# Adaptive Management in Invasive Species Control

## a case history with *Phragmites australis*

**IAIA Biodiversity & Ecology Section**
**Biodiversity & Ecosystem Services in Impact Assessment**
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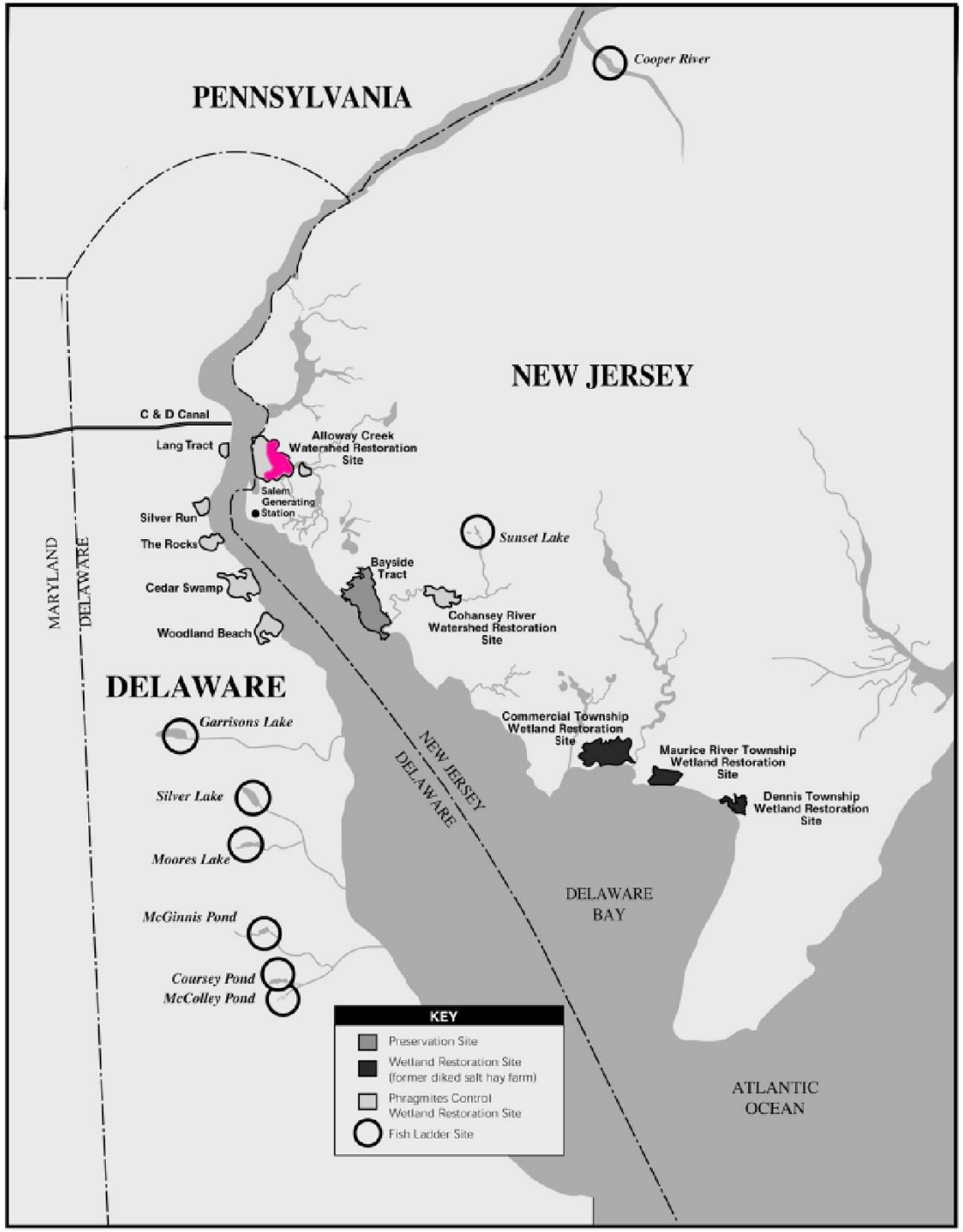
URS

# Case History – Alloway Creek Site, NJ (USA)

- Component of the PSEG Estuary Enhancement Program (EEP)
- Associated with NJPDES permit issued for Salem Generating Station
- Required restoration/enhancement/preservation of 20,000 acres of coastal marsh and uplands along Delaware Bay
- Includes restoration of 5,000 acres of *Phragmites* dominated marsh at four locations (NJ and DE)


PENNSYLVANIA
Cooper River
NEW JERSEY
C & D Canal
Lang Tract
Alloway Creek Watershed Restoration Site
Salem Generating Station
Silver Run
The Rocks
Cedar Swamp
Woodland Beach
MARYLAND
DELAWARE
Sunset Lake
Bayside Tract
Cohansey River Watershed Restoration Site
DELAWARE
Garrisons Lake
Silver Lake
Moores Lake
McGinnis Pond
Coursey Pond
McColley Pond
NEW JERSEY
DELAWARE
Commercial Township Wetland Restoration Site
Maurice River Township Wetland Restoration Site
Dennis Township Wetland Restoration Site
DELAWARE BAY
ATLANTIC OCEAN
KEY
Preservation Site
Wetland Restoration Site (former diked salt hay farm)
Phragmites Control Wetland Restoration Site
Fish Ladder Site

# What characteristics make *Phragmites* so invasive?

- Invasive haplotype (Type M) is resistant to native insects/diseases
- Produces copious amounts of air-born seed (variable viability)
- Uses successful dispersal mechanism – viable rhizomes fragments
- Thrives on disturbance, opportunistic to colonize bare ground
- Fast-growing: lateral spread by above ground "runners"
- Habitat generalist – can tolerate moderate salinity
- Demonstrates alleleopathy (gallic acid)
- Has long photosynthetic period
- Alters soil and habitat conditions to better suit it's own survival and expansion – sediment accretion and marsh surface leveling

# Examples of Invasive Plant Control Methods

- Herbicide Application
- Prescribed Burning
- Mowing
- Compressing or Rollling
- Hand-pulling or Mechanical Excavation
- Flooding
- Tarping
- Biological Controls

