Butterfly Inventory

of the

Benjamin Property:

Initial Seasonal Survey

Final Report

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Abstract

The 391-acre Benjamin property, contiguous to Betasso Preserve on the latter's northwestern boundary, was purchased by Boulder County Parks and Open Space in May of 2007. As part of the county's research to determine special habitat and wildlife characteristics that would need to be considered in the development of a long-term management plan for the Benjamin area, we performed 20 surveys of butterfly populations in the property throughout the April-August 2008 active butterfly season. The weather for the season was characterized by a cool and dry April, followed by a very hot and dry summer. This weather apparently impacted the butterfly fauna of the area, as the dry conditions in seasonal riparian areas and open hillside and ridgetop meadows resulted in a lack of abundance of wildflowers and hence relatively low total butterfly numbers. However, 47 butterfly species were observed in our four-and-a-half-month-long inventory, including some that are relatively rare in our county. Highlights of the season's surveys include: a surprising variety of members of the hairstreak family; a California Tortoiseshell (*Nymphalis californica*), unusual in our county; and a relatively high number of Rocky Mountain Parnassians (*Parnassius smintheus*). There were three locations in the Benjamin property that provided the best habitat for butterflies throughout the season: the small ridgetop area near the Alaska Road entrance; the more extensive ridgetop meadows just below and east of the peak of Arkansas Mountain; and a small meadow near the confluence of Arkansas Gulch and Fourmile Creek. In addition, in the course of our surveys we encountered several plant communities that, because of their importance for butterfly nectaring or reproduction (and, in one case, because of its rarity), should be protected from disturbance by future trail construction and public use of the property.

Introduction

Butterfly population surveys provide valuable information for a variety of uses. Studies in recent years point to global effects of climate change on a range of vertebrate, plant, and insect species (e.g., Parmesan and Yohe, 2003). Researchers have used extensive historical survey records to track shifts in butterfly species ranges and correlate these shifts to climate change. Parmesan et al. (1999) published the first comprehensive study of this phenomenon, detailing northward shifts in range of dozens of butterfly species throughout Europe. Subsequent researchers have continued to track the effect of climate change on butterflies. Warren et al. (2001), for example, used tens of thousands of recorded data observations from 1970-82 and 1995-99 to analyze butterfly species range shifts throughout Great Britain. Though warming temperatures may have been expected to increase ranges for butterflies, this study found that concomitant habitat degradation in fact decreased range size for three-quarters of species studied. In another study of Great Britain's butterfly populations, Roy and Starks (2000) reported trends of earlier first appearance and longer flight time toward the end of their study period (1976-1998) compared to early in that period. These phenomena were correlated with an increase in mean temperature in central England of approximately 1.5°C in spring and 1°C in summer over that same time period. Forister and Shapiro (2003) performed a similar phenological study on butterfly species in the Central Valley of California, and their results paralleled those of Roy and Starks; the California butterflies also showed a trend toward earlier first flight as the 31-year study (1972-2002) progressed, and these shifts occurred concomitantly with a significant rise in average maximum and minimum daily temperatures for the period studied. The value of these long-term observational records is apparent; however, records in the United States are less

complete than in areas such as Great Britain. The North American Butterfly Association keeps records of one-day butterfly surveys conducted on or around the 4th of July each year throughout the continental United States; 483 sites were surveyed in 2007, the 33rd annual occurrence of this event. In the western U.S., Ray Stanford has compiled an extensive county-by-county database of butterfly records, including earliest and latest appearance of species each year, with data going back to the 1970's. In Colorado, lepidopterist Richard Bray performed up to 35 transects each week in Rocky Mountain National Park for 20 weeks each year from 1997-2008, recording butterfly observations at high elevation. Our research group has surveyed a variety of Boulder County habitats since 2002 (e.g., Chu and Sportiello, 2008), providing a valuable, ongoing local database for butterfly species and population dynamics throughout the spring and summer. An annual, comprehensive database of butterfly species throughout the United States, including here in Boulder County, will provide a valuable resource for researchers as they continue to monitor environmental effects of changing climate patterns.

In addition, butterfly surveys provide natural resource managers with valuable data regarding productive butterfly habitat, including the location of host plants used by butterfly larvae as a required food source during their progression through their various stages of growth, giving the managers vital information for planning trail locations, uses, and seasonal closures. These surveys are particularly important when rare or unusual butterflies are observed and documented. Several species of butterflies extant in Boulder County are listed by the Colorado Natural Heritage Program on their Watch List as imperiled in Colorado. Identification of local habitats where these rare butterflies can or do flourish will allow these areas to be protected. Boulder County supports some of the highest butterfly species diversity in the United States, matched only by Gilpin County here in Colorado and by the southern tier of states. An ongoing inventory of butterfly populations in our county provides valuable information not only to resource managers in BCPOS but to butterfly researchers from many areas who are interested in our great species diversity.

A further benefit of butterfly population research is its public educational value. In addition to their ethereal beauty and enchanting behavior, butterflies are an important ecosystem indicator, providing a readily observable invertebrate measure of local habitat health and diversity. Information about these beautiful insects can be used to introduce the public to details about their local ecosystem, enhancing the public's understanding of and appreciation for their precious and often fragile environment.

Background

In May 2007, Boulder County purchased the 391-acre Benjamin property, a foothills area bounded on the northeast by Fourmile Creek and on the east by the northern portion of Betasso Preserve. A preliminary resource assessment of the property was conducted by ERO Resources Corporation of Denver in the summer of 2007. ERO's report stated that the Benjamin property contained one of the most significant parcels of intact habitat in the Boulder foothills area, and, though the periphery of the property apparently was being used on an informal basis by hikers, mountain bikers, and horseback riders, the interior of the property was in good health and could provide prime habitat for a wide variety of species. The property is currently maintained by BCPOS under an interim management plan, but a viable long-term plan will provide the parameters under which the property's valuable natural resources can be preserved. A survey of resident and migratory butterfly populations in the Benjamin property, along with an inventory

of associated plant communities, will help provide BCPOS managers with information that will help them plan responsible public use of this valuable resource.

