La Sal Mountain alpine arthropod communities: establishing baseline conditions

2017 Annual Report to Canyonlands Natural History Association

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All 2014 and 2015 pitfall traps have now been through the initial sorting process and about 20% of the 2016 pitfall traps have been sorted as well. Pollinator trap samples from 2016 have all been sorted (a total of 2100 samples were collected from the three sites over 3 collecting periods) and I just have begun to go through these samples to assign names to the bees and butterflies, and consistent morphospecies epithets to the flies and moths. Work on sorting the 2017 pollinator cups began in winter 2017-18.

All pollinators netted in 2017 (primarily bees, wasps, butterflies, moths and flies) have now been pinned, and the Hymenoptera and Lepidoptera have been identified at least to genus, or to family and assigned a morphospecies epithet. I have not had a chance to begin to identify and enumerate the pollinator trap specimens yet, but will be working on that this winter.

I re-analyzed the Hymenoptera and Lepidoptera data from 2016 based on more accurate identification of specimens, and have analyzed the 2017 data as well, relative to flower color choice. Brief preliminary results of these analyses are presented in this report; I also compare results of 2016 to 2017 in terms of flower color preference (as indicated by numbers of captures) each year for the two orders overall and at each site. The two years are not entirely comparable because I was only able to conduct two sessions at each site in 2017 as opposed to three sessions at each site in 2016; nevertheless, comparisons provide useful information about the pollinator community changes over time. This report does not include the flies, as I am waiting for better identifications from Dr. Cobb, and the morphospecies reference specimens I designated for 2016 specimens are all still at NAU, so I could not even assign names to 2017 specimens that would be consistent with the 2016 data. I plan to go to Flagstaff to work with Neil on the flies in November or December and will conduct those analyses this winter.

Ten bumblebee species were caught at least once over the two years; two species were found only in 2016 and a different species was documented by a single specimen at the Beaver Basin site in 2017. The other seven species were recorded in both years; seven species (although not the same species) occurred at all three sites at least one year (Table 1 and Figure XX). The number of species found at each site varied from 9 at Mt. Peale in 2016 to 5 at Manns Peak in 2017. Fewer species were captured in 2017 at all three sites. *Bombus appositus* and *B. nevadensis* were found at all three sites in 2016, but were not caught at any site in 2017. The Beaver Basin and Mt. Peale sites each lost the same two above species, but *B. melanopygus* was found for the first time at Mt. Peale, and *B. rufocinctus* was only caught at Beaver Basin in 2017 for a net change in number of species of -1 at these two sites. At Manns Peak, four of the species caught in 2016 were absent in 2017, but *B. balteatus* was caught there for the first time in 2017, for a net difference of -3 species.

Community composition of both Hymenoptera and Lepidoptera communities can be compared among the sites and between 2016 and 2017 collections now using a variety of tools. Cluster analysis is a relatively quick technique that maps the "distance" between communities, which is one way to think about how similar or different communities are. Analysis of the Hymenoptera caught at the sites over both years (three collecting periods in 2016 and two in 2017) resulted in the cluster diagram shown in Figure WW. The Mt. Peale and Manns Peak Hymenoptera communities of 2016 were very similar (notwithstanding the differences in bumblebee species caught discussed above). The Mt. Peale 2017 community was also quite similar to the above two communities, more so than the 2016 Beaver Basin community. The Manns Peak 2017 Hymenoptera differed quite a lot from all 2016 communities, and the Mt. Peale 2017 assemblage, but still showed relatively high similarity with those communities. The Beaver Basin 2017 community showed little similarity with any of the other five species communities; this result is surprising given that many species were shared between Beaver Basin in 2017 and the

other communities. In fact, calculations of Sorensen's Similarity Index show different results (Table 3) for Hymenoptera, indicated greater similarity among the communities than distinguished by cluster analysis.

I am working on comparisons between sites and between years both in terms of community composition (species present in both years vs. a single year, or at a single site vs. two or all three sites, etc.) using Nonmetric Multidimensional Scaling ordination, which incorporates species identities and abundances and will have those results in the first interim report for 2018.

Notable observations

A scorpion was found in one of the 2015 pitfall traps from the Manns Peak site. There are very few records of scorpions at high elevations in North America (the trap was at about 3510 m above sea level), and those recently found in Arizona, New Mexico and Nevada have been described as new species (Graham and other papers). The specimen from Manns Peak is now at the Denver Museum of Nature and Science, which has a particularly strong arachnid department. The curator of that department, Paula Cushing, will oversee the proper treatment of this specimen, including providing access to the specimen for scorpion taxonomists that have been involved in finding and naming the new species in the sky islands of the Southwest over the past 10-15 years.

In 2016 we documented two species of butterfly in the La Sals not previously reported from this area (FIgure 1): a male Lycaenus cupreus, the *Lycaenus cupreus* (Lustrous copper) at the Mt. Peale site, and *Parnassius smintheus* (Rocky Mountain Parnassian) two specimens from the Manns Peak site, and one or two others observed but not caught. In 2017, we caught a female *L. cupreus*, also at the Mt. Peale site; the 2016 specimen was a male. Captures of both sexes is good evidence of a resident population. No *P. smintheus* were caught, or even observed, in 2017, but there were some other species caught in 2016 that were rare or not observed at all in 2017 (see Table XX), so it may be that 2017 was not as good a year as 2016 for some species. Whether *P. smintheus* has a resident population in the La Sals remains to be seen; another year with no observations of this species might indicate the captures in 2016 were of errant individuals. However, it is perhaps less likely that there would be 3-4 errant individuals seen over the course of two days, so perhaps there is a resident population after all.

