Pollinator Meadow Report: Two Year Update

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GORGE WATERWAY NATURE HOUSE

Introduction

The Pollinator Meadow (PM) project was initiated in the summer of 2020 by the Gorge Waterway Action Society (GWAS). The PM is located on the unceded territory of the Lekwungen speaking peoples, and is situated adjacent to Gorge Creek in Esquimalt-Gorge Park (EGP), a large urban park which borders the Gorge Waterway. The Gorge Waterway has been heavily impacted by urbanization and pollution over time, resulting in a significant decline in native ecosystems in the area. The PM project was initiated to contribute to the restoration of native ecosystems in the area and to increase native pollinator presence in EGP, such as insects and birds. Insects are key components of ecosystems, as they are the primary vector for transferring energy from plants to other animals in a food web (Tallamy, 2019). Therefore, increasing pollinator insect presence is predicted to enhance the overall ecological health of the park.

During the winter of 2021, a monitoring plan for the PM project was developed by GWAS; this plan included a range of surveys to be repeated over time to assess the project's success. The monitoring plan also included a maintenance plan to aid in the meadow's overall health over time. The first round of surveys and maintenance procedures took place during the summer of 2021, and in the previous report (Pollinator Meadow Update: 1 Year Later [1]*) these results were compared to site conditions from summer 2020 and winter 2021. Surveying and maintenance was repeated in the summer of 2022, and those results are summarized in this report. Survey methods and timing will continue to be adjusted in future years to better accommodate staff availability and to better assess PM conditions.

* [#] *indicates a hyperlink GWAS removed from their internal report for the public access document you are now reading. These additional documents are available upon request for those interested in more information regarding the EGP Pollinator Enhancement Project.*

Methods

The PM Monitoring Plan was developed during GWAS's Youth Community Partnership (YCP) funded internship program during the winter of 2021. This plan includes a variety of surveys to monitor changes in the PM over time, including a floral biophysical inventory, photo point survey, insect survey, and bird point count survey, as well as site maintenance. These surveys were selected to measure changes in vegetation composition, changes in pollinator insect presence, and overall health of the meadow over time. Measuring these variables was predicted to reveal if the PM was successful in its goal of attracting native pollinator insects to the area. Detailed methods for these surveys are available upon request from our Monitoring Plan Documents [2].

Results

Biophysical Inventory

Previously, three floral biophysical inventories have been conducted at the PM. In the summer of 2020, prior to the construction of the PM, the dominant species recorded were grasses and creeping buttercup (*Ranunculus repens*); survey results available upon request [3]. The second survey occurred in January 2021 according to methods [4], and found only 9.4% vegetation cover, with 25 species but none clearly dominant. The third survey, in July 2021, found 41 species and determined that vegetative cover increased to 60.3%, of which 67.6% was native. The dominant species included yarrow (*Achillea millefolium*) at 7.2%, entire-leaved gumweed (*Grindelia stricta*) at 6.9%, Douglas aster (*Symphyotrichum subspicatum*) at 4.6%, and invasive vetch (*Vicia* sp.) at 4.6% of total groundcover.

During June 2022, the fourth floral biophysical inventory of the PM was conducted. Compared to the previous year, vegetative cover increased to 89.4% from 60.3% the previous year. Of the total vegetative cover, the proportion of native plants decreased to 47.9%, while invasives became more prevalent (Figures 3 and 4). 35 taxa were recorded in the survey; however, the observed species count was approximately 58 (see Appendix A or request PM Plant Species Catalogue [5]), indicating an overall increase in species diversity. The dominant taxa recorded were invasive grasses, primarily the annual *Bromus hordeaceus*, at 15.9%; invasive annual vetches, specifically *Vicia sativa* and *V. hirsuta*, at 12.1%; native gumweed (*Grindelia stricta*) at 12.0%; and invasive annual geranium (*Geranium dissectum*) at 8.1%. It is also noteworthy that although invasive clovers (*Trifolium* sp.) were recorded at only 4.2%, annual *T. subterraneum* was present in large quantities, and was likely underrepresented due to being obscured by taller vegetation. Compared to the previous year, the PM saw a decrease in the relative dominance of yarrow (*Achillea millefolium*) from 7.2% in 2021 to 3.5%. Overall, invasive species were dominated by the five annual species mentioned above, while the native plants were predominantly represented by gumweed.

