

# Native Prairie Adaptive Management in the USFWS Refuge System

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## An Overview for Potential Partners

Webinar

January 17, 2014

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Presented by:

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USGS Northern Prairie Wildlife Research Center

# Purpose of Webinar

- Share details of Native Prairie Adaptive Management (NPAM) initiative
- Explore potential for expanding NPAM to partners beyond USFWS NWRS
- 60 min presentation
- Explain questionnaire
- Q & A session



# Outline

- Problem background and genesis of NPAM
- Adaptive management
- NPAM technical elements
- NPAM infrastructural elements
- What cooperators gain from participation
- How a new partner could potentially participate in NPAM



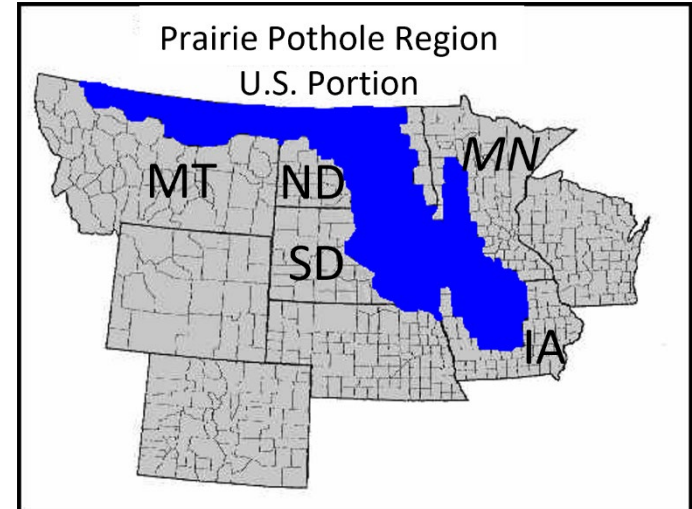
# Native Prairie in North America

- Widespread loss to agricultural conversion
  - Mixed-grass prairie reduced by >70%
  - Tallgrass prairie reduced by >85%
- In remainder, exclusion of historic disturbances
  - Grazing by native ungulates
  - Frequent fires



# Native Prairie in the USFWS Refuge System - Prairie Pothole Region

- USFWS Refuge System an important conservation reservoir of remaining native prairie
- Invasion by cool-season introduced grasses
  - Smooth Brome (*Bromus inermis*)
  - Kentucky bluegrass (*Poa pratensis*)



Smooth brome  
(*Bromus inermis*)



Kentucky bluegrass  
(*Poa pratensis*)

# Native Prairie in the USFWS Refuge System

- Management against invasive species
  - Re-introduction of disturbance to mimic natural processes that historically shaped native vegetation communities



- Success has been poor to inconsistent
  - Uncertainties about biological response to management
  - Absence of systematic evaluation of management effects
  - Inadequate monitoring, record-keeping
  - No coordination of effort

# Native Prairie in the USFWS Refuge System

- “Brome Summit” 2006
- Dakota-wide inventory 2006 – 2008
  - ❑ 5 – 55% native grasses and forbs (NP)
  - ❑ 10 – 45% smooth brome (SB)
  - ❑ 10 – 45% Kentucky bluegrass (KB)
- 1984, 2007 site comparison
  - ❑ 39-63% reduced NP cover, replacement by SB and KB
- Conclusion
  - ❑ Invasion problem is bad and getting worse
  - ❑ USFWS Refuge System is accountable
  - ❑ Need to act now

# Collaborative Management

- Traditional land management approach – “Go it alone”
  - Despite commonalities in objectives, tools, processes, and uncertainties, decision making is often an individual struggle
- We can link efforts with a multi-partner approach to more effectively learn about management as we’re doing it
  - Potential for great conservation benefit, but requires ...
    - lots of planning and groundwork
    - tight coordination and clear communication
    - ability to focus on the big picture



# NPAM – A Coordinated, Adaptive Approach

- Joint USGS – USFWS effort
  - Began in 2008
- Develop an adaptive decision support system (NPAM)
  - Coordinates local efforts to pursue joint conservation objective
  - Assists in selecting management actions under uncertainty
  - Employs monitoring to learn from management outcomes
  - Reduces uncertainty through time and improves future decision making
- Hierarchical decision framework
  - Individual land units (actions, monitoring)
  - Region (models, learning)

# Adaptive Management

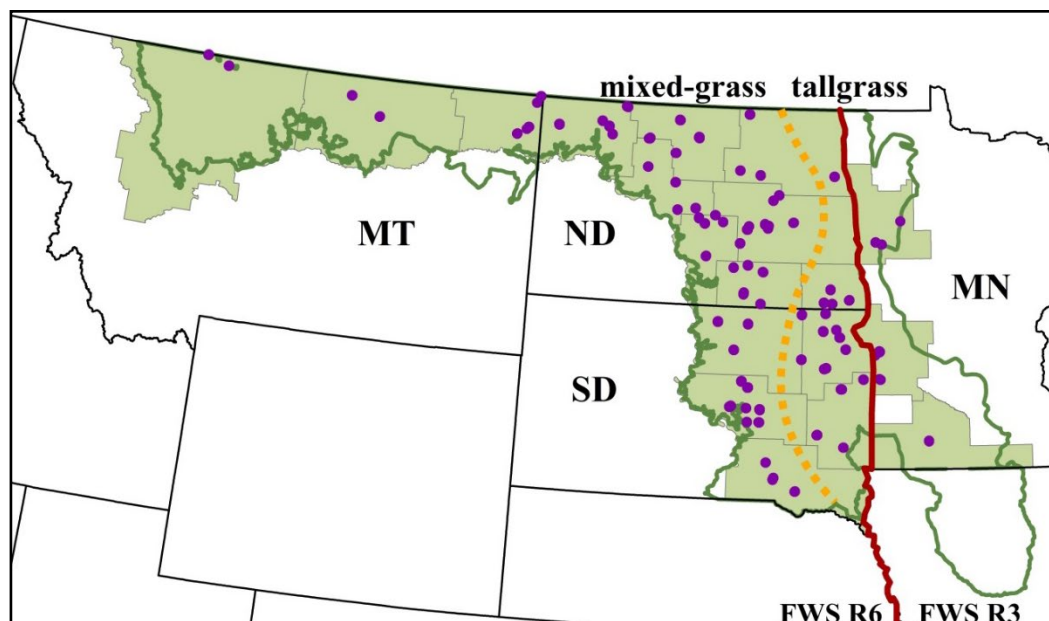
- Form of structured decision making, useful for guiding management under uncertainty
- Approach to recurrent decision making based on predictive modeling, monitoring, and knowledge updating
- Integrates decision making and learning to reduce uncertainty and improve decision making through time
- Learning can be accelerated if decision making and monitoring are distributed over space
  - Approach fits naturally in a cooperative conservation environment

# NPAM Technical Elements

- Management objective
  - What we are trying to achieve through our management
- State structure
  - How we describe each parcel
- Management alternatives
  - The “menu” of actions
- Competing models
  - Identifying uncertainty that makes decision making difficult
- Reward function
  - Payoffs for good and poor outcomes
- Optimization
  - Combining models, uncertainty, and rewards → recommendations
- Monitoring
  - Determining where we are today and assessing our predictions
- Model weight updating
  - Learning and the adapting management

