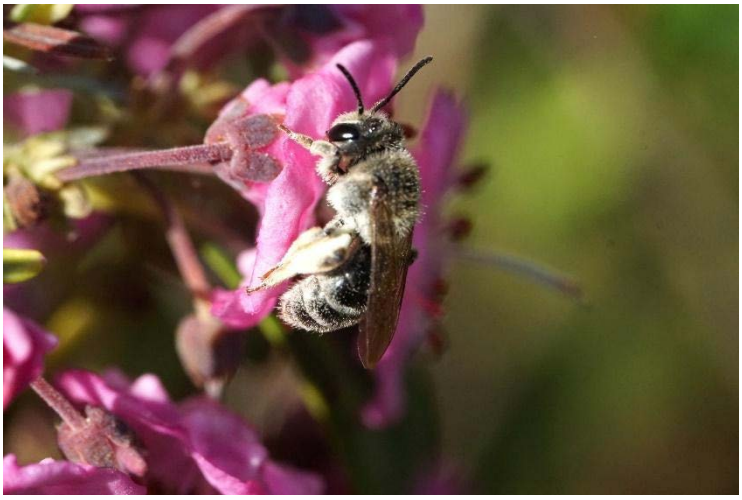
OLIGOLECTIC BEES

AT LONG POINT WILDLIFE REFUGE

WEST TISBURY, MASSACHUSETTS

2023



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Long Point Wildlife Refuge, comprising 632 acres of Martha's Vineyard's lower sandplain, is one of the premiere conservation properties on Martha's Vineyard. During a three-year study of Vineyard bees conducted in 2010-2013, two rarely reported *Lyonia* specialist bees were documented at Long Point's Middle Cove frost bottom: *Colletes productus* (Colletidae) and *Melitta melittoides* (Melittidae), both represented by single male specimens collected in early July (Goldstein and Ascher 2016). These bee species went unrecorded at Middle Cove, and indeed everywhere else on Martha's Vineyard, for the next decade, probably because no one was looking for them. But in 2022, I was able to document the continued presence at the Middle Cove frost bottom of *M. melittoides* by means of a "research-grade" photographic observation in iNaturalist, made on July 10. The same visit also yielded a "research-grade" iNaturalist observation of *Colletes productus*. Both bees were pollen-laden females.

The continued presence of both species across a decade is not surprising since the *Lyonia* population at the head of Middle Cove is immense. The conservation significance of enduring populations of these highly specialized bees is difficult to assess precisely: bees, like many insects, are under-studied, and therefore it's likely or even probable that undiscovered populations exist. But both *M. melittoides* and *C. productus* are known to be highly specialized and strongly associated with their host plant, and both rank among the most infrequently reported bees of our region. The persistence of these bees, then, combined with the presence of a large, secure population of their preferred food plant, suggests that the Middle Cove frost bottom is a site of regional significance for bee conservation.

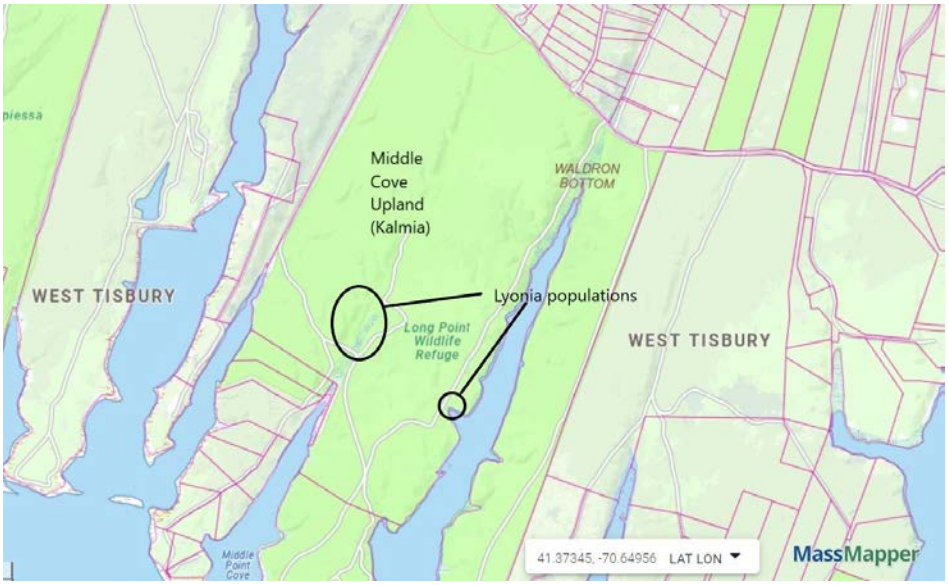
Another notable bee was documented at Long Point on June 18, 2022. Found on sheep laurel (*Kalmia angustifolia*) blossoms during a “bioblitz” event, captured in a vial, photographed, and released, the bee was eventually identified in iNaturalist as *Andrena kalmiae*. This bee represented a first Dukes County (and hence Martha’s Vineyard) record for this species (Viet *et al*. 2021). Again, relatively few records of this bee can be found for southeastern Massachusetts, and the species appears closely associated with its preferred host plants.

These populations are particularly important because they can be monitored and managed over the long term: the Middle Cove frost bottom, like all of Long Point Wildlife Refuge, is protected land owned by a leading conservation organization. And the topography of the site — with land rising steadily from the current perimeter of the *Lyonia* population to the east and west, and rising more gradually north and inland — will make it possible for the population to migrate upward and inland in response to rising sea levels for many decades into the future.

With a mission centered on documenting and protecting the Vineyard’s distinctive biodiversity, the Martha’s Vineyard Atlas of Life program at BiodiversityWorks was interested in learning more about the status and ecology of these bees. Accordingly, in the spring of 2023, we applied to The Trustees for a research permit allowing access and judicious collecting at Long Point. This report summarizes the field research that followed. The purpose of the study was simply to learn what was possible about these three oligolectic bees, while also searching for other insects of interest and assessing the site’s ecology from a pollinator perspective

I made a total of nine visits to Long Point during the central timeframe of this project, the first on May 6, the last on July 12. A 10th visit, on August 16, was added in consultation with The Trustees. On each visit, notes were made on the floral resources available, with particular emphasis on the preferred hosts of the three target bee species. All bees encountered were identified to the lowest taxonomic level possible by sight, photography (often assisted by submission to iNaturalist), or collection followed by identification using the keys available on discoverlife.org. I spent considerable time in unstructured observation of *Melitta melittoides*, *Colletes productus*, and *Andrena kalmiae*, watching them forage, patrol, and interact with each other and with their habitat. For each visit, I recorded the most complete list of bee observations that I could, including the number (sometimes precise, sometimes estimated) of each taxon. A table summarizing bee observations during this project appears at Appendix B. Specimens collected are summarized in Appendix C. My field notes also captured observations of potential

predators or parasites of bees. Most of my time was spent at the Middle Cove frost bottom, but I also twice visited a small *Lyonia* population about a quarter-mile farther east as the bee flies, along the shoreline of Long Cove Pond.



