Bees of the Cove Point Liquefied Natural Gas Site and Vicinity, Calvert County, Maryland

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BACKGROUND

This report describes the results of a bee survey carried out by Leo Shapiro under contract with the Cove Point Natural Heritage Trust (CPNHT), working in close collaboration with Sam Droege of Patuxent Wildlife Research Center (USGS).

Recently there has been great concern about dramatic declines of the managed honeybee populations on which much of our agriculture depends. There is strong evidence that many of our relatively well studied bumblebees are declining as well—some quite precipitously—but in general very little is known about the status of the remainder of native species. Roughly 800 species of bees occur in North America east of the Mississippi, including 390 species known from Maryland (with additional survey data in upcoming years we are likely to find that the actual total is closer to 450). Many of these bees are important pollinators in both natural and anthropogenic ecosystems.

Even in eastern North America, our bee fauna remains surprisingly poorly known. Although this fauna is far better known than that of western North America and many other regions, our knowledge of even basic geographic distribution remains limited. As an illustration of the current inadequacy of our information about bee distributions even in eastern North America, in most of the National Wildlife Refuges Droege and others have surveyed along the East Coast (Assateague, Carolina Sandhills, Patuxent, Heinz, and others) new state records, and often quite rare species, have been discovered, and these have been the first documented sets of bee records for all of them. In recent years, Carolina Sandhills alone has recently produced about 100 new state records for South Carolina!

As part of an ongoing effort by CPNHT to develop a baseline inventory of the biodiversity of Cove Point, Maryland, we undertook a survey of the bees of this area. Additional sampling would surely yield additional species, but the results reported here represent a solid foundation for future surveys.

METHODS

We established 17 sampling sites around the Cove Point Dominion LNG site and vicinity. Eight sites were in the natural areas immediately surrounding the footprint of the plant itself, six sites were in Chesapeake Bay beach swales south of this area, and three sites were just to the west in Cove Point Park along the natural gas right-of- way (Figure 1, Table 1). Previous analyses based on our work in numerous National Wildlife Refuges in USFWS Region 5 (which includes the 13 states from Maine to Virginia) has suggested that sites in moderate proximity such as these can be treated as multiple replicate samples of the same bee fauna (Shapiro and Droege 2009). Sites 1 through 3 were in open areas around the perimeter of Lake Levy, Site 4 was in a somewhat open area between Lake Levy and Lake Osborne, Site 5 was in a somewhat open area between a wooded stream and a paved work area, Site 6 was along the beach edge of a marsh, Site 7 was on a wooded ridge above the Bay, and Site Sam20 was an open area in woods.

Most bee species do not fly throughout the bee flight year. In fact, entire genera may be almost completely associated with spring or late summer/fall, making it essential to sample across the entire flight season to have even a chance of detecting all bees occurring at a site during the course of a year. We sampled bees on seven dates across the spring, summer, and fall (Table 2). Most sites were sampled on each date, the main exception being sites 16 and Sam20, which were sampled only on 20 March 2008.

Our sampling relied mainly on pan-trapping using what we refer to as "bee bowls" (Shapiro and Droege 2009; Droege 2009) Bee bowls are small plastic deli cups (painted white, fluorescent blue, or fluorescent yellow), partly filled with slightly soapy water (Blue Dawn dishwashing liquid), and placed out on the ground in potential bee habitat for ~24 hours. Bees are attracted to the bowls, but due to the reduced surface tension of the soapy water they cannot fly out. Bowls were placed out in 15-bowl "transects" (not necessarily straight), alternating colors, with about 5 m between bowls. Grass and other obscuring vegetation were avoided whenever possible. Some bees were netted as well, but at most sites floral resources and bees were low and not conspicuous, making netting impractical.

To estimate true species richness from our sampling, we used EstimateS (Colwell 2006) to calculate the Chao2 and Jack2 nonparametric incidence-based estimators of asymptotic species richness. These estimators are based mainly on the number of sites at which rare species were detected in the original sampling data (Chao 1987; Palmer 1991; Walther and Martin 2001).

RESULTS

In total, across our seven dates and 17 sites, we collected 699 bees, representing a minimum of 83 species (summarized by date and site, respectively, in Tables 2 and 3).