A queen *Bombus balteatus* was found in one of the pitfall traps at the Manns Peak site in 2014. This represented only the 2nd record of *B. balteatus* in Utah; the first was in 1964 in the Uintas. I have not examined other bees caught in pitfall traps to know if we caught any more B. balteatus in 2014-2016 during the pitfall trapping sessions. Over the course of 2016 and 2017, with our emphasis on pollinators, we have added a number of *B. balteatus* records. Interestingly, we only netted one female at the Manns Peak site over the two years, but seven females and five males at the Mt. Peale site, and two females and two males at the Beaver Basin site (Table 1). There appears to be a resident population of *B. balteatus* in the alpine zone of the La Sals, with both males and females collected from the northern and southern parts of the range, and at least a couple females from the middle. This population is notable to bumblebee biologists because not only is it quite isolated from other populations of this species, but it is one of the southernmost populations. I will be working with Dr. Terry Griswold, a bee biologist at the Pollinating Insect-biology, Management, Systematics Research Lab of the USDA, located on the Utah State University campus, Logan, Utah, to learn more about this species in the La Sals, and to compare this population with a another disjunct population in the Sierra Nevada Mountains. We anticipate this will yield a manuscript we will submit for publication to the appropriate journal (to be determined after we get the manuscript done).

We continue to find specimens of an ant mimic Hemipteran and are working to determine what species this is. McIver and Stonedahl (1993) list 44 genera of Hemiptera that contain species mimicking ants, so it may take some time to find the species we have.

Figure 1A. *Lycaenus cupreus*; Lustrous copper. Photo by Robb Hannawacker.

Figure 1B. *Parnassius smintheus,* Rocky Mountain Parnassian.

Volunteers

A total of 27 volunteers helped with fieldwork and sample sorting in 2017, including 4 high school students, along with Laura Reed, one of the science teachers at Grand County High School (Figure 2A), and other members of the Moab community (FIgure 2B). Two of the volunteers came from southern Californai to help with fieldwork for about two weeks; they saw my report to the American Alpine Club for providing support for the project in 2015.

Figure 2A. Laura Reed, Hannah Stripeika and Ryan Lewis at Manns Peak. Photo Gina Roberti.

Figure 2B. Maddy Fisk sorts a pitfall trap sample.

Table 1. Capture numbers for each species of Hymenoptera at each site, and total of the three sites, in 2016 and 2017.

	MtP		BB		MPk		Total	
Bees:	2016	2017	2016	2017	2016	2017	2016	2017
Bombus appositus ♀	2		1		1		4	
Bombus appositus ♂			1				1	
Bombus balteatus ♀	5	2	1	1		1	6	4
Bombus balteatus ♂		5	1	1			1	6
Bombus bifarius ♀	8	9	16	6	14	1	38	16
Bombus bifarius ♂	2		1	1	2		5	1
Bombus flavifrons ♀	10	16	13	2	8	8	31	26
Bombus flavifrons ♂	4	6	5	3	1		1	9
Bombus huntii ♀	1	2	1	1	1		3	3
Bombus huntii ♂								
Bombus melanopygus ♀		3			2	1	2	4
Bombus melanopygus ♂		1						1
Bombus morrisoni ♀	2	1			1		3	1
Bombus morrisoni ♂								
Bombus nevadensis ♀	2		5		1		8	
Bombus nevadensis ♂			1				1	
Bombus rufocinctus ♀				1*				1
Bombus rufocinctus ♂								
Bombus sylvicola ♀	3	7	1	2	5	8	9	17
Bombus sylvicola ♂			6		4		1	
Megachile melanophaea		1		1	1		1	2
Megachile inermis					1		1	
Halictus rubicundus	2		3				5	
Lasioglossum sp. 1 ♀	6	3	4	2	26	26	36	31
Lasioglossum sp. 1 ♂	24		8		9	1	41	1
Lasioglossum sp. 2			1				1	
Lasioglossum mellipes				1				1
Lasioglossum sp. 3?		1						1
Osmia tanneri ♀	2		3			1	5	1
Osmia tanneri ♂	2	2		1	1	1	3	4
Osmia (Melanosomia)	1						1	
Osmia grandeliae	3		1				4	
Osmia pusilla				1				1
Osmia subaustralis						1		1
Osmia sp. 5?						1		1
Agapostemon angelicus ♀			1				1	
Agapostemon angelicus ♂			1				1	
Andrena apacheorum			1				1	
Panurginus sp.			1				1	
Anthophora urbana	1					1	1	1

	MtP		BB		MPk		Total	
	2016	2017	2016	2017	2016	2017	2016	2017
Wasps:								
Aneistroceros		2						2
Cricetidae sp. 1		1						1
Cricetidae sp. 2	1						1	
HYw1	1	1	5	2	2	7	8	1
HYw 2	1		1	1	1		3	1
HYw 3			1		2		3	
HYw 4			1				1	
HYw 5	2	1	2				4	1
HYw 6					1		1	
HYw 7					1		1	
HYw 8			1				1	
HYw 9								
HYw 10		2	1	1	1		2	3
HYw 11			2		2		4	
HYw 12								
HYw 13			2	4		1	2	5
HYw 14	1						1	
HYw 20		1						1
HYw 21				1				1
HYw 22						1		1
HYw 23				1				1
HYw 24				1				1
HYw 25				1				1
HYw 26		1						1
HYw 27		2						2
HYw 28		1						1
HYw 29		1						1
HYw 30						1		1
HYw 31						2		2
HYw 32		1						1
HYw 33		1						1
HYw 34		1						1
Formica sp.	9	11	20	2	9	12	38	25
Number of specimens	95	86	113	38	97	75	287	190
Number of taxa	20	25	25	20	20	16	35	40
proportion of total	0.33	0.42	0.42	0.33	0.33	0.27	0.58	0.67

*Not verified by the “Bee Lab” yet

Table 2. Capture numbers for each species of Lepidoptera at each site, and total of the three sites, in 2016 and 2017.