Its oligolectic bees aside, my observations suggest that Middle Cove frost bottom is not a particular productive site for bee observation. My 10 visits resulted in a tally of only 21 bee species (see Appendix B), and with just a few exceptions, these species were observed in low numbers. This is presumably because the site is dominated by woody vegetation, especially tree and scrub oak resprouts, and offers relatively little in the way of flower diversity. A few species of flowering plants are abundant here, notably *Kalmia angustifoli*a and *Lyonia ligustrina* (the lower portion of the frost bottom, around the very head for Middle Cove on the north side of the Long Point access road, features the most extensive *Lyonia* population I've ever seen or heard of). But some of the important early-season nectar sources are not well represented here (e.g., willows and blueberry). And later-season forbs — indeed, herbaceous species in general — tend to be patchily distributed and never present in large quantities among the dominant oaks.

Seasonal Summary

I began fieldwork on this project in early May in order to track the phenology of floral resources and to be sure I didn't miss the beginning of the flight period of any of the target bee species. My first visit, on May 6, was early enough in the season so that oak leaves were just beginning to appear, making it easy to locate spot patches of *Lyonia*, *Kalmia*, or other potential floral resources. On that date, I noted that *Kalmia angustifolia*, while widespread, is most concentrated in the southeastern section of the frost bottom, with a secondary concentration about two hundred meters to the northwest, on the western side of the frost bottom. I was also surprised by the relatively small amount of blueberry (*Vaccinium*) present here, with only scattered patches of lowbush blueberry and a few isolated highbush blueberry plants evident. Lowbush blueberry was in bloom and attracted modest numbers of bees, mostly *Lasioglossum* sp. and metallic sweat bees in the tribe Augochlorini (both Halictidae).

By my next visit, on May 21, changes had occurred that would affect conditions deep into the summer. On that date, I found that recent, unseasonably late frosts had severely damaged much of the *Kalmia angustifolia* at the site: I noted that "[a] lot of the *Kalmia* got really badly frosted on one of the very cold nights recently; damage is uneven, with some patches seemingly untouched but others nearly defoliated and with the flower buds brown instead of pink." Perhaps as another result of the recent frost, bees were scarce on this visit, although a few were visiting *Hudsonia* and *Vaccinium* flowers. None of the target bee species were observed.

A visit on June 4 reminded me of how raw and chilly the south shore of the Vineyard can be even in early June; the temperature at the time of my late morning visit was about 55° F, accompanied by most cloudy skies and a brisk northerly wind. Very few insects of any kind were observed. There had been a couple more unseasonable frosts since my previous visit, and woody vegetation in much of the frost bottom had been severely affected:

> "...pretty much all the woody vegetation on the floor of the frost bottom has been defoliated: *Kalmia*, oaks, huckleberry. Lowbush blueberry seems to have tolerated frost pretty well, though there seems to be very little fruit set. Along most of the edge of the frost bottom, there is a very clear elevational cutoff below which everything is brown and above which everything is green. I got some photos that show this clearly. More

obvious on the west side, but it's clear that the frost bottom filled up with cold air like a bathtub."

"Bathtub effect" frost damage in the Middle Cove
frost bottom, June 4, 2023

In spite of the conditions, the first few *Kalmia* flowers had opened. I spent little time examining *Lyonia* on this visit, but subsequent visits showed that this species, too, had been severely impacted by the frost: on July 9, I estimated that flowering of *Lyonia* had been reduced by about 70% by frost damage, with many sections of plants or entire plants killed. (In spite of the damage, there was still a huge quantity of *Lyonia* flowers in this very impressive population.) *Kalmia*, too, continued to show frost effects, On June 19, I noted that some *Kalmia* plants had managed to produce blooms despite being completely leafless. By mid-July (my last early

summer visit was on July 12), *Kalmia* had almost completely finished blooming, and *Lyonia* had passed in peak of bloom.

Frost-damaged *Kalmia angustifolia*, Middle Cove frost bottom, June 4, 2023

Plant life and floral resources

As I note above, the Middle Cove frost bottom is dominated by a few woody species, most notably tree and scrub oaks, which distribute their pollen via wind rather than insects. So the site is rather depauperate in terms of floral resources, especially herbaceous species, for pollinators. Early-season floral resources included lowbush blueberry (*Vaccinium* spp.), observed flowering as early as May 6. By the third week of May, blueberry had been augmented by flowering *Hudsonia*, *Houstonia caerulea*, and *Nuttallanthus canadensis*. None of these seem to be particularly good pollen or nectar sources, but as the only games in town, they attracted a few Halictid bees and an even smaller number of an early-season bumblebee, *Bombus bimaculatus*. *Kalmia angustifolia*, the preferred food plant for one of the target bees of this study, began blooming in early June, with the bloom period extending into mid-July. Around the middle of June, an easily overlooked but possibly important nectar/pollen source came into bloom in the wet portion of the frost bottom, just north of the access road: bog dewberry, *Rubus hispidoides*, plentiful but with a low-lying habit, attracted good numbers of small bees including Halictids and *Calliopsis andreniformis*. *Lyonia ligustrina*, the preferred food plant for two of this study's focal bee species, began blooming in early July, which personal observations in previous years suggest is abnormally late. Also available to pollinators in early July is swamp

azalea, *Rhododendron viscosum*, which is fairly common around the edge of the wet portion of the frost bottom. The elongated shape of the flowers of this shrub must pose challenges to pollinators, though I observed bumblebees and even a few *Andrena* sp. foraging on *R. viscosum*.

Lyonia ligustrina

Generally associated with wet, acidic, open settings, maleberry (*Lyonia ligustrina*) is primarily a shrub of wetland edges and shrub swamp on Martha's Vineyard. Data in iNaturalist suggest that the species is fairly common here, occurring mainly around the upper reaches of Great Pond cove heads (this is the situation of the Middle Cove frost bottom) or around ponds and wetlands in the morainal portion of the island. Most of these populations, however, are quite small; several that I'm personally familiar with consist of just a few plants. The population at Middle Cove is an impressive one, ringing the uppermost reaches of Middle Cove to the north of the "winter entrance" road into Long Point Wildlife Refuge. The water level in the Tisbury Great Pond varies with periodic pond openings to the open ocean, which drop the water level in the pond by a couple of feet and make the pond somewhat tidal until the opening closes again. These changes presumably affect soil hydrology in areas adjacent to the pond. During this study, *Lyonia* plants were growing from saturated soil "up-slope" for 20-30 meters onto drier soil on the slopes of the frost bottom. Within the zone where it grows well, *Lyonia* is the clearly the dominant woody plant at Middle Cove. Above a certain elevation, the soil is apparently too dry or the water table too far down for this shrub to flourish, and *Lyonia* gives way abruptly to oak, huckleberry, and sheep laurel.

In terms of phenology, *Lyonia* leafs out later than some of its Ericaceous relatives and blooms from late June into late July. The tiny, white, round flowers grow in dense clusters with their open ends pointing down; on a healthy plant, these clusters can be large and plentiful. In 2023, early season conditions apparently impacted *Lyonia* quite severely, with late frosts damaging leaves and flower buds and significantly reducing the quantity of blossoms present.

