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Living Lab Program for Climate Change and Conservation - Final Report

Building Climate Resilient Butterfly Habitat, Year 3

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Building Climate Resilient Butterfly Habitat, Year 3 is a project of the Pollination Pathway Climate Adaptation Initiative, a signature program of the Kootenay Native Plant Society. This project receives core funding from the Columbia Basin Trust Ecosystem Enhancement Program, additional funding and support from BC Parks, administrative support from Selkirk Innovates at Selkirk College, and a summer student intern wage subsidy from Eco-Canada.

Research Findings

The aim of this project is to determine the present-day extent of plant-butterfly associations and to establish butterfly meadow habitat in Beaver Creek and Syringa Provincial Parks, both located in the West Kootenay Region of the British Columbia (BC) Interior (Appendix A). Although all butterflies are included in the research, the ecological restoration focus is on the enhancement of habitat with climate resilient native plants that have nectar and host plant value for butterflies at risk and those species predicted to be climate vulnerable.

Determining which butterflies might be more severely impacted by the climate crisis than others cannot be predicted, but there are some traits that have been suggested to increase vulnerability (e.g., see Caldas 2014; Essens et al. 2017). First, some butterflies use only one genus or family of plants as their larval food plants, while others are more generalists. Specialists might be at greater risk to ecosystem changes. Second, butterfly species that overwinter as eggs or larvae are thought to be more vulnerable to temperature and precipitation variations than those that overwinter as adults or pupae. Third, as with any conservation issue, species with smaller ranges are generally more sensitive to habitat impacts. Finally, some of the smaller butterflies have very limited ranges of flight (e.g., only in the 10s of metres). This clearly limits a species ability to respond to factors that cause their habitat to become unsuitable. See Appendix B for a brochure entitled “Rare & Climate-Vulnerable Butterflies of the West Kootenay,” produced as part of the Pollination Pathway program.

This is the third and last year of the Living Lab funded project. In this report, the results from 2023 research and project summary and highlights are presented. Results focus on data collected at or near the ecological restoration sites located in each park and the Butterfly Habitat Learning Garden (formerly Butterfly Habitat Interpretive Garden; BHLG; “interpretive site”) at Syringa Park, which is also an important monitoring site for this project.

Butterflies

Over the three years, thousands of butterfly records were collected (Table 1). Full surveys occurred in 2021 and 2022, and modified surveys were conducted in 2023. In this last year, investigations focused on the ecological restoration sites and BHLG, and included stationary surveys during which the researcher recorded species and behaviour of butterflies visiting the site. Plant species were also noted when a butterfly clearly interacted with a plant (e.g., nectaring, perching, ovipositing).

Table 1. Monitoring effort showing numbers of butterfly detections for the three years of the project.

Survey Type	2021	2022	2023	Total
Formal	492	709	429	1,630
Checklist	532	683	420	1,635
Stationary	n/a	n/a	189	189
Total Records	**1,024**	**1,392**	**1,038**	**3,454**

Regardless of reduced monitoring efforts in 2023, 37 butterfly species were recorded at Beaver Creek and 27 species at Syringa. The numbers of species are similar to the previous two years, including the total number of species documented (Table 2). There were 53 total butterfly species recorded in both parks and all years (See Appendix C for full list of butterfly species). These numbers include all species seen during formal surveys, checklist observations, and incidental sightings within and outside of the research sites.

Table 2. Number of butterfly species observed in 2021 and 2022 in both parks.

Park	2021 # Species	2022 # Species	2023 # Species	Total # Species
Beaver Creek	31	33	28	42
Syringa	29	28	28	42
Total	**40**	**38**	**37**	**53**

The blue-listed Silver-spotted Skipper (*Epargyreus clarus*) was recorded in both parks in 2021 and 2022, and at Beaver Creek only in 2023. The Syringa records represent a small extension west for the nominate subspecies in BC. The red-listed Edith's Copper (*Tharsalea editha*) was recorded at Beaver Creek in 2022 and 2023 and marks a new occurrence record for this species in British Columbia. The species was only known from the Kimberley-Cranbrook area, Yahk, and near Nelson previously.

Growing Degree Days, a measure of the accumulation of heat units based on daily mean temperature, was used to help explain butterfly responses to annual variations in local climate. Accumulation occurs more quickly during warmer springs; in general, spring temperatures advanced more quickly in 2021 and 2023 than in 2022 (Figure 1). The phenologies of most of the butterfly species followed this pattern: adults flew earlier in 2021 and 2023 and later in 2022.

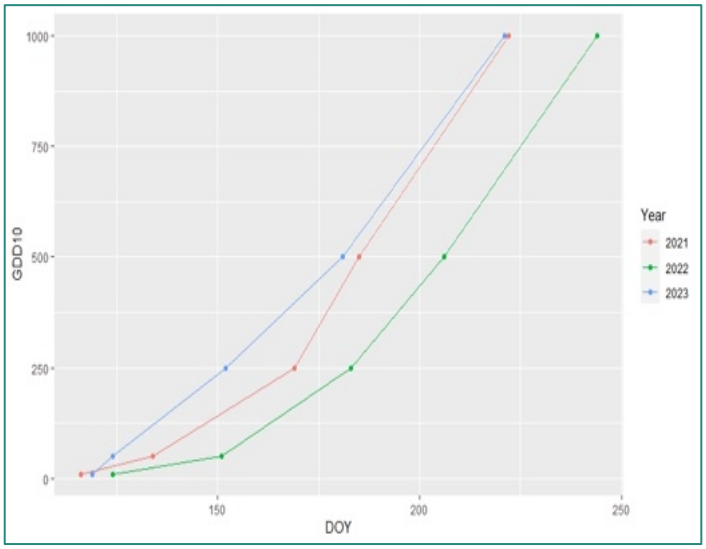

Figure 1. Growing Degree Days for 2021-23 showing the accumulation of heat units (base 10 ℃).

Butterfly Profiles

Highlights of select butterfly species resulting from the project and supplemented by additional regional data collected by Janice Arndt over the last decade will be presented in this portion of the report. These analyses help illustrate the variability of local butterfly life-histories, thus introducing complexity to our efforts as we try to understand conservation needs of butterflies in the West Kootenay.

Boisduval's Blue (Plebejus icarioides)

Boisduval's Blue (Figure 2A) is important to document and track in our region because it is a larval food-plant specialist (only uses silky lupine [*Lupinus sericeus*]), has poor dispersal capabilities, and overwinters as a caterpillar. As can be seen in the box plot (Figure 2B), adult butterflies of this species varied the timing of their flight time in response to local climate and this is the general pattern for most of the butterfly species recorded as part of this project. Although this species was observed at the Charbonneau Creek site in Year 1 of this project, it is the hope that with the planting of silky lupine into restoration and interpretive sites, this climate-vulnerable species will begin to occur in Beaver Creek and Syringa parks.

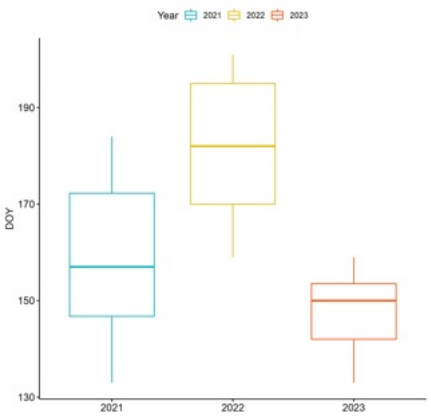

Figure 2. Boisduval's Blue: Photo (left) and box plot showing adult flying timing over the three years of the project (right). J. Arndt photo.

Western Pine Elfin (Callophrys eryphon)

Western Pine Elfin (Beaver 2021-23, Syringa 2021, 2023; Appendix D) (Figure 3A) had an unusually long flight in 2022. Due to the cooler and wetter conditions that year, flowering shrubs appeared to bloom for longer periods of time; hence, the long-lasting floral resources and milder weather may have extended the flight period for adults of this butterfly species (Figure 3B).

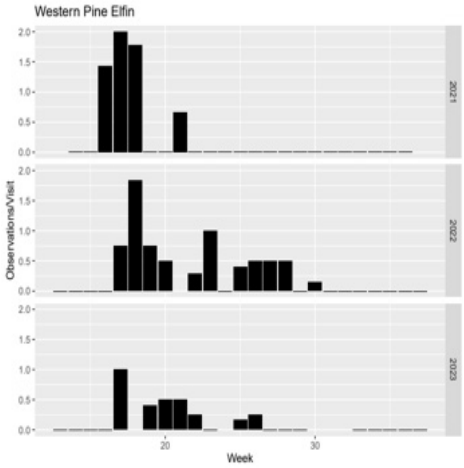

Figure 3. Western Pine Elfin: Photo (left) and bar chart showing adult flying periods over the three years of the project (right). J. Arndt photo.