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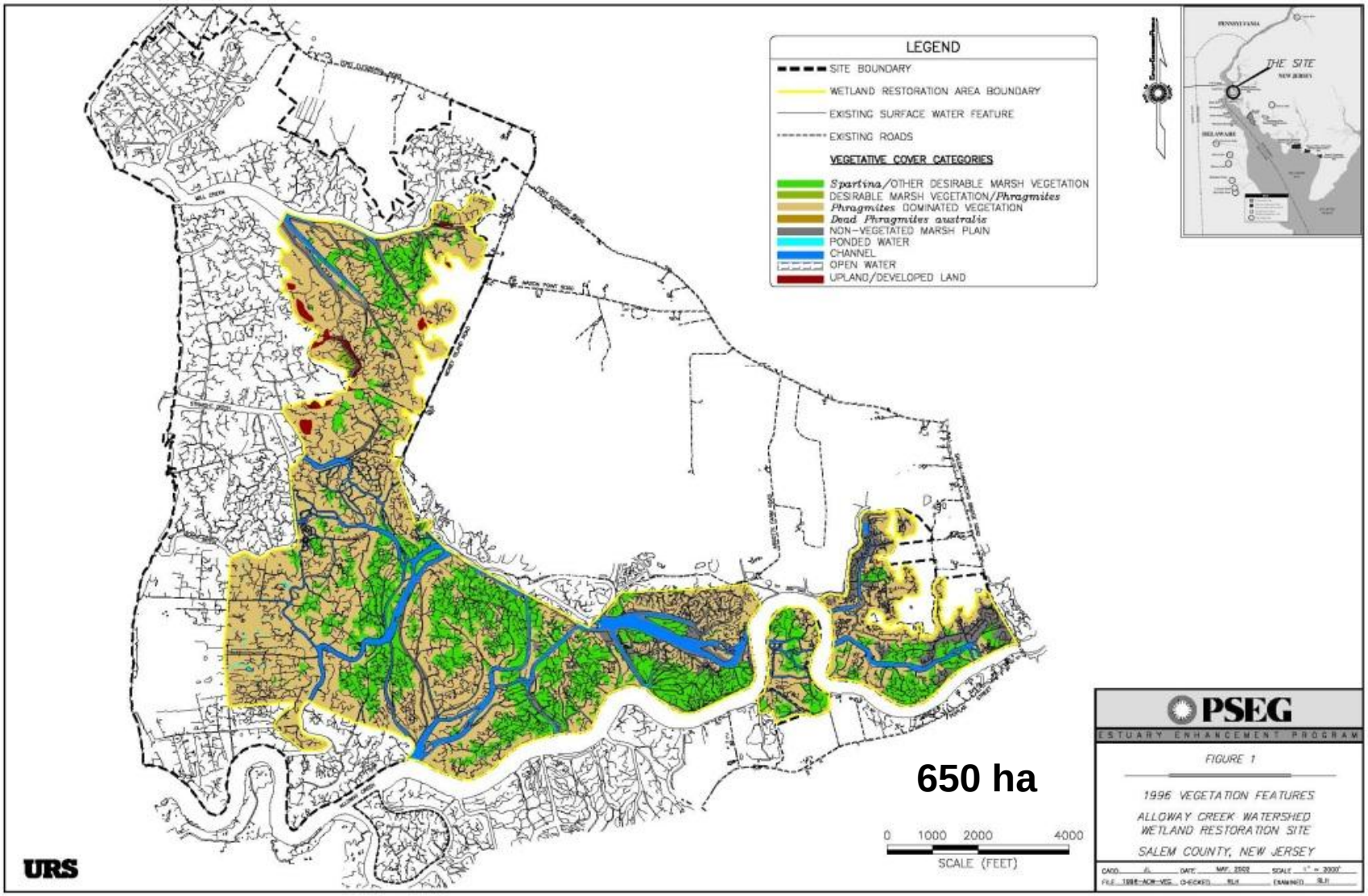
# Case History – Alloway Creek Site, NJ (USA)

- Success Criteria: < 5% coverage by *Phragmites*
- Initial *Phragmites* Treatments w/Glyphosate-based Herbicide in 1996
- Prescribed Burn in Winter of 1997
- Significant Reduction 1997 - 1998
- Significant Regrowth in 1999
- Adaptive Management Evaluations 1999 – 2001
- Continuing Adaptive Management Evaluations of Glyphosate-based and Imazapyr-based Herbicides (2002 – Present)


LEGEND
SITE BOUNDARY
WETLAND RESTORATION AREA BOUNDARY
EXISTING SURFACE WATER FEATURE
EXISTING ROADS
VEGETATIVE COVER CATEGORIES
Spartina/OTHER DESIRABLE MARSH VEGETATION
DESIRABLE MARSH VEGETATION/Phragmites
Phragmites DOMINATED VEGETATION
Dead Phragmites australis
NON-VEGETATED MARSH PLAIN
PONDED WATER
CHANNEL
OPEN WATER
UPLAND/DEVELOPED LAND
THE SITE
650 ha
0 1000 2000 4000
SCALE (FEET)
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
FIGURE 1
1996 VEGETATION FEATURES
ALLOWAY CREEK WATERSHED
WETLAND RESTORATION SITE
SALEM COUNTY, NEW JERSEY

1996

Alloway Creek Site - 1996

Aerial Herbicide Treatment

# 1996 Herbicide Treatments

Ground Herbicide Treatment


Winter 1997 Prescribed Burn


Initial Results of Herbicide Treatment/Burn Appeared Successful
Summer 1997


Summer 1997


Summer 1997

# Two Years Later - Summer 1999

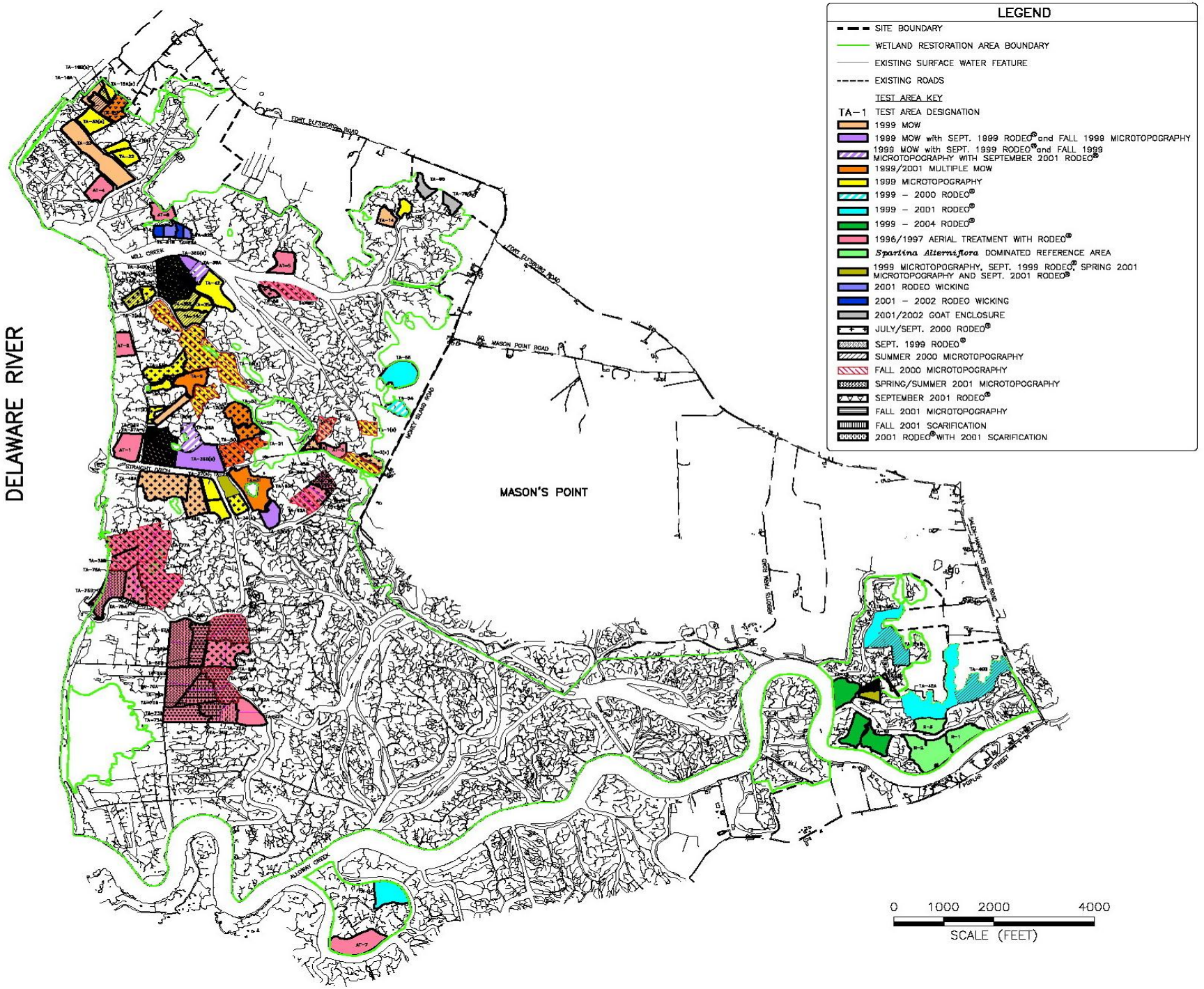
# 1999 Regrowth of *Phragmites* Triggered Adaptive Management Process

- Management Alternatives Considered:
  - Continued Herbicide Treatments
  - Mowing at Various Cycles
  - Micro-topographic Modifications
  - Biological Control (Goats)
  - Combination Treatments
  - No Additional Treatments (Reference)
- >100 Test Areas Established