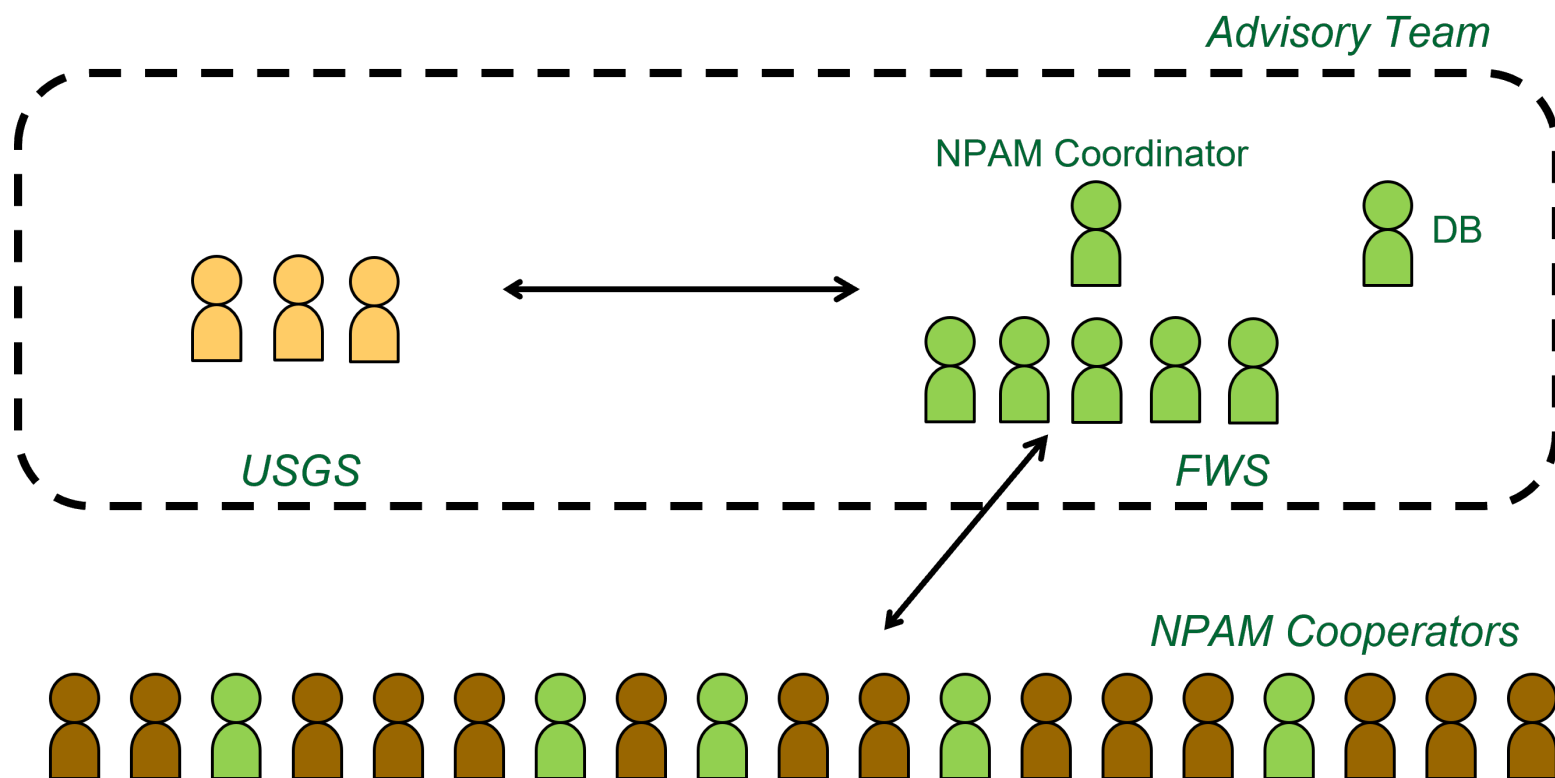
# USFWS Refuge System Cooperators

- Prairie Pothole Region
- Mixed-grass and tallgrass
- USFWS Refuge System, Regions 3 and 6
- Four states: MN, ND, SD, MT
- 20 stations
- 120 management units (81 mixed-grass, 39 tallgrass)





# NPAM Elements – Governance structure



# NPAM – Decision Makers

- USFWS National Wildlife Refuge System (NWRS)
  - Multiple decision makers under a single authority
- Decision makers
  - Individual managers of each refuge
  - Autonomy in interpreting goals and implementing management

# NPAM – Bounding the Problem

- The Resource Problem
  - ❑ Loss of native prairie to cool-season invasive grasses, smooth brome and Kentucky bluegrass
- Area of focus
  - ❑ Native sod on NWRS lands across the Prairie Pothole Region in USFWS Regions 3 and 6, where SB and KB are the main invasive species of concern.
- Spatial unit of focus
  - ❑ Management unit

# NPAM – Mixed-Grass & Tallgrass Differences

- Warm-season component of tallgrass prairies
  - Existence of a “cool-season window”
- Increased precipitation within tallgrass prairies
  - Expect different abilities to carry out management actions and different responses to management actions
- Created similar, yet separate, frameworks for mixed-grass and tallgrass that account for their unique needs
  - Management actions
  - Predictive models
  - Uncertainties
  - Recommendations



# NPAM – Management Objective

- Management Objective
  - Measurable
  - Capable of being predicted

**Increase the cover of native grasses and forbs  
while minimizing cost**



# NPAM Elements – Management Actions

## ■ Decision Alternatives

- ❑ Small set of distinct actions
- ❑ Ability to predict response



## ■ Menu of management action alternatives

### Mixed-Grass

Rest

Graze

Burn

Burn/Graze combo

### Tallgrass

Rest

Graze w/in window

Burn w/in window

Graze, Burn, or Hay outside window

# NPAM – Decision Cycle

- Management cycle
  - Decisions made on an annual basis
- Management year is 1 September – 31 August
  - Designed around the timing when management and follow-up monitoring occur
    - Management implemented – fall, spring
    - Monitoring – July/August (growing season, post-management)

# NPAM Elements – Describing a Unit

## ■ Vegetation state

### □ Percent cover of native grasses and forbs

- 0-30%, 30-45%, 45-60%, 60-100%

### □ Type of dominant invader

- Smooth Brome (SB)
- Kentucky Bluegrass (KB)
- Co-dominant SB and KB (CO)
- Other (RM)

		<u>Dominant Invasive</u>			
		SB	CO	KB	RM
<u>Native Cover</u>	60 – 100%	1	2	3	4
	45 – 60%	5	6	7	8
	30 – 45%	9	10	11	12
	0 – 30%	13	14	15	16

## ■ Defoliation history

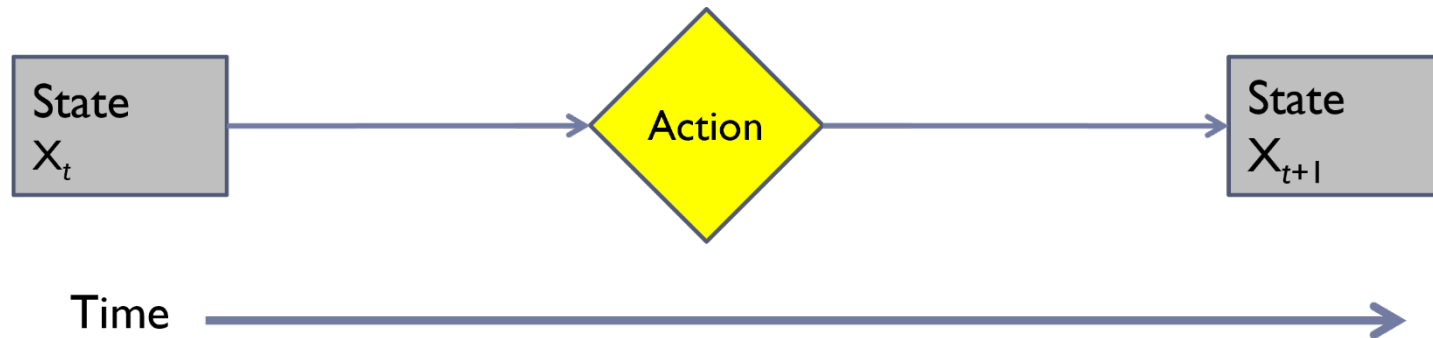
### □ Frequency of defoliation: Low, Med, High

### □ Years since defoliation: 1, 2-4, 5+



# NPAM Elements – Predictive Model

- State transition probability model
  - Predicts the consequences of each management action
  - Links current system state ( $X_t$ ) to future system state ( $X_{t+1}$ ) via the management action taken



