

The Effect of Nutrient Supply on the Primary Production and the Participation of *Phalaris arundinacea* in a Wet Grassland Plant Community

Miroslava Káplová, Keith Edwards and Jan Květ

Department of Ecosystem Biology, University of South Bohemia,
České Budějovice, Czech Republic

Wet Grasslands

- Important wetland ecosystems
- High species diversity
- Important habitats for birds and invertebrates
- High production (up to $4000 \text{ g DW} * \text{m}^{-2} * \text{yr}^{-1}$)
- Europe – artificial systems – human-created and maintained – vulnerable to changed management regimes

Wet Grasslands

- **Last 60 years:**
 - **large decline in wet grassland area**
 - **changed management practices (agricultural intensification, abandonment) – large changes in structure and functions**
 - **ex. Eutrophication – changed species composition, decreased diversity, species invasions**

Our Study

- **Mokr  Louky (Wet Meadows) - Třeboň Basin Biosphere Reserve (TBBR):**
 - historic overflow area of Rožmberk fishpond
 - flood protection for Třeboň
 - divided into 500 x 100 m strips, separated by ditches
- **Pre- 1956: sedge meadows (*Carex* spp) common**
 - extensive management
 - low fertilizer additions
 - 1-2 cuts per year

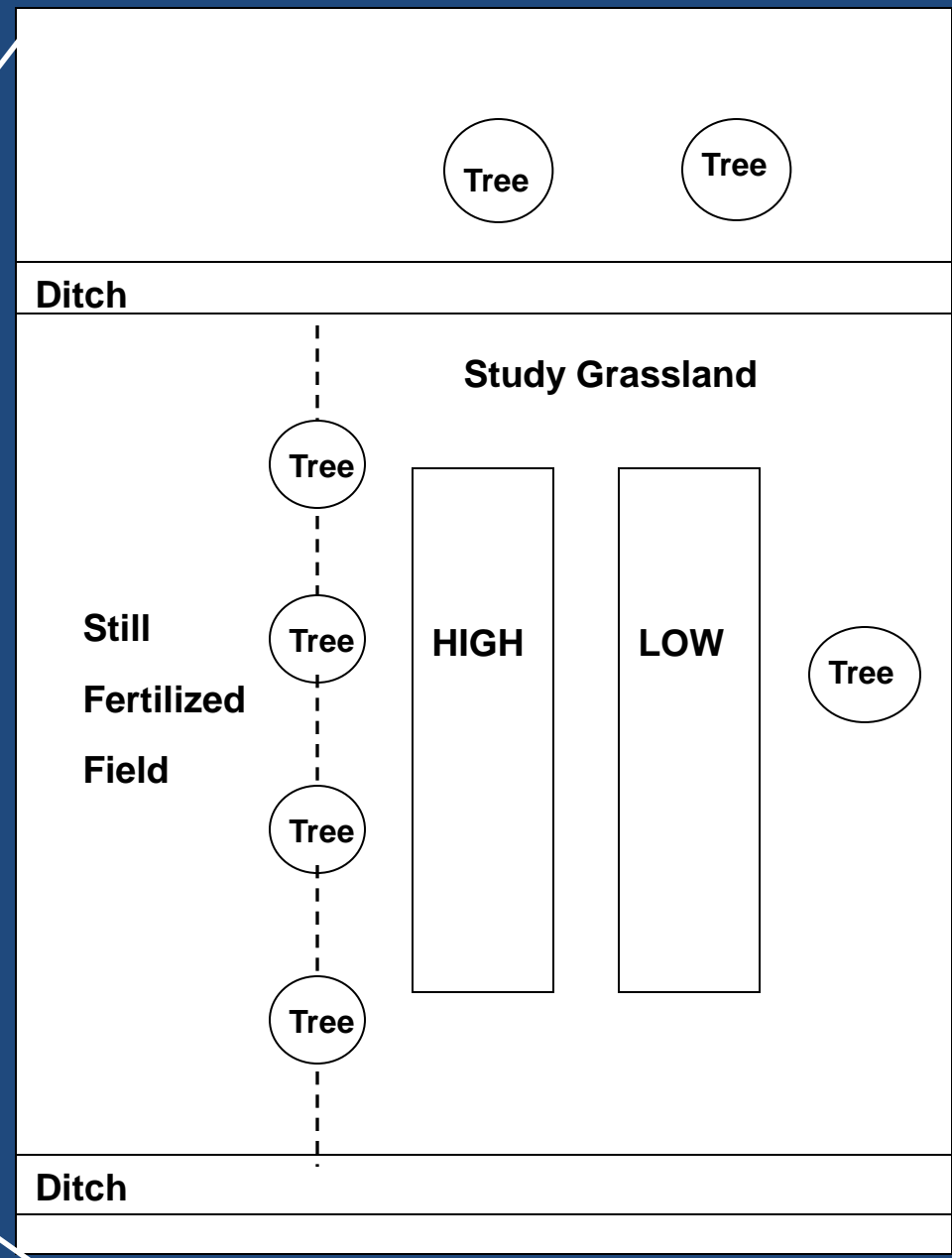
- **Post – 1956: intensive management (increased fertilization, cuts)**
 - grasses dominant (*Alopecorus pratensis*, *Calamagrostis canascens*)
 - *Phalaris arundinacea* along ditch margins

