

Variable responses of a California grassland to the reintroduction of tule elk

Brent Johnson - National Park Service

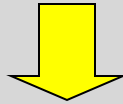


large mammalian herbivores



effects of large herbivores

- **consuming & trampling plants**
- **changing nutrient cycles**



- **alter competition between plants**
- **modify successional processes**



human impacts on herbivores

- **altered distribution and abundance**
 - **10,000+ years in N. America**
 - **negative impacts increased with the arrival of Europeans**
 - **increased hunting and habitat loss**
- **conservation efforts**
 - **species and habitat protection**
 - **reintroductions are often necessary**
 - **many herbivore populations are now increasing**

human impacts

- **bison**
 - 1800: 30-60 million
 - 1889: fewer than 1,000
- **protection & reintroduction**
 - presently 5,000–6,000 in U.S
 - still increasing



prevailing focus of reintroduction

- **target species**
 - **population size**
 - **genetic diversity**
 - **health of population**
- **less emphasis on recipient community**

reintroduction into altered landscapes

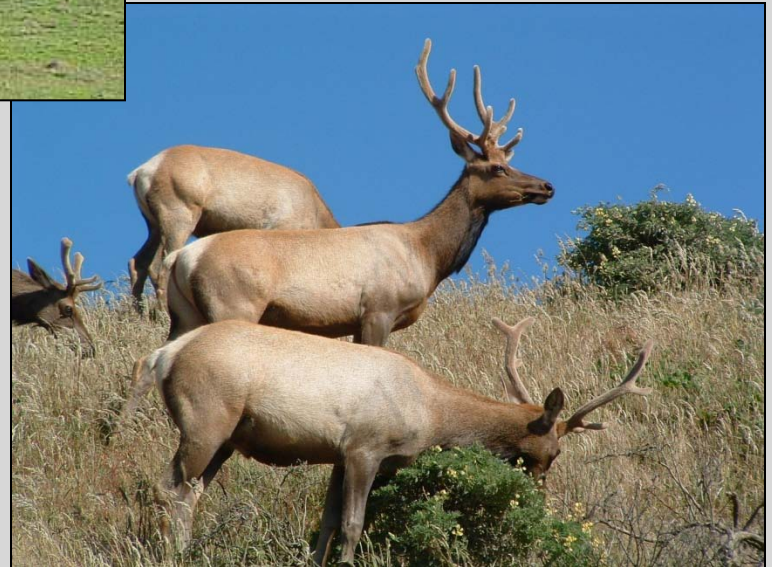
- **fragmented**
 - movement patterns changed
- **reduction of predator populations**
- **transformed plant communities**
 - **non-native species**



Tule Elk (*Cervus elaphus nannodes*)



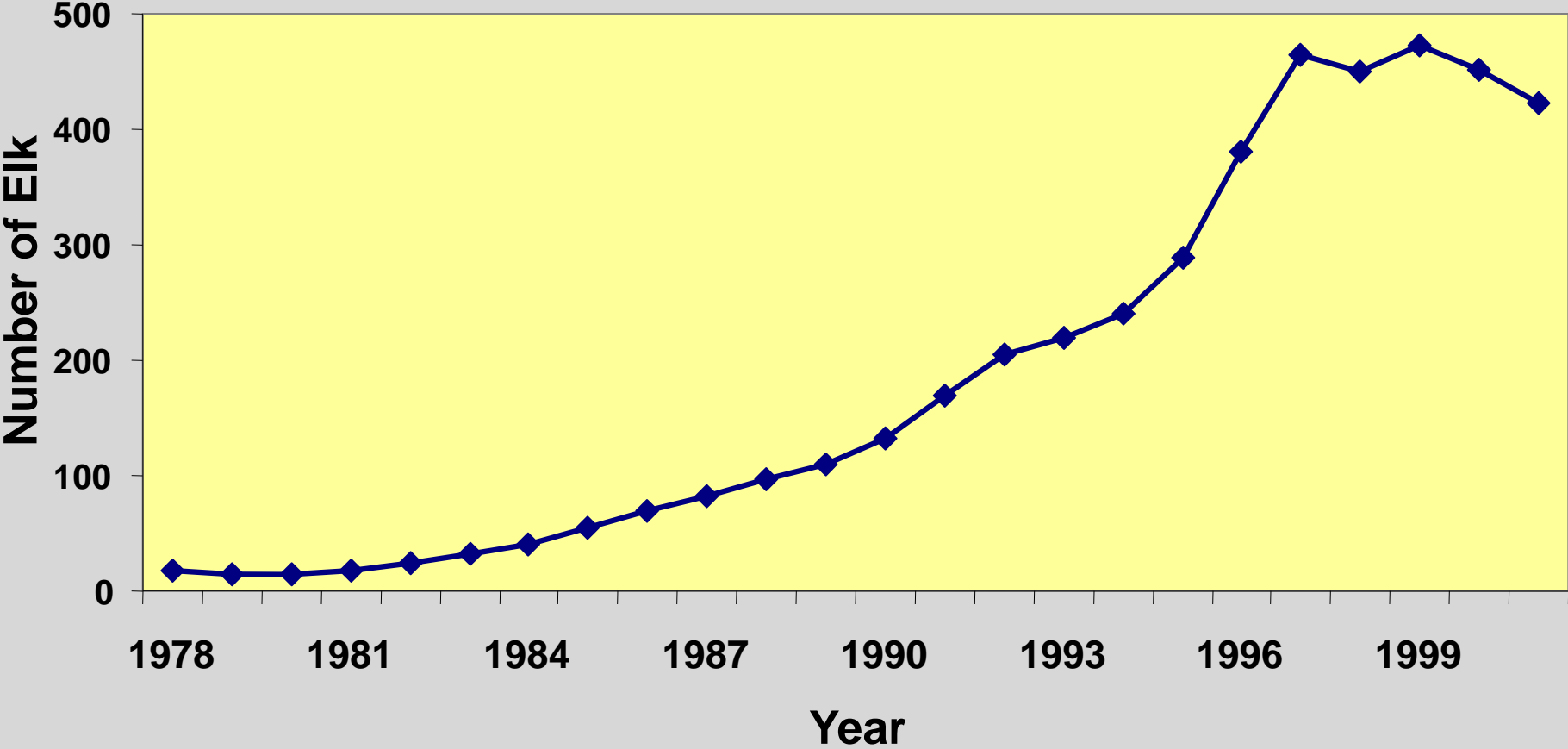
- endemic to California
- subspecies of North American elk



tule elk through the years

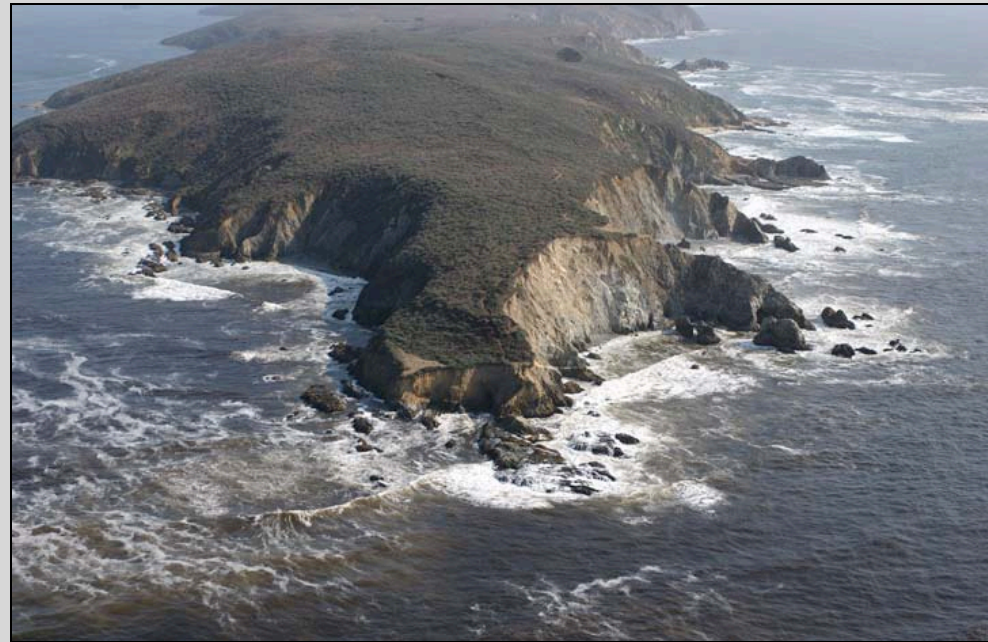
- **1769 – 500,000 tule elk in California**
- **1850 – <10 tule elk in California's Central Valley**
- **1873 – protected species**
- **1905 – reintroduction efforts began**
- **1970 – 500 tule elk throughout CA**
- **Present – 2,700 individuals in 22 sites**
- **1978 – 13 tule elk to Tomales Point Elk Reserve**

elk population on Tomales Point



Tomales Point Elk Reserve

- Point Reyes National Seashore, Marin Co.
- 1030 ha enclosed reserve



Tule Elk in an altered landscape

- movements restricted to the point
- large predators absent
- transformed by introduced plant species
- unclear consequences