Maleberry is disturbance-tolerant. Carey 1994 emphasizes the capacity of *Lyonia* to resprout from rhizomes following fire (and, presumably, following other kinds of disturbance such as brush-cutting that top-kill the plant). Its ability to sprout from lateral rhizomes allows formation of clonal clumps, which at Middle Cove range up to five meters in diameter (most are smaller). Isolated individual plants also occur here. While this shrub can grow fairly tall (up to four meters, according to some general-interest web sources), most of the plants at Middle Cove were less than a meter in height. This may reflect the history of management by periodic brush-cutting at Middle Cove. A few plants immediately along the access road, where it crosses Middle Cove, exceeded two meters in height, and many of the plants in the unmanaged population I visited along the shoreline of Long Cove Pond reached a similar height. Observations in 2023 suggested important management implications from these differences in height, which I will discuss later under Management Recommendations.

In addition to *Melitta melittoides* and *Colletes productus*, a number of generalist bees were observed foraging on *Lyonia*, and my impression was that this plant is a key pollinator resource at this location. Four species of bumbebees, *Bombus impatiens*, *B. bimaculatus*, *B. griseocolis*, and *B. perplexus*, were observed foraging on *Lyonia*, sometimes in considerable numbers. Many of these bees were males, suggesting that *Lyonia* may be exploited more for nectar than for pollen by *Bombus*. But on my July 12 visit, I did note that some female *Bombus* visting *Lyonia* flowers were carrying pollen loads, which may have been collected from this plant. Among the Halictids, *Augochlora pura*, *Agapostemon*, and *Lasioglossum* were all observed foraging on *Lyonia*. Observations of female Halictids on *Lyonia* with empty scopa suggest that these bees may have a hard time collecting pollen from *Lyonia* flowers and may be using this plant mainly as a nectar source.

Limited attention band width kept me from keeping detailed notes on insects other than bees during this project, but wasps including *Sphex ichneumoneus* and *Ermnophila aureonotatus* (Sphecidae) and *Monobia quadridens* (Vespidae, Eumeninae) were observed in significant numbers visiting *Lyonia* blossoms. Finally, although the Middle Cove frost bottom is not prime butterfly habitat, the scrub oak obligate *Satyrium edwardsii* was observed many times on *Lyonia* flowers, e,g.,

https://www.inaturalist.org/observations/172528888.

And on July 12, two oak hairstreaks (*Satyrium favonius*) were observed nectaring on this plant, e.g.,

https://www.inaturalist.org/observations/172528867.

Kalmia angustifolia

Another member of the family Ericaceae, sheep laurel (*Kalmia angustifolia*) is a rugged, low-growing shrub favoring acidic soils. It is quite adaptable, tolerating anything from quite moist to quite dry soils but strongly preferring open settings and full sunlight. It produces copious pink, parasol-shaped flowers in late spring. Van Deelen 1992 notes that "[a]ll but the most severe fires enhance the growth of sheep laurel stands," removing competitors while prompting vigorous resprouting from rhizomes. As observed at Middle Cove and at other locations on Martha's Vineyard, including Correllus State Forest and The Nature Conservancy's Woods Preserve in West Tisbury/Chilmark, *Kalmia* when growing in suitable conditions expands laterally to form clonal clumps by extending rhizomes. These clones can be fairly large, up to about 10 meters across at Middle Cove. Sheep laurel is abundant in the Middle Cove frost bottom, with the largest clones in the southeast portion of the managed area north of the access road. There are also some significant clones on the western slope of the frost bottom, a few hundred meters north of the road. While *K. angustifolia* can reportedly reach a height of a full meter, the shrubs at Middle Cove rarely approach half that height, probably reflect recent management of the site by brush-cutting.

Kalmia angustifolia is a widespread and locally abundant species on Martha's Vineyard, though iNaturalist observations suggest it is scarce or absent from the wetter, more forested morainal habitats of Chilmark and Aquinnah. Given the abundance of this plant and its association with one of the target bees of this study, it made sense to visit some other concentrations of this plant to look for additional Vineyard sites for *Andrena kalmiae*. In particular, on June 19 I made a thorough search of an extensive *Kalmia* population south of the Correllus State Forest Headquarters area. I didn't find any *Andrena kalmiae*, though I encountered more than 40

Andrena visiting *Kalmia* and showing the large size and weak or absent tergal hair bands of the subgenus *Melandrena.* A specimen I took keyed out to *A. carlini*, a very common species on Martha's Vineyard, and it seems likely that either that species or the equally common *A. (Melandrena) vicina* accounted for most of the *Andrena* individuals present. I created four iNaturalist observations based on my *Andrena* photographs from this visit:

https://www.inaturalist.org/observations/168319489

https://www.inaturalist.org/observations/168319485

https://www.inaturalist.org/observations/168319484

https://www.inaturalist.org/observations/168319491

Modest numbers of three bumblebee species were also present and visiting *Kalmia*:

Bombus griseocollis:

https://www.inaturalist.org/observations/168319481

B. bimaculatus:

https://www.inaturalist.org/observations/168308759

and *B. impatiens*:

https://www.inaturalist.org/observations/168309028

Some of the bumblebees were males, presumably visiting the *Kalmia* flowers for nectar. Many females were not carrying noticeable amounts of pollen, but on the ones that were, the pollen ball was orange, quite different from the off-white pollen that *Andrena kalmiae* collects and hence probably from some plant other than *Kalmia*. Likewise, all or most of the *Andrena* I saw here (including all of the iNaturalist records I submitted) had bare or nearly bare scopa.

Apparently, then, *Kalmia* blossoms are attractive to some (but by no means all) species of bees but are difficult to collect pollen from successfully.

Bees and Other Insects at Long Point

Melitta melittoides (Viereck 1909)

First documented at Long Point (and on Martha's Vineyard) by the Goldstein-Ascher study of 2010-2012 (Goldstein and Ascher 2016), *Melitta melittoides* is closely associated with *Lyonia*. Aside from that association, not much appears to be known about this bee's biology. I confirmed the continued presence of this bee at Middle Cove in 2022, with a "research grade" iNaturalist observation of a pollen-laden female on July 10: https://www.inaturalist.org/observations/125640418

A female *Melitta* photographed on July 4, 2022, is identified only to the subgenus level (*Cilissa*) in iNaturalist, though on balance I feel this individual must certainly also have been referable to *M. melittodes*:

https://www.inaturalist.org/observations/124746091

During this present study, *Melitta* was first detected at the Middle Cove frost bottom on June 19, 2023, when a male specimen (#8123; here and elsewhere in this report, specimen numbers are unique identifiers for material in the BiodiversityWorks insect collection) was taken off of *Kalmia angustifolia*:

https://www.inaturalist.org/observations/168478665

I mistook this bee for an odd-looking *Andrena* and discovered the error only when keying the bee out. At the time, no *Lyonia* flowers were open, and *Kalmia* was by far the most abundant floral resource at this site. The fact that *M. melittoides* is at least sometimes active before its preferred host plant is in bloom is interesting, and while one doesn't want to put too much strain

on a single observation, it is certainly possible that *Kalmia* could be an important alternative food source for *M. melittoides* in the earliest part of its flight period, at least providing nectar for early-emerging males.