(It should be noted that 204 of these 699 bees were *Ptilothrix bombiformis*, with 198 of these 204 captured on our single July sampling date, accounting for 70% of the individual bees captured on this date). Excluding our extreme outlier March collecting date, which involved a large number of bowls but yielded a total of just 4 individual bees, we captured 695 bees from around 1320 bowls, giving a capture rate of about 0.5 bees/bowl, which is a moderately low but unremarkable yield for bee bowls (the actual capture rate was slightly higher than this since this calculation ignores lost and damaged bowls).

In fact, our species total is almost surely a bit higher than 83, but in several instances the limits of current understanding of species boundaries preclude identification to the species level. The following "species" in our data set involve such ambiguities: (1) *Hylaeus affinus* and *H. modestus* are probably both present in our Cove Point collections, but we cannnot yet confidently distinguish these two species so we have lumped them together; (2) We almost surely collected more than one species from within the *Lasioglossum viridatum* group, but taxonomic understanding of this group is currently in flux; in Tables 2 and 3, we have recognized three "morphospecies" (*L. viridatum* A, *L. viridatum* B, and *L. viridatum* C), which may or may not turn out to perfectly match valid species recognized in the future, but because of their provisional nature, for species tallies and analyses we pooled these morphospecies as a single *L. viridatum* group. (3) *Nomada* "bidentate" and *Nomada* "white setae" are both complexes of species, the boundaries of which are currently being worked out by Droege and collaborators; for this report, again using a morphospecies approach, we recognize a single *Nomada* "white setae" form, *Nomada* "bidentate" A, and *Nomada* "bidentate" B . As for the *L. viridatum* group, for species tallies and analyses we have pooled these latter two morphospecies under the single name *Nomada* "bidentate". (4) Occasional *Ceratina* individuals cannot be easily classified as either *C. dupla* or *C. calcarata* (a single individual in this dataset, shown in Tables 1 and 2), but this difficulty does not affect our total species count since both clear *C. dupla* and clear *C. calcarata* are present in our collections. (5) Many *Lasioglossum* males cannot currently be identified to species. We did not count the single such male in our collections as an additional species because it is quite possible that it represents a species we have already collected. (6) Both the more northern *Halictus ligatus* and the more southern *H. poeyi* probably occur in Maryland, but because we cannot yet confidently distinguish these two species morphologically, we list these bees as *H. ligatus*/*H. poeyi*. Three additional species have some degree of uncertainty about their identities, but have been included in our tallies and analyses: *Lasioglossum* "kevini", *Triepeolus obliteratus,* and *Ceratina floridana*. Our *Lasioglossum* "kevini" was confirmed by Jason Gibbs, who is revising the *Lasioglossum* of eastern North America and is currently using this provisional name for what is either a new species or the female of *L. philanthanum*. The *Triepeolus obliteratus* was determined by Dr. Molly Rightmyer, who is

a leading expert on this genus but was not absolutely certain of the identification. *Ceratina floridana* looks very much like *C. dupla* and our identification is tentative, but will be followed up with the researcher currently working on the systematics of this group.

As is often the case with surveys of terrestrial arthropods, a large proportion of species were detected only once or a few times. In fact, well over half the species were captured only once or twice (Figure 2). Some of these rarely sampled species may have been truly rare at Cove Point during our sampling period, while in other cases apparent rarity may be a sampling artifact (e.g., some species, such as the honeybee *Apis mellifera*, do not often show up in bowls even if they are present) or represent bees that are simply dispersing from sites off the property and are not a major component of the regular Cove Point fauna. In either case, however, this frequency distribution suggests that our sampling (as is the case for nearly all faunal investigations of bees) is incomplete with respect to the actual number of bee species that could be found occurring at Cove Point. As is typical for bees in eastern North America, the greatest numbers of both species and individuals (ignoring the 198 *Ptilothrix bombiformis* captured in July) were encountered in the spring (Table 2), when a great number of specialists are out on flowers and woody plants and vernal forbs associated with woodlands are in bloom.

Although the observed number of species was only 83 (excluding three provisional morphospecies), statistical estimators of species richness suggest a true species richness for the sites and dates sampled of around 150 species (Chao2: 153, estimated 95% confidence limits 114 and 243; Jack2: 148). These numbers should be interpreted cautiously as very general estimates (Colwell 2006), especially given the known tendency of these estimators to underestimate species richness given the degree of incomplete sampling common in real-world surveys (Coddington et al 2009).

