Appendix 15-H

Gillette's Checkerspot Survey - Crown Mountain Project

Crown Mountain Project

Gillett's Checkerspot Survey

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Life size images of a *Euphydryas gillettii* voucher specimen

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Executive Summary

This project was focused on determining whether the Gillett's Checkerspot butterfly, a red-listed species, occurred within the Local Study Area of the Crown Mountain project. Published and unpublished information on the biology of Gillett's Checkerspot was reviewed to assist with location efforts. Aerial imagery of the general project area was reviewed for habitat features potentially suitable for Gillett's Checkerspot, in order to direct field surveys. Field surveys were conducted in areas deemed potentially suitable as well as areas that were potentially unsuitable, to account for discrepancies from digital imagery.

The species was found to be present in two areas within the Local Study Area; one location in the Crowsnest Pass and another in the valley of Alexander Creek. Two areas south of Grave Creek were found with abundant larval food plant presence but no adults, egg masses or larvae were detected.

Incidental observations prior to and during Checkerspot field surveys also detected the presence of another provincially red-listed butterfly species – *Lycaena dione* (Grey Copper). One location was coincident with the Crowsnest Pass Gillett's Checkerspot location and another was outside the study area, near Airport Road north of Sparwood.

Even though the project area is primarily composed of unsuitable or less than favourable habitat for this localized species, two occurrences of Gillett's Checkerspot were observed, and project work resulted in the recording of an additional red-listed butterfly within the study area.

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1. Introduction

Gillett's Checkerspot (*Euphydryas gillettii*) is a butterfly with a highly restricted global range; known to be present only in parts of Idaho, Montana, Oregon, Utah and Wyoming in the USA, and only in very small portions of Alberta and British Columbia in Canada. Kondla (2005) estimated that the Canadian species range consists of less than 0.2% of the national land base. It is a red-listed species of conservation concern in BC. The project area is situated in a part of the province that has been identified by Kondla *et al*. (2000) as an area of conservation interest for butterflies.

The species has a significant amount of available information with respect to its biology, habitat and range. See for example: Boggs et al (2006), Bonebrake et al. (2010), Bowers & Williams (1995), Comstock (1940), Coolidge (1909), Debinski (1994), Dulc & Hobbs (2013, 2014), Hobbs (2008, 2012), Holdren & Ehrlich (1981), Kondla (2005), McCoy et al. (2014), Williams (1981,1988,1990, 1995, 2012), Williams & Bowers (1987), Williams et al. (1984). Brief accounts also appear in butterfly books that describe all or parts of the species range, for example: Bird et al (1995), Ferris & Brown (1981), Guppy & Shepard (2001), Layberry et al (1998), Scott (1986), Warren (2005). Williams (2001) provides a well-written non-technical essay on this species in the USA. Various species of the genus *Euphydryas* have received considerable attention from biological researchers from various perspectives. Much of this has been summarized in a book edited by Ehrlich and Hanski (2004), which contains a large amount of information on the population biology of checkerspot butterflies.

This report presents the findings of field surveys for Gillett's Checkerspot in the Crown Mountain coal mine project area. Familiarity of the field lead with the collective body of written information on this species plus past field experience with the insect in Alberta and British Columbia was critical to an efficient survey execution and the results reported herein.

2. Species Overview

In relation to the butterfly fauna of the project area, this species is an average size butterfly with a wingspan typically in the range of 40 to 45 mm. It has an overall appearance of blackish, whitish and broad reddish-orange banding; thus rendering it quite distinctive in relationship to other local butterflies and in comparison to the other two checkerspot species known in this region; Edith's Checkerspot (*Euphydras editha*) and Anicia Checkerspot (*Euphydryas anicia*). Male and female Gillett's Checkerspot are not distinguishable by wing appearance. Additional adult descriptive information is available in multiple books, articles and reports, including: Bird et al (1995), Ferris & Brown (1981), Guppy & Shepard (2001), Kondla (2005) Layberry et al (1998), Scott (1986).

Butterflies have a life cycle of egg, larva, pupa, and adult. Kondla (2005) provided early stage illustrations and summarized information from Williams et al (1984). Text descriptions are quoted below:

"Egg: nearly spherical, with rounded base and sides sloping in to flattened top; approximately 22 longitudinal ridges with irregular pitting on base and horizontal striations between ridges; egg diameter average 0.78 mm and height average 0.86 mm; eggs are pale straw-yellow when laid and darken with age to red-brown; becoming blue-grey shortly before hatching due to formation of a dark head capsule beneath the translucent egg shell.

