

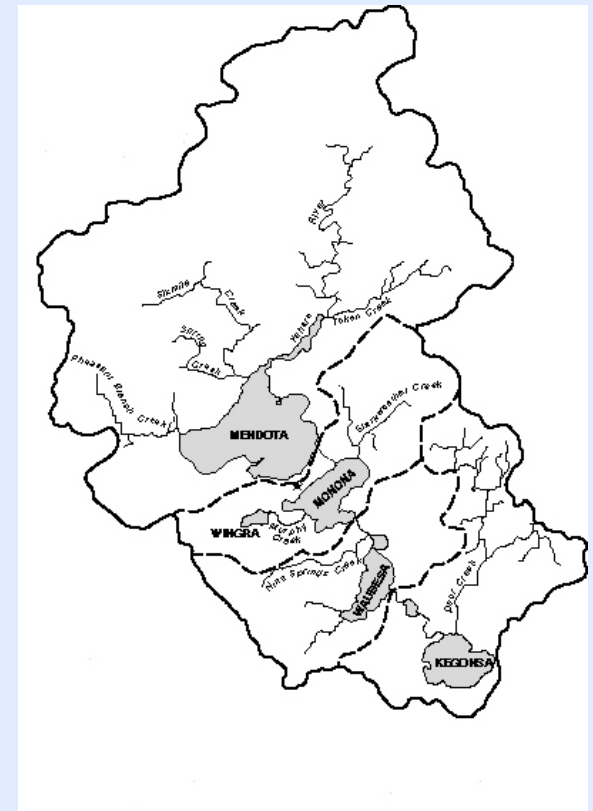
Contrasting effects of early-season harvesting and chemical treatment in Lake Monona (Madison, WI)

November 10, 2010

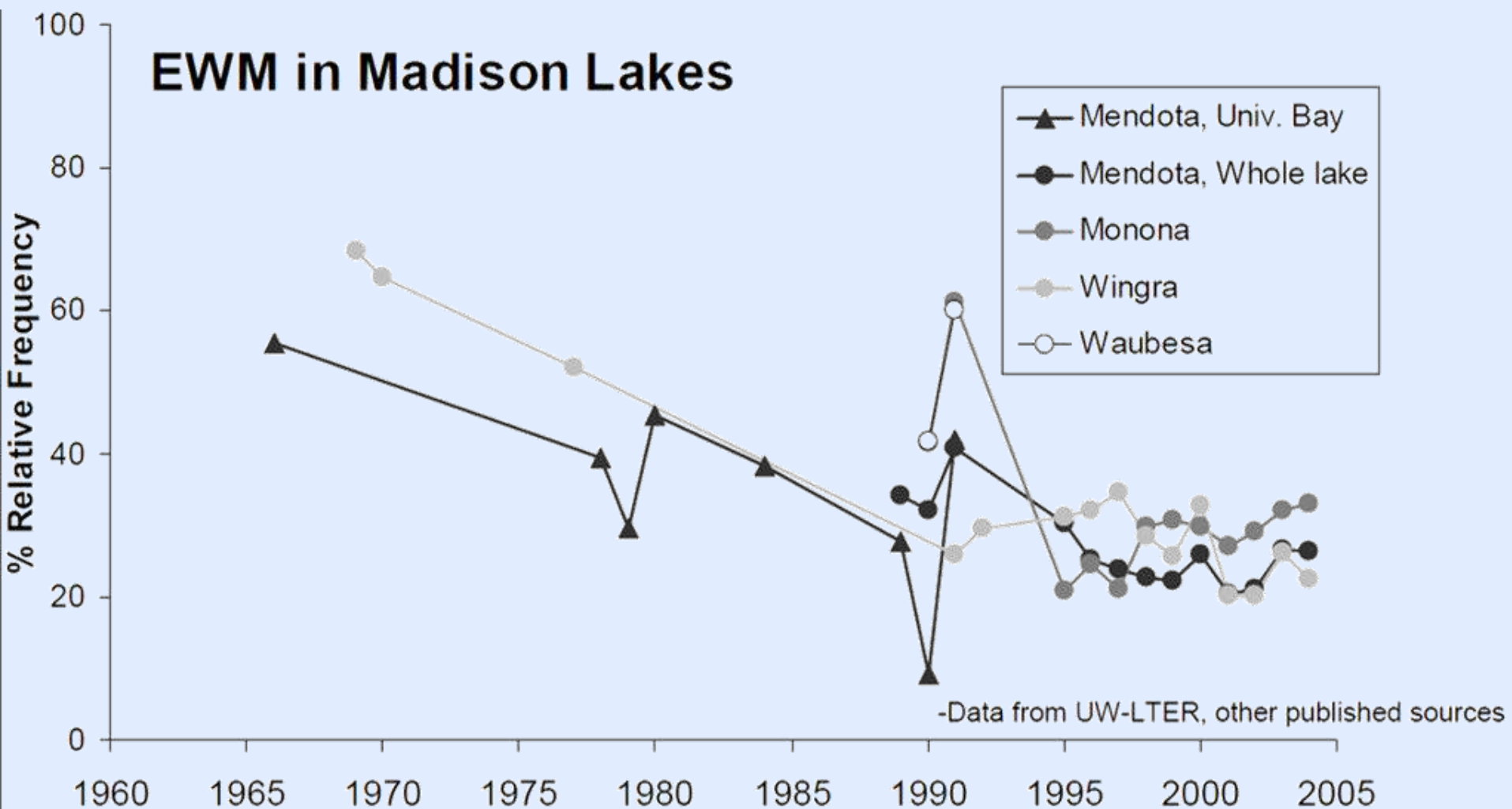


EWM in the Madison Lakes

- Found in lake Mendota in 1962
- Most dominant plant in the 1960s
- Decrease over time



EWM in Madison Lakes



“...an 18-inch-thick carpet of weeds,
muck...and storm sewer garbage”

(Capital Times, 2004)

“...a tide of the invasive exotic
weeds clogging the shorelines”

(Capital Times, 2005)

“I have to remove weeds
literally every other day”

(Lake Views, 2006)

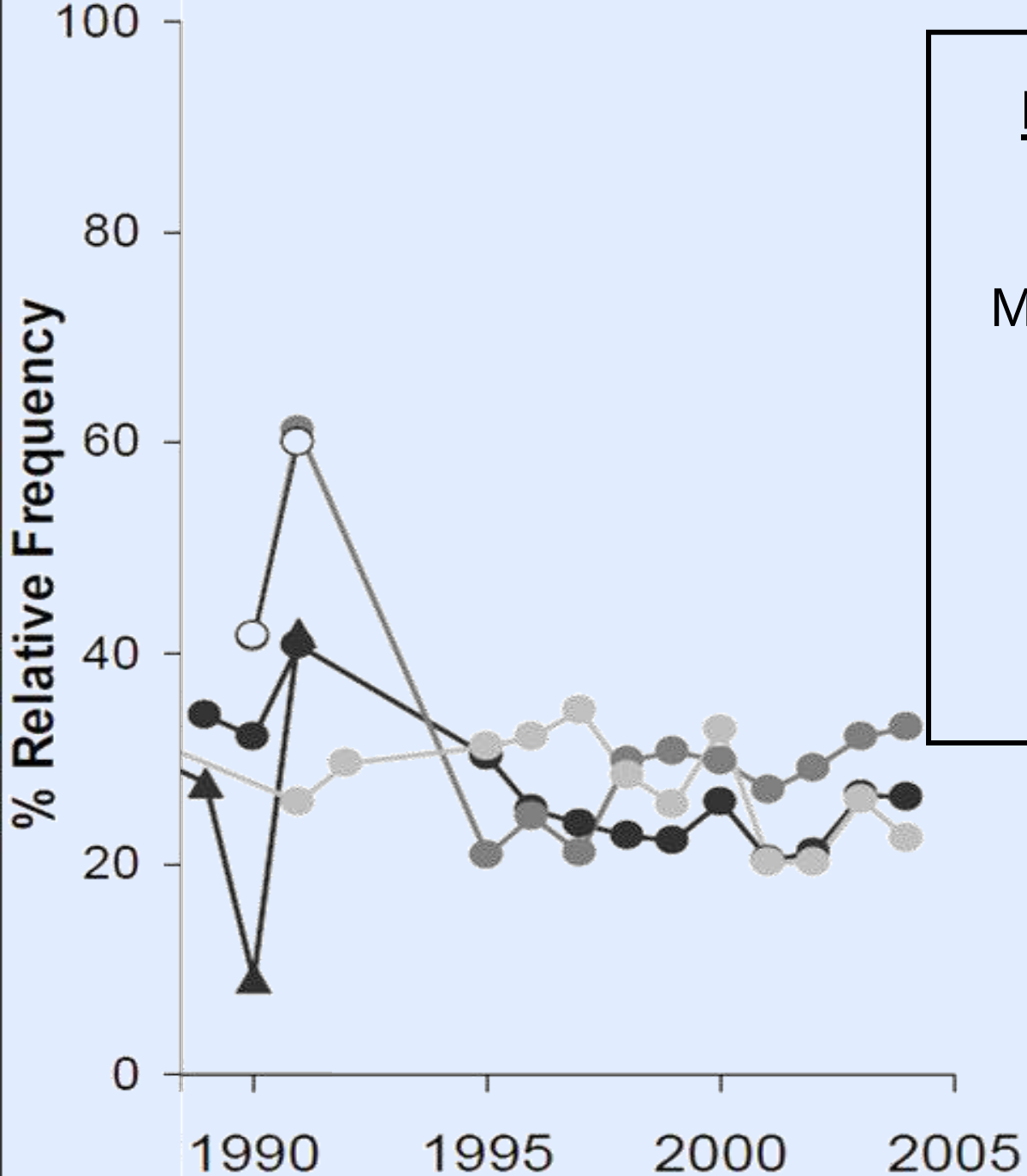


“Rowing across Squaw Bay was a long, hard pull through close-grown patches of reeds and lily pads...”

“...numerous public protests to the bad odors and obnoxious water growths existing during the spring, summer, and fall months in the lakes around Madison, Wisconsin...”

“Every season a greenish-yellow scum occurs... which quickly putrefies, giving off a very disagreeable odor...”





