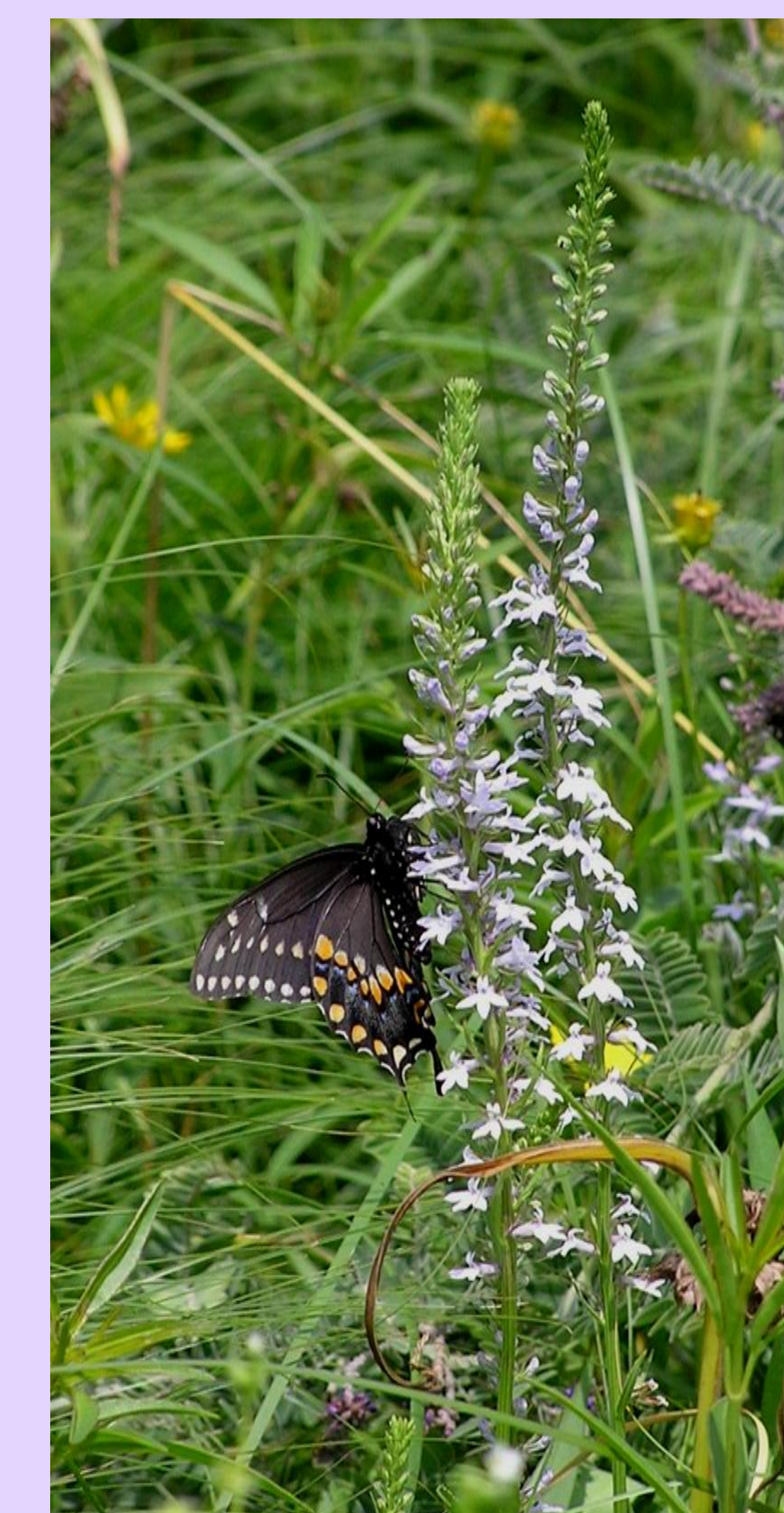


# Living in a fragmented landscape: sex ratio, pollinators, and the consequences for reproduction in *Lobelia spicata*

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## Introduction

Fragmented landscapes may negatively affect mutualistic interactions among species. Breeding systems such as gynodioecy (plants having female or hermaphroditic flowers), having likely evolved for promotion of outcrossing in a more continuous landscape, may be less advantageous in the current fragmented landscape. Less than 1% of the historic prairie ecosystem remains today in Illinois, with the remaining prairies being very isolated and often very small areas.

