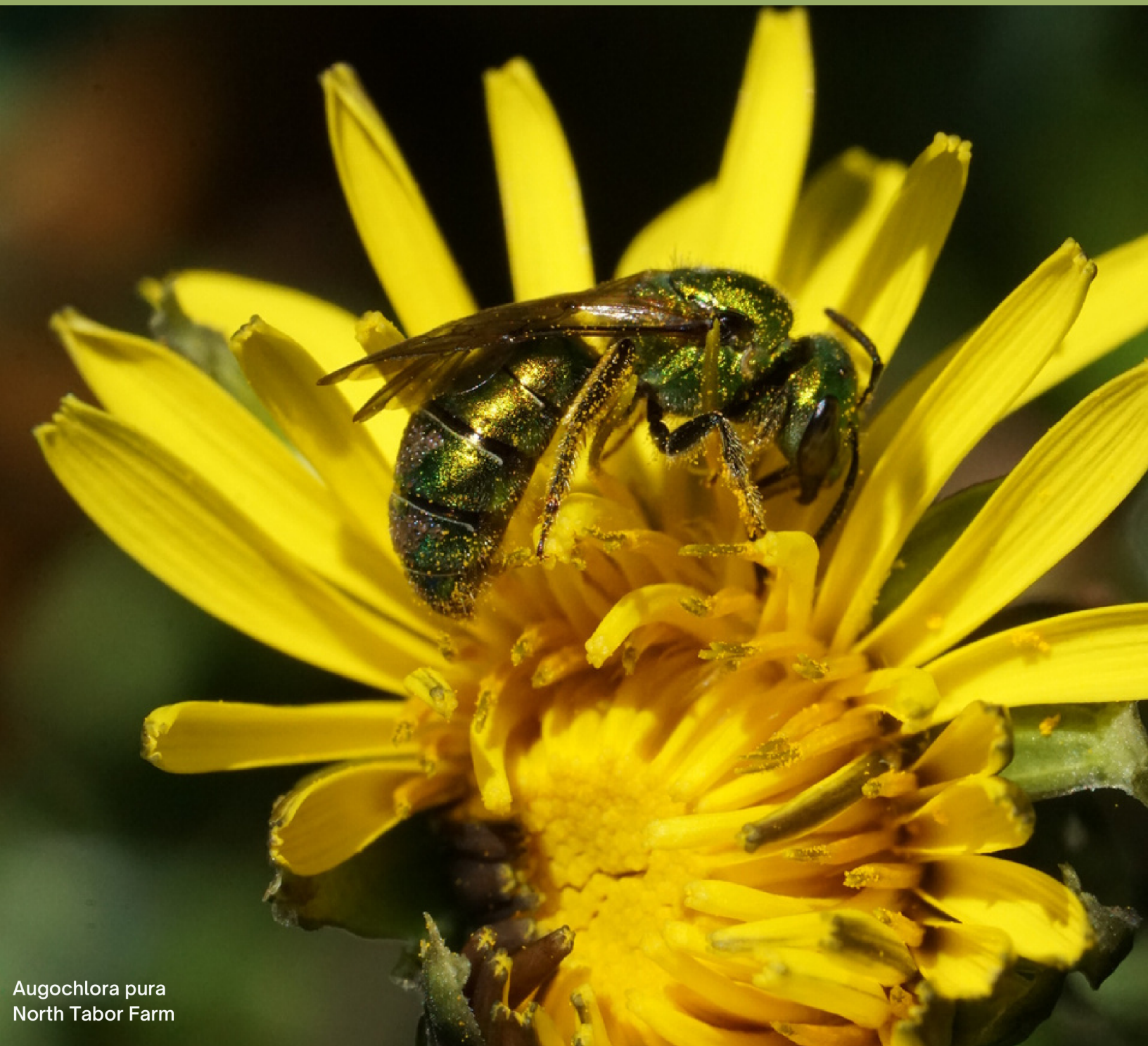
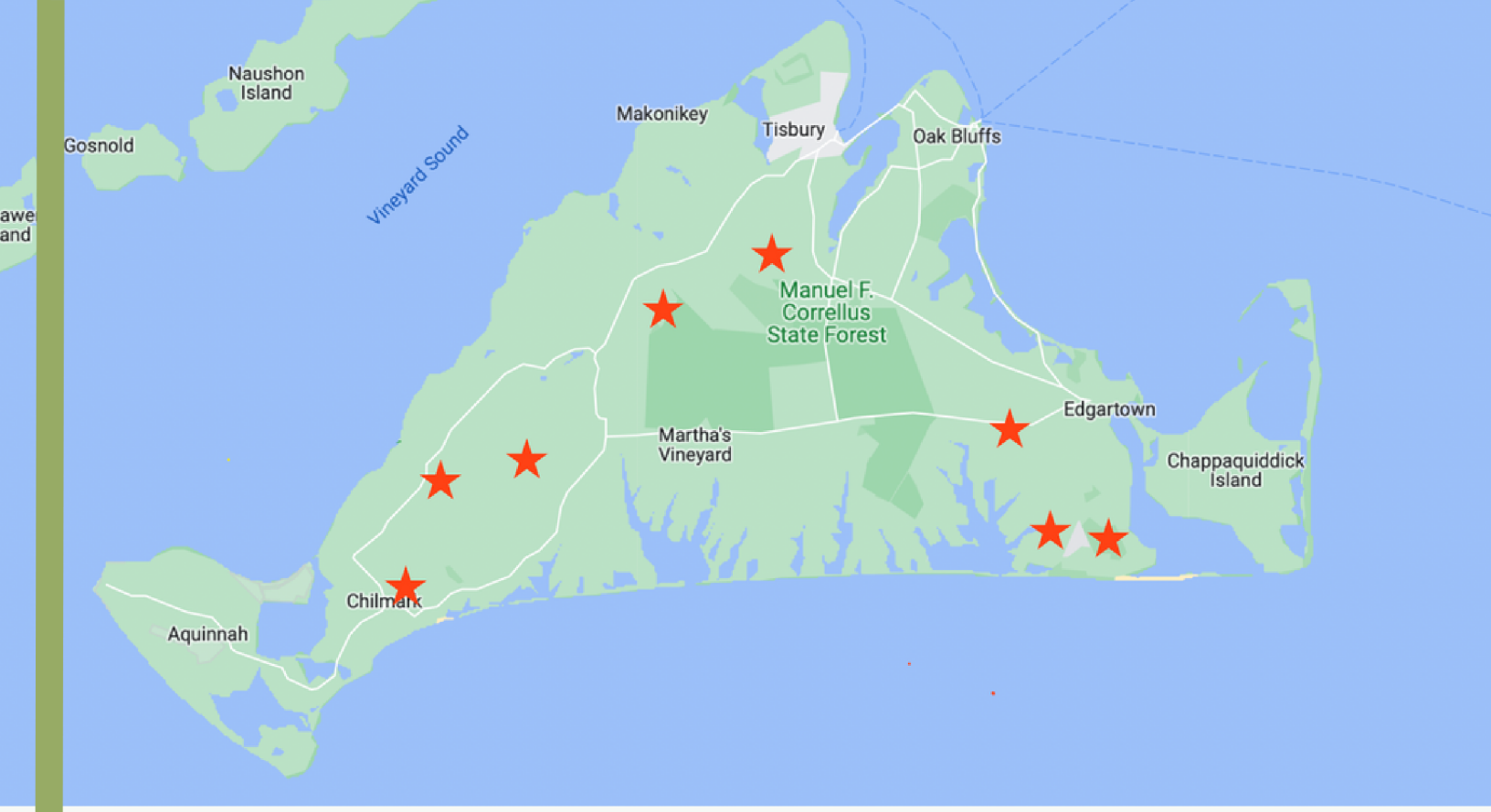
Martha's Vineyard Pollinator Pathways
Promoting Pollinators on Island Farms