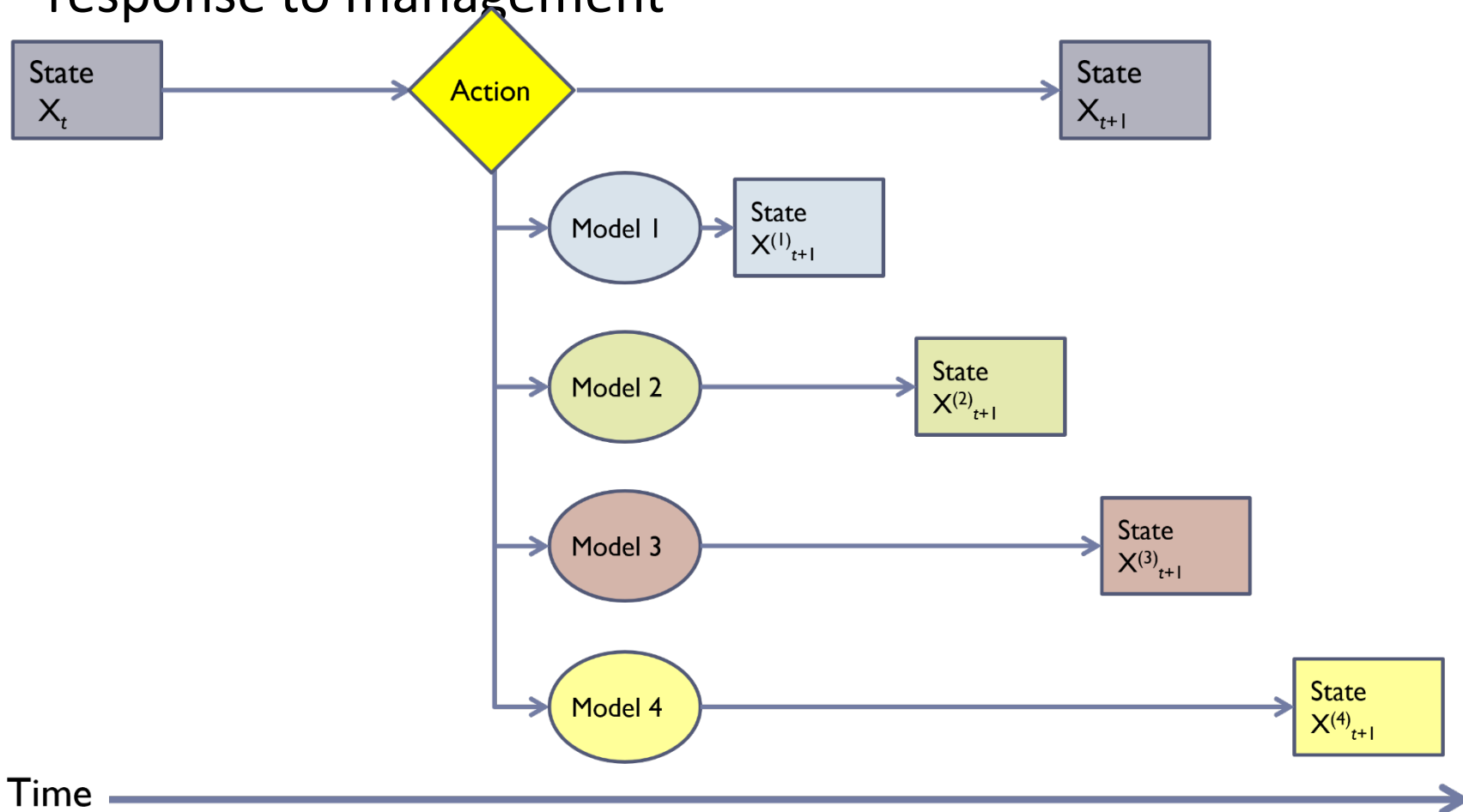
$$\Pr(X_{t+1} \mid X_t, \text{action}_t)$$

# NPAM – Uncertainty

- Uncertainty about vegetation response makes choice of best action difficult
  - Does effectiveness of a given action depend on
    - The type of dominant invader?
    - The past defoliation history of the unit?
    - The level of invasion?
    - Tallgrass: Timing of action relative to a cool-season window?
- We formulated these questions as alternative hypotheses and expressed them as a set of four competing predictive models
  - Tallgrass: Two additional models related to timing

# NPAM Elements – Competing Models

- ▶ Competing models make different predictions of system response to management

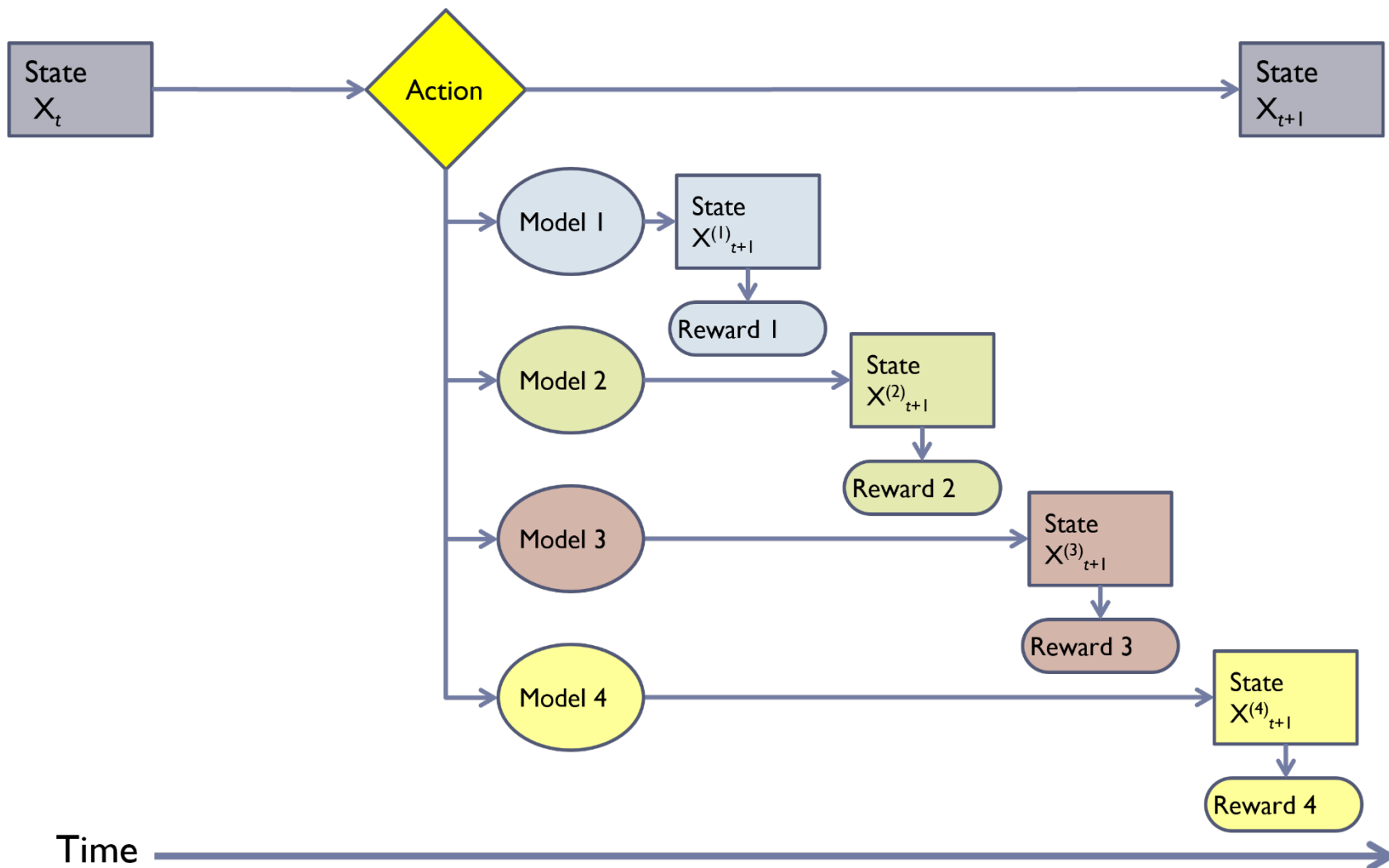


# NPAM Elements – Reward Function

- Quantifies how cooperators value an action taken and the outcome it produces
- Combines both aspects of the management objective and is a function of
  - Native cover outcome relative to starting state (resource gain)
  - Management action applied (cost)
- Unitless number between 0 and 1
- Annual measure of what is received for what is invested
  - Larger the value, greater the payoff
- Derived from cooperator elicitation