EWM Management

Chemical treatment

Mechanical harvesting

Drawdowns

Benthic barriers

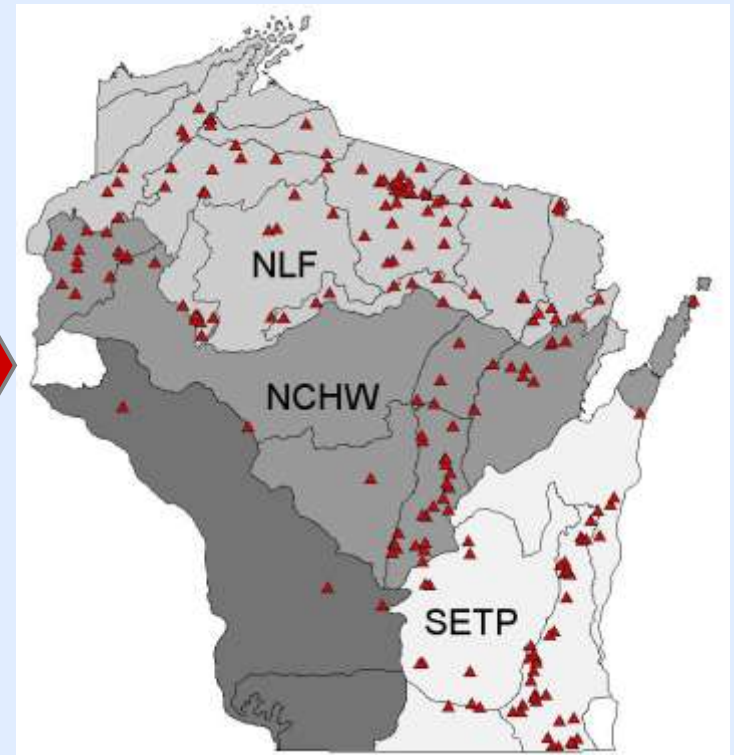
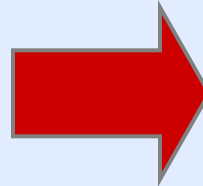
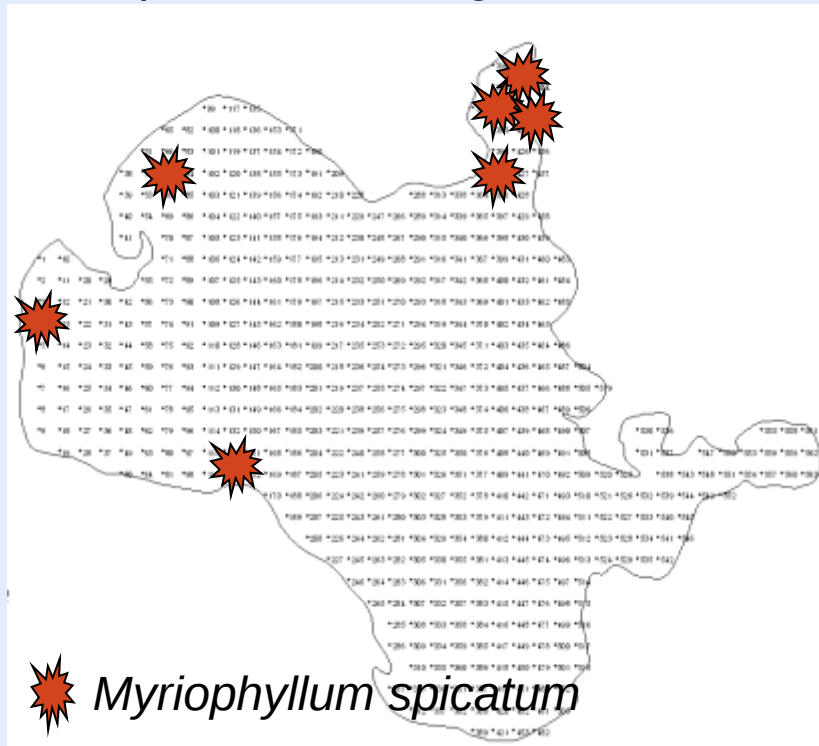
Other experimental
techniques

**is management
working?**

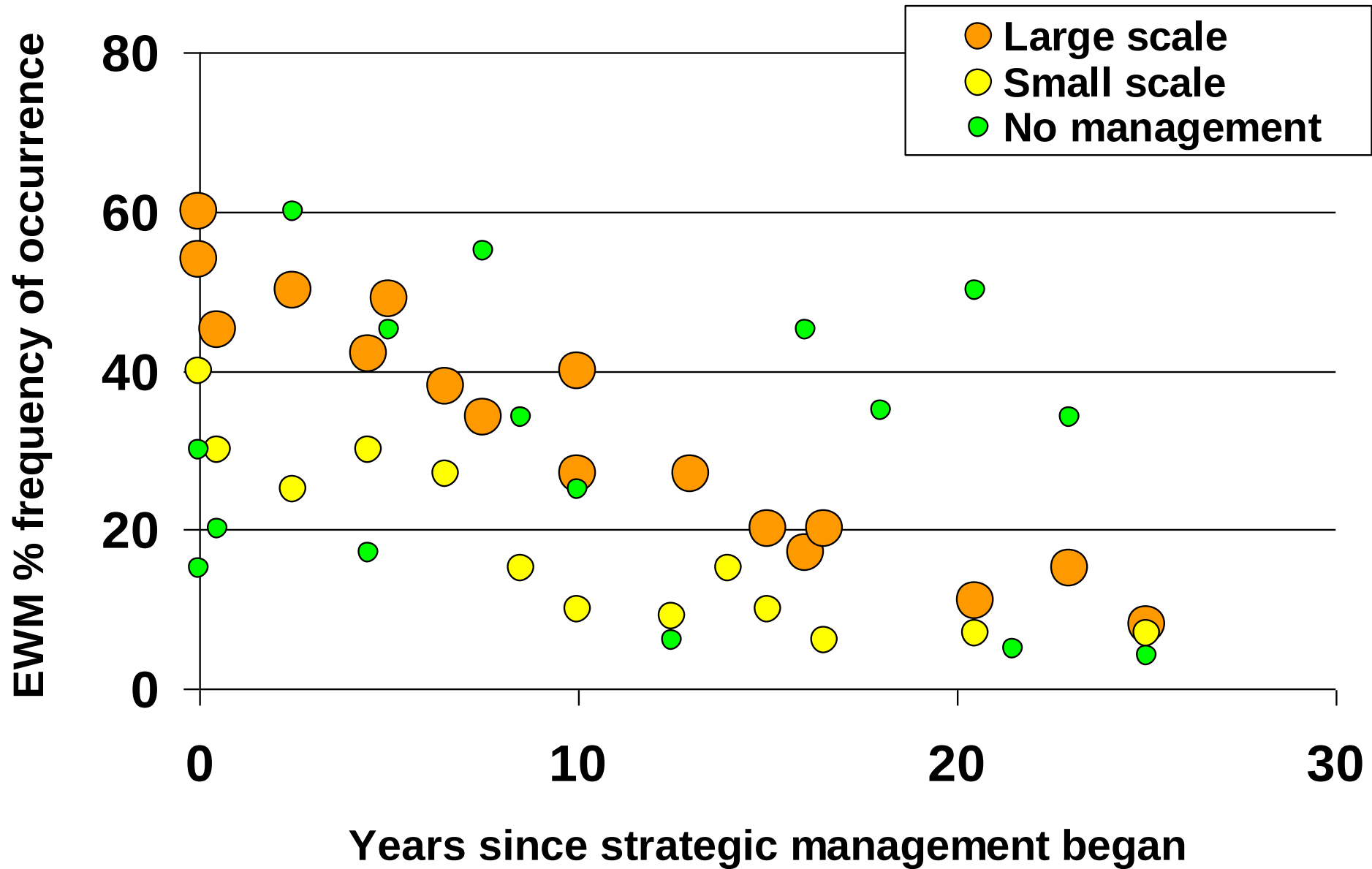
Evaluation of EWM Management

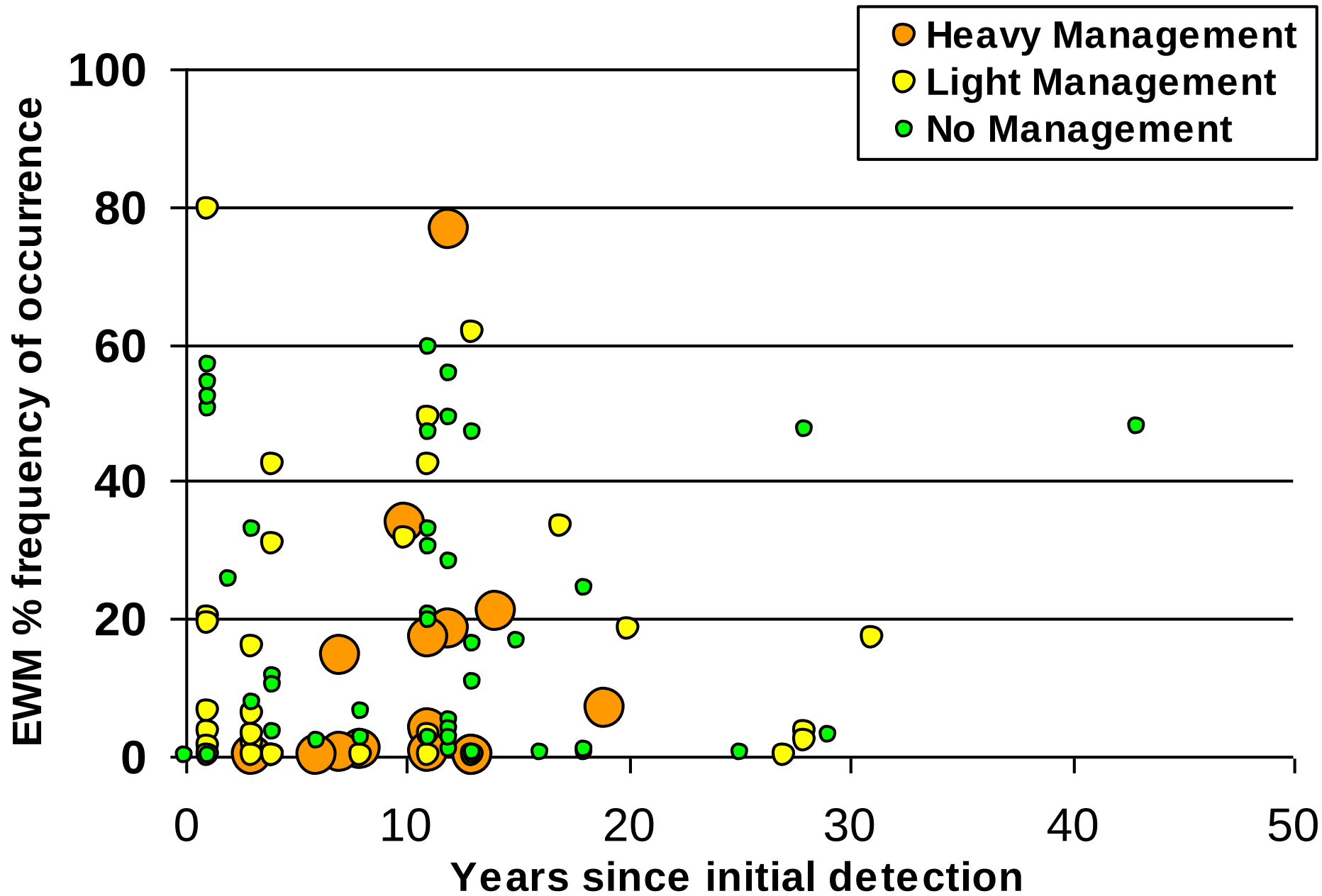
- Sampled 100 milfoil lakes
~20% of state lakes
- Assess distribution and density of EWM
- Collect treatment records