Appendix 1 includes brief comments on the species found in this survey. Collection data for each individual bee collected in this study are incorporated in the publicly available online database at www.discoverlife.org: all records for individual species in the database (not only those from this study) can be viewed using the Global Mapper (http://pick14.pick.uga.edu/mp/20m?act=make_map). For most species sampled, we provide maps in Appendix 2 showing all sites at which they were detected (for the following OTUs, we do not provide maps, but all recorded occurrences are still shown in Tables 1 and 2: *Andrena* sp., *Ceratina dupla*/*calcarata*, *Lasioglossum* sp. male, *Lasioglossum viridatum* A, *L. viridatum* B, *L. viridatum* C, *Nomada* "bidentate" A, *Nomada* "bidentate" B, and *Nomada* "white setae").

DISCUSSION

Despite the relative lack of conspicuous floral resources around most of our sampling sites and a fairly low number of captures, in the course of this survey we caught more than a fifth of the bee species known from Maryland. If we were to exclude from the Maryland total bees always associated with ecological conditions clearly not present at Cove Point, the fraction of potential bees actually encountered in just seven days of sampling is even higher. Furthermore, given the prevalence in our data set of species captured just once or twice, there is little doubt that additional sampling would yield additional species.

ACKNOWLEDGEMENTS

We are grateful to the Cove Point Natural Heritage Trust and, in particular, to Bob Boxwell for providing the opportunity to carry out this survey, and to Dominion Cove Point LNG for facilitating access to their property. We thank Molly Rightmyer for identifying our *Triepeolus obliteratus* specimen.

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Table 1. The 17 sampling sites.

SITE	LATITUDE	LONGITUDE
1	38.3871	-76.4044
2	38.3887	-76.4044
3	38.3890	-76.4029
4	38.3882	-76.4016
5	38.3905	-76.4019
6	38.3922	-76.3997
7	38.3957	-76.4038
8	38.3863	-76.3869
9	38.3868	-76.3857
10	38.3870	-76.3859
11	38.3871	-76.3864
12	38.3871	-76.3864
13	38.3886	-76.4218
14	38.3886	-76.4176
15	38.3884	-76.4251
16	38.3857	-76.3879
Sam20	38.3921	-76.4041

Table 2. Bees collected, by date.

SPECIES	20 Mar. 2008	26-27 Apr. 2008	3-4 May 2007	22-23 June 2007	21-22 July 2007	24-25 Aug. 2007	7-8 Oct. 2007	TOTAL
Agapostemon splendens	0	0	0	0	1	0	0	1
Agapostemon virescens	0	3	2	4	13	3	1	26
Andrena banksi	0	0	2	0	0	0	0	2
Andrena bradleyi	0	1	0	0	0	0	0	1
Andrena erigeniae	0	7	8	0	0	0	0	15
Andrena hilaris	0	0	1	0	0	0	0	1
Andrena imitatrix	0	0	1	0	0	0	0	1
Andrena macra	0	1	0	0	0	0	0	1
Andrena nasonii	0	0	1	0	0	0	0	1
Andrena neonana	0	0	8	0	0	0	0	8
Andrena perplexa	0	3	4	0	0	0	0	7
***Andrena* sp.**	0	1	0	0	0	0	0	1
Andrena vicina	0	1	0	0	0	0	0	1
Andrena violae	0	1	5	0	0	0	0	6
Apis mellifera	0	0	0	1	0	0	1	2
Augochlorella aurata	0	0	7	2	3	0	0	12
Augochloropsis metallica	0	0	1	0	0	0	0	1
Bombus bimaculatus	0	0	0	7	0	0	0	7
Bombus fervidus	0	0	0	0	1	0	0	1
Bombus griseocollis	0	0	0	7	0	0	0	7
Bombus impatiens	0	1	0	0	0	0	4	5
Bombus pensylvanicus	0	0	1	0	0	0	0	1