By July 3, a few *Lyonia* blossoms were opening (I estimated that 1% were open). While I didn't make any written record of my visit here the previous year, on July 4, 2022, *Lyonia* flowers were plentiful then. Taken together, these observations suggest that the phenology of *Lyonia* is variable and that 2023 saw a relatively late bloom period for this plant. On the July 3, 2023, visit, I observed four *M. melittoides*, all males; I collected one (#10323), observed another individual closely in a vial before releasing it, and visually identified the other two. While it's not certain that no females were present on this date, the fact that I encountered only females on July 4, 2022, and only males (four individuals) on July 3, 2023, suggests that the phenology of this bee may vary from year to year in tandem with that of its primary host plant.

Visiting on July 9, 2023, I found the *Lyonia* markedly more advanced. I estimated that this species was near the peak of its bloom period (though subsequent observations suggest that I was premature in that assessment), and it was also on this visit that I first noted the dramatic effect spring frost damage had on reducing the numbers of *Lyonia* flowers. Both male and female *Melitta melittoides* were present, concentrated around clumps of *Lyonia*. I estimated 10 individuals, probably a fairly solid count despite the fact that it reflects only visual identifications (no photos and no specimens). On July 12, I made a fairly firm count of five females and four males at Middle Cove. On this visit as well as others, males proved exceedingly difficult to photograph, spending most of their time patrolling rapidly low over clumps of *Lyonia* and, when visiting flowers, only sitting for a few seconds before taking flight again. (See Appendix A for more observations on the behavior and identification of this species.) I did manage photographs of two females on this occasion:

https://www.inaturalist.org/observations/172528872

https://www.inaturalist.org/observations/172528877

Visiting a small *Lyonia* population on the western shore of Long Cove Pond, I observed two individuals that I thought were *M. melittoides*. But specimen and photographic evidence from that visit only document *Colletes productus*, and it's very possible I was mistaken about the

presence of *Melitta*. So the presence of *M. melittoides* at Long Point anywhere outside the Middle Cove frost bottom remains unproven.

To sum up this year's observations of *Melitta melitoides*: at least at Long Point, males of the species appear to begin emerging earlier than females, with the earliest individuals relying at least sometimes on food sources other *Lyonia* because that species is not in bloom. The first females were present by early July, and overall, this bee appears to be fairly common at the Middle Cove frost bottom. Once *Lyonia* flowers are available, this bee does indeed seem to associate very closely with this shrub. I did not encounter *M. Melittoides* anywhere else at Long Point. But the numbers encountered in 2023 and the fact that the population has persisted at for at least 10 years suggest that this population is fairly secure.

***Colletes productus* (Roberson 1891)**

Another oligolect associated with *Lyonia*, *Colletes productus* was another species detected by the Goldstein-Ascher study in 2010-2012 and then reconfirmed at Middle Cove via a "research grade" iNaturalist observation in July 2022:

https://www.inaturalist.org/observations/125640412

While this bee is in a different family from *Melitta melittoides*, it proved disconcertingly easy to confuse the two species in the field. One useful mark for distinguishing these two species under field conditions are the apical hair bands on the abdominal tergites, which are dense and wide on *C. productus*, thinner and more sparse on *M. melittoides*.

I observed this species only sparingly during this project, with the maximum count of 3-5 individuals (split between Middle Cove and Long Cove Pond) coming rather late in the season, on July 12. One females from the Long Cove Pond *Lyonia* patch is in iNaturalist:

https://www.inaturalist.org/observations/172528895

as is a female specimen (#9023) taken at Middle Cove on June 25 (not yet “research grade”):

https://www.inaturalist.org/observations/170092332

As was the case with *Melitta melittoides*, the advent of *Colletes productus* in 2023 preceded the presence of *Lyonia* flowers, with the June 25 specimen being taken off a *Kalmia angustifolia* flower. So for both of these species, it seems possible that plants other than *Lyonia*, in particular *K. angustifolia*, might sometimes be useful or even important alternate food sources, buffering annual variation in plant phenology. Otherwise, the association between *C. productus* and *Lyonia* appeared strong indeed, with all the other individuals I encountered visiting *Lyonia* flowers. As is the case with *Melitta*, *C. productus* is a determined forager when on *Lyonia*, often spending a minute or two methodically working all the flowers in a cluster. Because of the nature of *Lyonia* flowers, which tend to hang with their open ends pointing down, both species spend a good portion of their foraging time hanging upside down on a flower cluster, making them difficult to spot and even more difficult to photograph successfully. Temporary capture in a vial proved to be a valuable method for studying these bees, which can be readily identified once you get a clear look at them.

Puzzled by the low numbers I was finding of *C. productus*, I entertained the possibility that the species is active mainly early in the day and that I was missing it because my visits were taking place mostly midday. Hence my final visit, on July 12, began at 8:00 a.m. While I still didn’t find a lot of *Colletes productus*, this day did produce my high count of the species, despite coming rather late in the bloom period of *Lyonia*, So the possibility of varying levels of activity or detectability during the day might be something to keep in mind during future research.

Given how little time I was able to spend with this bee, there is little I can add to elucidate its status or ecology at Long Point. On the one hand, its sparse numbers might make one worry about its security at this site. On the other hand, the fact that it turned up at two sites about a quarter of a mile apart suggest that the species may be broadly distributed at Long Point, gaining some security from that distribution.

***Andrena kalmiae* (Atwood 1934)**

First documented on Martha's Vineyard during a 2022 "bioblitz" at Long Point -

https://www.inaturalist.org/observations/122399891 -

Andrena kalmiae is an infrequently reported oligolect associated with Ericaceae, especially *Kalmia angustifolia* and *K. latifolia* (discoverlife.org also lists *Lyonia* as a host). iNaturalist contains 18 observations of this bee, half of them from Martha's Vineyard; other observations are from New Jersey, New Hampshire, Vermont, and Maine. Occurrences of *A. kalmiae* fall in a relatively narrow temporal window, basically the month of June, coinciding with the bloom period of its preferred hosts. The Global Biodiversity Information Facility (GBIF) lists 67 occurrences, all from New England except for one from central New Jersey, one from western New York state, and two from the Canadian Maritime Provinces. Except for one May and one July record, all occurrences in GBIF fall in the month of June. It is fair, then, to describe this bee as a quite strongly oligolectic species with a fairly small geographic range — nearly a New England endemic — and a phenology tightly focused on the bloom period of its preferred food source.

Observations made during this project suggest that *Andrena kalmiae* is a genuinely common species in the Middle Cove frost bottom. Records in 2023 extended from June 10, when at least two individuals were observed, to July 12, when a single individual was noted on one of the few remaining *Kalmia angusitifolia* blossoms still present. (As noted elsewhere, bee phenology at Long Point appeared to run late in 2023, so the normal flight period of this bee may skew somewhat earlier.) Maximum abundance occurred in the second half of June, with at least 20 individuals observed on June 19 and at least 10 observed during a shorter and less bee-focused visit during the "bioblitz" on June 25. Both specimens I took (#6823 and #8023) and all of my observations of this species in iNaturalist (n = 9) reflect females, and I don't find any reference to visual observations of males of this species in my field notes. Presumably males of

this species exist! But this appears to be an insect for which females are either much more numerous or much more detectable than males.