Enterprise Lake, Langlade



Compare EWM to management

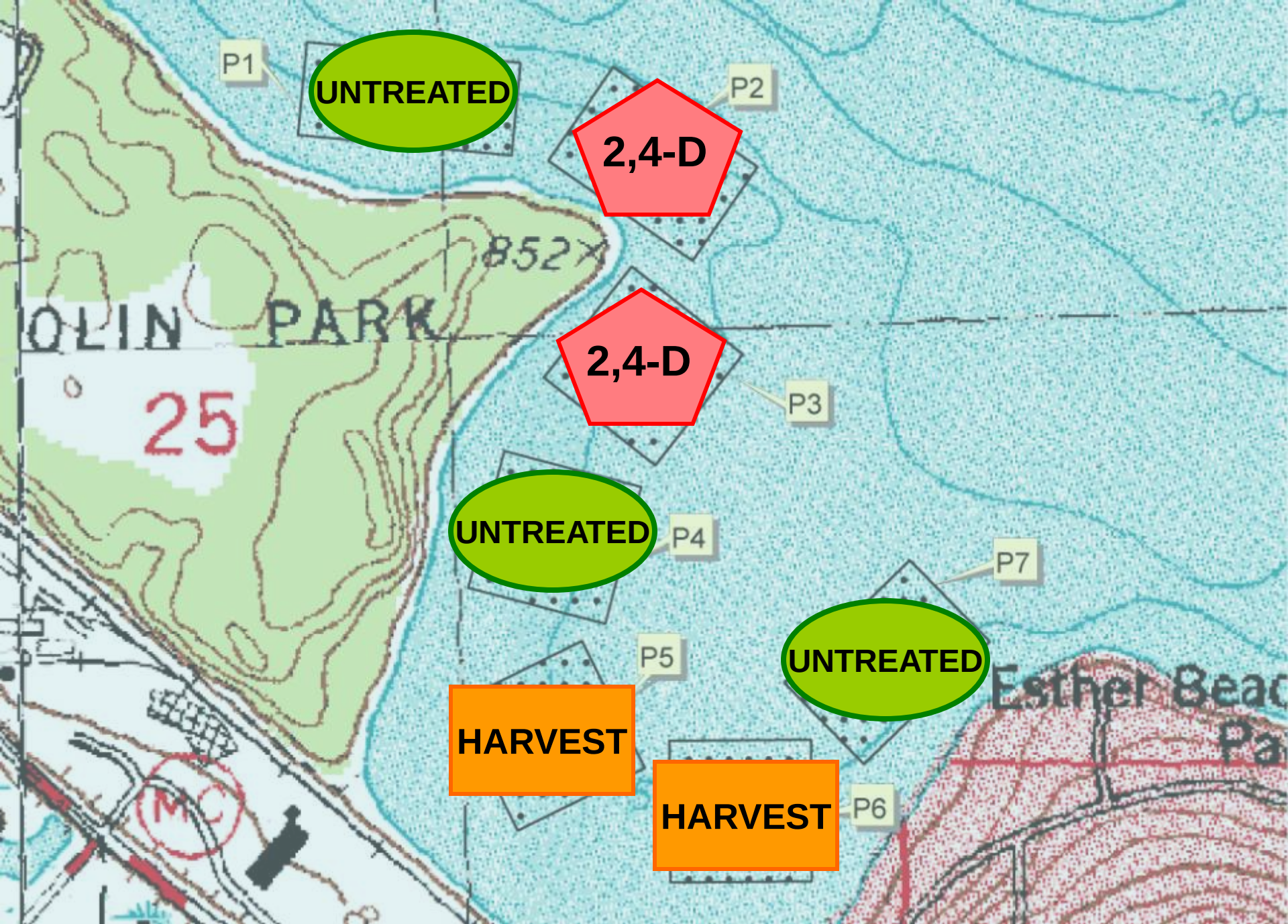




Early-Season Control Strategies

- 2,4-D treatment
 - Semi-selective
 - Dicots: EWM, Coontail, Water stargrass
- Deep harvesting
 - Non-selective
- Can treating early increase selectivity?





Chemical Treatment

- 2,4-D as granular Navigate
- 2008
 - 100 - 150 lbs/acre (by depth)
 - Average residual concentration < 10 ug/L
- 2009 and 2010
 - 150 lbs/acre

Harvesting

- Deep harvesting
- 2008 (30 May)
 - high water levels prevented harvesting until later in the season (July)
- 2009 (early June) and 2010 (25 May)
 - timing was based on start of EWM growth

Assessing Plant Response

- 8 Surveys : June & August, 2007-2010
- ~40 points per plot
- **Plant presence/absence**
 - Generalized Linear Mixed-Effect Models
 - Presence/absence (binomial distribution)
 - Make linear predictions, assess significance of response to treatment



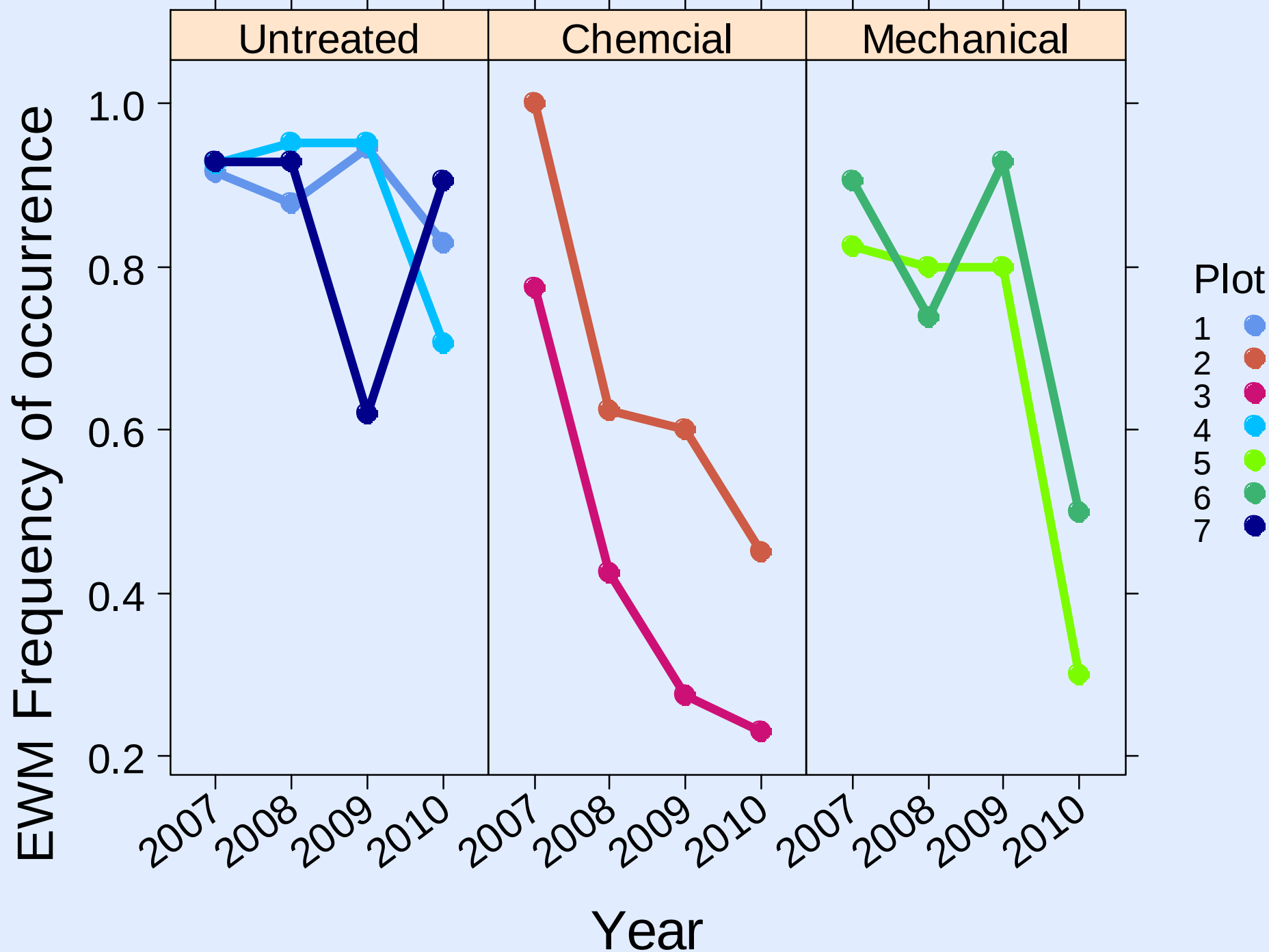






Results

- Decrease in EWM Frequency observed over four years with either treatment



Results

- Decrease in EWM frequency after four years with either treatment
- Considerable variation
 - Among plots
 - Among years