2022 Year End Report
Reported by Matt Pelikan, Science Advisor

The Betsy and Jesse Fink
FAMILY FOUNDATION



Augochlora pura
North Tabor Farm



Farms participating in the pilot: Beetlebung Farm, North Tabor Farm, Mermaid Farm, Whippoorwill Farm, The Island Grown Farm, Morning Glory Farm, Slough Farm, The Farm Institute

Included in this report:

Summary

The Betsy and Jesse Fink Family Foundation (BJFFF) and the Martha's Vineyard Atlas of Life (MVAL) are grateful for the cooperation of eight Vineyard farms in this pilot project to enrich pollinator diversity. Thanks to participating farms for their commitment to sustainable food production and the ecological health of the Vineyard. And thanks also for your assistance with plot preparation, installation of irrigation, and facilitation of access to the sites.

The essence of this project, which is projected to run for three years, is the creation of small "project plots" planted with a selection of pollinator plants. Intensive monitoring of the project plots, and of the surrounding areas of the participating farms, should allow us to assess the diversity of pollinators visiting flowers and offer recommendations for how farms can increase pollinator diversity and, especially, help support populations of rare or specialized pollinators. In 2022, plants were installed in early June, and monitoring began in late March and early April, intensifying as the growing season progressed. An interim report was circulated to each farm in August and included more details on the project goals and methodologies, as well as presented some tentative conclusions based on field work through the beginning of August.

Between late March and the end of October, BJFFF or MVAL staff made a total of 88 data collection visits to participating farms including 61 site visits specifically for bee monitoring. Seven observers compiled 315 observations in iNaturalist documenting 113 species in general farm areas; three observers compiled 209 observations in iNaturalist documenting 67 species in the project plots. Combining results of the two data collection projects created for "MV Pollinator Pathways," eight observers compiled 524 observations documenting 138 species that visited flowers on participating farms in 2022.

It's important to acknowledge the 92 iNaturalist users who provided identifications for "MV Pollinator Pathways" observations. An important principle of iNaturalist is "crowd-sourcing" identifications, and one of the strengths of the iNat platform is the way it brings natural history knowledge and expertise to bear where it is needed.

45 species of bees were documented across all the farms, by collection, photography, or direct observation. 141 arthropod specimens were collected across the eight participating farms. Most were bees; a few significant wasps, sawflies, and flies were also collected. All specimens were pinned, labeled with collection data (date, location, collector, plant association, etc.), identified at least to genus level, and added to the curated BiodiversityWorks arthropod collection. BJFFF Fellow Molly Jacobson, a pollinator ecologist and bee specialist at the College of Environmental Science and Forestry at SUNY/Syracuse, visited the Vineyard in late January to assist with difficult bee identifications.

We did not track planting maintenance effort, in part because visits for plant maintenance were often combined with data collection visits. But in general, project plots were visited at least once each week by BJFFF staff to water, weed, add plants, or otherwise maintain plantings.

Project Plot Performance

In early June, nine species of flowers were planted in the project plots. Most of our native-species plants were purchased as seedlings from Pinelands Nursery in New Jersey, which specializes in propagation of native wildflowers. Pinelands was unable to deliver sufficient quantities of Asclepias tuberosa, so we purchased these locally. A variety of annual sunflower planted as seed, obtained from Johnny's Selected Seeds in Maine, were planted. We chose relatively short varieties (because of the small plot size) and selected several varieties with different disk sizes. Two common clover varieties were purchased as seed from Johnny's. The clover varieties were interplanted.

Native Species

Symphyotrichum laeve (smooth aster): This aster, with large flowers with blue rays, is native to the Vineyard, though not very common here. It was not our first choice for an aster species and was selected for this project largely because it was readily available. It grew readily in our project plots and bloomed heavily in its first year. Smooth aster performed quite well was a pollinator plant during its late-season bloom period, attracting bumblebees (Bombus impatiens), small carpenter bees (Ceratina sp.), several types of sweat bees (Halictidae) including the locally uncommon Agapostemon texanus, the mining bees Andrena braccata, A. hirticincta, and A. asteris, Colletes compactus, and several types of hover flies (Syrphidae). Andrena braccata and A. asteris are both pollen specialists associated with composite flowers, so their use of smooth aster is an example of the effects we hoped the project plots would have. Colletes compactus is known on the Vineyard only from a small number of previous records and is presumed to be rare or uncommon here, so its presence in a project plot is another example of the beneficial effects of native plantings.