Julia Orangetip (Anthocharis julia)

Several early-spring species exhibited a very short season with few records in 2023, including Julia Orangetip (Beaver 2021-22, Syringa 2021; Appendix D) (Figure 4), Silvery Blue (*Glaucopsyche lygdamus*), Echo Blue (*Celastrina echo*), and Western Brown Elfin (*Callophrys augustinus*). Their delayed emergence in 2023 can be explained by cool temperatures in April; however, reasons for the low number of observations and early end to the flight are uncertain. It may be that a sharp rise in temperature and abundant rainfall in April-May cut short the flight (Figure 8). Moreover, fewer adults may have emerged, possibly the result of poor breeding success the previous year or poor overwinter survival. Populations of butterflies, along with most other insects, can experience pronounced natural fluctuations from year to year compared to vertebrates. Often the causes, which can include disease and parasitism, are unknown or unseen.

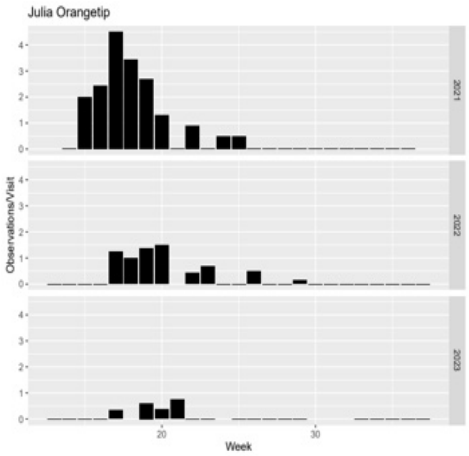

Figure 4. Julia Orangetip: Photo (left) and bar chart showing adult flying periods over the three years of the project (right). J. Arndt photo.

Purplish Copper (Tharsalea helloides)

A preferred host plant of the Purplish Copper (Beaver 2021-23, Syringa 2021-23; Appendix D) (Figure 5A), one of the few double-brooded species in our area (Figure 5B), is the introduced sheep sorrel (*Rumex acetosella*). Two-brooded species experience two generations in one year. As observed at Beaver Creek Park, by the time the second-generation females are ready to lay eggs, the sheep sorrel has usually senesced. The adult butterflies lay their eggs on this plant anyway; the larvae will not hatch until the following year. These late summer fliers receive their nectar from the asters (*Symphyotrichum* spp.) blooming along the Columbia River shoreline, about 100 metres away.

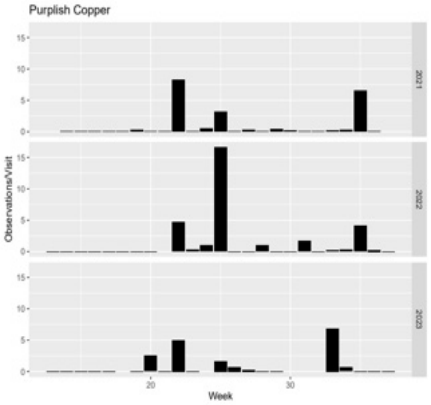

Figure 5. Purplish Copper: Photo (left) and bar chart showing flight times for two broods of adults over the three years of the project (right). J. Arndt photo.

Western Tiger Swallowtail (Papilio rutulus)

Western Tiger Swallowtail (Beaver 2021-23, Syringa 2021-23; Appendix D) (Figure 6A) and Common Roadside Skipper (*Amblyscirtes vialis*) showed exceptionally long flights in 2021. These butterflies are usually single brooded in the West Kootenay, but it appears that they began flying early enough in that year to experience a partial second brood (Figure 6B). A second generation in one year allows greater potential for a strong flight the following year (Macgregor et al. 2019). The larval food plants for Western Tiger Swallowtail are shrubs such as birch (*Betula* spp.) and willow (*Salix* app.) which may have been more resilient to the heat event of 2021 and helped support a second generation of this butterfly species. Grasses, the host plants for the Common Roadside Skipper, may be more hardy and quicker to respond to rebounding moisture levels in the late summer and early fall.

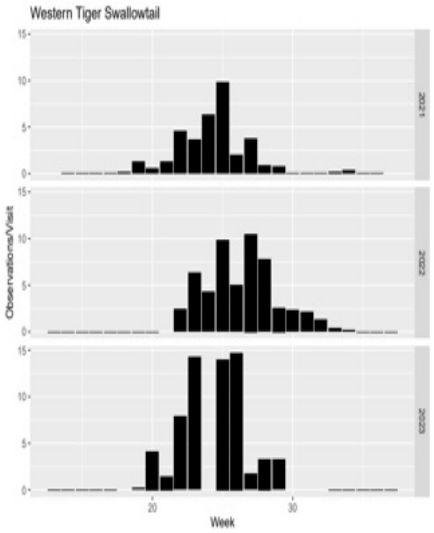

Figure 6. Western Tiger Swallowtail: Photo (left) and bar chart showing flight times over the three years of the project, including possible second brood in 2021 (right). J. Arndt photo.

Plants

Results from monitoring the establishment and phenology of plants in or near the two ecological restoration sites, as well as the interpretive site, will be presented in this section of the report.

Overall, at Beaver Creek Park, plant species planted in the fall of 2022 were successful in their establishment in 2023. The plants experienced over 90% survival, on average, and most flowered in their first year (Table 3). Those with lower establishment were likely dug up by wildlife, as holes where plants were known to be planted were observed in the field.

Table 3. Establishment and phenology of plant species planted at Beaver Creek Park in 2022.

Species	Percent Survival	Phenological Notes
Parsnip-flowered buckwheat (*Eriogonum heracleoides*)	100%	Remained vegetative in first year
Yellow penstemon (*Penstemon confertus*)	100%	Flowered and seed set in first year
Menzie's campion (*Silene menziesii*)	93%	Flowered but no viable seed in first year
Common harebell (*Campanula rotundiflora*)	86% (some dug up)	Flowered and seed set in first year
Golden-aster (*Heterotheca villosa*)	83% (some dug up)	Flowered and seed set in first year

At Syringa Park, the plants fared less well. Average establishment for the eight species was 63% and all species, except scarlet gilia (*Ipomopsis aggregata*), did not flower in the first year after planting. This site is warmer and more arid than the ecological restoration site at Beaver Creek. It is possible that some of the small plants had senesced early or were not observed during monitoring. Most of the established species are expected to flower in 2024. An interesting note, scarlet gilia had the lowest percent survival (13%) but was the only species to flower in 2023 and remain blooming well into September despite site conditions and lack of watering.

Table 4. Establishment and phenology of plant species planted at Syringa Park in 2022.

Species	Percent Survival	Phenological Notes
Old mans' whiskers (*Geum triflorum*)	100%	Remained vegetative
Yarrow (*Achillea millefolium*)	100%	Remained vegetative
Showy daisy (*Erigeron speciosus*)	83%	Dried up before flowering
Western blue flax (*Linum lewisii*)	75%	Remained vegetative
Scouler's hawkweed (*Hieracium scouleri*)	50%	Remained vegetative
Balsamroot (*Balsamorhiza sagittata*)	44%	Remained vegetative
Silverleaf phacelia (*Phacelia hastata*)	38%	Remained vegetative
Scarlet gilia (Ipomopsis aggregata)	13%	Still flowering in September

Results from treatment applications showed that scalping plots led to greater native plant abundance (percent cover) than the plots that were raked. As was expected, scalping, or the removal of both aboveground biomass and the top thin layer of soil, removed the moss crust and exposed more bare soil than in the plots where only loose aboveground biomass was removed (i.e. raking). However, the native plants that established from seed in these plots were, in general, more abundant, larger, and more robust, and showed greater reproductive success than the native plants that established in the raked plots. Annual species, including pink fairies (*Clarkia pulchella*), common clarkia (*Clarkia rhomboidea*), grand collomia (*Collomia grandiflora*), and threadleaf phacelia (*Phacelia linearis*), were all documented in seeded plots in 2023 (Figure 7).

Figure 7. Scalped and seeded plot at Syringa Park, showing flowering pink fairies.

Plant Phenology

Given the weather conditions over the last three years, patterns in plant phenology are difficult to find. In general, the spring period in 2021 was warm and dry, whereas the weather in spring 2022 was cooler and wetter for the same period (Figure 8). In 2023, the increase in average monthly temperature was steeper than in either of the previous two years until May when the temperature appears to plateau. Much more precipitation fell in April and May 2023 than in the previous two years as well. In those two months, twice as much rain fell in the region than in the cool and wet 2022, and almost ten times as much rain fell than in the warm and dry 2021.