SPECIES	20 Mar. 2008	26-27 Apr. 2008	3-4 May 2007	22-23 June 2007	21-22 July 2007	24-25 Aug. 2007	7-8 Oct. 2007	TOTAL
Calliposis andreniformis	0	0	0	0	1	4	0	5
Ceratina calcarata	0	9	0	0	0	1	0	10
Ceratina dupla	0	7	0	0	4	4	1	16
***Ceratina floridana*?**	0	0	0	0	0	0	1	1
Ceratina strenua	0	1	0	0	0	0	0	1
Coelioxys sayi	0	0	0	0	0	0	1	1
Colletes inaequalis	1	0	0	0	0	0	0	1
Colletes latitarsis	0	0	0	1	0	0	0	1
Epeolus lectoides	0	0	0	0	0	1	0	1
Eucera hamata	0	1	1	0	0	0	0	2
Habropoda laboriosa	0	0	1	0	0	0	0	1
Halictus confusus	0	0	0	0	1	0	0	1
Halictus ligatus/poeyi	0	1	0	7	34	4	1	47
Halictus parallelus	0	0	0	1	0	0	0	1
Halictus rubicundus	0	0	0	2	0	0	0	2
Hoplitis pilosifrons	0	7	1	0	0	0	0	8
Hoplitis spoliata	0	0	1	0	0	0	0	1
Hylaeus affinus/modestus	0	0	0	2	0	1	1	4
Hylaeus ornatus	0	0	0	4	0	0	0	4
Lasioglossum bruneri	0	0	0	2	1	5	0	8
Lasioglossum callidum	0	1	2	1	1	0	0	5
Lasioglossum coeruleum	0	0	0	2	0	0	0	2
Lasioglossum coreopsis	0	1	0	0	1	1	1	4

SPECIES	20 Mar. 2008	26-27 Apr. 2008	3-4 May 2007	22-23 June 2007	21-22 July 2007	24-25 Aug. 2007	7-8 Oct. 2007	TOTAL
Lasioglossum fuscipenne	0	0	0	5	0	0	1	6
Lasioglossum illinoense	0	0	0	0	0	1	0	1
Lasioglossum **"kevini"**	1	0	0	0	0	0	0	1
Lasioglossum marinum	0	0	0	16	5	2	0	23
Lasioglossum oblongum	0	0	0	11	4	1	1	17
Lasioglossum pectorale	0	0	0	1	0	0	0	1
Lasioglossum pilosum	0	0	1	0	0	0	0	1
Lasioglossum tegulare	0	0	0	2	0	0	2	4
Lasioglossum versans	0	0	0	0	0	1	0	1
Lasioglossum viridatum **A**	0	0	1	5	0	0	0	6
Lasioglossum viridatum **B**	1	0	0	0	0	0	0	1
Lasioglossum viridatum **C**	0	1	1	1	0	0	0	3
Megachile brevis	0	0	1	1	1	0	1	4
Megachile exilis	0	0	0	0	0	0	1	1
Megachile mendica	0	0	0	0	5	0	0	5
Megachile sculpturalis	0	0	0	1	0	0	0	1
Melissodes comptoides	0	0	0	0	0	9	0	9
Melissodes **near** ***subillata***	0	0	0	1	0	0	0	1
Melissodes trinodis	0	0	0	1	8	0	0	9
Melitoma taurea	0	0	0	0	1	1	0	2
Nomada australis	0	1	1	0	0	0	0	2
Nomada **"bidentate" A**	1	0	9	0	0	0	0	10
Nomada **"bidentate" B**	0	0	1	0	0	0	0	1

SPECIES	20 Mar. 2008	26-27 Apr. 2008	3-4 May 2007	22-23 June 2007	21-22 July 2007	24-25 Aug. 2007	7-8 Oct. 2007	TOTAL
Nomada imbricata	0	0	3	0	0	0	0	3
Nomada luteola	0	0	1	0	0	0	0	1
Nomada luteoloides	0	1	0	0	0	0	0	1
***Nomada* "white setae"**	0	2	1	0	0	0	0	3
Osmia atriventris	0	1	1	0	0	0	0	2
Osmia bucephala	0	12	12	0	0	0	0	24
Osmia collinsiae	0	2	2	0	0	0	0	4
Osmia conjuncta	0	0	5	0	0	0	0	5
Osmia georgica	0	0	1	0	0	0	0	1
Osmia inspergens	0	1	0	0	0	0	0	1
Osmia lignaria	0	2	0	0	0	0	0	2
Osmia pumila	0	47	42	0	0	0	0	89
Osmia taurus	0	1	0	0	0	0	0	1
Peponapis pruinosa	0	0	0	0	0	1	0	1
Ptilothrix bombiformis	0	0	0	0	198	6	0	204
Sphecodes coronus	0	6	1	0	0	0	0	7
***Triepeolus obliteratus*?**	0	0	0	0	0	0	1	1
Xylocopa virginica	0	0	0	0	0	2	0	2
Ceratina dupla/calcarata	0	0	0	0	1	0	0	1
***Lasioglossum* sp. male**	0	0	0	1	0	0	0	1
Total individuals	4	124	131	89	284	48	19	699
Total species (minimum)	4	28	32	24	18	18	15	83

Table 3. Bees collected, by site.