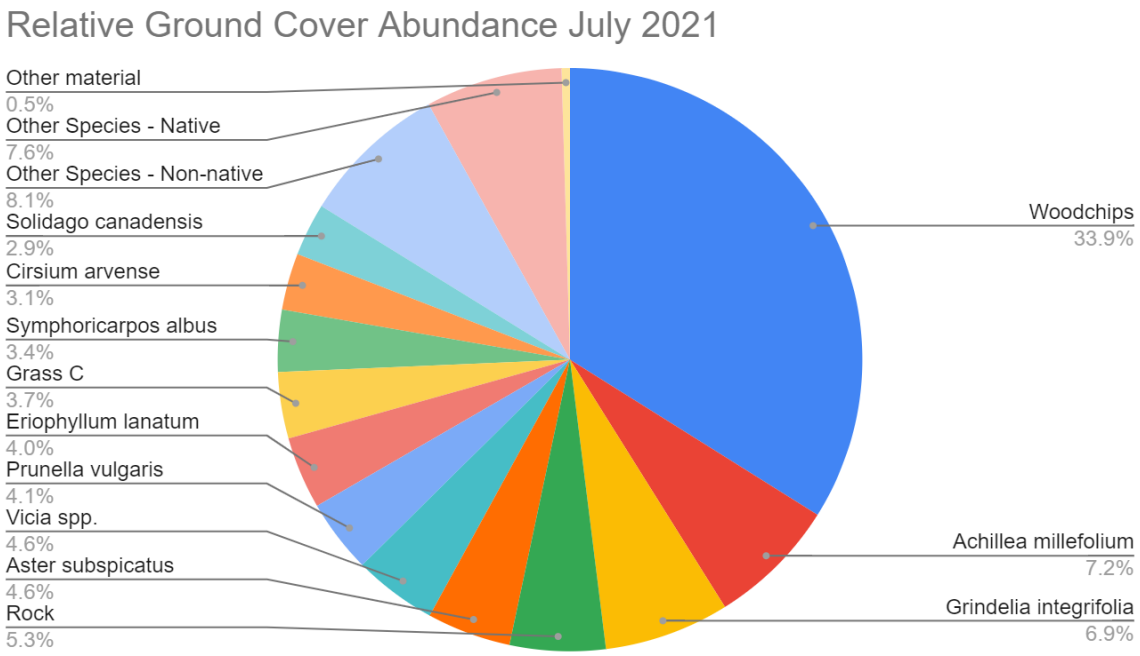

Figure 1. Relative ground cover abundance recorded during summer 2021 biophysical inventory. A large proportion of ground cover is unvegetated woodchips, while the two dominant plants are yarrow (*Achillea millefolium*) and gumweed (*Grindelia integrifolia*).

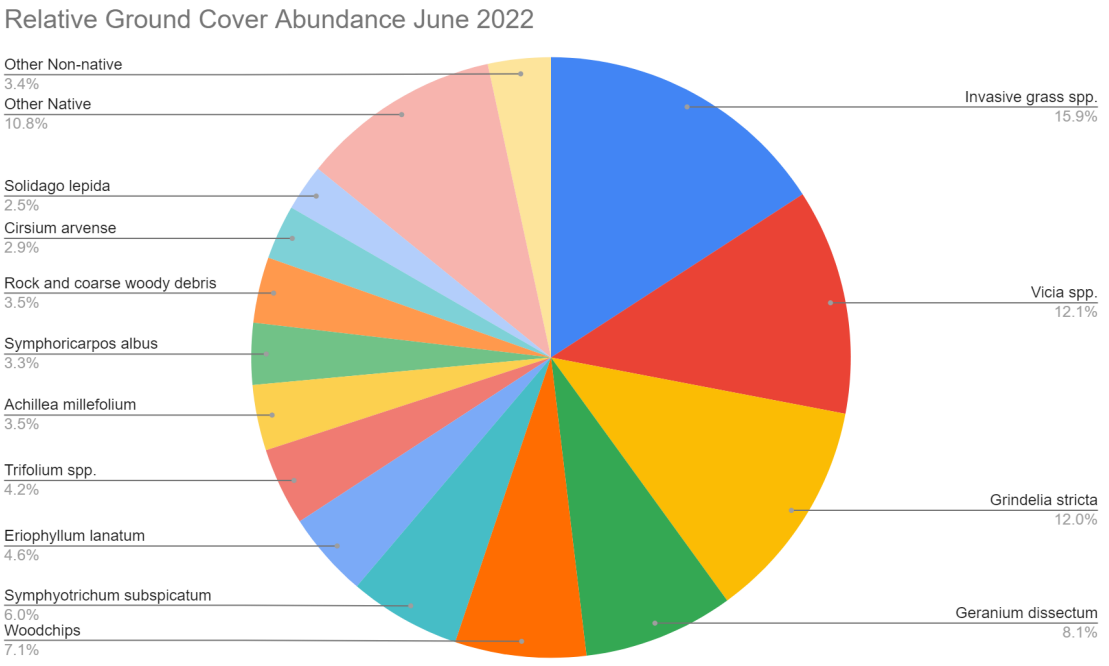

Figure 2. Relative ground cover abundance recorded during summer 2022 biophysical inventory. There is more vegetation overall, with very little bare woodchip. Plant cover is dominated by four taxa, only one (*Grindelia stricta*) of which is native.

