

# Bases del manejo de la humedad del suelo

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Manejo de humedales para técnicos en México II

LAGUNA MEXICANOS, CHIHUAHUA

Club Raramuri

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# WHAT WAS ORIGINAL SEASONAL (MOIST-SOIL) MANAGEMENT

- IN SOUTHERN US WHERE IT IS DRY DURING THE GROWING SEASON AND WET DURING THE DORMANT SEASON
- ON MUDFLATS IN FLOODPLAINS OR AROUND WETLANDS DURING THE GROWING SEASON
- IN BEAVER PONDS
- IN OPENINGS IN SOUTHERN FORESTS
- LARGE SEASONALLY-FLOODED BASINS
- IN ARID SYSTEMS WITH VARIABLE INPUTS DURING THE GROWING SEASON

# SEASONAL WETLANDS IN ARID SOUTHWEST

## ■ MONSOONAL DRIVEN

- HIGH LOCAL INPUTS
- NOT CONSIST IN TIMING OR AMOUNT
- LOWER PROBABILITY FOR REFLOODING

## ■ SNOW PACK DRIVEN

ALWAYS IN SPRING

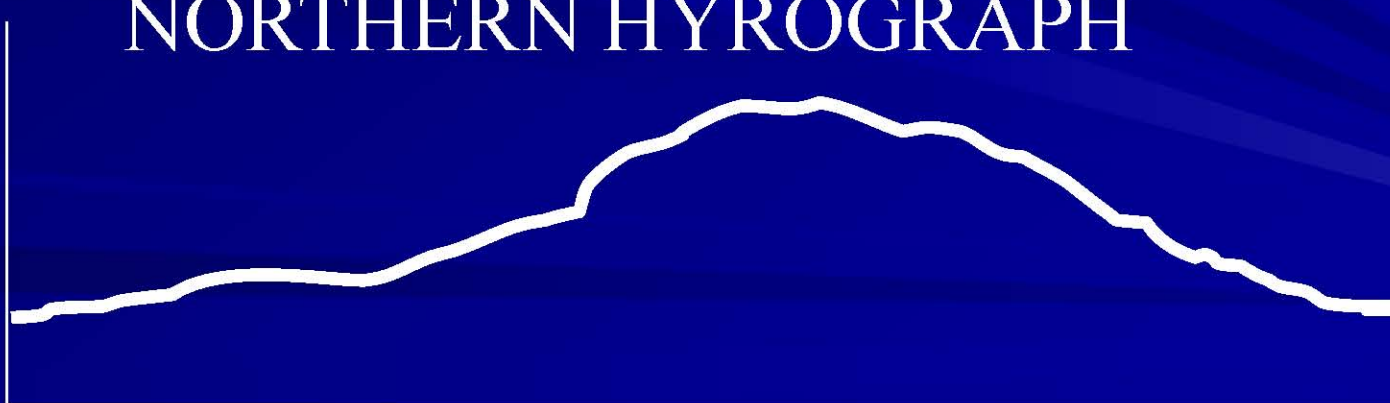
HIGHLY VARIABLE IN AMOUNT

EFFECTS WITHIN FLOODPLAIN

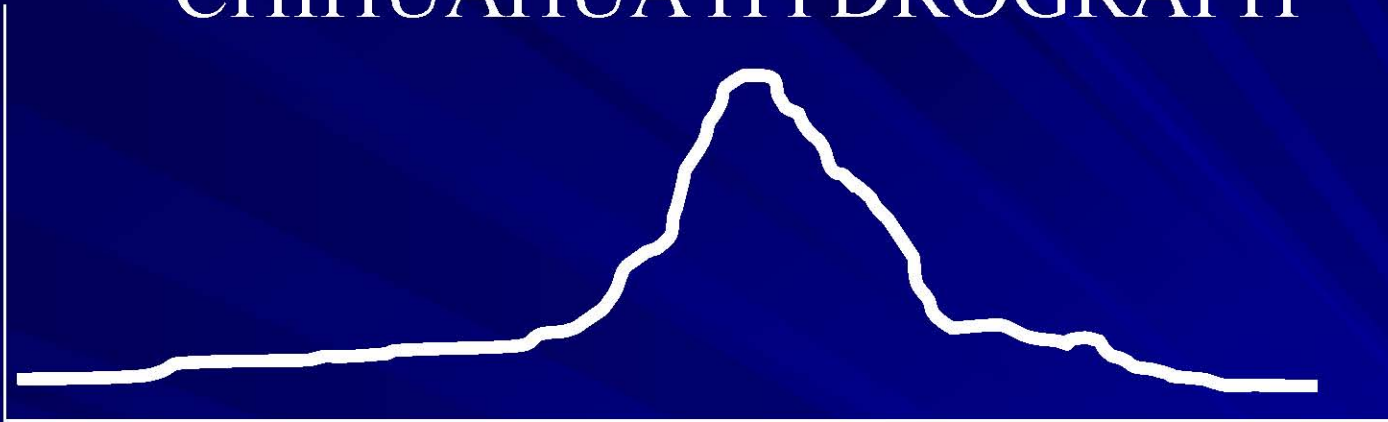
## SOUTHERN HYDROGRAPH



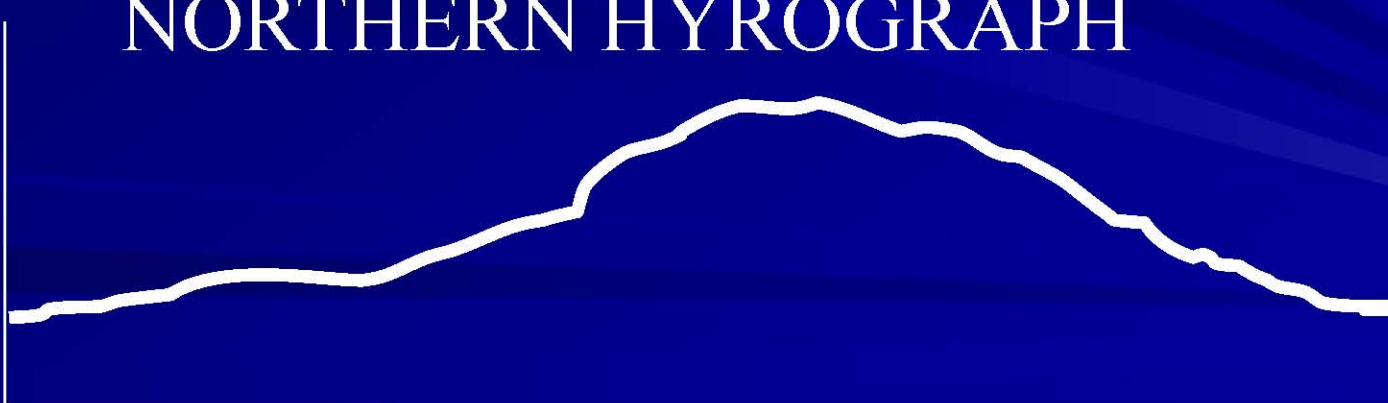
## NORTHERN HYDROGRAPH



# CHIHUAHUA HYDROGRAPH



# NORTHERN HYROGRAPH



# SOME COMMON QUESTIONS ASSOCIATED WITH MOIST-SOIL MANAGEMENT

- WHAT IS MOIST-SOIL MANAGEMENT?
- HOW LARGE AN AREA IS NEEDED?
- CAN MOIST-SOIL REPLACE OTHER HABITATS?
- WHAT TYPES OF FOODS CAN BE PRODUCED?
- WILL THE TECHNIQUE WORK ON MY SITE?
- WHERE DO I PURCHASE SEED?