- **August 2002: large floods**
 - extensive spread *P. arundinacea*
 - dominant in large areas of meadows

- **Our study:**

- **Affect of changing nutrient conditions on:**
 - **production (above and belowground) of *P. arundinacea***
 - **species composition**
 - **plant nutrient contents**
 - **implications for restoration**

Study Site: Mokré Louky



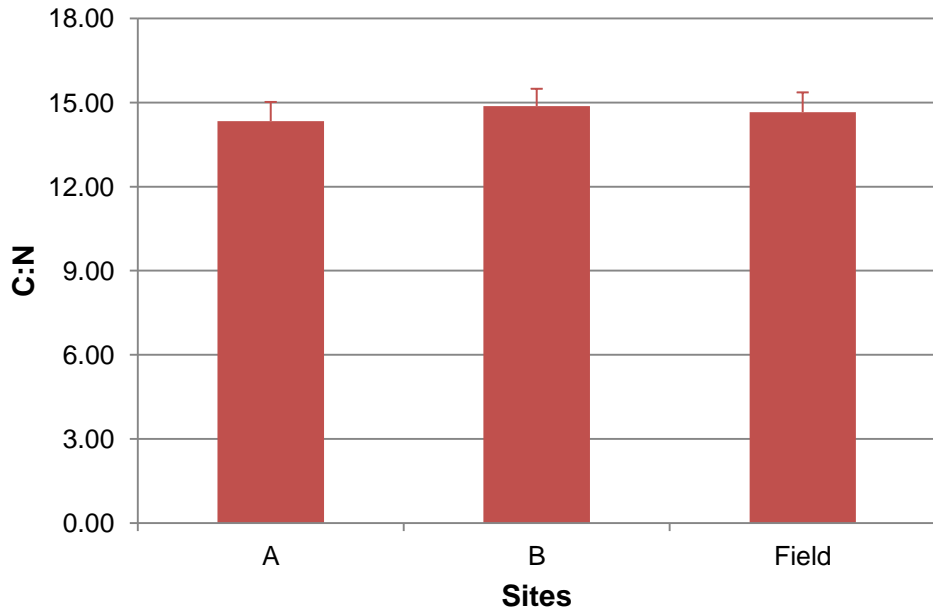
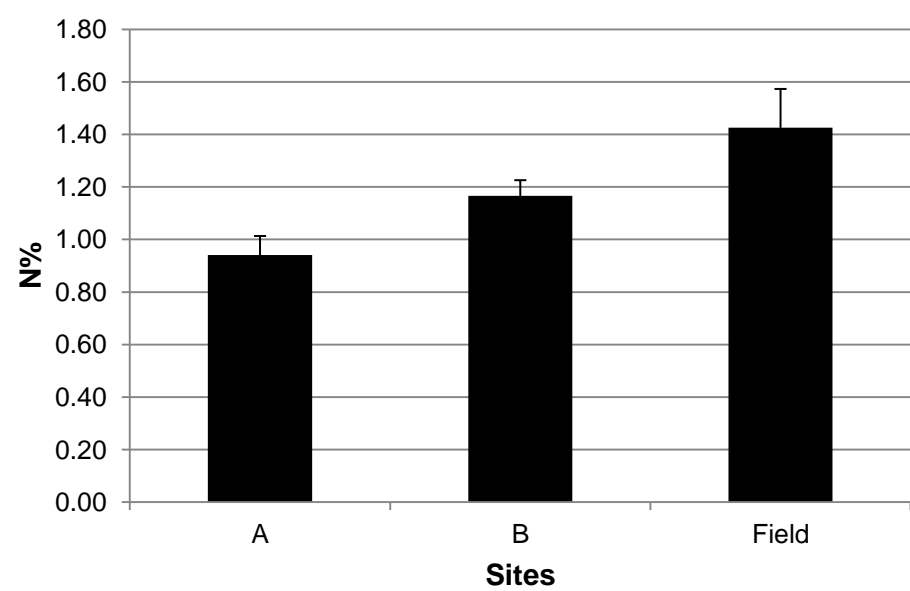
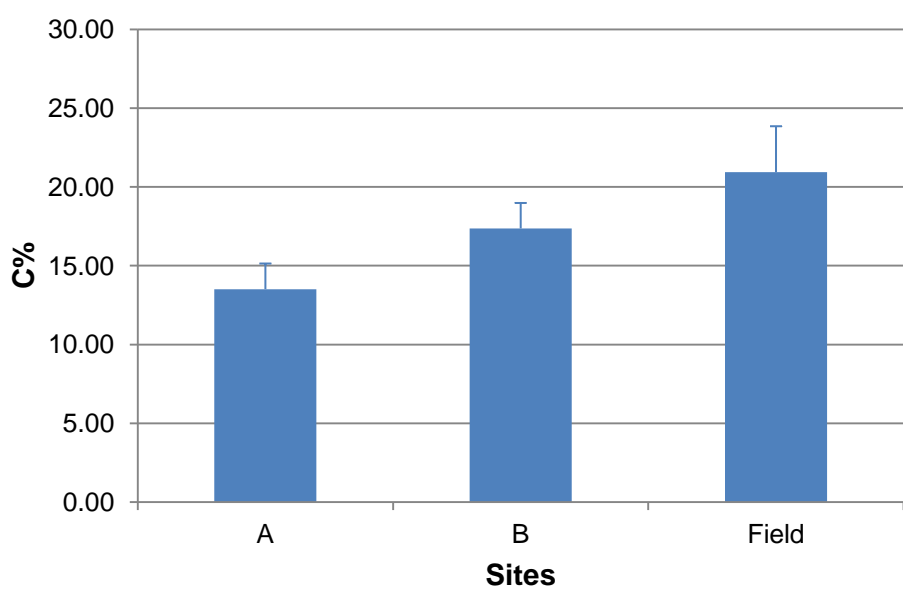
Methods