First instar larva: blackish brown head and pale body spotted with brown; body length 3-4 mm.

Second instar larva: body developing typical banding pattern of later instars; dorsal band pale yellow, dorsolateral band brown, lateral band dull white, ventrolateral band light brown and ventral band cream colored; legs remain brown and branching spines develop from papillae; body length 4-6 mm.

Third instar larva: head black and deeper colors to banding; shafts of spines mostly darker; legs black; body length 5-9 mm.

Fourth instar larva: further development of banding pattern; dorsal band lemon yellow, dorsolateral band blackish brown, ventrolateral band brown, ventral band pale yellow with brown mid-ventral stripe; shafts of all spines black; body length 9-13 mm.

Fifth instar larva: as fourth instar but dorsal stripe bright lemon yellow, dorsolateral band black and spines jet black. Sixth instar larva is as previous but sharper banding contrast and midventral line blackish brown. Body length of fifth instar ranges from 12-18 mm and of sixth instar ranges from 15-30 mm.

Pupa: cream colored with black markings; seven orange warts per abdominal segment; pupal length average 16 mm."

Kondla (2005) also summarized the reproductive biology of the species, mostly from Williams et al (1984), quoted below:

"Females lay eggs on bracted honeysuckle (*Lonicera involucrata*) as the predominant larval food plant. In one Wyoming study population a small percentage (1 to 4 %) of egg masses were found on *Valeriana occidentalis*. Williams and Bowers (1987) found that larval survival and growth on both host plants was statistically equivalent. Bracted honeysuckle has a continental distribution that far exceeds the small range of Gillett's Checkerspot. Larval foodplant availability is thus not a plausible explanation for the range boundaries of this butterfly. Williams (1988) also reported one population ovipositing on *Pedicularis* and another species of *Lonicera*. Only bracted honeysuckle has been confirmed as a larval food plant in Alberta.

The leaves of the honeysuckle are large enough to allow the females to move to the underside, which is where the eggs are deposited. Egg laying mostly occurs in the late morning. When a female has found a suitable honeysuckle plant it can take more than two hours before an agreeable leaf and location on a leaf is selected for oviposition. Wings are normally held open while laying eggs. In a Wyoming population egg clusters ranged in size from 23 to 310 eggs, with a mean of 146 eggs per cluster. Leaves chosen for oviposition are large and at or near the top of honeysuckle plants. Prime leaves often receive more than one egg cluster. Females oviposit at an average rate of 3.8 eggs per minute, thus needing 38 minutes to deposit an average size egg cluster.

Empirical data from a Wyoming population shows that eggs are preferentially placed on leaves which face the southeast and thus the morning sun. Since the eggs are laid on the underside, this places the ovipositing female in shade and presumably reduces predation frequency while ovipositing. The combination of egg laying on southeast oriented leaves at higher locations on honeysuckle plants provides a better thermal regime and significantly faster egg hatching on these microsites. Eggs have

been found to hatch from 18 to 45 days after laying; dependent on various scale climatic variables.

A variable percentage of eggs become detached through natural process prior to hatching, however most clusters lose few eggs this way. Predators of eggs and larvae that have been reported are: erythraid mites, myrid bugs, beetle larvae, parasitic wasps and browsing mammals, including moose and cattle. Prediapause larval mortality is high; at least 80 % of prediapause larvae disappeared in one monitored population. Newly emerged larvae feed partially on the empty egg shells and within one day move to the upperside of the leaf where they form a communal feeding web.

The prediapause larvae feed only on the epidermis and parenchyma of the leaves, leaving behind the network of veins. Over time the feeding web increases in size through inclusion of lower leaves. Feeding occurs during the day and the communal web can contain different aged larvae from egg masses laid by different females. The feeding web becomes the overwintering hibernaculum. These are well attached to shrub stems but most are dislodged by winter snow. Overwintering larvae can be second, third or fourth instar larvae.

Overwintering larvae terminate diapause soon after the snow melts and begin feeding on newly formed buds of honeysuckle. They bore holes into the larger apical buds and entirely consume the smaller axillary buds. Some postdiapause larvae disperse and will also feed on other plants in the genera Castilleja, Pedicularis and Valeriana. All of these plants contain iridoid glycosides which are sequestered as defensive chemicals by the larvae (Bowers and Williams 1995).