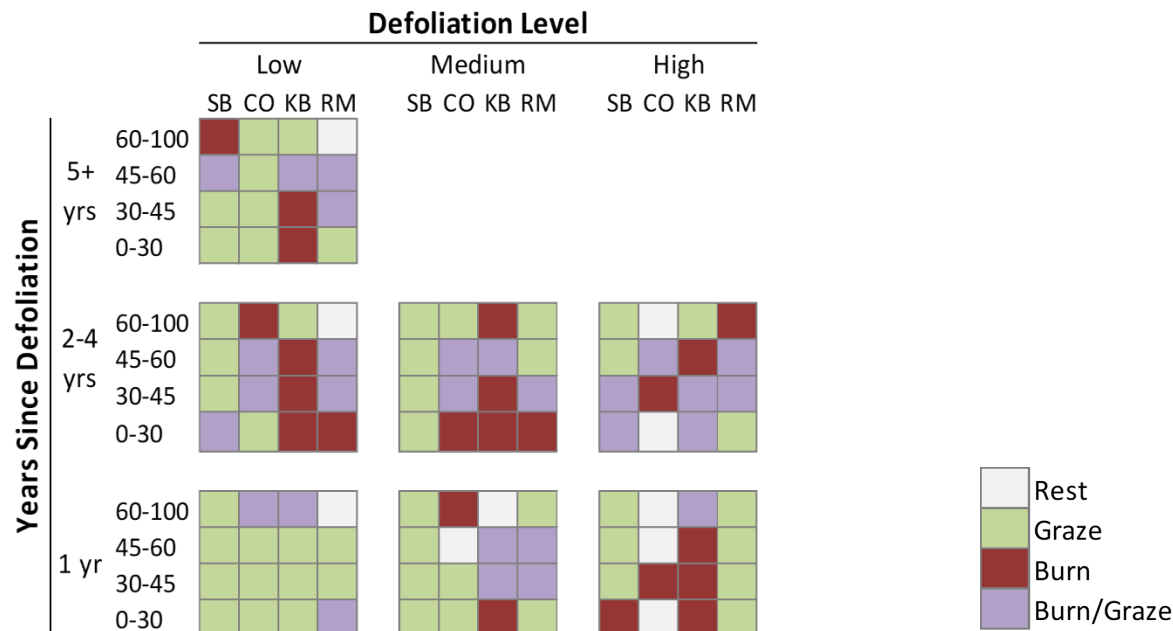
# NPAM Elements – Reward Function



# NPAM Elements – Optimization (mixed)

- Optimization computes decision policy
  - Integrates models, uncertainty, reward function

	Model 1	Model 2	Model 3	Model 4
Weight	0.25	0.25	0.25	0.25



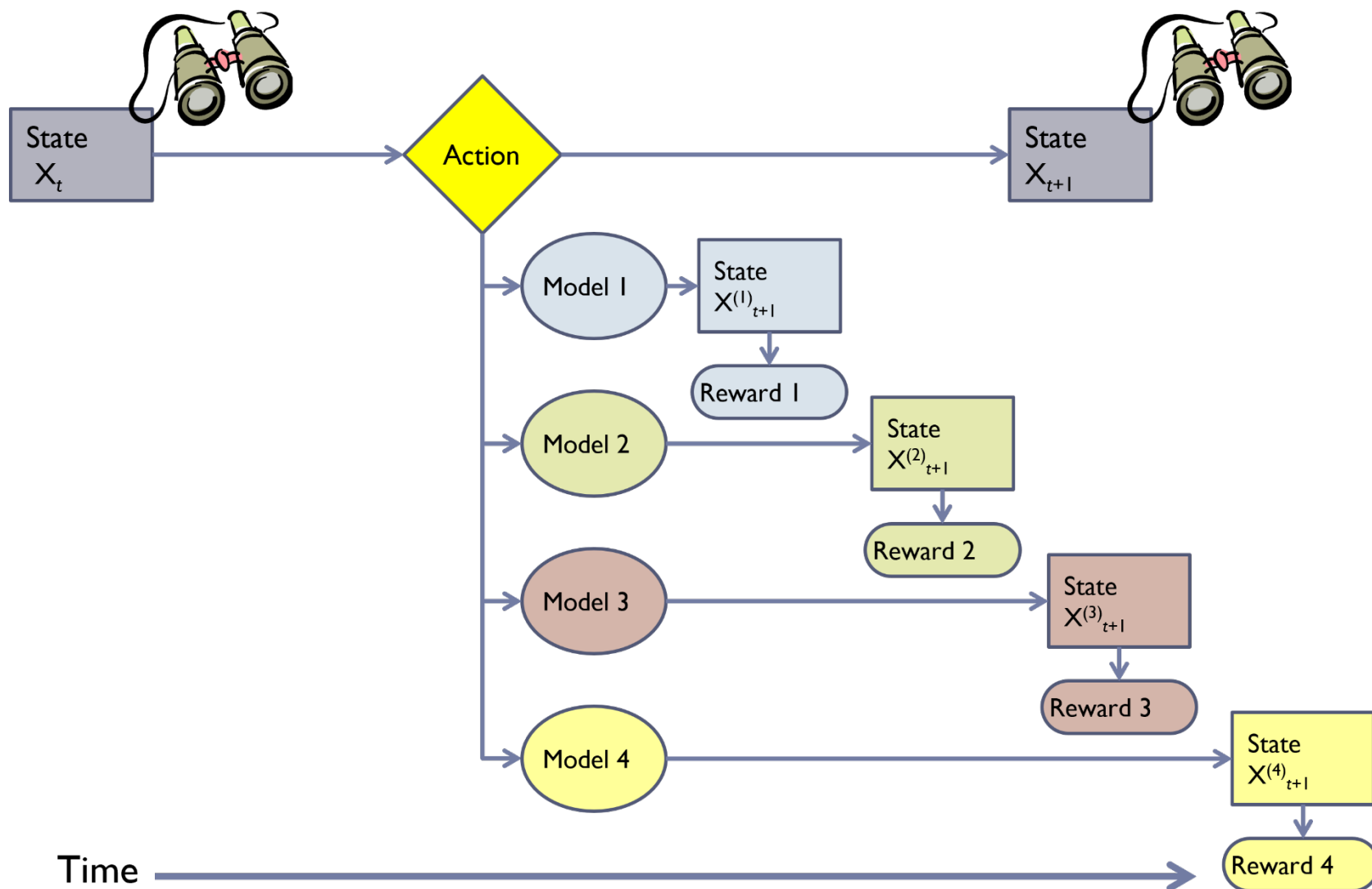
# NPAM Elements – Optimization (tallgrass)

- Optimization computes decision policy
  - Integrates models, uncertainty, reward function

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Weight	0.167	0.167	0.167	0.167	0.167	0.167



# NPAM Elements – Monitoring



# Monitoring – What it Provides

- Monitoring provides
  - Current prairie composition
    - So we can make state-based management decisions
  - Outcome prairie composition (post management)
    - So we can assess the predictive abilities of our alternative models
  - Amount of native cover
    - So we can gauge our progress towards the management objective

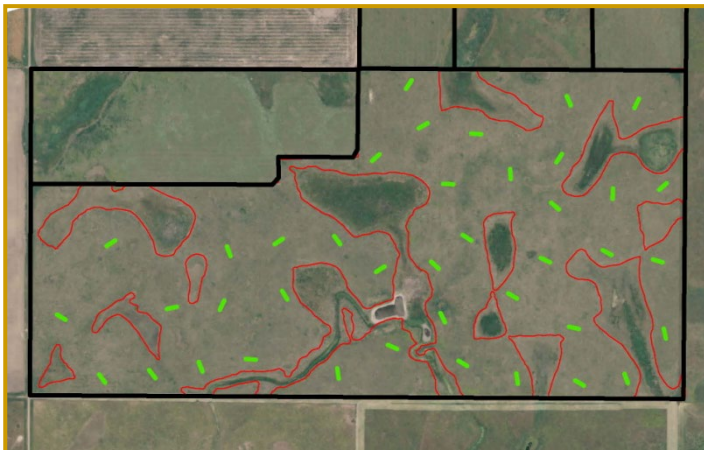


# Monitoring – What Data are Necessary

- Monitoring needed for decisions and learning
  - Unit level vegetation composition
    - Percent cover of native grasses and forbs, smooth brome, Kentucky bluegrass, other
  - Management actions implemented
- Some considerations
  - Logistically feasible by Refuge staff
  - Sustainable for the long-term