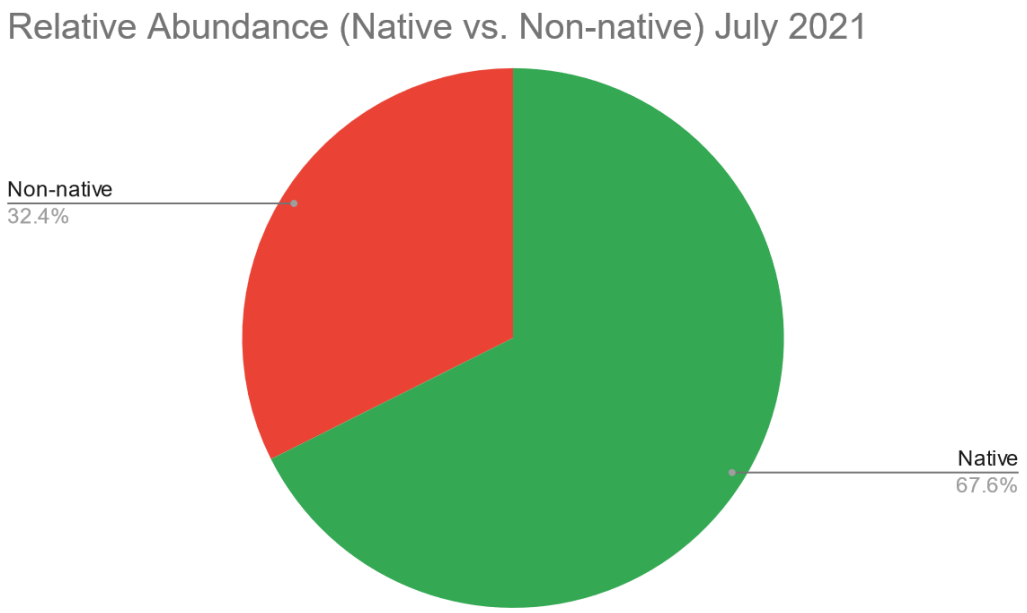

Figure 3. Relative percent cover of native and non-native plant species recorded during summer 2021 biophysical inventory. Two thirds of plant cover are native.

