

Comparison of Bee Bowls and Netting for Monitoring Native Bees

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Full Time Independent Research 2022

Abstract

This study looked at the differences in bee community composition between estimates obtained from pan traps vs. netting. Comparing species richness, evenness and community composition between the two sampling types from the years 2009-2017 and 2009-2021. Based on a rate of bees caught per hour, without the *Bombus* genus, bee bowls were more efficient, however, the catch rate of the *Bombus* genus alone was much higher than the catch rate of the bowls.

However, bee bowls still caught a wider range of genus, with the netting still missing around 50 species over the course of the years studied. However, the nets were able to catch larger bodied bees that were missed by the bowls. Overall, it was determined that to get a full understanding of the bee genus/species populations, both bee bowls and netting is needed.

Introduction

The United States government is working on creating a national native bee monitoring program. There are vigorous discussions on what kind of methods should be used to monitor the distribution, abundance, and diversity of native bees. The two most common ways to collect bees are by pan trapping and netting. Pan traps are also referred to as bowl traps or bee bowls; they are a passive sampling method in which bowls are colored and filled with soapy water. Bees mistake the bowls as flowers, fall in the liquid, and drown. Pan trapping is cost-efficient, since the bowls can be used multiple times, placed out in the field all day, and then collected later. They also capture smaller species of solitary bees that can be difficult to collect through netting, such as in early spring when there are few bees flying around. The bowls collect ground-nesting bees that could potentially be missed otherwise, and in cases where traps collect a large number of individuals, they allow for more robust estimates of bee phenophases. However, pan traps are

controversial since they can potentially kill a large number of individuals passively, especially skewed towards bees in the Halictidae family (sweat bees), and they cannot collect larger bodied bees (these bees can crawl out of the traps). A paper in 2020 found that averaged across 9 sites in the US, 74.4% of bees caught in pan traps were in the Halictidae (Portman et al., 2020). These analyses informed the best practices for bee surveying and monitoring in the Rocky Mountain West region.

Netting can be time-consuming and the amount of bees collected can depend on a multitude of factors. However, it can record many larger-bodied bees that would not otherwise be in the pan traps. It is also possible to get flower association which is not possible with bowl traps.

There are other methods of collecting, such as blue and yellow vane traps, pitfall traps, malaise traps, observational recording (without collecting), and mobile gardens. Some of these methods have been used around the Rocky Mountain Biological Laboratory (RMBL, the location and general area of the research sites) with variable success. Non-viable options of collecting for monitoring at least at the RMBL include Malaise traps and blue vane traps. Malaise traps at the RMBL do not capture bees. Blue vane traps capture an exceedingly large number of bees (more than pan traps), including bumble bee queens and males. Observational recording of bees does not allow for accurate species-level identification. Thus, the two most viable methods of collecting at the RMBL and likely nationally are pan traps and netting and will be the focus of this study.

We determined the differences in bee community composition between estimates obtained from pan traps vs. netting, comparing species richness, evenness and community composition between the two sampling types. The pan traps did not effectively collect the *Bombus* genus, and so all analyses were run with and without bumble bees (Prendergast et al.,

2020). We hypothesized that pan traps and netting will not capture the same species composition of bees, and that both methods were necessary for a full understanding of bee community composition for survey and monitoring (Roulston et al., 2007). We also hypothesized that bee size will be an important factor associated with changes in species composition between the two sampling types, with smaller bodied bees caught in traps instead of getting netted.

It was important that this research be done at RMBL because of the continued use of bee bowls in a long term study at and around RMBL. Although previous research shows that lethal collecting does not impact diversity (Gezon et al, 2015), it is still important to understand if it is necessary for a more complete estimate of bee species evenness and richness. This data more accurately represented native bees in the mountain region because honey bees(*Apis mellifera*) had not yet started to severely impact native populations of bees, although there had been sightings of them around sites in lower elevations. Because of that, RMBL was almost like a blank slate, only the native pollinators would be in this data collection. The consequences on native bees can be more accurately measured if there is a baseline of the species richness if/when *Apis mellifera* or other non-native pollinators invade the region. Not only that, but it also provided evidence as to whether bee bowls are needed to continue collecting sufficient data for monitoring populations.

Methods

We sampled 16 sites roughly every two weeks. These sites varied in habitat (either dry meadow, wet meadow-willow, or wet meadow-veratrum) and elevation. We used a standard bioquip butterfly net and small plastic hexagonal bowls painted fluorescent yellow, blue, and