Geographically, the Benjamin property consists of the northern and eastern flanks of 7710-foot Arkansas Mountain, which descends steeply on the north to Arkansas Gulch, the major drainage for the northern side of the mountain. Arkansas Gulch runs in a general west-to-east direction and empties into Fourmile Creek on the Benjamin property's northern boundary. Smaller gulches descend from the high ridge of Arkansas Mountain and empty into Arkansas Gulch. The steep hillsides, including the gulches, are covered mainly with Ponderosa Pines and Douglas Firs, with communities of a variety of smaller plant species populating open meadow areas. The steep slopes and extensive woods create almost constant shade in the gulches, limiting favorable habitat for butterfly feeding and reproduction in these areas. Open areas containing foothills grassland species of plants (mixed communities of grasses and wildflowers) can be found at various locations throughout the Benjamin property, particularly on the high ridgetops just below the peak of Arkansas Mountain, on east-facing slopes, and, most favorably for butterflies, in a small, flat meadow near the confluence of Arkansas Gulch and Fourmile Creek.

Methods

In general, surveys were performed at least every week to ten days to facilitate observation of butterfly species that are only on the wing in the adult stage for approximately two weeks. On each survey day, we hiked through portions of the Benjamin property for about three hours, focusing on areas of productive butterfly habitat. These tended to be locations open to sunlight, allowing growth of a variety of wildflower species used by butterflies for nectaring and by their larvae for feeding. We observed butterflies on the wing and, when necessary, in the net, recording both species identity and number of butterflies observed. In addition, we identified and recorded, using GPS-derived coordinates, the location of pertinent flora (i.e., nectar sources and host plants) associated with the observed butterfly species and populations. We made extensive use of digital photography to record significant butterflies and plants observed in the course of our surveys.

Total numbers of individual butterflies observed for each species on each field day were recorded on spreadsheets and analyzed for patterns for the 2008 field season and for any significant variations from data from other county foothill areas that our group surveyed. Informal mapping of important floral communities was performed, providing GPS-derived location information for these butterfly habitat areas.

Results and Discussion

Butterfly species and population numbers observed on each survey day are listed in Table 1. Twenty separate surveys were performed on 19 survey days (on May 17, two parties of researchers surveyed mostly separate areas of the Benjamin property). The table lists butterfly species commonly observed in Boulder County foothills habitats; not all of these species were observed in the Benjamin property during our season's surveys. Table 2 contains information related to each survey day, including time of the survey, weather conditions, specific survey area, and any notable observations.

Table 1. Number of individuals of each species observed each survey day

2008 Date (mo-day)	**4-15**	**4-23**	**4-30**	**5-5**	**5-17**	**5-17**	**5-29**	**6-6**	**6-18**	**6-27**	**6-30**	**7-8**	**7-15**	**7-23**	**7-26**	**7-30**	**8-4**	**8-9**	**8-22**	**8-25**		**Total**
Common Name ***Scientific Name***																						
Black Swallowtail *Papilio polyxenes*															**1**							**1**
Anise Swallowtail *P. zelicaon*																						
Short-tailed Black Swallowtail *P. indra*																						
Western Tiger Swallowtail *P. rutulus*																						
Pale Swallowtail *P. eurymedon*								**1**	**2**	**1**	**2**											**6**
Two-tailed Swallowtail *P. multicaudata*																						
Rocky Mountain Parnassian *Parnassius smintheus*								**1**		**3**	**14**	**1**	**8**									**27**
yellow swallowtail sp.*								**1**		**4**	**2**	**1**	**1**			**1**						**10**
black swallowtail sp.*									**1**													**1**
Pine White *Neophasia menapia*																						
Checkered White *Pontia protodice*												**1**										**1**
Spring White *P. sisymbrii*			**1**	**1**		**3**		**1**														**6**
Western White *P. occidentalis*																						
Cabbage White *Pieris rapae*										**1**	**1**	**1**										**3**
Mustard White *P. marginalis*																						

2008 Date (mo-day)	4-15	4-23	4-30	5-5	5-17	5-17	5-29	6-6	6-18	6-27	6-30	7-8	7-15	7-23	7-26	7-30	8-4	8-9	8-22	8-25		
Large Marble *Euchloe ausonides*					1	1		1	1													4
Olympia Marble *E. olympia*				2		1																3
So. Rocky Mountain Orangetip *Anthocharis julia*		1		2		3		1														7
white sp.*	7	1		8	12	9		3	1				1	1				1				44
Clouded Sulphur *Colias philodice*				2											1					1		4
Orange Sulphur *C. eurytheme*											1											1
Queen Alexandra's Sulphur *C. alexandra*																						
Mexican Sulphur *Eurema mexicana*																						
Dainty Sulphur *Nathalis iole*																						
sulphur sp.*				1									2		1							4
Blue Copper *Lycaena heteronea*																						
Western Green Hairstreak *Callophrys affinis*					2	3		2	1	1												9
Sheridan's Hairstreak *C. sheridanii*			1	2	2																	5
Siva Juniper Hairstreak *C. gryneus siva*									11	4												15
Brown Elfin *C augustinus*					1																	1
Hoary Elfin *C. polios*				2		1																3
Western Pine Elfin *C. eryphon*				1		1																2
elfin sp.*										1												1
Gray Hairstreak *Strymon melinus*				1	1					1					4	1	1			1		10
Hedgerow Hairstreak *Satyrium saepium*												1		4	1	1	1	1				9