Microtopography

Mowing

Goat Grazing


LEGEND
SITE BOUNDARY
WETLAND RESTORATION AREA BOUNDARY
EXISTING SURFACE WATER FEATURE
EXISTING ROADS
TEST AREA KEY
TA-1 TEST AREA DESIGNATION
1999 MOW
1999 MOW with SEPT. 1999 RODEO® and FALL 1999 MICROTOPOGRAPHY
1999 MOW with SEPT. 1999 RODEO® and FALL 1999 MICROTOPOGRAPHY WITH SEPTEMBER 2001 RODEO®
1999/2001 MULTIPLE MOW
1999 MICROTOPOGRAPHY
1999 – 2000 RODEO®
1999 – 2001 RODEO®
1999 – 2004 RODEO®
1996/1997 AERIAL TREATMENT WITH RODEO®
Spartina Alterniflora DOMINATED REFERENCE AREA
1999 MICROTOPOGRAPHY, SEPT. 1999 RODEO®, SPRING 2001 MICROTOPOGRAPHY AND SEPT. 2001 RODEO®
2001 RODEO WICKING
2001 – 2002 RODEO WICKING
2001/2002 GOAT ENCLOSURE
JULY/SEPT. 2000 RODEO®
SEPT. 1999 RODEO®
SUMMER 2000 MICROTOPOGRAPHY
FALL 2000 MICROTOPOGRAPHY
SPRING/SUMMER 2001 MICROTOPOGRAPHY
SEPTEMBER 2001 RODEO®
FALL 2001 MICROTOPOGRAPHY
FALL 2001 SCARIFICATION
2001 RODEO® WITH 2001 SCARIFICATION
DELAWARE RIVER
MASON'S POINT
FORT DUPONT ROAD
MASON POINT ROAD
MOAT ISLAND ROAD
ABBOTTS FARM ROAD
SALEM CHURCH ROAD
POPLAR STREET
MILL CREEK
STRAIGHT DITCH
ALLOWAY CREEK
0 1000 2000 4000
SCALE (FEET)

URS

| Physical Treatments | Symbol |
|---|---|
| Spring Mowing | SPMOW |
| Summer Mowing | SUMOW |
| Multiple Mowing | MLMOW |
| Summer Microtopography | SUMTM |
| Spring Microtopography | SPMTM |
| Fall Microtopography | FLMTM |
| **Chemical Treatments** | **Symbol** |
| Summer Glyphosate | SUGLY |
| Fall Glyphosate | FLGLY |

| Duration / Frequency of Treatments |
| --- |
| One Year / Single Treatments |
| One Year / Multiple Treatments |
| Two Consecutive Year / Single Treatments |
| Two consecutive Year / Multiple Treatments |
| Three Consecutive Year / Single Treatments |

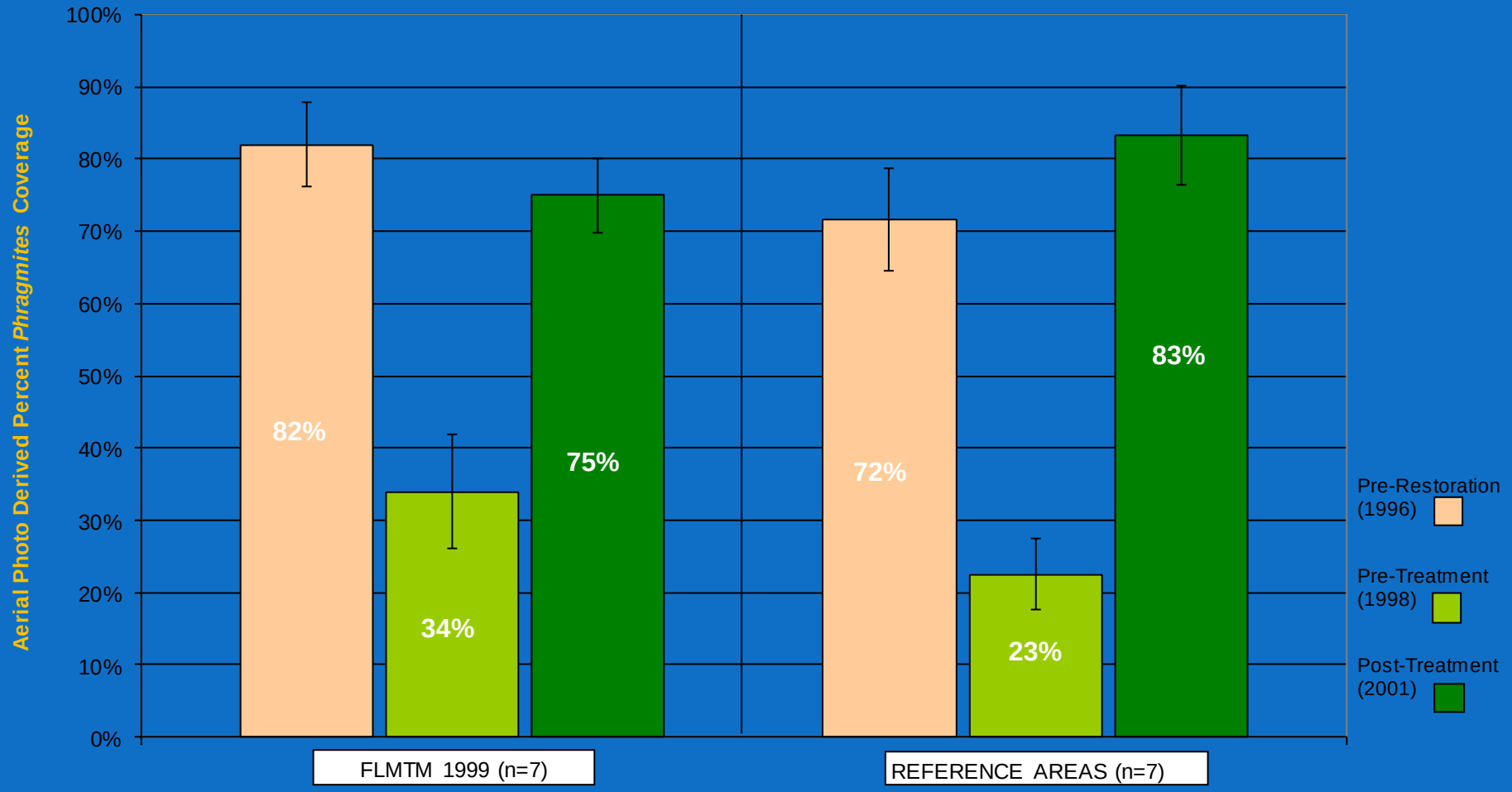
# Vegetation Cover Data Analysis

- Aerial photography available for all Test Areas from pre-restoration (1996) thru current year.
- Classification of 20 randomly selected 0.01-acre “photo-quadrats” per Test Area
- “Percent Coverage” data represents general vegetative response of treatments