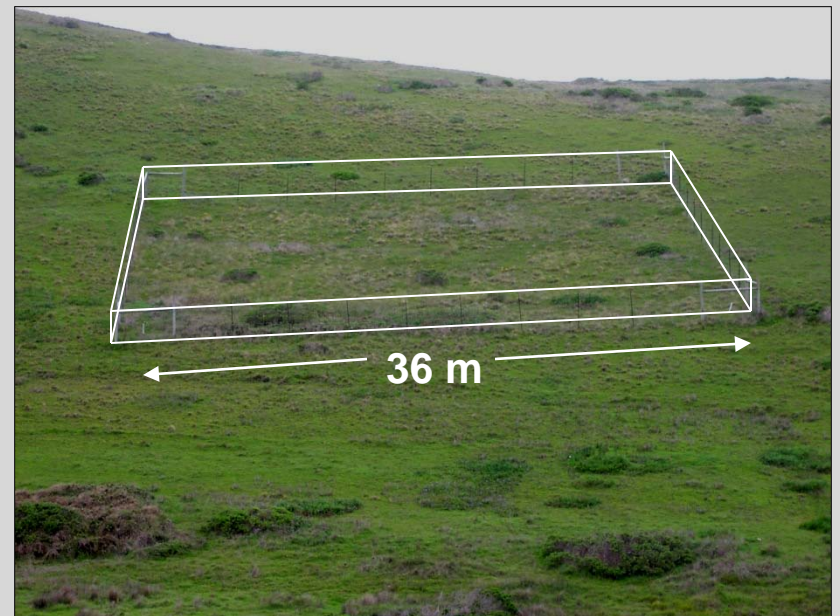


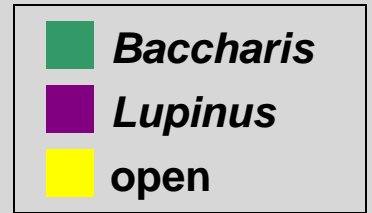
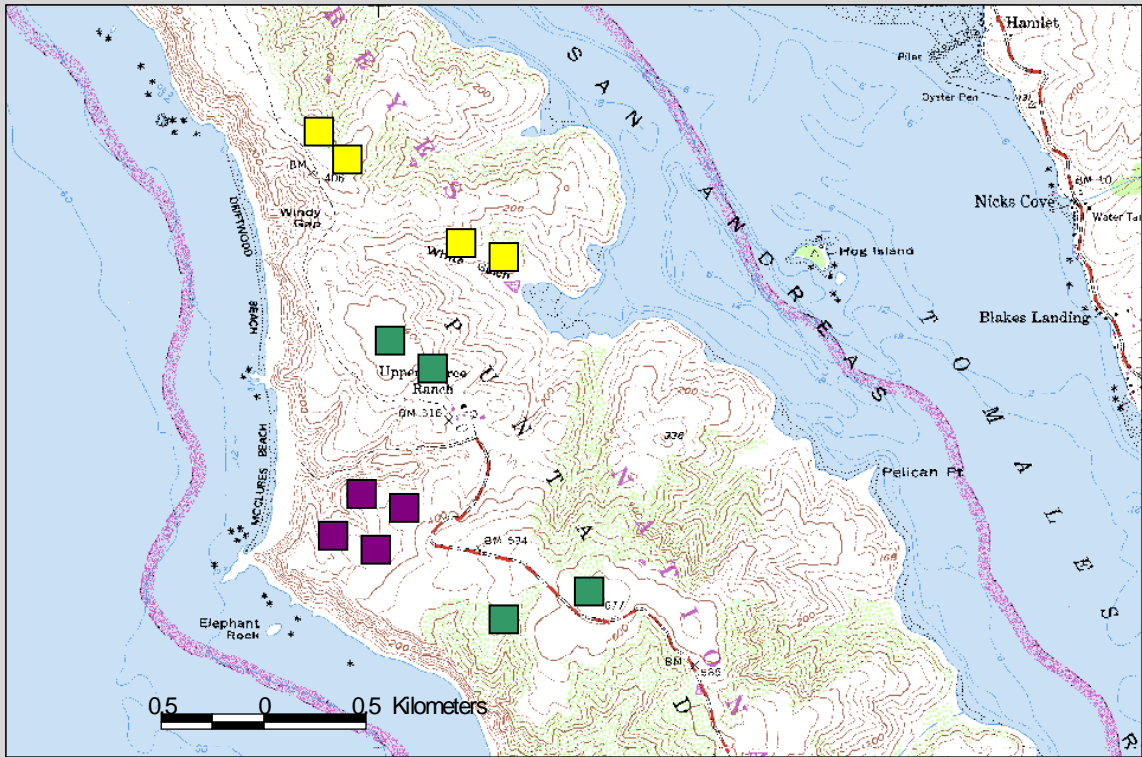
research questions

- **Does an invasive grass avoid elk herbivory by associating with a native shrub species?**
- **Do elk play a critical role in maintaining grasslands by slowing the colonization of shrubs?**
- **How does herbivory by reintroduced elk alter plant communities, and does this vary with habitat type?**

experimental design

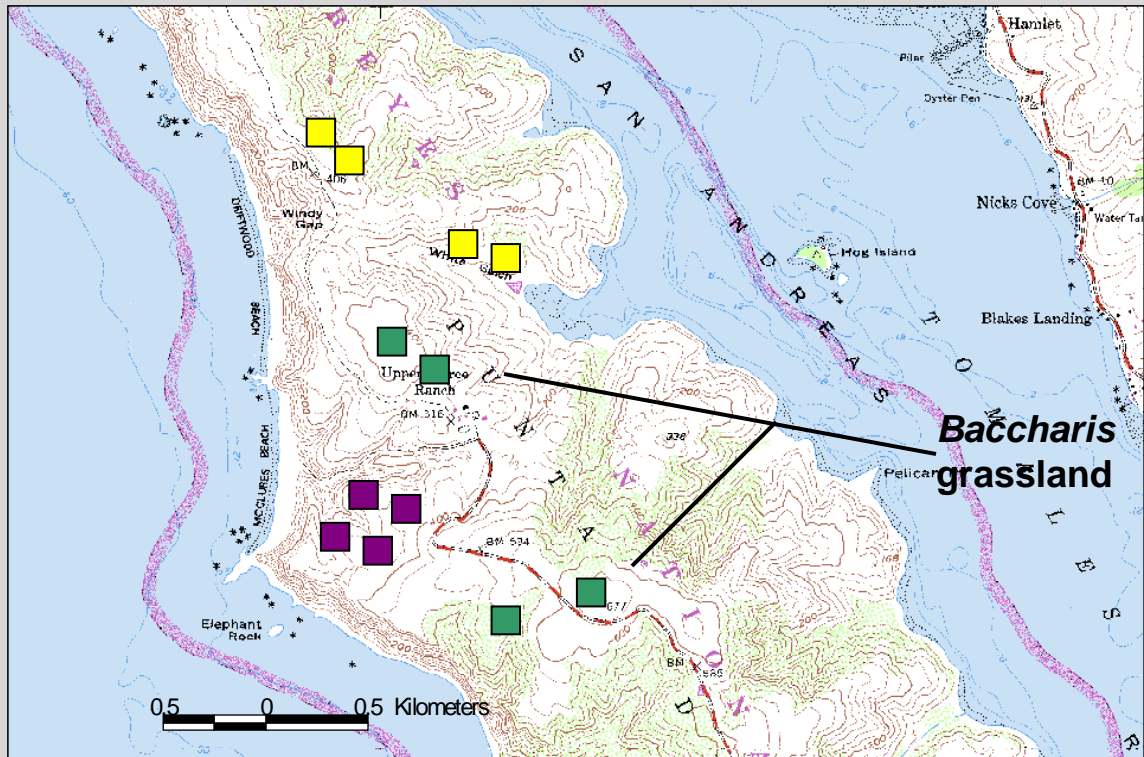
- **large scale exclosure experiment**
 - established in 1998 by National Park Service
 - 24 plots: 12 fenced and 12 unfenced
 - 36 x 36 m