# INTENSIVE MANAGEMENT

## ■ GOAL

- INCREASE WILDLIFE NUMBERS/UNIT AREA
- ENHANCE OR INCREASE USE DURING SPECIFIC TIME PERIODS
- INCREASE DIVERSITY OF USE
- REPLACE OR SUPPLEMENT FOODS NO LONGER PRODUCED IN NATIVE HABITATS

# INTENSIVE MANAGEMENT

- MOST IMPORTANT
  - WHERE WETLAND LOSSES ARE HIGH
  - WHERE PERTURBATIONS ARE EXTENSIVE
  - WHERE HYDROLOGY HAS BEEN DISRUPTED

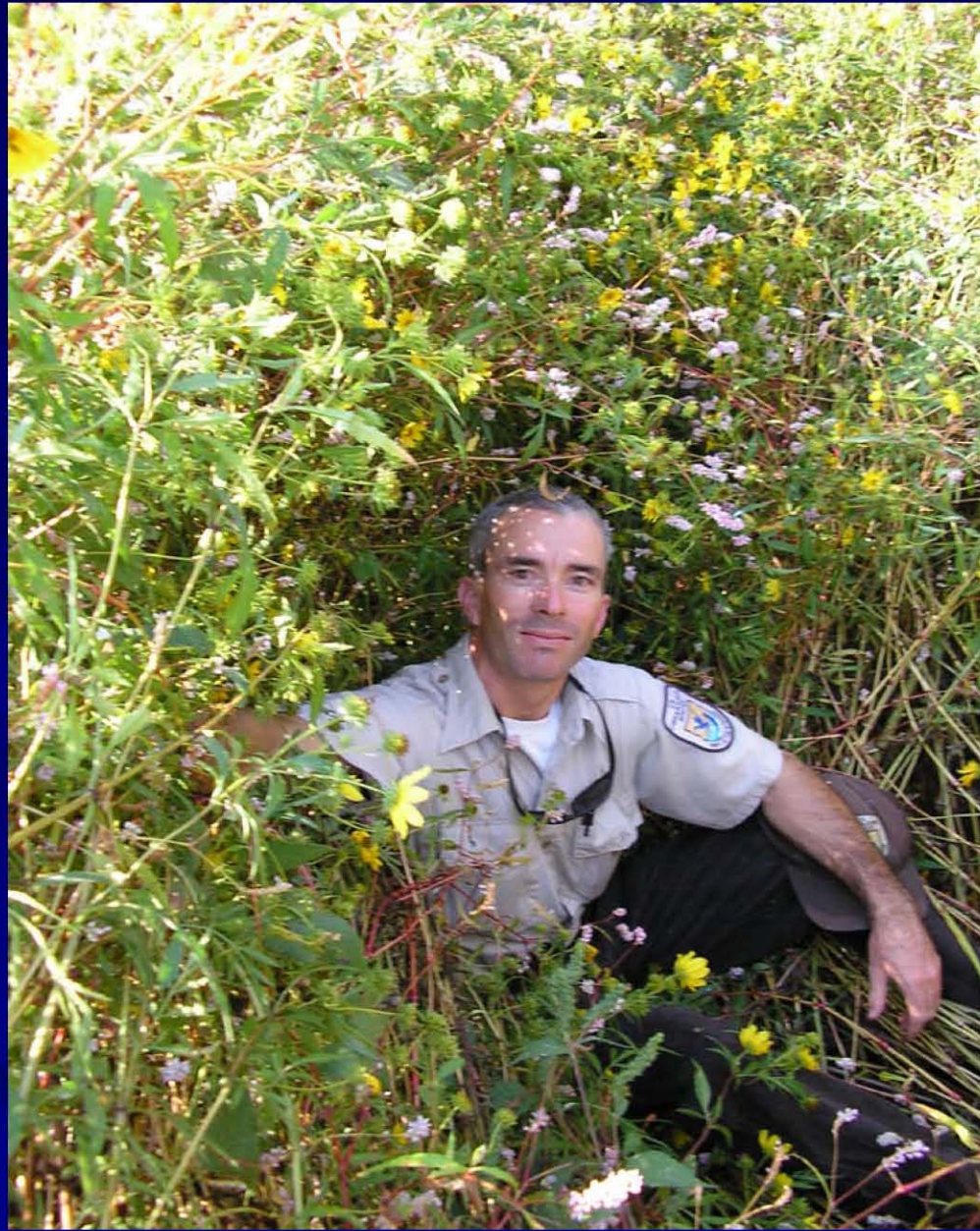


# INTENSIVE MANAGEMENT

- COST INCREASE
  - PERSONNEL
  - EQUIPMENT
  - OPERATIONS

# HOW MANY ACRES CAN ONE FTE WITH AVERAGE EXPERIENCE MANAGE

- MAINLAND
  - 300 ACRES
- HAWAII
  - 90 ACRES















# RAILS



# WADERS



# MOIST-SOIL POTENTIAL

- COVER

- FOOD

- SEEDS

- BROWSE

- TUBERS, ROOTS, ETC.

- INVERTEBRATES

\*OVER 140 SPECIES RESPONDED TO  
MOIST-SOIL CONDITIONS ON MINGO NWR

# MOIST-SOIL PLANT COMPOSITION DETERMINED BY

- SUCCESSIONAL STAGE
- DRAWDOWN DATE
- DURATION OF DRAWDOWN
- TYPE OF DRAWDOWN
- TURBIDITY/SHADE
- FLOODING AND REFLOODING







# AMMANIA









# FRIMBRISTYLIS



# PICKELWEED









# YOUR MANAGEMENT RESPONSIBILITY

- OPTIMIZE AREA OF EXPOSED MINERAL SOIL
- CREATE TEMPERATURE AND MOISTURE CONDITIONS ON THIS MINERAL SOIL TO STIMULATE GERMINATION OF DESIRED SPECIES
- PROMOTE GROWTH OF DESIRED SPECIES
- OPTIMIZE THE USE OF THE FOOD RESOURCES PRODUCED
  - DURATION OF USE
  - TIMING OF USE
  - TARGET SPECIES NEEDS



# The decisions related to SUCCESS

- The administrative level
  - Ideological constraints
    - Level of intensity
    - Whether population or habitat driven
    - Level of support
- The field level
  - Promote bare mineral soil
  - Promote germination conditions
  - Promote plant growth
  - Promote seed production
  - Promote invertebrate production
  - Make resources available