S. laeve was less attractive to non-bee pollinators than the goldenrod species we used. And based on our observations of bees in natural settings on the Vineyard in 2022, we tend to think that native aster species with white rays tend to be more attractive to pollinators than asters with blue rays. S. laeve would certainly be an appropriate and effective addition to any farm pollinator plot, but all in all we think that one of the more locally common asters, such as New York aster (Symphyotrichum novi-belgii) or stiff aster (Ionactis liniariifolia) might be better choices for blue asters. The best plan for incorporating asters would probably be to include a mix of multiple species, including at least one blue aster and one white-rayed species, such as white heath aster (Symphyotrichum ericoides). Farms sourcing native aster plant material for pollinator plantings, though, may run into the same problem we did: relatively few species seem to be readily available in the commercial market. Any farm willing to take on the challenge of propagating local-genotype asters from wild seeds would be doing a huge service for Island pollinators!

Andrena asteris on smooth aster
Beetlebung Farm

Project Plot Performance Continued

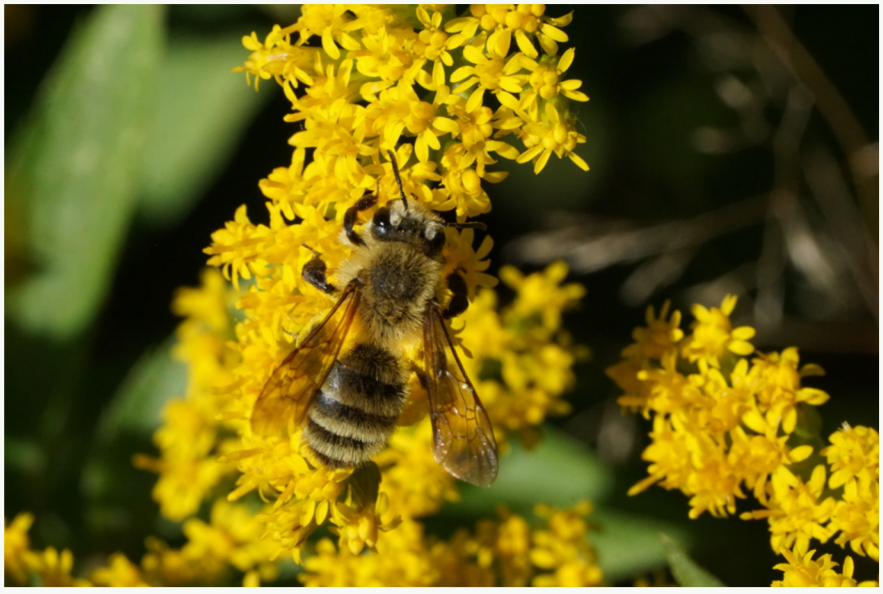
Asclepias tuberosa (butterfly weed): This orange-flowered milkweed, which is abundant in open native habitats on Martha's Vineyard, is legendary for its appeal to pollinators of all kinds. Despite its common name, butterflies often seem to prefer the flowers of common milkweed (A. syriaca) if both species are available. Still, butterflies, bees, wasps, and flies of many kinds flock to A. tuberosa wherever it grows.

Unfortunately, the butterfly weed we installed failed almost entirely, apparently due to an undetermined pathogen. Nearly all the plants withered and died before blooming, and the plants that did succeed in blooming were stunted and produced meager inflorescences. We expect to try again in 2023 with new stock.

Despite the poor results we had with this species in 2022, butterfly weed is well established as one of the most effective pollinator native plants in our region. It is usually a very rugged perennial, producing a deep taproot and resisting both drought and competition. It would be a good choice for inclusion in any pollinator planting.

Euthamia graminifolia (grass-leaved goldenrod): A common and widespread native plant on Martha's Vineyard, this relatively early-blooming goldenrod grew vigorously in the project plots and bloomed prolifically. As we expected, this species attracted a wide range of pollinators: bees, wasps, flies, moths, and even a Mecopteran (Panorpus sp., a scorpion fly) and a grasshopper (Chortophaga viridifasciata). Bees visiting Euthamia included many individuals of the common bumblebee species Bombus impatiens and the western honey bee (Apis mellifera). But Euthamis also attracted a wide range of solitary bees: the mining bees Andrena simplex, A. asteris, and A. hiriticincta; the metallic sweat bee Augochlora pura; tiny Hylaeaus bees, including one were able to identify to species as H. affinis; and the project's only record of Colletes simulans, which appears to be scarce on Martha's Vineyard, were all documented on Euthamia in project plots. Many of these same bees were found on Euthamia growing wild on farms, outside of the project plots. No species involved in the project produced a more impressive record of supporting specialized bees.

Euthamia was important partly for the numbers and diversity of wasps it attracted. Wasps probably have limited efficiency as pollinators, although adults of many species visit flowers to feed on pollen. But generally, wasps are predators or parasites of other arthropods, and the presence of a robust wasp fauna benefits farms and gardens by providing natural pest control. We strongly recommend the inclusion of either this species or the very similar E. caroliniana (= E. tenuifolia) in any pollinator plantings on Martha's Vineyard. Long experience with this genus in the field has convinced us that it is a popular and versatile nectar pollen source, and both members of the genus are vigorous and easy to grow.