white. For the solution in the bee bowls, we used a few drops of Dawn dish soap in a one gallon jug of water. After 4-5 hours, the bees in each bowl will be collected in 20 mL disposable scintillation vials with a few milliliters of 70% Ethanol for preservation, separated by the color bowl they were collected in. At the same time that bowls are out, we sampled the sites by netting. Sites were netted for one person hour each in the morning and afternoon. The solitary bees collected by net will be kept in 20 mL disposable scintillation vials with a few milliliters of 70% Ethanol for preservation. These were labeled with the date, am or pm, the flower it was collected on, the location, and the collector. Bumble bees caught with a net will have the species, flower, sex, site, AM or PM, and collector recorded. The bumblebee was then marked with a non-toxic paint pen and released. All collected bees from each method were be pinned, labeled, entered into a database and during the winter identified to the lowest taxonomic resolution possible. My project focused on the years 2009-2017 that have the highest taxonomic resolution. For the analysis, we used R studio and some excel programs. Using the average catch rate for each method per day per site per year, we calculated the mean rate for solitary bees for each method. Then, the mean rate of *Bombus* caught per day based on time spent netting per site was averaged as well. A general bar chart was used to display generally the number of genus/species caught using bowls vs. nets. Then, a pie chart was used for a more specific visualization, including the top 20 genus caught for each method.

Results

When only comparing solitary bees, the bowls tend to have a higher bees per hour catch rate with an average of 5.11870790919 bees per hour compared to 1.97777778 bees per hour

caught using a net. However, the average catch rate of *Bombus* per hour was 10.69656444. As seen in figure 3, roughly 50 species are not seen in netting that are in bowls. In figure 4, the top 20 genera are seen for each method. *Lasioglossum* and *Halictus* are two of the highest genera for both netting and bowls.

Discussion

The primary function of the discussion section is to provide your explanations for the results. Back up your claims with specific results. Your literature research also should inform your explanations. In the process of interpreting your results, you will find yourself comparing your results with previous studies.

Without including *Bombus*, the bowls are much more efficient in collecting, both in number of specimens and in number of species. This is likely because a majority of bees caught by nets are in the *Bombus* genus, possibly because they are much larger than most solitary bees, making them easier to see. This is also likely the reason why roughly 50 species are missing from netting, as many of the missing species are rare or quite small, and therefore not seen in the bowls (Prendergast et al., 2020). These results indicate that if you were trying to get an idea for the dominant species, you could just net and not worry about the bee bowls. However, to get an accurate idea of the breadth of species, you would need both nets and bowls. Also, since the analysis was done using data from multiple years, this helped reduce the amount of possible bias from some people netting having different levels of skill. So, these 50 missing species are missing from netting, regardless of the skill of the people netting and regardless of year/site. Since *Lasioglossum* and *Halictus* are two of the highest genera for both netting and bowls, that indicates that those genus are very common in the survey area. As said in the introduction, a high

percentage of *Haluctus* was expected in the bowls(Portman et al., 2020), however since there is a high collection rate in both methods, it is likely that it is just a common genera in the United States. These analyses informed the best practices for bee surveying and monitoring in the Rocky Mountain West region.

Tables and Figures

	method	date_sampled	year	site	n	time	rate
1	Bowl	1-Jul	2009	Beaver	23	5.916667	3.8873239
2	Bowl	1-Jul	2009	Gothic	17	5.583333	3.0447761
3	Bowl	1-Jul	2009	Seans	56	6.250000	8.9600000
4	Bowl	14-Aug	2013	Copper	57	4.500000	12.6666667
5	Bowl	14-Aug	2013	Hill	7	4.000000	1.7500000
7	Bowl	22-Jun	2009	Davids	115	6.066667	18.9560440
8	Bowl	22-Jun	2009	Tuttle	114	7.850000	14.5222930
9	Bowl	22-Jun	2009	Willey	86	8.866667	9.6992481
10	Bowl	24-May	2017	Almont	70	5.55	12.612613
12	Bowl	26-Jul	2013	Mexican Cut	5	4.566667	1.0948905

15	Bowl	31-Aug	2017	Copper	6	5.75	1.04347826
16	Bowl	31-Aug	2017	Hill	17	5.666667	3.0000000
17	Bowl	31-Jul	2013	Beaver	8	4.633333	1.7266187
18	Bowl	31-Jul	2013	Gothic	24	4.066667	5.9016393
19	Bowl	31-Jul	2013	Seans	42	4.050000	10.3703704
20	Bowl	5-Aug	2013	Davids	2	2.850000	0.7017544
21	Bowl	5-Aug	2013	Tuttle	2	4.283333	0.4669261
22	Bowl	6-Aug	2013	Almont	7	4.933333	1.4189189
23	Bowl	6-Jul	2009	Davids	12	5.933333	2.0224719
24	Bowl	6-Jul	2009	Tuttle	16	5.816667	2.7507163
25	Bowl	6-Jul	2009	Willey	11	5.433333	2.0245399
26	Bowl	7-Sep	2016	Beaver	16	3.58333333	4.465116279
27	Net	1-Jul	2009	Gothic	7	2.000000	3.5000000
28	Net	14-Aug	2013	Copper	13	1.000000	13.0000000
29	Net	14-Aug	2013	Hill	1	2.000000	0.5000000