Larvae normally move away from the host honeysuckle shrubs before pupating and usually pupate within 50 cm of the ground. Pupation normally lasts three weeks, after which the adults emerge. “

Adult behavior was summarized by Kondla (2005):

“Adults typically fly for about a four week period in a given location; earlier in the season at lower elevation and warmer sites but later at higher elevation and cooler sites. As is the norm in butterflies, the males emerge earlier in the season and the male to female ratio declines gradually during the flight season. Males are reported to fly earlier in the day than females and also in relatively greater abundance on cloudy days.

The adults are reported to spend much of the day sunning near the ends of branches high in coniferous trees. Adults perch overnight in trees and mating also occurs in the trees. Males apparently fly through the habitat more than females while females fly down to nectar more frequently although both males and females take nectar from available flowers, which are normally in ample supply in occupied habitat patches. Occasional puddling is reported in the literature and adults spend the nights in trees at least 3 m tall. Adult flight period likely varies from one year to the next as determined by weather in any given year. A variety of plant species are used as nectar sources.”

Growing degree days could be used to better predict adult flight times in a given year, as was done by McInnes and Gibson (2012) for this species in Idaho. Although this does require some historical butterfly flight data and nearby meteorological data, it can produce very precise predictions of adult emergence, as shown by Dearborn & Westwood (2014).

Habitat characteristics of the species, outside of British Columbia have been described by Kondla (2005) and Williams (1988), with very brief habitat generalizations appearing in

multiple books. Until recently almost nothing was known about the species in British Columbia. For example, Guppy & Shepard (2001) showed only 2 known locations in the province and mentioned the habitat as "open riparian situations". However, this brief habitat description is still appropriate. Only 3 known locations for the species were reported as recently as 2004 by British Columbia Ministry of Water, Land and Air Protection (2004). No British Columbia populations were reported by Williams (1988).

Subsequently there have been exploratory survey projects directed to this species in British Columbia: Dulc & Hobbs (2013, 2014), and Hobbs (2008, 2012). These were mostly undertaken in the Flathead River basin and the upper Elk River drainage. This work has revealed numerous previously unknown locations of *E. gillettii* populations, in areas with habitat attributes consistent with past work. The basic habitat gestalt for this species is wet to mesic non-forested patches within a forest matrix and open canopy forests, both with the primary larval food plant *Lonicera involucrata* present. American entomologists refer to many of these forest openings as "meadows", although they do not qualify as meadows from a plant ecology and vegetation structure perspective. These butterflies are dependent on habitat patches that are not static over time and which often proceed to closed canopy forest conditions, thus making them unsuitable as breeding habitat in the future. A regimen of natural and human disturbance across the landscape maintains patches of breeding habitat containing larval food plants and within-patch or near-patch trees for overnight roosting and mating. Debinski (1994) concluded that stream corridors may be significant in the maintenance of *E. gillettii* metapopulations, which is consistent with this researchers' observations.

This species has consistently been reported to exist in mostly small and localized populations. Boggs *et al*. (2006) reported a normal population size of less than 200 adults. Checkerspots often occur in groups of populations known as metapopulations and these can have more substantial numbers of adults. Detailed population monitoring or size estimating has not been conducted in Canada; although some anecdotal information is available in Kondla (2005), some count based information from brief site visits is available in Dulc & Hobbs (2013, 2014). Williams (1988) visited 15 sites (including some Alberta sites) in the years 1982 to 1984 and then revisited 14 of them in the years 2002 to 2006. He also conducted monitoring of two populations in Wyoming during 16 of 20 years. He discovered that half of these populations disappeared due to a combination of plant succession, habitat drying and isolation from other populations.

Boggs et al. (2006) reported on 29 years of monitoring of a population that was introduced to Colorado by a researcher in 1977; far to the south of the natural range of the species. They found that the introduced population size remained below 200 adults for at least 21 years and remained confined to the site of introduction. However, in 2002 the population increased dramatically to more than 3000 adults and expanded geographically as well. This was followed by a local distribution contraction and, in 2005, a population crash back to more average levels. The population experienced two genetic bottleneck events of less than 25 individuals but still managed to rebound. More recently the Colorado population has apparently experienced another upsurge, with McCoy *et al*. (2014) reporting a high population estimate of approximately 10, 000 adults based on capture-mark-recapture data. In short, the long term Colorado research detected substantial population fluctuations in this introduced population, which are commonly seen in other non-introduced butterfly populations by population observers in a given area over a period of years. This propensity of insect populations to undergo substantial population fluctuations due to natural causes presents a significant challenge to making inferences about the effects of human activity on populations over time, against a background of natural

variation that can easily mask changes precipitated by non-natural events.