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sam 20	TOTAL
Agapostemon splendens	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Agapostemon virescens	1	5	15	1	0	0	0	0	1	0	0	0	2	0	1	0	0	26
Andrena banksi	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Andrena bradleyi	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Andrena erigeniae	1	0	1	1	2	0	5	2	0	0	0	1	1	0	1	0	0	15
Andrena hilaris	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Andrena imitatrix	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Andrena macra	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Andrena nasonii	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Andrena neonana	0	0	0	0	0	0	4	0	0	0	0	0	4	0	0	0	0	8
Andrena perplexa	0	0	0	0	2	1	3	0	0	0	0	0	0	1	0	0	0	7
***Andrena* sp.**	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Andrena vicina	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Andrena violae	3	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	6
Apis mellifera	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
Augochlorella aurata	0	5	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	12
Augochloropsis metallica	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Bombus bimaculatus	0	0	0	0	1	0	1	2	0	0	0	0	1	1	1	0	0	7
Bombus fervidus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sam 20	TOTAL
Bombus griseocollis	1	0	2	1	1	0	0	0	0	0	1	0	0	1	0	0	0	7
Bombus impatiens	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	5
Bombus pensylvanicus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Calliposis andreniformis	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	5
Ceratina calcarata	0	1	2	0	0	0	2	0	0	0	0	0	1	0	0	4	0	10
Ceratina dupla	0	2	0	0	2	0	0	3	1	1	2	3	0	0	0	2	0	16
***Ceratina floridana*?**	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ceratina strenua	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Coelioxys sayi	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Colletes inaequalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Colletes latitarsis	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Epeolus lectoides	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Eucera hamata	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Habropoda laboriosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Halictus confusus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Halictus ligatus/poeyi	1	4	32	0	0	0	0	1	1	2	0	2	1	2	1	0	0	47
Halictus parallelus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Halictus rubicundus	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Hoplitis pilosifrons	0	3	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	8
Hoplitis spoliata	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sam 20	TOTAL
Hylaeus affinus/modestus	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	4
Hylaeus ornatus	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4
Lasioglossum bruneri	1	0	0	2	0	2	0	0	0	1	1	0	1	0	0	0	0	8
Lasioglossum callidum	0	0	2	0	1	0	0	0	0	0	0	1	0	0	1	0	0	5
Lasioglossum coeruleum	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Lasioglossum coreopsis	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	4
Lasioglossum fuscipenne	0	1	0	1	1	1	0	0	0	0	0	0	1	1	0	0	0	6
Lasioglossum illinoense	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lasioglossum **“kevini”**	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Lasioglossum marinum	0	0	0	0	0	0	0	15	1	1	6	0	0	0	0	0	0	23
Lasioglossum oblongum	0	0	0	0	1	0	1	2	2	0	7	2	0	1	1	0	0	17
Lasioglossum pectorale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Lasioglossum pilosum	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Lasioglossum tegulare	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	4
Lasioglossum versans	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lasioglossum viridatum **A**	0	0	0	0	0	0	0	0	0	0	1	0	1	0	4	0	0	6
Lasioglossum viridatum **B**	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Lasioglossum viridatum **C**	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	3
Megachile brevis	0	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4
Megachile exilis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sam 20	TOTAL
Megachile mendica	0	1	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	5
Megachile sculpturalis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Melissodes comptoides	0	1	2	1	0	0	0	1	1	0	1	2	0	0	0	0	0	9
Melissodes* near *subillata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Melissodes trinodis	0	1	0	0	0	0	0	0	0	1	1	0	2	3	1	0	0	9
Melitoma taurea	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2
Nomada australis	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
***Nomada* "bidentate" A**	4	0	0	0	0	0	1	0	1	0	0	0	4	0	0	0	0	10
***Nomada* "bidentate" B**	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Nomada imbricata	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Nomada luteola	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Nomada luteoloides	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
***Nomada* "white setae"**	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
Osmia atriventris	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2
Osmia bucephala	2	6	6	0	5	0	2	1	1	0	0	0	0	1	0	0	0	24
Osmia collinsiae	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4
Osmia conjuncta	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	5
Osmia georgica	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Osmia inspergens	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Osmia lignaria	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	2

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sam 20	TOTAL
Osmia pumila	8	18	13	2	25	0	0	5	6	2	1	1	3	1	3	1	0	89
Osmia taurus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Peponapis pruinosa	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Ptilothrix bombiformis	7	30	27	9	24	37	4	13	10	13	11	4	7	4	4	0	0	204
Sphecodes coronus	0	1	5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	7
***Triepeolus obliteratus*?**	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Xylocopa virginica	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Ceratina dupla/calcarata	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
***Lasioglossum* sp. male**	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Total individuals	34	92	124	21	76	44	30	67	35	22	38	16	36	27	29	7	1	699
Total species (minimum)	14	25	22	11	19	6	14	23	18	8	15	8	20	20	17	3	1	83

Figure 1. The 17 sampling sites.