To summarize, then, *Andrena kalmiae* is a fairly common bee at Long Point, although its presence anywhere else on Martha's Vineyard is yet to be demonstrated. Its phenology and behavior here are in line with what has been observed elsewhere, with a relatively narrow temporal window of adult activity and a very strong association with its preferred host plant, from which females seem uniquely suited for collecting pollen. Male *Andrena kalmiae* are elusive. Given the numbers of this species observed at the Middle Cove frost bottom and the large amount of *Kalmia angustifolia* growing here, this bee is probably fairly secure at Long Point.

***Calliopsis andreniformis* (Smith 1853)**

While not a target species of this study (and the farthest thing from an oligolect), this species is small, inconspicuous, and not frequently reported (though said to be common). I first observed this tiny species during the 2023 "bioblitz" on June 25, mistaking it for *Megachile* (in a different family altogether) based on its rather stubby shape and a misinterpretation of abdominal hairs as scopa. Even with *Calliopsis* on my mind, I misidentified it again on July 3, mistaking it this time for *Lasioglossum*! Fortunately I collected a specimen on the latter occasion (#10423), and under the microscope, the specimen showed two submarginal cells in the wing and a pattern of pale facial spots that readily marked it as *Calliopsis andreniformis*. That individual also furnished a "research-grade" iNaturalist observation:

https://www.inaturalist.org/observations/171195082

On both encounters, this species was associated with the flowers of bog dewberry, *Rubus hispidoides*, which is plentiful in the wet areas at the southern end of the frost bottom's managed area. I observed more than 20 individuals on the July visit, suggesting that this bee is quite common here, if confined to a relatively narrow flight window.

***Colletes solidaginis* (Swenk 1906)**

An oligolectic bee associated (as its specific epithet suggests) with goldenrod, especially *Solidago* species, *C. solidaginis* seems to occur rather locally across a large geographical range in eastern North America. The Goldstein-Ascher study found one male and five females of this species on Martha's Vineyard, most of them collected during the month of August (P. Goldstein and J. Ascher 2016). The distribution of the 32 observations of this bee in iNaturalist suggest that southeastern New England, including the Cape and Islands, is the core range of the species. Prior to this year, iNaturalist included only a single Vineyard observation, from the extensive goldenrod patches near Brine's Pond on Chappaquiddick in August 2021. My own fieldwork on Martha's Vineyard this season, assisted sometimes by Molly Jacobson and Jennifer Sepanara, added 11 more observations, from West Chop, Long Point, and several spots within Correllus State Forest. The number of 2023 iNaturalist observations is a bit misleading: some of these reflect multiple individuals working the same small patch of goldenrod, and in any case the number reflects considerable observer effort, since this is a bee that I made special efforts to find this season. Based on current knowledge, I wouldn't describe this species as rare on Martha's Vineyard. But it is uncommon and quite local, apparently absent from a high percentage of the vast amount of goldenrod I surveyed. So the discovery of five individuals on a small patch of *Solidago odora* in the Middle Cove frost bottom on August 16 is of some interest. A female specimen was taken (#13523), and a male was photographed and entered into iNaturalist:

https://www.inaturalist.org/observations/177024089

One intriguing aspect of the Long Point sightings was the small amount of goldenrod that attracted this species. Relatively little goldenrod is to be found in the frost bottom, which is dominated by scrub oak, tree oak resprouts, and other woody vegetation. Most of the goldenrod occurs in very small patches or even as isolated single stems in small areas of herbaceous vegetation, many of them along the "jeep road" that runs up the middle of the frost bottom. I estimated the patch on which Jennifer Sepanara and I found the bees at about 400 square feet

and about 30 stems of *Solidago*. The apparently patchy distribution of this bee on Martha's Vineyard (and indeed across its known range) and its ability to find and utilize small patches of goldenrod while apparently being absent from much larger patches suggest that the host flower is only part of the story for this bee. Perhaps it has very specific soil conditions necessary for nesting. In any event, documentation of both males and females of this uncommon bee working the same patch of goldenrod at Middle Cove is one more indicator of how important this site is for bee conservation on Martha's Vineyard.

***Epeolus* sp. (Latreille)**

This large and difficult Apid genus comprises "cuckoo bees" that parasitize the nests of *Colletes*. The relationships between cuckoos bees, including members of this genus, and their hosts can be highly specific, with the nest parasite often using only one species as its host. *Epeolus* has rarely been reported on Martha's Vineyard: the Goldstein-Ascher study collected only 20 individuals representing three species (Goldstein and Ascher 2016), and prior to this summer, no Vineyard observations of the genus were in iNaturalist. During this year's "bioblitz" at Long Point on June 25, I photographed a single *Epeolus* as it fed briefly on a *Kalmia angustifolia* blossom near the edge of the boggy portion of the Middle Cove frost bottom:

https://www.inaturalist.org/observations/169803457

The hasty photos did not support a species-level identification, and the genus ID came from Max McCarthy. As far as I know, the only *Colletes* likely to be active on Martha's Vineyard in late June would be the *Lyonia* specialist *C. productus*, known to be present in the area in which I found this *Epeolus*. So it seems like a reasonable inference that, whatever species that *Epeolus* belonged to, it is a nest parasite of *C. productus* (and therefore a specialist dependent on another rare or uncommon specialist). Nest parasite/host relationships are difficult to study and have not been established for many cuckoo bees. So it is not surprising that I haven't succeeded in finding any host information that would help refine the identity of this *Epeolus*.

***Myopa virginica* (Banks 1916)**

Myopa (Diptera: Conopidae) is an interesting acalyptrate fly genus the members of which parasitize honey bees (*Apis mellifera*), *Andrena*, and *Anthophora* (Murray 2022). Female Conopids typically attack their hosts in flight, with at least some species prying up the edge of an abdominal segment on the host and laying an egg under the raised edge. Of the 15 North American species of *Myopa*, one of the less frequently observed and least well known is *M. virginica*. Prior to this project, iNaturalist contained only 18 observations of this species (counting both "research grade" and unconfirmed sightings). These observations fall into a broad swath of eastern North America bounded by southeastern South Dakota, southern Minnesota, southeastern Ontario, eastern New York state, North Carolina, and southwestern Missouri. The more comprehensive Global Biodiversity Information Facility (GBIF), which reflects "research grade" iNaturalist observations as well as other kinds of data sets (e.g., museum collections), lists 23 occurrences, with the georeferenced ones basically reiterating the distribution shown by iNaturalist (*Myopa virginica* Banks, 1916 in GBIF Secretariat 2022).

So the documentation of *M. virginica* at Long Point by this study is interesting, representing a significant eastward extension (from the Hudson River Valley of New York state) of the known distribution of this fly.