Total Lepidoptera data	MtP		BB		MPk		Total	
pollinator species:>>>	2016	2017	2016	2017	2016	2017	2016	2017
Papilio zelicaon			1	2		2	1	4
Parnassius smintheus					2		2	
Aglais milberti	3	9	3	3	4	6	10	18
Boloria chariclea		1	2				2	1
Coenonympha tullia			1		1		2	
Speyeria hesperis			1				1	
Speyeria mormonia	1	8	2	1	1		4	9
Vanessa cardui		2	2	4		3	2	9
Vanessa virginiensis			1				1	
Erebia epipsodea		5	2	1	1	1	3	7
Polygonia sp comma	3	1	1	2	2	5	6	8
Adelpha eulalia			1				1	
Plebejus glandon	7	10	15	8	10	14	32	32
Plebejus saepiolus	5	18	11	2	1	2	17	22
Lycaena helloides					1		1	
Lycaena cupreus	1	1					1	1
Colias eurytheme	2		1		1		4	
Pieris marginalis		2	4		4	2	8	4
Pontia occidentalis	7	7	7	12	4	7	18	26
Pontia protodice		1	3	2	2	2	5	5
Pontia sp.						1		1
Pontia syssimbrii		1				3		4
Euchloe ausonides		1				1		2
Pyrgus communis						1		1
Polites draco		1				1		2
Thorybes mexicana				1		2		3
Hesperia juba	3	1			2		5	1
Hylea lineata					1		1	
Autographa californica	1	1	1			3	2	4
Syngrapha ignea		2	1		5	3	6	5
Syngrapha sp.						1		1
Schinia sp1	4	4	3	3	5	4	12	11
Agrotis brown	1		1	3	3		5	3
Agrotis dk grey	1				1		2	
Noctuidae tan			1		2		3	
Noctuidae pronotum shiny			1		2		3	
Noctuidae ripple lines			1		1	1	2	1
white noctuid						1		1
brown dk stripes			1			1	1	1

	MtP		BB		MPk		Total	
	2016	2017	2016	2017	2016	2017	2016	2017
pale grey-brn dirty forewing			1				1	
orange sandstone pattern					1		1	
little pale orange			1			1	1	1
orang-brn dk dashes		2	1				1	2
opalw/ brn specks	1	1					1	1
lt brn dk band forewing		1	2		1	3	3	4
plain dk grey wings			1				1	
Parasemia sp.		1	1				1	1
Gnophaela vermiculata		2	1		3		4	2
µLep1	1	1	1	1	1		3	2
µLep2		1			1	3	1	4
µLep3			2		1		3	
µLep4					1		1	
µLep5			2	1		4	2	5
µLep6					1	2	1	2
µLep7					3		3	
µLep8	1	1	9		1	3	11	4
µLep9					1		1	
µLep10			2		1		3	
µLep11			2			2	2	2
µLep12	2	4	3	2	1		6	6
µLep13	1	2	3			7	4	9
µLep14		1						1
µLep15		1	1				1	1
µLep16		1						1
µLep17		2	1				1	2
µLep18						2		2
µLep19								
µLep20								
µLep21								
µLep22								
µLep23			1				1	
Pteridae1				2				2
Totals	45	97	103	50	73	94	221	241

Similarity indices comparing Hymenoptera and Lepidoptera captures at the different sites each year, and between years at each site are shown in Tables 3 (Hymenoptera) and 4 (Lepidoptera). Hymenoptera communities, as represented by netted individuals, were quite similar between sites in 2016, but varied much more in 2017. Between years, Hymenoptera caught at each site varied quite a lot as well; assemblages varied from less than 60% similar (Manns Peak) to more than 80% similar (Mt. Peale).

Table 3. Sorensen's Similarity Index values comparing Hymenoptera species assemblages at the three sites each year, and at each site between years.

	MtP16	MPk16			MtP17	MPk17
MPk16	0.857143			MPk17	0.5625	
BB16	0.857143	0.903226		BB17	0.647059	0.666667

	MtP17	MPk17	BB17
MtP16	0.647059		
MPk16		0.571429	
BB16			0.727273

For Lepidoptera, there was no consistent pattern between years in similarity among the sites. Similarity between Mt. Peale and both Manns Peak and Beaver Basin sites increased in 2017, but declined in 2017 between Manns Peak and Beaver Basin. The assemblages at Mt. Peale were quite similar between years, but much less so at the other two sites.

Table 4. Sorensen's Similarity Index values comparing Lepidoptera species assemblages at the three sites each year, and at each site between years.

	MtP16	MPk16			MtP17	MPk17
MPk16	0.717949			MPk17	0.826087	
BB16	0.595745	0.888889		BB17	0.631579	0.648649

	MtP17	MPk17	BB17
MtP16	0.833333		
MPk16		0.588235	
BB16			0.666667

Figure 1A. Proportional abundance of flowers of each color based on number of species observed at the three alpine sites. Note, I did not include the non-floral substrates (ground, rock and foliage) or aerial sweeps in generating this graph.