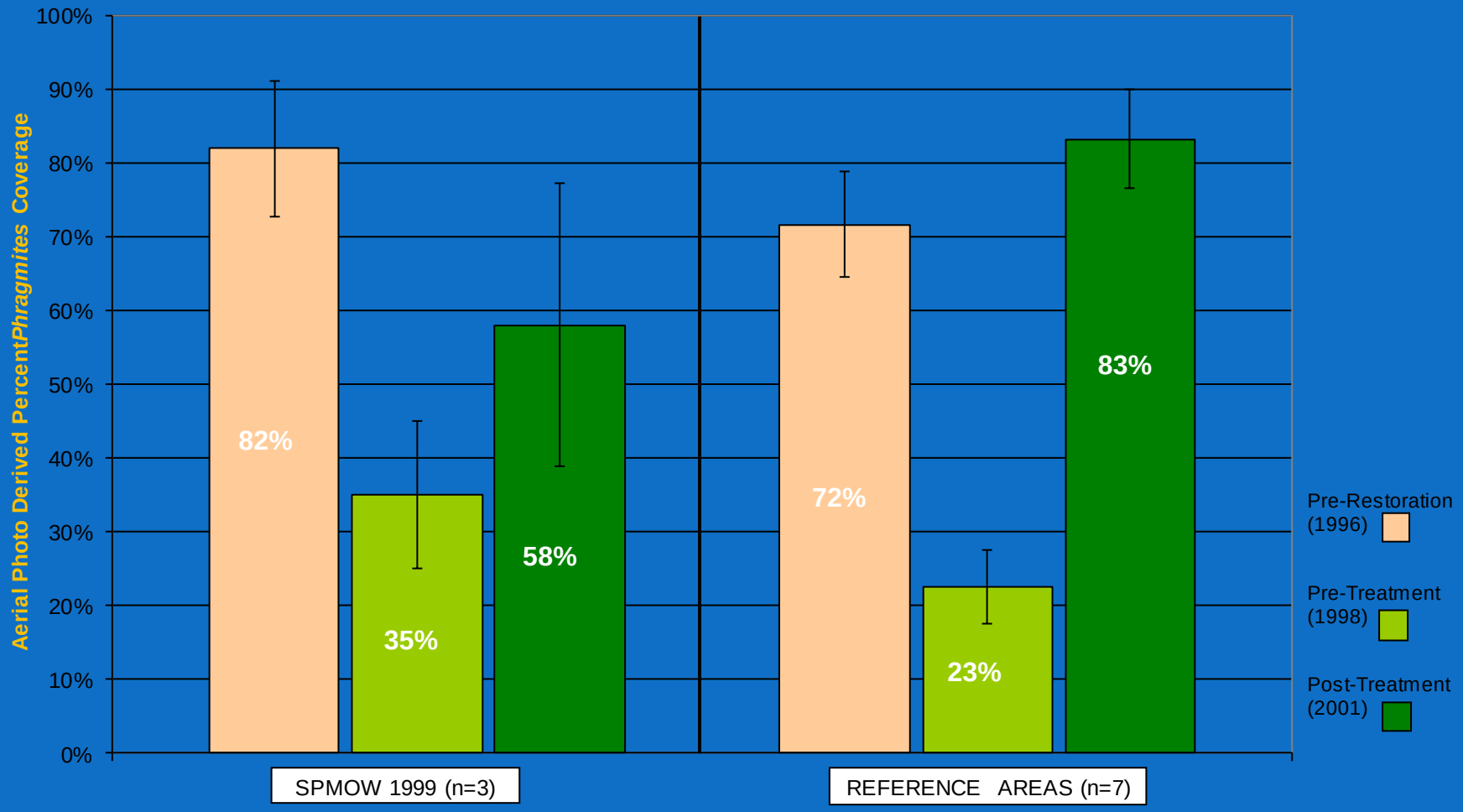
## Can Physical Treatment Alone Control *Phragmites?*

- Micro-topographic Modification (MTM)
- Single Mow
- Multiple Mows
- Compared to No Treatment References

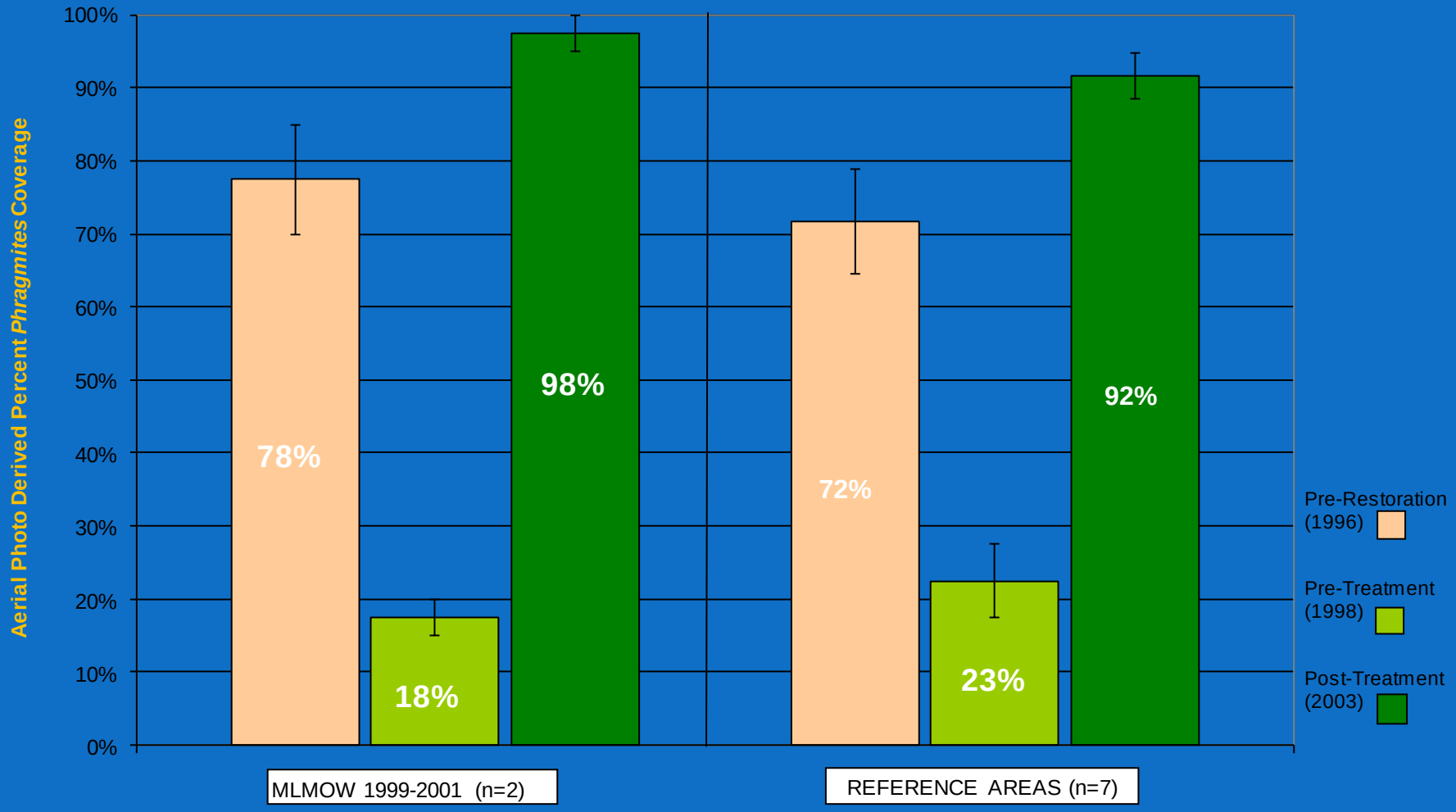
# Is Microtopography an Effective *Phragmites* Control Treatment?