3. Methods

In preparation for the field survey, key documents about the species were reviewed, and aerial imagery of the project area was examined to identify potential habitat areas to be surveyed on the ground. Keefer Ecological Services staff had recorded the presence of *Lonicera involucrata* (only known larval host plant for the target butterfly in Canada) during vegetation project work in the study area and these sites were added to the list of locations for field review.

Potential habitat was identified as forest openings and open canopy forest, preferably in riparian or valley bottom locations. Some sites known to have *L. involucrata* present but without the structural attributes associated with breeding habitat for the species were also examined. Field work was undertaken by N. Kondla, D. Nicholson and B. Liesch, during the prime flight window for the species and during weather conditions suitable for adult butterfly activity. Other butterfly species seen incidentally during field surveys were also recorded.

Standard butterfly survey methods were employed, including walking slowly through and along the edges of selected habitat areas and visually scanning for butterfly activity, standing and observing flight activity of butterflies, checking flowers for butterflies taking nectar, and checking damp soil areas for puddling activity by butterflies. The presence of *L. involucrata* was also recorded, and potential habitats were rated for their ability to support Gillett's Checkerspot.

4. Results and Discussion

Surveys were conducted on the 12th, 13th and 14th of July 2014. A total of 36 locations were examined (Figure 1) and general habitat suitability was scanned in transit between locations. Gillett's Checkerspot was found in only two locations. One area was along Alexander Creek (Figure 2), an area of riparian forest with small openings and some open canopy forest. *L. involucrata* was present at this site. Two adult Gillett's Checkerspot were found here, one taking nectar on a weedy *Ranunculus* sp. The other location with the target species present was north of the weigh scales on Highway 3 in the Crowsnest Pass (Figure 3). Two adults were also seen here. The genesis of the Crowsnest Pass forest opening appears to be from ancient beaver activity.

Results of this survey are consistent with results from past surveys and academic research on this species. It is not a species of closed canopy forests, especially not steep and relatively dry mountainside forest. It is a species of valley bottom and or riparian area forest openings with sufficient moisture to support a reasonable plant biomass of *Lonicera involucrata*. Although *L. involucrata* has been found in multiple locations within the project area, it is present mostly as small and scattered plants, usually growing in sites that do not receive enough sunlight to attract ovipositing females.