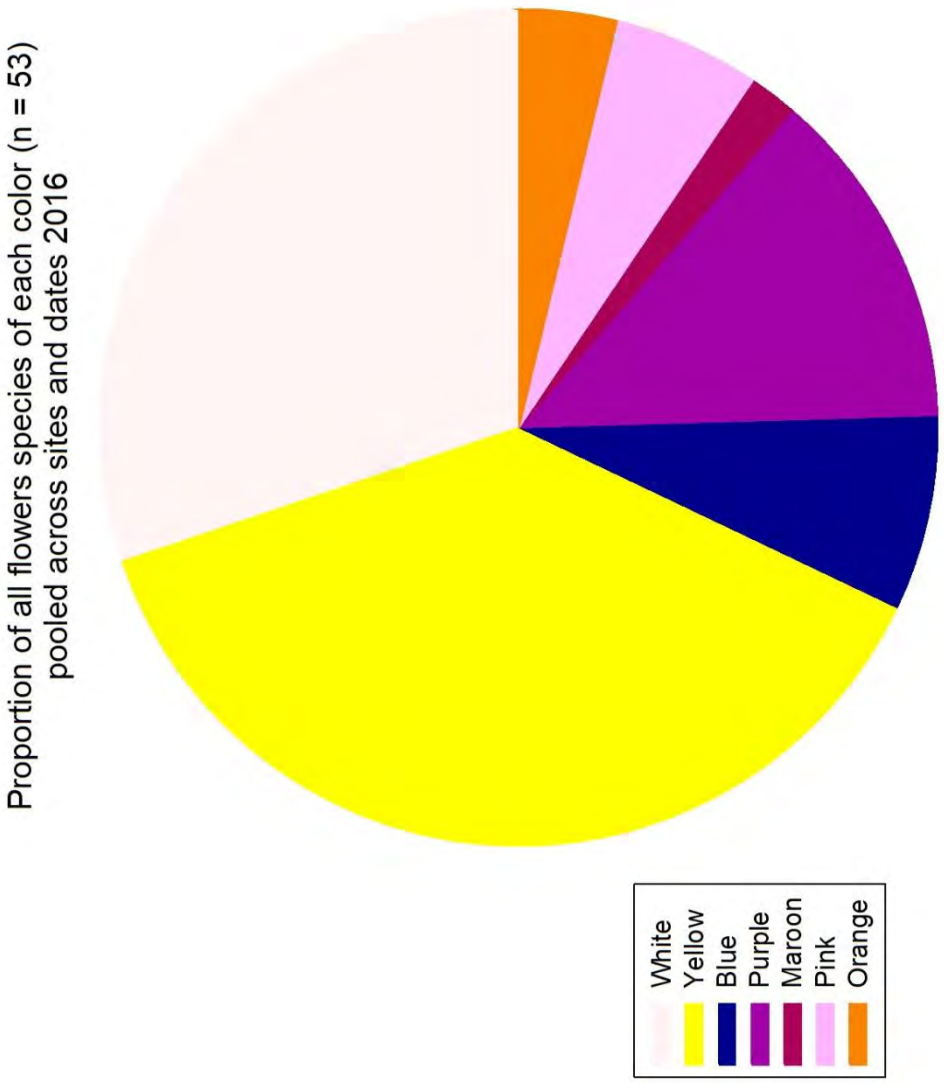
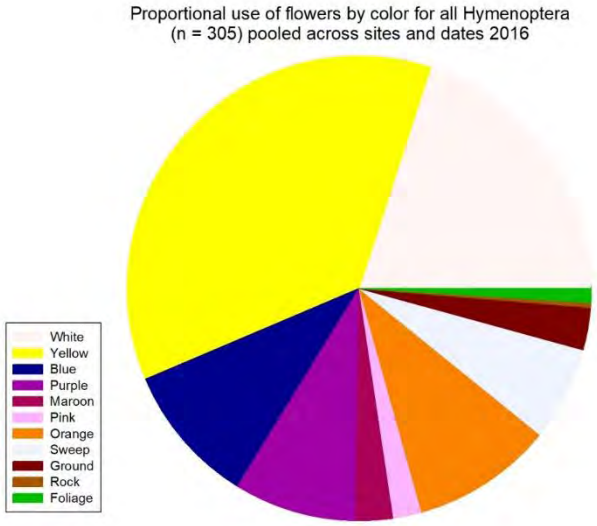


Figure 2A. Proportional use of flower colors by all Hymenoptera combined, over all three sites and all three sampling periods in 2016.



Most Hymenoptera used yellow flowers in both years, but use of blue flowers increased greatly in 2017, with a drop in use of yellow and orange flowers. The Hymenoptera species varied a little between years, but not a lot, especially the most abundant species (bumblebees and Lasioglossum species, Table 1).

Figure 2B. Proportional use of flower colors by all Hymenoptera combined, over all three sites and all three sampling periods in 2017.

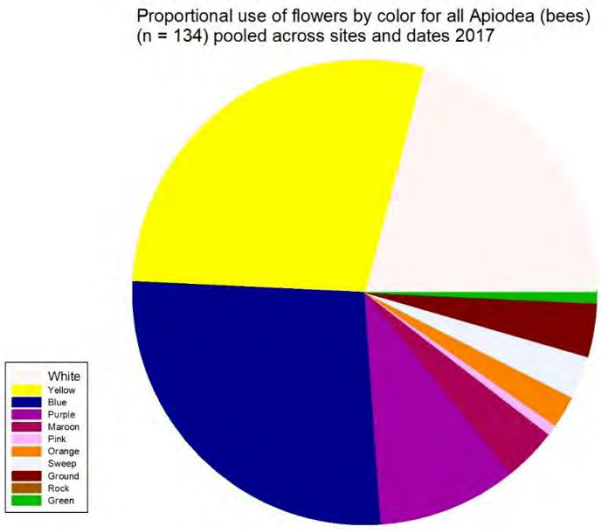
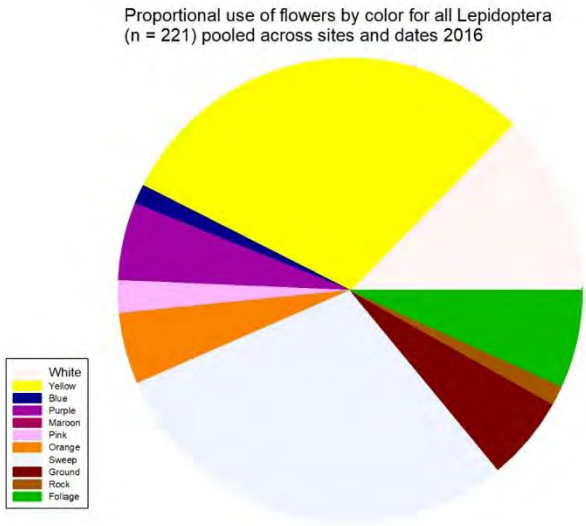


Figure 3A. Proportional use of flower colors by all Lepidoptera combined, over all three sites and all three sampling periods in 2016.