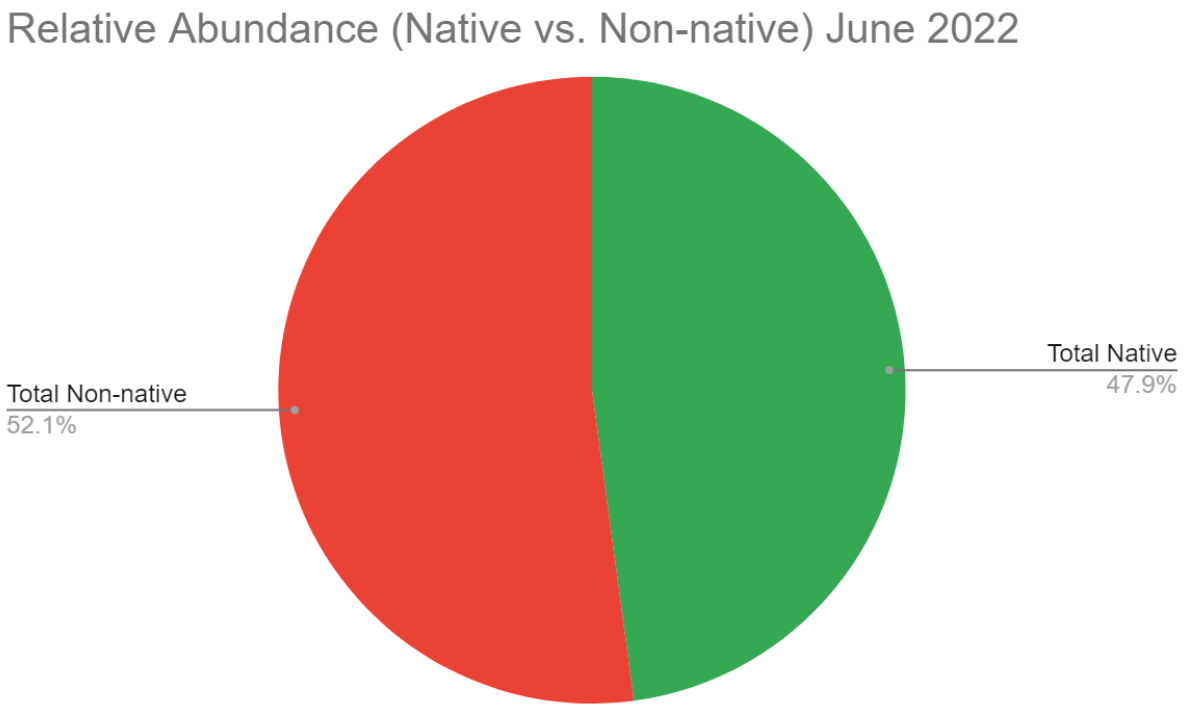

Figure 4. Relative percent cover of native and non-native plant species recorded during summer 2022 biophysical inventory. Only half of the plant cover is native, a decrease of almost 20%.

Photo Point Survey

Photo point surveys were conducted in late May, early June, July, and August, and again at the end of August. Although not quantitative, this photo data revealed an increase in plant cover in the meadow compared to data collected during summer 2021 (Figure 5). Photos taken monthly from May to August 2022 provide information about species bloom and seeding times (Figure 6). In May, photos reveal that sticky cinquefoil (*Drymocallis glandulosa*), vetch (*Vicia* sp.), rose (*Rosa* sp.), woolly sunflower (*Eriophyllum lanatum*), and red columbine (*Aquilegia formosa*) have bloomed. It should be noted that the columbine was not recorded in the biophysical inventory survey. The photos taken in May also reveal several dandelion (*Taraxacum officinale*) plants that have gone to seed. Cinquefoil, rose, woolly sunflower, and columbine continue to bloom in the photos taken in June. These photos also reveal that vetch has started to form seed pods in early June. Photos taken in July contain the highest level of floral diversity, showcasing the flowers of yarrow (*Achillea millefolium*), goldenrod (*Solidago lepida*), gumweed (*Grindelia stricta*), self-heal (*Prunella vulgaris*), Henderson's checkermallow (*Sildalcea hendersonii*), and woolly sunflower. Photos taken in August and September show gumweed and Douglas' aster (*Symphyotrichum subspicatum*) in bloom, which shows an increase in total blooming plants with a decrease in blooming species diversity.

(a)  **(b)** 

(c) 

Figure 5. PM Photo Point Photo 3 (taken at 18 m mark) **(a)** January 19, 2021 **(b)** July 6, 2021 **(c)** July 6, 2022

(a)  **(b)** 

(c)  **(d)** 

(e) 

Figure 6. PM Photo Point Photo 3 (taken at 18m survey mark) **(a)** May 26, 2022 **(b)** June 6, 2022 **(c)** July 6, 2022 **(d)** August 16, 2022 **(e)** September 2, 2022. Vegetation appears denser and more green in photo (**a)** and **(b)** as they were taken prior to invasive species removal on site**.**

Meadow Maintenance

Invasive species removal in the PM during the summer of 2022 took place over the course of two weeks, from June 21 to July 5, starting at the southern end. Most days, 2 participants worked to remove invasives for 3-6 hours. The duration and number of these sessions reflects limited staff availability and unusually high temperatures that limited the longevity of this fieldwork. Methods for this invasive species removal procedure can be found in the maintenance plan [6] created for the meadow during the 2021 YCP program. Photo data for

the sessions completed during the summer of 2022 are available upon request [7]. During sessions, all invasive species were targeted for removal, but due to their abundance, the annuals *Bromus hordeaceus* (and other grasses), *Vicia sativa, V. hirsuta*, *Geranium dissectum*, and *Trifolium subterraneum* received the most attention. Annuals were pulled by hand, while taprooted perennial invasives were dug out.

It is extremely important to note the extensive labour hours required to perform invasive species removal in the PM this summer. Removal in the previous summer occurred too late in the season, so many invasive species had already gone to seed. This likely caused an overabundance in invasives this year, which required major efforts to remove. Removal took so long that despite starting earlier this year, invasive species still had time to go to seed before removal was completed. Therefore, it is recommended to start removal in early June next year, to enable completion by mid-June, prior to the start of seeding. It may also be helpful to begin removal at the northern end of the PM, to give plants at that end an equal opportunity to become established.