Type, size,  
location and  
number of water  
control structures

Herbicides

Plant composition

Amount of  
organic matter

Time since disturbance

Wet year

Presence and  
amount of  
ground water  
discharge

**BARE MINERAL SOIL**

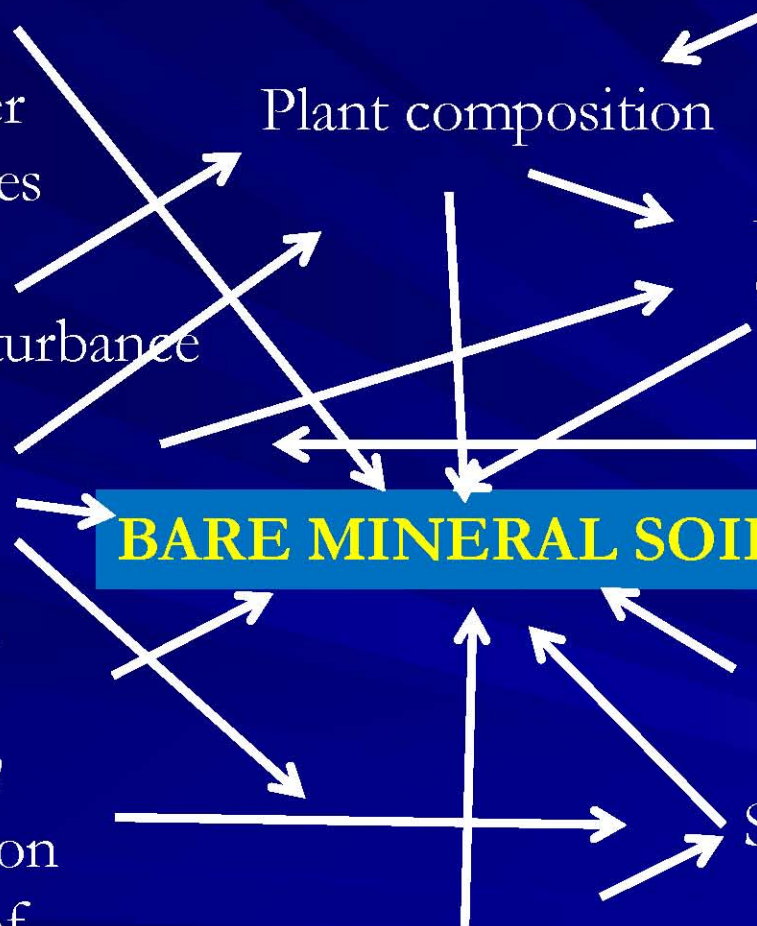
Time in wetland cycle

Dry year

Type, condition  
and power of  
equipment

Skill of operators

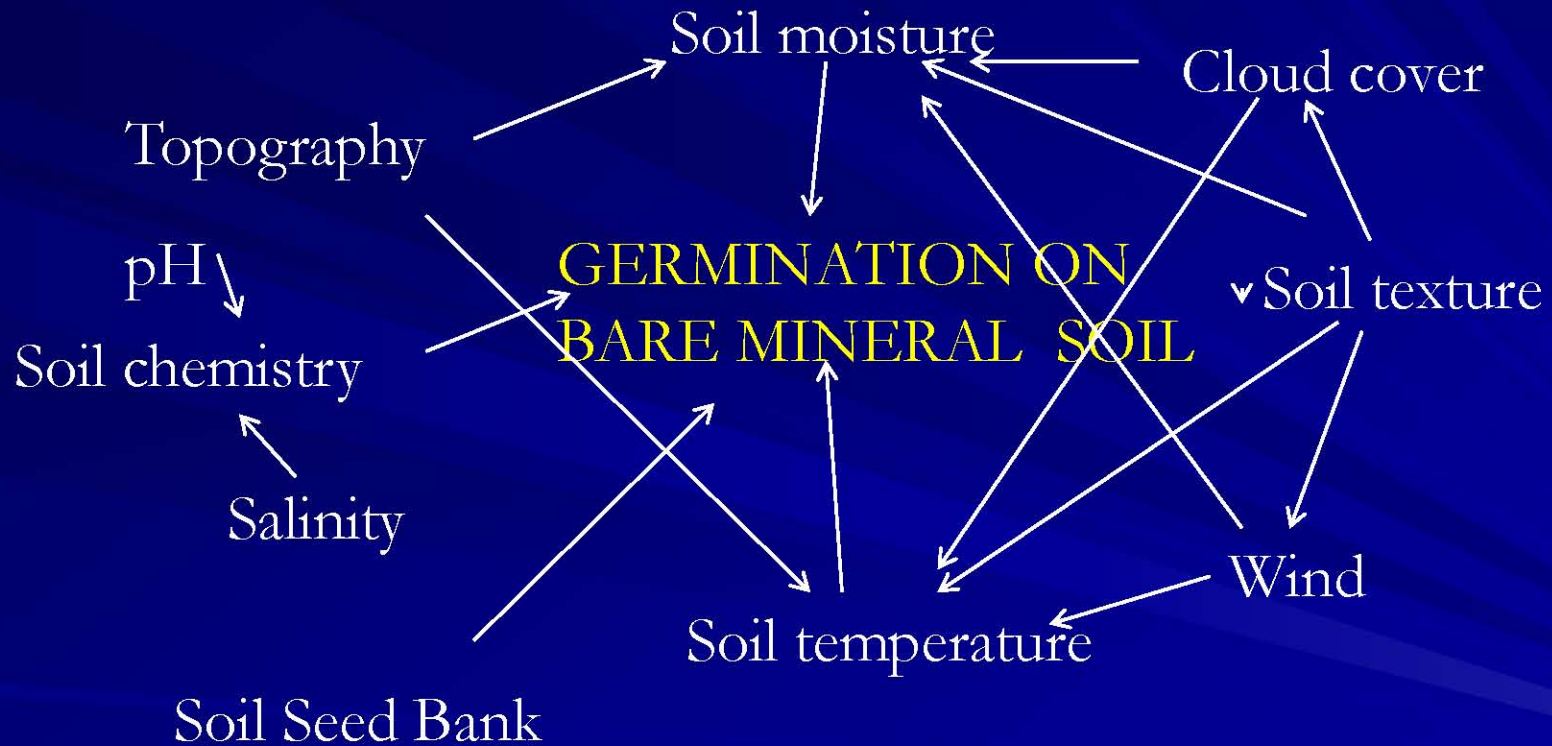
Number of different  
implements



# Create Bare Mineral


- Best to let the birds do it with foraging activities
- Fire
- Tillage of various types
- Rolling
- Prolonged flooding
- Some action this season for benefits in future season

# FACTORS AFFECTING GERMINATION



# Control of germination conditions

- Influence water in pore spaces
- Organic matter content
- Texture of surface soils
- Topography of surface
- Color of surface
- Cloudy or sunny conditions

A photograph of a wetland area. The foreground is dominated by dense, green sedges growing in dark, moist soil. In the middle ground, there is a small, shallow pond or impoundment. The background shows a flat, green field extending to a line of trees and distant mountains under a clear sky.

After wet-tilling of fine textured soils, native sedges from the seed bank germinate and compete well with the undesired invasives that once dominated these impoundments.