- **Soil Nutrient Content – C, N, P (2007, 2009)**
- **Aboveground Biomass / Production – monthly harvests during growing season (2007, 2008)**
- **Belowground Production – in-growth core bags (2007)**
- **Plant Nutrient Contents – C, N, P (2007, 2008)**
- **Species Cover – line intercepts (2005, 2007, 2008)**

Soil Nutrient Content - 2007

| | Low | High | t | P |
|------------|--------------|--------------|---------------|-------------------|
| C % | 13.02 | 17.87 | -4.75 | 0.009 |
| N % | 0.87 | 1.16 | -3.96 | 0.017 |
| P % | 0.21 | 0.18 | 1.83 | 0.141 |
| C:N | 15.06 | 15.39 | -0.79 | 0.472 |
| C:P | 63.17 | 97.91 | -11.28 | < 0.001 |
| N:P | 4.19 | 6.36 | -12.18 | < 0.001 |

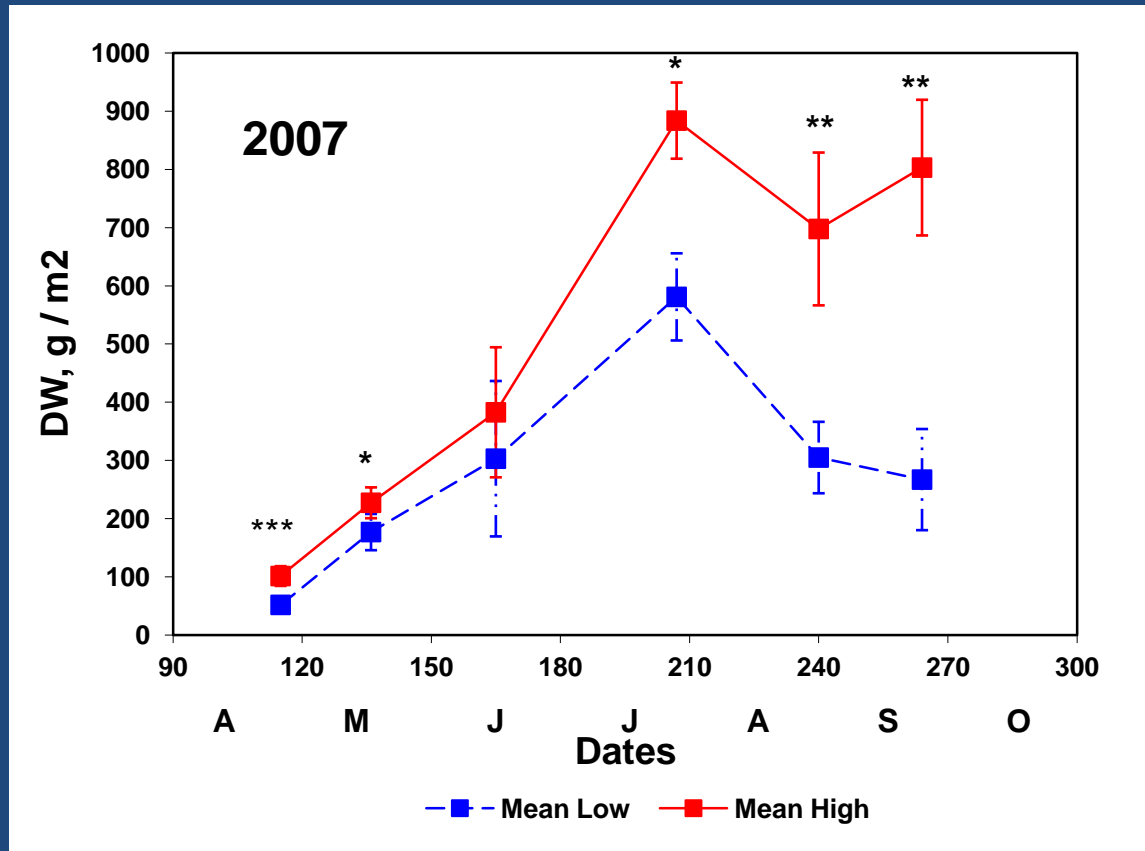
- High significantly greater C%, N%; C:N same
- P % similar; significant differences C:P, N:P
- High area nutrient-richer