While performing removal, it was observed that plants such as *Achillea millefolium* and *Eriophyllum lanatum* were struggling to compete with the invasive species. Species such as *Carex deweyana*, *Chamaenerion angustifolium*, *Philadelphus lewisii*, and to a lesser extent *Sidalcea hendersonii*, appeared to be suffering from lack of water. Evidence was also observed that rabbits were chewing through the fencing and entering the PM, though damage to plants appeared minimal.

Watering of the PM occurred periodically via hose, primarily after particularly hot periods. Fresh mulch was put down in the PM on July 6 to aid in invasive species suppression. Butterfly puddlers were refilled, but not until mid-July.

Insect Survey

To examine the effectiveness of the pollinator meadow in supporting insect diversity, a pollinator survey was conducted on July 25. Survey methodology was repeated according to previous insect surveys from 2020 and 2021, and results were compared. In addition, modifications were made to the survey methodology to improve its robustness and increase how accurately it reflects the true insect community. One major improvement was the addition of coloured bowl traps, used on August 3, which selectively trapped pollinators so more comprehensive data could be collected. Changes to the methodology were made such that previous surveys could still be compared to future surveys. A comprehensive identification guide was also created for reference in future surveys.

In 2021, 8 orders of insects were collected in the meadow, predominantly Hymenoptera (ants, bees, wasps) especially Formicidae (ants), and Diptera (flies). There was also an abundance of Lepidoptera (butterflies, moths), primarily Hesperiidae (skipper butterflies). In 2022, only 3 orders of insects were collected during sweeps, and Hymenoptera and Diptera were once again the dominant orders observed. Diptera in particular were dominated by a single species of fruit fly (Tephritidae), *Campiglossa jamesi*, which was observed in association with gumweed, and made up 35% of the total observations. Hemiptera (true bugs) were also

abundant, but are not considered pollinators. Hesperiidae were conspicuously few in number, though they were visually observed in the meadow.

With the addition of the coloured bowl traps, the number of insect orders that was collected in 2022 increased to 5, and the number of families caught increased from 10 (with just sweeping) to 15 (sweeping plus bowls). This represents an increase of about 50% biodiversity just by adding another method of collection. The relative abundance of each order is shown in Figure 7, the family biodiversity of each order is shown in Figure 8, and a summary of specimens caught is reported in Table 1.