Figure 1. Location of sites examined for presence of Gillett's Checkerspot

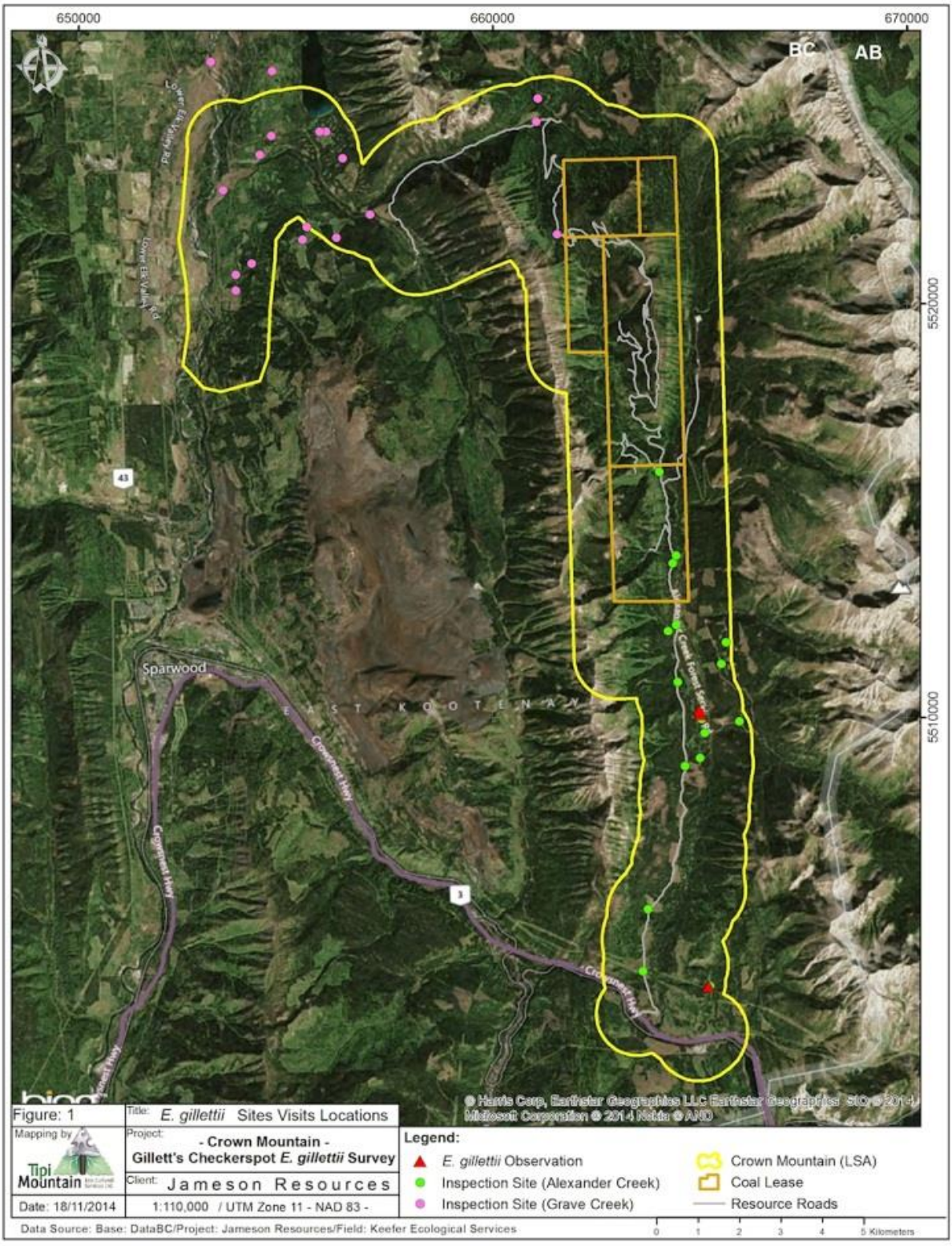

Figure 2. Alexander Creek site occupied by Gillett's Checkerspot.

Figure 3. Crowsnest Pass site occupied by Gillett's Checkerspot.

One site south of Grave Creek was scored as excellent habitat for Gillett's Checkerspot. It had the ideal attributes of being a clearing in the forest, moist, and with abundant large plants of *L. involucrata*. No adults or egg masses of the checkerspot were seen. The site appeared to be isolated from riparian movement corridors but it is not impossible that a dispersing gravid female Checkerspot could find this location in the future and deposit eggs.

A total of 38 additional butterfly species were incidentally noted as being present in the project area, some of them in substantial numbers. A list of these species is provided in Appendix A. These species are mostly sufficiently widespread in western Canada that they are not of conservation concern. One exception is that an adult *Lycaena dione* (Grey Copper) was found at the Crowsnest Pass *E. gillettii* site, and it was also found on personal time near Airport Road, north of Sparwood. The Grey Copper is also a red listed species in British Columbia.

This project confirmed the presence of Gillett's Checkerspot within the study area but it does not constitute a thorough search of all potential sites that may be occupied by the species. Brief visits to areas with naturally small populations, or areas with robust populations that are at a low swing on the population abundance cycle can easily miss the presence of small organisms. This project did not include work to estimate population sizes, and no inference is made at this time about the normal abundance of the species in the project area.

It is important to emphasize that neither butterfly populations nor the environment they live in are static. Changes over time occur, even without human activity, and butterfly populations are subject to both extirpation through natural processes and re-establishment in suitable habitats; human activities need to be considered in addition to these natural processes.

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Appendix A

List of other butterfly species observed while searching for *E. gillettii.* Taxonomic concepts and resulting scientific names mostly follow Guppy & Shepard (2001) and Pohl et al. (2010). English names mostly follow Guppy & Shepard.