Also interesting was its apparent host association at Long Point: *Andrena kalmiae*, a strongly oligolectic bee and one of the target species of this study. *M. virginica* appeared to be reasonably common at the Middle Cove frost bottom when I first observed it on June 19, 2023; I saw perhaps a dozen individuals that appeared to be this species and managed photographs of two individuals:

https://www.inaturalist.org/observations/168325351

https://www.inaturalist.org/observations/168325355

The latter observation is particularly interesting because it includes a (totally fortuitous) photograph of the fly attacking a female *Andrena kalmiae* in mid-flight:

I photographed another individual during the 2023 Long Point “bioblitz” on June 25:

https://www.inaturalist.org/observations/169803454

There is also circumstantial evidence to support an association between this fly and *Andrena kalmiae*: the observations of *M. virginica* coincide perfectly with the peak observed abundance of *A. kalmiae*, and relatively few *Andrena* of other species were present at this location during the fly’s flight period. It is also suggestive that the only Vineyard records for either the bee or the fly come from the same place. I can find no existing information on host associations of *Myopa virginica* and can’t determine based on available evidence whether it truly prefers *A. kalmiae* or is a more generalized parasite of *Andrena* and uses *A. kalmiae* at this site because that species happens to be the most common *Andrena* present during the fly’s flight period. The overall distribution of *M. virginica* appears to greatly exceed that of *Andrena kalmiae*, so the fly must be capable of using additional host species. But in the Vineyard context specifically, the coincidence of this infrequently reported fly and an infrequently reported bee is intriguing, especially given the photographic evidence of an attempt at parasitism.

Given the apparent abundance of *M. virginica* at this location, it seems possible that parasitism by this species might be a significant factor in the local population dynamics of *Andrena kalmiae*.

Potential predators

I didn't observe any instances of predation of bees during this project, though I made a point of keeping an eye out for potential predators. Perhaps the most prevalent of this group would be the Odonata: dragonflies and damselflies. Some species in this order, including all of the damseflies (Zygoptera), are probably too small to successfully capture bees, except perhaps for the smallest examples. But larger dragonflies are certainly capable of taking bees, and I've observed them doing it at other locations. In 2023, a range of Odonates were observed at Middle Cove, with iNaturalist observations document the presence of four species that seem large enough to pose threats to bees (including possibly the oligolects that were the focus of this study).

Calico pennant (*Celithemis elisa*) was the most common, observed in good numbers on every visit, *e.g.*:

https://www.inaturalist.org/observations/169799699

Somewhat less common were painted skimmer (*Libellula semifasciata*)

https://www.inaturalist.org/observations/168325366

and white corporal (*Ladona exusta*)

https://www.inaturalist.org/observations/169806184

The genus *Sympetrum* is also well represented at Middle Cove,

https://www.inaturalist.org/observations/169801914

though its peak of abundance comes later in the summer, after *Melitta melittoides*, *Colletes productus*, and *Andrena kalmiae* have finished for the season.

How much impact Odonates have on bee populations at Middle Cove is an open question. But medium-sized dragonflies figure prominently among the insect fauna at this site, and anecdotally, it appeared that they tend to concentrate around flowering clones of *Lyonia* or *Kalmia* (which in turn tend to concentrate other insects). So it seems likely that Odonates prey on bees here at least occasionally.

Recommendations

Suggestions for Future Research

While the present study added to our knowledge of the target bees at Long Point, additional work on all the species mentioned in this report would be useful. Does *Melitta melittoides* also occur at the Long Cove Pond *Lyonia* patch that yielded *Colletes productus* in 2023? Does the apparent connection between *Andrena kalmiae* and *Myopa virginica* hold up across multiple seasons? It would be helpful to search for additional *Lyonia* populations at Long Point and check any that are found for *Colletes productus* and *Melitta melittoides*. Patrolling the shoreline of Long Cove Pond from the water from a canoe or kayak might work for locating *Lyonia*, if not for surveying bees. Information on the nesting of any of the bees mentioned in this report would also be extremely useful. The nests of ground-nesting bees are not easy to locate (and my attempts in 2023 to follow pollen-laden female bees to their nests were risibly unsuccessful). But with sufficient field time in dry portions of the Middle Cove frost bottom, someone will eventually stumble over a nest, and observations on the soil type, vegetative cover, and even distance from *Lyonia* or *Kalmia* could be extremely useful for informing management of these bee species.

In addition to the spring/early summer bees that were the focus of this study, Long Point is known to host a number of goldenrod specialists that are infrequently reported on Martha's Vineyard: e.g., *Colletes compactus*, *C. simulans*, *C. solidaginis*, *Andrena* asteris, *A. braccata*, and *A. hiritcincta*. None of these species really qualifies as rare, but taken together, they represent an interesting specialized fauna that merits a closer look. Moreover, many "goldenrod bees" found at Long Point and entered in iNaturalist are identified only to the genus level (mostly *Andrena*), and it's probable that additional goldenrod specialist species are among them. A study similar to the present one but taking place late in the season would yield useful information on the full list of oligolects present, their relative abundance, and (if appropriate data

were collected) a sense of what goldenrod species are most important to various bee species. Such a study would require a fair amount of field time (the more, the better), focused on the goldenrod of the managed sandplain grassland south of the “winter parking area” but including other sections of the property with goldenrod (including the Middle Cove frost bottom). Collecting would be necessary to allow identification precise enough to make such a study useful.

Management Recommendations

Between their modest numbers and their limited known distribution on the Vineyard, all three of the focal species of this study should be considered at least somewhat vulnerable at Long Point, and important for conserving from a regional conservation perspective. In the absence of any information about ecological requirements for successful nesting by these species, and of any indication that predation or other causes of mortality are taking an excessive toll, management measures to secure these populations would probably need to focus on maximizing the food supply by augmenting the size and health of the *Lyonia* and *Kalmia* populations.

One key management method would be monitoring to track the extent of coverage by these two important plants. I had hoped to delineate at least the upper, or outer, perimeter of the *Lyonia* population this summer but did not have sufficient time to do this. But GPSing the outer and inner edges of the population every few years, and perhaps even counting the number of clones and individual stems, would be an excellent way to track the amount of maleberry present and to verify that it is moving up-slope in response to sea level rise.

It is probably not feasible to monitor all the *Kalmia* clones at Middle Cove, given the size and extent of the population. But a good precautionary measure might be to flag and GPS some of the largest clones, so that periodic re-monitoring could ensure that the local population of this plant was remaining healthy.

As noted earlier, both of these shrubs are disturbance-tolerant (or in the case of *K. angustifolia*, arguably disturbance-dependent). So continuing the current regime of periodic brush-cutting is probably a suitable way to encourage these plants. The intensifying effects of climate change, however, may create some complications for managing these plants. As I’ve noted, unseasonably late frost events in the second half of May impacted these plants, which were just

leafing out and presumably vulnerable as a result, severely. Stems and some entire plants were killed outright. Leaves were damaged, with some replaced by a second flush of leaves but others persisting through the season with brown spots and presumably reduced photosynthetic capacity. And flower buds were killed, substantially reducing food availability for bees. One central prediction about climate change is increasingly volatile weather — that is, an increased likelihood of anomalous events such as late May frosts in low spots on the Vineyard sandplain. *Andrena kalmiae*, *Colletes productus*, and *Melitta melittoides*, then, may be at least somewhat vulnerable to secondary effects of climate change at this location.

Anecdotally, it appeared to me that taller plants experienced less frost damage than shorter ones; the *Lyonia* shrubs along the access road showed no frost damage to their flowering tips, and the same was true of the tall shrubs along the Long Cove Pond shore. If this observation is accurate, the mechanism was probably that the “bathtub effect” of cold air pooling meant that taller plants were partially above the elevation at which tissue-killing conditions occurred. Increasing shrub height, in other words, may be a useful climate change resilience strategy for these shrubs.