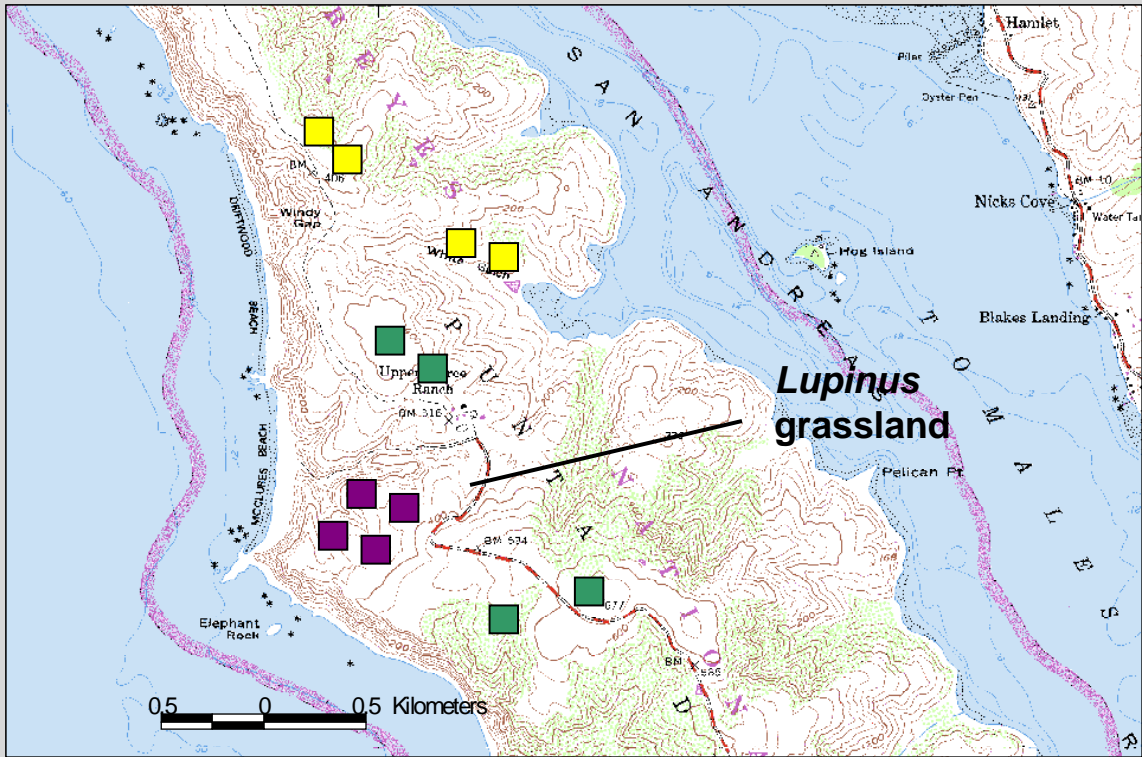
experimental plots on Tomales Point





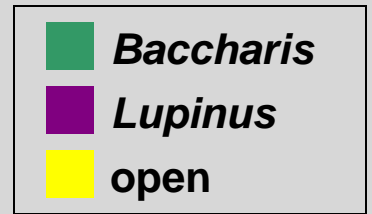
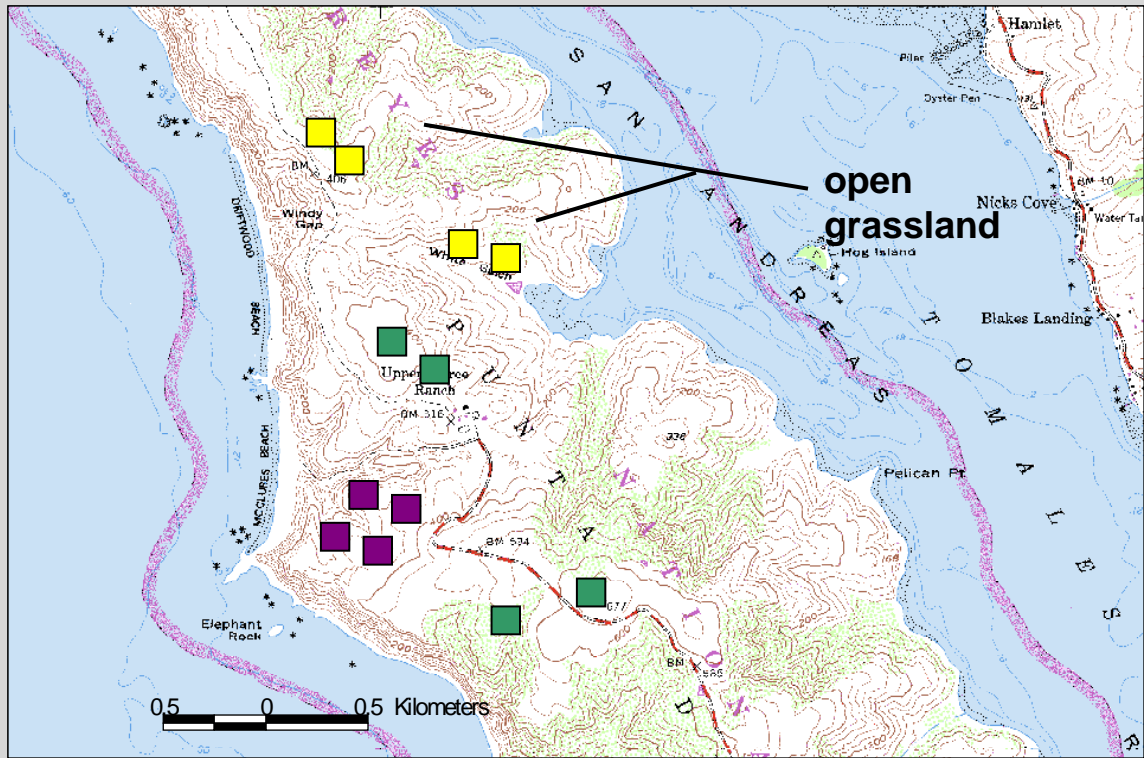
experimental plots on Tomales Point





experimental plots on Tomales Point





experimental plots on Tomales Point



neighborhood effects

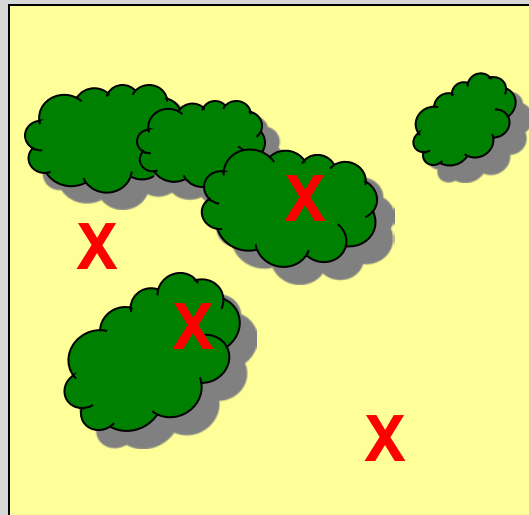
- Does an invasive grass avoid elk herbivory by associating with a native shrub species?
- *Holcus lanatus* (velvet grass)
 - non-native perennial grass
 - invasive in California's coastal grasslands
- *Baccharis pilularis*
 - native shrub
 - widespread



