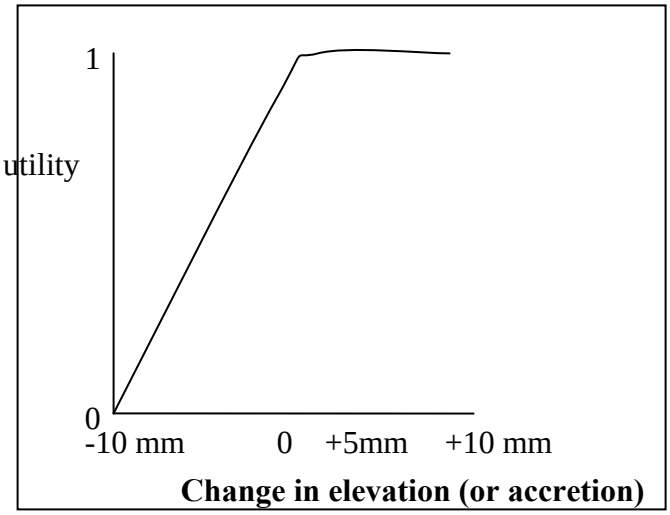


Graphs proposed by the group:

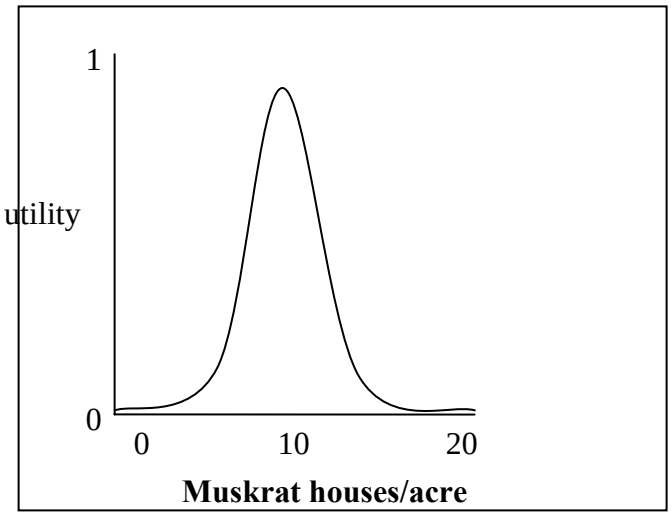
MSCI



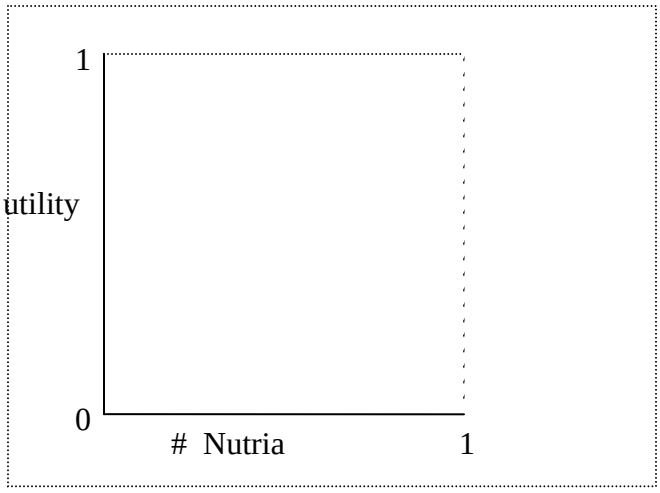
Marsh Elevation and Accretion:



Muskrat Populations



Nutria Populations



Property Damage

Unfinished Work for Next Meeting

Likely next meeting will have to start with finishing utility curves. Then move on to expected change tables.

Final Thoughts:

There was consensus that we will likely need to collect data on some metrics beyond the ABCD study plots.

Don Cahoon suggests not changing burn regimes in the study plots. Don't combine 7-10 and burn exclusions. Keep the integrity of the original rotations.

Melinda: refuge will need to decide when to update records in model. "Time step" - Annual was agreed to be preferred.

Revisited – the purpose is to pick the optimal regime. The group voted Yes.

Major discussion about how there are 3 distinctly different tidal marsh systems experiencing Rx fire, the data should be treated differently among them. 1: Moneystump is the Honga River basin, 2: central refuge, then 3: Fishing Bay WMA. Possibly even 4 marsh systems.

Adam - Question – do we have to build 2 different models – Blackwater central and Fishing Bay WMA? Or is it one model with a factor inserted that separates the two?

Don – Fishing Bay, more inorganic deposition, higher tides, central refuge only organic deposition, low tidal range. These are very different systems.

Court – recommends just working AM model on central part of refuge.

Request to work through this issue with Clint Moore. Committee formed (Gwen, Adam, Don, Suzanne, Dixie).

Committees:

The following groups will need to meet/exchange to do the following:

1. pick an agreed upon metric
2. define success or failure for that metric
3. develop a utility graph for that metric

Key Species/Bird Community survey techniques: **Adam D**, Dixie B, Melinda K, (Laura will contact to see if Adam can lead), Gwen B, Sean

Muskrat populations: **Dixie,** Roger S., Court S, unnamed state representative

Critical Forest Habitat: **Dawn W**, Gwen B, Bill G, , Dixie B

The following group needs to work with Clint Moore to determine how many AM models we are assembling, question of different groups of models for different marsh ecosystems (Core of Blackwater vs. Fishing Bay WMA, for example): Gwen B, Adam D, Don C, Suzanne B. , Dixie B, **Laura M**.