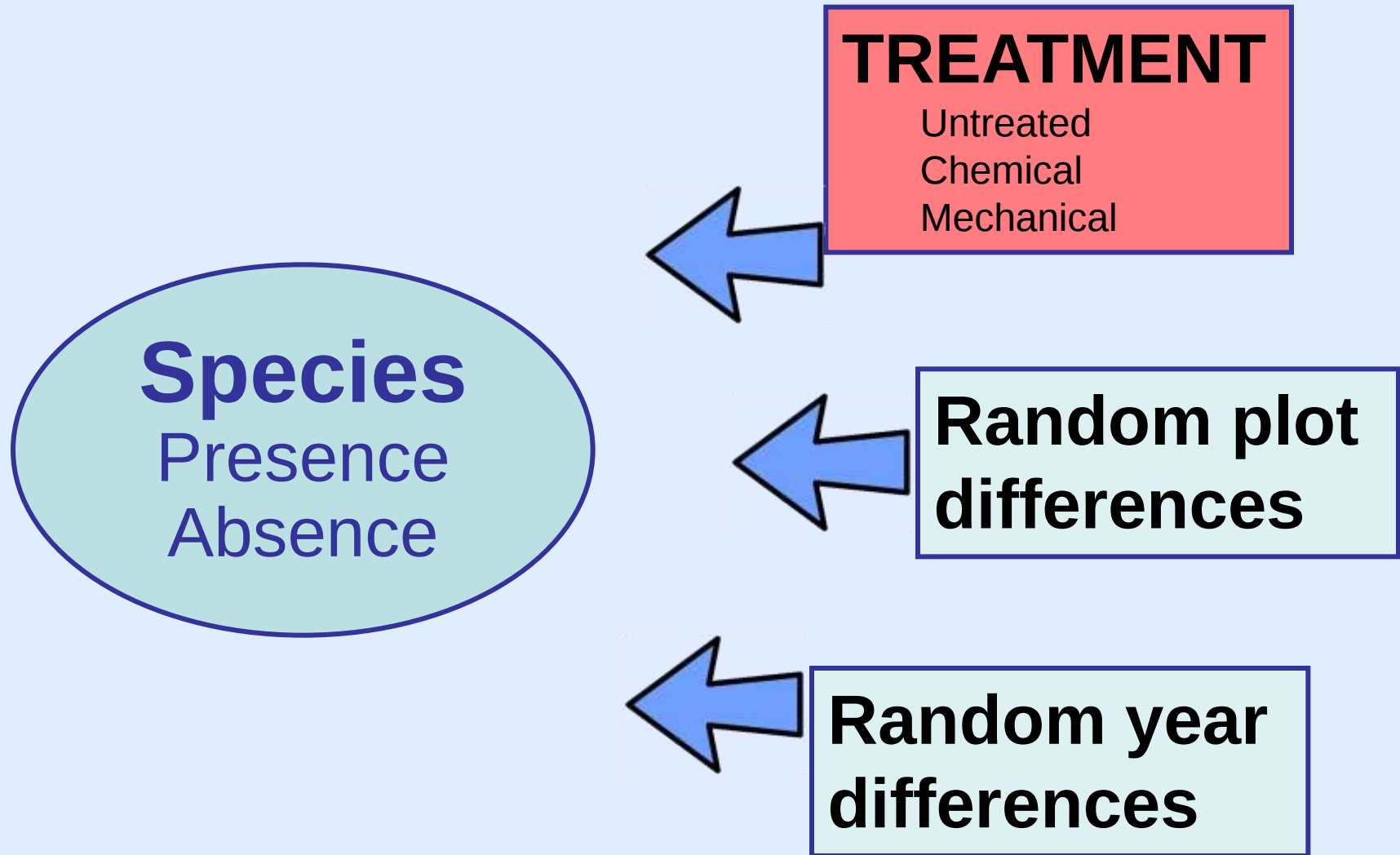
Are there
significant
differences among
treatment groups?

Analysis must know that:

- Plots are not identical
- Each plot was measured multiple times
 - Non-independent samples

Predict:

Given:

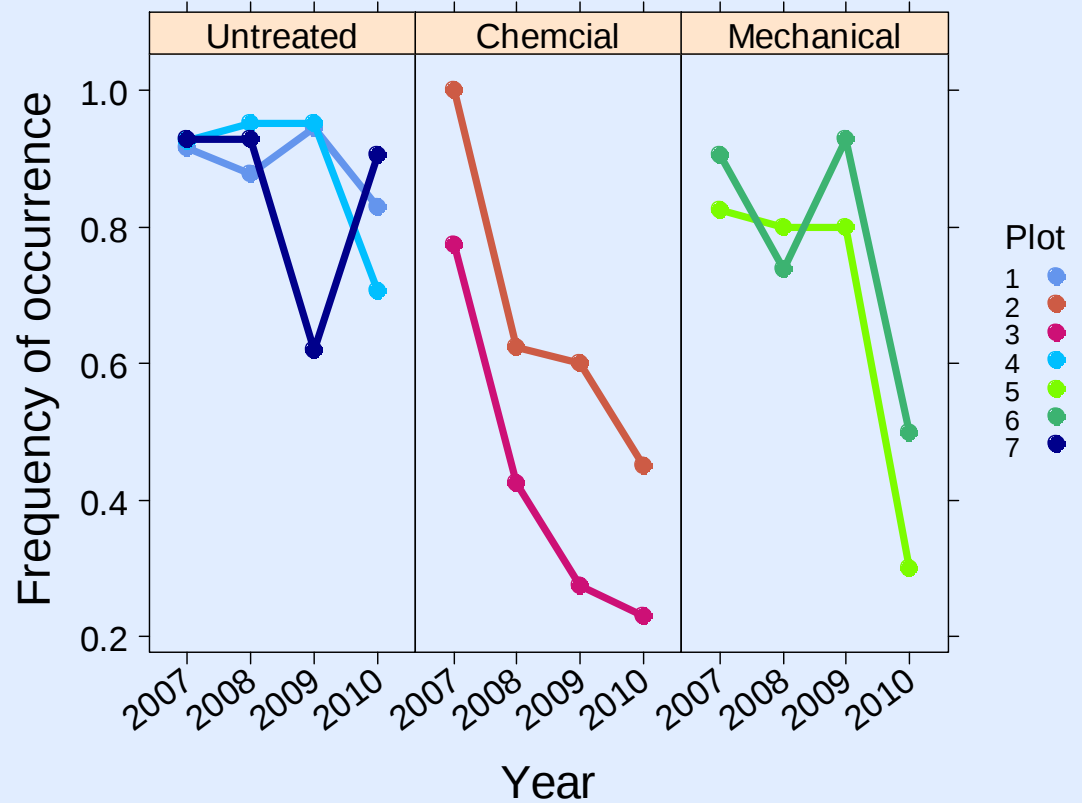


Generalized Linear Mixed Model

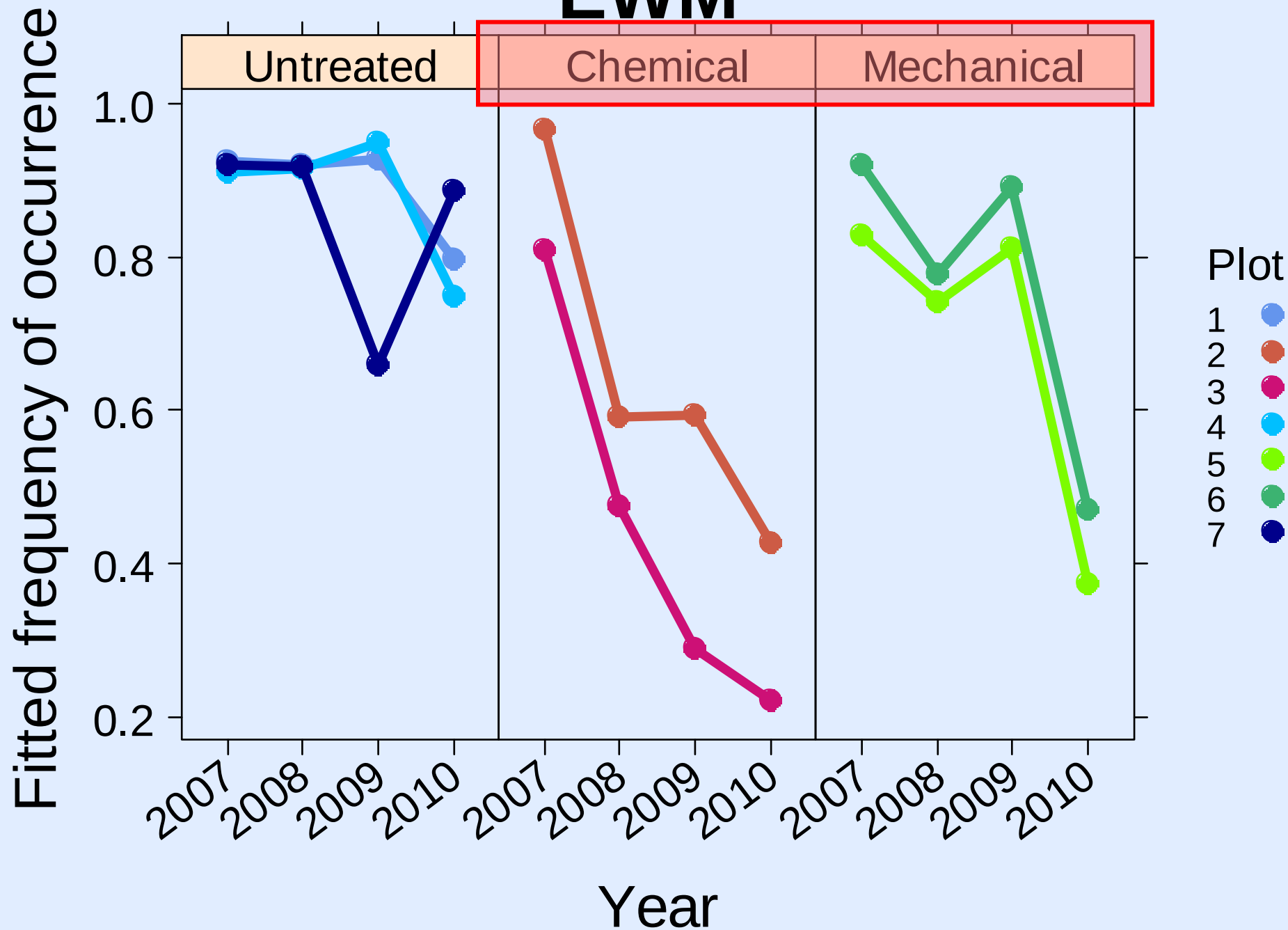
$\text{SPECIES} \sim \text{TREATMENT} + \text{YEAR} + (1 \mid \text{PLOT}) + (\text{YEAR} \mid \text{PLOT})$

Species results:

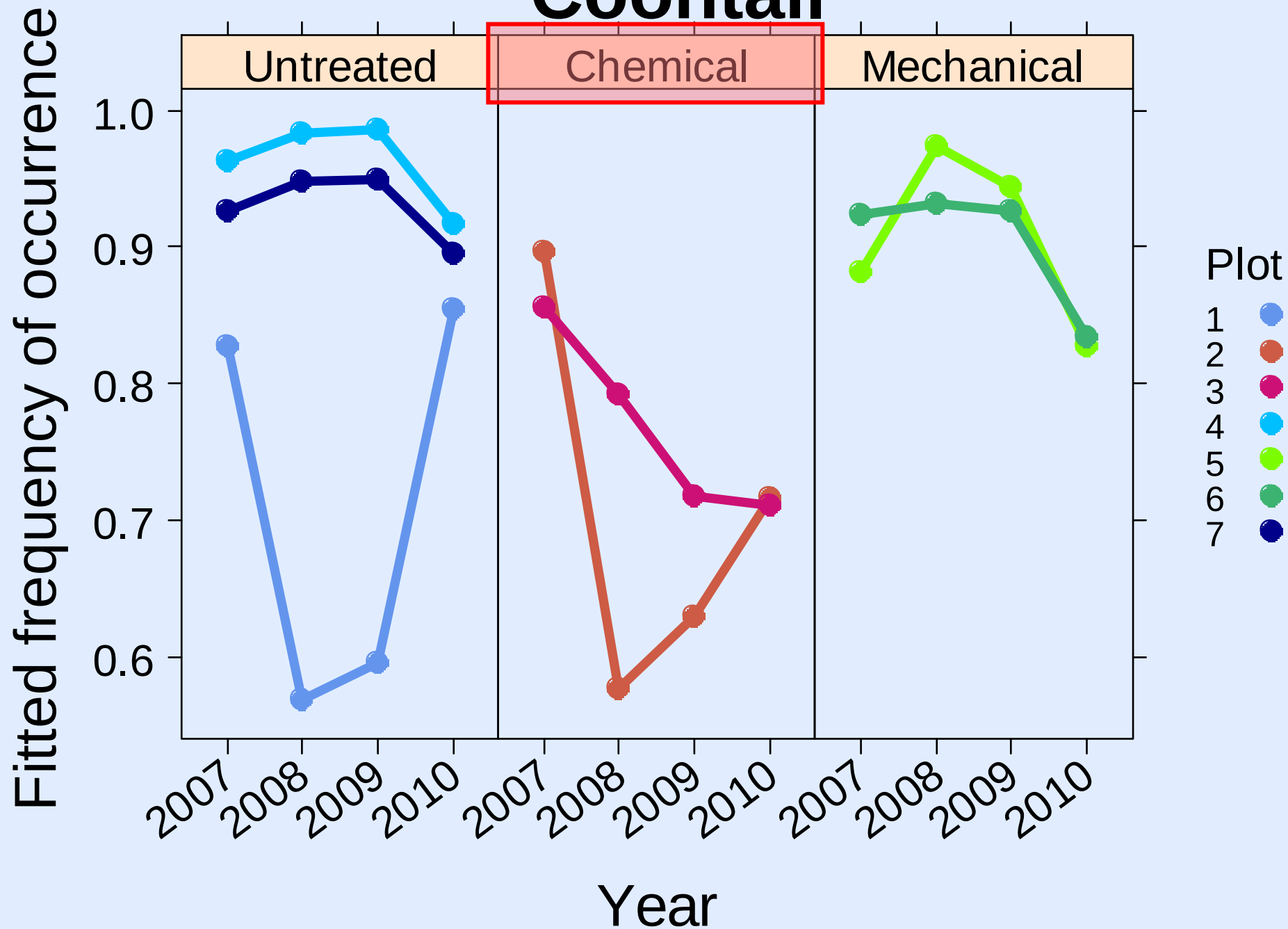
- EWM
- Coontail
- Elodea
- CLP (June data)



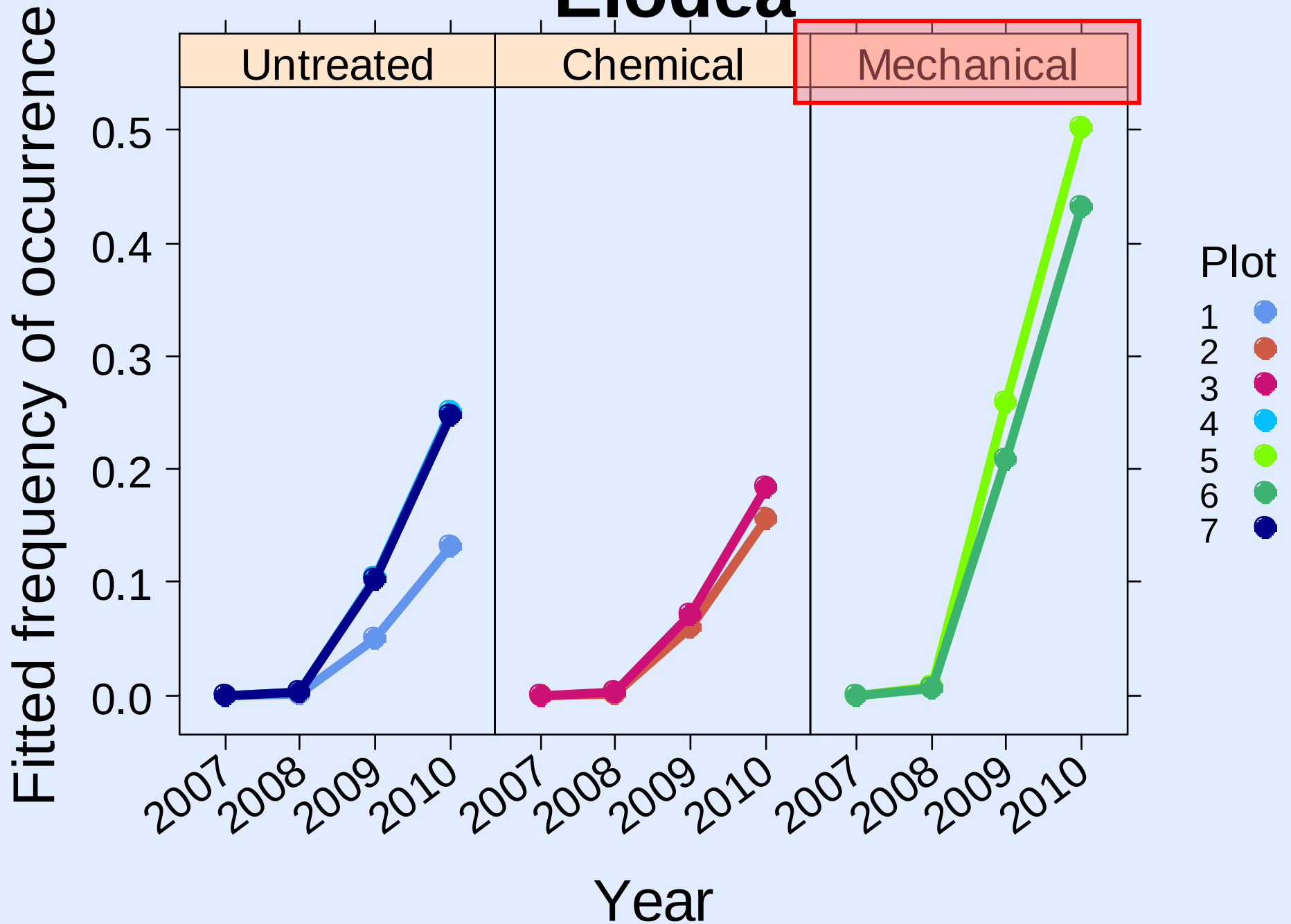
EWM



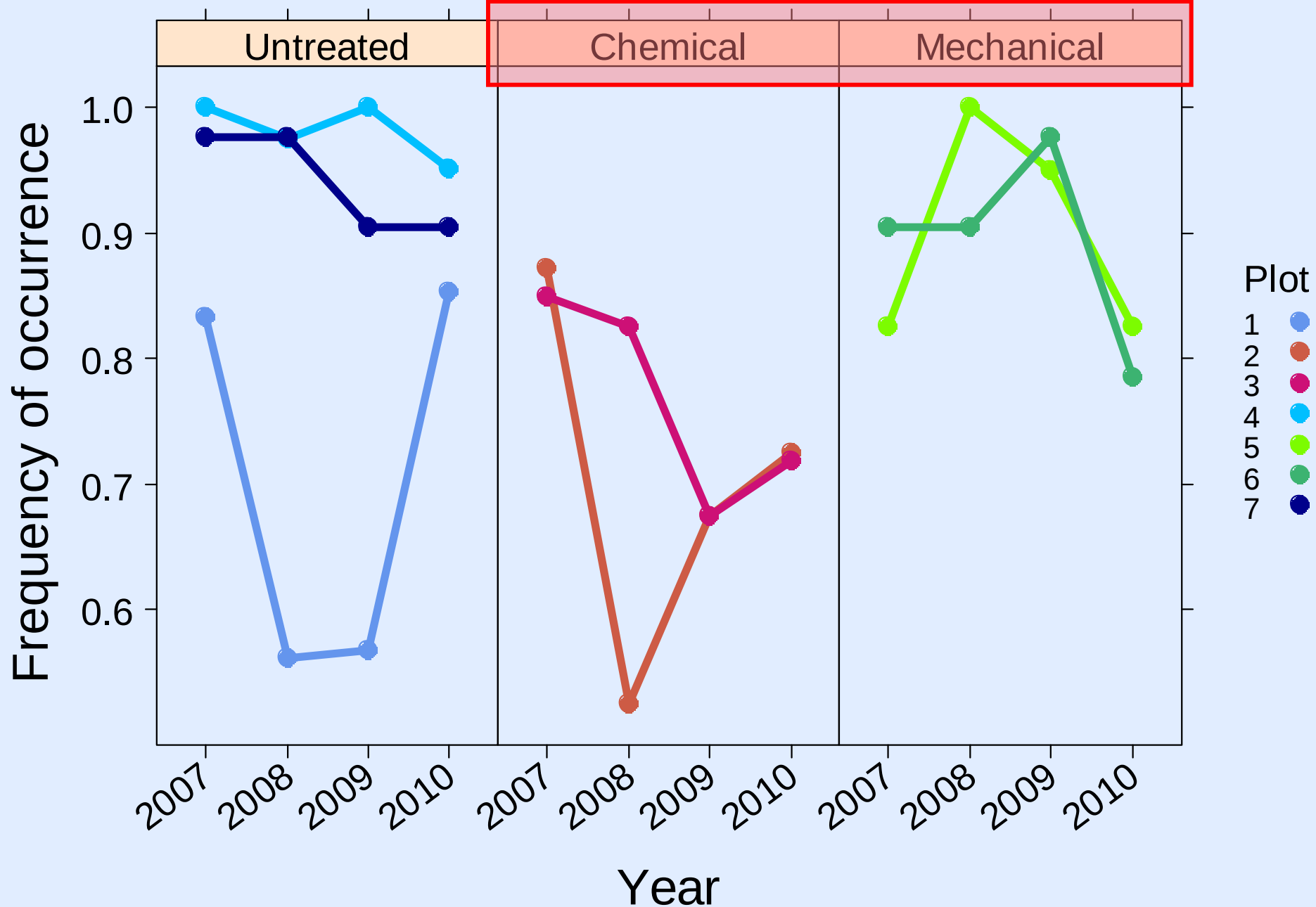
Coontail



Mechanical



CLP



Other natives

- No significant effects, although most species were less than 10% frequent throughout the majority of the study

SUMMARY

- EWM (decrease)
 - Mechanical harvesting
 - Chemical application
- Coontail (decrease)
 - Chemical application
- Elodea (increase)
 - Mechanical harvesting
- CLP
 - Increase: Mechanical harvesting
 - Decrease: Chemical application