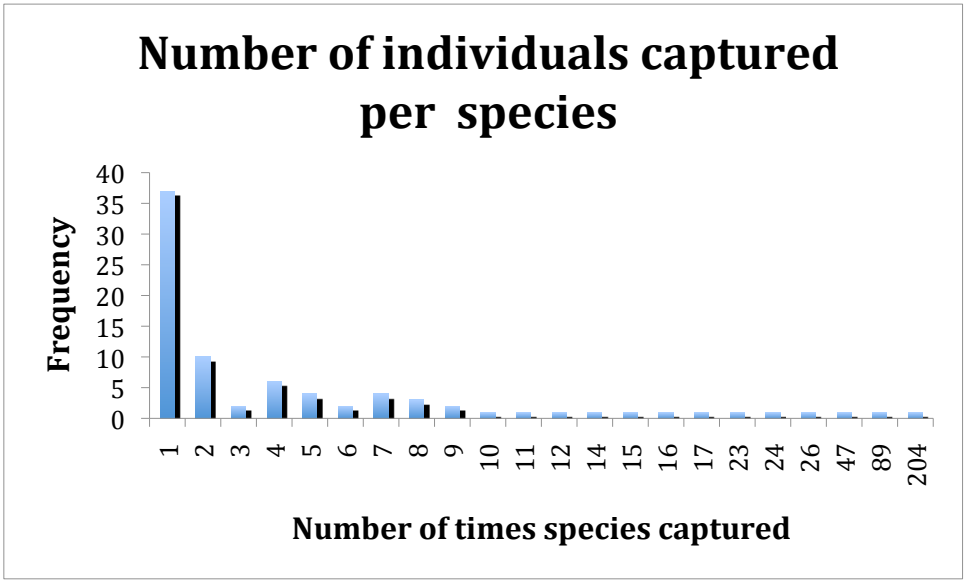

Figure 2. Number of species in each capture class (total *N* = 83).

APPENDIX 1

Agapostemon splendens – This species is associated with sandy areas. It is widespread on Maryland's Eastern Shore, but elsewhere in the state it is restricted to small pockets of sand. A single specimen was found along the beach at Site 6.

Agapostemon virescens – A ubiquitous and common species throughout the region. Captures were concentrated in the mown areas around Lake Levy, with scattered individuals elsewhere.

Andrena banksi – An uncommon spring species. Two individuals were found at Site 6 along the beach.

Andrena bradleyi – An uncommon spring species associated with woodland populations of ericaceous shrubs. One specimen was found at Site 7, which has many huckleberries (*Gaylussacia* sp.) or blueberries (*Vaccinium* sp.).

Andrena erigeniae – A regionally common species usually associated with spring beauties (*Claytonia virginica*). This species was recorded from sites throughout the study area, but oddly *Claytonia virginica* was not seen by us nor recorded during an extensive botanical investigation of Cove Point (Steury, 2002).

Andrena hilaris – An uncommon species. A single individual was recorded from Site 7.

Andrena imitatrix – A regionally relatively common species, but here only 1 specimen was detected (at Site 4).

Andrena macra – Regionally, this is an uncommon to rare species and we found just a single individual. Elsewhere in the region, we have usually found this species not far from Chesapeake Bay or a major river channel, consistent with its occurrence at Cove Point.

Andrena nasonii – A ubiquitous species of disturbed sites. One individual was found in the mown areas near Lake Levy.

Andrena neonana – A spring woodland species, relatively uncommon in the state. We found eight individuals at two wooded sites.

Andrena perplexa – A common large spring species found at several sites.

Andrena vicina – A common large spring species.

Andrena violae – As the name implies, this species is associated with violets. This species is common in the region and was found along the pipeline cut and around Lake Levy.