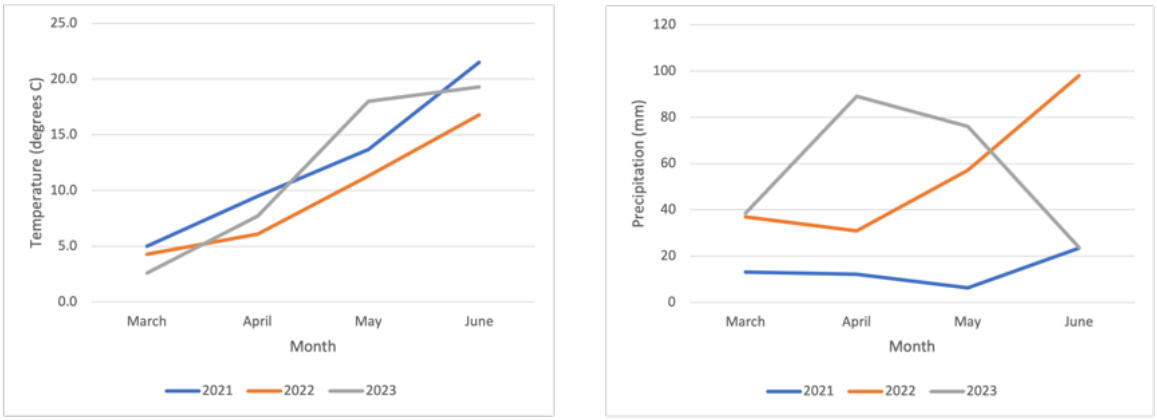

Figure 8. Climate graphs for March-June 2023: Average monthly temperature (℃) (left) and total monthly precipitation (mm) (right) (Gov't of Canada 2024).

Overall, plant phenology at Beaver Creek Park appears to be less affected by annual climatic variation than at Syringa Park. The research site at Beaver Creek is characterized as brushlands on broad benches spanning from the Columbia River to the Trail Regional Airport. The upper portion of this area is the uncommon Gb06 Snowbrush, Poverty Oatgrass plant community (MacKillop and Ehman 2016), and the lower area is characterized as low bench flood (McKenzie and Machmer 2021). The site receives subsurface water from a large bedrock aquifer extending from Fruitvale to the Columbia River (BC Gov't 2022), and the flatter aspect of the location combined with available soil moisture may help maintain more consistent plant growth and development over time. Both native forb and shrub species show similar stability patterns in phenology. Kinnikinnick (*Arctostaphylos uva-ursi*), choke cherry (*Prunus virginiana*), and common snowberry (*Symphoricarpos albus*) are an exception, as all three species recorded shorter bloom periods in 2023 than in either of the previous two years. It may be that these species were compensating for an over-expenditure of flowering potential, in terms of both abundance and blooming period, in 2022.

The research location at Syringa Park, alternatively, can be described as shallow-soiled and steep forest gaps characterized as a Gg11 Bluebunch Wheatgrass, Idaho Fescue plant community (MacKillop and Ehman 2016). When comparisons are made in annual plant phenology, more variability among species and years is observed. For the forbs at Syringa, the species that bloom later in the season show greater differences in phenology from year to year than those with earlier flowering times. Because the soils are coarse and well-drained at this location, the earlier bloomers likely take advantage of spring precipitation whereas the soils become droughty and the site more arid as the season progresses. Generally, the shrubs species did not bloom as long in 2023 as in 2022.

Introduced weedy species can also be compared at the Syringa research site. For many of the species tracked from all three years, the trends are like the native forbs. No large differences in year-to-year phenology can be determined and each species appears to adapt in its own way. For example, the same phenological patterns were recorded for hare's-foot clover (*Trifolium arvense*) in all three years regardless of climate. On the other hand, the phenology of sulphur cinquefoil (*Potentilla recta*) showed wide annual variation in the three years. Finally, a good news story is the massive bloom and seeding of woolly vetch (*Vicia villosa*) witnessed in 2022 was met with an equally as long blooming time in 2023 but with a fraction of the overall plant abundance and flower number. However, given that this species can have a biennial growth form, it is possible that there could be more widespread distribution of woolly vetch in 2024.

Butterfly Habitat Learning Garden

As reported last year, the Butterfly Habitat Learning Garden at Syringa Park was planted with the help of park staff, KNPS employees, and many volunteers in late October 2022. The plants that went into the ground are, in part, important nectar and potential host plants for many butterflies, including species that are at risk and thought to be climate vulnerable. This year, this garden space has become successful butterfly habitat and an important research site for this project (Figure 9). This occurred, in part, by the periodic watering and care (every 2-3 weeks, on average) of our summer student intern and then park staff.

The shrub species planted onsite showed 80% establishment. Just over half (55%) did not flower in 2023 but will likely flower in 2024. Some non-flowering species, for example saskatoon (*Amelanchier alnifolia*) and redstem ceanothus (*Ceanothus sanguineus*), were heavily browsed in the spring but appeared to rebound and put on new growth throughout the summer. Showy milkweed (*Asclepias speciosa*) did not flower in 2023 but looked robust and healthy and will likely flower for the first time in 2024 (Figure 9B). Spreading dogbane (*Apocynum androsaemifolium*) was added to the site through the transplanting of rhizomes. Although reduced establishment was observed for this species, of the plants that did grow, all of them flowered in the first year. It is expected that many of the other rhizomes are likely still viable and remained dormant in 2023. The forbs established well (72%) and only 17% did not flower in 2023. The extra maintenance provided to this site helped to prolong the blooming times for many for the forb species (Figure 9C). On average, some of the plants continued to flower for almost 10 weeks. To further this point, yarrow (*Achillea millefolium*), golden-aster (*Heterotheca villosa*), brown-eyed Susan (*Gaillardia aristata*), silverleaf phacelia (*Phacelia hastata*), and scarlet gilia flowered from mid-spring through August and into September.

Figure 9. Photos of Butterfly Habitat Learning Garden 2023: (A) Garden on August 29, (B) Pink fairies and yarrow growing with showy milkweed (Jun. 28), (C) Plants going to seed and continuing to bloom (Aug. 29), (D) Infill planting with volunteers (Sep. 23). Photos A, B, and C from B. Beckwith; photo D from T. Ernst.

Methods Summary

Because of the establishment of ecological restoration sites within the research areas in the fall 2022, surveys of plant and butterfly presence, abundance, and phenology in 2023 focused in and near those sites. Hence, at Beaver Creek, only monitoring along the upper bench transect, labeled "T4" (Appendix D), was routinely walked. At Syringa Park, the monitoring was restricted to the lower part of the western transect near the road junction (Appendix E). Full surveys, as implemented in the first two years of the project, were conducted twice during the field season to provide some continuity of data. The research sites were monitored on five occasions between mid-May through mid-August – three modified surveys and two full surveys. BHLG was also monitored during every visit to Syringa Park and included additional surveys in late August and early September.

Additional monitoring efforts for both butterflies and plants also occurred in 2023 at both restoration sites and the interpretive site. For butterflies, stationary surveys were added to better document the use of plants by butterflies. At the restoration sites, the researcher conducted two paired 10-minute stationary surveys. The first pair of surveys was conducted at the beginning of the field day and the second pair was conducted at a minimum of 30 minutes later, most often after other work had been completed. The sites are large enough that it is believed two surveys, conducted at opposite ends of a restoration site, would better capture the butterfly diversity at the site. Because BHLG has a smaller area, only two surveys were completed during a visit at this site, each separated by at least 30 minutes.

For the stationary surveys, the researcher would record each butterfly species observed and record a code denoting its behaviour (Table 5), following first detection. If butterfly abundance was low, a butterfly's behaviour during each 1-minute segment of the 10-minute survey was noted.

Table 5. Behaviour codes used during stationary surveys for butterflies.

Code	Behaviour
F	Flying
N	Nectaring (plant species recorded)
OV	Ovipositing (plant species recorded)
P	Perching (wings closed)
B	Basking (wings open)
T	Twirling
M	Mating
D	Puddling
L	Flushed by observer, behaviour unknown
C	Suspected courtship

Ovipositing and nectaring were both considered to be priority behaviours to document and the lowest priority behaviour documented was flying. Therefore, a nectaring or ovipositing butterfly was prioritized over individuals engaged in other behaviours. Moreover, because records of oviposition are relatively rare, if a butterfly appeared to be laying an egg (i.e. bending her abdomen down onto a plant substrate), the 10-minute survey was interrupted to follow the butterfly and record all instances of apparent egg-laying behaviour. When observations of oviposition were concluded, the researcher returned to the stationary survey and completed the time that was remaining.

