New Mexico Native Plant Society Grant
End of year report

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

The applicant sampled twelve sites in the southwest U.S. in 2016 to assess the status of sunflower pollinators compared to historical records. The applicant received a $1000 NPSNM grant to sample the three New Mexico sites (the remaining nine sites to be funded by other sources). Funding was sufficient to sample a nearby site in southeast Arizona (Benson) in addition to the New Mexico sites (Silver City, Animas, Rodeo).

Grant expenditures

Mileage: 854 mi. @ $0.50 per mile (round-trip from Albuquerque, NM)	$ 427.00
Lodging: Southwestern Research Station, August 31–September 6	
Sites: Animas, NM, Rodeo, NM	$ 322.00
Lodging: Copper Manor Hotel, September 13–15	
Site: Silver City, NM	$ 179.67
Lodging: Motel 6, September 10–12	
Site: Benson, AZ	$ 143.85
	$ 1072.52

Mileage includes round trip from Albuquerque to sampling sites, plus 20 miles per site to locate suitable sunflower patches and commute to sampling areas. Site information and lodging receipts attached.

Status of Sunflower (*Helianthus annuus*) Pollinators in the Southwest United States

Background

Human impacts have decreased the abundance and diversity of the earth's biota. Some ecologists maintain that we have entered "The Homogocene:" a human-dominated era during which only a simplified version of Earth's former biological complexity will persist. 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 am conducting a two-year follow-up 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.

I requested NPSNM funding to sample the three New Mexico sites in year two of my study (2016). I received a $1000 grant, which was sufficient to sample an additional site in nearby Benson, Arizona. Species identifications are time-consuming and 2016 specimens will not be identified to species until 2017. However, most of the 2015 specimens have now been identified to species and I am therefore reporting 2015 results (from all sites). Based on this year's observations I do not expect 2016 results to differ substantially from 2015.

My results suggest native bee abundance has declined since the 1970s. At Rodeo, NM for instance, sunflower patch size was similar to the 1973 survey, but native bee abundance was < 10% of that recorded in 1973. As with other insects, bee abundance varies from year to year. However, at the same time, 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 (Fig. 1).

This result was not simply driven by high honey bee abundance at 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. In terms of abundance they were the top-ranked (most abundant) species at eight sites in 2015. In the 1970s they were never more than the third most abundant species (Fig. 2).

Finally, my results suggest specialist bee species have declined as a proportion of the sunflower bee community since the 1970s (Fig. 3). The three most common specialist species decreased by as much as 22% (average 14%) and the overall percentage of specialists was significantly lower.

The finding of significant increases in introduced bee abundance raises a new question for this study: Are the honey bees I collected Africanized bees? Africanized bees are a subspecies of honey bees with distinct behavioral and genetic differences. They were introduced into South America in the 1950s and by the 1990s had made their way to the U.S. If the honey bees I collected are Africanized, it could help explain why the species is more abundant now than it was 40 years ago. Therefore, in addition to analyzing changes in bee community structure, I will analyze the honey bees collected, to determine whether they are Africanized strains.

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

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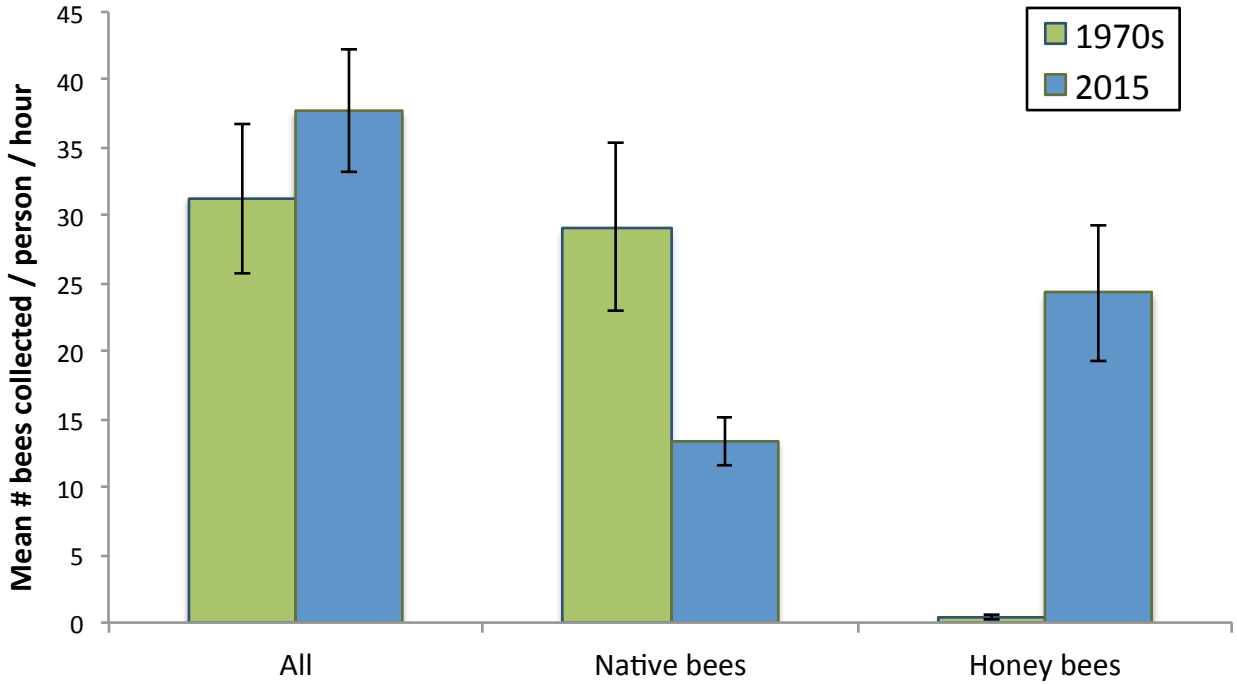
Figure 1. Native bees less abundant than 1970s. Introduced honey bees more abundant.