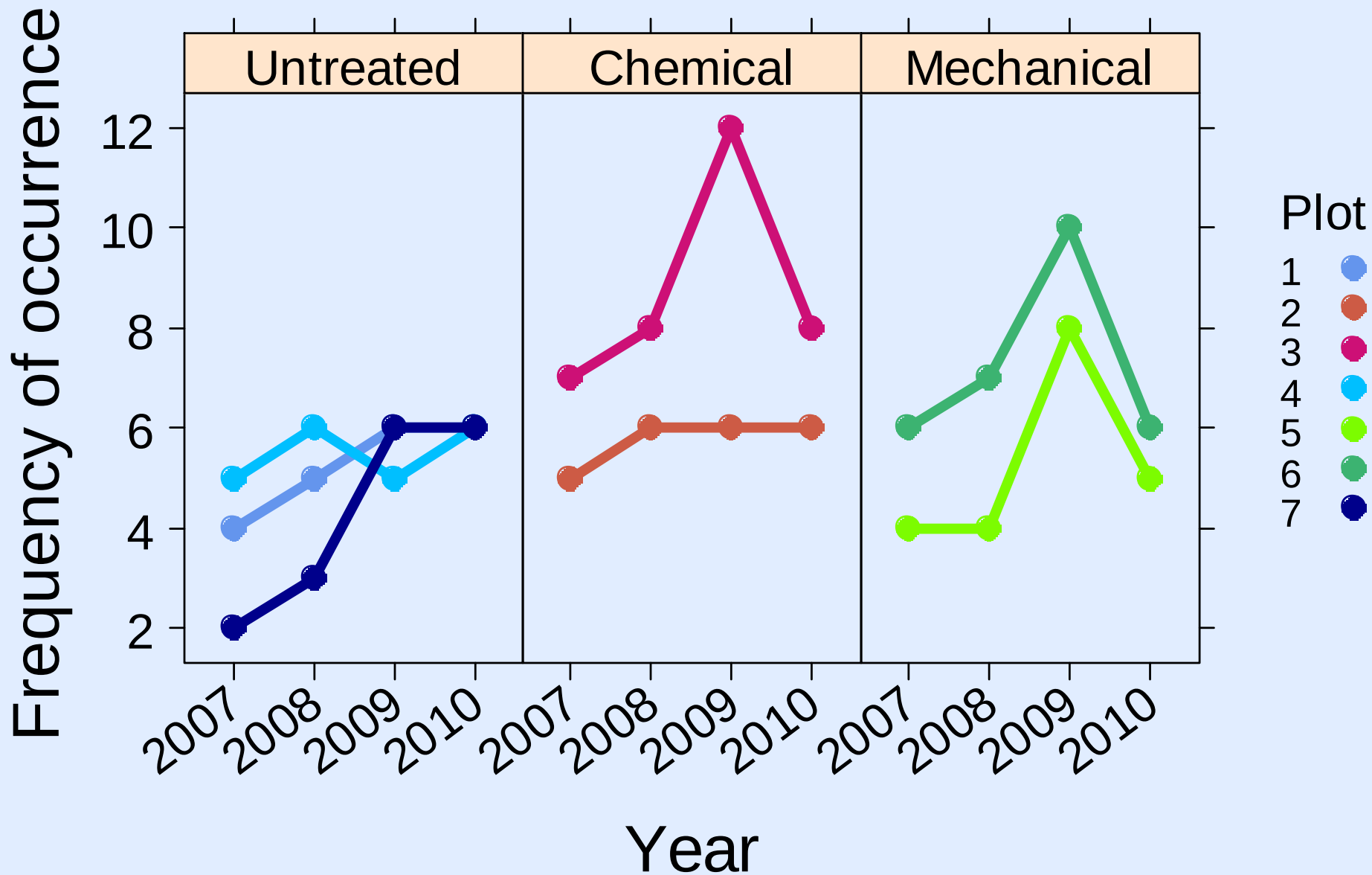
SUMMARY

- Results of harvesting are variable
 - Multiple years required to be comparable to chemical treatments
- Non-target effects of chemical treatment
- Interannual variation can be great

Going forward

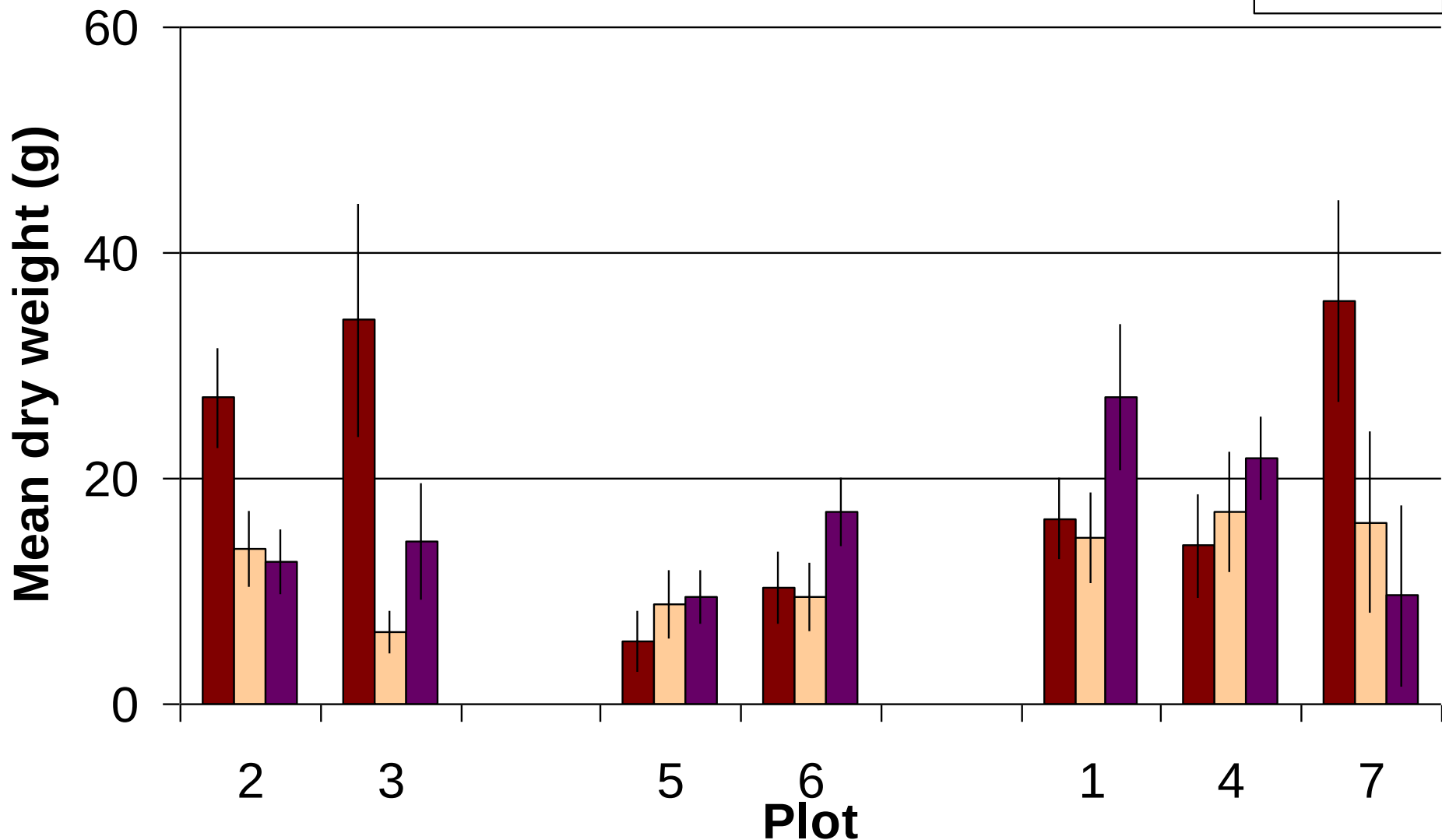
- Financial cost
 - One year (?) of chemical treatment
 - Four years of harvesting
- Ecological cost
 - Non-target effects of chemicals
 - Will track 2 years post-treatment
- Careful weighing of options
 - Science to support good decision making

Species richness



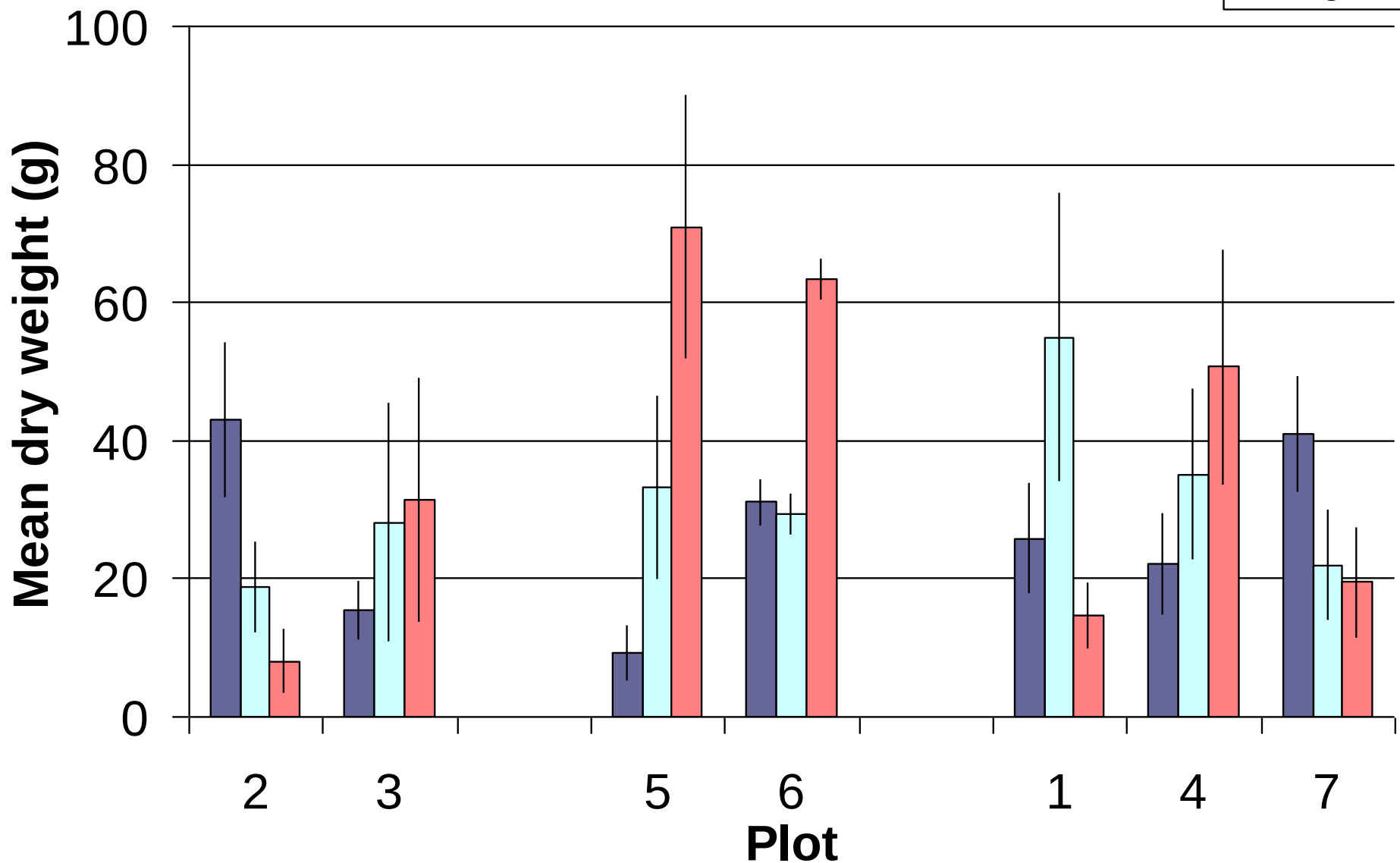
Mean total biomass per point 2007 - 2009