30	Net	14-Aug	2013	Little	4	1.000000	4.000000
31	Net	22-Jun	2009	Davids	2	2.000000	1.000000
32	Net	22-Jun	2009	Tuttle	3	2.000000	1.500000
33	Net	22-Jun	2009	Willey	5	2.000000	2.500000
37	Net	31-Aug	2017	Copper	1	2.000000	0.500000
38	Net	31-Aug	2017	Hill	1	2.000000	0.500000
39	Net	31-Jul	2013	Gothic	1	1.500000	0.666667
40	Net	6-Jul	2009	Tuttle	1	2.000000	0.500000
41	Net	6-Jul	2009	Willey	2	2.000000	1.000000
42	Net	7-Sep	2016	Beaver	1	2	0.5

Table 1: Rate of Bees Caught per Hour Based on Day and Method(Without Bombus)
The method refers to whether the bee was caught using a net or the bee bowls. “N” refers to the number of bees caught that day, and rate is the rate of bee per hour caught.

	date_sampled	year	site	n	time	rate
1	1-Aug	2016	Almont	4	2.000000	2.000000
2	1-Aug	2016	Almont Curve	13	2.000000	6.500000
3	1-Aug	2017	CDOT	21	2.000000	10.500000

	date_sampled	year	site	n	time	rate
4	1-Aug	2017	Lypps	36	2.000000	18.0000000
5	1-Aug	2018	Beaver	1	2.000000	0.5000000
6	1-Aug	2018	Gothic	5	1.783333	2.8037388
7	1-Aug	2018	Seans	29	1.000000	29.0000000
8	1-Jul	2009	Beaver	1	1.670000	0.5988024
9	1-Jul	2009	Seans	2	1.530000	1.3071895
10	1-Jul	2013	Davids	1	2.000000	0.5000000
11	1-Jul	2013	Tuttle	3	2.000000	1.5000000
12	1-Jul	2013	Willey	2	2.000000	1.0000000
13	1-Jul	2015	CDOT	5	1.700000	2.9411765
14	1-Jul	2019	Almont	2	2.000000	1.0000000
15	1-Jul	2019	Almont Curve	6	2.000000	3.0000000
16	1-Jul	2020	Rustlers	3	2.000000	1.5000000

	date_sampled	year	site	n	time	rate
17	1-Jul	2021	Rustlers	22	2.000000	11.0000000
18	1-Jun	2021	Tuttle	3	2.000000	1.5000000
19	1-Jun	2021	Willey	1	2.000000	0.5000000
20	1-May	2021	Lypps	8	2.000000	4.0000000
21	1-Sep	2016	Elko	11	2.000000	5.5000000
22	1-Sep	2016	Mexican Cut	6	2.000000	3.0000000
23	10-Aug	2010	Mexican Cut	15	2.0	7.5000000
24	10-Aug	2015	Beaver	54	2.000000	27.0000000
25	10-Aug	2015	Gothic	51	2.000000	25.5000000
26	10-Aug	2015	Seans	67	2.000000	33.5000000
27	10-Aug	2016	Beaver	49	1.000000	49.0000000
28	10-Aug	2016	Gothic	18	1.000000	18.0000000
29	10-Aug	2016	Seans	14	0.166666	84.0003360

	date_sampled	year	site	n	time	rate
30	10-Aug	2017	Davids	34	2.000000	17.0000000
31	10-Aug	2017	Tuttle	54	2.000000	27.0000000
32	10-Aug	2017	Willey	23	2.000000	11.5000000
33	10-Aug	2020	Rustlers	5	2.000000	2.5000000
34	10-Jul	2010	Almont	1	2.000000	0.5000000
35	10-Jul	2012	Seans	1	2.000000	0.5000000
36	10-Jul	2017	Mexican Cut	1	2.000000	0.5000000
37	10-Jul	2018	Davids	2	1.000000	2.0000000
38	10-Jul	2018	Tuttle	7	2.000000	3.5000000
39	10-Jul	2018	Willey	2	2.000000	1.0000000
40	10-Jul	2019	Beaver	2	2.000000	1.0000000
41	10-Jul	2019	Gothic	3	2.000000	1.5000000
42	10-Jul	2019	Seans	2	2.000000	1.0000000

	date_sampled	year	site	n	time	rate
43	10-May	2012	Hill	2	2.000000	1.0000000
44	10-May	2012	Little	6	2.000000	3.0000000
45	10-Sep	2019	Seans	77	1.750000	44.0000000
46	11-Aug	2011	Beaver	21	2.000000	10.5000000
47	11-Aug	2011	Gothic	19	2.000000	9.5000000
48	11-Aug	2011	Seans	4	2.000000	2.0000000
49	11-Aug	2014	Beaver	14	1.000000	14.0000000
50	11-Aug	2014	Gothic	19	1.000000	19.0000000
51	11-Aug	2014	Seans	11	1.000000	11.0000000
52	11-Aug	2016	Copper	13	2.000000	6.5000000
53	11-Aug	2016	Hill	12	2.000000	6.0000000
54	11-Aug	2016	Little	50	2.000000	25.0000000
55	11-Aug	2017	Almont	2	2.000000	1.0000000