2008 Date (mo-day)	4-15	4-23	4-30	5-5	5-17	5-17	5-29	6-6	6-18	6-27	6-30	7-8	7-15	7-23	7-26	7-30	8-4	8-9	8-22	8-25		
Behr's Hairstreak *Satyrium behrii*												**1**										**1**
hairstreak species*																**1**						**1**
Western Tailed-Blue *Cupido amyntula*								**1**														**1**
Spring Azure *Celastrina ladon sidara*				**2**					**1**													**3**
Arrowhead Blue *Glaucopsyche piasus*																						
Silvery Blue *G. lygdamus*																						
Rocky Mt.Dotted Blue *Euphilotes ancilla*									**7**	**4**	**7**	**1**			**1**							**20**
Reakirt's Blue *Echinargus isola*																						
Greenish Blue *Plebejus saepiolus*																						
Melissa Blue *Plebejus melissa*																						
Boisduval's Blue *P. icarioides*																						
Lupine Blue *P. lupini lutzi*																						
Arctic Blue *P. glandon rustica*																						
blue sp.*					**1**				**3**	**1**	**7**											**12**
Monarch *Danaus plexippus*																						
Variegated Fritillary *Euptoieta claudia*																						
Aphrodite Fritillary *Speyeria aphrodite*										**1**			**2**	**9**		**8**		**3**	**1**	**4**		**28**
Edwards' Fritillary *S. edwardsii*									**1**		**2**				**1**	**1**				**1**		**6**
Coronis Fritillary *S. coronis*																						

2008 Date (mo-day)	4-15	4-23	4-30	5-5	5-17	5-17	5-29	6-6	6-18	6-27	6-30	7-8	7-15	7-23	7-26	7-30	8-4	8-9	8-22	8-25		
Callippe Fritillary *S.callippe*										2	3	1	1		1	1	2					11
Northwestern Fritillary *S. hesperis*																		1				1
Mormon Fritillary *S. mormonia*																						
fritillary sp.*								1	6	9	36	12	23	25	6	15	1	7	4	9		154
Gorgone Checkerspot *Chlosyne gorgone*																						
Silvery Checkerspot *C. nycteis*																						
Northern Checkerspot *C. palla*										1												1
checkerspot sp.*										1												1
Pearl Crescent *Phyciodes. tharos*											1	1										2
Northern Crescent *P. cocyta*																						
Field Crescent *P. pulchella*					1				1	1	1											4
Pale Crescent *P. pallida*										1	1											2
crescent sp.*								1		1												2
Hoary Comma *Polygonia. gracilis*	4	3	1	4	1	2		1		1		1										18
Milbert's Tortoiseshell *Aglais milberti*	1			1																		2
Mourning Cloak *Nymphalis antiopa*		1																				1
California Tortoiseshell *N. californica*				1																		1
Red Admiral *Vanessa atalanta*																						
Painted Lady *V. cardui*		4	1	5	3	3			1		3	1			2		1					24
American Lady *V. virginiensis*																						

2008 Date (mo-day)	4-15	4-23	4-30	5-5	5-17	5-17	5-29	6-6	6-18	6-27	6-30	7-8	7-15	7-23	7-26	7-30	8-4	8-9	8-22	8-25		
Weidemeyer's Admiral *Limenitis weidemeyerii*									**1**	**3**	**1**	**1**	**2**	**1**	**1**	**1**		**2**				**13**
Ochre (Common) Ringlet *Coenonympha tullia ochracea*									**2**		**2**											**4**
Common Wood-Nymph *Cercyonis pegala*																						
Small Wood-Nymph *C. oetus*												**1**	**6**	**6**	**8**	**3**	**20**	**6**		**6**		**56**
wood nymph species*													**12**	**12**	**38**	**3**	**19**		**1**	**1**		**86**
Common Alpine *Erebia epipsodea*																						
Chryxus Arctic *Oeneis chryxus*																						
Uhler's Arctic *O. uhleri*								**1**	**4**	**2**	**1**											**8**
arctic sp.*								**4**	**4**	**1**												**9**
Silver-spotted Skipper *Epargyreus clarus*													**1**									**1**
N. Cloudywing *Thorybes pylades*																						
Dreamy Duskywing *Erynnis icelus*																						
Pacuvius Duskywing *E. pacuvius*											**1**											**1**
Afranius Duskywing *E. afranius*																						
Persius Duskywing *E. persius*																						
duskywing sp.*				**1**																		**1**
Common Checkered-skipper *Pyrgus communis*																						
Russet Skipperling *Piruna pirus*										**1**												**1**
Garita Skipperling *Oarisma garita*																						

2008 Date (mo-day)	4-15	4-23	4-30	5-5	5-17	5-17	5-29	6-6	6-18	6-27	6-30	7-8	7-15	7-23	7-26	7-30	8-4	8-9	8-22	8-25		Total
Common Branded Skipper *Hesperia colorado*																			**1**	**3**		**4**
Green Skipper *H. viridis*																						
Nevada skipper *H. nevada*																						
Tawny-edged Skipper *Polites themistocles*																						
Long Dash *P. mystic*															**1**		**1**	**3**	**1**	**4**		**10**
Woodland Skipper *Ochlodes sylvanoides*																						
Taxiles Skipper *Poanes taxiles*												**1**		**2**		**4**						**7**
Dun Skipper *Euphyes vestris*									**3**	**2**	**1**	**1**	**3**	**5**		**3**						**18**
Bronze Roadside-skipper *Amblyscirtes aenus*																						
skipper sp.*									**2**	**5**	**2**		**3**	**1**		**8**		**6**	**1**	**2**		**30**
Total number observed																						**726**
Researcher(s) (C=Chu, S=Sportiello)	C,S	S	S	C,S	S	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S		
* = individuals not identified to species level																						

Table 2. Notes for each survey day, describing weather, route taken, special observations, etc.