■ Jun-07
■ Jun-08
■ Jun-09

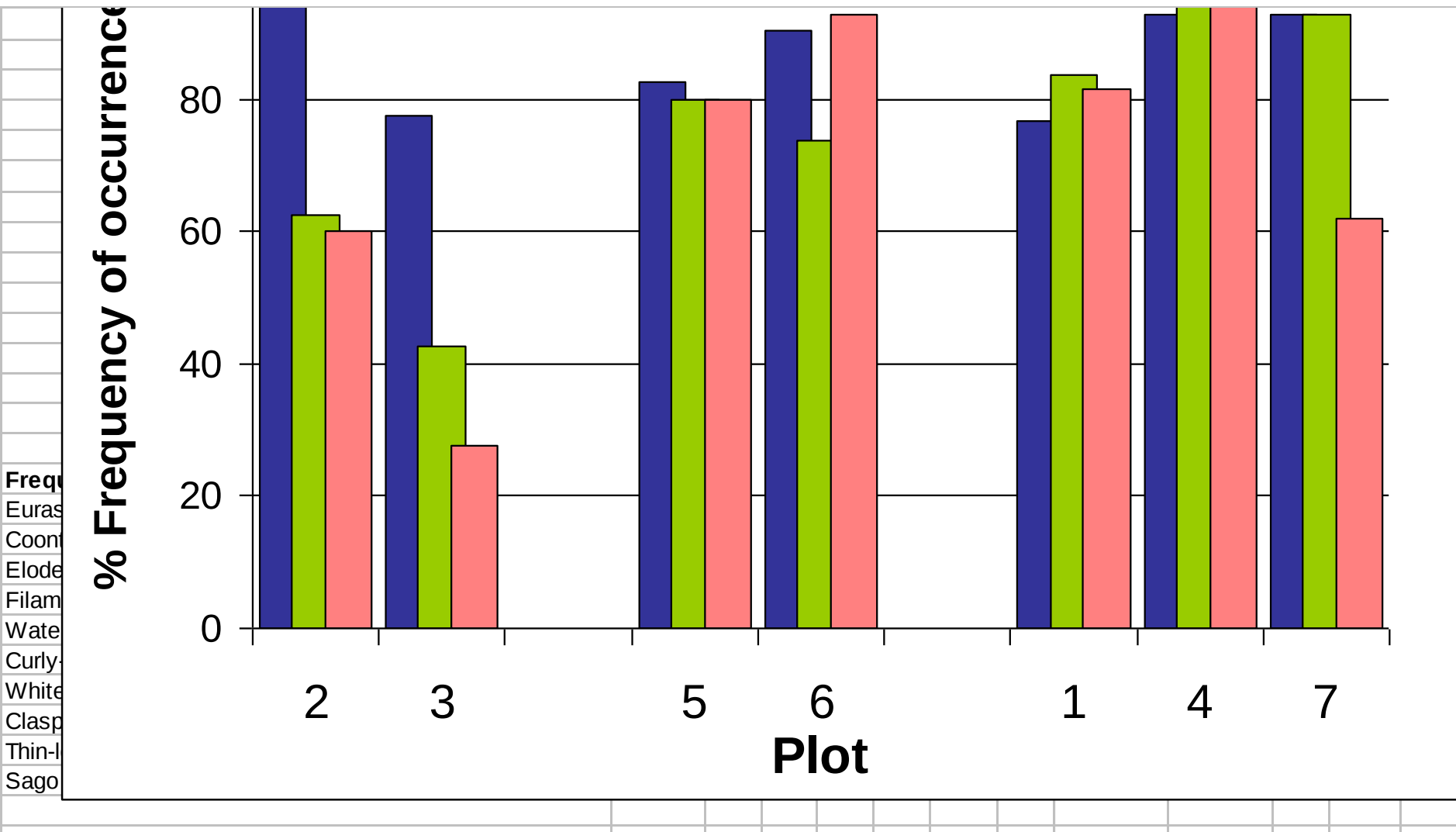


Mean total biomass per point 2007 - 2009

Aug-07
Aug-08
Aug-09



Biomass: EWM & Natives



EWM

June 2007, June 2008

PLOT 2

PLOT 3

PLOT 5

PLOT 6

PLOT 1

PLOT 4

PLOT 7

Chemical

Harvest

Recommendations (from 2009)

- Adaptive management
 - No significant revisions to date
 - Continue treatment and monitoring as scheduled (approximately 5 years)
- Army Corps coordinates '09 treatment
- Monitoring
 - DNR / ACOE – plants
 - County / ACOE – water chemistry

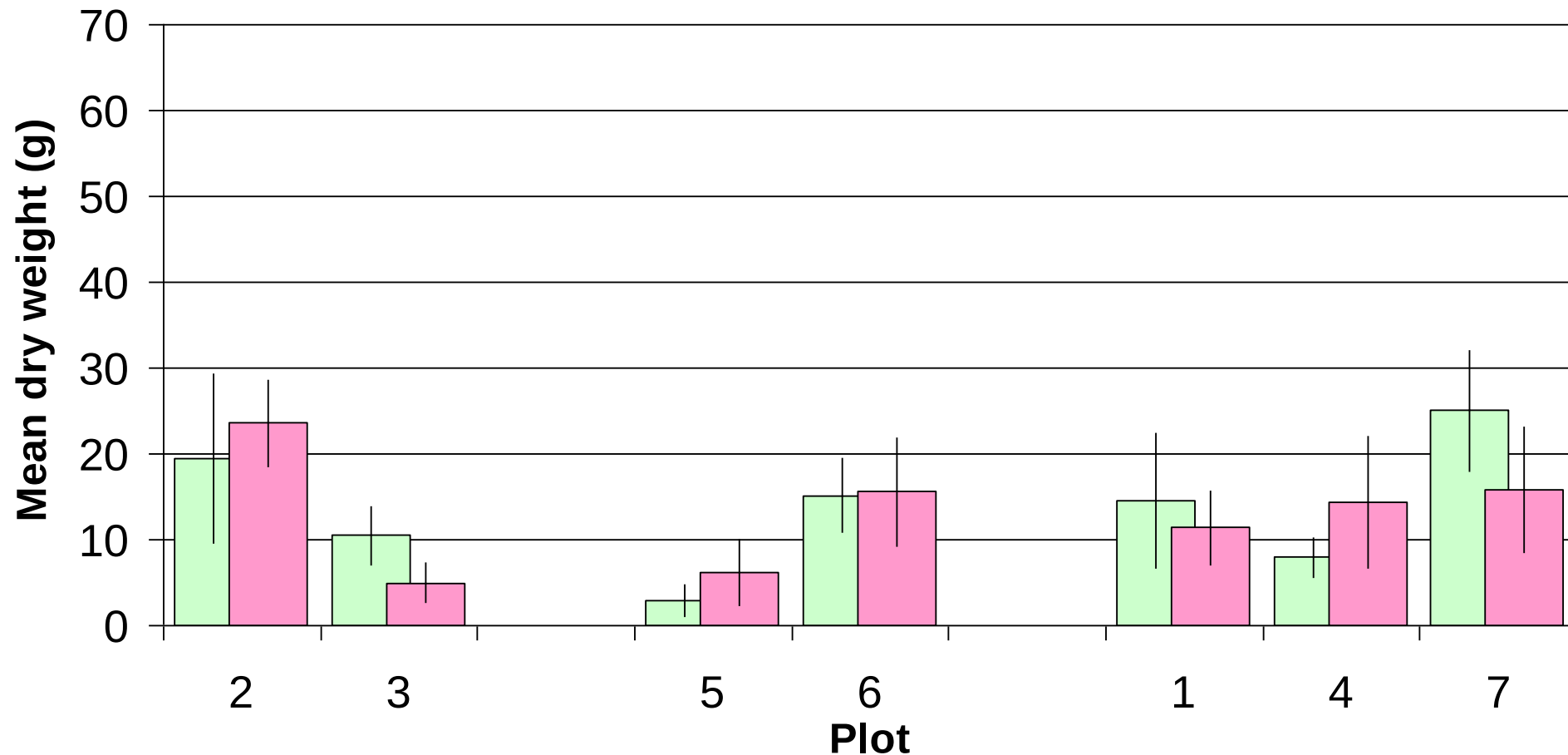
Mean Biomass per point Native vs Exotic, August 2007