Additional monitoring for plants at Beaver Creek Park included surveys of presence/absence and plant phenology, as well as additional observations, of plants in the permanent monitoring plots located within the restoration site (Appendix F). As described last year, 12 treatment plots (Table 6) were established within the Syringa Park restoration site. To determine treatment success,

abundance was measured as percent cover. Cover data included vascular plants (to species if possible), moss, rock, bare ground, and other. To compare the seeded plots (scalped vs. raked), the vascular plants were lumped into cover classes: existing non-native forbs, existing native forbs, and seeded species.

Again, because of the smaller overall size of BHLG, the site was treated as one monitoring plot in its entirety.

Table 6. Preparation and planting treatments for restoration plots at Syringa Provincial Park.

No. Plots	Preparation	Planting
4	all aboveground biomass cleared and plot scalped	seeded
4	all aboveground biomass cut and plot raked	seeded
4	all aboveground biomass cut and plot raked	planted

Maintenance, largely in the form of weeding (all sites) and watering (BHLG only) occurred during the field season. At Beaver Creek in early June, weeding focused on the ubiquitous sheep sorrel growing in all planted areas and included the area making up a 0.5 m buffer around those plots. As it was deemed that the Menzies' campion (*Silene menziesii*) plots were too exposed, a mulch of ponderosa pine needles was added around the small plants.

Weeding of the treatment plots also occurred once, in early June, at the Syringa Park restoration site. Large amounts of cheatgrass (*Bromus tectorum*) and other non-native grasses, hare's-foot clover, and sulphur cinquefoil were removed from the plots. Other species targeted at this site, though occurring with lower abundance, were stork's-bill (*Erodium cicutarium*), wall speedwell (*Veronica arvensis*), spotted knapweed (*Centaurea stoebe*), woolly vetch, and sheep sorrel. As with Beaver Creek, weeding was restricted to permanent plots including a 0.5 m buffer around each plot.

The interpretive site, BHLG, was weeded and watered on five occasions over the summer, focusing the efforts between June 9 and July 13, to remove the weeds before these plants reached maturity and to prepare the site for the Open House on July 16. It is believed that park operators continued to water the site occasionally for the remainder of the summer. The site was weeded one more time during the fall planting day in later September (Figure 9D).

Planting in Fall 2023

In the fall of 2023, more plants and seeds were added to the restoration and interpretive sites. At Beaver Creek Park, 92 plants of 10 species were planted, including two species of native grasses (*Achnatherum nelsonii, Danthonia spicata*) and showy milkweed (*Asclepias speciosa*) (Table 7; Appendix F). One hundred and thirty-one plants of nine species were planted at Syringa Park (Appendix E). At BHLG, 10 species (n=71 plants) were added. Of special note, dangling suncress (*Boechera retrofracta*) was added to all three sites. As seen from the results of our research, non-native plants in the Mustard Family (Brassicaceae) appear to be supporting a wide range of butterflies, especially in the spring. It is the hope that this native suncress will become a preferred mustard for butterflies in the future.

Based on mixed establishment results at Syringa Park, a new planting area, uphill from the 2022 restoration site, was chosen because it was thought to be more sheltered and shaded for planting in the fall 2023 (Appendix E).

Planting locally collected seed of target native plant species is an important conservation initiative in ecological restoration. In 2022, seeds were broadcast at both restoration sites; however, determining success of this seeding effort was difficult because of this approach. To better measure establishment, seed germination plots were installed near the 2022 restoration sites in both parks (Appendices E, F). As learned from the seeding treatments at Syringa, better germination rates come when there is good seed-soil contact. Also, through our other KNPS work, the effectiveness of mulching the seeding areas has shown to be inconclusive, though has appeared to be beneficial for germination at some locations.

Table 7. Plant species and quantities planted at restoration and interpretive sites at Beaver Creek and Syringa parks in fall 2023. All plants were in small containers or were plugs at the time of planting.

Site	Scientific Name	English Name	Qty.
Beaver Creek Park	*Achillea millefolium*	yarrow	12
	Achnatherum nelsonii	Columbia needlegrass	3
n = 92	*Asclepias speciosa*	showy milkweed	12
	Boechera retrofracta	dangling suncress	10
	Campanula rotundifolia	common harebell	5
	Danthonia spicata	poverty oatgrass	10
	Erigeron speciosus	showy daisy	12
	Eriogonum heracleioides	parsnip-flowered buckwheat	4
	Heterotheca villosa	golden-aster	12
	Penstemon confertus	yellow penstemon	12
Syringa Park	*Arnica fulgens*	orange arnica	20
	Asclepias speciosa	showy milkweed	12
n = 131	*Boechera retrofracta*	dangling suncress	10
	Cirsium undulatum	wavy-leaved thistle	18
	Eurybia conspicua	showy aster	10
	Geum triflorum	old man's whiskers	30
	Linum lewisii	western blue flax	18
	Penstemon fruticosus	shrubby penstemon	8
	Solidago simplex	spikelike goldenrod	5
Butterfly Habitat Learning Garden	*Aquilegia formosa*	Sitka columbine	3
	Boechera retrofracta	dangling suncress	3
	Erigeron speciosus	showy daisy	12
n = 71	*Grindelia squarrosa*	curly-cup gumweed	8
	Heterotheca villosa	golden-aster	8
	Lomatium ambiguum	swale desert-parsley	5
	Penstemon fruticosus	shrubby penstemon	5
	Primula pauciflora	pretty shootingstar	5
	Solidago simplex	spikelike goldenrod	10
	Symphyotrichum lanceolatum var. *hesperium*	western willow aster	12

Only six species of native plants were chosen for this study. These species were selected because they are predicted to establish and persist at each of the three locations, have known values for butterflies, and/or are recognizable at the seedling phase.

It should also be noted that, in addition to the Beaver Creek and Syringa parks, this seed germination study was also started at a third KNPS research site: Fort Shepherd Conservancy. Hence, there will be three locations and a total of 36 plots to compare for establishment success of these six target species.

The step-by-step methods for the seed germination study were:

- Mark out locations for twelve 1 m^2 quadrats in an area with similar environmental attributes (slope, plant cover, rockiness).
- Randomly divide 12 plots into two treatments (mulch/no mulch).
- Randomly assign the treatment plots into one of two species mixes:
  - Species Mix A: silky lupine (*Lupinus sericeus*), yellow penstemon (*Penstemon confertus*), golden-aster (*Heterotheca villosa*)
  - Species Mix B: showy daisy (*Erigeron speciosus*), silverleaf phacelia (*Phacelia hastata*), swale desert-parsley (*Lomatium ambiguum*)
- Remove all weeds and bag them for removal.
- Roughen soil with rake and other soil loosening tools.

- In small bucket, add seed mix to clean play sand and stir well with hand. Using handfuls of seed-soil mix, sprinkle over plot, back and forth, and then criss-cross to ensure complete coverage across the plot.
- Tamp seeds into the soil using palms of hands.
- Mulch half of marked plots with pre-soaked chopped straw, spreading straw evenly over each plot.

Treatment	**Species Mix A** *L. sericeus* *P. confertus* *H. villosa*	**Species Mix B** *E. speciosus* *P. hastata* *L. ambiguum*
Mulch	A/M (3 plots)	B/M (3 plots)
No Mulch	A/no M (3 plots)	B/no M (3 plots)

Beaver Creek Seeding Plots (B. Beckwith Photo)

Key Outcomes for BC Parks

After three years of this research, we have learned much about plant and butterfly interactions and phenology. With the planting of the ecological restoration and interpretive sites, as well as the focused surveys tracking plant-butterfly interactions and plant establishment, we believe we can better inform ecological restoration efforts in the West Kootenay region.

Plant Establishment

Getting plants to grow at the Syringa Park restoration site proved to be more difficult than at Beaver Creek Park. The well drained soils and steep slope at the Syringa location make this an arid site with little soil moisture holding capacity; young plants and seedlings struggled to become established. Moreover, watering of this site is impossible due to the long distance up a steep incline to the planting areas from the main road. Watering is also limited at the Beaver Creek restoration site; however, the flat aspect and available subsurface water likely helped young plants establish at this location.

The watering of plants at the interpretive site, BHLG, extended the period of available floral nectar for adult butterflies dramatically. It appears that young plants can respond well to periodic watering

during the hot summer months and regular weekly watering is not necessary. The plants were watered every 2-3 weeks, on average, largely during the months of July and August.

Just as plant establishment varies from site to site, plant species differ in their development capacity. For example, vegetative rosettes of scarlet gilia, a biennial species, did not appear to establish well at the Syringa restoration site. However, the individuals that did survive were able to flower and provide nectar for butterflies and other pollinators. Alternatively, there are perennial species that establish well but do not reach maturity in the first year after transplanting. It is believed that many of these species will flower in subsequent years. Finally, seeded annual species that are well adapted to dry conditions show establishment and flowering success, regardless of site.