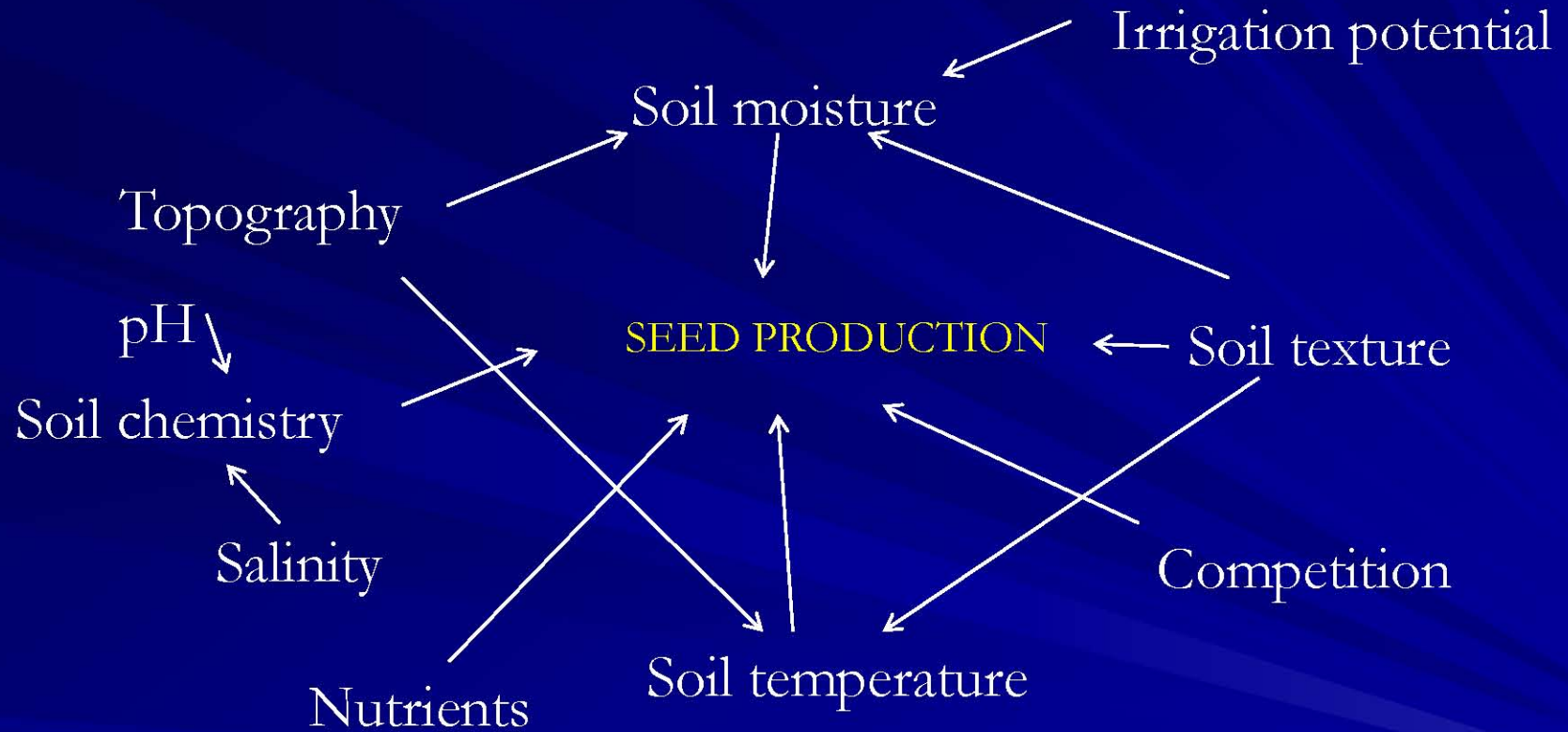


11 years of “natural” water fluctuations at Beaver Pond  
= substantial increase in emergent vegetation  
= interspersed of cattail, spikerush, baltic rush & sedges