It may be advisable, then, to modify the existing management regime slightly to allow for less frequent disturbance and a greater average height of both of these species. In most of the area it occupies at Middle Cove, *Lyonia* is the only woody species present. Since the *Lyonia* is not facing competition, there is no particular need to mow these areas; instead, the *Lyonia* can be allowed to grow to its full natural height. Hopefully this would result in greater flower production and lower impacts from disruptive spring weather. This goal could be achieved by flagging the perimeter of *Lyonia* distribution around the cove head and mowing only outside the flagged area. It is probably neither feasible nor necessary to flag all the *Kalmia* clones; but flagging and mowing around at least the largest ones might allow somewhat greater shrub heights for some portion of the local population, again affording some resistance to abnormally late frost events.

Conclusion and Acknowledgements

The spring and summer of 2023 posed some challenges for invertebrate fieldwork, with late-season frosts inflicting damage on vegetation that affected plant grown and flowering through the entire growing season. This summer was also an unusually cloudy one, with long periods of

damp, overcast weather limiting the opportunities for effective observation. But this project was successful in its main goal of clarifying the status of the target bees at Long Point, especially in the Middle Cove frost bottom. In combination with previous observations extending back more than a decade, this summer's fieldwork effectively highlighted the importance of this site for bee conservation. It's clear that all three target species, *Melitta melittoides*, *Colletes productus*, and *Andrena kalmiae*, are represented by significant populations at Long Point, and all three appear to be reasonably secure at this location for the foreseeable future. Observations of several other interesting bee species, most notably *C. solidaginis*, also support this assessment of the site's value. And the documentation of *Myopa virginica* at Long Point seems like a significant find, especially given this fly's apparent relationship to *Andrena kalmiae*. In my view, The Trustees of Reservations deserves considerable credit for ongoing management that has allowed these highly specialized insects to flourish here. I hope that the results of this project help make the case for continued research and active management at Long Point.

Thanks to The Trustees for supporting this project, and especially thanks to the conservation and management staff for facilitating access: Russ Hopping, Shea Fee, and Elliot Ptaszynski. I also gratefully acknowledge the sharp eyes and observation skills of Jennifer Sepanara, who assisted with my August visit to the property. Molly Jacobson helped with the identification of many specimens. Molly was also one of 18 experts who assisted with identifying bees posted to iNaturalist; we're grateful to all who helped, but especially to John Ascher, Max McCarthy, Joel Neylon, and Xian Zhou. Finally, the Martha's Vineyard Atlas of Life project at BiodiversityWorks is generously supported by the Betsy and Jesse Fink Family Foundation, and without the foundation's vision and commitment, none of our work would be possible.

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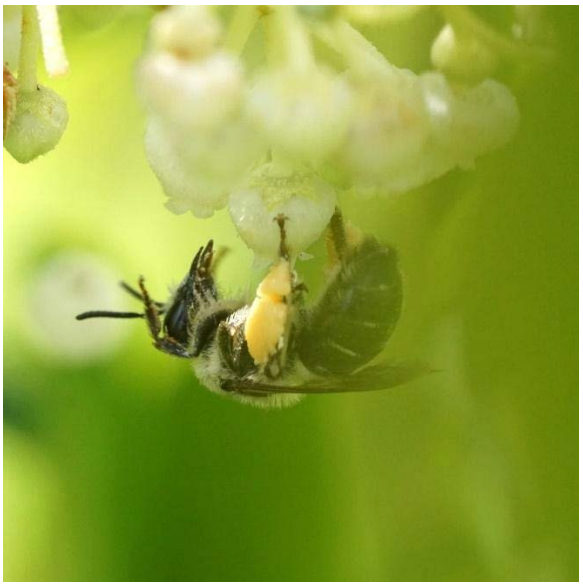
A**ppendix A: Notes on the Behavior and Field ID of *Melitta melittoides***

This species has a rather generic look about it at first glance; if you're not looking for it, it's possible to dismiss either sex as to some other genus such as *Andrena* or *Colletes*. But when you get familiar with them (and get a good look at an individual), both sexes of *Melitta melittoides* are fairly distinctive, each showing useful field marks and sometimes creating a strong and correct impression even at a quick glance. Because of the rarity of this species, one should be careful not to diagnose it casually. But I feel confident that a careful observer who has taken the time to study some specimens and photographs can learn to recognize this bee quite reliably in the field. (All this said, even at the end of my field work in 2023 I was still perfectly capable of confusing *M. melittoides* with *Colletes productus* in the field. Despite being in different families, the two species are about the same size, have clear hair bands on the abdominal terga, and of course share a close association with *Lyonia*.)

Female *M. melitoides* are good-sized bees. Discover Life puts their length at 11 mm, and the specimen I took at Middle Cove measured 11.4 mm during the pinning process. They often appear rather chunky, especially when foraging, since the abdomen is often curled forward under the bee. They have no significant femoral scopa; the tibial scopa are long, sparse, largely simple, and graduated in length, longer apically than basally. The scopa continue onto the basitarsus. The effect is this creates is of a rather pronounced tuft of sparse, long hairs far out on the leg, well set out from the body. Scopal hairs are yellowish; hairs on the inside-facing side of the basitarsus are almost golden.

Scopal hairs on the tibia and basitarsus of a female *Melitta melittoides*. Note, also, the relatively broad abdomen and complete but rather sparse hair bands on the second, third, and fourth tergal segments.

Females will often be observed carrying a full pollen load of waxy, yellowish-white pollen, which almost looks like a pollen ball in a *Bombus* corbiculum and is unlike the powdery pollen typically accumulated by *Andrena* or other solitary bees. I don't know if this reflects the characteristics of *Lyonia* pollen or if the bees process the pollen in some way, perhaps mixing it with saliva, that accounts for the color and consistency of the pollen ball. As with the scopal hairs, the pollen load appears restricted to the tibia and basitarsus, forming a waxy blob on the leg well separated from the body. The broad, rather parallel-sided abdomen has complete but fairly weak apical hair bands on T1 – T4 (weakest on T1); the weakness of these bands is a helpful though not completely reliable way of distinguishing a female *Melitta* from a female *Colletes productus* in the field. The abdomen tapers rather abruptly to a somewhat pointed apex. The vestiture is pale underneath, more yellow and mixed with black on the dorsum of the thorax, where the hairs are short but usually dense.



A female *Melitta melittoides* foraging on *Lyonia* flowers. Note the long mandibles, extended in this photo; the yellowish, waxy blob of pollen on the hind tibia and basitarsus; the short, dense hair on the thorax; and the relatively weak apical hair bands on the abdominal terga. Because the open ends of *Lyonia* blossoms face downward, the inverted position shown here is typical foraging behavior for both *M. melittoides* and *Colletes productus*.

The best field mark, readily visible if you have a female in a vial and sometimes even on freely foraging individuals, is mandible length. Females of this species have magnificent, long mandibles; when closed, the tip of each mandible extends well beyond the base of the other mandible, and when the bee is foraging, the mandibles are often extended and inserted into *Lyonia* flowers.