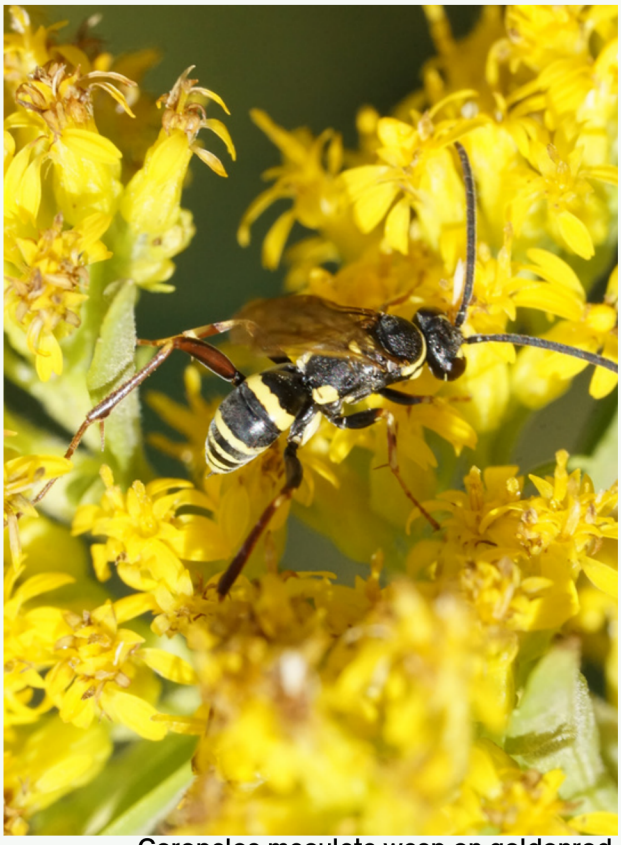
Andrena hirticincta on goldenrod
Mermaid Farm

Project Plot Performance Continued

Solidago nemoralis (gray goldenrod): Native to the Vineyard, though not common here, this species is a typical goldenrod with a fairly late bloom period (late August through September), producing large, bright yellow, terminal flower clusters. The plants we installed in the project plots performed well, with a high survival rate among the transplants, vigorous growth, and strong blooming. At one farm, where most of the Solidago plants were inadvertently weed-whacked, they resprouted vigorously and still managed to bloom heavily in plenty of time for late-season bees to make use of them. A wide range of other pollinators were documented visiting this goldenrod, including representatives of four wasp families, two beetle families, several moth and fly species, and the sachem butterfly (Atalopedes campestris). S. nemoralis was quite attractive to solitary bees; late-season Lasioglossum (many of which we have not been able to identify to the species level) used this plant heavily, and we found Halictus confusus on it as well. We were able to document use of this plant by the uncommon Andrena simplex and somewhat more widespread A. hirticincta, both closely associated with goldenrods on the Vineyard; the uncommon sweat bee Agapostemon texanus; and, at the other extreme, the large, abundant generalist common eastern bumble bee, Bombus impatiens. Looking more broadly at our observations from around the Vineyard, several other Andrena species associate closely with goldenrods, including the uncommon A. braccata. And while it prefers aster, A. asteris turns up on Solidago with some regularity.

Based both on 2022 project results and our broader studies of insects on Martha's Vineyard, we strongly urge the inclusion of some species of Solidago in any type of pollinator planting. If goldenrods are not grown deliberately, we'd urge that they be tolerated or encouraged where they manage to get established on their own. While S. nemoralis performed well, we don't think it is likely to be any more or less effective at supporting pollinators than other native members of the genus. The precise species of goldenrod used probably does not matter much, and ideally, more than one species would be grown to extend bloom period and perhaps cater to subtle preferences among bees and other pollinators.

**** It's worth noting that many species of bees that we found on one species of native composite flower (Solidago, Euthamia, Symphyotrichum) also turned up one or more of these other species. In other words, although a particular bee species may associate primarily with one or the other of these flowers, that bee likely has a more general preference for the composite family as a whole and will make at least occasional use of any member of this family it has access to. So perhaps the strongest and most confident recommendation we can make for augmenting bee resources boils down to: ***Plant as much of as many kinds of native composites as you can.***



Ceropales maculata wasp on goldenrod
Island Grown Farm

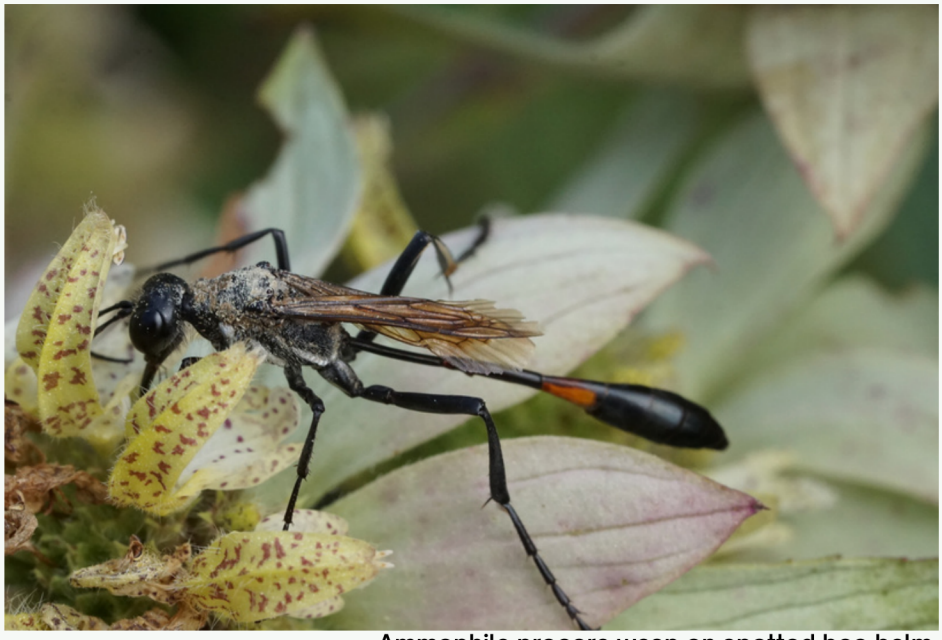
Project Plot Performance Continued

“Near-Native” Species
These species are not considered native to Martha’s Vineyard, but are native to the New England region and are suitable to growing in conditions found on the Vineyard.

Monarda didyma (scarlet beebalm): This familiar garden plant is said to be a favorite of several species of bumble bees, including a couple of the species that this project hopes to find strategies to encourage. Bumble bees probably access the nectar in the long, tubular flowers not by inserting their tongues through the opening of the flowers, but rather by using their mandibles to cut holes near the bases of the flowers, allowing access to nectar.