	date_sampled	year	site	n	time	rate
56	11-Aug	2020	CDOT	1	2.000000	0.5000000
57	11-Aug	2020	Lypps	1	2.000000	0.5000000
58	11-Aug	2021	Davids	98	1.833333	53.4545552
59	11-Aug	2021	Tuttle	173	1.250000	138.4000000
60	11-Aug	2021	Willey	92	2.000000	46.0000000
61	11-Jul	2011	Tuttle	3	2.000000	1.5000000
62	11-Jul	2011	Willey	1	2.000000	0.5000000
63	11-Jul	2012	Mexican Cut	7	2.000000	3.500000
64	11-Jul	2016	Copper	3	2.000000	1.5000000
65	11-Jul	2016	Hill	37	2.000000	18.5000000
66	11-Jul	2016	Little	8	2.000000	4.0000000
67	11-Jun	2020	Davids	13	0.683333	19.0243995
68	11-Jun	2020	Tuttle	17	1.283333	13.2467567

	date_sampled	year	site	n	time	rate
69	11-Jun	2020	Willey	1	0.850000	1.1764706
70	11-Jun	2021	Almont Curve	9	2.000000	4.5000000
71	12-Aug	2009	Copper	4	2.000000	2.0000000
72	12-Aug	2009	Hill	1	2.000000	0.5000000
73	12-Aug	2009	Little	24	2.000000	12.0000000
74	12-Aug	2011	Davids	21	2.000000	10.5000000
75	12-Aug	2011	Tuttle	37	2.000000	18.5000000
76	12-Aug	2011	Willey	13	2.000000	6.5000000
77	12-Aug	2015	CDOT	10	2.000000	5.0000000
78	12-Aug	2015	Lypps	8	2.000000	4.0000000
79	12-Aug	2016	Davids	16	1.000000	16.0000000
80	12-Aug	2016	Willey	2	1.000000	2.0000000
83	12-Aug	2021	Rustlers	99	1.500000	66.0000000

	date_sampled	year	site	n	time	rate
84	12-Jul	2011	Beaver	5	2.000000	2.5000000
85	12-Jul	2011	Gothic	3	2.000000	1.5000000
86	12-Jul	2011	Seans	1	2.000000	0.5000000
87	12-Jul	2016	Davids	13	2.000000	6.5000000
88	12-Jul	2016	Tuttle	24	2.000000	12.0000000
89	12-Jul	2016	Willey	9	2.000000	4.5000000
90	12-Jul	2017	Davids	8	1.000000	8.0000000
91	12-Jul	2017	Tuttle	9	1.000000	9.0000000
92	12-Jul	2017	Willey	11	1.000000	11.0000000
93	12-Jul	2019	Davids	1	2.000000	0.5000000
94	12-Jul	2019	Tuttle	17	2.000000	8.5000000
95	12-Jul	2019	Willey	3	2.000000	1.5000000
96	12-Jun	2013	Copper	8	2.000000	4.0000000

	date_sampled	year	site	n	time	rate
97	12-Jun	2013	Hill	4	2.000000	2.0000000
98	12-Jun	2013	Little	2	2.000000	1.0000000
99	12-Jun	2017	Davids	5	2.000000	2.5000000
100	12-Jun	2017	Willey	2	1.000000	2.0000000
101	12-Jun	2018	Beaver	1	2.000000	0.5000000
102	12-Jun	2019	Gothic	2	1.500000	1.3333333
103	12-Jun	2020	Copper	15	2.000000	7.5000000
104	12-Jun	2020	Hill	3	2.000000	1.5000000
105	12-Jun	2020	Little	24	2.000000	12.0000000
106	13-Aug	2009	Beaver	11	2.000000	5.5000000
107	13-Aug	2009	Gothic	13	2.000000	6.5000000
108	13-Aug	2009	Seans	19	2.000000	9.5000000
109	13-Aug	2014	Mexican Cut	21	2.000000	10.500000

	date_sampled	year	site	n	time	rate
110	13-Aug	2015	Copper	18	2.000000	9.0000000
111	13-Aug	2015	Hill	5	2.000000	2.5000000
112	13-Aug	2015	Little	86	2.000000	43.0000000
113	13-Aug	2018	Rustlers	32	2.000000	16.0000000
114	13-Aug	2019	Copper	143	1.316670	108.6073200
115	13-Aug	2019	Hill	69	1.433333	48.1395461
116	13-Aug	2019	Little	112	1.117000	100.2685765
117	13-Aug	2020	Beaver	2	2.000000	1.0000000
118	13-Aug	2020	Gothic	3	2.000000	1.5000000
119	13-Aug	2020	Seans	21	2.000000	10.5000000
120	13-Jul	2011	Copper	2	2.000000	1.0000000
121	13-Jul	2011	Hill	6	2.000000	3.0000000
122	13-Jul	2011	Little	4	2.000000	2.0000000