Our research focuses on *Lobelia spicata*, a gynodioecious species that today grows in highly fragmented prairie. Previous research suggests that the restoration of male function of this species is being influenced by genetic drift (Byers *et al.* 2005). Here we present further research focusing on the behavior of pollinators and female reproductive success.

We proposed that within this fragmented landscape the sex ratios of female vs. hermaphrodites will be variable due to genetic drift, and pollinator visitations will be limited. We predict visitation rate to female plants will be particularly low due to lower reward for pollinators from female plants (limited to no nectar) compared to hermaphroditic plants (produce nectar and pollen). As female plants only achieve reproductive success via seed production, they are predicted to have greater seed production and/or higher quality seeds to achieve the same fitness as hermaphrodites. However, in fragmented prairies, lower pollinator visitation may result in decreased seed production and lower population viability.

## Research Questions:

Is there evidence of genetic drift of the sex ratio in small populations or smaller size prairies?

Do the differences in reward affect pollinator behavior between the sexes?

Are there reproductive differences associated with the different sexes?

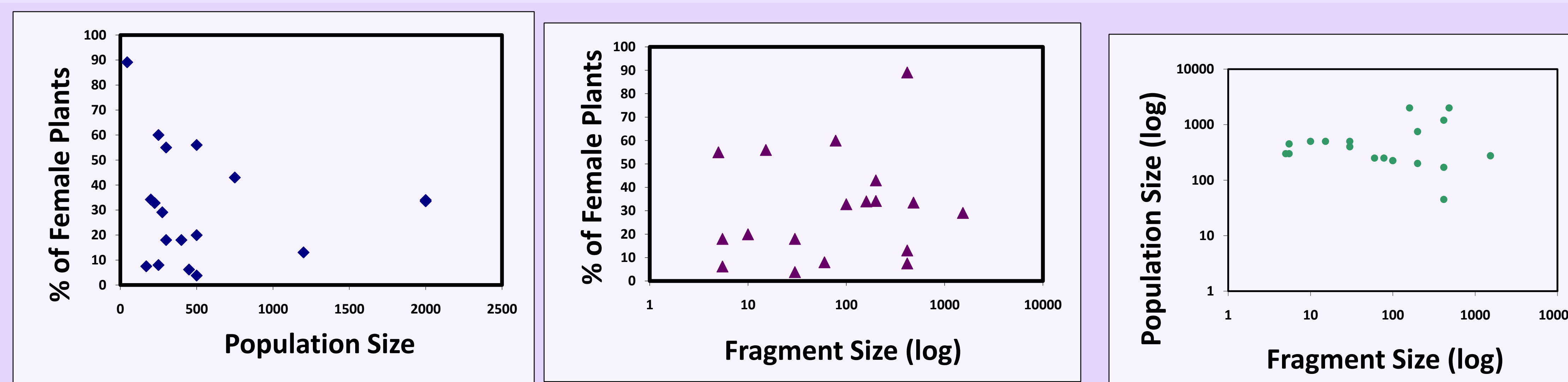


## Methods

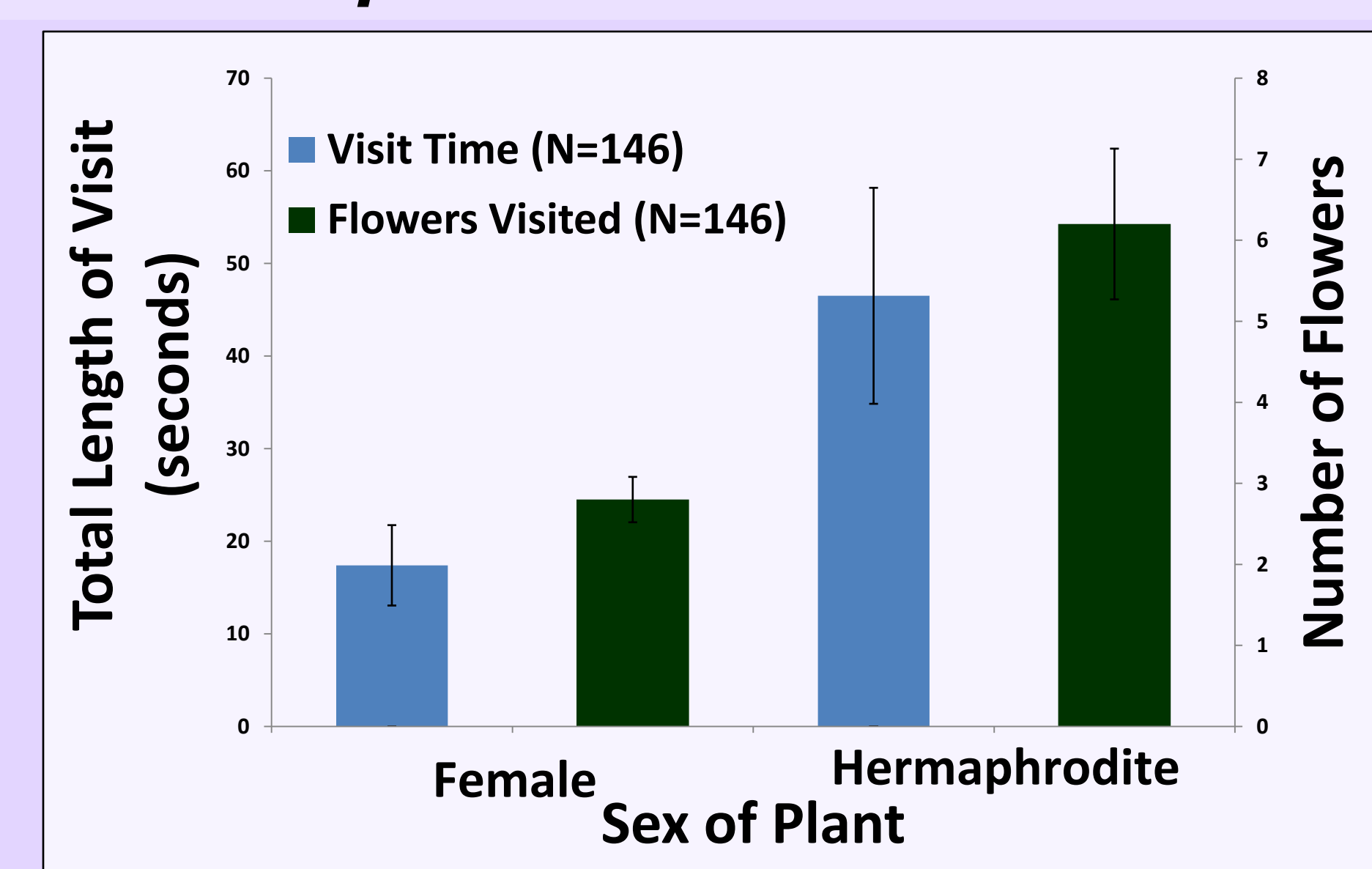
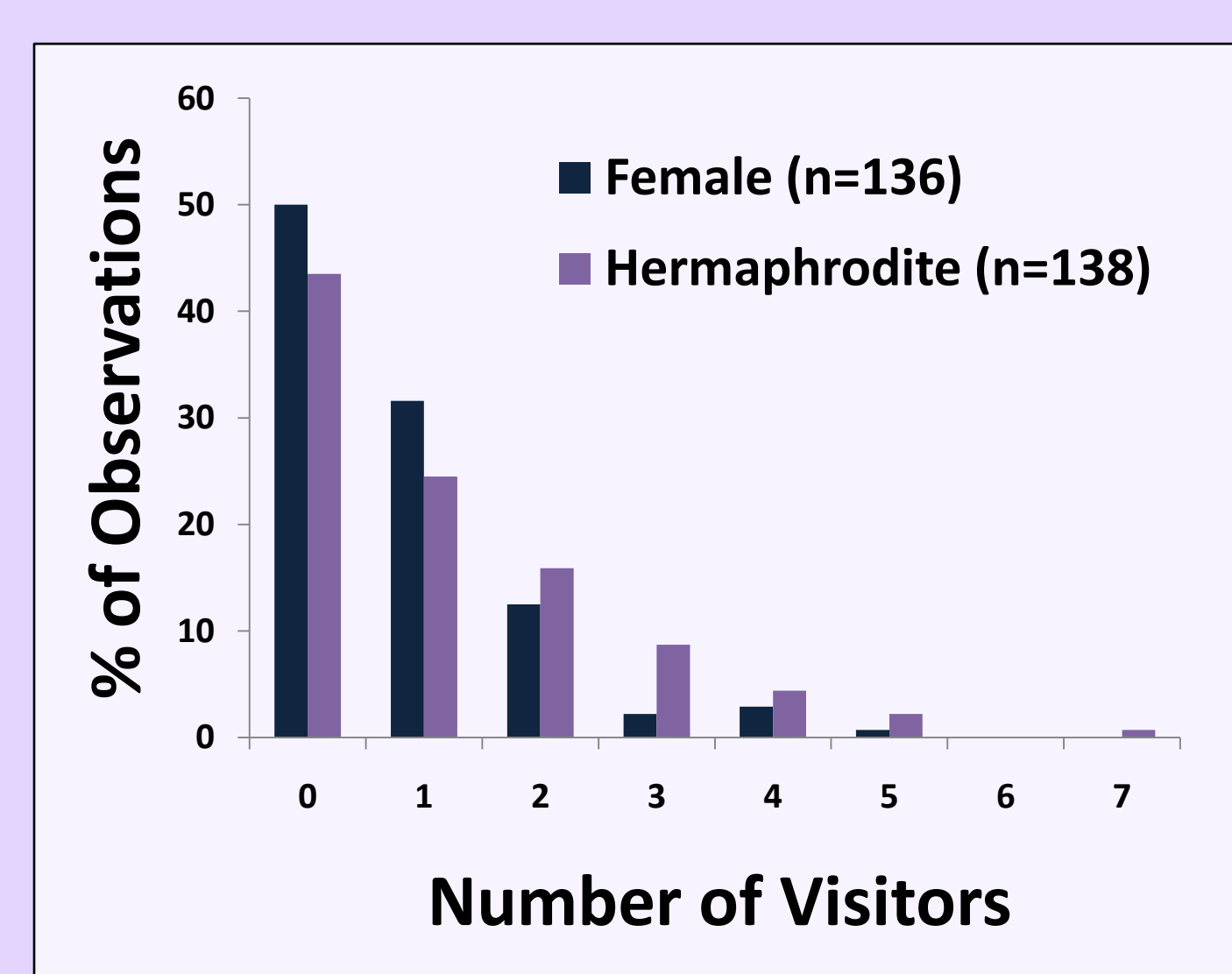
- 1. Survey of Remnant Prairies:** 100 plants were randomly selected to determine the sex ratio in populations of different sizes (N=45-~2,000) and habitat fragments (5-1537 acres) in 12 remnant prairies across Illinois.
- 2. Visitor Behavior:** In Weston Pioneer Cemetery (small and isolated prairie, N=~300 and 5 acres), plants were observed for 20 minute periods in which visitors, number of flowers visited and total visitation time were recorded. The observations are from this summer. We only recorded individuals which appeared to be exhibiting appropriate behavior of a pollinator. Other visitors were noted.
- 3. Female Reproductive Success:** Collection of fruits from individuals were taken to determine the number of fruits/plant and seeds/fruit at Weston). The number of seeds/fruit was also determined at a less isolated prairie (Grant Creek, N=250 and 78 acres).