Bees collected per hour in studies of bees pollinating sunflower (Helianthus annuus) *at 11 sites in the southwest United States [Hurd, et al. 1980; Cumberland, unpublished data].*

Native bees per hour significantly lower in 2015 **(p=0.02)**
Introduced honey bees per hour significantly higher in 2015 **(p<0.01)**

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Figure 2. Introduced honey bees (*Apis mellifera*) more widespread now than in the 1970s.

Rank order: 1 = most abundant

1970s species ranks

	ESC	M1J	BIS	ROD	ANI	SIL	BEN	IND	MA2	MER	COR
1	SVAOBL	DIAENA	MELAGI	SVAMAC	MEGPAR	MEGINI	MELAGI	MELAGI	SVAOBL	SVAOBL	DIAENA
2	DIAENA	SVAOBL	ANDACC	MELAGI	MELTRIS	MEGPAR	PSEAET	DIEHET	MELAGI	MELAGI	HALLIG
3	MELAGI	APIMEL	DIAENA	MEGPAR	MELAGI	MELMON	MELTRI	APIMEL	DIAENA	BOMPEN	MELAGI
4	HALLIG	MELAGI	APIMEL	SVAOBL	SVAMAC	MEGAGU	HALLIG	MEGPAR	MELLUP	APIMEL	MELLUP
5	APIMEL	HALLIG	BOMPEN	TRISPP	SVAOBL	MELAGI	BOMPEN	HALLIG	BOMPEN	DIAENA	SVAOBL
6	AGATEX	BOMPEN	MEGPOL	AGAANG	PSEAET	MELSON	ANDACC	AGATEX	ANTURB	HALLIG	ANTURB
7	MELLUP	XERCAL	ANTURB	MEGINI	TRISPP	SVAOBL	PSEHEL	MELROB	HALLIG	ANTURB	ANTSQU
8	ANTURB	ANTURB	MEGPAR	MELSUB	COEEDI	MELMEN	DUFMAR	MEGOCC	AGATEX	MELLUP	LASSPP
9	TRICON	MEGBRE	MELAPP	MELMON	SVASIL	SYNEXQ	AGAOBL	DIENEV	MEGINI	MEGPAR	AGATEX
10	BOMPEN		MELLUP	HALLIG	BOMPEN	SVAMAC	MELMEN	TRISUB	MELROB		TRIHEL

2015 species ranks

	ESC	M1J	BIS	ROD	ANI	SIL	BEN	IND	MA2	MER	COR
1	APIMEL	APIMEL	MELAGI	HALLIG	APIMEL	APIMEL	APIMEL	BIGSLO	APIMEL	APIMEL	APIMEL
2	MELAGI	DIA001	APIMEL	BOMPEN	BOMPEN	BOMPEN	MELAGI	APIMEL	MELLUP	MELAGI	MELLUP
3	DIA001	MELAGI	DIA001	MEG007	ANDACC	MELSP1	MELPAR	MELAGI	MELAGI	AGA004	MELAGI
4	HALLIG	MELMAL1	TRI004	MELTHE	AGA004	PSE001	HALLIG	MEG009	DIAENA	MELLUP	DIA003
5	SVAOBL	SVAOBL	MELMAL1	MELPAR	AGA001	MELCOR	MEG010	MEG014	HALLIG	AGA001	HALLIG
6	DIA001	HALLIG	MEG004	APIMEL	HALLIG	AND003	MELSON	MEG013	ANTURB	ANTURB	ANTURB
7	DIA007	MELMAL2	MEG006	MEG013	SVAOBL	TRA001	AGA001	HALLIG	HALTRI	MEG001	DIA004
8	AGA002	AGA004	SVAOBL	MEG005	ANT001	ANDACC	COE002	SVAHEL	MELROB	MELROB	AGA001
9	MEG008	AGA001	AND001	AGA005	AGA002	HALLIG	PSE001	COE001	MELMAL1	MEG007	MEG001
10	AGA004	SVAMAL1	MEG009	PSE001	XYL001	MELAGI	BOMPEN	MEG007	AGA001	MEG011	DIA005