	date_sampled	year	site	n	time	rate
123	13-Jul	2014	Tuttle	9	1.750000	5.1428571
124	13-Jul	2014	Willey	4	2.000000	2.0000000
125	13-Jul	2015	Davids	19	2.000000	9.5000000
126	13-Jul	2015	Tuttle	19	1.000000	19.0000000
127	13-Jul	2015	Willey	18	1.000000	18.0000000
128	13-Jul	2017	Rustlers	19	1.000000	19.0000000
129	13-Jul	2018	CDOT	1	2.000000	0.5000000
130	13-Jun	2013	Beaver	2	2.000000	1.0000000
131	13-Jun	2013	Seans	7	2.000000	3.5000000
132	13-Jun	2014	Almont	4	2.000000	2.0000000
133	13-Jun	2014	Davids	3	2.000000	1.5000000
134	13-Jun	2014	Tuttle	3	2.000000	1.5000000
135	13-Jun	2014	Willey	2	2.000000	1.0000000

	date_sampled	year	site	n	time	rate
136	13-Sep	2011	Tuttle	2	2.000000	1.0000000
137	13-Sep	2011	Willey	2	2.000000	1.0000000
138	14-Aug	2013	Copper	10	1.000000	10.0000000
139	14-Aug	2013	Hill	64	2.000000	32.0000000
140	14-Aug	2013	Little	22	1.000000	22.0000000
141	14-Aug	2015	Elko	30	2.000000	15.0000000
142	14-Aug	2015	Mexican Cut	39	2.000000	19.500000
143	14-Aug	2018	Beaver	1	2.000000	0.5000000
144	14-Aug	2018	Gothic	9	2.000000	4.5000000
145	14-Aug	2018	Seans	79	2.000000	39.5000000
146	14-Aug	2019	Almont	7	1.466666	4.7727294
147	14-Aug	2019	Almont Curve	9	2.000000	4.5000000
148	14-Aug	2020	Hill	5	2.000000	2.5000000

	date_sampled	year	site	n	time	rate
149	14-Aug	2020	Little	17	2.000000	8.5000000
150	14-Jul	2009	Copper	8	2.000000	4.0000000
151	14-Jul	2009	Hill	26	2.000000	13.0000000
152	14-Jul	2009	Little	15	2.000000	7.5000000
153	14-Jul	2015	Beaver	42	2.000000	21.0000000
154	14-Jul	2015	Gothic	7	1.000000	7.0000000
155	14-Jul	2015	Seans	10	1.000000	10.0000000
156	14-Jul	2016	Beaver	61	2.000000	30.5000000
157	14-Jul	2016	Gothic	15	2.000000	7.5000000
158	14-Jul	2016	Seans	10	2.000000	5.0000000
159	14-Jul	2017	Almont Curve	8	1.580000	5.0632911
160	14-Jul	2020	CDOT	2	2.000000	1.0000000
161	14-Jun	2017	Rustlers	8	2.000000	4.0000000

	date_sampled	year	site	n	time	rate
162	14-Jun	2018	Tuttle	3	2.000000	1.5000000
163	14-Jun	2018	Willey	4	2.000000	2.0000000
164	14-Jun	2019	Almont Curve	2	2.000000	1.0000000
165	14-May	2012	Davids	1	2.000000	0.5000000
166	14-May	2012	Tuttle	7	2.000000	3.5000000
167	14-May	2012	Willey	1	2.000000	0.5000000
168	14-Sep	2011	Mexican Cut	16	2.000000	8.000000
169	14-Sep	2019	Mexican Cut	5	1.500000	3.3333333
170	14-Sep	2019	North Elko	2	1.500000	1.3333333
171	15-Aug	2013	Mexican Cut	16	2.000000	8.000000
172	15-Aug	2016	Rustlers	34	2.000000	17.0000000
173	15-Aug	2017	Elko	13	2.000000	6.5000000
174	15-Aug	2017	Mexican Cut	27	2.000000	13.500000

	date_sampled	year	site	n	time	rate
175	15-Aug	2019	CDOT	88	2.000000	44.0000000
176	15-Aug	2019	Lypps	24	2.000000	12.0000000
177	15-Jul	2014	Beaver	5	2.000000	2.5000000
178	15-Jul	2014	Gothic	2	1.000000	2.0000000
179	15-Jul	2014	Seans	3	2.000000	1.5000000
180	15-Jul	2015	Copper	21	2.000000	10.5000000
181	15-Jul	2015	Hill	31	2.000000	15.5000000
182	15-Jul	2015	Little	39	2.000000	19.5000000
183	15-Jul	2016	Rustlers	32	2.000000	16.0000000
184	15-Jul	2019	WG 2D	5	2.000000	2.5000000
185	15-Jul	2019	WG 2W	24	2.000000	12.0000000
186	15-Jul	2020	Rustlers	2	1.000000	2.0000000
187	15-Jul	2021	Beaver	60	1.500000	40.0000000