Foraging behavior is deliberate; the bee works a blossom thoroughly before moving on to the next one and may spend a considerable time on one cluster of *Lyonia* flowers. But when she is ready to leave a particular cluster of flowers, she takes off abruptly, flies rapidly, and may move a considerable distance (even out of sight) before landing again. If disturbed while foraging, the

bee's escape flight is rapid, erratic, and very hard to follow. When released from temporary confinement in a vials onto the flower clusters they were captured from, female *M. melittoides* invariably flee instantly and rapidly. This behavior contrasts with that of some other bees, notably *Bombus*, that sometimes resume foraging as soon as released.

Males run a bit smaller than females: Discover Life gives a length of 9 mm, and my two specimens, measured during the pinning process, registered 9.5 and 9.6 mm. In flight, they create the impression of a rather slender bee, with the abdomen held out straight; specimens, however, prove to be more typical in proportions, with the abdomen fairly broad. Perhaps the explanation for this discrepancy is that abdomen is compressed when viewed from the side, though fairly broad viewed from above. They are very hairy for male bees.

Male *Melitta melittoides*. Note the overall hairiness, especially on the face; long antennae; and broad abdomen with complete but sparse hair bands on terga 2, 3, and 4.

Apical fascia on the abdominal terga are white and complete but rather weak (especially on T1) and composed of loose, complex hairs, producing an almost ragged effect. There is a prominent white "beard" on the clypeus, and the rest of the face is also largely hidden by long, pale hair. The cheeks, thorax, and legs are covered with long, soft, mostly complex hairs, with hairs on the dorsum of the thorax yellow and darker than on most of the rest of the body (quite a few black hairs are mixed in). **The antennae are very long — this may be the most useful mark in the field — and if individual flagellar segments can be discerned, these are roughly twice as long as they are broad.** The antennae are not as long as those on a male longhorn bee

(*Melissodes* sp.), but the effect is similar, of really exaggerated length. Males tend to be hard to observe; they spend much of their time patrolling rapidly around *Lyonia* patches, flying low over and among flower clusters. Visits to flowers are often brief, and the bee often takes flight again after feeding rather than moving over to another flower. Note that while males associate strongly with *Lyonia*, I collected one of my specimens off of *Kalmia angustifolia*, before any *Lyonia* flowers had opened.

Appendix B: Bee Observations at Long Point, 2023

The following table summarizes bee observations made during this project. All forms of observation are included here: direct visual observation, photography, and collection. Most bees photographed were entered as observations into iNaturalist. Because visual identification of bees in the field can be tricky, the numbers presented here are best considered approximate. However, I tried to be conservative in assigning specific identifications to bees, and I believe the numbers presented here give a fairly good indication of abundance.

Family	Genus	Species	5/6	5/21	6/4	6/10	6/19	6/25	7/3/	7/9	7/12	8/14
Colletidae	*Colletes*	*productus*						1	1		3-5	
	Colletes	*soladiginis*										5
Halictidae	*Augochlorini*	sp.	c. 10	c. 15			2	2	2	5	5	4
	Agapostemon	*sericeus*		1				1				
	Agapostemon	*texanus*									2	
	Agapostemon	*virescens*						1				
	Agapostemon	sp.				1				3	3	

Family	Genus	Species	5/6	5/21	6/4	6/10	6/19	6/25	7/3/	7/9	7/12	8/14
	Lasioglossum	sp.	c. 3					1	10	4		2
	Lasioglossum	*Dialictus* sp.	2	1								
	Sphecodes	sp.					1					
Andrenidae	*Andrena*	*kalmiae*				2	c. 20	c. 10	4		1	
	Andrena	*rufosignata*				1						
	Andrena	*vicina*					1	4				
	Andrena	sp.				c. 10			1	2		
	Andrena	sp. (*Melandrena*)					4					
	Calliopsis	*andreniformis*						1	25	2		
Melittidae	*Melitta*	*melittoides*					1		4	10	10-12	
Megachilidae	*Megachile*	*texana*							2			
	Osmia	*atriventris*							1			
Apidae	*Bombus*	*bimaculatus*		2				8		c. 15	c. 25	
	Bombus	*griseocollis*		1				4		c. 6	2	

Family	Genus	Species	5/6	5/21	6/4	6/10	6/19	6/25	7/3/	7/9	7/12	8/14
	Bombus	*impatiens*						6	3	2	15	c. 10
	Bombus	*perplexus*								2-3	3	
	Epeolus	sp.						1				

Appendix C: Specimens Collected at Long Point, 2023

The following table lists bee specimens taken at Long Point during this project. All specimens have been pinned and entered into the BiodiversityWorks arthropod collection. The numbers in the left-hand column are unique reference numbers for each specimen.

Specimen #	Month	Day	Collector	Method	Flower Association	Family	Genus	Species	Sex
4023	May	21	M. Pelikan	vial	*Hudsonia ericoides*	Halictidae	*Agapostemon*	*texanus*	Female
6823	June	10	M. Pelikan	vial	*Kalmia angustifolia*	Andrenidae	*Andrena*	*kalmiae*	Female
6923	June	10	M. Pelikan	vial	*Kalmia angustifolia*	Andrenidae	*Andrena*	*rufosignata*	Female
7923	June	19	M. Pelikan	vial	*Kalmia angustifolia*	Andrenidae	*Andrena*	*vicina*	Female
8023	June	19	M. Pelikan	vial	*Kalmia angustifolia*	Andrenidae	*Andrena*	*kalmiae*	Female
8123	June	19	M. Pelikan	vial	*Kalmia angustifolia*	Melittidae	*Melitta*	*melittoides*	Male
9023	June	25	M. Pelikan	vial	*Kalmia angustifolia*	Colletidae	*Colletes*	*productus*	Female
10123	July	3	M. Pelikan	vial	*Kalmia angustifolia*	Megachilidae	*Osmia*	*atriventris*	Female
10223	July	3	M. Pelikan	vial	*Rubus hispidoides*	Megachilidae	*Megachile*	*texanus*	Male

Specimen #	Month	Day	Collector	Method	Flower Association	Family	Genus	Species	Sex
10323	July	3	M. Pelikan	vial	*Lyonia ligustrina*	Melittidae	*Melitta*	*melittoides*	Male
10423	July	3	M. Pelikan	vial	*Rubus hispidoides*	Andrenidae	*Calliopsis*	*andreniformis*	Female
10923	July	9	M. Pelikan	vial	*Lyonia ligustrina*	Apidae	*Bombus*	*perplexus*	Male
11023	July	9	M. Pelikan	vial	*Lyonia ligustrina*	Halictidae	*Lasioglossum*	sp.	Female
11123	July	9	M. Pelikan	vial	*Lyonia ligustrina*	Halictidae	*Lasioglossum*	sp.	Female
11223	July	9	M. Pelikan	vial	*Lyonia ligustrina*	Melittidae	*Melitta*	*melittoides*	Female
11423	July	12	M. Pelikan	vial	*Lyonia ligustrina*	Colletidae	*Colletes*	*productus*	Female
11523	July	12	M. Pelikan	vial	*Lyonia ligustrina*	Halictidae	*Agapostemon*	*texanus*	Female
11623	July	12	M. Pelikan	vial	*Lyonia ligustrina*	Halictidae	*Agapostemon*	*texanus*	Female
13523	August	16	M. Pelikan	vial	*Solidago odora*	Colletidae	*Colletes*	*solidaginis*	Female