Lepidoptera use of different flower colors was again dominated by yellow flowers, but many captures came from sweeping individuals out of the air because many moths, and especially butterflies, spend very little time on a flower at any one landing. Use of purple and orange flowers increased in 2017, as did use of blue flowers, although blue flowers were not used much either year. The majority of foliage captures were of small moths, mostly Tortricidae and Pteriphoridae (SP?????).

Figure 3B. Proportional use of flower colors by all Lepidoptera combined, over all three sites and all three sampling periods in 2017.

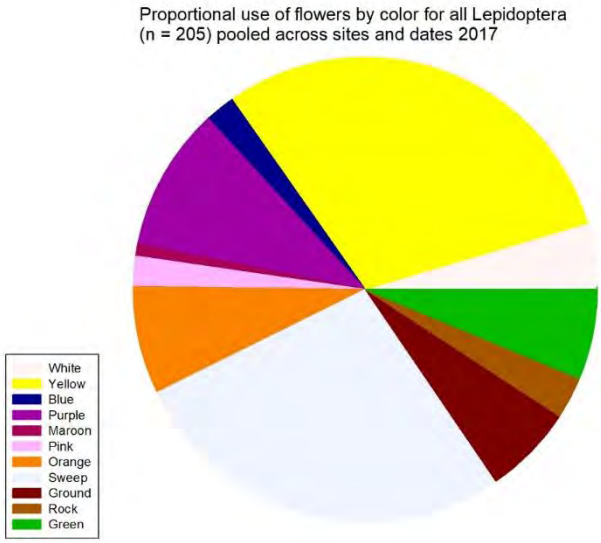


Figure 4A. Proportional use of flower colors by all Hymenoptera combined, total captures at all three sites and captures at each of the three sites; data are pooled across the three sampling periods in 2016.

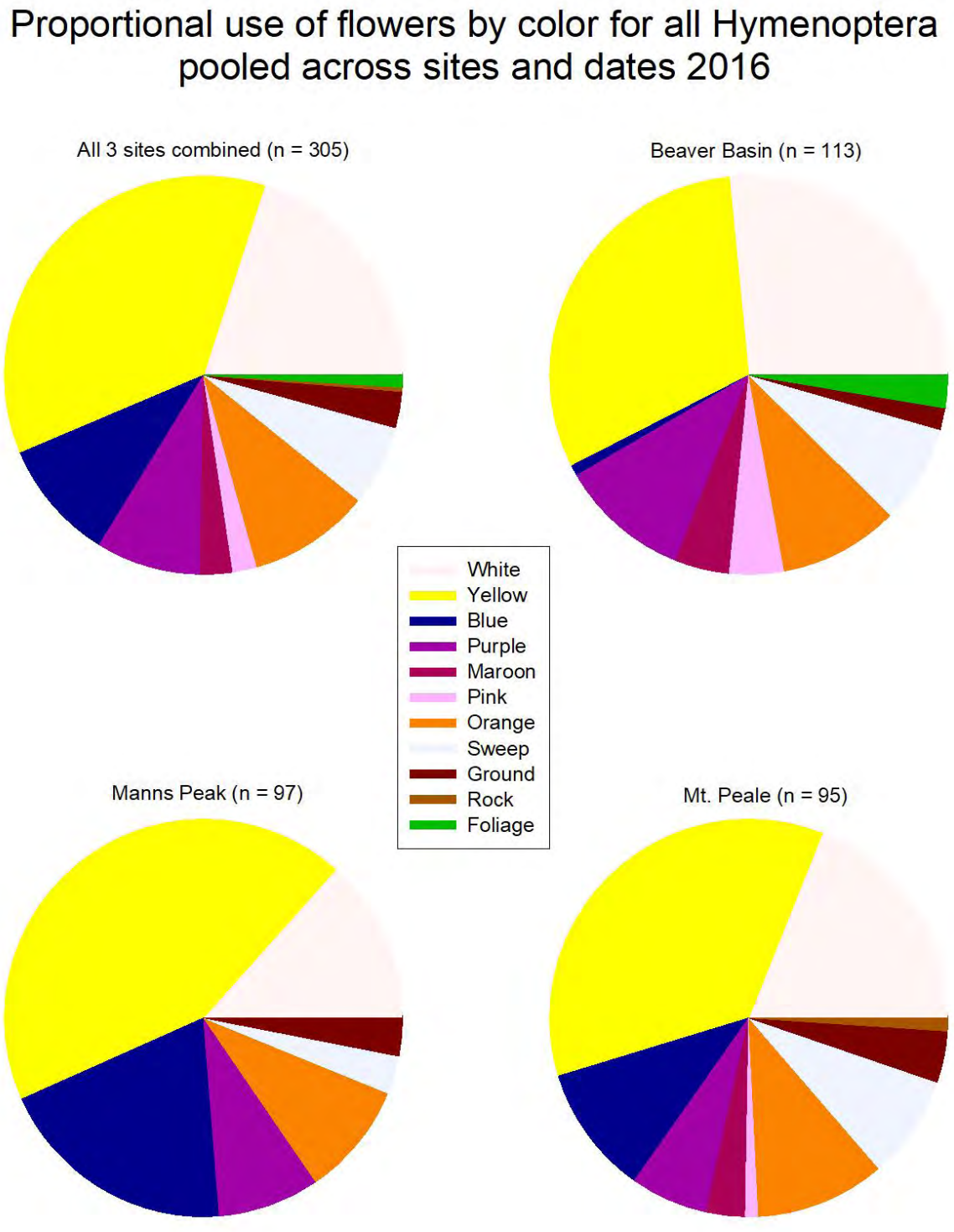
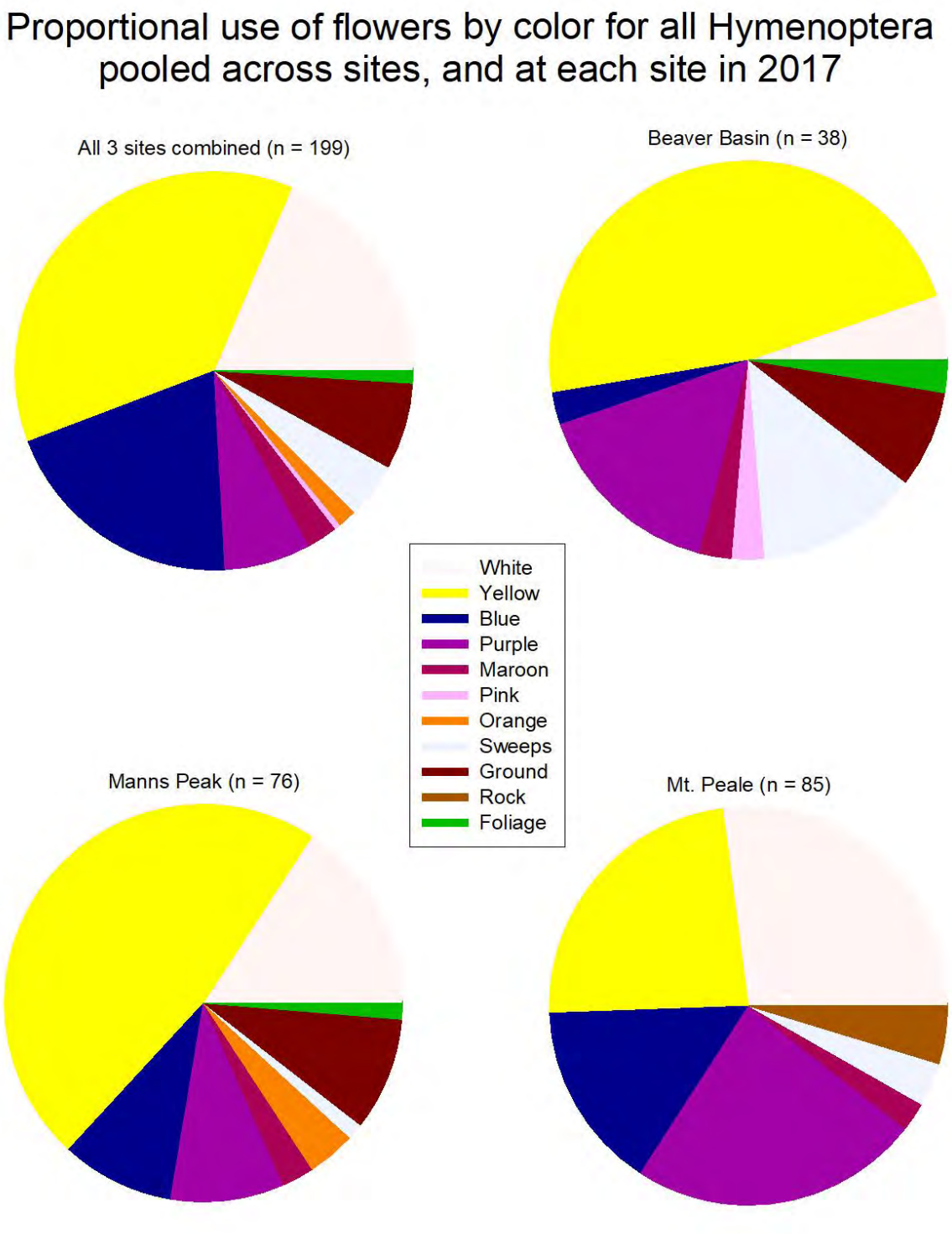