Date: 4-15-08 **Time/Temp**: 12:00 p.m. (21°C) to 2:55 p.m. **Weather**: sunny with few clouds, breezy **Route**: Alaska Road entrance down hillside to Social Trail A (see Appendix A), east and west on A for ¼ mile each way **Observations**: Initial foray into property; Holly Grape covering hillsides, ready to bloom
Date: 4-23-08 **Time/Temp**: 11:10 a.m. (17°C) to 2:15 p.m. (17°C) **Weather**: sunny, but clouding ~12:45; mostly cloudy at end **Route**: Alaska Road entrance down trail south to Arkansas Gulch (Social Trail A); east on A to open hillside north of A, covered with blooming Holly Grape (*Mahonia repens*) (6304' N 40º 2' 9" W 105º 21' 17.8"); to plank bridge over Fourmile Creek (6296' N 40º 2' 9.4" W 105º 21' 4.3"); retraced a bit to gulch heading uphill SE (mouth of gulch is at 6270' N 40º 2' 6.4" W 105º 21' 6.3"); went up gulch to where it splits into two (6411' N 40º 1' 58.2" W 105º 21' 3.8") and climbed to outcrop above this point (6560' N 40º 1' 59.3" W 105º 21' 3.4"); storm on horizon, so returned to Trail A, headed west to hillside with blooming Holly Grape (see coordinates above), went up trail on this hillside to private property sign, back down to Trail A, west on A, then back to Alaska Road entrance **Observations**: Hillside meadow full of flowering Holly Grape, some butterflies: good habitat while Holly Grape in bloom
Date: 4-30-08 **Time/Temp**: 11:50 a.m. (20°C) to 2:10 p.m. (21°C) **Weather**: sunny, windy; clouding toward end of survey **Route**: Alaska Road entrance west to Trail C; up C to hillside meadow (6994' N 40º 1' 58.4" W 105º 21' 44.9"); Double Bladderpod (*Physaria bellii*) in bloom at 7003' N 40º 1' 56.3" W 105º 21' 48.0; went about 50 yards farther on trail, then returned to entrance **Observations**: Hillside meadow very dry; Yellow Stonecrop along Trail C below hillside meadow
Date: 5-5-08 **Time/Temp**: 11:05 a.m. (18°C) to 12:45 p.m. (20°C) **Weather**: sunny with few clouds, breezy **Route**: Alaska Road entrance down hillside to Social Trail A, east on A to hillside with *Mahonia repens* (see 4-23-08 notes), surveyed this area, then back west on A, then up to entrance **Observations**: Many wildflowers; California Tortoiseshell on *Mahonia*
Date: 5-17-08 **Time/Temp**: 10:30 a.m. to 2:00 p.m. **Weather**: sunny **Route**: Alaska Road entrance to Social Trail C; up C to B; short south branch of B; east on main B to large east-facing hillside meadow (Elev. 7245', N 40° 01' 46.3", W 105° 21' 23.3"); east on B another few hundred yards, then returned west on B to end of far western spur; returned to entrance on C **Observations**: Kinnikinnick at several places on Trail B, Brown Elfin seen near this, its host plant; rare *Physaria bellii* near trail at western spur of B
Date: 5-29-08 **Time/Temp**: 11:10 a.m. (19°C) to 1:30 p.m. (23°C) **Weather**: mostly sunny **Route**: Alaska Road entrance to Social Trail C; up C to B; east on main B to large east-facing hillside meadow (Elev. 7245', N 40° 01' 46.3", W 105° 21' 23.3"); then returned west on B to meadows at B-C junction; returned to entrance on C **Observations**: Trail slightly damp after a couple days of rain previously
Date: 6-6-08 **Time/Temp**: 11:45 a.m. (19°C) to 1:40 p.m. (20°C) **Weather**: mostly sunny, windy in unsheltered areas **Route**: Alaska Road entrance down straight trail south to Arkansas Gulch (Social Trail A); east on A to meadow near Fourmile Creek;

return by same route
Observations: Canadian Violets abundant; hillside of *Mahonia* by "Mahonia Trail" no longer in bloom; meadow near Fourmile Creek had nice variety of butterflies

Date: 6-18-08 **Time/Temp**: 8:30 a.m. (23°C) to 12:10 p.m. (26°C) **Weather**: mostly cloudy early, sun later, then cloudy from meadow at coordinates (see Route, below) to end
Route: Alaska Road entrance down straight trail south to Arkansas Gulch (Social Trail A); east on A to meadow near Fourmile Creek; to plank bridge over Fourmile Creek; retraced a bit to trail heading uphill SE (at a gulch mouth), to meadow at elev. 6425' N 40º 2' 2.2" W 105º 20' 54.6"; return by same route
Observations: Hillside meadow at above coordinates lightly flowered

Date: 6-27-08 **Time/Temp**: 10:10 a.m. to 2:10 p.m. (26°C) **Weather**: mostly sunny
Route: Alaska Road entrance down straight trail south to Arkansas Gulch (Social Trail A); east on A to meadow near Fourmile Creek; to plank bridge over Fourmile Creek; retraced a bit to trail heading uphill SE (at a gulch mouth), to meadow at elev. 6425' N 40º 2' 2.2" W 105º 20' 54.6"; return by same route
Observations: Dogbane along trail in Fourmile Creek meadow and further east