Butterfly Phenology

Our field work demonstrated that the timing of the adult flight period of many of BC's butterfly species is responsive to annual variations in temperature, as has been showed in other studies elsewhere. Our results indicated that, during periods of dry weather, butterflies are present in greater numbers in areas that provide suitable blooming plants compared to areas that are devoid of flowers. In the West Kootenay, the driest part of the year is often in mid to late summer; therefore, the availability and reproductive success of late-blooming plants is critical for sustaining butterflies in August and early September. Presumably, these resources allow individual butterflies to live longer and potentially increase their reproductive capacity.

Our findings also underscore the importance of providing plants that are preferred nectar sources for local butterflies. Though there is much overlap, good butterfly flowers aren't always the same as those that are beneficial for bees or hummingbirds, for example. Observing the behaviour and preferences of butterflies regarding which plants they are using, relative to availability, helps inform ecological restoration planning. Similarly, each local butterfly community contains species with diverse life histories, which can be explored to diversify restoration approaches that are tailored to target species. For instance, plant resources that are suitable for species with two generations per year could be prioritized to ensure they are supported throughout their extended flight season.

Relevance to BC Parks Management

More information regarding butterfly-plant interactions was garnered from the stationary surveys in 2023. In addition to data on perching and ovipositing, among other behaviours, we now know much more about plant food favourites of adult butterflies. This information is at the heart of this research – helping us to better understand what plants across the landscape are both available (i.e. flowering at the right time) and preferred (i.e. nectaring when flowering) by adult butterflies. It's important to note that both native and non-native plant species support adult butterflies and any ecological restoration activities that target the removal of non-native plants should be sure to replace them with equivalent native species.

An analysis of nectaring records was conducted based on all available observations over the three years and includes 40 butterfly species, 57 plant species, and a total of 850 observations. In the tables below, the highest ranking native (Table 8) and non-native (Table 9) plant species are listed. Included information is growth form, scientific and English names, site where the plants currently occur (or nearby, for non-native species), overall ranking, and conservation benefit. Ranking was determined by adding the total number of observations for each plant taxa, the total number of butterfly species visiting that plant taxa, and the number of observations for rare and/or climate vulnerable butterflies. For the native plants, the two highest ranking plant taxa are asters in the *Symphyotrichum* genus (ranking = 333) and spreading dogbane (ranking = 136) (3 stars each). The second highest ranking plants are those taxa with a combined score between 20 and 100 (2 stars).

Finally, those taxa with one star have a ranking between 10 and 20. For the non-native plant taxa, spotted knapweed ranked the highest (n = 59). The number of stars for non-native plants follows that of the native plants. The plant taxa observed to support butterflies considered to be locally rare ("R") or climate-vulnerable ("CV") are indicated in the Conservation Benefit column in both tables.

Table 8. Native plant taxa that have been observed to support adult butterflies, based on selective list of nectaring records 2021-2023.

Growth Form	Scientific Name	English Name	Site	Overall Ranking	Conservation Benefit
Annual/ biennial	*Clarkia pulchella*	pink fairies	SYR, BHLG	*	
	Coreopsis tinctoria	coreopsis	BEA, BHLG	*	
Perennial	*Achillea millefolium*	yarrow	BEA, SYR, BHLG	*	
	Allium schoenoprasum	wild chives	BEA	**	R
	Anaphalis margaritacea	pearly everlasting	BHLG	**	
	Apocynum androsaemifolium	spreading dogbane	BEA, SYR, BHLG	***	R, CV
	Gaillardia aristata	brown-eyed Susan	BEA, SYR, BHLG	**	CV
	Helenium autumnale	mountain sneezeweed	BEA, BHLG	*	
	Heterotheca villosa	golden-aster	BEA, BHLG	*	
	Phacelia hastata	silverleaf phacelia	SYR, BHLG	*	
	Symphyotrichum spp.	asters	BEA, SYR, BHLG	***	R
Shrub	*Ceanothus velutinus*	snowbrush	BEA	**	CV
	Mahonia aquifolium	tall Oregon-grape	BEA, SYR, BHLG	**	
	Physocarpus malvaceus	mallow ninebark	BHLG	*	
	Prunus virginiana	choke cherry	BEA, SYR, BHLG	**	CV

Table 9. Non-native plant taxa that have been observed to support adult butterflies, based on selective list of nectaring records 2021-2023.

Growth Form	Scientific Name	English Name	Site Proximity	Overall Ranking	Conservation Benefit
Annual/ biennial	*Vicia villosa*	woolly vetch	BEA, SYR	**	R, CV
Biennial/ perennial	*Centaurea stoebe*	spotted knapweed	BEA, SYR, BHLG	**	CV
Perennial	*Cichorium intybus*	chicory	SYR, BHLG	**	
	Lythrum salicaria	purple loosestrife	BEA	**	
	Medicago sativa	alfalfa	BEA, SYR	**	

The native plants listed in Table 8 should be considered priority species for ecological restoration and butterfly conservation. As we continue to learn more about butterfly species and their behaviours in BC Parks in our region (Appendix G), the list will likely grow and become more comprehensive and regionally relevant. As noted in Table 9, non-native species can be valuable food sources for butterflies including those deemed rare or climate vulnerable. Care needs to be taken when engaging in weed and invasive species removal activities to replace the non-native species with plants of appropriate native species (growth form, blooming phenology, ecological resilience).

Project's Challenges & Opportunities

A main challenge this year was like that of previous years – variable climate. Determining multi-year research outcomes based on weather is challenging when each year is different without discernable trends. Over the last three years, we have witnessed both plants and butterflies adapt to the changing climate. However, the long-term persistence of these species and their synchronous phenological calendars is uncertain given the unpredictability of annual climate patterns. We are hopeful because, through our restoration efforts, we can get plants to establish; some species (i.e. annuals, biennials) provide immediate nectar rewards for butterflies and many other plant species (i.e. perennials) will ensure long-term floral benefits for butterflies in future years.

Even though cool and moist soils can favour young plant and seedling success over the first summer, maintaining these soil conditions is challenging when working in remote sites in the face of the climate crisis. Plant establishment can be enhanced by adapting planting and seeding strategies, as well as providing site maintenance, to meet and enhance the environmental conditions of the ecological restoration site. How best to maintain soil conditions conducive to plant growth and development? Watering is not an option for our restoration sites; however, we have seen more establishment success at Beaver Creek Park due to the likelihood of subsurface water and flatter aspect. Water appears to be more available and stick around longer at this site. Because we cannot change the site conditions at Syringa Park, we moved our plantings into areas that are more shaded from summer heat and less steep. Moreover, we are testing the application of a light mulch onto seeded plots in both parks through our new seed germination study. It is believed that chopped straw will help maintain soil moisture, shade the ground, reduce competition from encroaching weedy species, and will not impede germination. Watering should always be considered for new plantings if possible; however, we have learned that likely only periodic watering may be sufficient to help the plants get through their first summer. If soil moisture can be maintained at ecological restoration, and interpretive, sites, the new plants are more likely to establish and the flowering periods for some plant species may be lengthened, thereby providing food to many different species of butterflies and other pollinators.

Conclusions & Next Steps

Although 2023 marks the end of Living Lab funding for this project, the work will continue as part of the larger Pollination Pathway program of the Kootenay Native Plant Society. Through the seeking of other avenues of funding, in 2024 we hope to continue monitoring the butterflies and plants associated with the ecological restoration and interpretive sites, as well as the seed germination study plots, maintain and provide interpretation at BHLG, and get more plants and seeds into the sites in the fall.

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List of Appendices

Appendix A. Location of research and interpretive sites at Beaver Creek and Syringa Provincial Parks.

Appendix B. "Rare & Climate-Vulnerable Butterflies of the West Kootenay" brochure developed in 2023 by Brenda Beckwith and Janice Arndt as part of this project. Brochures were made available at the gate house and park host kiosk at Syringa Park last summer and will be available to park visitors in future years as well.

Appendix C. Summary of butterfly species recorded during formal surveys, checklist observations, and incidental sightings within and outside of research and interpretive sites, 2021-23. Bold = SAR.

Appendix D. Research sites showing locations of survey transects and restoration site at Beaver Creek Provincial Park.

Appendix E. Ecological restoration site at Syringa Provincial Park.

Appendix F. Ecological restoration site at Beaver Creek Provincial Park.

Appendix G. "Butterfly Checklist for Beaver Creek, Syringa, and King George VI Provincial Parks" handout developed in 2023 by Valerie Huff and Janice Arndt as part of this project.