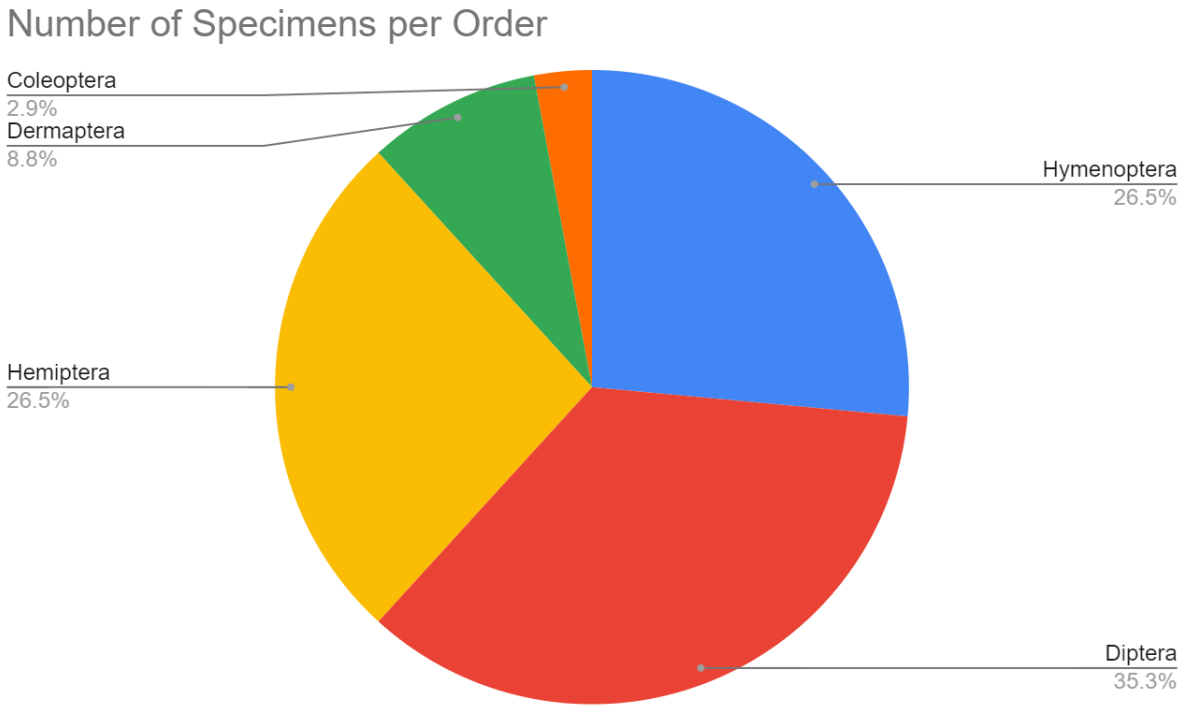

Figure 7. Relative abundance of each order, showing the number of specimens per order. This chart includes specimens caught via net sweep and coloured bowl traps.

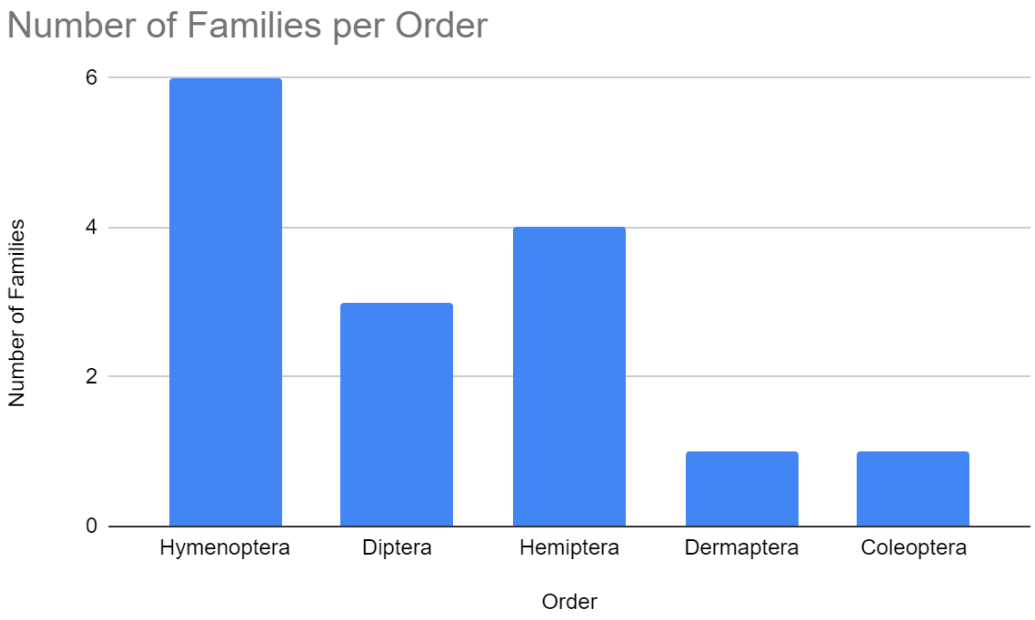

Figure 8. Biodiversity of each order, showing the number of families per order. This chart includes specimens caught via net sweep and coloured bowl traps.

Table 1. Summary of specimens caught, sorted into orders and families. Specimens labeled under "Unknown" were distinctly not part of any of the other listed families. This table includes specimens caught via net sweep and coloured bowl traps.

Order	Family	Number of Individuals
Hymenoptera	Apidae	3
	Halictidae	1
	Andrenidae	2
	Ichneumonidae	1
	Formicidae	1
	Crabronidae	1
	Total	9
Diptera	Tephritidae	8
	Chironomidae	2
	Unknown	2
	Total	12
Hemiptera	Aphrophoridae	1
	Cicadellidae	3
	Lygaeidae	1
	Unknown	4
	Total	9
Dermaptera	Forficulidae	3
Coleoptera	Unknown	1
Total		34

Using the 2022 pollinator survey data, we further analyzed the relationship between insect order and dominant vegetation cover. We observed that insects in the order Hymenoptera were most often found on yellow flowers, such as goldenrod and gumweed (Table 2). This is a common trend observed in other literature, and supported by the previous year's data, and is attributed to the visual spectrum of bees in the UV range, which makes yellow more visible. Unexpectedly, Diptera were also most abundant at yellow flowers; last year they were more commonly observed on white flowers such as yarrow. This could be explained in part due to the unusual abundance of *Campiglossa jamesi*, since they were associated with yellow gumweed. It is also important to note that the yarrow had already begun to finish blooming due to a previous dry period, and Douglas aster had not yet begun to bloom, so there was a lack of flowers in the meadow at the time of the survey. This is especially significant since last year Diptera was most attracted to the white flowers of yarrow, and Lepidoptera (which were not collected at all this year) were most attracted to the purple flowers of Douglas aster.