Our single year of data was not sufficient to assess how well this plant performs in supporting pollinators. Very little was observed visiting it. But because the plants were installed at the start of the 2022 season and did not bloom until fairly late in the summer, the bloom period may have missed the relatively short or early flight seasons of the bumble bee species (e.g., Bombus fervidus, B. citrinus, B. affinus, and B. perplexus) we were targeting. The 2023 growing season, which we expect will see this species flowering earlier in the year, may produce different results. But based on 2022 observations, we think it is premature to consider M. didyma a priority plant for inclusion in pollinator plantings.

Monarda punctata (spotted beebalm): In contrast to M. didyma, M. punctata was wildly popular with a wide range of pollinators in 2022. It was visited especially by the larger bees, such as the ubiquitous Bombus impatiens and the eastern carpenter bee, Xylocopa virginica, and by some of the larger wasp species, including northern paper wasps (Polistes fuscatus) and the predatory Sphecid wasps Sphex ichneumoneus (“great golden digger wasp”) and S. pensylvanicus (“great black wasp”). All of these insects fed by entering deeply into the Monarda blossoms, emerging well covered with pollen. As we’ve noted on many occasions, wasps are desirable on a farm for their roles as predators and parasites, controlling populations of other arthropods, as well as for their ability to function as pollinators. Because of its popularity with these important insects, we think Monarda punctata is very valuable plant for inclusion on pollinator plots or rows. We note, furthermore, that it grew vigorously, bloomed copiously even its first season, and had a very long bloom period, extending from mid-July deep into September. These qualities add to the value of this plant.



Ammophila procera wasp on spotted bee balm
Morning Glory Farm

Project Plot Performance Continued

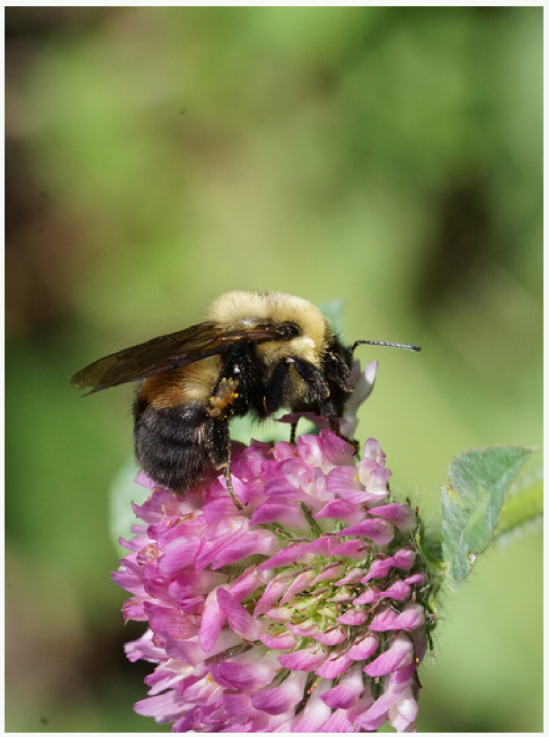
Non-Native/Horticultural Varieties

Helianthus (sunflower varieties): The sunflowers were a great success (and that success was echoed by the sunflowers most of the farms planted, either as cut-flower crops or just as pollinator plants). A wide range of bees were observed visiting sunflowers. The most numerous ones were members of the family Apidae: honey bees (Apis mellifera), bumble bees (Bombus sp.), and long-horned bees (Melissodes sp.). Smaller solitary bees, notably the very common species Halictus ligatus, did use sunflowers, though in general these bees tended to prefer smaller flowers. The leafcutter bee Megachile latimanus, which appears to be uncommon on Martha's Vineyard, was also found on sunflowers in one of our project plots. The use of sunflowers by Melissodes was striking and significant: M. trinodis and M. agilis were found on sunflowers almost exclusively, and sunflowers wherever they occurred (inside and outside project plots) almost invariably attracted these bees. We know from experience elsewhere that very small quantities of sunflower - just a few individual plants - can attract bees of this genus. Based on this year's results across the eight participating farms, we can pretty much guarantee that if you plant sunflowers, you'll help support these specialized bees. We strongly urge the use of sunflowers, either as a cut-flower crop or just as a plant to support pollinators.

Our observations, though, did suggest that all sunflowers are not created equal from a pollinator perspective. Certainly varieties attracted a lot more pollinators than others. We did not know the names of any of the varieties growing outside the pollinator plots, but in general, flower characteristics of the most attractive varieties including medium to large size disks, yellow rays, and uncomplicated flower structure. Less attractive were varieties with brown or mahogany rays, small flowers, or "doubled" structure. Varieties bred to produce little or no pollen, intended to avoid the mess of dropped pollen in houses, can also be presumed to be unappealing to pollinators. This means that many varieties grown for the cut-flower market are sub-optimal for pollinator support and, if grown, should ideally be accompanied by varieties meeting the more traditional and pollinator-friendly profile.

Trifolium pratense, T. repens (red and white clovers): The clovers we started from seed did not bloom in 2022, and in some locations the plants struggled due to drought conditions. We did, though, have ample opportunity to observe the utility of clover, since several types of clover were included in cover crop mixes that we observed, and red and white clovers are very common plants in fringe or uncultivated areas on most farms.

Bumble bees (including the uncommon species Bombus vagans), several Halictid ("sweat bee") species, the non-native (but probably benignly naturalist) mining bee Andrena wilkella, and honey bees were all observed using the common clover species T. pratense and T. repens. Several butterfly species were documented using these flowers as well. And the only Vineyard record we're aware of for the sawfly Macrophya nigristigma was found on crimson clover (T. incarnatum). Based on 2022 results, we feel confident in recommending any of the clover species in pollinator plantings, or in cover crop mixes as long as the clover is allowed to bloom before it is cut or turned under.