Date: 6-30-08 **Time/Temp**: 10:10 a.m. (24°C) to 1:50 p.m. (28°C) **Weather**: sunny
Route: Alaska Road entrance west to Trail C; up to Trail B; western spur of B to boundary, and adjacent meadows; east on B to hillside meadow about ½ way across property; back on B to C, then return to trailhead
Observations: Ridgetop meadows abundant with fritillaries and parnassians

Date: 7-8-08 **Time/Temp**: 10:00 a.m. (25°C) to 1:05 p.m., with weather break from 10:50-11:30 **Weather**: mostly sunny to begin, then cloudy late morn; sun again ~ 11:45, but cloudy, then rain and thunder the last 30'
Route: Alaska Road entrance down straight trail south to Arkansas Gulch (Social Trail A); east on A to meadow near Fourmile Creek; to trail heading uphill SE (at a gulch mouth), to meadow at elev. 6425' N 40º 2' 2.2" W 105º 20' 54.6"; continued on trail through break in barbed wire fence to another meadow; return by same route
Observations: Unusual hairstreaks

Date: 7-15-08 **Time/Temp**: 9:10 a.m. (26°C) to 12:45 p.m. (32°C) **Weather**: sunny, except partly cloudy 11:30-noon
Route: Alaska Road entrance to Trail C, then up to Trail B; ridgetop meadows, then east on B to last high, bare hill before trail descends sharply (elev. 6929' N 40º 1' 48.3" W 105º 21' 1.1"); then north off trail to easternmost gulch, down gulch to Arkansas Gulch trail (Trail A), east to plank bridge over Fourmile Creek, then west on A, then off trail up hillside back to Alaska Road entrance
Observations: *Monarda* in bloom at Fourmile Creek meadow

Date: 7-23-08 **Time/Temp**: 9:40 a.m. (29°C) to 12:10 p.m. (27°C) **Weather:** mostly sunny until clouds and thunder from 11:30 on
Route: Alaska Road entrance to Trail A, then east to plank bridge over Fourmile Creek, then west on A, then off trail up hillside back to Alaska Road entrance
Observations: Sulphur flower in bloom near entrance; *Monarda* in full bloom at Fourmile Creek meadow

Date: 7-26-08 **Time/Temp**: 9:40 a.m. (22°C) to 1:25 p.m. (29°C) **Weather:** mostly sunny to begin, but soon hazy, cloudy at end **Route**: Alaska Road entrance to Trail C up to Trail B, west and south spurs of B, then east on B to hillside meadow (Elev. 7245', N 40° 01' 46.3", W 105° 21' 23.3"), then back west on B to C, and down to Alaska Road entrance **Observations**: Hillside meadow at coordinates very dry, sulphur flower there no longer in bloom
Date: 7-30-08 **Time/Temp**: 8:10 a.m. (26°C) to 11:10 a.m. (30°C) **Weather:** sunny, breezy **Route**: Alaska Road entrance to Trail A, then east to plank bridge over Fourmile Creek, then west on A, then off trail up hillside back to Alaska Road entrance **Observations**: Sulphur flower in bloom near entrance; Gayfeather starting to bloom
Date: 8-4-08 **Time/Temp**: 9:00 a.m. (23°C) to 11:25 a.m. (28°C) **Weather:** sunny initially, but cloudy by 9:00 **Route**: Alaska Road entrance to Trail C up to Trail B, west and south spurs of B, then rest of ridgetop meadows near B, then back to C, and down to Alaska Road entrance **Observations**: Sulphur flower in C hillside meadow no longer in bloom
Date: 8-9-08 **Time/Temp**: 8:40 a.m. (22°C) to 11:55 a.m. (25°C) **Weather:** sunny, growing partly sunny and breezy **Route**: Alaska Road entrance to Trail A, then east to plank bridge over Fourmile Creek, then up trail to hillside meadow at elev. 6425' N 40º 2' 2.2" W 105º 20' 54.6", then back to A, west on A, then off trail up hillside back to Alaska Road entrance **Observations**: Hillside meadow at coordinates very dry; most *Monarda* in Fourmile Creek meadow no longer in bloom; some butterflies using Pineywoods Geranium in this meadow to nectar
Date: 8-22-08 **Time/Temp**: 8:50 a.m. (27°C) to 11:20 a.m. (22°C) **Weather:** sunny **Route**: Alaska Road entrance to Trail A, then east to plank bridge over Fourmile Creek, then west on A, then off trail up hillside back to Alaska Road entrance **Observations**: Gumweed, Violet Aster, Goldenrod, Soapwort in bloom; *Monarda* no longer in bloom; Field Crescent near car at end
Date: 8-25-08 **Time/Temp**: 9:25 a.m. (22°C) to 12:25 a.m. (27°C) **Weather:** sunny initially, clouding later, but mostly sunny **Route**: Alaska Road entrance to Trail C up to Trail B, much of ridgetop meadows near B, then back to C, and down to Alaska Road entrance **Observations**: Some Sulphur Flower, Harebells, Nodding Onions still in bloom; butterflies mostly nectaring on Gayfeather

The weather during our survey season naturally had a significant impact on butterfly numbers and activity. Statistics for each of our survey months, generated by the official Boulder weather station at the National Bureau of Standards and Technology (NIST) and compiled by long-time Boulder weather historian Bill Callahan, are summarized in Table 3. A cool and dry April (average daily temperatures 1.5° F below normal, and only about 40% of the normal rainfall) was followed by a relatively wet May, though May average daily temperatures were a full degree below normal, contributing to less than optimal conditions for wildflower growth and butterfly activity. Like April, June was also a drier month than average, and virtually all the rainfall occurred on June 4 and 5, leaving the remainder of the month very dry. This trend continued into July, which tied for the driest July on record in Boulder, with less than 0.1" of precipitation. In addition, July was very warm, recording an average daily temperature 2.6° F higher than normal. Reflective of this extended heat wave, there were 26 days in the month where the high was at least 90° F. August remained hot and dry, spelled by continual showers and cool temperatures August 15-16, yet the ground at Benjamin was so dry, the rain did little to produce abundant wildflowers. Rainfall totals for August, due to the mid-month showers, were above average, and the average daily temperature was slightly below normal.