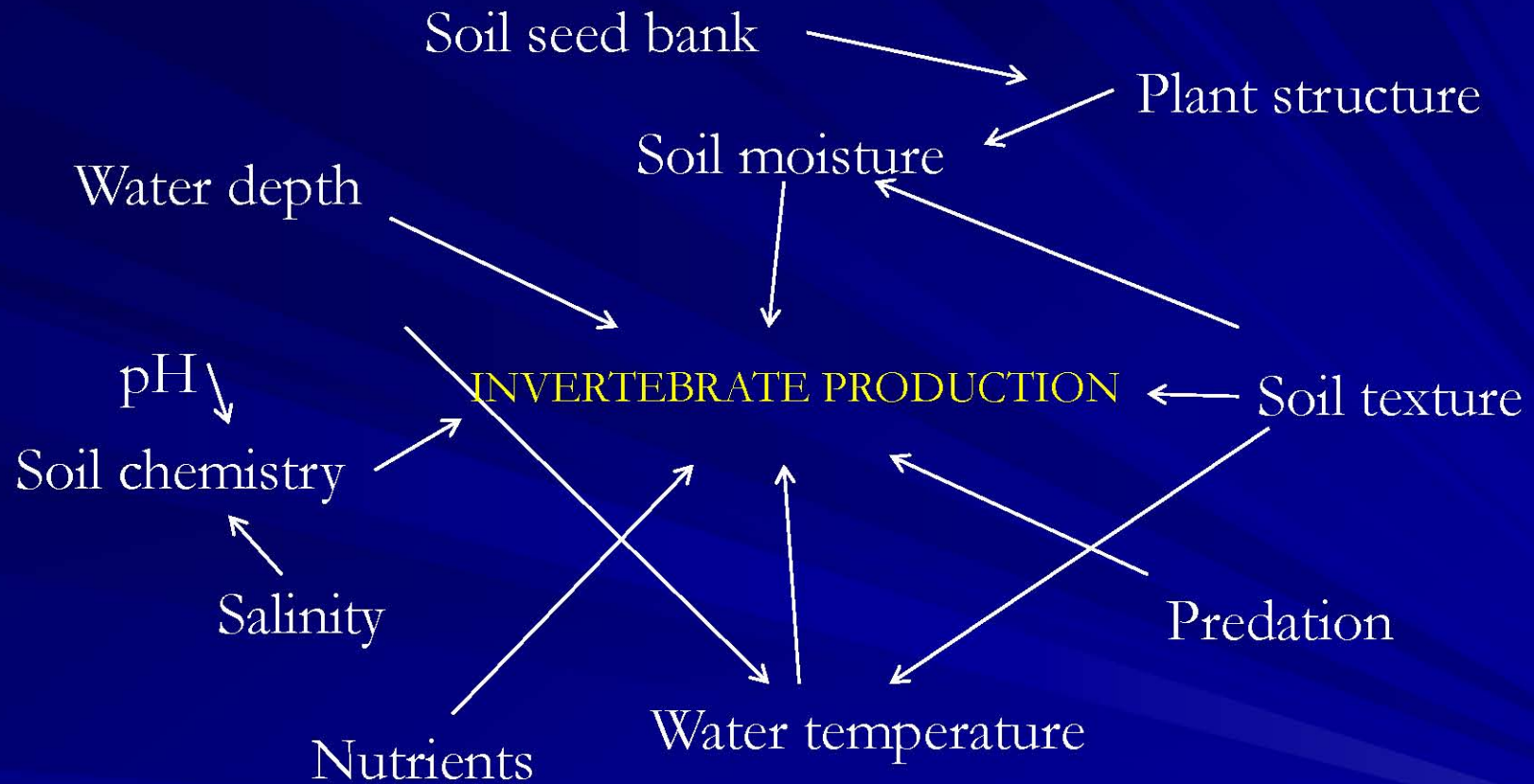




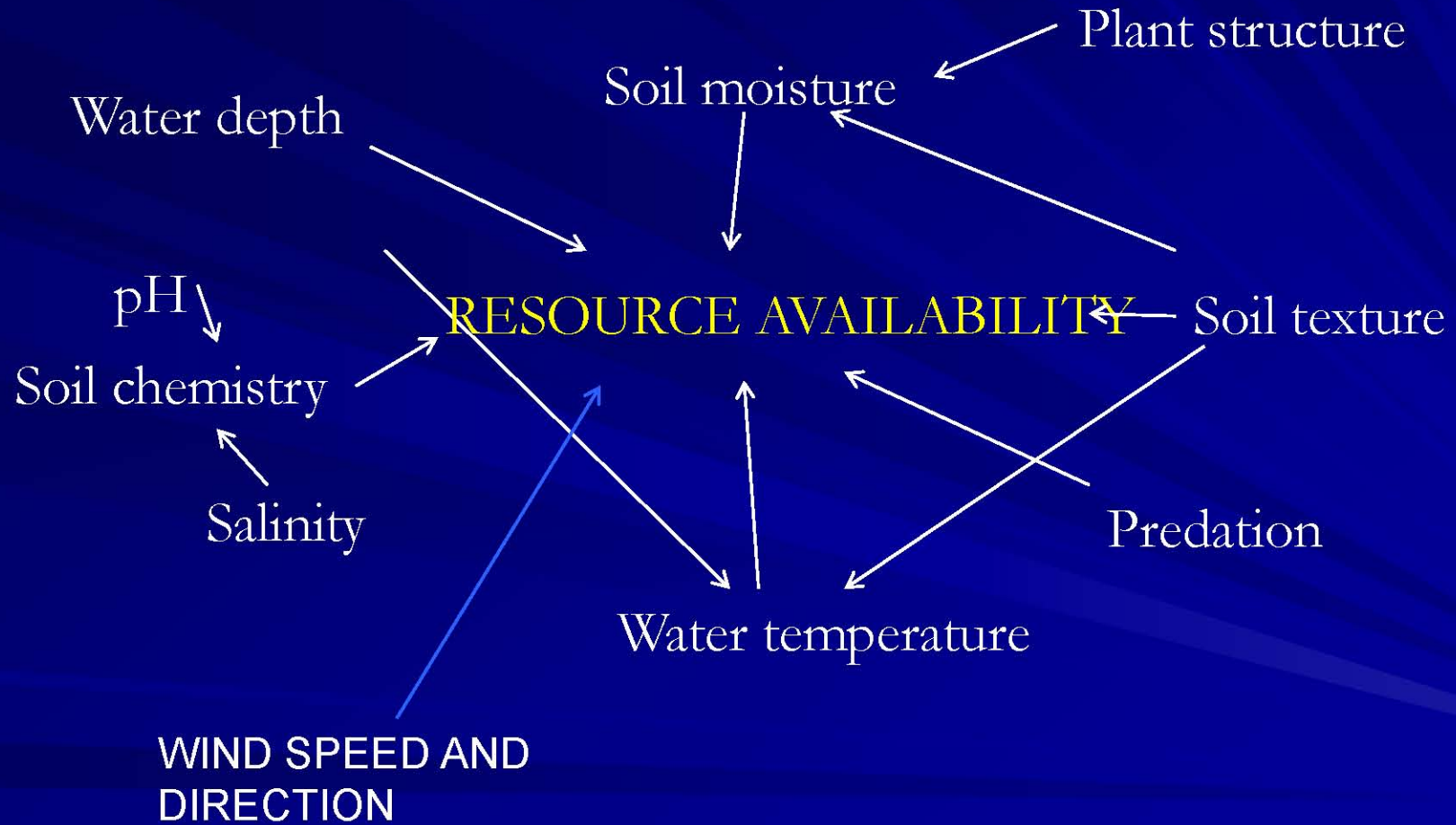
# FACTORS AFFECTING SEED PRODUCTION



# FACTORS AFFECTING INVERTEBRATE PRODUCTION



# FACTORS AFFECTING RESOURCE AVAILABILITY



Fields are mowed for desired habitat mosaic



Initial flooding of freshly treated ponds provides foraging opportunity for endangered waterbirds.

Invertebrate production is apparent shortly after flooding.



# ANNUALS

- EXCELLENT SEED PRODUCERS
- HIGHEST PRODUCTION AFTER DISTURBANCE
- EXCELLENT NUTRITIONAL VALUES
- DIVERSE NUTRITIONAL VALUES

# IDENTIFICATION OF SMALL PLANTS IS IMPORTANT







Area 100 - Area 100  
Plot 10  
July 10, 1960



# PERENNIALS

- POOR SEED PRODUCERS
- EXTENSIVE BELOW GROUND BIOMASS

# Above and Below Ground Biomass Production of 3 Common Perennial Wetland Plant species

Species	Production Lbs/Acre	
	Above	Below
Phragmites	9,580	64,060
Cattail	7,580	16,060
Yellow water lily	5,400	10,225

# REGULAR DISTURBANCE

- MORE ANNUALS
  - HIGHER SEED PRODUCTION
  - PLANTS THAT DECOMPOSE MORE RAPIDLY
- FEWER WOODY SPECIES
- FEWER PERENNIALS

# TYPES OF DISTURBANCE

- FLOODING
- TILLAGE
- FIRE
- MOWING
- DROUGHT CONDITION
  - SEVERITY
  - DURATION
- HERBICIDES

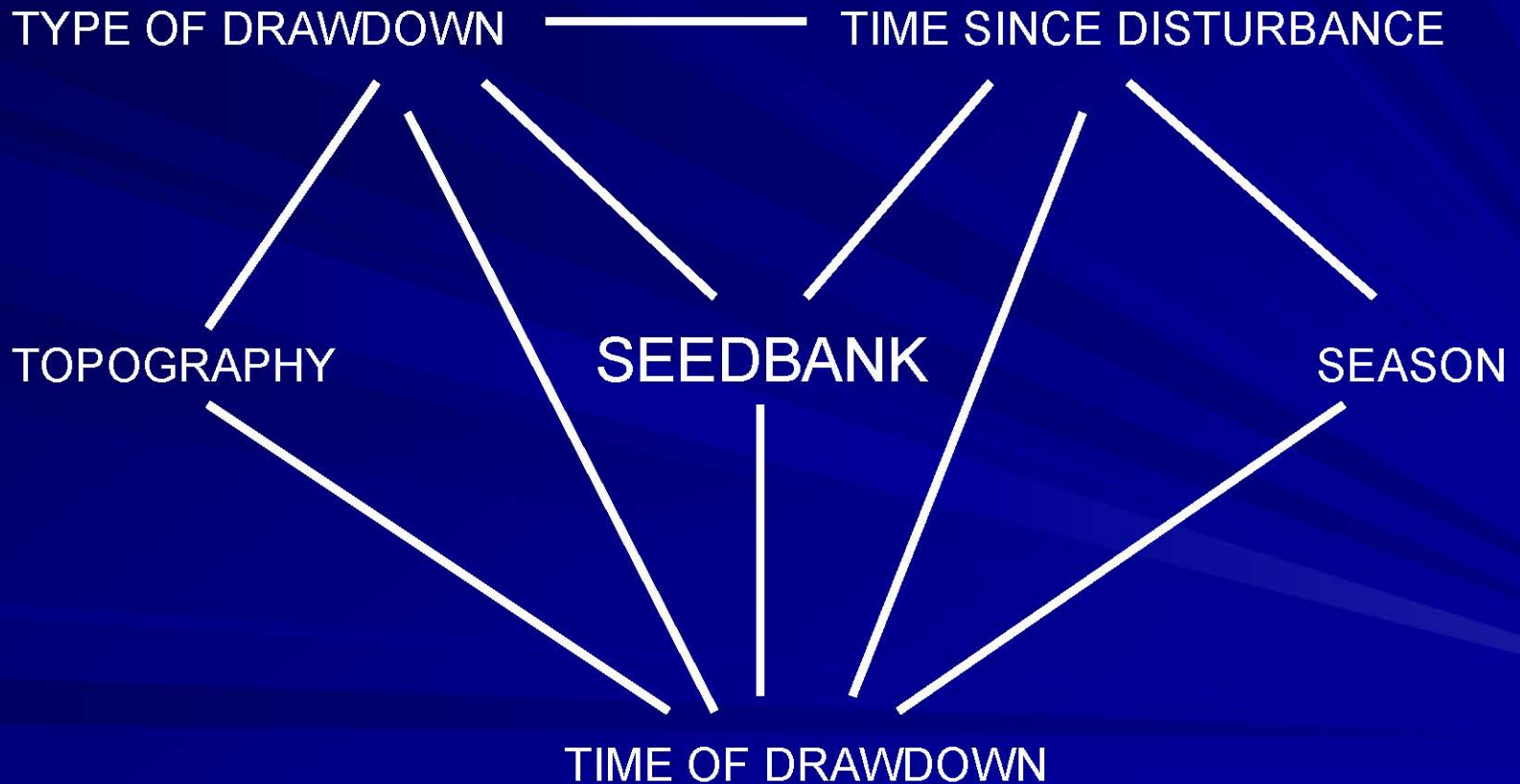
# Moist-soil Management Strategies

## ■ Water as a TOOL

- Drawdown (Time and Type)
- Flooding (for benefits and for stress)
  - Depth
  - Duration
  - Extent
- Keep Dry

## ■ Mechanical Treatments as a substitute for natural disturbance

# VEGETATION RESPONSE TO DRAWDOWN





# **GENERAL PLANT RESPONSE**

**EARLY DRAWDOWN SMARTWEEDS**

**MID-SEASON DRAWDOWN MILLETS**

**LATE SEASON DRAWDOWN  
SPRANGLETOP**

# TIME OF DRAWDOWN

(36 DEGREES NORTH LATITUDE)