Bombus griseocollis
Whippoorwill Farm

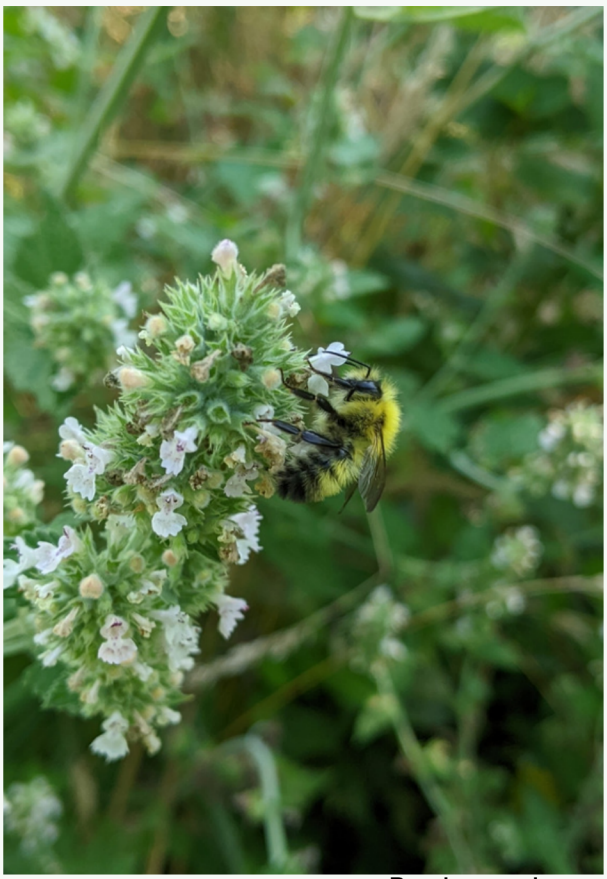
Other Pollinator Plants

One of the most satisfying aspects of this project in 2022 was seeing the energy and intelligence with which participating farms were already providing floral resources for pollinators. Whether with cover crops allowed to bloom, pollinator rows or plots, uncultivated land allowed to grow up into a mix of wildflowers, herbs allowed to flower, or flowers grown for the cut-flower market, every farm involved in the project offered a real bounty to bees and other pollinators. We strongly urge that farms continue and, if possible, expand this practice, and continue to experiment with new species. (As we noted in our interim report, we also urge that spring-blooming shrubs, notably blueberry [Vaccinium spp.] and chokeberrry [Aronia spp.] be included as crops and/or pollinator plantings.)

We do think that, all other things being equal, plant species native to the Vineyard or at least the southern New England coastline offer the best possible choices for pollinator plants. These are the plants that our pollinators have evolved to co-exist with. But 2022 project results as well as our ongoing studies of Vineyard insects makes it clear that pollinators benefit from a wide range of non-native flowers, including both deliberately planted ornamental species and agricultural “weeds” that often flourish on field edges and waste land.

We don’t have enough data to give a detailed accounting of all the plants that we found pollinators using in 2022. But here is a short list of plants that we observed supporting pollinators in large numbers or on a consistent basis. We think that any or all of these species could appropriately be included in pollinator rows or plots, or allowed to flourish on uncultivated land on farms.

Alexanders (Smyrnium spp.)
Anise Hyssop (Agastache foeniculum)
Catmint (Nepeta sp.)
Chicory (Cichorium intybus)
Crown Daisy (Glebionis coronaria)
Dill (Anethum graveolens)
Fleabane (Erigeron spp.)
Kale and related varieties (Brassica oleracea)
Mint (Menthus sp., many species and varieties)
Phacelia (Phacelia tanacetifolia)
Shasta Daisy (Leucanthemum x superbum or L. vulgare)
Queen Anne’s Lace (Daucus carota)
Verbena (multiple species but V. bonariensis is a winner)
Zinnia (multiple cultivars; simple flowers work best)



Bombus perlexus
Mermaid Farm

Honey Bees and Native Bees

One goal of this project is to assess the implications of competition between western honey bees (Apis mellifera) and native bee species. The western honey bee is native to Eurasia but widely introduced around the world. It is easily the most cosmopolitan of bee species, often raised in agricultural settings both as a pollinator and as a source of honey. With its profoundly social life history, Apis mellifera can be a highly efficient forager, able to coordinate the efforts of an entire hive to exploit rich sources of pollen and nectar. But a steadily increasing body of scientific literature shows that, under at least some conditions, the efficiency of this species can allow it to compete strongly and sometimes destructively against native bee species. Honey bees in large numbers can drink or collect nectar and pollen as fast as flowers can produce it, leaving no resources for other pollinator species. And as a fairly large insect by bee standards, honey bees often physically displace other insects from flowers (bumble bees, carpenter bees, and the larger wasps, however, seem to be able to hold their own against honey bees). Local effects – reduced native bee diversity or reduced numbers of native bees found in areas heavily used by honey bees – are relatively easy to investigate and have been documented in a large number of peer-reviewed scientific publications. It's more challenging to demonstrate that the presence of honey bees is actually reducing native bee numbers at the population level, though there is some evidence for that as well. Competition between honey bees and native bees has not been studied on the Vineyard specifically, but it is safe to assume that in general, results documented elsewhere apply here as well.

Project observations in 2022 did suggest that honey bees do sometimes displace native bees on farms participating in the project, reducing the number and diversity of native species using floral resources in a particular area. But we also found situations in which Apis mellifera and native species appeared to co-exist reasonably well, pointing to some practices that we think will tend to mitigate the negative impacts honey bees might have on native bee species.

One dramatic example suggesting displacement of natives by honey bees was observed on October 11th, with seasonally mild weather producing good conditions for insect observations. At one farm that keeps honey bees, we tallied 82 honey bees (probably far less than were actually present) on various flower types around the farm. Eleven common eastern bumble bees (Bombus impatiens) were observed, but only a total of five small, solitary bees across the entire area surveyed. Out of curiosity, we also checked a patch of goldenrod across the road from the farm, finding 22 honey bees, one Bombus impatiens, and no pollinators of any other kind - a reminder that ecological effects can spill across the boundaries of a farm, in both directions. Notable for their absence, both on-site and across the road, were any metallic sweat bees (the tribe Augochlorini), normally very common at this point in the seasons.

On the same day, at a farm short distance away and in a fairly similar setting, results were dramatically different. At this farm, which apparently does not have hives, we found only a single honey bee. Six species of small solitary bees were recorded, with the tribe Augochlorini represented by at least 88 individuals.