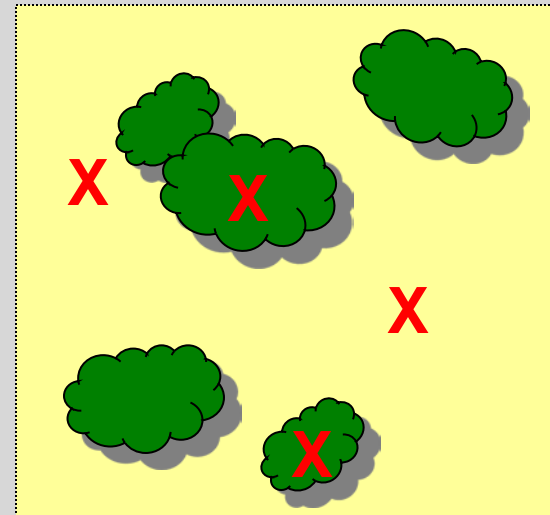
neighborhood effects

- only in *Baccharis* plots
- abundance (2003) and biomass (2002) of *Holcus*

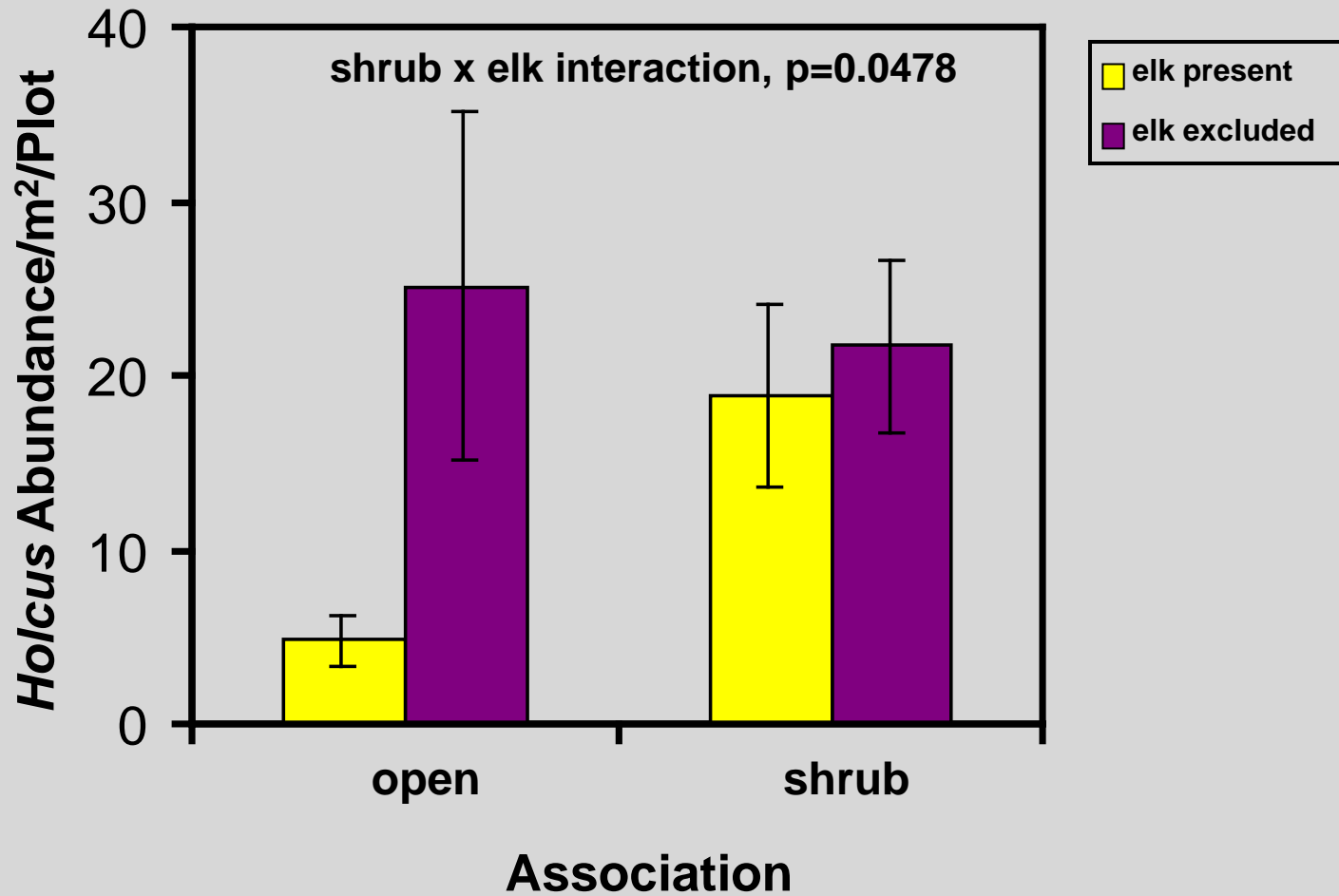
elk excluded



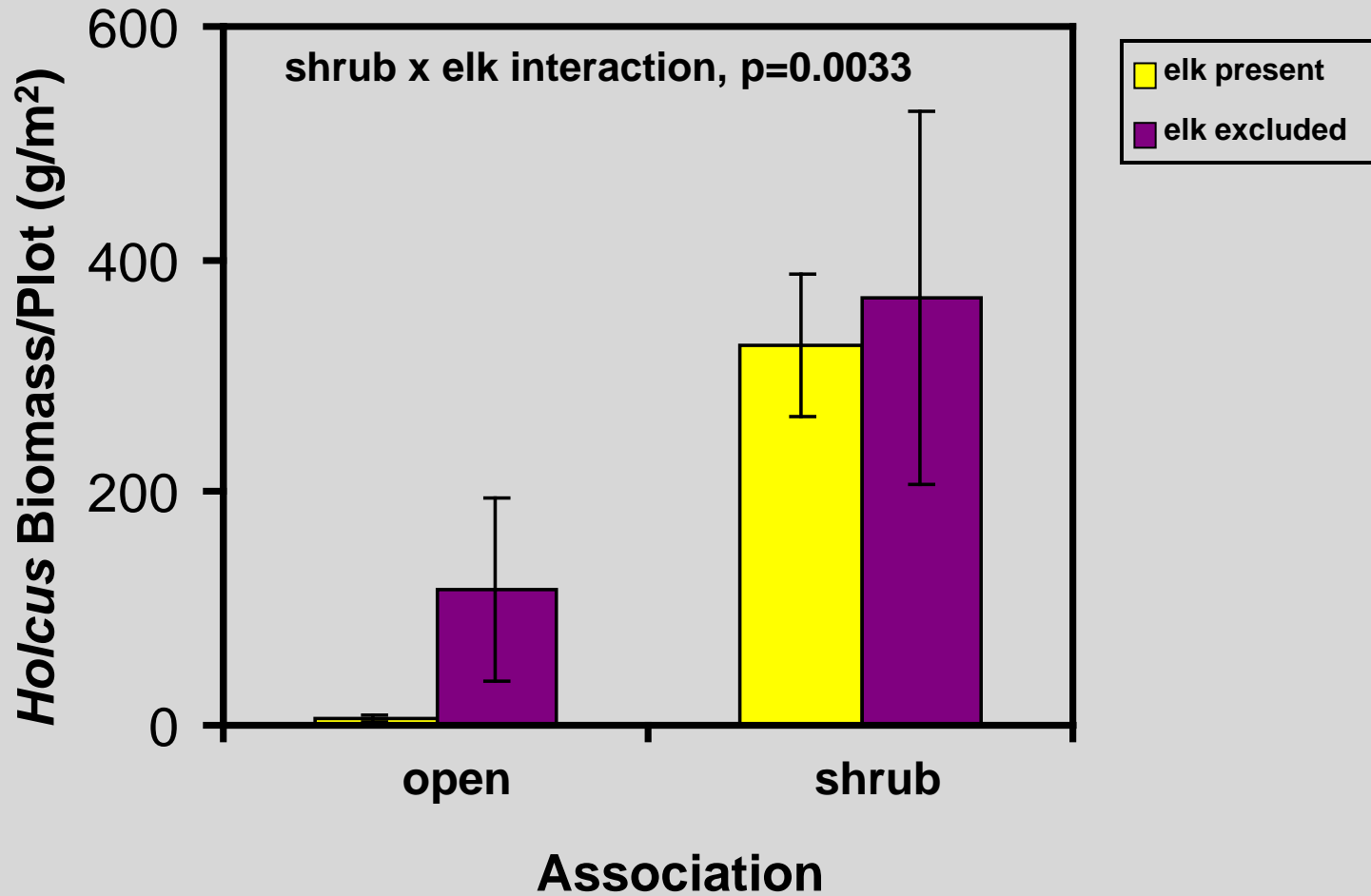
elk present



neighborhood effects: abundance



neighborhood effects: biomass



neighborhood effects

- native shrubs provide refuge for an exotic grass by protecting it from elk herbivory

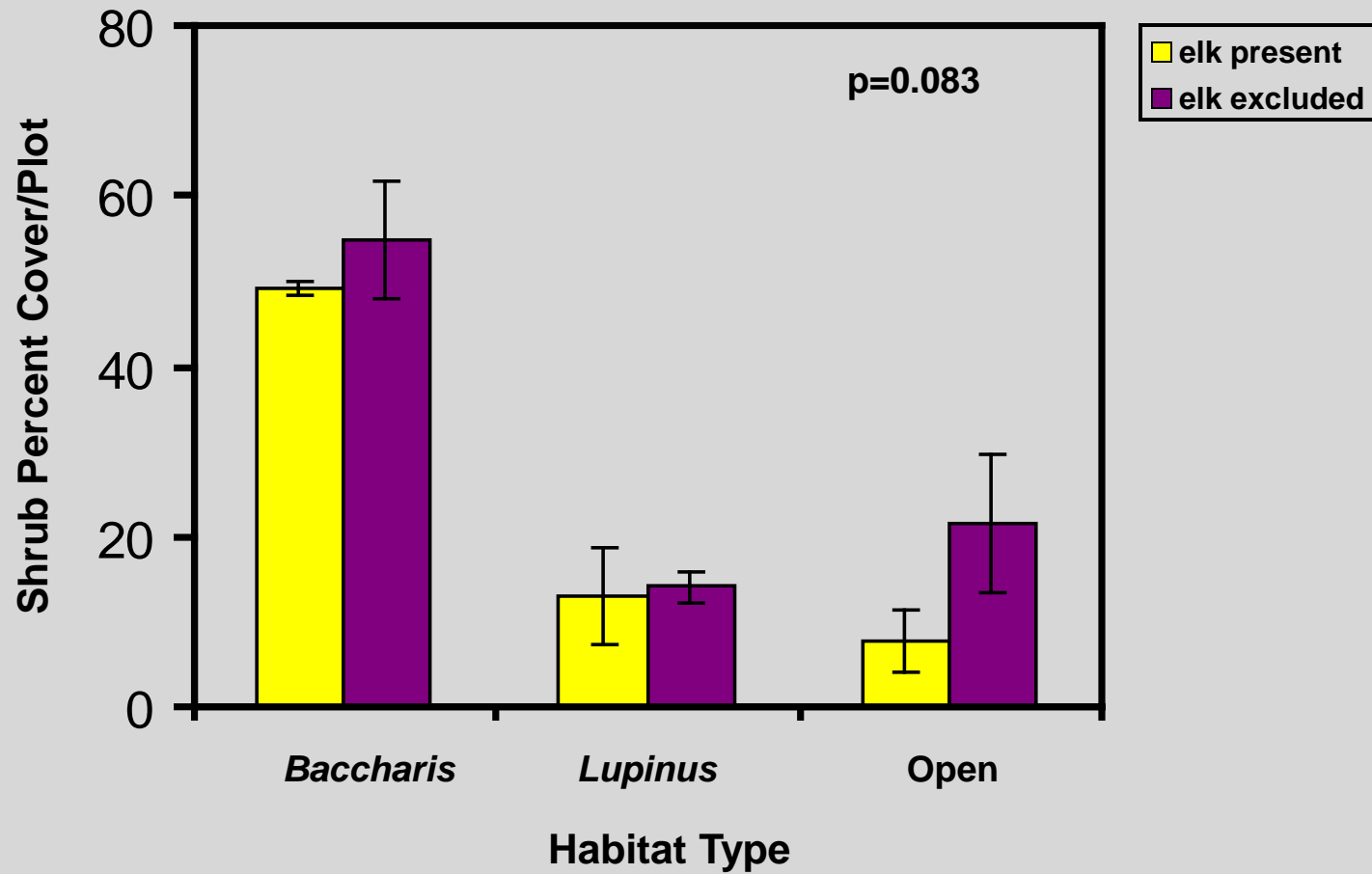


shrub cover

- **Do elk play a critical role in maintaining grasslands by slowing the colonization of shrubs?**



shrub cover



community composition

- How does herbivory by reintroduced elk alter plant communities, and does this vary with habitat type?