Natives
Exotics

Chemical

Harvest

Control



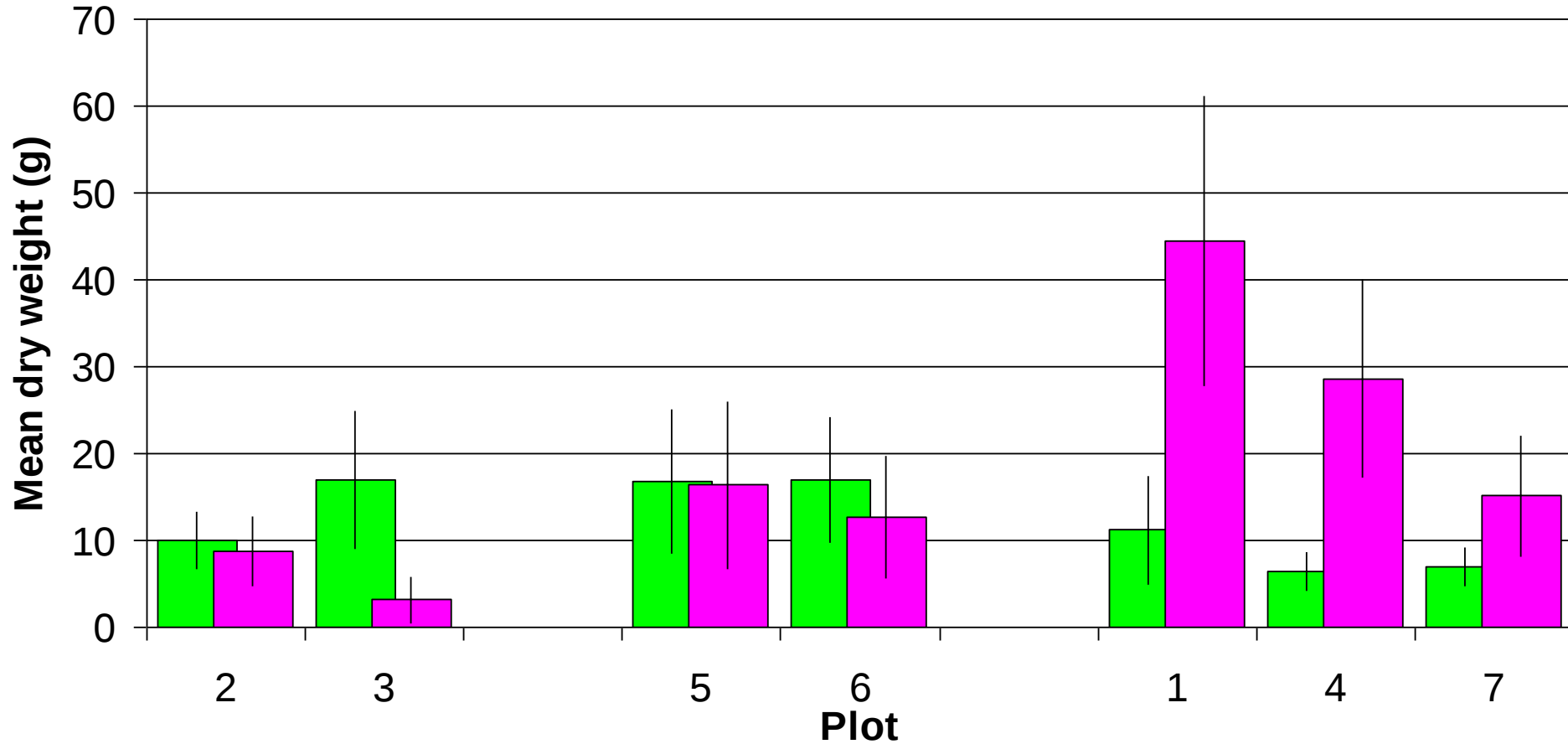
Mean Biomass per point Native vs Exotic, August 2008

■ Natives
■ Exotics

Chemical

Harvest

Control



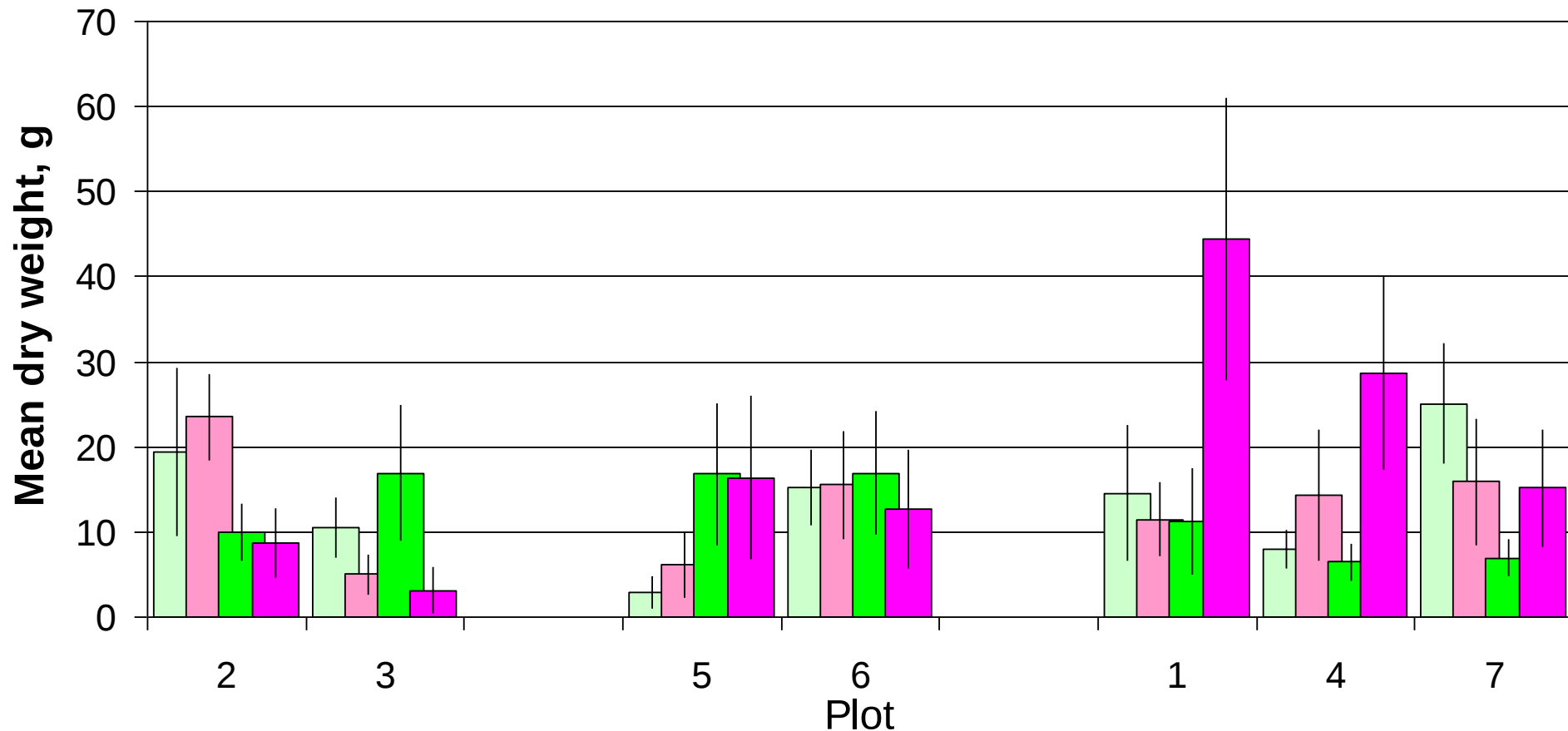
Mean Biomass per point Native vs Exotic, August 2007-2008

2007 Natives
 2007 Exotics
 2008 Natives
 2008 Exotics

Chemical

Harvest

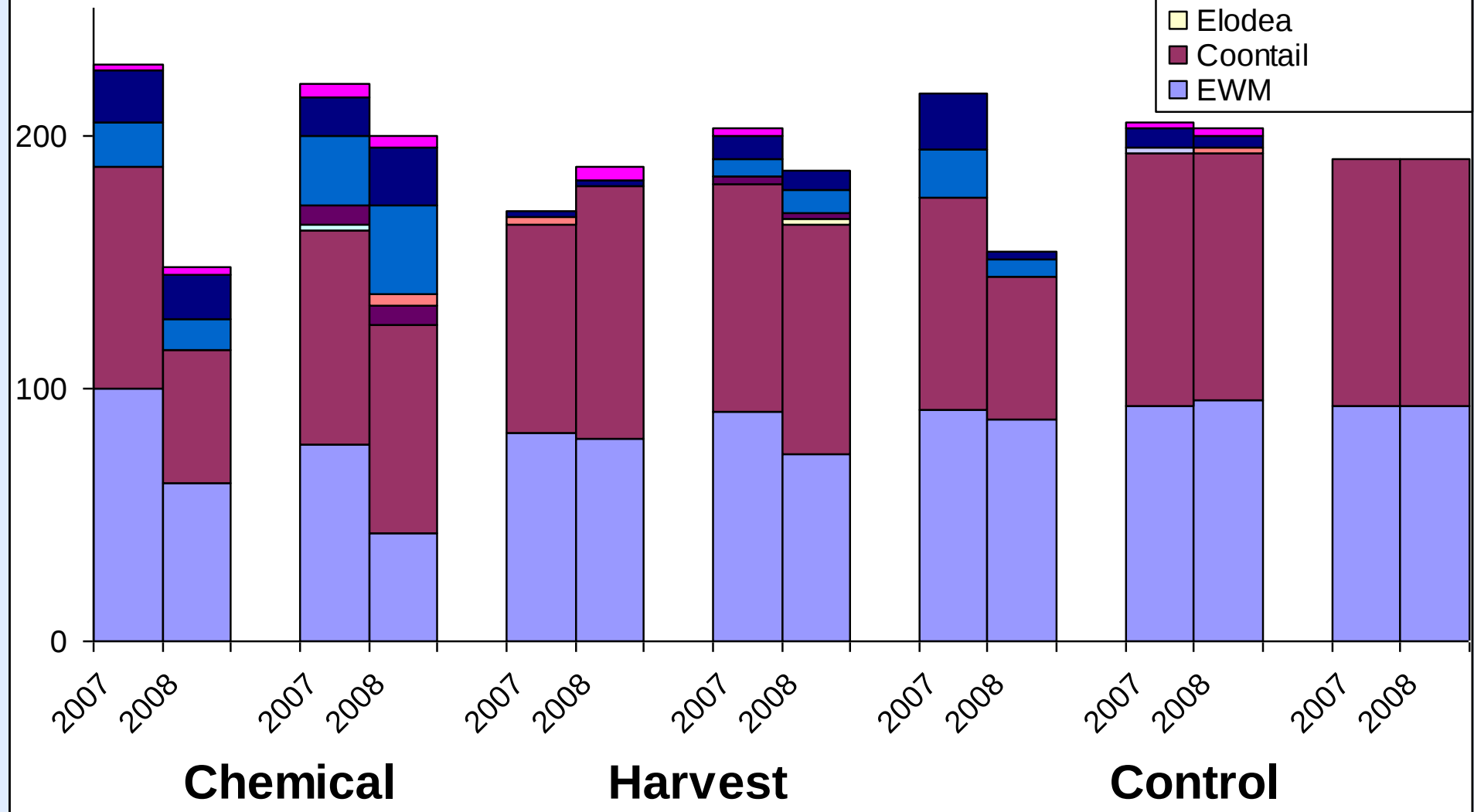
Control



NO SIGNIFICANT TREATMENT EFFECT 2007 – 2008 (ANOVA, exotics: $p = 0.69$; natives: $p = 0.99$)

% Frequency of occurrence 2007-2008 (August)

- Wild celery
- Sago
- Stiff water crowfoot
- Clasping-leaf
- CLP
- Water Stargrass
- Chara
- Elodea
- Coontail
- EWM



QAQC field assessments