	date_sampled	year	site	n	time	rate
188	15-Jul	2021	Gothic	81	1.500000	54.0000000
189	15-Jul	2021	Seans	21	1.833333	11.4545475
190	15-Jun	2011	Gothic	1	2.000000	0.5000000
191	15-Jun	2015	Copper	27	2.000000	13.5000000
192	15-Jun	2015	Hill	3	2.000000	1.5000000
193	15-Jun	2015	Little	34	2.000000	17.0000000
194	15-Jun	2017	Copper	7	2.000000	3.5000000
195	15-Jun	2017	Little	37	2.000000	18.5000000
196	15-Jun	2020	CDOT	2	2.000000	1.0000000
197	15-Jun	2021	CDOT	2	2.000000	1.0000000
198	15-Jun	2021	Lypps	2	2.000000	1.0000000
199	15-May	2012	Beaver	3	2.000000	1.5000000
200	15-May	2012	Seans	1	2.000000	0.5000000

	date_sampled	year	site	n	time	rate
201	15-May	2018	Lypps	2	2.000000	1.0000000
202	16-Aug	2010	Tuttle	17	2.000000	8.5000000
203	16-Aug	2010	Willey	2	1.350000	1.4814815
204	16-Aug	2017	Beaver	13	2.000000	6.5000000
205	16-Aug	2017	Gothic	9	2.000000	4.5000000
206	16-Aug	2017	Seans	68	2.000000	34.0000000
207	16-Aug	2018	North Elko	12	1.400000	8.5714286
208	16-Aug	2021	Copper	18	1.000000	18.0000000
209	16-Aug	2021	Hill	25	1.000000	25.0000000
210	16-Aug	2021	Little	56	1.000000	56.0000000
211	16-Jul	2009	Beaver	10	2.000000	5.0000000
212	16-Jul	2009	Gothic	9	2.000000	4.5000000
213	16-Jul	2009	Seans	3	2.000000	1.5000000

	date_sampled	year	site	n	time	rate
214	16-Jul	2014	Copper	1	1.000000	1.0000000
215	16-Jul	2014	Hill	7	2.000000	3.5000000
216	16-Jul	2014	Little	1	1.000000	1.0000000
217	16-Jul	2015	CDOT	13	2.000000	6.5000000
218	16-Jul	2015	Lypps	1	2.000000	0.5000000
219	16-Jul	2015	Rustlers	16	2.000000	8.0000000
220	16-Jul	2018	Beaver	15	2.000000	7.5000000
221	16-Jul	2018	Gothic	17	2.000000	8.5000000
222	16-Jul	2018	Seans	27	2.000000	13.5000000
223	16-Jul	2019	Copper	2	2.000000	1.0000000
224	16-Jul	2019	Hill	1	2.000000	0.5000000
225	16-Jul	2019	Little	2	2.000000	1.0000000
226	16-Jul	2021	Mexican Cut	18	1.666666	10.8000043

	date_sampled	year	site	n	time	rate
227	16-Jul	2021	North Elko	46	1.666666	27.6000110
228	16-Jun	2016	Beaver	5	2.000000	2.5000000
229	16-Jun	2016	Gothic	4	2.000000	2.0000000
230	16-Jun	2016	Seans	10	2.000000	5.0000000
231	16-Jun	2017	Almont Curve	7	2.000000	3.5000000
232	16-Jun	2020	Beaver	11	1.916666	5.7391324
233	16-Jun	2020	Gothic	3	2.000000	1.5000000
234	16-Jun	2020	Seans	18	1.750000	10.2857143
235	16-May	2021	Davids	1	2.000000	0.5000000
236	16-May	2021	Seans	3	2.000000	1.5000000
237	17-Aug	2009	Davids	10	2.000000	5.0000000
238	17-Aug	2009	Tuttle	31	2.000000	15.5000000
239	17-Aug	2009	Wiley	13	2.000000	6.5000000

	date_sampled	year	site	n	time	rate
240	17-Aug	2010	Beaver	10	2.000000	5.0000000
241	17-Aug	2010	Gothic	17	2.000000	8.5000000
242	17-Aug	2010	Seans	27	2.000000	13.5000000
243	17-Aug	2011	Mexican Cut	15	2.000000	7.500000
244	17-Aug	2017	CDOT	13	2.000000	6.5000000
245	17-Aug	2017	Lypps	24	2.000000	12.0000000
246	17-Aug	2018	Copper	2	2.000000	1.0000000
247	17-Aug	2018	Little	4	2.000000	2.0000000
248	17-Aug	2021	CDOT	20	1.416666	14.1176537
249	17-Aug	2021	Lypps	8	1.416666	5.6470615
250	17-Jul	2015	Elko	9	2.000000	4.5000000
251	17-Jul	2015	Mexican Cut	1	2.000000	0.500000
252	17-Jul	2017	Copper	16	2.000000	8.0000000