APIMEL = *A. mellifera*

NPSNM-funded sites outlined in red:
ROD (Rodeo, NM)
ANI (Animas, NM)
SIL (Silver City, NM)
BEN (Benson, AZ)

1970s *A. mellifera* in top 10 at 5/11 sites; ranked #1 = 0
2015 *A. mellifera* in top 10 at 11/11 sites; ranked #1 = 8

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Figure 3. Specialist species less widespread now than in the 1970s.

Rank order: 1 = most abundant

1970s species ranks

	ESC	M1J	BIS	ROD	ANI	SIL	BEN	IND	MA2	MER	COR
1	SVAOBL	DIAENA	MELAGI	SVAMAC	MEGPAR	MEGINI	MELAGI	MELAGI	SVAOBL	SVAOBL	DIAENA
2	DIAENA	SVAOBL	ANDACC	MELAGI	MELTRIS	MEGPAR	PSEAET	DIEHET	MELAGI	MELAGI	HALLIG
3	MELAGI	APIMEL	DIAENA	MEGPAR	MELAGI	MELMON	MELTRI	APIMEL	DIAENA	BOMPEN	MELAGI
4	HALLIG	MELAGI	APIMEL	SVAOBL	SVAMAC	MEGAGU	HALLIG	MEGPAR	MELLUP	APIMEL	MELLUP
5	APIMEL	HALLIG	BOMPEN	TRISPP	SVAOBL	MELAGI	BOMPEN	HALLIG	BOMPEN	DIAENA	SVAOBL
6	AGATEX	BOMPEN	MEGPOL	AGAANG	PSEAET	MELSON	ANDACC	AGATEX	ANTURB	HALLIG	ANTURB
7	MELLUP	XERCAL	ANTURB	MEGINI	TRISPP	SVAOBL	PSEHEL	MELROB	HALLIG	ANTURB	ANTSQU
8	ANTURB	ANTURB	MEGPAR	MELSUB	COEEDI	MELMEN	DUFMAR	MEGOCC	AGATEX	MELLUP	LASSPP
9	TRICON	MEGBRE	MELAPP	MELMON	SVASIL	SYNEXQ	AGAOBL	DIENEV	MEGINI	MEGPAR	AGATEX
10	BOMPEN		MELLUP	HALLIG	BOMPEN	SVAMAC	MELMEN	TRISUB	MELROB		TRIHEL
	3	3	4	4	5	4	5	3	4	4	3

42 total

MELAGI = specialist

2015 species ranks

	ESC	M1J	BIS	ROD	ANI	SIL	BEN	IND	MA2	MER	COR
1	APIMEL	APIMEL	MELAGI	HALLIG	APIMEL	APIMEL	APIMEL	BIGSLO	APIMEL	APIMEL	APIMEL
2	MELAGI	DIA001	APIMEL	BOMPEN	BOMPEN	BOMPEN	MELAGI	APIMEL	MELLUP	MELAGI	MELLUP
3	DIA001	MELAGI	DIA001	MEG007	ANDACC	MELSP1	MELPAR	MELAGI	MELAGI	AGA004	MELAGI
4	HALLIG	MELMAL1	TRI004	MELTHE	AGA004	PSE001	HALLIG	MEG009	DIAENA	MELLUP	DIA003
5	SVAOBL	SVAOBL	MELMAL1	MELPAR	AGA001	MELCOR	MEG010	MEG014	HALLIG	AGA001	HALLIG
6	DIA001	HALLIG	MEG004	APIMEL	HALLIG	AND003	MELSON	MEG013	ANTURB	ANTURB	ANTURB
7	DIA007	MELMAL2	MEG006	MEG013	SVAOBL	TRA001	AGA001	HALLIG	HALTRI	MEG001	DIA004
8	AGA002	AGA004	SVAOBL	MEG005	ANT001	ANDACC	COE002	SVAHEL	MELROB	MELROB	AGA001
9	MEG008	AGA001	AND001	AGA005	AGA002	HALLIG	PSE001	COE001	MELMAL1	MEG007	MEG001
10	AGA004	SVAMAL1	MEG009	PSE001	XYL001	MELAGI	BOMPEN	MEG007	AGA001	MEG011	DIA005
	2	2	2	0	1	2	1	2	2	1	1

16 total

NPSNM-funded sites outlined in red:
ROD (Rodeo, NM)
ANI (Animas, NM)
SIL (Silver City, NM)
BEN (Benson, AZ)

1970s top-ranked = 38% specialist
2015 top-ranked = 15% specialist

Percentage of specialists lower compared to the 1970s ($p<0.05$)