# Is a Single Mow an Effective *Phragmites* Control Treatment?



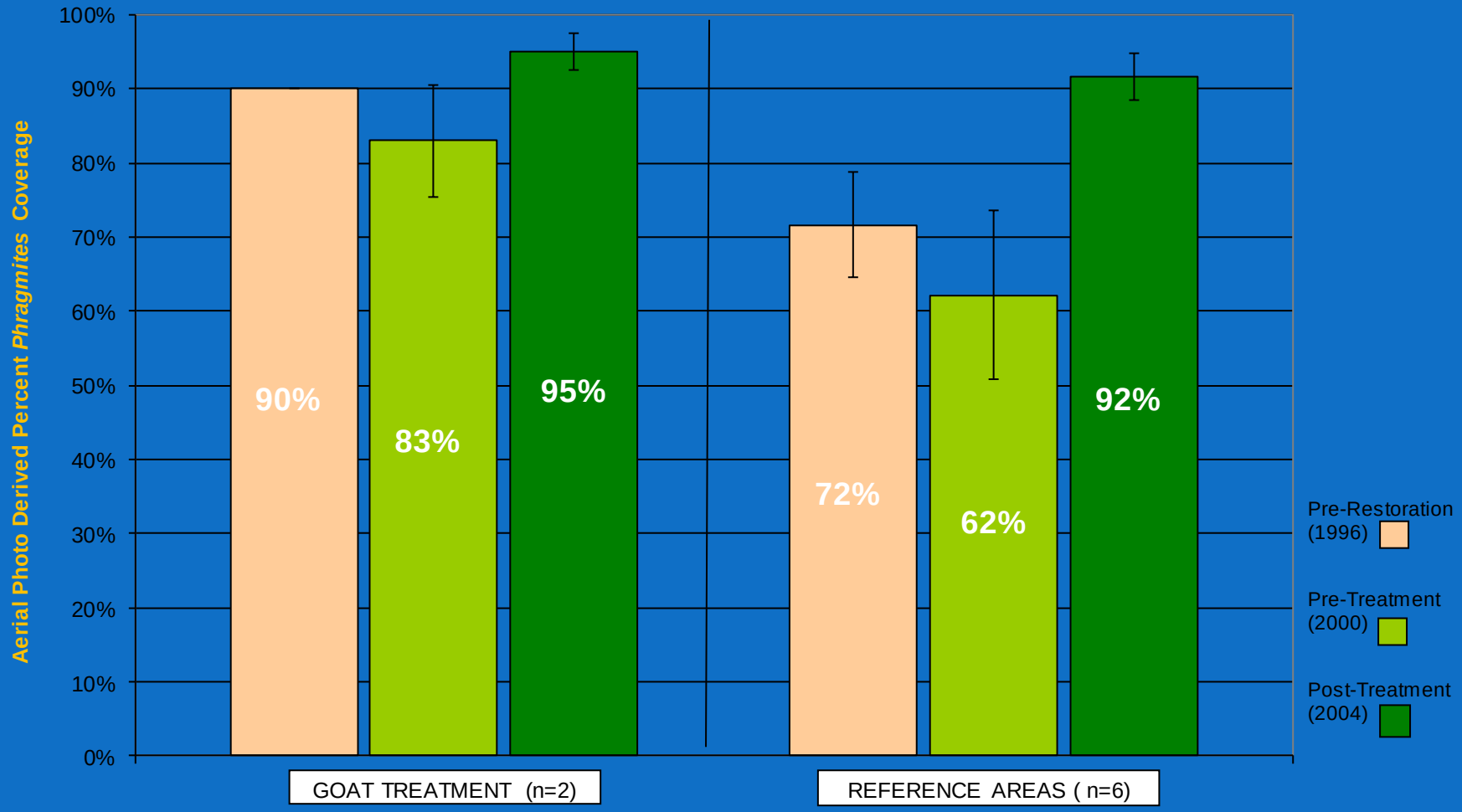
## Is Multiple Mowing an Effective *Phragmites* Control Treatment?



# Can Grazing Alone Control *Phragmites?*

Goat Grazing

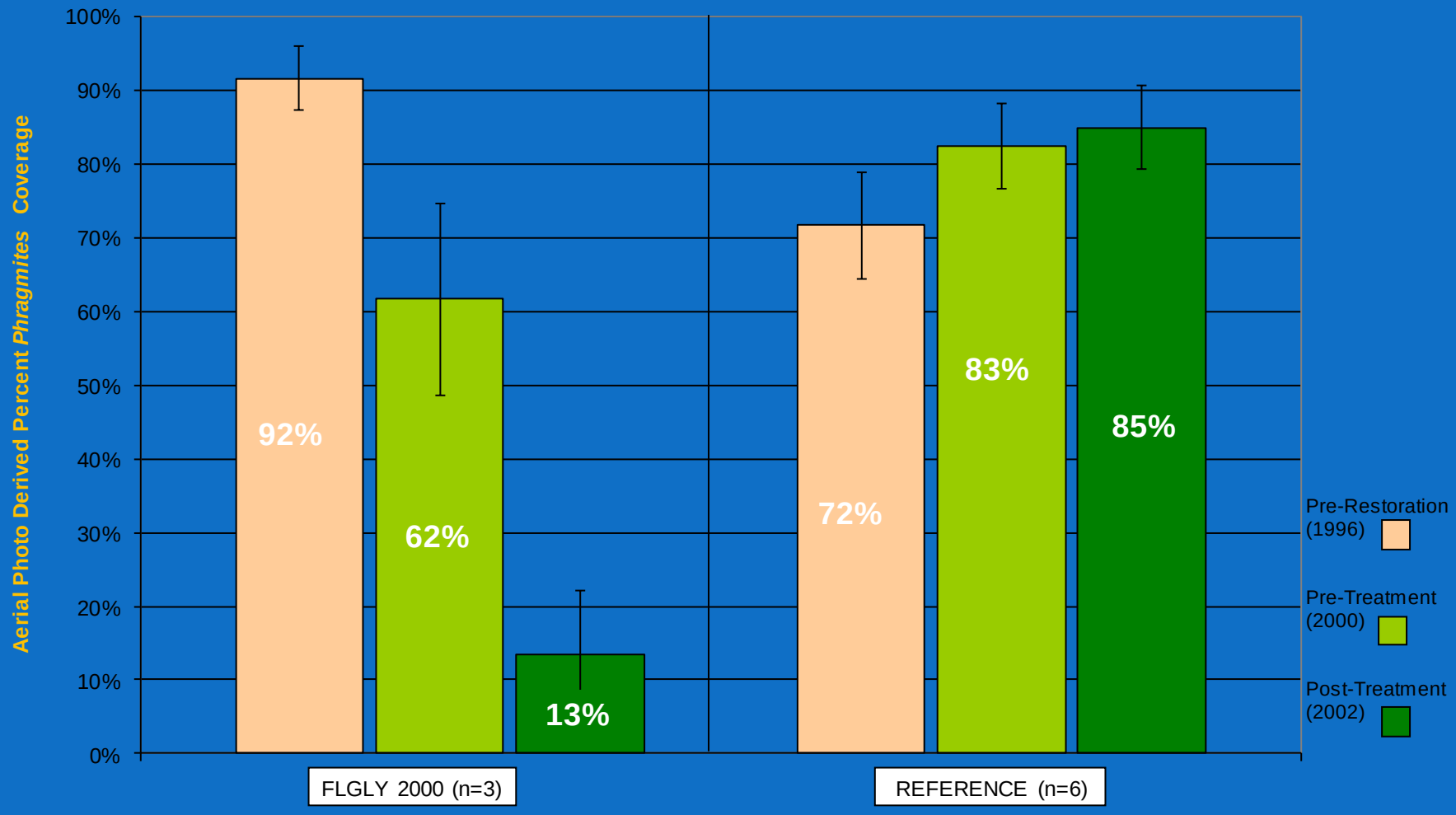
## Are Goats an Effective *Phragmites* Control Treatment?