Figure 4B. Proportional use of flower colors by all Hymenoptera combined, total captures at all three sites and captures at each of the three sites; data are pooled across the three sampling periods in 2017.



As expected from the overall bee use in 2016, yellow flowers comprised the majority of captures at all three sites, but preference differed between sites for the other flower colors. Manns Peak had the smallest persent use of yellow flowers, with more captures on white, and especially on blue flowers compared to Beaver Basin captures. At the Mt. Peale site, more Hymenoptera were caught on white flowers than on yellow; together they accounted for about half the captures. Purple and blue flowers comprised most of the remaining captures.

In 2017, yellow flower use was still quite high at all three sites, but proportions were quite different from those of 2016 at Beaver Basin and Mt. Peale. At Beaver Basin, captures on yellow flowers accounted for almost half of all captures, showing a marked increase over 2016 captures. Mt. Peale captures on yellow flowers on the other hand, were less than 25% of all captures in 2017, a significant decline in yellow flower use from 2016. At Manns Peak, yellow flower captures increased some, but by a much smaller percentage than at Beaver Basin. In contrast, captures on white flowers at Beaver Basin in 2017 were much fewer than in 2016, with large increases in purple flower, sweep, and ground captures increasing over 2016 levels. Manns Peak captures on blue and orange flowers declined and captures on purple flowers and the ground increased in 2017. At the Mt. Peale site, the decrease in yellow flower captures was related to increases in white, blue and purple flowers, and a decline sweeps; there were no captures on orange flowers or bare ground in 2017, which was a change from 2016 captures.

Figure 6. Number of individual bumblebees captured at each site each year. Five species were present at all three sites in at least one year; two species occurred only in 2016, one species was only found at a single site in 2017.