# Monitoring – Vegetation

- Belt-transect vegetation monitoring
  - ❑ Familiar; quick; short learning curve for seasonal staff; robust to multiple observers
  - ❑ 25-m transect, stop every 0.5m, 0.5m x 0.1m area, record plant code\*   for dominant cover type
  - ❑ Density of 1 per 5 acres (native upland only)





# Monitoring – Management

- Past management history for all newly enrolled units
- Management actions and details of application
  - Which action (e.g., Rest, Graze, Burn, Burn/Graze)
  - Timing and length of application
    - Tallgrass includes phenology component to capture timing relative to cool-season window
  - Intensity (e.g., fire heat, stocking rate, utilization)

# Monitoring – Centralized Database

- Centralized database
  - ❑ Hosted on SharePoint
  - ❑ Accessible to cooperators
  - ❑ Data entry/access is password protected and specific to each cooperating refuge
  - ❑ Observations are immediately captured and centrally stored
  - ❑ Built in queries generate cooperator-level data summaries



# Monitoring – Centralized Database

## ■ Vegetation data & Management action details

**View/Edit Existing Transect Monitoring Data**

Find complex  Password

Monitoring Yr  Unit (optional)

**Enter New Transect Monitoring Data**

Copy defaults from previous entry:

1.

2.  3. Fill to

4.

Complex

Password

Org

Unit

Monitoring Year, Date

Primary Obs

Secondary Obs

Transect Name

List Used

Comments

1.

2.  3. Fill to

4.

☒ Add additional form

**View/Edit Existing Treatment Action(s)**

Complex  Password

Management Year

**Enter New Treatment Action(s)**

Copy defaults from previous entry:

Complex

Password

Management Unit

**Warning: Unit changed. Check all existing data.**

Grassland type

Management Unit Contact

Management Year

Management Type

**When management type is changed, data for old management types is erased.**

Start Date

End Date

Native sod uplands (acres)

Native sod uplands treated (acres)

Special treatments? ☒ (If multiple, follow link below form after hitting submit).

Comments

☒ Open additional form

**Grazing Data**

Number of animals

Grazing animal type

Stocking rate (AUMs/acre)