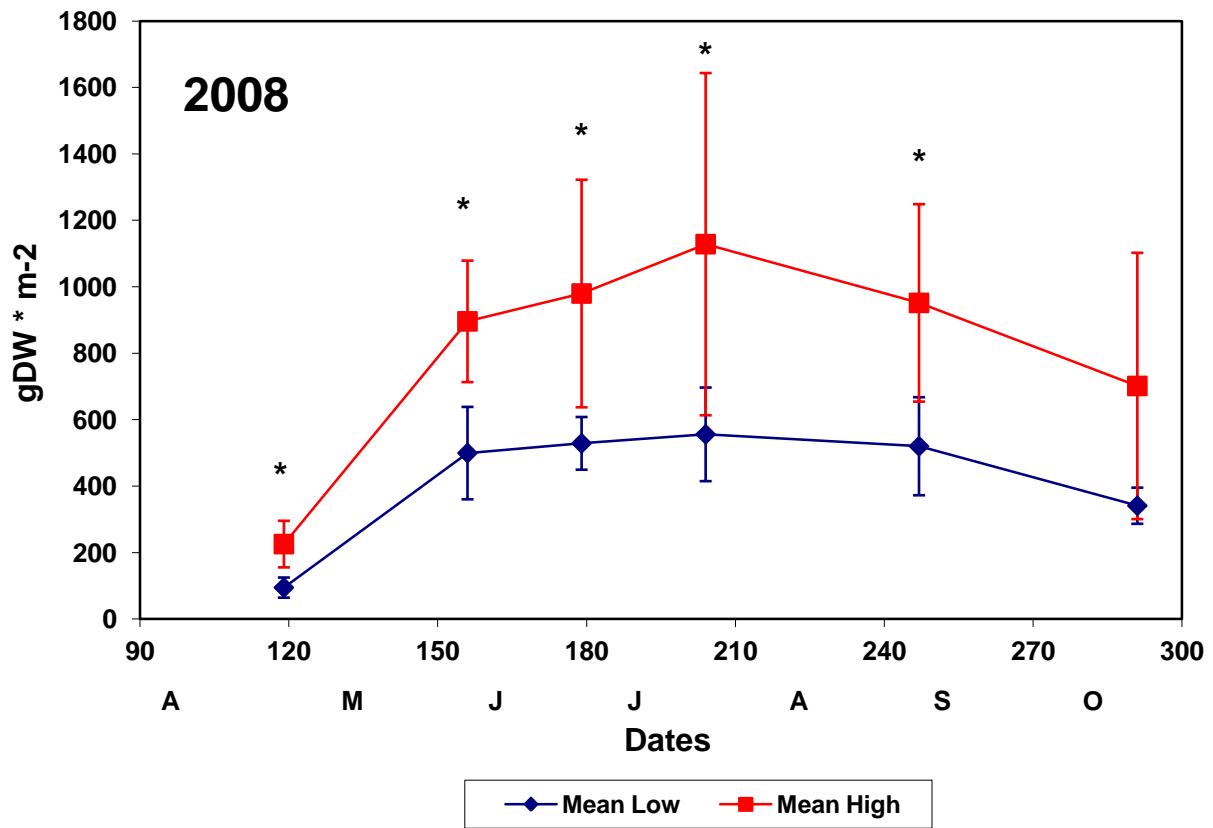
Soil Nutrients, 2009:

- significant ($P < 0.001$) decrease in C %, N % from Field to Low area
- C:N same

Mokr  Louky – Aboveground Biomass



ANOVA results: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$



Primary Production, g DW * m⁻² * yr⁻¹

| Area | NAPP 2007 | NAPP 2008 | NBPP 2007 | NAPP:NBPP 2007 |
|------|-----------|-----------|-----------|----------------|
| Low | 708.6 | 874.4 | 1017.2 | 0.70 |
| High | 1323.1 | 1689.5 | 730.4 | 1.81 |

Nutrient Contents, *Phalaris arundinacea* Aboveground

2007

16 May

28 August

| | Low | High | p | | Low | High | p |
|------------|-------------|-------------|-------------|--|--------------|--------------|-------------------|
| C % | 40.4 | 40.7 | 0.66 | | 44.4 | 45.3 | < 0.001 |
| N % | 2.93 | 2.85 | 0.89 | | 2.87 | 4.27 | 0.001 |
| P % | 0.37 | 0.42 | 0.11 | | 0.28 | 0.30 | 0.63 |
| C:N | 14.85 | 15.28 | 0.88 | | 15.63 | 10.63 | 0.02 |
| C:P | 108.5 | 101.3 | 0.21 | | 169.5 | 152.8 | 0.52 |
| N:P | 8.82 | 6.73 | 0.02 | | 13.00 | 14.33 | 0.34 |