Table 2. Summary of specimens caught, according to the dominant vegetation they were caught at, or coloured bowl trap.

Dominant Plant Species	Insect Order Observed	Number of Individuals
Yarrow	Hymenoptera	1
	Diptera	2
	Hemiptera	1
Gumweed	Hymenoptera	5
	Diptera	8
	Hemiptera	2
Fireweed	Hemiptera	1
Goldenrod	Hemiptera	2
Yellow Bowl	Hymenoptera	3
	Diptera	2
	Hemiptera	2
	Coleoptera	1
	Dermaptera	3

Bird Point Count Survey

Several bird point count surveys were conducted throughout the summer within the PM; methods were developed during the YCP program in Spring 2021. Because birds are easy to survey and are sensitive to environmental change, they are excellent indicators of ecosystem

health. This year, a total of 21 unique avian species were identified (Table 3), compared to only 14 the previous year; however, the diversity of sparrows was lower. Observations were found to be consistent throughout the survey period, primarily identifying bird species that are common in partially urbanized areas (*e.g.* spotted towhee, Anna's hummingbird, song sparrow, house finch).

On August 2, 2022, a Cooper's hawk was observed circling the park; Cooper's hawks are specialist predators of songbirds, so the observation suggests a healthy songbird population. Surprisingly, during surveys such as August 16, 2022, there were multiple anthropological disturbances (*e.g.* vehicles, dogs), yet they still had high numbers of bird sightings. Anna's hummingbird, an important pollinating species, was the most abundant kind of bird sighted around the pollinator meadow.

Table 3. List of avian species diversity observed within the PM between July and August 2022.

Species
Anna's Hummingbird
Spotted Towhee
Chestnut-backed Chickadee
Dark-eyed Junco
Song Sparrow
American Robin
Red-breasted Nuthatch
Warbling Vireo
Bewick's Wren
Bushtit
Purple Finch
American Crow
American Goldfinch
House Sparrow
House Finch
Brown Creeper
Cedar Waxwing
Mallard
Cooper's Hawk
Downy Woodpecker

Discussion

Collectively, the biophysical inventory, photo point survey, maintenance procedures, and insect survey provide a representation of the meadow's changing vegetation composition, pollinator insect presence, and health over time. Further monitoring will be conducted to document future changes.

Overall, plant biodiversity in the meadow has seen a significant increase, and bare ground has significantly decreased, but the meadow has also seen a dramatic increase in the relative abundance of invasive species compared to native species. This can be partially attributed to the timing of invasive species removal, which occurred too late in the summer of 2021, allowing invasive species enough time to release their seeds into the meadow. Unfortunately, due to employment issues beyond GWAS's control, removal occurred too late, though it did occur earlier than in 2021. Therefore, next year we may see a larger proportion of invasive species. It is highly recommended that invasive species removal be performed earlier next year if possible, in order to prevent this problem from recurring annually.

Unfortunately, the heavy presence of invasive plant species significantly damaged the ecological integrity of the meadow as a whole. Invasive plants outcompeted native species such as the wooly sunflower and yarrow, harming the plants and causing them to very clearly grow less vigorously or in a leggy fashion as they reach for sunlight. It also led them to produce fewer flowers and bloom for a shorter duration of the summer. This further contributed to the reduced biodiversity observed during the insect survey, relative to the previous summer. Many insect pollinators, especially Diptera (flies), preferentially visit white flowers such as yarrow, which was one of the most heavily impacted species of native plants in the meadow this year. Nevertheless, insect biodiversity remained far greater than prior to the construction of the PM.

Encouragingly, bird surveys indicated an increase in avian diversity. This could be an indication of a healthy insect population upon which the birds feed; however, numerous other factors could also contribute to the increase, including improvements to survey technique or improvements to habitat outside the PM.

Conclusion

Monitoring during the summer of 2022 showed that the pollinator meadow remains healthy overall, but requires more careful management of invasive species to preserve its long-term integrity. Key conclusions from these results include the following:

- Total plant species recorded during the survey within the PM decreased slightly from **41** (July 2021) to **35** (July 2022); however, the total observed number of species was actually found to be **58**.
- Percentage of plant cover that was native decreased from **67.6%** (July 2021) to only **47.9%** (July 2022). This is almost certainly because invasive species removal occurred too late last summer so they had time to go to seed. Invasive species also had time to go to seed this year, so results in some areas may be similar next year.