Apis mellifera – Although still a regular part of the Maryland bee fauna, this species is both in decline and tends to avoid bowl traps, as evidenced by just captures across just two sites.

Augochlorella aurata – A regionally abundant species of open fields, this species was found mainly around Lake Levy, with a single individual along the pipeline cut.

Augochloropsis metallica - While regularly occurring, this species is almost always found in small numbers; we detected it just once, along the pipeline cut.

***Note that *Bombus* species are usually detected in bowl traps at apparently lower rates than many other species, but it is possible this is an artifact of their high visibility.

Bombus bimaculatus – A common bumblebee; found throughout the study area.

Bombus fervidus – A regular but much less common species. One individual was found between Lake Levy and Lake Osborne.

Bombus griseocollis – A common bumblebee; found throughout the study area.

Bombus impatiens – Regionally, this is by far the most common *Bombus* species, but at Cove Point its abundance was relatively low.

Bombus pensylvanicus – A regionally rare species. One individual was detected around Lake Levy.

Calliopsis andreniformis – This species is found at highest densities in areas with disturbed compacted soils; scattered individuals were found along the pipeline cut.

Ceratina calcarata – An abundant species in Maryland, found in most field habitats. Found throughout the study area.

Ceratina dupla – A common species, *C. dupla* seems to favor drier sites than *C. calcarata*, consistent with its commonness in the present study in sandy, scrubby sites near the beach.

Ceratina floridana – One specimen has been tentatively identified as this species. Although currently listed as a subspecies of *C. dupla*, recent unpublished molecular work has suggested it is a full species. If our specimen is verified, this would be the northernmost record we are aware of.

Ceratina strenua – A regular species in the region, though less common than *C. calcarata* and *C. dupla*; this species was found only once in our survey.

Coelioxys sayi – The most common *Coelioxys* and a nest parasite of *Megachile*, this species was detected once, at Site 7.

Colletes inaequalis – This species, although a common pollinator of woody plants in spring, is rarely caught in bowl traps. One individual was caught along a sandy road at its nest with an aquarium net. Several other nesting individuals were noted at the same site.

Colletes latitarsis – A specialist on weedy ground cherries (*Physalis* spp.). This species is likely under-reported in the region and more common than generally recognized. One specimen was recorded along the pipeline cut.

Epeolus lectoides – An uncommon parasite of the genus *Colletes*. It possibly is a parasite of *C. latitarsis*. One individual was found in the present survey.

Eucera hamata – A regular, but uncommon, large spring bee of fields in the region. Two individuals were detected in the present study, one around Lake Levy and the other along the pipeline cut.

Habropoda laboriosa – This species preferentially visits ericaceous shrubs and requires deep sand for its nesting site. We are near the northern limit of its range. A single individual was found in this study, along the pipeline cut.

Halictus confusus – A regionally common member of weedy fields and disturbed areas, a single individual was found at Site 11, just behind the beach.

Halictus ligatus/ Halictus poeyi – These two species are generally considered to be impossible to tell apart morphologically; however, our impression after looking at many specimens is that these specimens are most likely *H. poeyi*, which appears to be associated with sandy coastal areas.

Halictus parallelus – A regular but uncommon species in the region. One specimen was caught along the pipeline cut.

Halictus rubicundus – Similar in appearance to *H. parallelus*, this species is regionally a bit more common and two individuals were detected at Cove Point.

Hoplitis pilosifrons – A regular coastal plain species, several individuals were detected around Lake Levy.

Hoplitis spoliata – A less common *Hoplitis* than *H. pilosifrons*, this species was detected in an open sandy area behind the beach at Site 8.

Hylaeus affinus/Hylaeus modestus – These two species are the most common *Hylaeus* species in the region. Unfortunately, females are not currently thought to be separable by morphology. Four individuals were found across four sites.

Hylaeus ornatus – This species appears to be associated with coastal plain wetlands and four specimens were captured in an open sandy area behind the beach at Site 8.

Lasioglossum bruneri – A common species in the region.

Lasioglossum callidum - A common species associated with open areas; five individuals were captured in the present study.

Lasioglossum coeruleum – An uncommon species associated with woodlands. We captured two individuals on the wooded ridge at Site 7.

Lasioglossum coreopsis – A common species in the region associated with open areas.

Lasioglossum fuscipenne - A common species in the region associated with open areas.

*Lasioglossum illino*ense - A common species in the region associated with open areas. Only one specimen was captured in the present study, near Lake Levy.