EARLY (BEFORE 15 MAY) – SMARTWEEDS

MID-SEASON (15 MAY – 1 JULY) – MILLETS

LATE SEASON (After 1 July) – SPRANGLETOP  
BIDENS

# **LATITUDE VARIATION**

**EARLY DRAWDOWN**

**SOUTHERN LOUISIANA –  
FEBRUARY**

**ARKANSAS – MID-MARCH**

**MISSOURI – MID-APRIL**

# **SOIL TEMPERATURE**

**COOLER**

**EARLY IN SEASON**

**IF MOIST**

**IF ORGANIC SOIL**

**IF LITTER IS PRESENT**

# **SOIL MOISTURE WET**

**EARLY IN SEASON**

**IF ORGANIC SOIL**

**IF LITTER IS PRESENT**

**IF SURFACE IS LIGHTER**

**IF TEXTURE IS FINE**

**IF SOIL IS COMPACTED**

# **SOIL CONDITIONS FOR GERMINATION**

**SMARTWEEDS – COOL AND  
WET**

**MILLETS – WARM AND MOIST**

**SPRANGLETOP – HOT AND  
DRY**

Family	Species	Drawdown Date		
		Early	Mid-season	Late
Grass	Ricecut grass ( <i>Leersia</i> sp.)	+++	+	
	Sprangletop ( <i>Leptochloa</i> sp.)		+	+++
	Crabgrass ( <i>Digitaria</i> sp.)		+++	+++
	Panic grass ( <i>Panicum</i> sp.)		+++	++
	Barnyard grass ( <i>Echinochloa crusgalli</i> )	+++	+	+
	Barnyard grass ( <i>Echinochloa Walterii</i> )	+	+++	
	Barnyard grass ( <i>Echinochloa muricata</i> )	+	+++	+
Sedge	Red-rooted sedge ( <i>Cyperus erythrorhizos</i> )		++	
	Chufa ( <i>Cyperus esculentus</i> )	+++	+	
	Spikerush ( <i>Eleocharis</i> sp.)	+++	+	+
Pea	Sweet Clover ( <i>Mellilotus</i> sp.)	+++		
	Sesbania ( <i>Sesbania exalta</i> )		++	
Buckwheat	Big-seeded smartweed ( <i>Polygonum pensylvanicum</i> )	+++		
	Nodding smartweed ( <i>Polygonum lapathifolium</i> )	+++		
	Dock ( <i>Rumex</i> sp.)	+++	+	
Composite	Cocklebur ( <i>Xanthium strumarium</i> )	++	+++	++
	Beggarticks ( <i>Bidens</i> sp.)	+	+++	+++
	Aster ( <i>Aster</i> sp.)	+++	++	+
Loosestrife	Purple loosestrife ( <i>Lythrum salicaria</i> )	++	++	+
	Toothcup ( <i>Ammania coccinea</i> )	+	++	++

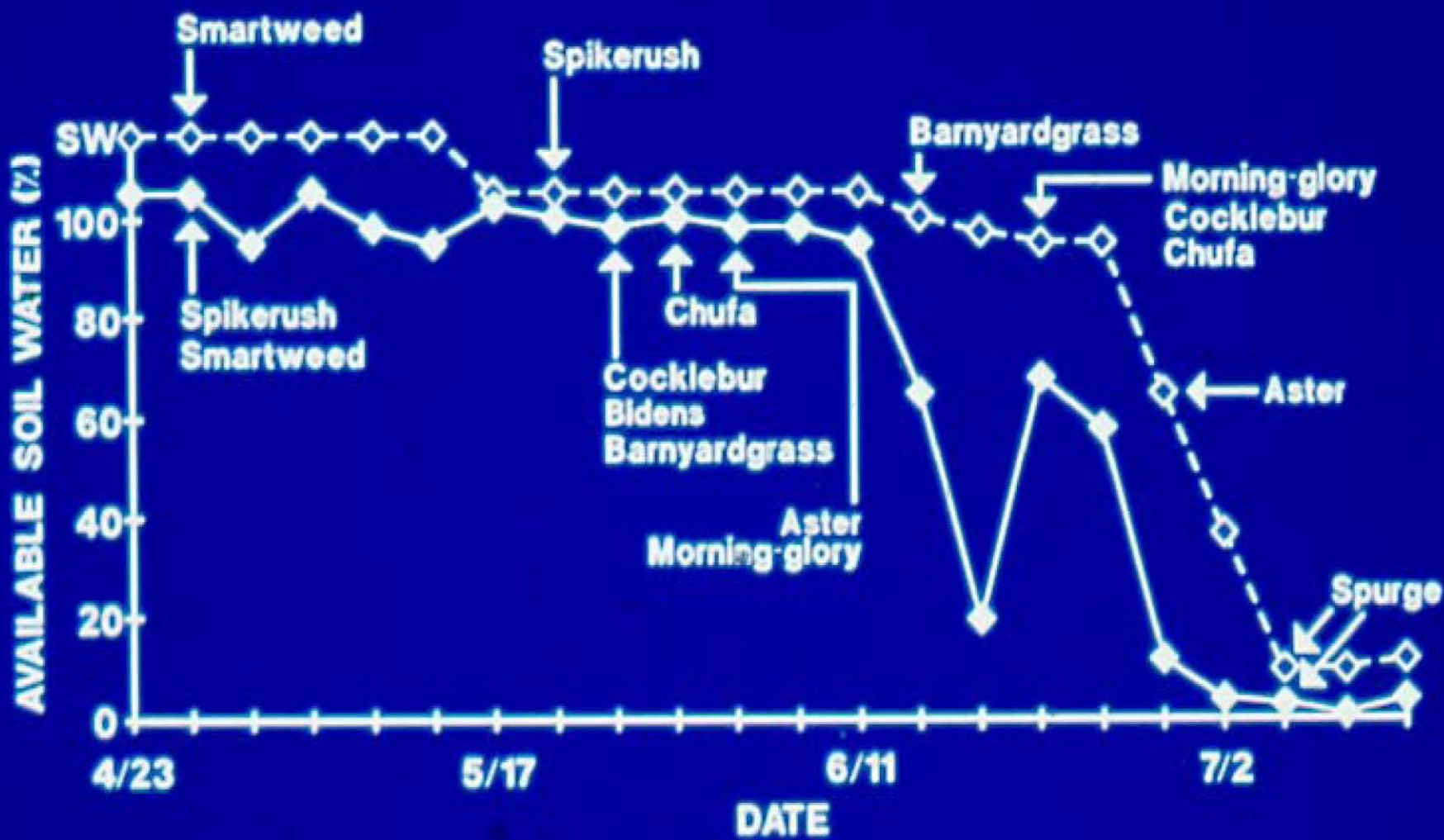
<u>Drawdown</u>		<u>Common Barnyardgrass</u>		<u>Cocklebur</u>	
<u>Date</u>	<u>Rate</u>	<u>Stems/m<sup>2</sup></u>	<u>Percent</u>	<u>Stems/m<sup>2</sup></u>	<u>Percent</u>
Early	Slow	44	40	8	7
Early	Fast	27	2	82	65



## Seed germination and soil moisture

Species	Soil water matrix potential (kPa)	
	Laboratory	Field
<b>Polygonum hydropiperoides</b> (swamp smartweed)	0	-5
<b>Eleocharis obtusa</b> (blunt spikerush)	-10	-10
<b>Echinochloa crusgalli</b> (common barnyardgrass)	-20	-40
<b>Xanthium pensylvanicum</b> (common cocklebur)	-60	-55

Data from Naim (1987).