2

2 September

C

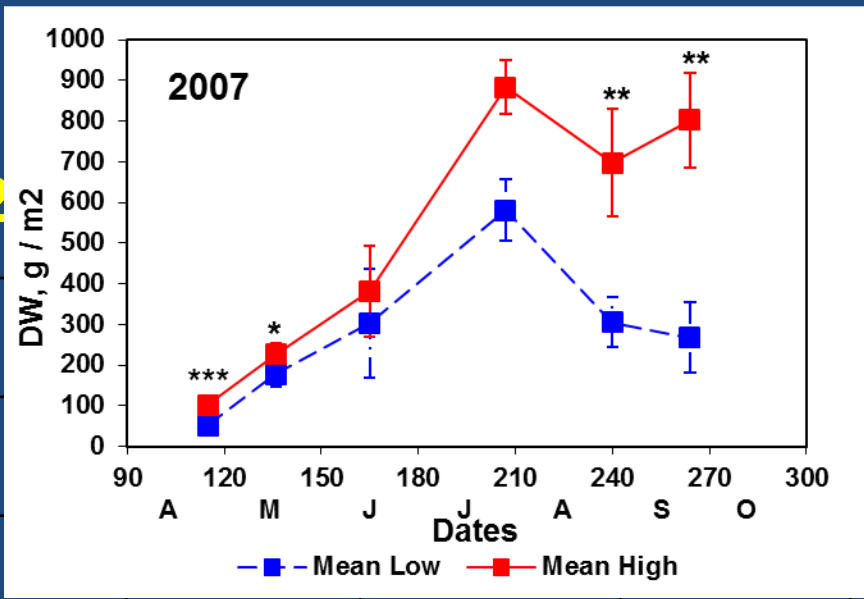
N

P %

C:N

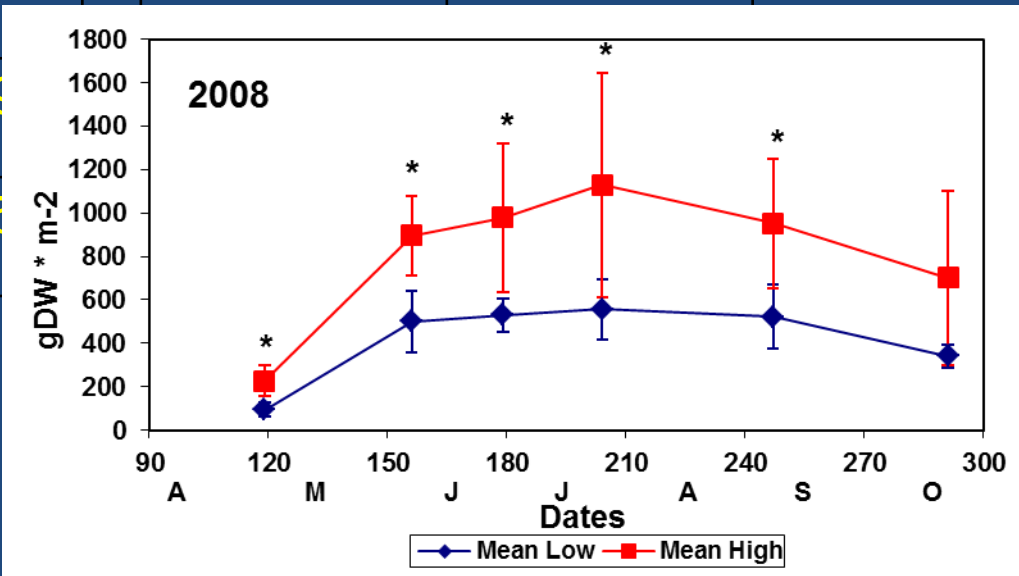
C:P

N:P



| Low | High | p |
|-------|-------|------|
| 44.3 | 44.8 | 0.12 |
| 3.60 | 3.94 | 0.41 |
| 0.22 | 0.24 | 0.66 |
| 12.44 | 11.58 | 0.48 |