It is important to note that these divergent results illustrate a correlation, not necessarily causality: high bumble bee numbers were associated with low numbers and diversity of small solitary bees at the first site, and low numbers of honey bees were associated high diversity and numbers of small solitary bees at the second site. Our study methods don't support a definitive claim that honey bees caused the dearth of solitary bees at the first site. But given the starkness of the contrast and the established fact that honey bees can out-compete other pollinators, our hypothesis is that these observations do suggest the displacement of small native bees by the larger, non-native honey bee.

Honey Bees and Native Bees Continued

A different and more encouraging situation was observed on one of our last field visits of the year, on October 27th. On that day, despite rather chilly conditions, at least 260 honey bees ("really just a guess and surely on the low side," read my field notes), were visiting flowers on a row of bolted kale plants. Only one other bee, a large carpenter bee (Xylocopa virginica), was observed on the kale, consistent with the hypothesis that honey bees were displacing other bees from this resource. However, this visit was quite productive for native solitary bees: at least 10 Lasioglossum sp. were visiting Solidago nemoralis in the project plot. A few honey bees were observed in and around the project plot, though none were observed competing with Lasioglossum on the goldenrod in the project plot.

Again, our methodology limits what we can conclude from these observations. But the pattern is certainly consistent with the interpretation that honey bees had found, in the kale flowers, a resource that they really liked, and were focusing most of the attention of the hives' worker force on exploiting that resource. This left other resources, notably the Solidago plants in the project plot, available for use by other bees. Honey bees may indeed have been displacing other species from the kale flowers; but if so, it didn't really matter because other flower types were available that were attractive to the displaced species. In our interim report, we mentioned another instance of such "resource partitioning," in which native bumble bees and non-native honey bees were found exclusively visiting different species in a two-species cover crop mix. Given that most pollinators seem to exhibit some degree of preference for particular types of flowers, encouraging "resource partitioning" seems like a useful strategy under any circumstances.

To draw some tentative conclusions from all this, we think that maintaining honey bees on a farm probably does have a negative impact on native bees, with this effect growing stronger later in the season, as honey bee numbers and foraging activity appear to reach a peak. But if many kinds of floral resources are present, we expect that use of those resources will often be partitioned among species, with honey bees focusing on particular flower types and other pollinators focusing on other types.

In sum, we recognize that farms may choose to maintain honey bees as crop pollinators, as a source of honey for sale, or both. Our point is not that this practice should be discontinued: farms are primarily for food production, and raising honey bees in support of that goal is a perfectly reasonable course of action on a farm. Farms that choose to raise honey bees can, we believe, mitigate any negative impacts by ensuring that large quantities and a high diversity of floral resources are present at all times, allowing pollinators to distribute themselves across the farm in ways that reduce direct competition.

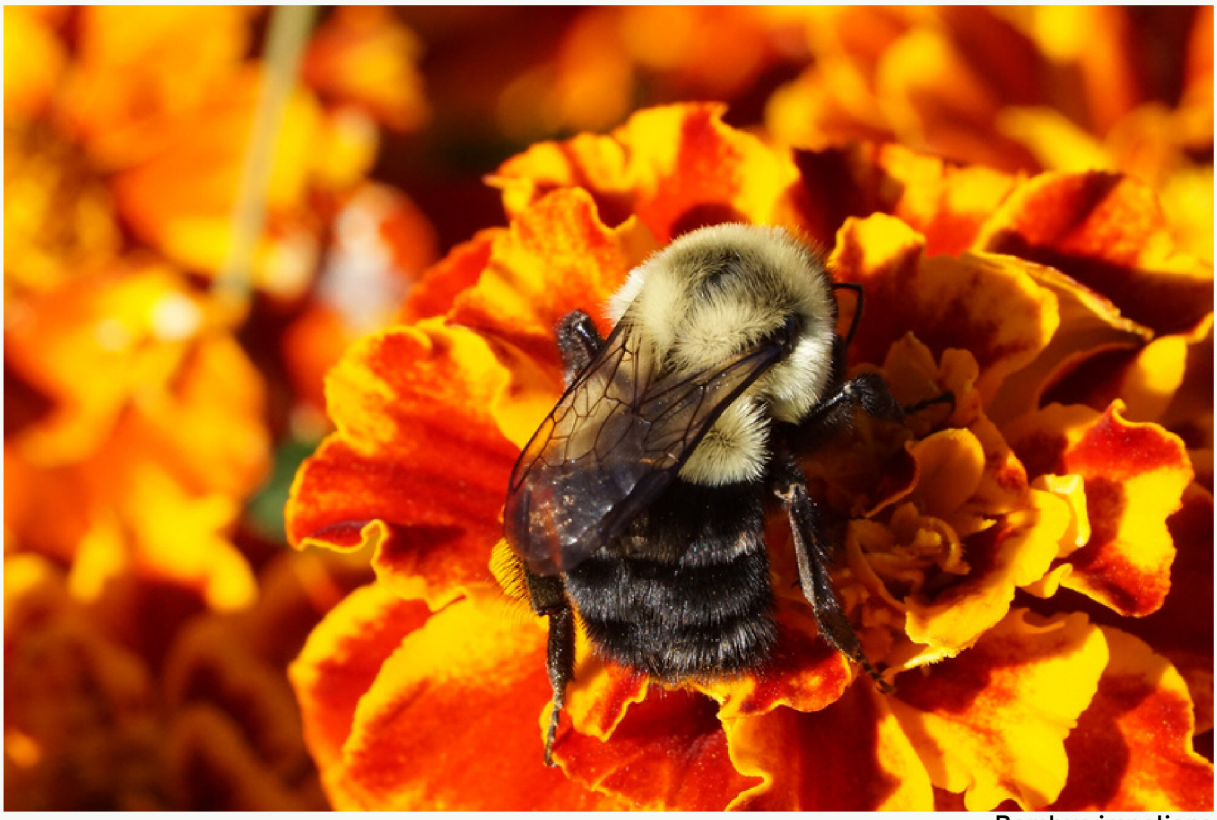
Megachile latimanus
Slough Farm

Other Questions

In this first year of the project, we focused mostly on documenting visitation of flowers by arthropods (and, occasionally, other types of animals), noting when possible what species were visiting what flowers. This approach allowed us to show that a surprisingly wide range of insects visit an equally surprisingly wide range of flowers on farms and we are able to draw some conclusions about what flowers tend to be most attractive (and hence, we assume, most useful) to pollinators. We will continue to pursue this approach in 2023 and are confident that the list of pollinators we can document on participating farms will continue to grow.