Table 3. Weather Statistics for Boulder, April-August 2008

		April	May	June	July	August
rainfall (in.)	2008	1.13	4.21	1.58	0.09	2.12
	normal	2.93	3.05	2.02	1.93	1.62
ave. temp. (° F)	2008	47.6	57.2	67.1	75.1	70.4
	normal	49.2	58.3	67.1	72.5	71.0
ave. high. (° F)	2008	62	71	82	92	84
	normal	62	70	82	85	84
ave. low. (° F)	2008	32	43	52	58	57
	normal	36	46	53	60	58

The weather data, as previously mentioned, are generated from the official Boulder weather station located at NIST on South Broadway in Boulder, in the southwestern part of the city. While providing a fairly accurate overall picture of the local weather, it is likely that these data will on occasion vary significantly from the actual weather at the Benjamin property, which is several miles northwest of the NIST site and from 1000 to 2000 feet higher in elevation. More accurate readings for the Benjamin area will be available for the 2009 butterfly season and beyond, as the University of Colorado is in the process of installing a weather station at the Betasso Water Treatment Plant, which is located just south of Betasso Preserve.

April's butterfly surveys produced observations of those species expected to be active in Boulder foothills habitat during that time of the year. Whites (including a Spring White [*Pontia sisymbrii*] and a Southern Rocky Mountain Orangetip [*Anthocharis julia*]), a Sheridan's Hairstreak (*Callophrys sheridanii*), Hoary Commas (*Phyciodes gracilis*), and a Mourning Cloak (*Nymphalis antiopa*) were all observed at this early point in the season, along with several Painted Ladies (*Vanessa cardui*), which migrated to our area from Southern California. The dominant wildflower in bloom was Oregon Holly Grape (*Mahonia repens*), which abundantly covered open hillsides.

May's warmer and wetter weather brought out more species of butterflies, including Olympia (*Euchloe olympia*) and Large (*Euchloe ausonides*) Marbles, several species of hairstreaks, the first blues of the season (though they were not abundant), and, unexpectedly, a California Tortoiseshell (*Nymphalis californica*), found nectaring on the still-abundant *Mahonia* blossoms. Wildflowers

blooming during the month also included Western Wallflower (*Erysimum asperum*) and Canadian (*Viola canadensis*) and Nuttall's (*Viola nuttallii*) Violets, among others, though *Mahonia* continued to be a favorite nectaring flower for butterflies.

In June, the first swallowtails were observed, along with a relatively abundant number of Juniper Hairstreaks (*Callophrys gryneus siva*), Rocky Mountain Dotted Blues (*Euphilotes ancilla*), and, especially toward the end of the month, fritillaries. Arctics and skippers made their first appearance of the season as well. Noteworthy was the relative abundance of Rocky Mountain Parnassians (*Parnassius smintheus*), even at the lowest elevations of the Benjamin property, lower than we usually observe them in our county's foothills areas. Pussytoes (*Antennaria* sp.), Spreading Dogbane (*Apocynum androsaemifolium*), and Sulphur Flower (*Eriogonum umbellatum*) were the primary nectar sources for butterflies.

July, due to the ongoing heat wave, along with very dry conditions, saw wildflower populations begin to appear stressed. Fritillaries dominated the butterfly landscape, though Small Wood Nymphs (*Cercyonis oetus*), making their first appearance of the season, also were abundant. An increase in the number of skipper species was also observed in July. A highlight of the month was sightings of two species of hairstreaks that we seldom encounter in our surveys in the county, Hedgerow Hairstreaks (*Satyrium saepium*) and Behr's Hairstreaks (*Satyrium behrii*). These butterflies were often encountered on Mountain Mahogany (*Cercocarpus montanus*). Hedgerow Hairstreaks were observed in multiple locations for over a month, indicating the presence of a healthy population in the area. Sulphur Flower (*Eriogonum umbellatum*) and Beebalm (*Monarda fistulosa*) served as the dominant sources of nectar for butterflies.

As dry and hot conditions persisted into August, wildflower numbers continued to decrease. Fritillaries and wood nymphs dominated the butterfly inventory numbers, with skippers also being regularly observed. However, the relative scarcity of butterflies was noticeable, as abundant nectar sources were lacking in most areas of the property, including the open hillside meadows, which, though fairly productive early in the season, were very arid by this time, with few wildflowers in bloom. Remnants of Beebalm (*Monarda fistulosa*) and Sulphur Flower (*Eriogonum umbellatum*), along with the newly-blooming Gayfeather (*Liatris punctata*), provided the favored nectar sources in areas where butterflies were most abundant.

We intended to perform at least one survey in the first half of September; however, the cool, wet weather during the first two weeks of the month was not conducive to butterfly activity, and hence no surveys were performed.