Lasioglossum marinum – A species associated with dunes and coastal beaches. All specimens in the present study were obtained in the open sandy areas behind the beach at Site 8 and adjacent sites.

Lasioglossum oblongum – A regionally uncommon species.

Lasioglossum pectorale – A regular species of fields in the region; we captured only one specimen, along the pipeline cut.

Lasioglossum pilosum – It was odd to see so few *L. pilosum* in this study. This species occurs commonly in open sites in the region and can be abundant in sandy areas where *L. marinum* also occurs. In the present study only one specimen found.

Lasioglossum tegulare - A common species in the region, associated with open areas.

Lasioglossum versans – An uncommon species. Although usually associated with woodlands, the one specimen detected was found in the open area around Lake Levy.

Lasioglossum viridatum group – The genus *Lasioglossum* is currently undergoing revision and members of this group are thought to represent several species.

Lasioglossum "*kevini*" – This determination was confirmed by Jason Gibbs, who is revising the *Lasioglossum* of eastern North America and is currently using this provisional name for what is either an undescribed species or the female of *L. philanthanum*. Gibbs reports that in his experience this bee is fairly common, but never abundant.

Megachile brevis – A common species in the region.

Megachile exilis – A somewhat uncommon species in the region. One specimen was found in an open sandy area behind the beach at Site 9.

Megachile mendica – A common species in the region.

Megachile sculpturalis – A very large alien species that favors leguminous plants. One specimen was found in an open sandy area behind the beach at Site 8.

Melissodes comptoides – A common coastal plain species. This species was captured both around Lake Levy and in the open sandy areas behind the beach at Site 8 and adjacent sites.

Melissodes near *subillata* – Species in this group are often difficult to determine to the species level. Comprison of one specimen captured near Lake Levy with museum collections suggested that it was close to *M. subillata* in its characteristics, but not a perfect match.

Melissodes trinodis – A common coastal plain species.

Melitoma taurea – A morning glory/bindweed specialist. Two individuals were captured.

Nomada australis – A nest parasite of *Andrena*. Two individuals were captured.

Nomada "bidentate": – Members of this group are taxonomically problematic, but all are presumably nest parasites of members of the genus *Andrena*.

Nomada imbricata – Regionally, a common nest parasite of *Andrena*.

Nomada luteola – A rare parasite of *Andrena*. A single individual was captured along the pipeline cut.

Nomada luteoloides – Regionally, a common nest parasite of *Andrena*; however, only one specimen was captured, near Lake Levy.

Nomada "white setae" – Another group of species with taxonomic problems. They have been left in their own group until better information is available.

Osmia atriventris – A regular but usually uncommon species in the region. Two individuals across two sites were detected.

Osmia bucephala – A regular species in the region, but not usually seen in the large numbers seen at Cove Point.

Osmia collinsiae – An uncommon spring bee in the region.

Osmia conjuncta – A regular species in the region, but usually present in low numbers. Here, it was found only in the open sandy areas behind the beach at Sites 8 and 9.

Osmia georgica – A regular species in the region, but uncommon. A single individual was found in the open sandy area behind the beach at Site 8.

Osmia inspergens – A regionally uncommon species. A single individual was found near Lake Levy.

Osmia lignaria – Regular in the region, but uncommon. Two individuals were found across two sites.

Osmia pumila – Usually the commonest *Osmia* in the region, although recently the exotic *O. taurus* has become very common near urban centers. This species was very common at Cove Point in all habitats.

Osmia taurus – An alien species. A single individual was found in the open sandy area behind the beach at Site 8, perhaps due to its proximity to the Cove Point community.

Peponapis pruinosa – A squash (*Curcurbita*) specialist. A single individual was detected along the pipeline cut.

Ptilothrix bombiformis – In absolute numbers, this was the most common species detected at Cove Point. This species is a Malvaceae specialist and its abundance is undoubtedly due to the large numbers of *Hibiscus moscheutos* and *Kosteletzkya virginica* plants in the fresh/brackish water wetlands along the Bay.

Sphecodes coronus – A nest parasite of *Lasioglossum* and possibly other halictids.

Triepeolus obliteratus – A rare nest parasite of *Melissodes*. A single individual was found in the open sandy area behind the beach at Site 9. This is one of the few records of this species from the East Coast. The species identification was independently confirmed (though without absolute certainty) by Dr. Molly Rightmyer.

Xylocopa virginica – A common species near human habitations. Two individuals were detected.