Aglais milberti – Milbert's Tortoiseshell
Anthocharis stella –Stella Orangetip
Carterocephalus skada – Arctic Skipper
Cercyonis oetus – Small Woodnymph
Clossiana epithore – Western Meadow Fritillary
Coenonympha inornata benjamini – Common Ringlet
Colias alexandra – Alexandra Sulphur
Colias interior – Pink-edged Sulphur
Cupido amyntula – Western Tailed Blue
Erebia epipsodea – Common Alpine
Erynnis icelus – Dreamy Duskywing
Erynnis persius – Persius Duskywing
Euphydryas anicia – Anicia Checkerspot
Glaucopsyche lygdamus – Silvery Blue
Hesperia manitoba – Manitoba Branded Skipper
Icaricia icarioides – Boisduval's Blue
Icaricia lupini – Lupine Blue
Icarioides saepiolus – Greenish Blue
Incisalia eryphon – Western Pine Elfin
Limenitis arthemis – White Admiral
Limenitis lorquini - Lorquin's Admiral
Lycaena dione – Grey Copper
Lycaena mariposa – Mariposa Copper
Nymphalis antiopa – Mourning Cloak
Papilio zelicaon – Anise Swallowtail
Phyciodes cocyta – Northern Crescent
Phyciodes pulchellus – Field Crescent
Pieris marginalis – Margined White
Pontia occidentalis – Western White
Plebejus idas – Northern Blue
Polites mystic – Long Dash Skipper
Polygonia faunus – Green Comma
Pterourus canadensis – Canadian Tiger Swallowtail
Speyeria hesperis – Northwestern Fritillary
Speyeria hydaspe – Hydaspe Fritillary
Speyeria mormonia – Mormon Fritillary

Thorybes pylades – Northern Cloudywing
Thymelicus lineola – European Skipper

Appendix B

GPS downloads of coordinates for areas examined

Site	lat/long	Zone	UTM
Checkerspot1	49.661537,-114.710139	11U	5503516.873,665250.801
Checkerspot2	49.665194,-114.732416	11U	5503874.642,663631.028
Checkerspot3	49.678662,-114.730112	11U	5505376.822,663752.031
Checkerspot4	49.709547,-114.716380	11U	5508840.158,664638.170
Checkerspot5	49.709475,-114.716343	11U	5508832.235,664641.081
Checkerspot6	49.711065,-114.711216	11U	5509020.242,665005.291
Checkerspot7	49.736038,-114.701330	11U	5511818.130,665632.917
Checkerspot8	49.731352,-114.703061	11U	5511293.393,665524.144
Checkerspot9	49.718795,-114.697688	11U	5509909.362,665954.119
Checkerspot10	49.716546,-114.709441	11U	5509633.437,665114.653
Checkerspot11	49.719511,-114.710284	11U	5509961.187,665043.837
Checkerspot12	49.727711,-114.717899	11U	5510856.025,664467.281
Checkerspot13	49.740167,-114.717810	11U	5512240.891,664431.587
Checkerspot14	49.753525,-114.718392	11U	5513724.561,664344.503
Checkerspot15	49.773514,-114.722012	11U	5515938.726,664016.300
Checkerspot16	49.755239,-114.717179	11U	5513917.755,664426.070
Checkerspot17	49.738861,-114.720594	11U	5512089.613,664235.428
Checkerspot18	49.850313,-114.759664	11U	5524394.577,661050.433
Checkerspot19	49.825749,-114.753782	11U	5521676.527,661555.088
Checkerspot20	49.855344,-114.758913	11U	5524955.475,661087.685
Checkerspot21	49.831194,-114.816364	11U	5522148.828,657036.755
Checkerspot22	49.837409,-114.865483	11U	5522737.983,653484.970
Checkerspot23	49.818951,-114.861983	11U	5520693.212,653795.155
Checkerspot24	49.815518,-114.862222	11U	5520311.081,653788.848
Checkerspot25	49.821323,-114.856568	11U	5520968.026,654177.102
Checkerspot26	49.828918,-114.837736	11U	5521851.249,655507.214
Checkerspot27	49.826342,-114.827936	11U	5521585.259,656220.256
Checkerspot28	49.826202,-114.839354	11U	5521545.961,655399.5646
Checkerspot29	49.862955,-114.847960	11U	5525613.928,654663.304
Checkerspot30	49.849435,-114.830294	11U	5524147.553,655976.347
Checkerspot31	49.849516,-114.832602	11U	5524151.755,655810.183
Checkerspot32	49.843600,-114.825051	11U	5523509.813,656372.053
Checkerspot33	49.844824,-114.852858	11U	5523588.229,654369.089
Checkerspot34	49.848910,-114.848751	11U	5524050.932,654651.295
Checkerspot35	49.865308,-114.868446	11U	5525833.417,653183.692
Checkerspot36	49.903040,-114.876615	11U	5530011.391,652477.741