Grass Utilization

**Special Treatment Data**

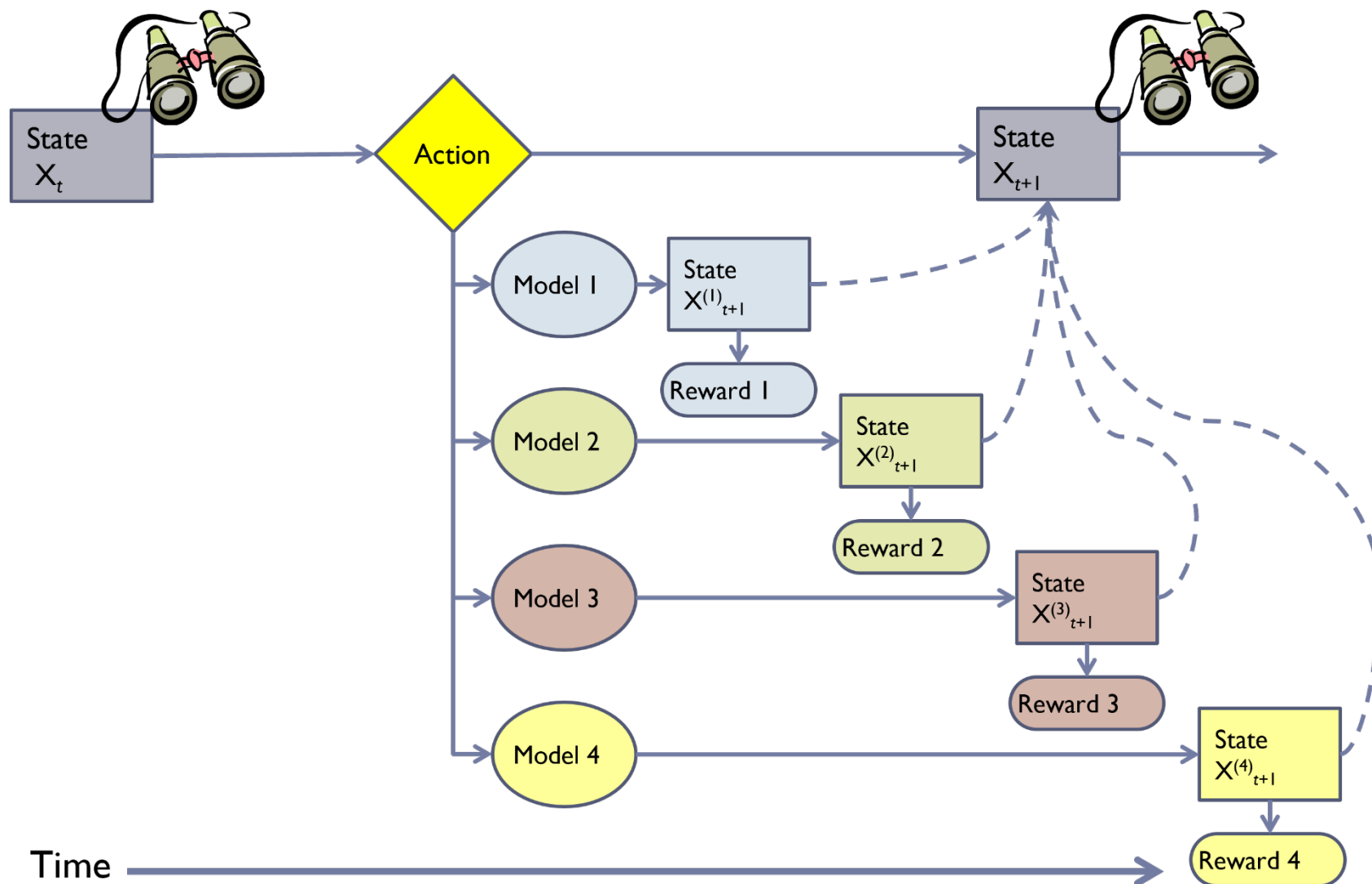
Description

Start date

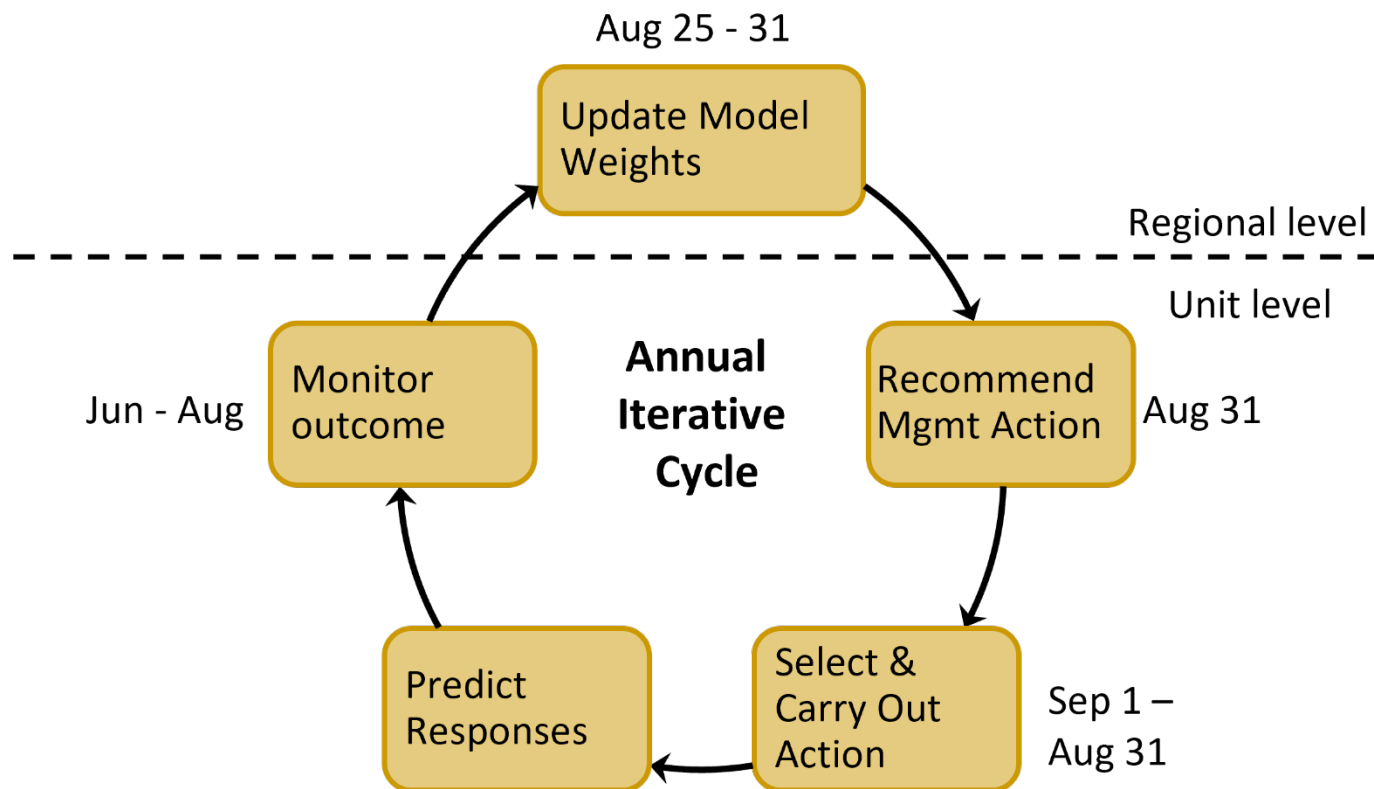
End Date

Acres Treated

# NPAM Elements – Updating

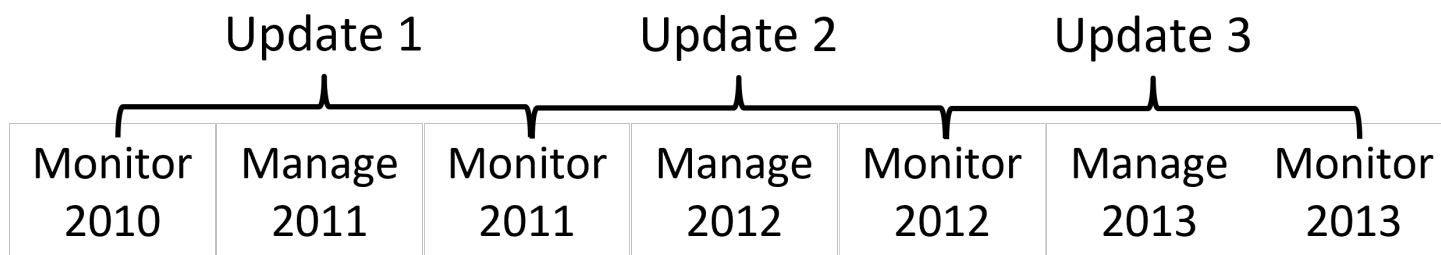


# Annual Cycle: Managing & Learning



# NPAM Updating Cycles (tallgrass)

- Completed three iterations of the AM decision cycle since project inception (2008)



- Reduced uncertainty among models

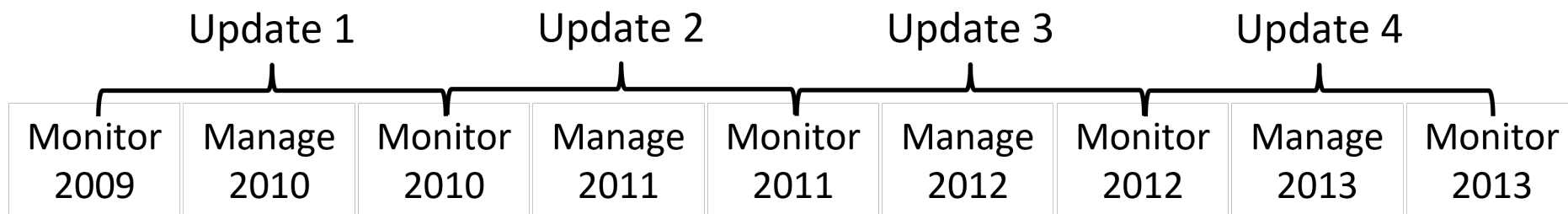
Year	M1	M2	M3	M4	M5	M6
2010	0.167	0.167	0.167	0.167	0.167	0.167
2011	0.179	0.148	0.167	0.173	0.167	0.166
2012	0.187	0.123	0.165	0.189	0.165	0.171
2013	0.210	0.113	0.158	0.187	0.159	0.173

Shift in model weights provides greater evidence for Model 1

- We know more about behavior of the system than we did before

# NPAM Updating Cycles (mixed)

- Completed four iterations of the AM decision cycle since NPAM inception (2008)



- Reduced uncertainty among models

Year	M1	M2	M3	M4
2009	0.25	0.25	0.25	0.25
2010	0.28	0.23	0.24	0.25
2011	0.34	0.19	0.22	0.25
2012	0.38	0.16	0.21	0.25
2013	0.42	0.13	0.20	0.25

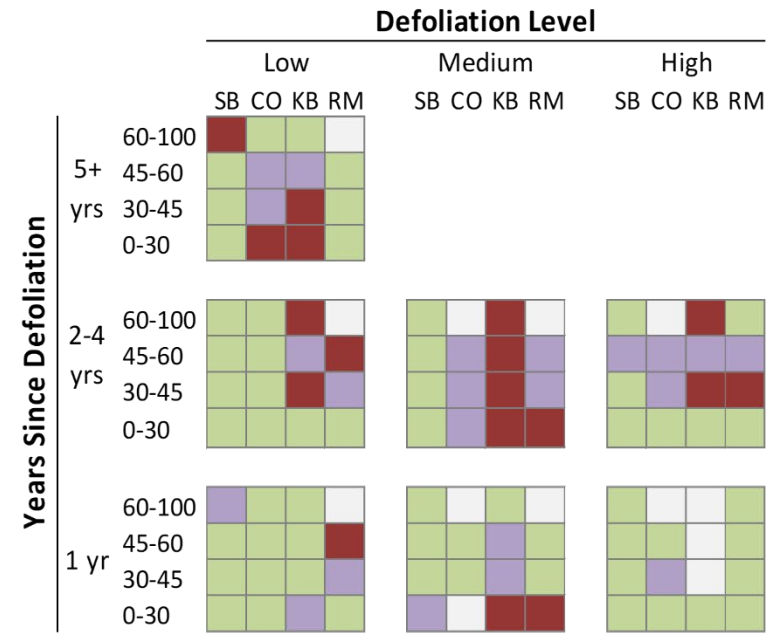
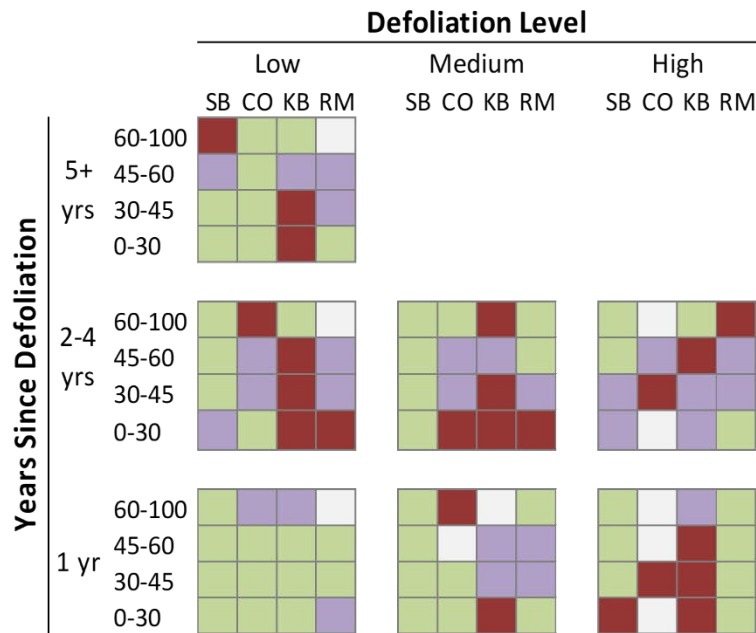
Shift in model weights  
provides greater  
evidence for Model 1