Overall, the season's surveys were characterized by noticeably low numbers of butterflies, and the butterflies that were observed were, in general, restricted to three locations: the ridgetop area just east of the Alaska Road entrance; the extensive ridgetop meadows along the western portion of Social Trail B (just below the peak of Arkansas Mountain); and a fertile, flat, low-lying meadow along Fourmile Creek, near its confluence with Arkansas Gulch on the northeastern end of the Benjamin property (marked 1, 2, and 3, respectively, on the map in Appendix C). In addition, many species of butterflies that we normally see in less arid foothills habitats in our county were either observed in Benjamin in very low numbers or were completely absent throughout the season. Unusually low numbers of several swallowtail species, for example, were observed, though we did record one female Black Swallowtail (*Papilio polyxenes*), a species whose numbers have been low throughout the county for several years. Blues were very scarce, and only three species of this family were observed, whereas in other foothills areas we routinely see many individuals, and at least half a dozen species, in May and June. The number of skipper species we observed in Benjamin (six) also indicated a lower diversity than we usually see. Topographically, a significant aspect of the Benjamin property is the steepness of the terrain; this feature, along with the thickly wooded hillside slopes, leaves Arkansas Gulch in mostly complete shade as it courses through the area. Because of this, there are few flowers growing in the

gulch itself, and hence few places for butterflies to nectar or lay their eggs. In addition, most of the open meadow areas on the hillsides receive abundant sunlight, but their steepness limits their retention of rainwater. Apparently, the less-than-optimal topography, greatly exacerbated by the unusually hot and dry summer, served to limit wildflower growth, and hence to keep overall butterfly populations and species diversity in the Benjamin research area low. However, it will be interesting to see how wetter conditions (if they occur) in subsequent years will affect the area. Though the steeper hillside meadows may never be prime butterfly habitat, the more level open areas, such as the three locations mentioned above (delineated in Appendix C), could provide excellent conditions for butterfly nectaring and reproduction, given enough rainfall to produce an abundance of wildflowers, and more moderate mid-summer temperatures, allowing the soil to retain more of its moisture.

In their "Rapid Resource Assessment," ERO's staff identified in the Benjamin property dozens of plant species that butterflies commonly use in our region either as host plants for their larvae or nectar sources. Of particular interest was ERO's observation of potential habitat for three species of butterflies (Ottoe [*Hesperia ottoe*] and Arogos [*Atrytone arogos*] Skippers and Moss' Elfin [*Callophrys mossii*]) listed by the Colorado Natural Heritage Program as imperiled in Colorado, and rarely observed in our county. These two skipper species utilize Big and Little Bluestem as larval host plants; Moss' Elfins use stonecrop species as host plants for their larvae. No members of these three butterfly species were observed in Benjamin this season, but their absence does not preclude the possibility of these species being found in the area in future years, particularly if conditions are more favorable.

While compiling our inventory of butterfly species and populations each survey day, we also recorded blossoming wildflowers of note. Though in general conditions were dry throughout the survey season, we recorded 53 species of wildflowers in bloom at some period throughout the season. In addition, there were other species that we did not record, due to their apparent lack of interaction with butterflies on the wing. Table 4 lists the recorded wildflower species, alphabetized by scientific name, along with the survey days on which they were observed. Of special note is the species *Physaria bellii* (Double Bladderpod), a member of the mustard family, which is rare in Colorado, and restricted to areas high in calcareous shale or limestone content. We also encountered a number of populations of *Sedum lanceolatum* (Yellow Stonecrop), a host plant for the imperiled Moss' Elfin butterfly, particularly along Social Trail C and in the area near the Alaska Road entrance. However, this rare butterfly was not observed in the Benjamin property this season, though there is a colony of Moss' Elfins near the mouth of a gulch draining into the South St. Vrain River near Lyons, approximately 15 miles north of our research area. In addition, kinnikinnick plants were abundant, particularly along Social Trail B. This plant serves as the larval food plant for Hoary Elfin (*Callophrys polios*) butterflies, and a few of these uncommon butterflies were in fact observed in the spring. Other wildflower species of note include *Monarda fistulosa* (Beebalm), a favorite nectaring plant of butterflies; this flower was abundant mid-to-late summer in the small meadow near Fourmile Creek on the property's northeastern end. Sulphur Flower (*Eriogonum umbellatum*), another favorite nectaring plant of butterflies, was abundant near the Alaska Road entrance and also on the high ridgetop meadows along the western portion of Social Trail B. This plant is also the larval food plant for Rocky Mountain Dotted Blues, which is the only species of blues that we observed in any abundance throughout the season (and one of only three species of blues observed at all in the property). Lupines, though observed in Benjamin this year, were very scarce, which helps explain the lack of variety of blue species of butterflies, as lupines are a larval host plant for a number of blue species.

Table 4. Notable Wildflower Species

Common Name ***Scientific Name***	**4-15**	**4-23**	**4-30**	**5-5**	**5-17**	**5-29**	**6-6**	**6-18**	**6-27**	**6-30**	**7-15**	**7-23**	**7-26**	**7-30**	**8-4**	**8-9**	**8-22**	**8-25**
Tansy Yarrow *Achillea millefolium*								•		•						•		
Nodding Onion *Allium cernuum*															•	•		•
Wild Onion *Allium textile*							•											
Pussytoes *Antennaria* sp.										•								
Spreading Dogbane *Apocynum androsaemifolium*									•									
Kinnikinnick *Arctostaphylos uva-ursi*					•													
Violet Aster *Aster lanceolatus hesperius*																	•	
Porter Aster *Aster porteri*																	•	
Ground Plum *Astragalus crassicarpus*					•													
Mariposa Lily *Calochortus gunnisonii*										•	•							
Common Harebell *Campanula rotundifolia*								•	•	•					•			•
Common Mouse-ear *Cerastium fontanum*			•	•	•	•												
Canadian Thistle *Cirsium arvense*										•								
Spring Beauty *Claytonia lanceolata*	•	•	•			•												