Flower visiting is the most obvious and easiest to study aspect of pollinator behavior. But of course it doesn't capture the entirety of pollinator ecology. In particular, it tells us little about actual reproduction - nesting and provisioning of nests, for example. Obviously, reproduction is a critical part of the survival of any organism.

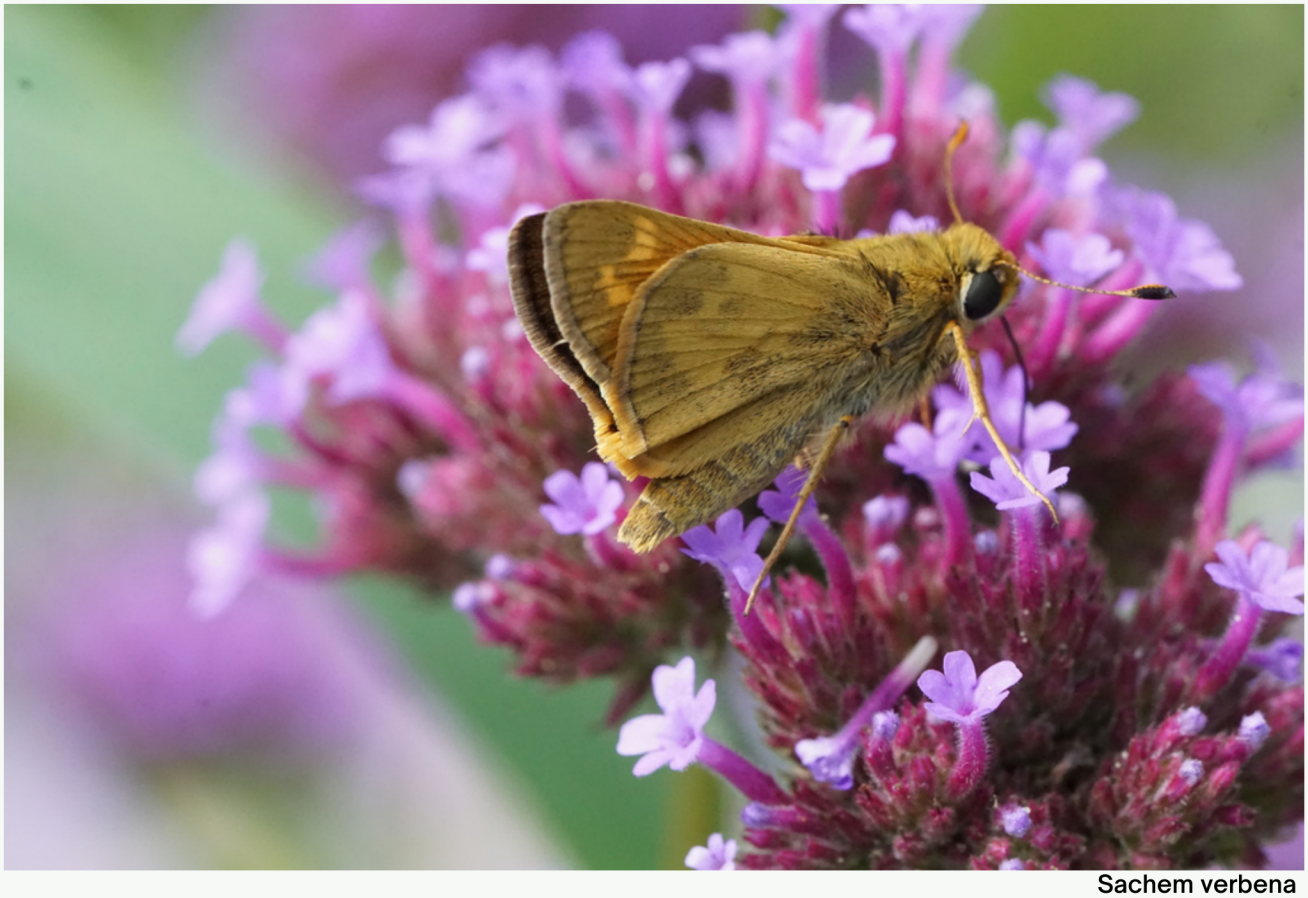
With bees, you can surmise a lot about reproductive activity by observing, not just the fact of flower visitation, but the specifics of how a bee interacts with a flower. Individual bees feed themselves by drinking nectar; they also may help feed larvae in a nest by transporting pollen from flowers to the nest, and indeed, the evolution of anatomical features to assist with pollen transport is one of the most important aspects of bee biology. It is important to note that pollen transport isn't the only way bees provision their nests (some species, for example, feed their young with oil, which adults transport internally). But it's easy to distinguish in the field between a bee that is taking nectar and a bee that is collecting pollen, and making that distinction can help you figure out which bees are actually feeding young versus which bees are just exploring and fueling themselves. So our field work next season will include attention to the foraging behavior of bees, with the goal of clarifying which species are actually reproducing in the vicinity of participating farms and using farm resources to support reproductive efforts.



Bombus impatiens
Beetlebung Farm

Conclusion

This year's work on this project was as illuminating as it was fun. We will continue to work on bee identifications over the winter, further clarifying what species are present and how common they are. And we will work to refine our plans for managing the project plots including replacing plants that were lost during the 2022 growing season. We look forward to working on your farms again in 2023 and we hope that the information presented in this report and in the interim report previously circulated will help farmers understand the important ecological roles their farms are playing, and maximize the ecological services they provide while continuing to serve as local, sustainable, and highly valued food sources for the Martha's Vineyard community.



Sachem verbena
Beetlebung Farm