# WOODY ESTABLISHMENT

## ■ PLANTING

- NUTS/SEEDS
- BARE ROOTS
- RPM TREES

## ■ CREATING SUITABLE SETTING FOR NATURAL ESTABLISHMENT

- CORRECT TIMING/DURATION FOR GERMINATION
- CORRECT TEXTURES
- CORRECT TIME/DURATION FOR GROWTH

# PLANTING

- CONDITIONS FOR STORAGE OF SEEDS/NUTS
- CONDITIONS FOR HANDLING BARE ROOTED SEEDLINGS
- PREPLANTING TREATMENTS
  - CHISEL PLOW
  - REMOVAL OF COMPETITION
    - MOWING/BURNING
    - SPECIAL COVER PLANTINGS
- HYDROLOGIC CONDITIONS
- PROTECTION OF PLANTINGS

# NATURAL ESTABLISHMENT

- SEED VIABILITY
  - MOST LIGHT SEEDED TREES – 2 WEEKS
- GERMINATION CONDITIONS
  - SATURATED SOIL
  - BARE MINERAL SOIL
- NATURAL TOPOGRAPHY
  - DIFFERENT CONDITIONS ON SITE
- HYDROLOGIC CONDITIONS
  - DURATION OF SATURATION
  - DEPTH TO GROUND WATER

Variable	Drawdown Rate	
	Fast <sup>1</sup>	Slow <sup>2</sup>
<b>Drawdown date</b>		
<b>Plants</b>		
Early season	Good	Excellent
Mid/late season	Poor	Good
<b>Invertebrates</b>		
Early season	Good	Excellent
Mid/late season	Poor	Good
<b>Germination</b>		
Period of ideal condition	Short	Long
<b>Root development</b>		
Wet year	Good	Excellent
Drought year	Poor	Excellent
<b>Seed production</b>		
Wet year	Good	Good
Drought year	Poor	Good
<b>Invertebrates</b>		
Period of availability	Short	Long
<b>Nutrient Export</b>	High	Low

<sup>1</sup> Less than 4 days.

<sup>2</sup> Greater than 4 days.

**AVERAGE PROXIMATE COMPOSITION OF SEEDS**  
(% Dry Matter)

<u>Species</u>	<u>Crude Fat</u>	<u>Crude Fiber</u>	<u>Crude Protein</u>	<u>Ash</u>	<u>NFE</u>
<u>Sorghum vulgare</u>	3.24	2.11	8.12	1.64	84.89
<u>Zea mays</u>	3.99	2.09	8.78	1.51	83.63
<u>Polygonum pennsylvanicum</u>	3.63	12.54	8.08	1.79	73.96
<u>Polygonum lapathifolium</u>	4.05	19.90	9.58	2.23	64.24
<u>Echinochloa crusgalli</u>	3.25	20.07	9.30	6.09	61.29
<u>Echinochloa muricata</u>	4.70	15.90	9.09	6.05	64.26
<u>Leersia oryzoides</u>	2.21	10.93	14.35	4.74	67.77
<u>Setaria Faberii</u>	2.28	20.48	17.78	10.78	48.68
<u>Bidens sp.</u>	20.26	22.21	23.08	5.96	28.49
<u>Glycine max</u>	19.49	5.46	44.54	5.99	24.52

# **EFFECTS OF SUCCESSION**

**NO DISTURBANCE**

**LOWER SEED PRODUCTION**

**MORE PERENNIALS**

**MORE WOODY VEGETATION**



# **CHANGES IN SEED PRODUCTION OVER TIME**

## **MILLETS**

**FIRST YEAR 1800 LBS/ACRE**

**SECOND YEAR 1400 LBS/ACRE**

**THIRD YEAR 950 LBS/ACRE**

**FOURTH YEAR 500 LBS/ACRE**

# **CONTROL OF VEGETATION TILLAGE**

**MOWING**

**FLOODING**

**HERBICIDES**

# Moist-soil Management Strategies

## Mechanical

- Mechanical treatments as a substitute for natural disturbance
  - Disk (Time, Depth, and Type)
    - Offset
    - Finish
  - Plow (Time, Depth, and Type)
    - Mold board
    - Chisel
    - Root
  - Rollers
    - Cultipackers
    - Rice
  - Mow (Time, Height)
    - Sickle bar
    - Rotary
    - Flail

# TILLAGE EQUIPMENT

CHISEL PLOW

BREAKS UP HARDPAN

MIXES SEEDS

MOLDBOARD PLOW

URNS VEGETATION

DEEP TREATMENT

OFFSET DISK

URNS SURFACE SOIL

CAN BE SHALLOW OR DEEP

FINISH DISK

URNS SURFACE MATERIAL

ROTOTILLER

PULVERIZES SOIL, SMOOTHER SURFACE

CULTIPACKER

FLATTENS OR SMOOTHS SOIL SURFACE

# HEAVY DISC





JOHN DEERE









# ROTOTILLER



# ROOT PLOW



# ROOT PLOW



# ROOT PLOW



# ROLLER



## RESULTS FROM ROLLER TREATMENTS



# ENHANCING PRODUCTION



# MOWING EQUIPMENT

## ■ IMPLEMENT

HEAVY BUSH HOG

FLAIL, SICKLE BAR,  
DISK, OR BUSH  
HOG

## ■ MANAGEMENT POTENTIAL

– IMPACT WOODY  
AND/OR ROBUST  
HERBACEOUS

– OPENS CANOPY  
FOR MORE SUN

– INCREASE  
PHOTOSYNTHESIS



JOHN DEERE

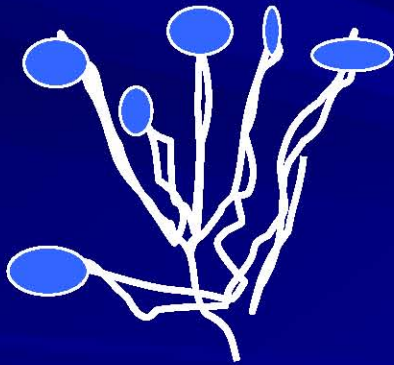
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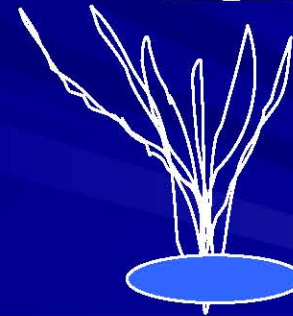
# EFFECTS OF MOWING