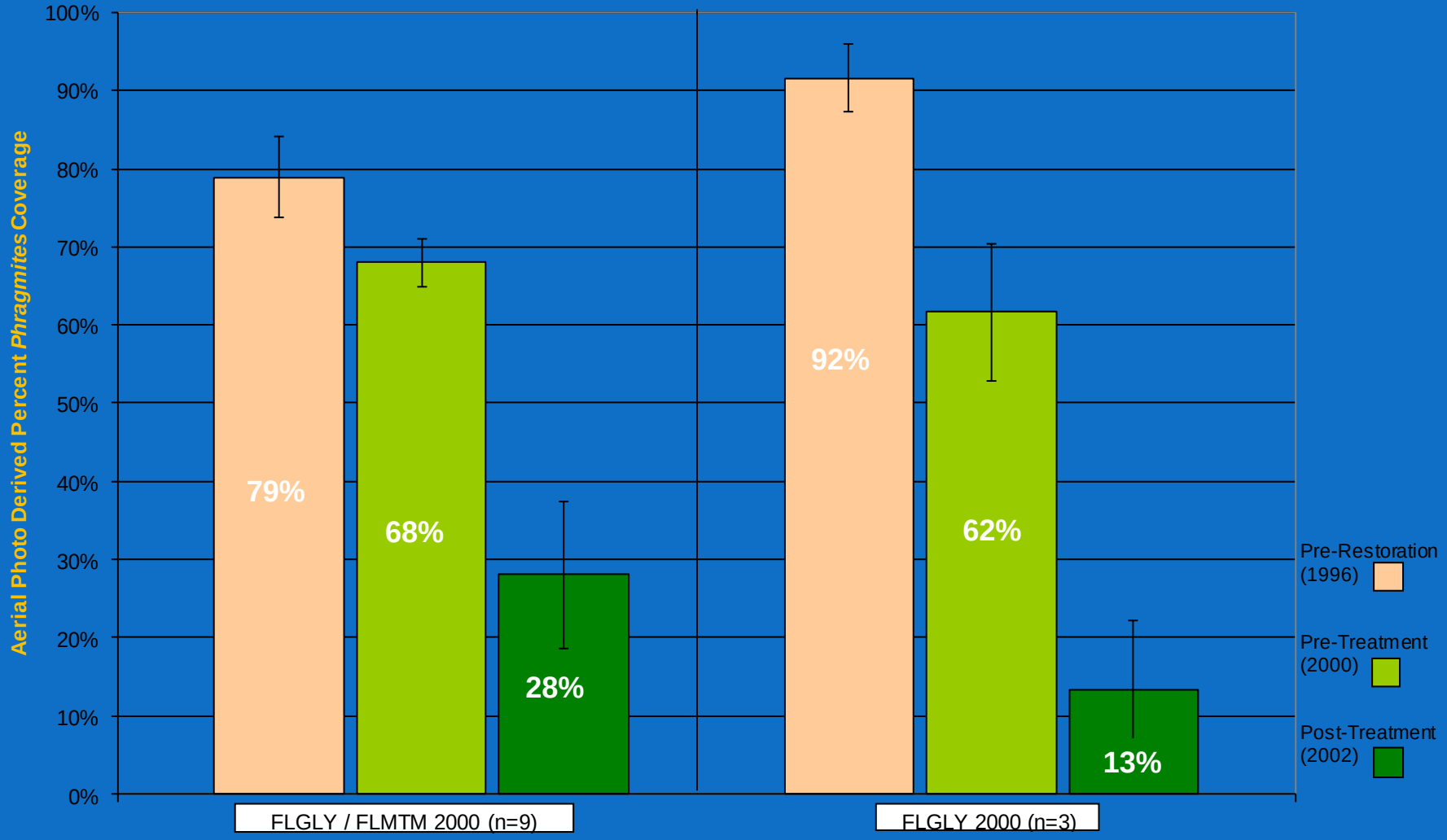
# Can Glyphosate-based Herbicide Treatment Alone Control *Phragmites?*

- Applied at 5.5 pints/acre (6.5 liters/hectare)
- Ground treatments using spray/wick applications
- Primarily Fall Applications (>translocation), with some growing season tests
- One-Year, Two-Year, and Multi-Year Applications Evaluated

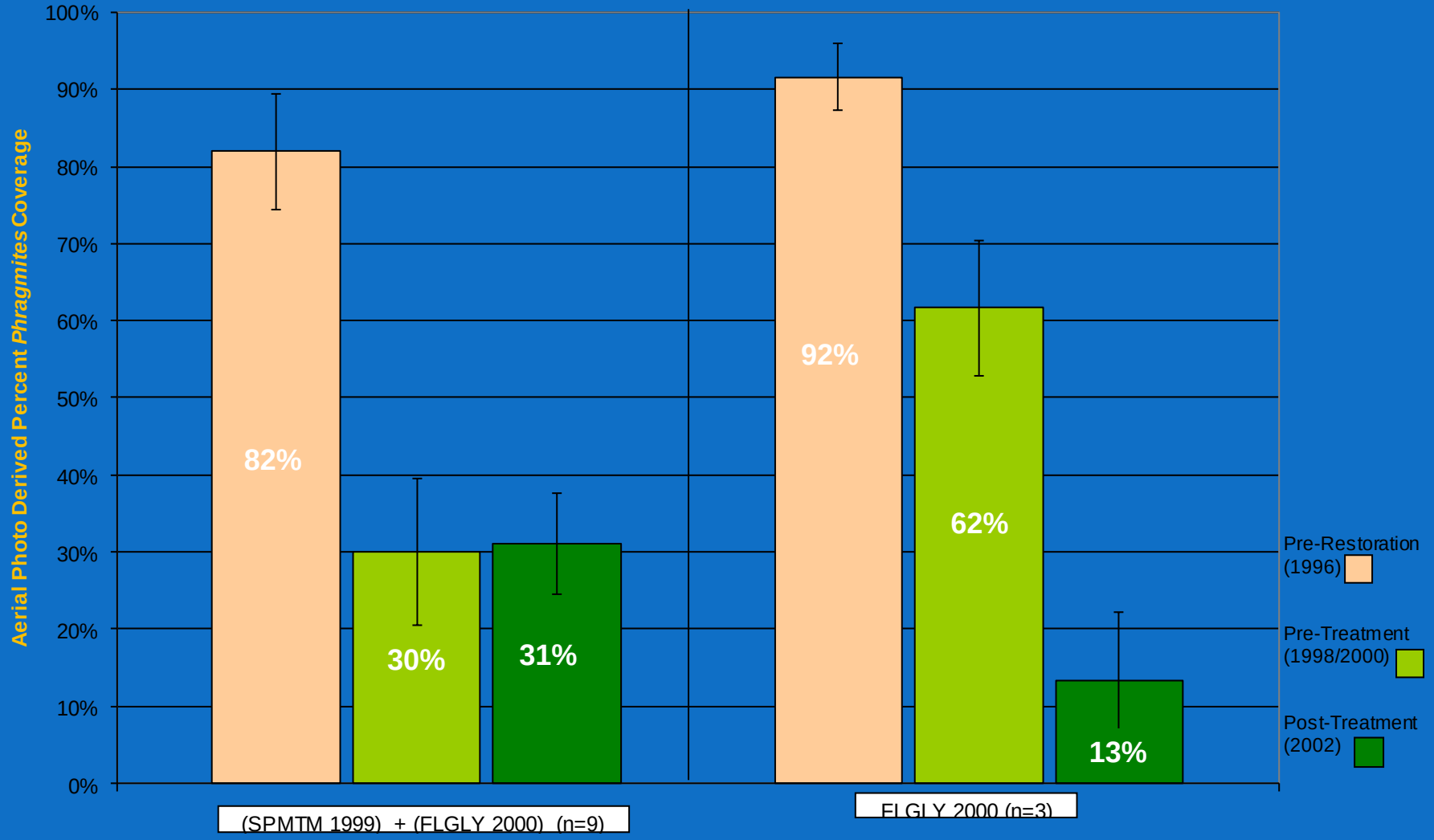
# Is Fall Herbicide Alone an Effective *Phragmites* Control Treatment?