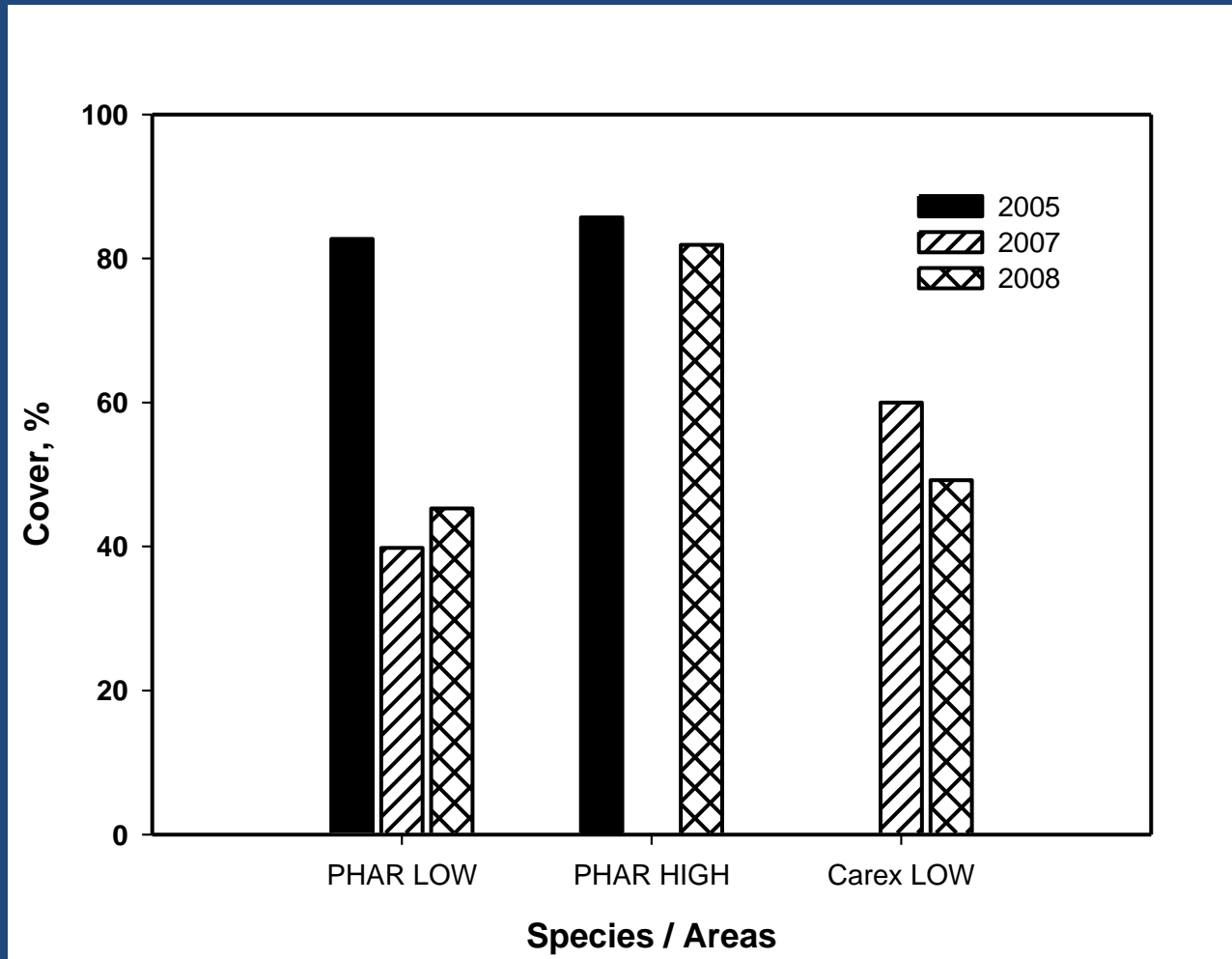
| | | |
|-------|-------|------|
| 0.19 | 0.24 | 0.06 |
| 20.49 | 14.86 | 0.02 |
| 233.0 | 188.7 | 0.09 |
| 11.34 | 12.97 | 0.35 |



Nutrient Contents, *Phalaris arundinacea* Belowground - 2007

| | Low | High | p |
|------------|-------|-------|-------|
| C % | 39.8 | 40.6 | 0.52 |
| N % | 1.47 | 2.14 | 0.02 |
| P % | 0.22 | 0.36 | 0.002 |
| C:N | 27.42 | 19.86 | 0.01 |
| C:P | 188.0 | 116.1 | 0.01 |
| N:P | 6.85 | 6.05 | 0.39 |

Percent plant cover – Mokré Louky



Káplová et al. 2011, Plant Ecology

Conclusions – Field Study

- **High nutrient conditions favor *Phalaris*:**
 - monoculture
 - faster litter decomposition and nutrient cycling (lower C:N)
- **Low nutrient area:**
 - *Phalaris* biomass and production as in less-than-optimal habitats
 - returning to more diverse, sedge meadow (rapid increase in *Carex* cover)
 - restoration implications

Mesocosm Study

- Determine the combined effects of nutrient additions and water level on the growth and spread of *C. acuta* and *P. arundinacea*
- Poster: Edwards, Káplová, Květ
Nutrient and water level effects on *Phalaris arundinacea* and *Carex acuta*: A mesocosm experiment
#32, Poster Session 1 (Monday)





Mirka



Hony

Thanks to Tomáš Píček, Terezia Řihová, Hana Čížková

Support for Project from the Grant Agency of the Czech Republic:

526/06/0276; 526/09/1545