	date_sampled	year	site	n	time	rate
253	17-Jul	2017	Hill	30	2.000000	15.0000000
254	17-Jul	2017	Little	50	2.000000	25.0000000
255	17-Jul	2018	Mexican Cut	29	2.000000	14.5000000
256	17-Jul	2018	North Elko	23	1.000000	23.0000000
257	17-Jul	2019	North Elko	2	2.000000	1.0000000
258	17-Jul	2020	Beaver	1	2.000000	0.5000000
259	17-Jul	2020	Gothic	2	2.000000	1.0000000
260	17-Jul	2020	Seans	19	1.800000	10.5555556
261	17-Jun	2010	Beaver	4	2.000000	2.0000000
262	17-Jun	2010	Gothic	5	2.000000	2.5000000
263	17-Jun	2010	Seans	7	2.000000	3.5000000
264	17-Jun	2013	Davids	3	2.000000	1.5000000
265	17-Jun	2013	Tuttle	1	2.000000	0.5000000

	date_sampled	year	site	n	time	rate
266	17-Jun	2013	Willey	1	2.000000	0.5000000
267	17-Jun	2014	Beaver	1	2.000000	0.5000000
268	17-Jun	2014	Gothic	4	2.000000	2.0000000
269	17-Jun	2014	Seans	3	2.000000	1.5000000
270	17-Jun	2015	Rustlers	11	2.000000	5.5000000
271	17-Jun	2021	Copper	4	2.000000	2.0000000
272	17-Jun	2021	Hill	4	2.000000	2.0000000
273	17-Jun	2021	Little	18	2.000000	9.0000000
274	17-May	2018	Willey	1	1.600000	0.6250000
275	17-May	2020	Seans	5	2.000000	2.5000000
276	18-Aug	2010	Copper	17	2.000000	8.5000000
277	18-Aug	2010	Hill	24	2.000000	12.0000000
278	18-Aug	2010	Little	31	2.000000	15.5000000

	date_sampled	year	site	n	time	rate
279	18-Aug	2016	CDOT	5	1.000000	5.0000000
280	18-Aug	2016	Lypps	1	1.000000	1.0000000
281	18-Aug	2017	Copper	4	2.000000	2.0000000
282	18-Aug	2017	Hill	9	2.000000	4.5000000
283	18-Aug	2017	Little	46	2.000000	23.0000000
284	18-Aug	2020	Davids	10	2.000000	5.0000000
285	18-Aug	2020	Tuttle	11	2.000000	5.5000000
286	18-Aug	2020	Willey	7	2.000000	3.5000000
287	18-Aug	2021	Beaver	12	1.000000	12.0000000
288	18-Aug	2021	Gothic	17	1.100000	15.4545455
289	18-Aug	2021	Seans	115	1.000000	115.0000000
290	18-Jul	2012	Copper	1	2.000000	0.5000000
291	18-Jul	2012	Little	1	2.000000	0.5000000

	date_sampled	year	site	n	time	rate
292	18-Jul	2016	Almont Curve	6	1.000000	6.0000000
293	18-Jul	2018	Rustlers	13	2.000000	6.5000000
294	18-Jul	2019	Almont	1	2.000000	0.5000000
295	18-Jul	2019	Almont Curve	5	2.000000	2.5000000
296	18-Jun	2010	Copper	9	2.000000	4.5000000
297	18-Jun	2010	Little	8	2.000000	4.0000000
298	18-Jun	2012	Little	5	2.000000	2.5000000
299	18-Jun	2014	Copper	3	2.000000	1.5000000
300	18-Jun	2014	Hill	2	1.000000	2.0000000
301	18-Jun	2014	Little	2	2.000000	1.0000000
302	18-Jun	2015	Davids	26	2.000000	13.0000000
303	18-Jun	2015	Tuttle	8	2.000000	4.0000000
304	18-Jun	2015	Willey	1	2.000000	0.5000000

	date_sampled	year	site	n	time	rate
305	18-Jun	2018	Elko	1	1.000000	1.0000000
306	18-Jun	2020	Almont Curve	2	2.000000	1.0000000
307	18-May	2013	Almont	2	2.000000	1.000000
308	18-May	2015	CDOT	8	2.000000	4.0000000
309	18-May	2020	CDOT	7	0.716666	9.7674509
310	18-May	2020	Lypps	2	0.816666	2.4489816
311	19-Aug	2013	Almont	1	2.000000	0.500000
312	19-Aug	2013	Davids	14	1.000000	14.0000000
313	19-Aug	2013	Tuttle	51	2.000000	25.5000000
314	19-Aug	2013	Willey	38	1.250000	30.4000000
315	19-Aug	2016	Almont Curve	1	2.000000	0.5000000
316	19-Aug	2019	Davids	80	2.000000	40.0000000
317	19-Aug	2019	Tuttle	89	0.750000	118.6666667

	date_sampled	year	site	n	time	rate
318	19-Aug	2019	Willey	63	1.000000	63.0000000
319	19-Jul	2010	Davids	2	2.000000	1.0000000
320	19-Jul	2010	Tuttle	20	2.000000	10.0000000
321	19-Jul	2010	Willey	9	2.000000	4.5000000
322	19-Jul	2013	Beaver	21	1.000000	21.0000000
323	19-Jul	2013	Gothic	30	1.000000	30.0000000
324	19-Jul	2013	Seans	12	1.300000	9.2307692

Table 2: Bombus Caught per Hour

“N” refers to the number of bees caught that day, time is the total amount of time netting during that day at that site, and rate is the rate of bee per hour caught.