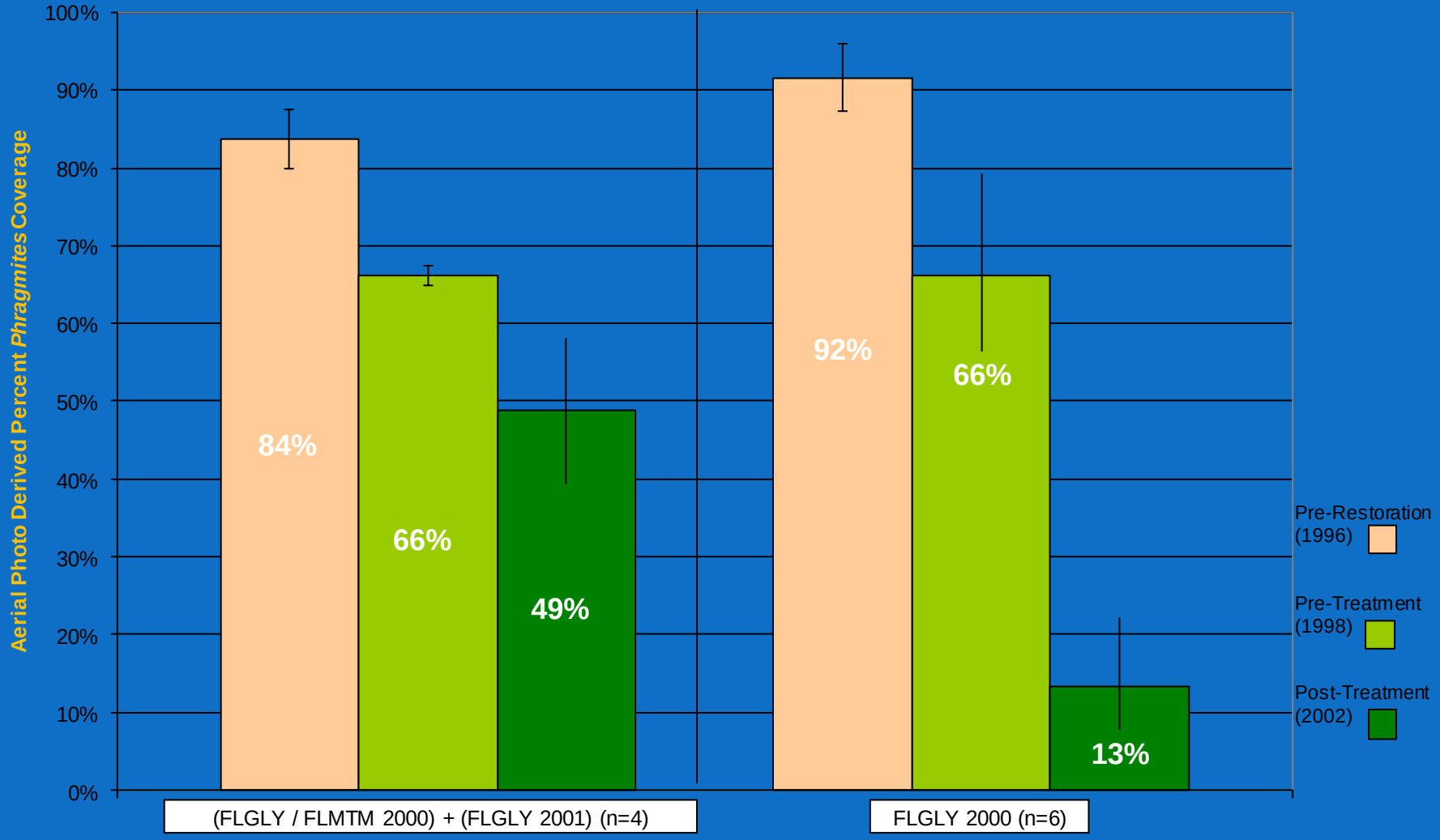
# Is Fall Herbicide Application Followed by Microtopography an Effective *Phragmites* Control Treatment than Herbicide Alone?



# Is Spring Microtopography Followed by Fall Herbicide Application in the Following Year an Effective *Phragmites* Control Treatment?



# Is Fall Herbicide Application and Microtopography Coupled with Fall Herbicide Application in the Following Year an Effective Phragmites Control Treatment?



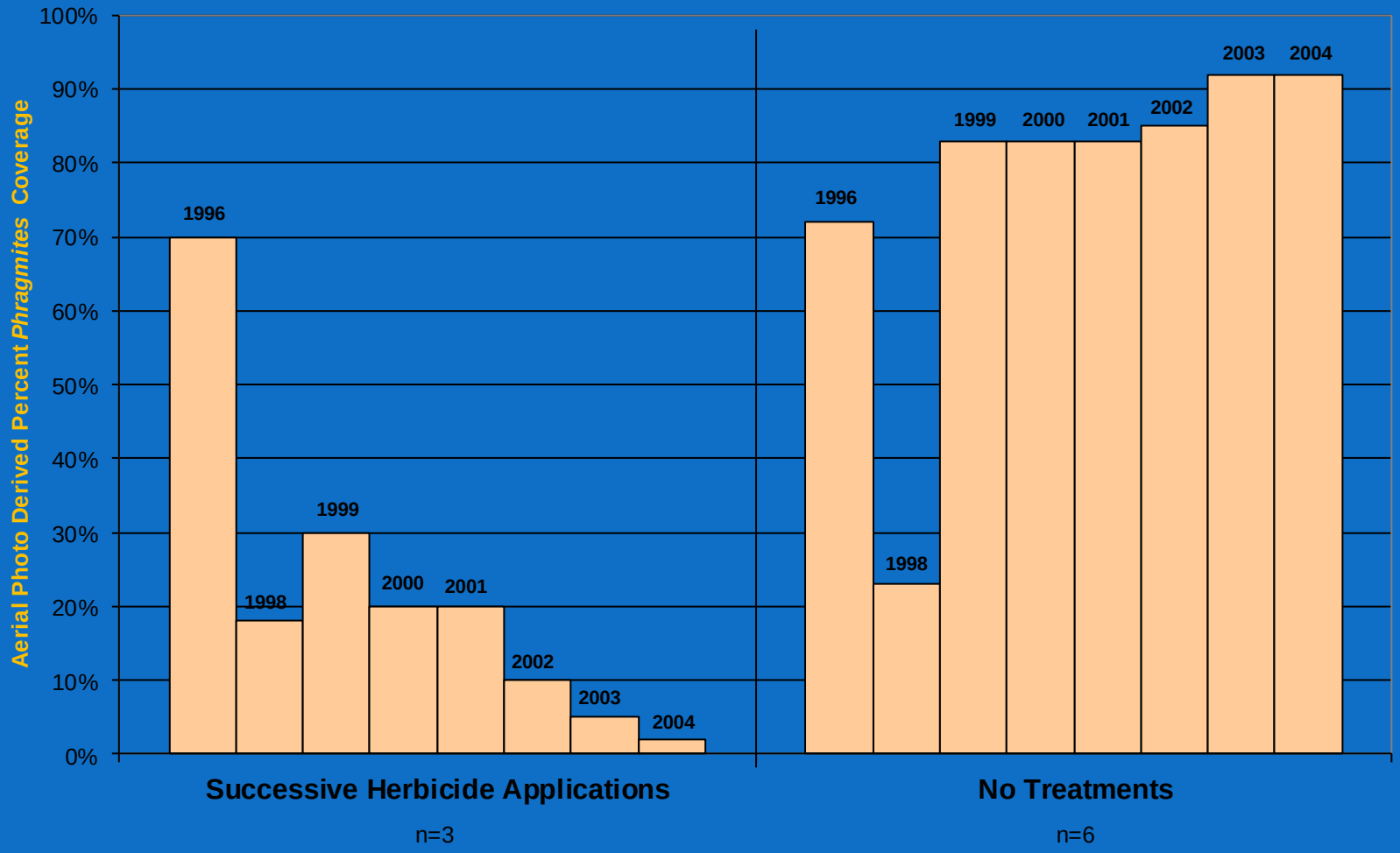
# Adaptive Management Conclusions:

- *Phragmites* coverage significantly reduced within areas receiving glyphosate-based herbicide treatment
- Additional mechanical/biological treatments did not result in measurable *Phragmites* coverage reduction
- No combination of treatments resulted in better control than herbicide alone

# Multi-Year Herbicide Treatments

- Initial Applications 1996-1997 followed by annual treatments during 1999 – 2004