- We know more about behavior of the system than we did before



# Adapting Management with Learning

Before update – complete uncertainty    After 4 updates – reduced uncertainty



Model	M1	M2	M3	M4
Weight	0.25	0.25	0.25	0.25

Model	M1	M2	M3	M4
Weight	0.42	0.13	0.20	0.25

Rest
  Graze
  Burn
  Burn/Graze

# The Annual Cycle: Result

- Result of going through the annual iterative cycle
  - Reduce uncertainty by distinguishing better models from poorer models
  - Improved management decisions as better models exert greater influence on the next management decision via the updated decision policy

# Each Annual Cycle Cooperators Receive

*Annual decision support for individual parcels, guided by current conditions on the ground and current understanding about system behavior*

## Management recommendations report

Management Recommendations for Tall Grass Units in 2014													Thursday, August 29, 2013 5:24:12 PM
Grassland	Complex	Org	Unit	Year	NP Proportion	SB Proportion	KB Proportion	RM Proportion	Vegetation State	Defoliation Level	Years Since Level	Management Restriction	Recommended Management Action
Tall Grass Prairie	SAND LAKE COMPLEX	SPINK COUNTY WPA	Sanderson	2013	0.25	0.60	0.08	0.07	{0-30, SB}	Med	1	None	GRAZE W/IN WINDOW
Tall Grass Prairie	TEWAUKON WMD	RICHLAND COUNTY WPA	Hartleben Unit A	2013	1.00	0.00	0.00	0.00	{60-100, RM}	Low	5+	None	DEFOLIATE
Tall Grass Prairie	TEWAUKON WMD	RICHLAND COUNTY WPA	Hartleben Unit B	2013	0.22	0.00	0.00	0.78	{0-30, RM}	Low	2-4	None	DEFOLIATE
Tall Grass Prairie	TEWAUKON WMD	RICHLAND COUNTY WPA	Hartleben Unit C	2013	0.33	0.09	0.00	0.58	{30-45, RM}	Low	2-4	None	REST
Tall Grass Prairie	TEWAUKON WMD	SARGENT COUNTY WPA	Gainor Unit A	2013	0.12	0.04	0.36	0.48	{0-30, KB}	Med	1	None	BURN W/IN WINDOW

# Each Annual Cycle Cooperators Receive

## Summary of land unit conditions since NPAM enrollment

Summary of Mixed Grass States from Project Inception (2009) to Present								Thursday, August 29, 2013 2:18:10 PM	
Grassland	Complex	Org	Unit	Management Year	Management Applied	Management Classified	Defoliation Level	Years Since Level	Vegetation State
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 1	2009	burn/graze	N/A	High	1	{30-45, Co}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 1	2010	rest	REST	High	2-4	{30-45, Co}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 1	2011	rest	REST	Med	2-4	{0-30, Co}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 1	2012	burn	BURN	High	1	{45-60, Co}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 1	2013	burn	BURN	High	1	{45-60, SB}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 2	2009	burn	N/A	High	1	{0-30, KB}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 2	2010	rest	REST	High	2-4	{0-30, Co}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 2	2011	rest	REST	Med	2-4	{0-30, Co}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 2	2012	burn	BURN	High	1	{60-100, RM}
Mixed Grass Prairie	ARROWWOOD COMPLEX	ARROWWOOD NWR	G14 Pasture 2	2013	burn	BURN	High	1	{45-60, Co}

# Into the Future – Continuing the Cycle

- FWS continues implementing the annual iterative cycle
  - Cooperators
    - Manage, Monitor, Enter Data
  - Project and Database Coordinators
    - Update model weights and decision policy
    - Provide recommended management actions
    - Overall guidance to cooperators as needed
- Long-term conservation objective requiring long-term commitment → simply a new way of doing business
- As uncertainties are resolved, management will continue
  - A continued role for monitoring to make state-based decisions

# NPAM Infrastructure

- MS SharePoint site for data entry and information support
- Data are entered by cooperators via web portal
- NPAM related information stored and retrieved
- NPAM announcements/communications

The screenshot shows a Firefox browser window displaying the NPAM SharePoint site. The browser's address bar shows the site URL. The page header includes the 'DOI CONNECT' logo and a navigation bar with 'People and Groups' and 'Site Actions'. The main content area features a banner for 'Connecting the Department of the Interior' and a section for 'Native Prairie Adaptive Management'. A sidebar on the left contains links to various NPAM resources, including historical documents, annual reports, and user guides. The main content area includes a welcome message, a notice about new items being added, a submission deadline for NPAM units due by February 15, 2013, and a link to the NPAM database. A table titled '2013 Recommended Management Actions' lists actions for Mixed Grass Prairie and Tall Grass Prairie. Another table titled 'NPAM Events and Deadlines' lists events for adding and revising units and monitoring data. The page also includes a section for NPAM team members and a list of contacts for participating stations.

Firefox

People and Groups

DOI CONNECT

Site Actions Browse Page

Clinton Moore

Connecting the Department of the Interior

Use DOI Connect to collaborate and share information with others across DOI.

Native Prairie Adaptive Management

R6 Division of Biological Resource

Search this site...

NPAM Home Page

NPAM Historical Documents/Meeting Notes and Presentations

NPAM Annual Reports and Summaries

NPAM Protocol Notebook (User Guides/Data Sheets)

Station Specific Information (Maps/Spatial Layers/Summary Data)

Plant Identification Guides

NPAM Literature and Presentations

Scientific Literature

Q&A's

Recycle Bin

All Site Content

Welcome to the Native Prairie Adaptive Management SharePoint Site

New items will be added to the SharePoint site soon which will include a complete user guide for the NPAM SharePoint site containing a navigational map showing the location of all documents with a brief description plus additional tips and tricks on using SharePoint 2010, station specific data summaries, and common Q&A's related to NPAM.

**Submission or Revision of NPAM Units due by February 15, 2013**

Deadline for submitting new or revising existing units is February 15, 2012.

Steps for submitting new units include:

1. Complete the 2012 NPAM Unit Questionnaire. Questionnaire can be downloaded by clicking [HERE](#).
2. ArcGIS file that contains the digitized proposed management unit with wetlands, cropland, and tree plantings clipped out. This can be submitted using the format from the Grassland Units feature class found in the FeaturesUnitsMonitoring geodatabase in RLGIS or similar structure.
3. Belt transects developed during the initial Dakotas native prairie inventory (2007-2008), if applicable.

Submit all required information by email to [jennifer\\_zorn@fws.gov](mailto:jennifer_zorn@fws.gov)

**NPAM DATABASE**

(Click on picture below to access)

Deadline for data submission is August 25, 2012.

2013 Recommended Management Actions

Click on the appropriate grassland type to view the recommended management actions for 2013 (Sept 1, 2012 - Aug 31, 2013)

**Mixed Grass Prairie**

**Tall Grass Prairie**

**NPAM Events and Deadlines**

Date	Title	Description
2/15/2013	<a href="#">Adding and Revising Units Deadline</a>	Deadline for adding new units or revising existing units. Submit the Management Unit questionnaire and GIS layers to the database manager by February 15th.
8/25/2013	<a href="#">Monitoring Data Deadline</a>	Monitoring data must be entered into the database by August 25th.