community composition

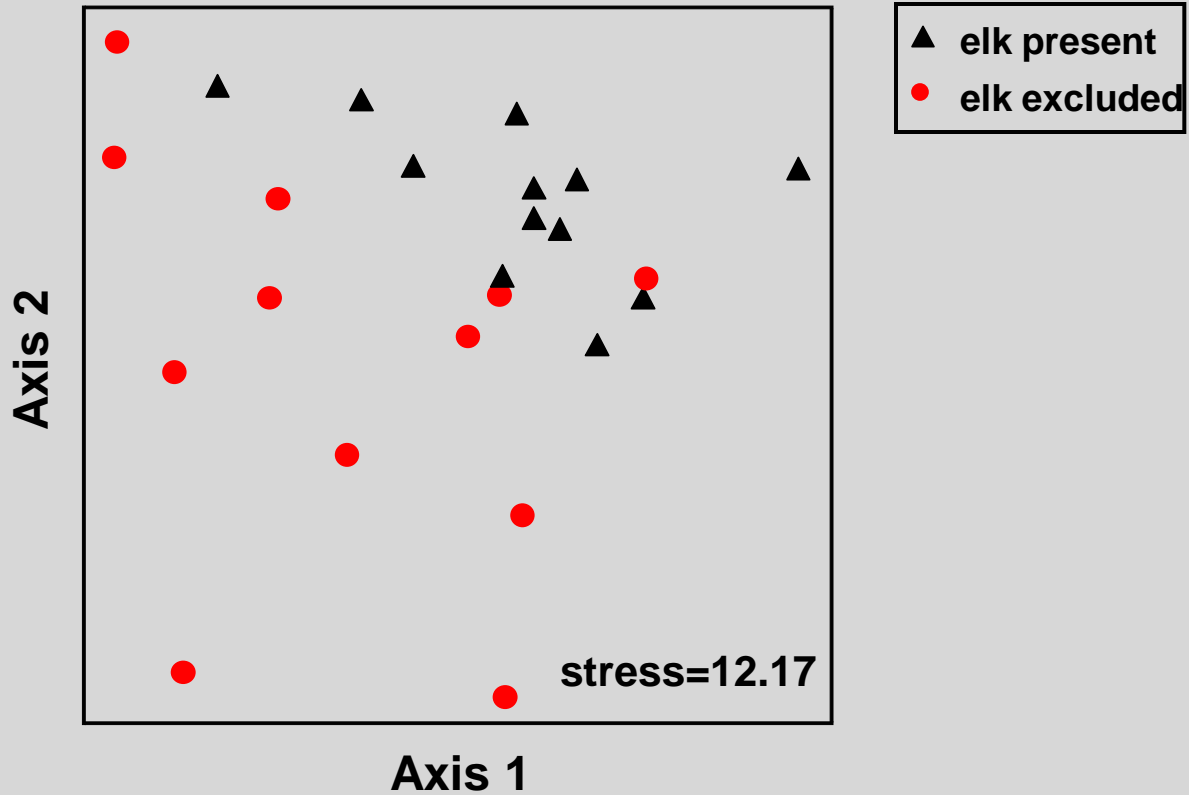
- **2002**
 - **harvested aboveground living and dead biomass**
- **2003**
 - **abundance (number of individuals)**
 - **species richness**

multivariate analysis

- **complexity of community data**
 - **reduce dimensionality of data set**
- **non-metric multidimensional scaling (NMS or nMDS)**
- **multi-response blocked permutation procedure (MRBP)**

multivariate analysis

NMS



MRBP: $A=0.35$, $p<0.0004$

community: statistical analysis

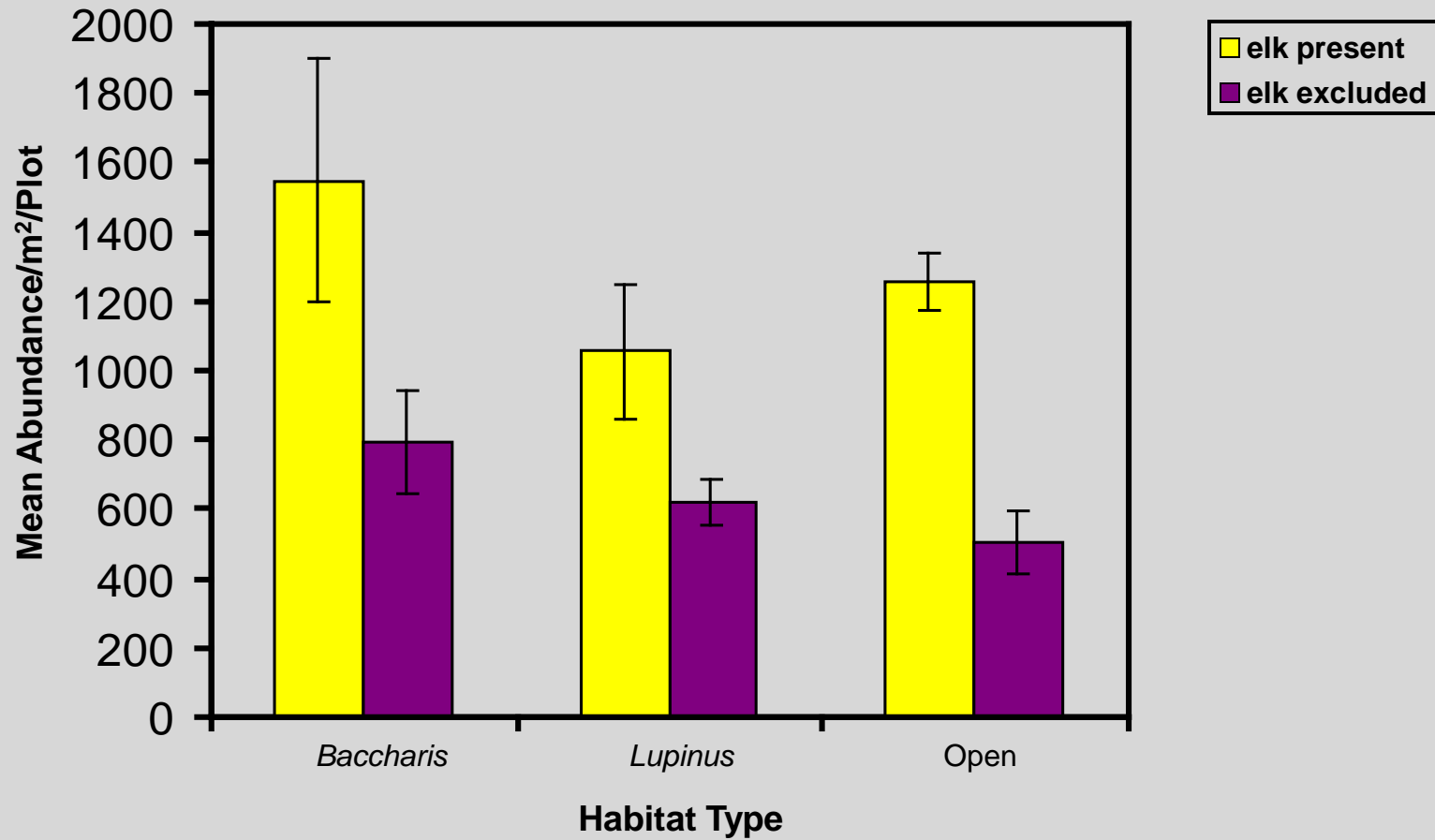
- **multifactorial MANOVAs & ANOVAs**
 - elk treatment (present or absent)
 - grassland type (*Baccharis*, *Lupinus*, open)
 - plot pair, nested within grassland type
- **response variables**