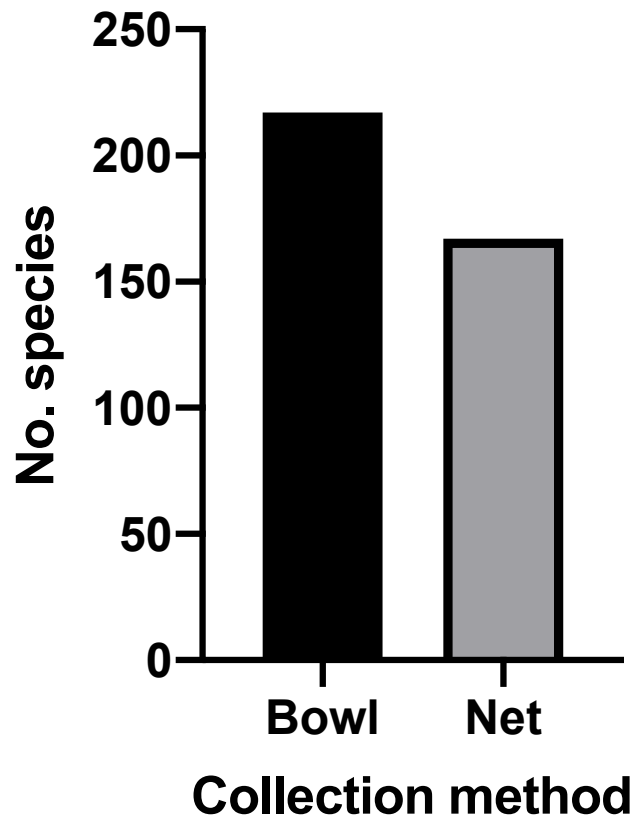


Figure 3: Number of Species Collected by Net versus Bowl

Genera in bowls vs. nets (top 20 listed for each in descending order of abundance)

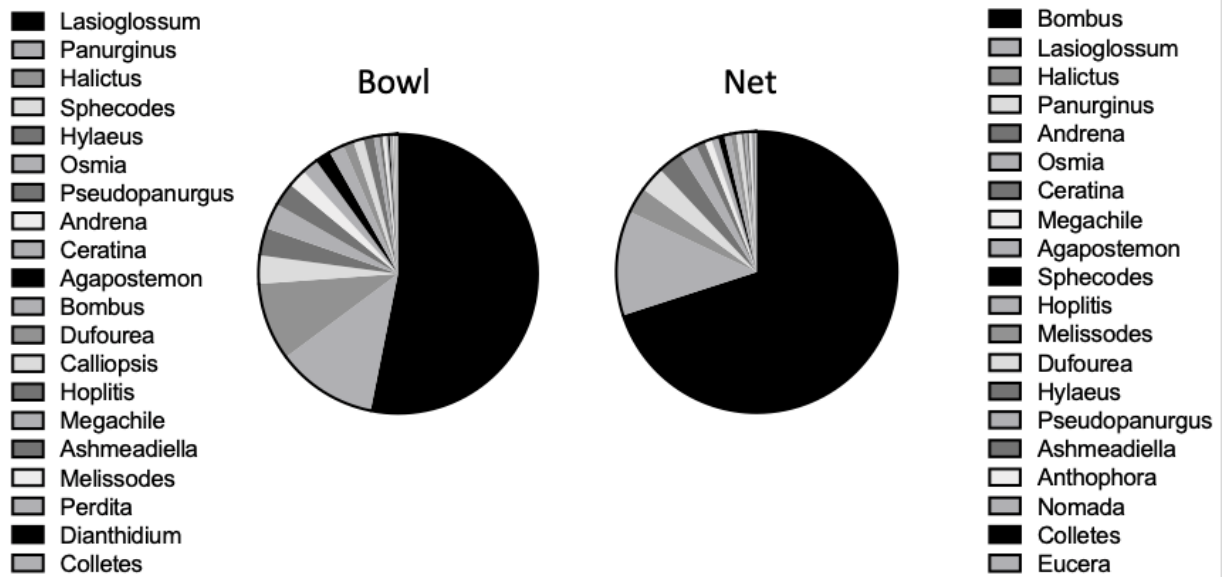


Figure 4: Pie Charts Comparing Genera Between Bowls and Nets

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