## Results

**1. Survey:** The frequency of females is highly variable, particularly in smaller size populations, while there is no pattern between sex ratio and habitat size. There is no relationship between population size and fragment size. The symbols represent the different populations



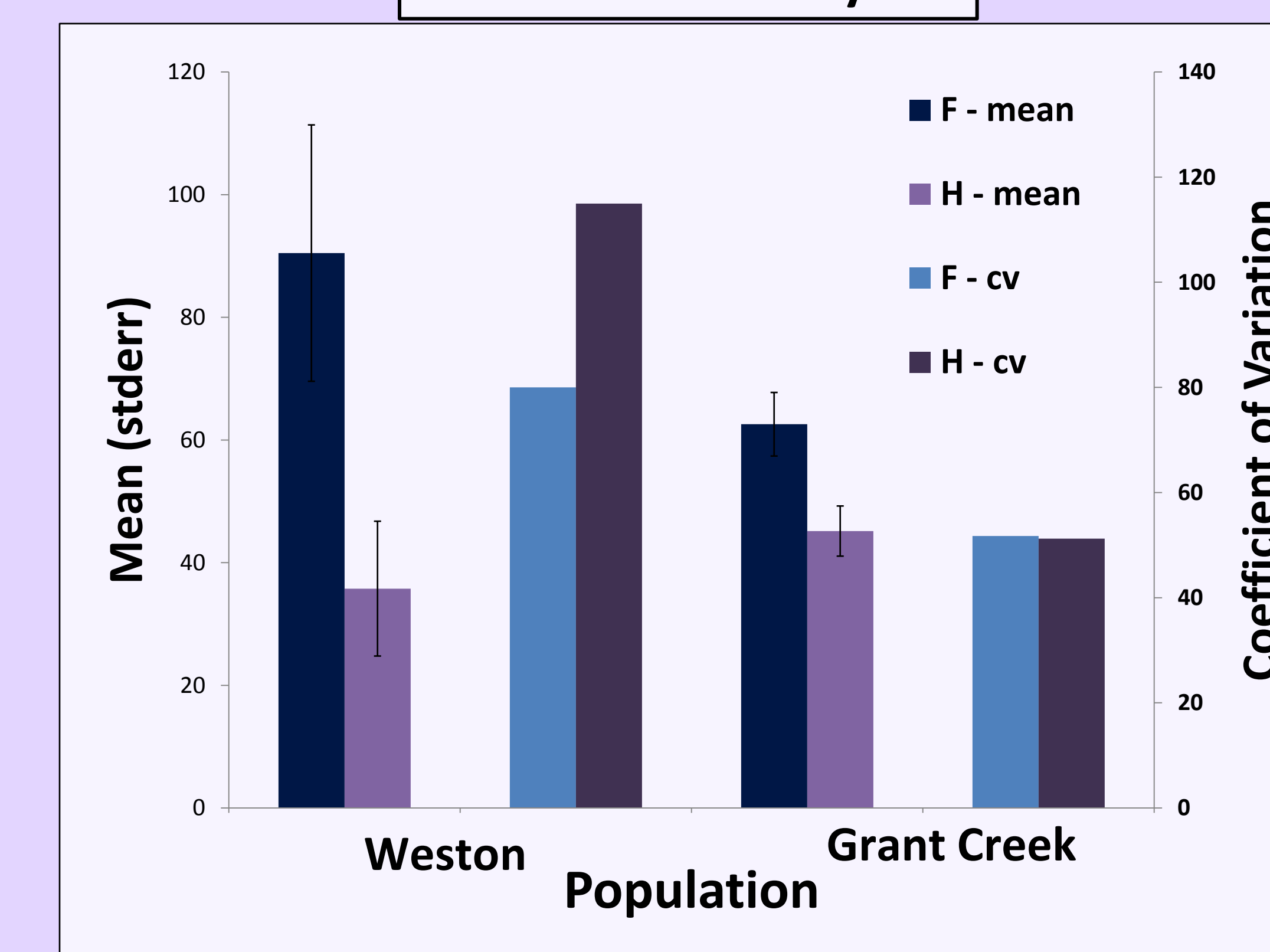
**2. Visitor Behavior:** While the number of visitors did not differ significantly (Fisher's Exact Test  $P = 0.1002$ ) between the sexes, the number of flowers visited ( $F_{1,144} = 11.7$ ,  $P = 0.0008$ ) and length of visit ( $F_{1,144} = 9.25$ ,  $P = 0.0028$ ) was greater for the hermaphrodites. A diversity of smaller bees (mostly sweat bees), mason bees, honey bees, bumblebees, a diversity of butterflies and bee hawk moths visit *L. spicata*.



## 3. Female Reproductive Success:

In Weston, there was no difference in the number of fruit produced between the sexes (female =  $41 \pm 7.4$ , male  $38 \pm 5.2$ ); however, females produced significantly more seeds/fruit ( $F_{1,24} = 8.28$ ,  $P = 0.0238$ ). In an unisolated but similar size population (Grant Creek) where seed production was also greater for females ( $F_{1,69} = 6.53$ ,  $P = 0.0128$ ), the variability is less than in Weston (isolated population).

## Seed Production by Sex



## Discussion and Future Directions

### 1. Survey:

- Genetic drift likely contributes to the greater variation in female frequency in smaller size populations. However, we have a fairly limited sample of the larger size populations, so next summer we will be expanding this work to include sampling populations in Iowa, some of which are very large.
- The lack of relationship between population size and fragment area suggests the quality of the habitat for the particular species is critical.

## Acknowledgments

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### 2. Visitor Behavior:

Floral visitors spend more time and visited more flowers on the hermaphroditic plants compared to female plants. This more extensive visit is not necessarily advantageous to the plants as it is likely to result in increased selfing. We are currently working in collaboration with Ken Paige, to determine the expression of the mating system which is likely to be influenced by changes in sex ratio of a population and contrasting behaviors.

**3. Female Reproductive Success:** Despite the differences in pollinator visitation, the female plants produce more seeds. This suggests that the lower visitation is sufficient for seed production. Furthermore, the longer visits on the hermaphrodites has the potential of increasing the selfing rate and lowering seed production if there is inbreeding depression. Current research will be examining seed production in the surveyed populations and expression of inbreeding depression.