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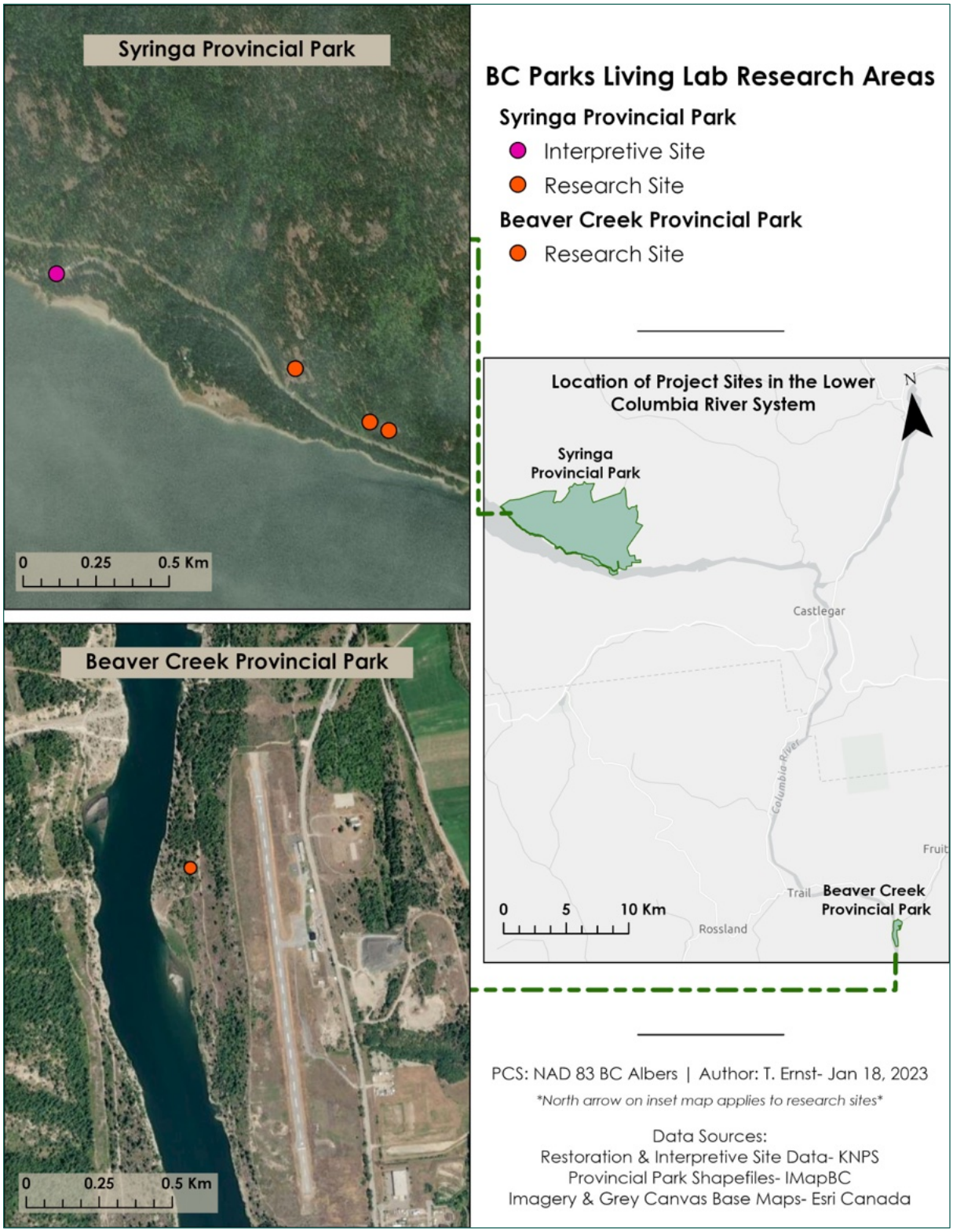

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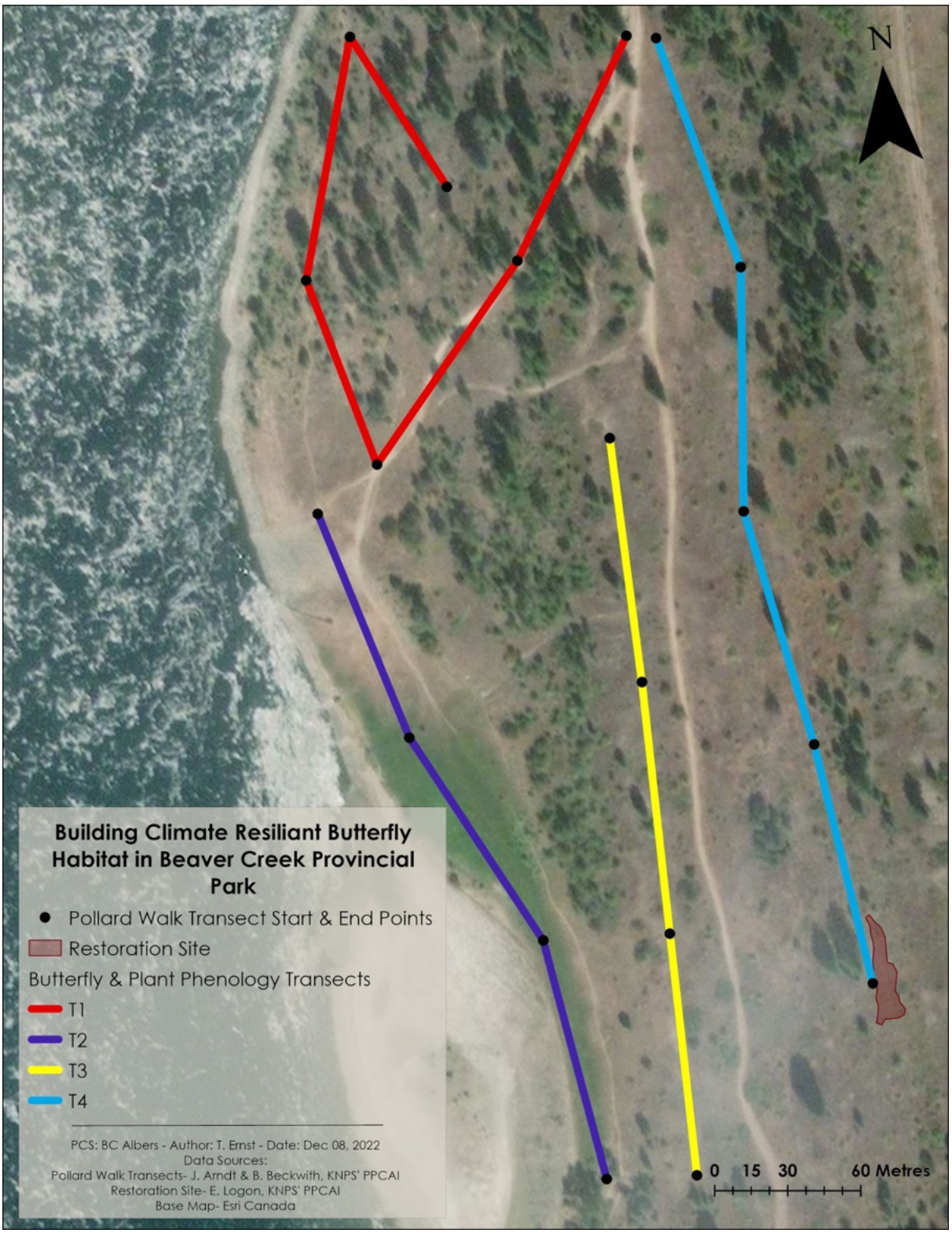
Appendix C. Summary of butterfly species recorded during formal surveys, checklist observations, and incidental sightings within and outside of research and interpretive sites, 2021-23. Bold = SAR.