GROWING POINT  
AT TIP



DICOTS

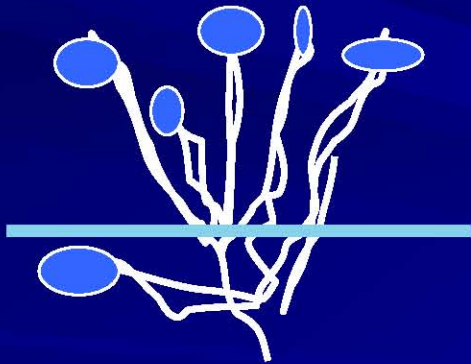
GROWING POINT  
AT BASE



MONOCOTS

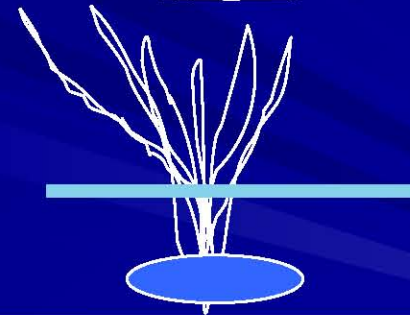
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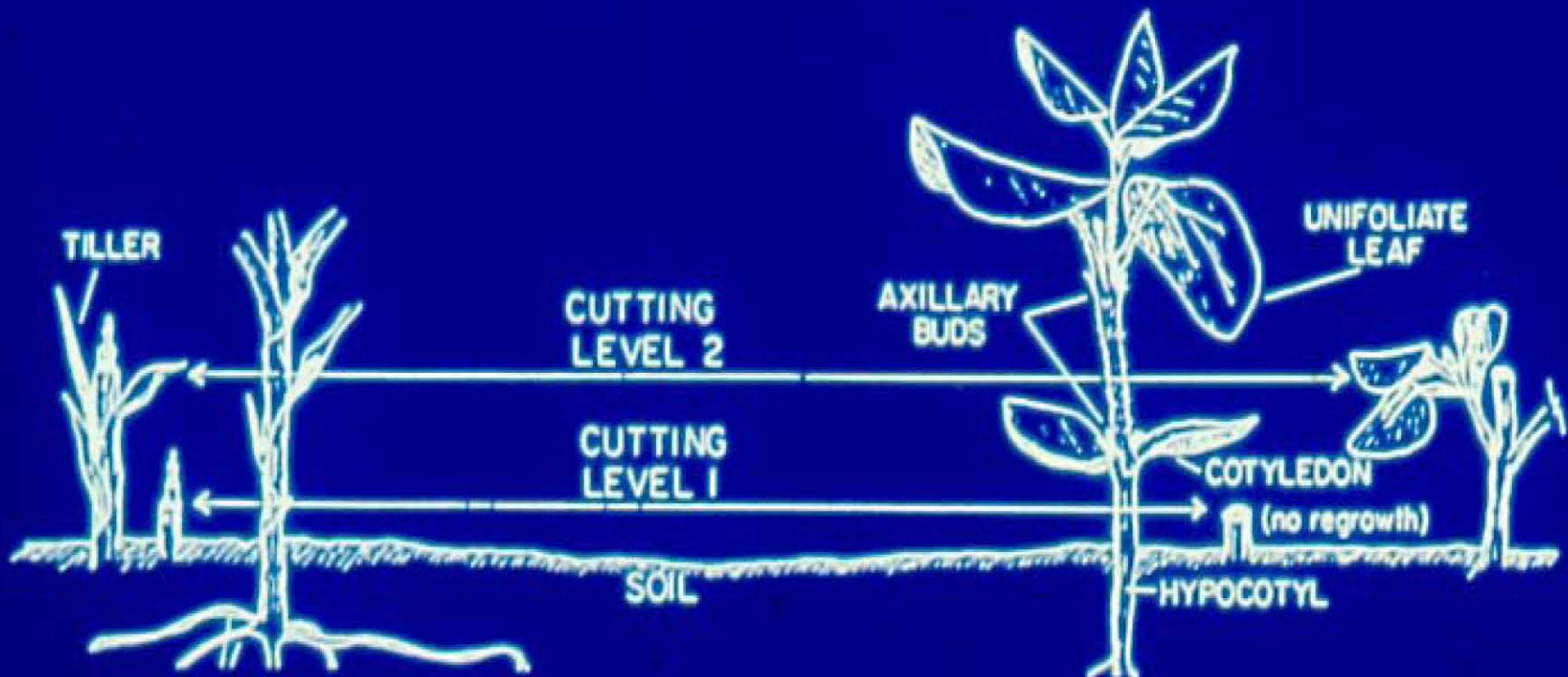


DICOTS

GROWING POINT  
AT BASE



MONOCOTS



# **EFFECTS OF MOWING**

**MONOCULTURE OF  
MONOCOTS**

**LESS STRUCTURAL  
DIVERSITY**

**POSSIBLE LOSS OF SEED  
PRODUCTION**



# Other Moist-soil Management Strategies

## ■ Fire

- Remove litter/shade/structure
- Release nutrients
- Compromise certain species

## ■ Get the birds to DO IT

- Heavy use
- Grubbers greater effect

# Moist-soil Management Strategies

- Chemical Treatments
  - Type of chemical and rate
  - Timing of treatment
  - Pretreatment

# **STRATEGY FOR CONTROL**

**MONITORING**

**LIMIT EXOTICS AND PERENNIALS**

**MULTIPLE TREATMENTS**

**PATIENCE**

**MOST IMPORTANT ASSET**

**■ YOUR BRAIN**

# IMPORTANT ASSETS

## ■ BRAIN

- CURIOSITY
- QUESTIONS

## ■ INFORMATION

- SOURCES (From site is critical)
- TYPE (Timing and duration of events)
- SYNTHESIS
  - WHAT IS IMPORTANT for your decisions
  - KEEP ON SAME SCALE (geomorphic surface, life cycle event, species vs group)

## ■ EXPERIENCE

# WHAT IS MULTIPLE TREATMENT?

- A COMBINATION OF ACTIONS WITHIN OR AMONG SEASONS TO CONTROL OR PROMOTE A PLANT COMMUNITY
- TIMING AND DURATION IS OFTEN CRITICAL

# EXAMPLES OF MULTIPLE TREATMENTS

- TILL AND KEEP DRY
- BURN, FLOOD, AND DRAWDOWN
- MOW AND HERBICIDE
- MOW, MOW, MOW
- MOW AND FLOOD
- HERBICIDE, BURN, TILL, KEEP DRY

# MUTIPLE BENEFITS

- UNIT CONDITIONS
  - 25% WOODY LESS THAN 1 M TALL
  - 55% PERENNIAL LITTLE SEED OR TUBERS
  - 20% ANNUALS WITH LIMITED SEED
- TREATMENT – DEEP DISKING/KEEP DRY
- SHALLOWLY FLOOD OR WAIT FOR RAINFALL



# MULTIPLE BENEFITS

- SHOREBIRD RESPOND WITHIN A FEW HOURS OF FLOODING
- SPIKERUSH APPARENT IN 12 DAYS
- DENSE SPIKERUSH GROWTH REDUCES VALUE FOR SHOREBIRDS IN 2 WEEKS
- TEAL, PINTAIL, AND GEESE FORAGE ON TENDER SPIKERUSH
- COMMON SNIPE ATTRACTED IN LARGE NUMBERS

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# FUTURE BENEFITS

YEAR 1 LATE SEASON DEEP DISK  
FOR SHOREBIRD HABITAT

YEAR 2 EARLY SEASON DRAWDOWN  
SMARTWEED 1500 LBS/AC  
MILLET 550 LBS/AC

YEAR 3 MIDSEASON DRAWDOWN  
MILLET 1300 LBS/AC  
SMARWEED 200 LBS/AC  
BIDENS 450 LBS/AC

# FLOODING TREATMENTS

- SCHEDULE TREATMENT WHEN PLANTS ARE SMALL
- FLOODING DEPTH AT LEAST  $\frac{2}{3}$  OF HEIGHT
- MAINTAIN FLOODING FOR 3 TO 7 DAYS

# FLOODED COCKLEBUR





# ROWCROP ISSUES

- BIOLOGICAL
- PRODUCTION
- OPTIMIZING OPTIONS
- POLITICAL

# BIOLOGICAL

- WHAT VERTEBRATE SPECIES ARE PRESENT
- WHAT ARE THEIR NUMBERS
- WHAT IS THE TIME OF USE
- WHAT LIFE HISTORY STAGES



# BIOLOGICAL

## ■ Soybeans

- High in Protein but seed must be cooked to remove inhibitors
- Cause crop impaction

## ■ Corn

Protein inadequate for breeding

Birds die within 60 days when foraging solely on corn

Birds foraging on corn do not lay eggs

High energy good for adding fat

# BIOLOGICAL

- WHAT IS IN THE SEED BANK
- WHAT CAN BE GROWN ON SITE
- WHAT IS PRODUCTION

# PRODUCTION

- CAN THE CROP BE GROWN ON THE SITE
- WHAT IS POTENTIAL PRODUCTION
- FORCED ACCOUNT
- COOP FARMER

# OPTIMIZING OPTIONS

- CROP TRADE-OFFS
- TRADING CROPS FOR  
MANIPULATIONS

# POLITICS

- HISTORIC DOGMA
- EXPERIENCE WITH THE PERFECT HUNT
- AGENCY EMPHASIS

# REALITY

- ALWAYS PLANT CORN AT THE GATE!!

# PROBLEM SOLVING FLOW CHART