# Do Successive Applications of Glyphosate-based Herbicide Control *Phragmites* Growth?

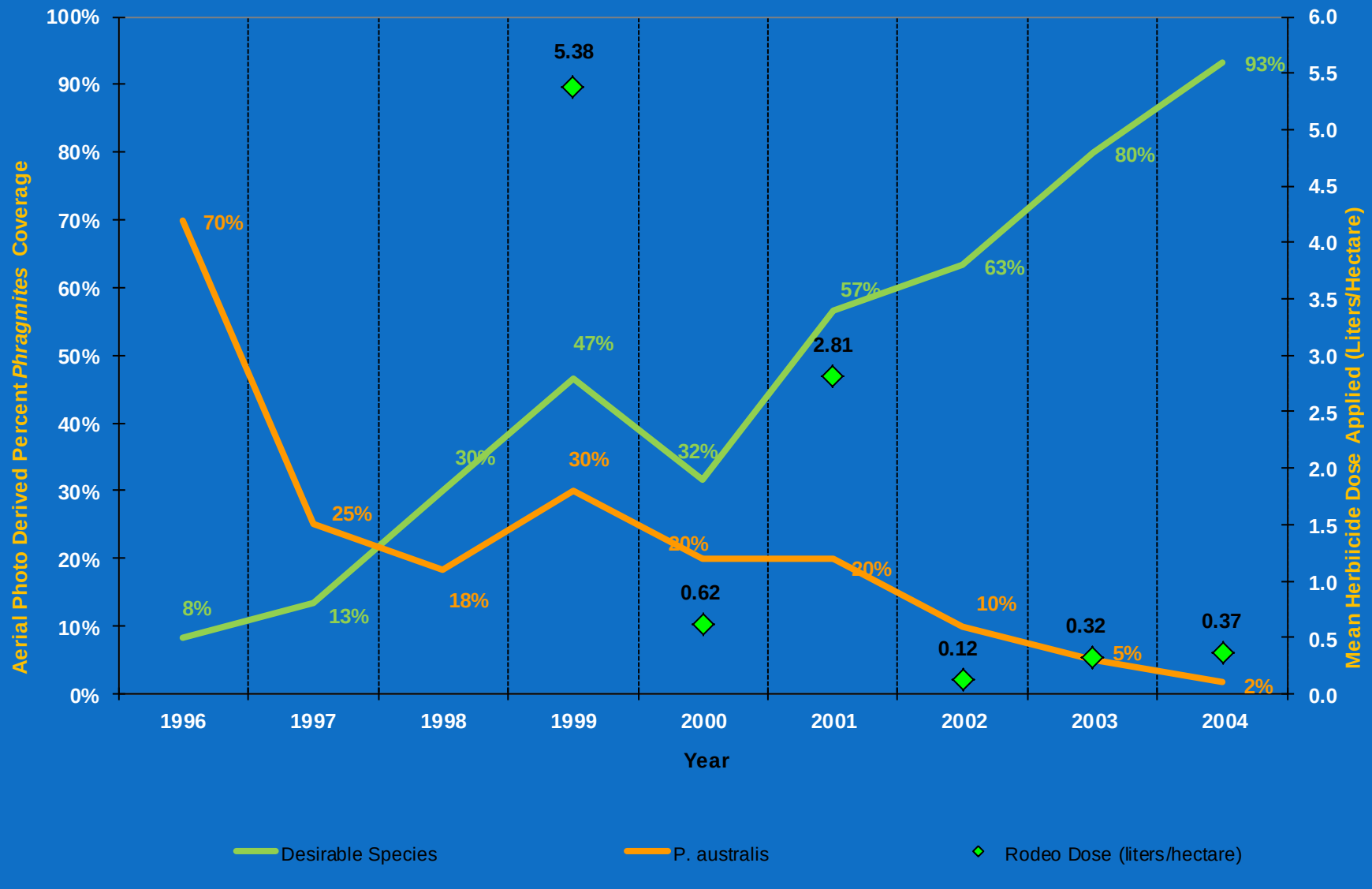


# Glyphosate-Based Herbicide Dose/Response Analyses

# Inputs to Dose/Response Analysis

- Interpretation of Aerial Photography from 1996 – 2004
- Aerial and Ground Spray Records of Total Volume of Herbicide Applied Annually
- Calculation of Dose (Liters/Hectare) Applied to Areas Each Year

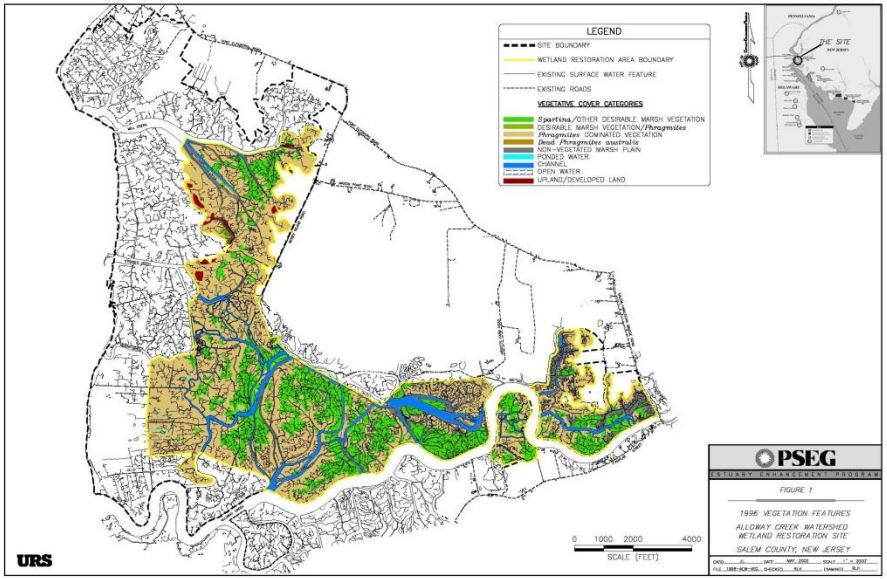
# PhragmitesResponse to Applications of Glyphosate-based Herbicide at Alloway Creek Watershed Wetland Restoration Site Test Areas 43, 44 and 45 1996 - 2004



# Herbicide Treatment Conclusions:

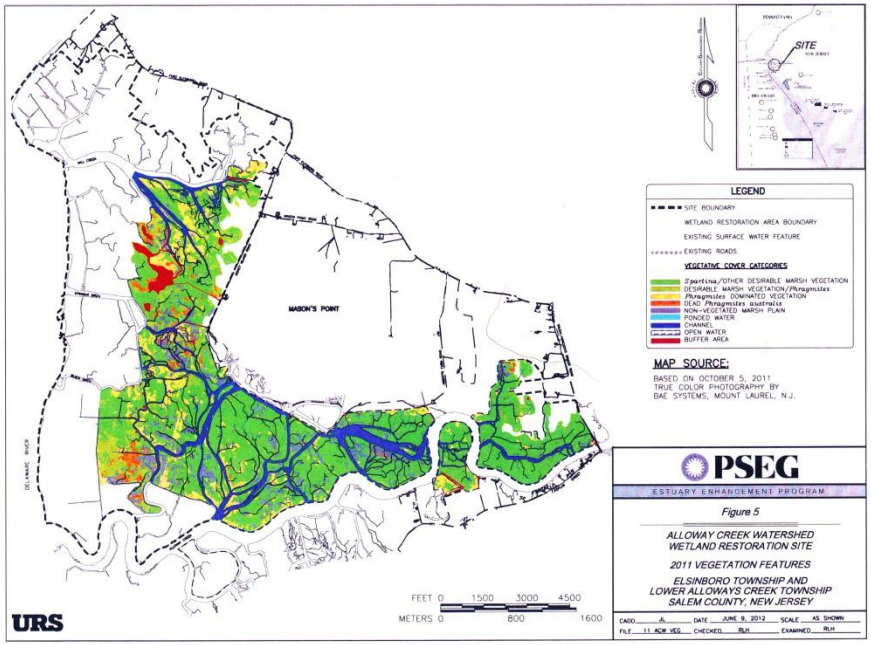
- Initial treatments with glyphosate-based herbicide significantly reduced *Phragmites* coverage
- Follow-up treatments have maintained higher species diversity
- Scattered *Phragmites* colonies still present on all areas
- Glyphosate-based herbicide more selective for *Phragmites* – less collateral damage
- Imazapyr-based herbicide less selective – recovery lag in seeing increased biodiversity

1996




650 ha

2011





















# Questions?

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