- Photo point survey displays greatest diversity of flowers blooming in July, and reduced diversity but greatest abundance of flowers blooming in August.
- The dominant plant cover species were invasive grasses (**15.9%**), invasive vetches, (**12.1%**), native gumweed (**12.0%**), and invasive geranium (**8.1%**). Yarrow, the dominant species in July 2021, was only the 9th most abundant component in July 2022.
- Only **3** orders of insects were collected during net sweeps in the PM in 2022, as opposed to **8** in 2021; however, the addition of coloured bowl traps increased the number of orders collected to **5** in 2022. **10** families were collected in 2022 (increased to **15** including the bowls), as opposed to **19** families in 2021. Although still far more diverse than prior to the construction of the PM, this decrease in biodiversity from 2021 to 2022 can be partially attributed to fewer flowers being in bloom within the PM.
- Total bird species observed was **21** in 2022, a substantial increase from **14** species in 2021.

GWAS's main goals for 2023 is to continue monitoring vegetation growth patterns, remove invasive species, and use the site as an environmental education tool. We plan to start the biophysical inventory earlier in the growing season to avoid unwanted seeding of common invasives throughout the PM, such as grass and vetch varieties. As well, GWAS will integrate the more robust insect survey methods introduced this year into the PM's regular monitoring plan to ensure a thorough representation on pollinating insects are recorded into the future.

GWAS would like to thank the Esquimalt Parks Department for their continued support of our work within Esquimalt Gorge Park, especially with the *Pollinator Enhancement Project.*

Appendix A: PM Plant Catalogue

Species Observed	Scientific Name
Natives	
Self-heal	*Prunella vulgaris*
Coastal Strawberry	*Fragaria chiloensis*
Wild Strawberry	*Fragaria virginiana*
Douglas Aster	*Symphyotrichum subspicatum*
Common Yarrow	*Achillea millefolium*
Common Snowberry	*Symphoricarpos albus*
Black Twinberry	*Lonicera involucrata*
Henderson's Checker-mallow	*Sidalcea hendersonii*
Western Canada Goldenrod	*Solidago lepida*
Entire-leaved Gumweed	*Grindelia stricta*
Red Columbine	*Aquilegia formosa*
Thimbleberry	*Rubus parviflorus*
Fireweed	*Chamaenerion angustifolium*
Lewis's Mock-orange	*Philadelphus lewisii*
Red-flowering Currant	*Ribes sanguineum*
Dewey's Sedge	*Carex deweyana*
Nootka Rose	*Rosa nutkana*
Nodding Onion	*Allium cernuum*
Hairy Honeysuckle	*Lonicera hispidula*
Common Woolly Sunflower	*Eriophyllum lanatum*
Pacific Ninebark	*Physocarpus capitatus*
Kinnikinnick	*Arctostaphylos uva-ursi*
Sticky Cinquefoil	*Drymocallis glandulosa*
Cleavers	*Gallium aparine*
Fringed Willowherb	*Epilobium ciliatum*
Hornemann's Willowherb	*Epilobium hornmannii*
Exotics	
Curled Dock	*Rumex crispus*
Wild Carrot	*Daucus carota*
Prickly Lettuce	*Lactuca serriola*
Cutleaf Geranium	*Geranium dissectum*

Hairy Vetch	*Vicia hirsuta*
Common Vetch	*Vicia sativa*
Red Deadnettle	*Lamium purpureum*
Canada Thistle	*Cirsium arvense*
Wild Garlic	*Allium vineale*
Creeping Buttercup	*Ranunculus repens*
Subterranean Clover	*Trifolium subterraneum*
Knotted Clover	*Trifolium striatum*
Common Dandelion	*Taraxacum officinale*
Ribwort Plantain	*Plantago lanceolata*
Black Medic	*Medicago lupulina*
Spotted Medic	*Medicago arabica*
Narrowleaf Bird's-foot Trefoil	*Lotus tenuis*
Common Daisy	*Bellis perennis*
Scotch Broom	*Cytisus scoparius*
Common Catsear	*Hypochaeris radicata*
Prickly Sowthistle	*Sonchus asper*
Purple Salsify	*Tragopogon porrifolius*
Smith's Peppergrass	*Lepidium heterophyllum*
Grasses	
Common Velvetgrass	*Holcus lanatus*
Common Soft Brome	*Bromus hordeaceus*
Salt Barley	*Hordeum marinum*
Tall Oatgrass	*Arrhenatherum elatius*
Quack Grass	*Elymus repens*
Bluegrass	*Poa sp.*
Bentgrass	*Agrostis sp.*
Barren Brome	*Bromus sterilis*
Orchardgrass	*Dactylis glomerata*