Previous Next

**NPAM Team Members:**

**Core Members:**

Cami Dixon: Coordinator- FWS R6 (701.752.4218 x9)

Terry Shaffer: Co Chair- USGS-Northern Prairie Wildlife Research Center (701.253.5522)

Jennifer Zorn: Database Manager- FWS R6 (701.385.4046 x235)

**Advisory Team:**

Kim Bousquet- FWS R3- Big Stone NWR

Pauline Drobney- FWS R3- Neal Smith NWR

Justin Dupey- FWS R6- Huron WMD

Vanessa Fields- FWS R6- Benton Lake NWR

Todd Grant- FWS R6- J. Clark Salyer NWR

Sara Vacek- FWS R3- Morris WMD

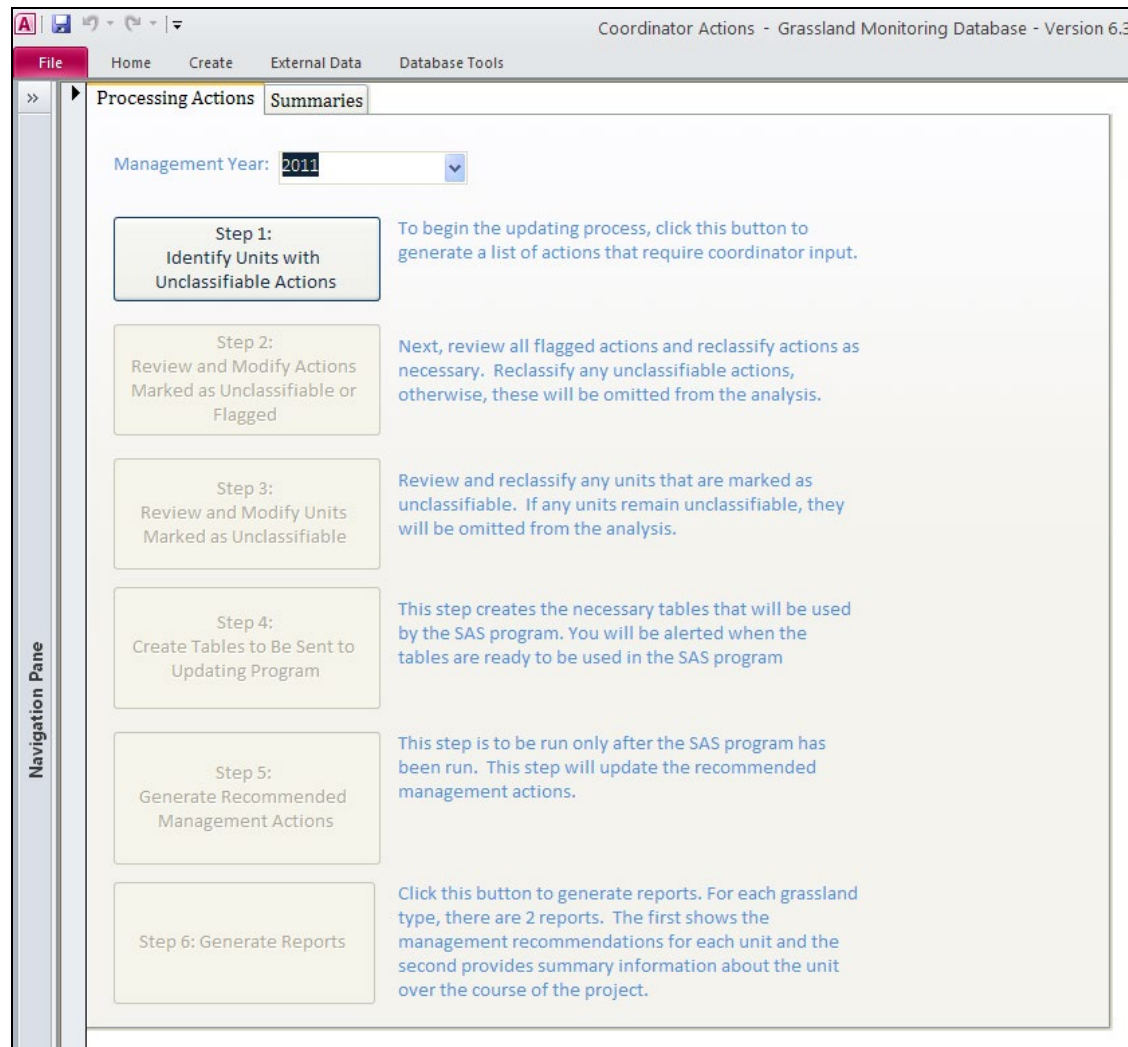
Jill Gannon- USGS- Northern Prairie Wildlife Research Center

Clint Moore- USGS- Georgia Cooperative Fish and Wildlife Research Unit

List of Contacts for Participating Stations

# NPAM Infrastructure

- MS Access database for project coordinator
  - ❑ Automated steps to process data
  - ❑ Prepares data for model weight updating
  - ❑ Identifies recommended management actions
  - ❑ Generates reports and data summaries for cooperators





# NPAM Infrastructure

- Protocol Notebook
  - NPAM Users' Manual
  - Principal document describing overall operation of NPAM
    - Roles
    - Timeline
    - Field protocols
  - Audience is cooperators and project coordinator

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# NPAM – Sustainable ‘New way of doing business’

- Relevant to cooperator needs and constraints
  - Uses pre-existing conventions and practices
  - Incorporates cooperator knowledge and preferences
- Operationalized with minimal cooperator investment
  - Seamless integration into routine operations
  - Automation of technical components
  - Flexibility for expansion to additional units
- Grassroots level involvement, not top-down
  - Trans-regional support and operation by cooperators themselves
- Periodic review by USFWS-USGS Advisory Team

# What cooperators gain from NPAM

## Pre-NPAM

- Working individually
- Different/Unstated objectives
- Decisions based on anecdotal observations
- Lack of recording and monitoring

## NPAM

- Coordination of effort
- Shared objective
- Same protocols
- Purposeful monitoring
- Decisions:
  - Transparent
  - Linked to objective
  - Based on:
    - Current system state
    - Current knowledge
  - Take into account uncertainty
- Learning while managing

# Spatially-distributed adaptive management: Benefits and Trade-Offs

## ■ Benefits

- ❑ Maintain flexibility of management at the station scale
- ❑ Common protocols for monitoring and decision making
- ❑ Broad-scale consensus on values and what is to be achieved
- ❑ Collective learning from “replication” across system
- ❑ Management improved locally and system-wide

## ■ Trade-offs

- ❑ Flexibility & Large Scales → Noise → Slower learning rate
  - But, learning occurs if stick to the framework

# What we have learned from NPAM

## ■ Coordination

- ❑ Timelines & standardized processes
- ❑ Understanding of roles & responsibilities
- ❑ Continuous communication

## ■ Commitment to the process

- ❑ Adherence to protocols
- ❑ Time for learning to unfold

## ■ Multi-partner participation



## ■ Leaders & champions

# Participation in NPAM would require potential partner to have...

- Control of native sod land units
- Compatible management objective
- Ability to apply compatible management actions
  - Make annual decisions, based on a management year of 1 Sep – 31 Aug
  - Refrain from broadcast application of herbicides or other non-appropriate actions (outside of spot treatments)
  - In tallgrass, ability to assess phenology to identify appropriate management windows

# Participation in NPAM would require potential partner to have...

- Ability to monitor annually and follow same protocol
- Ability to record details of management actions using same protocol
- Ability to enter data by the annual deadline (25 Aug)
- Ability/willingness to consider the recommended management (provided 1 Sep) before deciding upon the action to take that year

# Post-Webinar Questionnaire

- Purpose: to assess compatibility between NPAM and potential partner needs and abilities and assess potential to expand NPAM beyond the USFWS NWRS
- Delivery: via email attachment from Cami after the webinar
- Format: Excel file with directed questions that request responses by way of drop-down list or free-form typing, as well as an area for providing additional information\*
- Return: to Jill (contact info on questionnaire) within three weeks (7 Feb)



# Native Prairie Adaptive Management Team

- USFWS Development Team

- Kim Bousquet, Cami Dixon, Pauline Drobney, Vanessa Fields, Bridgette Flanders-Wanner, Todd Grant, Sara Vacek

- Database Team

- Development: Kevin McAbee, Todd Sutherland, Sarah Jacobi, Victoria Hunt
- Management: Justin Dupey and Jennifer Zorn

- USFWS Refuge Cooperators – Region 3 and Region 6

- USGS

- Terry Shaffer, Clint Moore, Jill Gannon