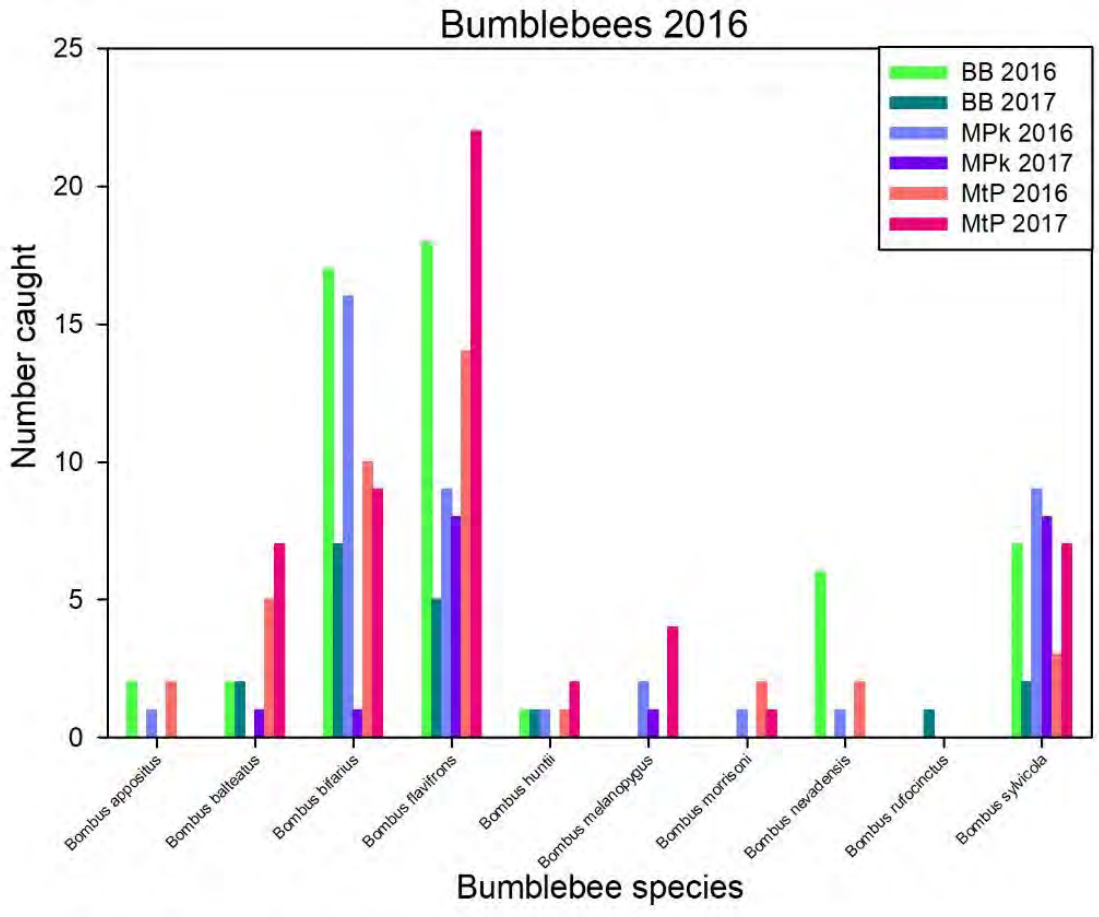


Figure 5a. Proportional use of flower colors by all Lepidoptera combined, total captures at all three sites and captures at each of the three sites; data are pooled across the three sampling periods in 2016.