Beaver Creek				Syringa			
English Name	**2021**	**2022**	**2023**	**2021**	**2022**	**2023**	**Scientific Name**
Silver-spotted Skipper	0	0	0	0	0		*Epargyreus clarus*
Northern Cloudywing				0			*Thorybes pylades*
Dreamy Duskywing				0		0	*Erynnis icelus*
Duskywing		0	0				*Erynnis* sp.
Two-banded Checkered Skipper				0			*Pyrgus ruralis*
Garita Skipperling	0						*Oarisma garita*
European Skipperling	0	0	0			0	*Thymelicus lineola*
Woodland Skipper	0	0	0	0	0	0	*Ochlodes sylvanoides*
Branded Skipper	0	0			0		*Hesperia* sp.
Common Roadside Skipper	0		0	0	0	0	*Amblyscirtes vialis*
Anise Swallowtail			0				*Papilio zelicaon*
Two-tailed Tiger Swallowtail		0	0	0	0	0	*Papilio multicaudata*
Western Tiger Swallowtail	0	0	0	0	0	0	*Papilio rutulus*
Pale Swallowtail	0	0	0	0	0	0	*Papilio eurymedon*
Clouded Sulphur	0	0	0		0	0	*Colias philodice*
Orange Sulphur		0	0	0	0	0	*Colias eurytheme*
Julia Orangetip	0	0		0			*Anthocharis julia*
Pine White					0	0	*Neophasia menapia*
Cabbage White	0	0	0	0	0	0	*Pieris rapae*
Margined White	0	0		0			*Pieris marginalis*
Western White		0	0				*Pontia occidentalis*
Edith's Copper		0	0				*Tharsalea editha*
Purplish Copper	0	0	0	0	0	0	*Tharsalea helloides*
Sylvan Hairstreak				0		0	*Satyrium sylvinus*
Coral Hairstreak	0		0				*Satyrium titus*
Hedgerow Hairstreak	0		0			0	*Satyrium saepium*
Thicket Hairstreak					0		*Callophrys spinetorum*
Juniper Hairstreak						0	*Callophrys gryneus*
Brown Elfin	0	0			0		*Callophrys augustinus*
Hoary Elfin	0	0	0				*Callophrys polia*
Western Pine Elfin	0	0	0	0		0	*Callophrys eryphon*
Grey Hairstreak	0	0	0	0	0	0	*Strymon melinus*
Silvery Blue	0	0	0	0	0	0	*Glaucopsyche lygdamus*
Echo Azure	0	0	0	0	0		*Celastrina echo*
Asher Blue*		0			0	0	*Celastrina asheri*
Acmon/Lupine Blue	0						*Icaricia acmon/lupini*
Great-spangled Fritillary	0		0				*Argynnis cybele*
Fritillary sp.			0		0	0	*Argynnis* sp.
Lorquin's Admiral	0	0	0	0	0	0	*Limenitis lorquini*
Milbert's Tortoiseshell		0					*Aglais milberti*
Compton Tortoiseshell		0			0		*Nymphalis l-album*
California Tortoiseshell	0	0	0	0	0	0	*Nymphalis californica*
Mourning Cloak	0	0		0	0	0	*Nymphalis antiopa*
Satyr Anglewing				0			*Polygonia satyrus*
Green Comma				0	0		*Polygonia faunus*
Hoary Comma	0	0		0	0		*Polygonia gracilis*
Painted Lady						0	*Vanessa cardui*
Northern Crescent	0	0	0	0	0	0	*Phyciodes cocyta*
Mylitta Crescent	0			0		0	*Phyciodes mylitta*
Ochre (Common) Ringlet	0	0					*Coenonympha california*
Common Wood Nymph	0	0	0	0	0	0	*Cercyonis pegala*
Dark Wood Nymph		0			0	0	*Cercyonis oetus*
Butler's (Common) Alpine				0			*Erebia epipsodea*
Total Number of Species/Year	**31**	**33**	**28**	**29**	**28**	**28**	
Total Beaver Creek Species No.		**40**	**42**		**38**	**42**	**Total Syringa Species No.**

* Asher Blue was split from Echo Azure in 2022. It was likely present at both sites in 2021.

Appendix D. Research sites showing locations of survey transects and restoration site at Beaver Creek Provincial Park.



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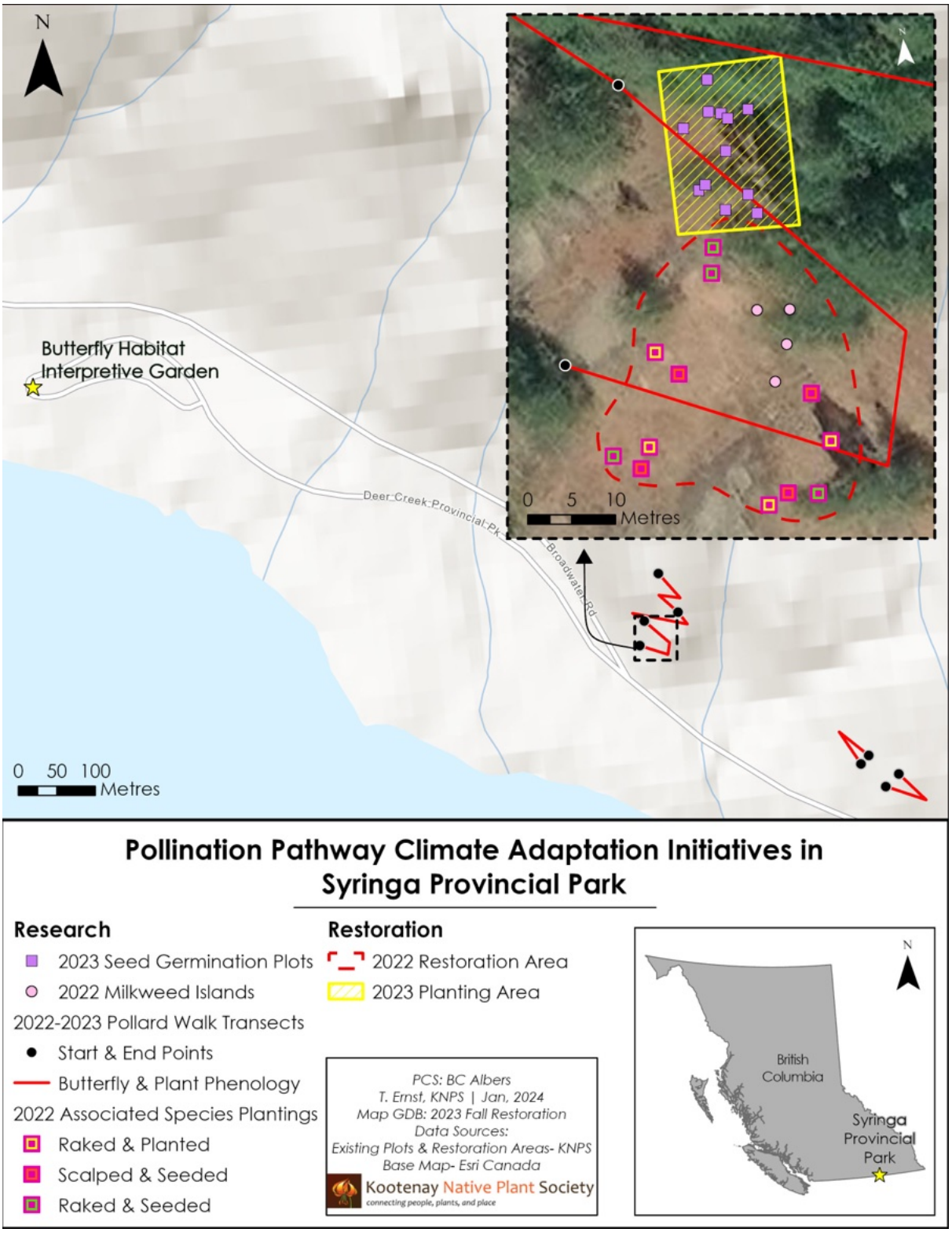
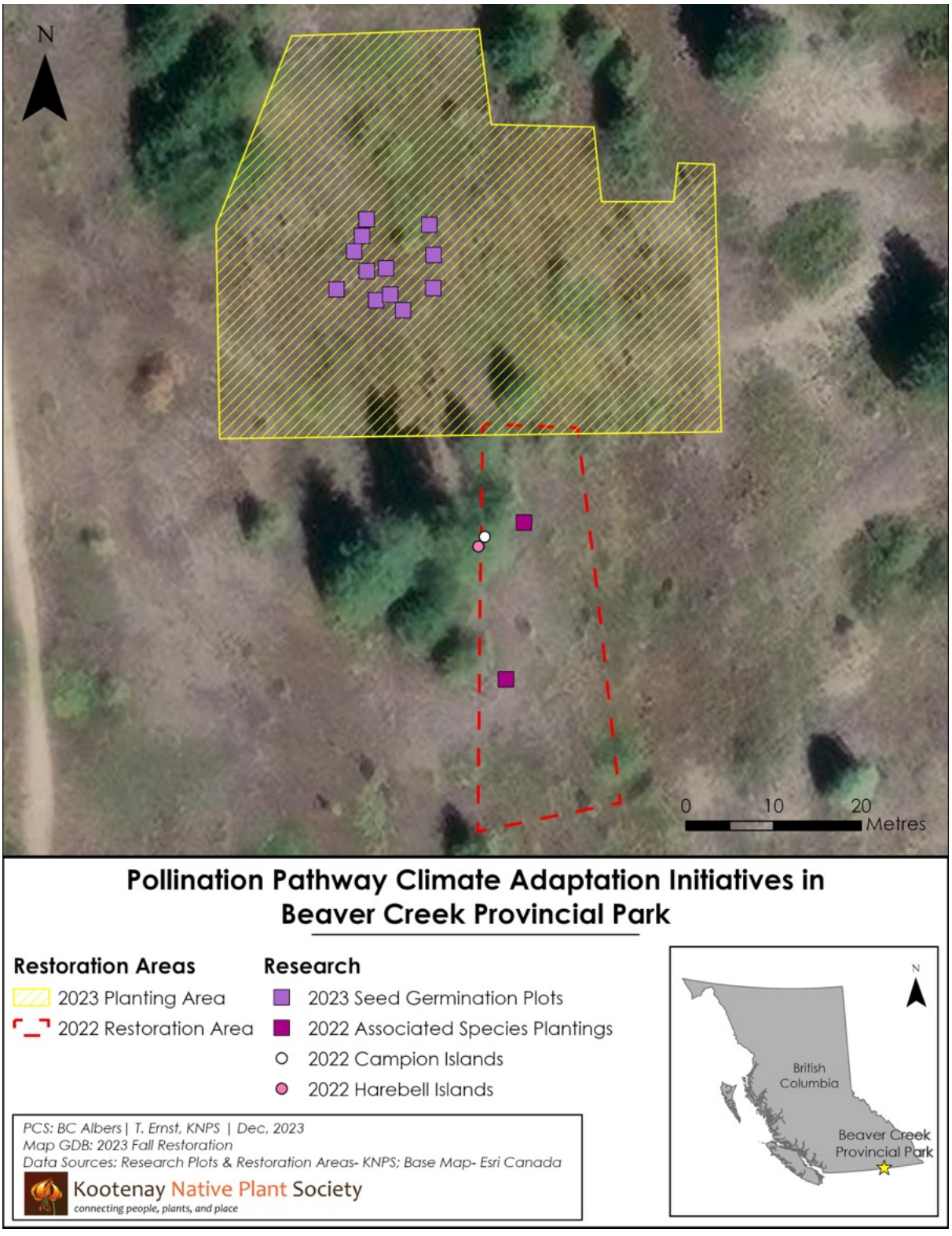