plant functional groups/life forms

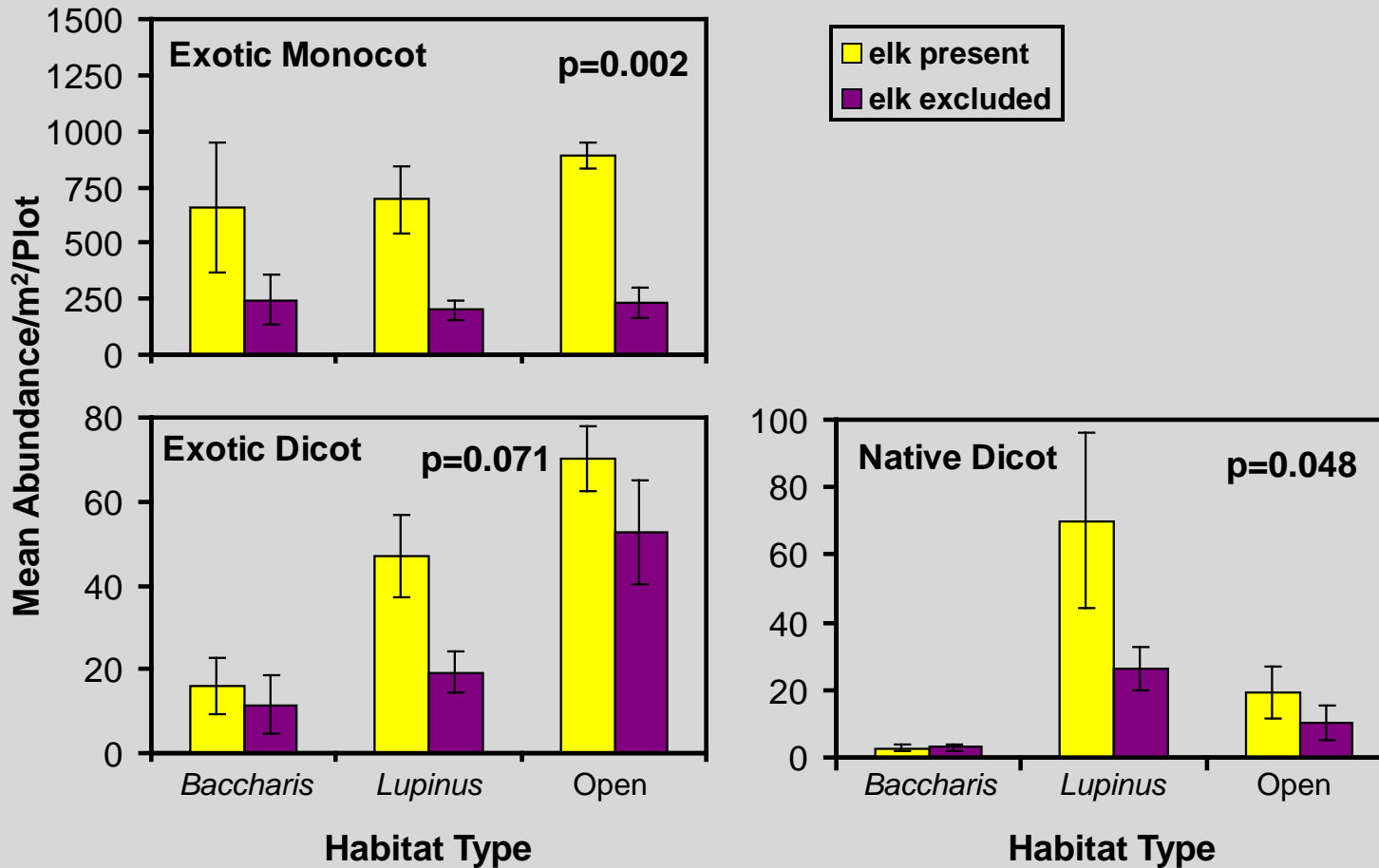
- **annual dicots**
 - native and exotic
- **annual monocots**
 - exotic
- **perennial dicots**
 - native and exotic
- **perennial monocots**
 - native and exotic