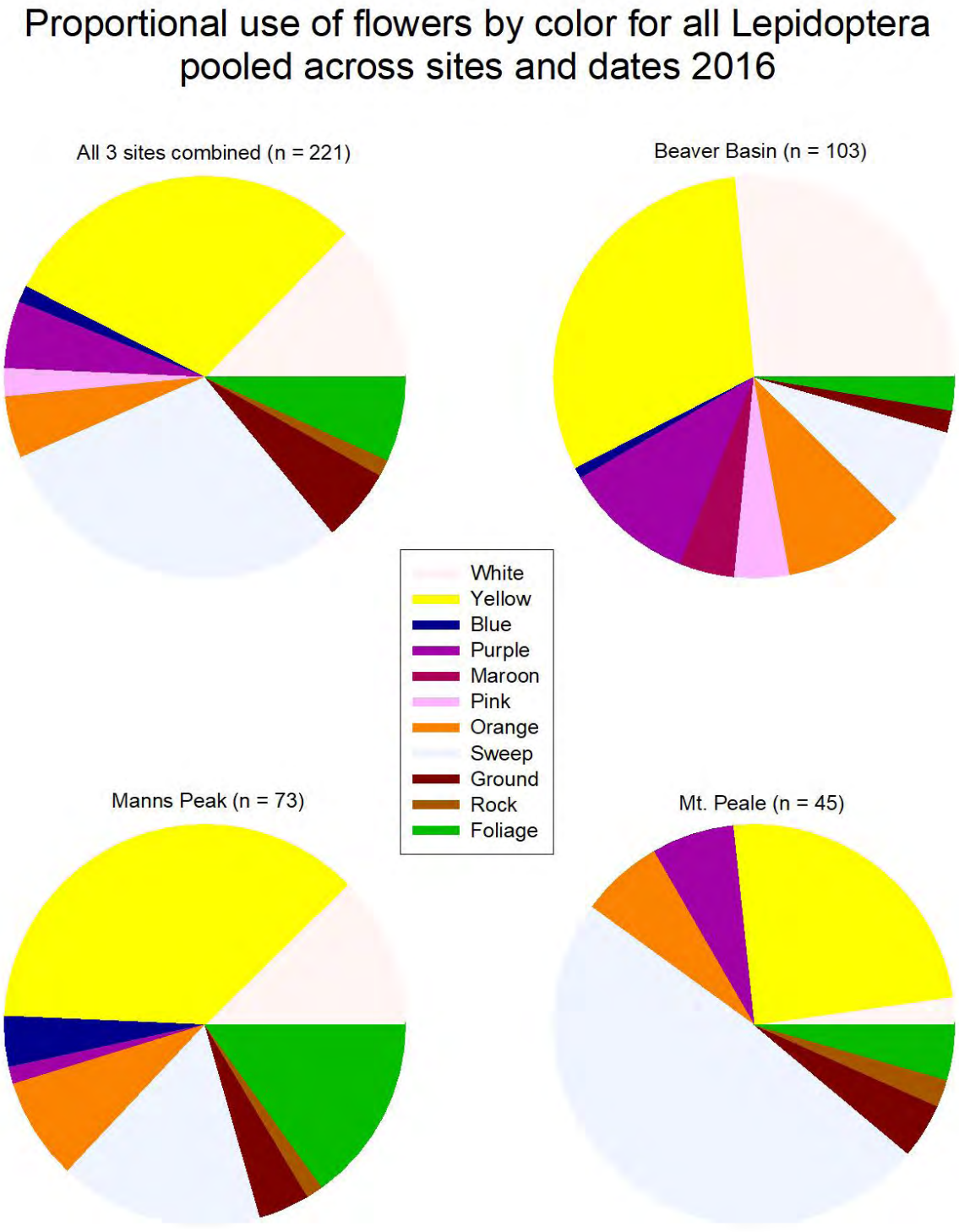
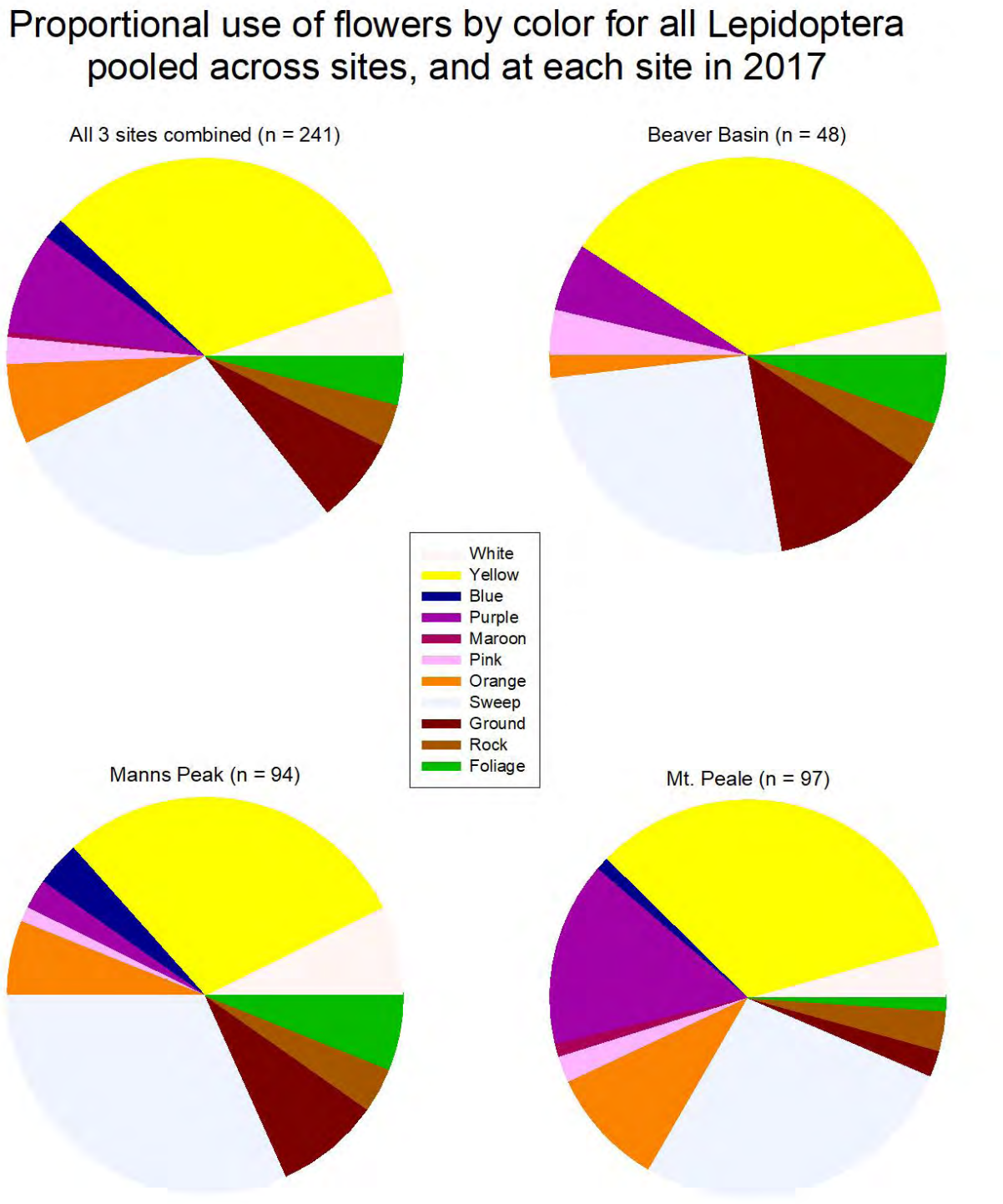


Figure 5B. Proportional use of flower colors by all Lepidoptera combined, total captures at all three sites and captures at each of the three sites; data are pooled across the three sampling periods in 2017.



Most captures in 2016 were on flowers at Beaver Basin and Manns Peak, but about half the captures of Lepidoptera at Mt. Peale were aerial sweeps. A similar pattern was seen at Manns Peak, with yellow flowers most abundant but white, blue and orange flowers, sweeps and foliage combined for about 70% of captures. Flowers other than yellow were not used much by Lepidoptera at Beaver Basin in 2017; sweeps and ground captures accounted for most of the non-yellow flower captures. At Manns Peak in 2017, sweep captures were the most numerous, but only slightly more so than on yellow flowers; white and orange flowers, and foliage all showed marked declines in capture frequencies, with ground and rock captures slightly more abundant in 2017. Aerial sweeps at Mt. Peale were significantly fewer in 2017, but yellow flower captures only increased slightly. Purple and orange flowers had many more captures on them in 2017 than 2016, and both blue and pink flowers were represented in 2017 but were absent from capture data in 216.