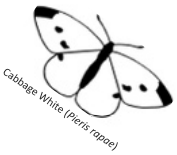
Appendix F. Ecological restoration site at Beaver Creek Provincial Park.



Appendix G. "Butterfly Checklist for Beaver Creek, Syringa, and King George VI Provincial Parks" handout developed in 2023 by Valerie Huff and Janice Arndt as part of this project.

Common Checkered Skipper (*Burnsius communis*)

Comma (Polygonia sp.)



Cabbage White (Pieris rapae)

Thanks to our project partners and sponsors:

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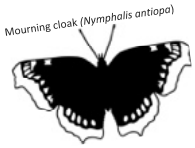
Silhouette images are by Andy Wilson (*Burnsius communis, Strymon melinus, Danaus plexippus, Pieris rapae, Polygonia* sp.) and Sara Gamboa (Swallowtail).

Kootenay Native Plant Society
connecting people, plants, and place



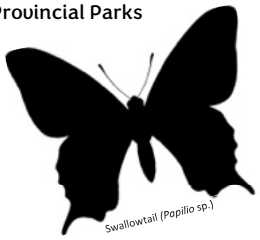
Mourning cloak (*Nymphalis antiopa*)

Monarch (*Danaus plexippus*)

BUTTERFLY CHECKLIST

For
Beaver Creek
Syringa
and
King George VI
Provincial Parks

Grey Hairstreak (*Strymon melinus*)



Swallowtail (Papilio sp.)

POLLINATION PATHWAY CLIMATE ADAPTATION

Skippers (Hesperiidae)	Park	Your Notes
☐ **Silver-spotted Skipper (*Epargyreus clarus*)**	B S	
☐ Northern Cloudywing (*Thorybes pylades*)	S	
☐ Dreamy Duskywing (*Erynnis icelus*)	S K	
☐ Pacuvius Duskywing (*Erynnis pacuvius*)	K	
☐ Two-banded Checkered Skipper (*Pyrgus ruralis*)	S	
☐ Western Arctic Skipper (*Carterocephalus skada*)	K	
☐ Garita Skipperling (*Oarisma garita*)	B	
☐ European Skipperling (*Thymelicus lineola*)	B S K	
☐ Woodland Skipper (*Ochlodes sylvanoides*)	B S K	
☐ Branded Skipper (*Hesperia* sp.)	B S	
☐ Common Roadside Skipper (*Amblyscirtes vialis*)	B S K	
Swallowtails (Family Papilionidae)		
☐ Anise Swallowtail (*Papilio zelicaon*)	K	
☐ Two-tailed Tiger Swallowtail (*Papilio multicaudata*)	B S K	
☐ Western Tiger Swallowtail (*Papilio rutulus*)	B S K	
☐ Pale Swallowtail (*Papilio eurymedon*)	B S K	
Whites and Sulphurs (Family Pieridae)		
☐ Clouded Sulphur (*Colias philodice*)	B S	
☐ Orange Sulphur (*Colias eurytheme*)	B S	
☐ Julia Orangetip (*Anthocharis julia*)	B S K	
☐ Pine White (*Neophasia menapia*)	S K	
☐ Margined White (*Pieris marginalis*)	B S K	
☐ Cabbage White (*Pieris rapae*)	B S K	
☐ Western White (*Pontia occidentalis*)	B	
Gossamer-Winged (Lycaenidae)		
☐ **Edith's Copper (*Tharsalea editha*)**	B	
☐ Purplish Copper (*Tharsalea helloides*)	B S K	
☐ Sylvan Hairstreak (*Satyrium sylvinus*)	S	
☐ Coral Hairstreak (*Satyrium titus*)	B	
☐ Hedgerow Hairstreak (*Satyrium saepium*)	B	
☐ Thicket Hairstreak (*Callophrys spinetorum*)	S	
☐ Brown Elfin (*Callophrys augustinus*)	B S	
☐ Hoary Elfin (*Callophrys polia*)	B	
☐ Western Pine Elfin (*Callophrys eryphon*)	B S	
☐ Juniper Hairstreak (*Callophrys gryneus*)	K	

Keep track of your butterfly discoveries, add notes as needed!
B = Beaver Creek S = Syringa K = King George

Gossamer-Winged (Lycaenidae) *cont'd*	Park	Your Notes
☐ Grey Hairstreak (*Strymon melinus*)	B S K	
☐ Silvery Blue (*Glaucopsyche lygdamus*)	B S K	
☐ Echo Azure (*Celastrina echo*)	B S K	
☐ Asher Blue (*Celastrina asheri*)	K	
☐ Greenish Blue (*Icaricia saepiolus*)	B S	
☐ Acmon/Lupine Blue (*Icaricia acmon/lupini*)	B	
Brush-Footed (Nymphalidae)		
☐ ***Monarch (*Danaus plexippus*)**	S	
☐ Great-spangled Fritillary (*Argynnis cybele*)	B K	
☐ Zerene Fritillary (*Argynnis zerene*)	K	
☐ Hydaspe Fritillary (*Argynnis hydaspe*)	K	
☐ Lorquin's Admiral (*Limenitis lorquini*)	B S K	
☐ Milbert's Tortoiseshell (*Aglais milberti*)	B	
☐ Compton Tortoiseshell (*Nymphalis l-album*)	B S	
☐ California Tortoiseshell (*Nymphalis californica*)	B S K	
☐ Mourning Cloak (*Nymphalis antiopa*)	B S K	
☐ Satyr Anglewing (*Polygonia satyrus*)	S K	
☐ Green Comma (*Polygonia faunus*)	S K	
☐ Hoary Comma (*Polygonia gracilis*)	B S	
☐ Northern Crescent (*Phyciodes cocyta*)	B S K	
☐ Mylitta Crescent (*Phyciodes mylitta*)	B S K	
☐ Common Ringlet (*Coenonympha california*)	B K	
☐ Common Wood Nymph (*Cercyonis pegala*)	B S K	
☐ Dark Wood Nymph (*Cercyonis oetus*)	B S	
☐ Common Alpine (*Erebia epipsodea*)	S K	
Other: _____		
Other: _____		
Other: _____		
Other: _____		

Species on this list were observed in surveys conducted for BC Parks by Janice Arndt in 2020, 2021 and 2022 in Beaver Creek (B) and Syringa (S) and King George VI (K) provincial parks.

*Except Monarch, last seen in Syringa by Valerie Huff in 2015.

Names in **Bold** indicate at-risk and vulnerable species.

Living Lab for Climate Change Project Lead: Brenda Beckwith