New Mexico Native Plant Society Grant
End of year report, December 2017
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Summary

The applicant sampled twelve sites in the southwest U.S. in 2015–2016 to assess the status of sunflower pollinators in comparison to historical records. The applicant received a $750 NPSNM grant in 2017 to resample two New Mexico sites. Schedule conflicts limited the sampling to only one of the two sites. Remaining funding was applied toward hiring an experienced lab technician to assist with processing insect specimens.

Grant expenditures

Mileage: round-trip from Albuquerque, NM	
$0.35 per mile x 927 mi.	$ 324.45
Lodging: Southwestern Research Station, August 30–September 2	
$47 / night x 4 nights	$ 188.00
Pinning assistance: Wesley Noe, lab technician, Department of Biology	
$10 / hour x 25 hours	$ 250.00
	$ 762.45

Status of Sunflower (*Helianthus annuus*) Pollinators in Southwest New Mexico

Background

Human impacts have decreased the abundance and diversity of the earth's biota. Pollinator declines, a specific case of biodiversity loss, have become a scientific and public policy concern. Pollinator losses could have both economic and ecological consequences, since insects enable reproduction in most crop species as well as almost all wild flowering plants. Bees, the largest contributors to pollination, have recently experienced population crashes and local extirpations.

Biodiversity declines are not equally distributed across all groups. A key question in pollinator conservation is whether specialist bees (which collect pollen from only a few plant species) are more vulnerable to declines than generalists (which collect from a wide variety of plants). Ecological theory suggests specialist species should be superior competitors, due to their efficiency in resource collection. Some specialist bees emerge at the same time as their host plants bloom, increasing the likelihood of both successful pollination and their own persistence. This should provide protection against extinction. However, there is evidence that specialists are more likely to decline than generalists.

Biotic homogenization involves not only the loss of local, unique species but their replacement with cosmopolitan, common ones. This is facilitated through one of the most ecologically transformative of human activities: the global redistribution of species. Introduced species are a leading cause of biodiversity declines. In the case of pollinators, potential impacts of introduced species include disruption of plant pollination, increased pollination of exotic weeds, and resource competition with native pollinators.

Among the most widely introduced species is the European honey bee, *Apis mellifera*. Pollinator communities worldwide have been homogenized through human translocations of this species. In North America, honey bees were introduced at the onset of European colonization and are now one of the most common insects in the U.S. Considered the "ultimate" generalist pollinators, honey bees have been documented visiting nearly 40,000 plant species. They may gain a competitive edge over native, specialist bees through: 1) escaping the predators and parasites of their home range; 2) competing with native bees (most of which are solitary) not as individuals, but as colonies whose members share information about and cooperatively acquire resources; 3) ability to switch to alternative host plants when preferred plants are unavailable.

Study & Results

I conducted a two-year follow-up (2015–2016) to a study conducted in the 1970s by Paul Hurd, Jr. and E. Gorton Linsley of sunflower (*Helianthus annuus*) bees in the southwest United States. Sunflowers are ideal for testing the hypothesis that specialist bees are at greater risk of extinction in a context of human-induced change. They rely on insect pollination for reproduction and provide a continuous supply of pollen and nectar throughout their growing season. This attracts a great variety of insect visitors — including species that specialize exclusively on sunflower.

Hurd & Linsley surveyed twelve sites[1] that have undergone various changes since the 1970s. Population growth, development, and agricultural intensification have occurred at some sites, while at others population remained static or declined. The 12 sites thus provide a gradient of impacts that can be examined for correlations with changes in the sunflower bee community.

My initial results suggest native bee abundance has declined since the 1970s. At Rodeo, NM for instance, native bee abundance was < 10% of that recorded in 1973. As with other insects, bee abundance varies from year to year. However, introduced honey bees significantly increased as a proportion of the sunflower bee community in this region. No honey bees were recorded in the original study at the New Mexico sites, but in 2015 the species was present at all three sites and in fact comprised nearly 60% of bees sampled in Animas. For all sites combined, the number of bees collected per person-hour did not differ significantly for the two sampling periods, but the proportion of native bees decreased dramatically. Native bees comprised 98% of the total 1970s sample, versus 50% in 2015. This result was not simply driven by high honey bee abundance at only a few sites. I sampled bees at 11 of the 12 original sites. Honey bees were present at all 11 sites in 2015, vs. five sites in the 1970s. Finally, my results suggest specialist bee species have declined as a proportion of the sunflower bee community since the 1970s. The three most common specialist species decreased by as much as 22% (average 14%) and the overall percentage of specialists was significantly lower.

The primary objective of my 2017 NPSNM funding request was to obtain a complete sampling record from Animas, New Mexico. A secondary objective was to also resample in Rodeo, NM, since the two sites are only about 25 miles apart and were sampled at

[1] NM: Silver City, Animas, Rodeo; AZ: Benson; CA: Indio, Corcoran, Merced, Madera (3 sites), Escalon, Bishop.

approximately the same time (early September) in the original study. These sites are very important to the study because in the 1970s, species diversity was very high (average of 47 species, vs. 14 species at other sites). Since the area is remote and has seen minimal increases in human disturbance since the 1970s, significant declines in bee diversity at these two sites would be unexpected but, if observed, could suggest a regional-scale problem.

Of the two sites, Animas took priority. Hurd & Linsley sampled there for 26 hours and found 41 species. In 2015 I recorded only 11 species at Animas, but this was probably an artifact of sampling effort. Rainy conditions cut short the sampling period to only 2.5 hours (compared to 16 hours at other sites). In order to compare species diversity across different time periods, sampling effort must be equal, because of course fewer species will be found if less time is spent sampling. Conditions were good in 2016 and I sampled Animas for the full period, bringing the total to 18.5 hours. A third year of sampling (2017) was intended bring the total up to 34.5 hours and help distinguish the "signals" of abundance and diversity from the "noise" of interannual variation.

Schedule conflicts with other ongoing research limited the available sampling period to two days, therefore I sampled Animas only and did not conduct an additional sample of Rodeo. Since Rodeo had been fully sampled in 2015 and 2016 this additional sample was not strictly necessary. However this meant I only needed to lodge at the Southwestern Research Station for four nights instead of seven; thus I retained some additional funding to apply to another purpose. In the interest of processing the specimens as quickly as possible I hired a lab technician with experience in pinning and labeling bees. With this help I was able to prepare all the remaining specimens (2016–2017) for identification by the end of the semester, which allowed me to take them to the USDA Agricultural Research Service facility in Logan, Utah in mid-December. Thanks to the expertise of Terry Griswold, PhD at the Bee Biology and Systematics Lab, all bee specimens from this study have now been identified to species! The next steps are to database the specimens and conduct statistical analysis. I will be excited to share the results of the final analyses with NPSNM in 2018.