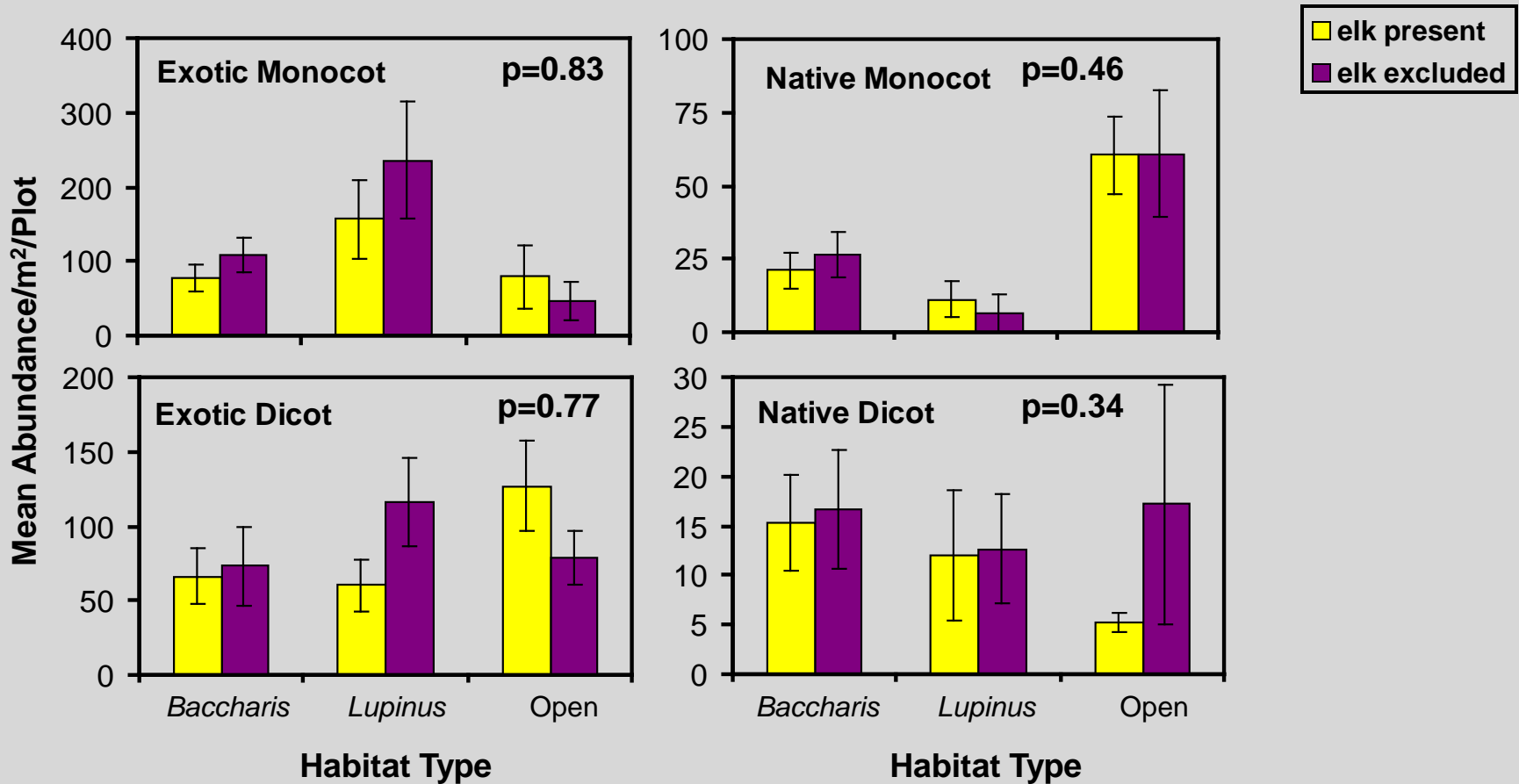
total abundance



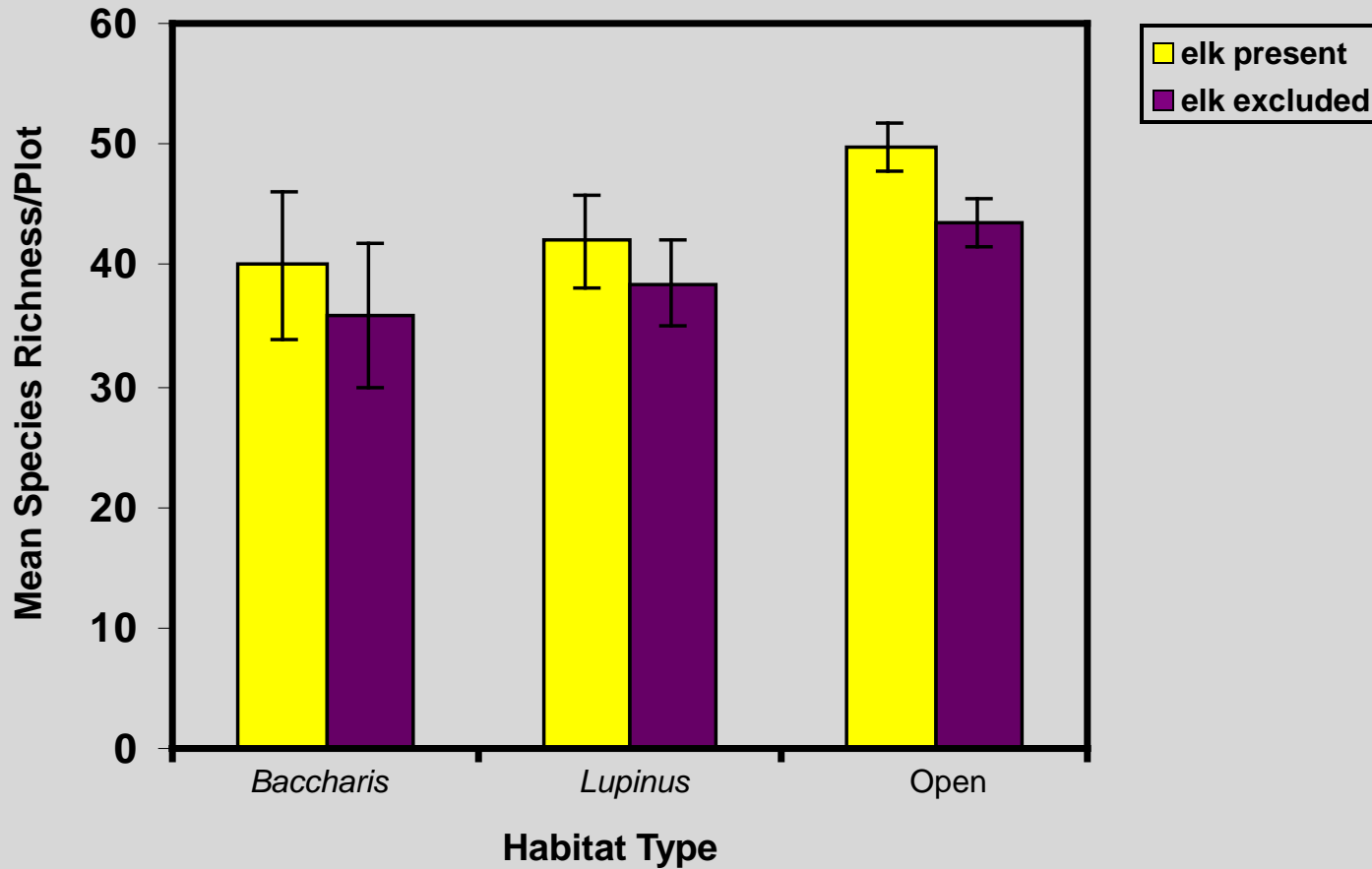
abundance: annuals



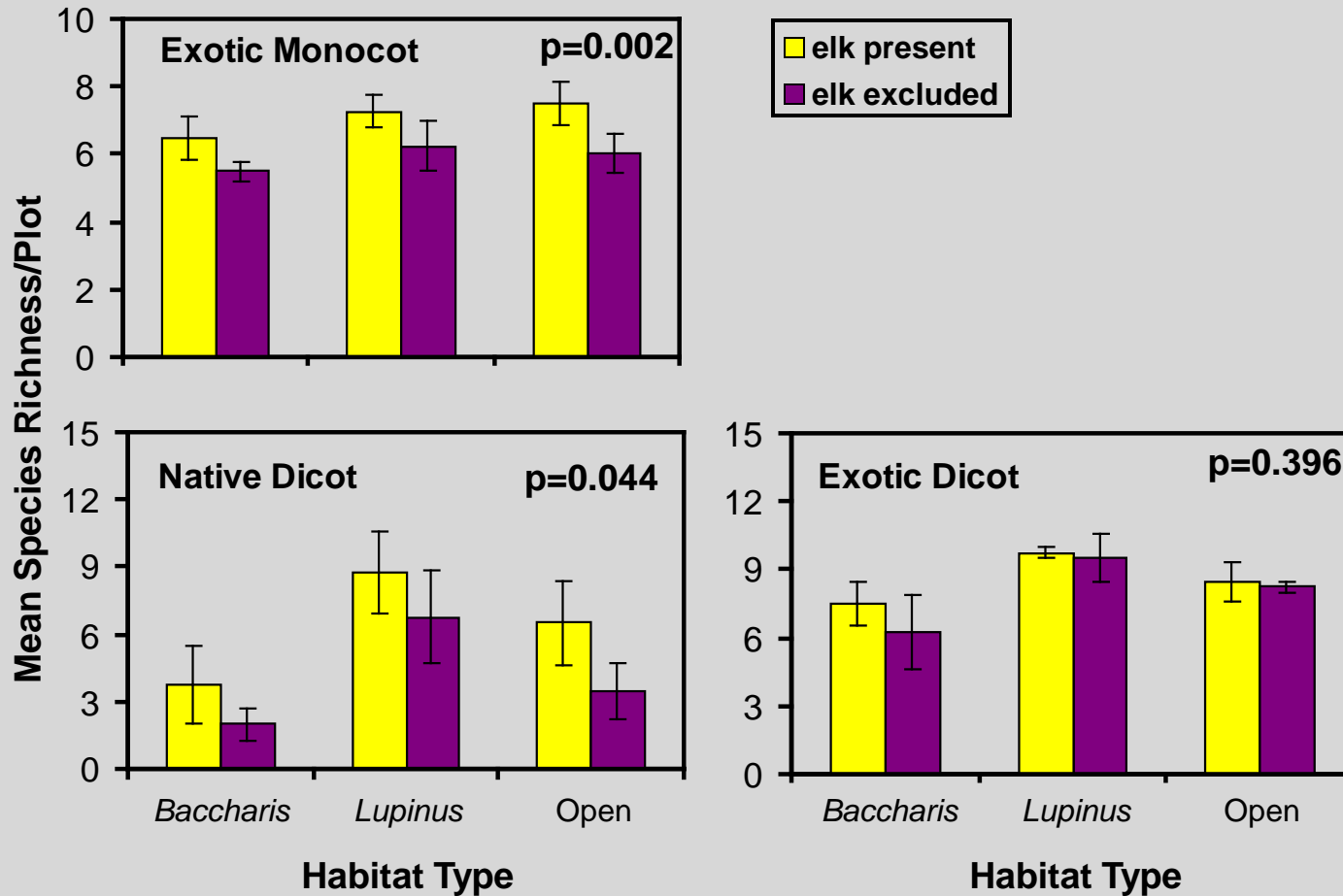
abundance: perennials



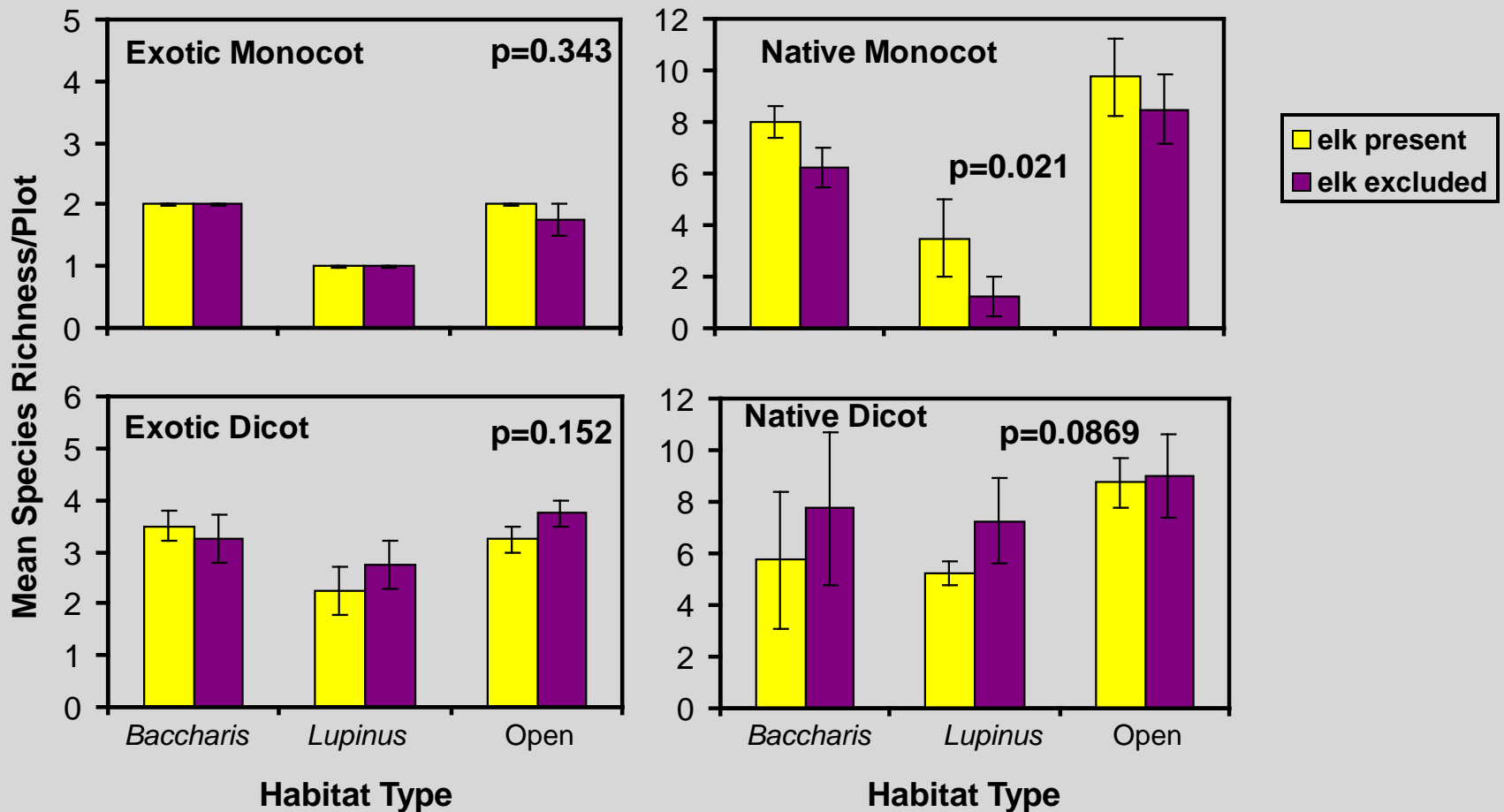
total species richness



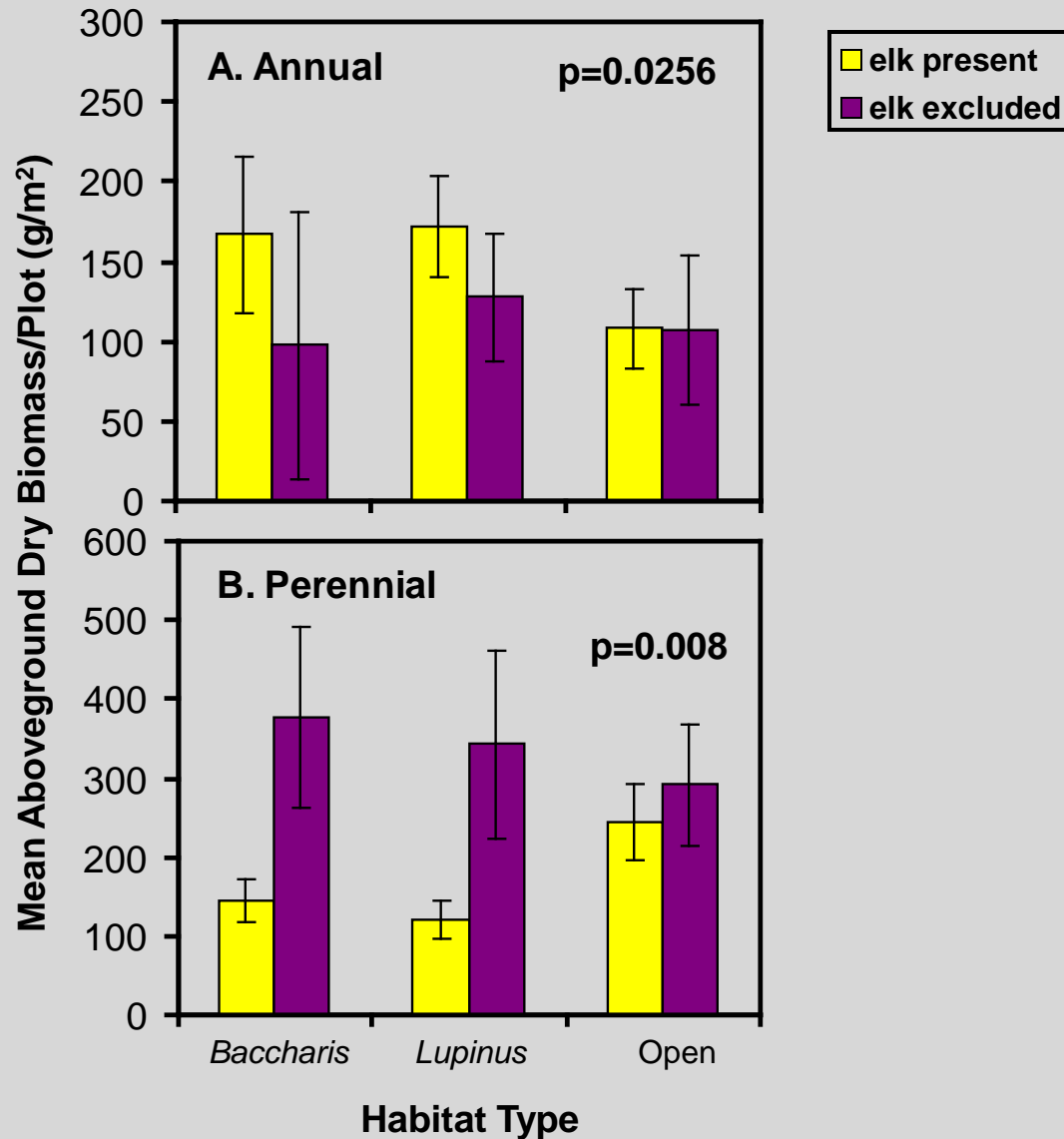
species richness: annuals



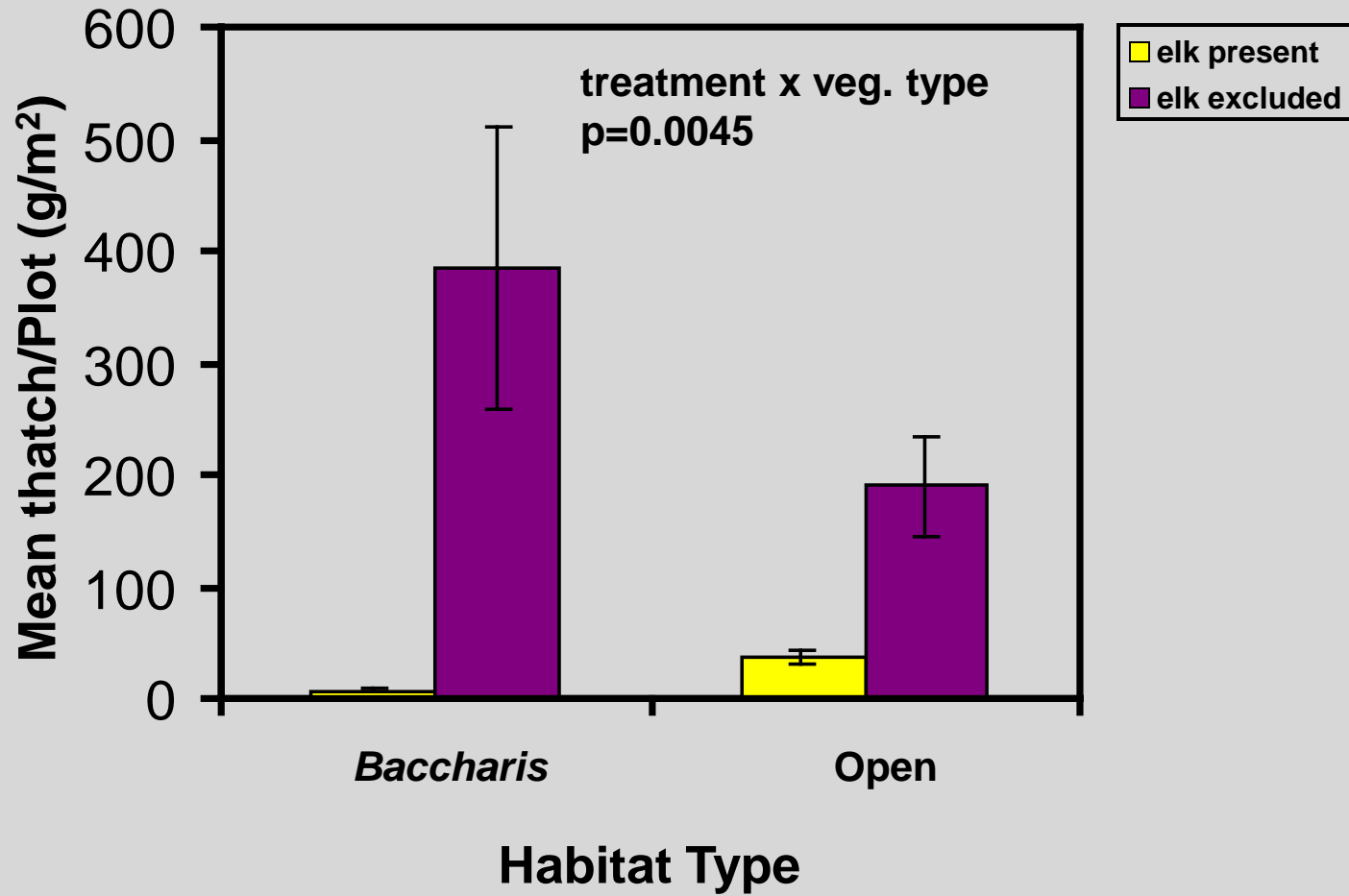
species richness: perennials



biomass: annuals and perennials

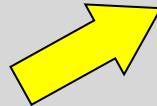


biomass: thatch



making sense of responses

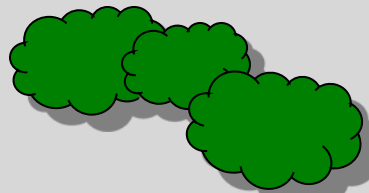
- ↓ - shrub cover
- ↓ - richness [native perennial dicots]



- ↓ - thatch biomass
- ↓ - living biomass [perennials]



- ↑ - biomass [annuals]
- ↑ - richness [annuals] & [native per. monocots]
- ↑ - abundance [annuals]



-Holcus lanatus

conclusions

- **they're back!**
- **complex**
 - elk have +/- effects on natives **and** exotics
 - no easy answers
- **potential solutions**
 - manage for mosaic of states

acknowledgements

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Tomales Point Elk Reserve