Common Name ***Scientific Name***	**4-15**	**4-23**	**4-30**	**5-5**	**5-17**	**5-29**	**6-6**	**6-18**	**6-27**	**6-30**	**7-15**	**7-23**	**7-26**	**7-30**	**8-4**	**8-9**	**8-22**	**8-25**
Blue-eyed Mary *Collinsia parviflora*		•	•	•		•												
Miner's Candle *Cryptantha virgata*									•	•								
Early Larkspur *Delphinium nuttalianum*			•	•		•												
Cutleaf Daisy *Erigeron compositus*						•												
Sprawling Daisy *Erigeron divergens*						•	•											
Sulphur Flower *Eriogonum umbellatum*								•		•	•	•		•	•	•	•	•
Western Wallflower *Erysimum asperum*				•		•												
White pea *Fabaceae*																		
Blanket Flower *Gaillardia aristata*										•	•							
Pineywoods Geranium *Geranium caespitosum*																•	•	
Gumweed *Grindelia squarrosa*													•		•	•	•	•
Parry Sunflower *Helianthella parryi*																•		
Pepper Weed *Lepidium densiflorum*			•	•		•												
Sand Lily *Leucocrinum montanum*		•	•	•	•	•												
Gayfeather *Liatris punctata*														•	•	•	•	•
Narrow-leaved Puccoon *Lithospermum incisum*												•						

Common Name ***Scientific Name***	**4-15**	**4-23**	**4-30**	**5-5**	**5-17**	**5-29**	**6-6**	**6-18**	**6-27**	**6-30**	**7-15**	**7-23**	**7-26**	**7-30**	**8-4**	**8-9**	**8-22**	**8-25**
Many Flowered Puccoon *Lithospermum multiflorum*									•									
Salt and Pepper *Lomatium concinum*	•		•	•														
Silver Lupine *Lupinus argenteus*								•										
Oregon Holly Grape *Mahonia repens*		•	•	•		•												
White Sweet Clover *Melilotus altissimus*																•	•	
Yellow Sweet Clover *Melilotus officinalis*									•									
Chiming Bells *Mertensia lanceolata*				•	•	•												
Beebalm *Monarda fistulosa*											•	•				•		
Prickly Pear Cactus *Opuntia macrorhiza*								•		•								
Ball Cactus *Pediocactus simpsonii*	•	•	•	•														
Double Bladderpod *Physaria bellii*			•		•													
Pasque Flower *Pulsatilla patens*		•	•	•														
Soapwort *Saponaria officinalis*																•		
Yellow Stonecrop *Sedum lanceolatum*			•					•		•								
Goldenrod *Solidago* sp.																•	•	
Dandelion *Taraxacum officinale*						•												

Common Name ***Scientific Name***	**4-15**	**4-23**	**4-30**	**5-5**	**5-17**	**5-29**	**6-6**	**6-18**	**6-27**	**6-30**	**7-15**	**7-23**	**7-26**	**7-30**	**8-4**	**8-9**	**8-22**	**8-25**
Wild Candytuft *Thlaspi montanum*	•	•	•	•		•												
Easter Daisy *Townsendia hookeri*			•	•														
Western Spiderwort *Tradescantia occidentalis*																		
Common Mullein *Verbascum thapsus*																•	•	
Canadian Violet *Viola canadensis*				•														
Nuttall's Violet *Viola nuttallii*				•														
Spanish Bayonet *Yucca glauca*															•			

Summary and Recommendations

The Benjamin property was surveyed for butterfly species and population numbers 20 times from mid-April to late August. Both in terms of number of species and number of individuals, butterflies were not abundant in the property. However, 47 species were observed, including several of special interest, among them California Tortoiseshells, Hedgerow Hairstreaks, and a Behr's Hairstreak. The steep and well-forested terrain, and its effect on the local flora, coupled with the unusually hot and dry summer weather, apparently adversely affected butterfly activity in the research area. However, there were three areas within the Benjamin property that did support significant populations of butterflies throughout the survey season, and these areas can be expected to continue to provide good habitat for butterfly activity in the future.

Though we did not observe any rare or imperiled species of butterflies in the course of our surveys, the habitat for some of these species that are occasionally seen in our county exists at Benjamin. In addition, the three primary butterfly habitats observed in our surveys (the area leading from the Alaska Road entrance; the high ridgetop meadows just east of and below the peak of Arkansas Mountain; and the small, flat meadow near the confluence of Arkansas Gulch and Fourmile Creek) provide fertile areas for a wide variety of butterflies to nectar and reproduce throughout the spring and summer. For these reasons, while planning future trail construction in and public use of the Benjamin property as it becomes incorporated into Betasso Preserve, care should be taken that human activity should minimally disturb these areas, allowing butterflies relatively undisturbed access to important habitat. For example, at the eastern edge of the ridgetop meadows along the western half of Social Trail B, there is an outcrop from which visitors may have a wonderful view of Mt. Audubon to the west (see photo in Appendix D). However, any trail spur to the top of this outcrop should be constructed as to avoid disturbing the wildflower community at the western base of the outcrop, which butterflies were actively visiting throughout the season, particularly while the Sulphur Flowers were in bloom.

We recommend that butterfly surveys be continued throughout the Benjamin area annually in the future. This initial survey year provided the beginnings of a local butterfly database, but its utility will be greatly enhanced in the future when it is supplemented by data for ensuing years, allowing a fuller picture of butterfly activity in the Benjamin area to be developed (and understood). The forthcoming weather station at the Betasso Water Treatment Plant will provide valuable local weather information that can be correlated over the years with butterfly activity at Benjamin. Particularly if wetter (and slightly cooler) summers occur in future years, the Benjamin area could provide important habitat for a large variety of butterflies, including species that are currently rare and imperiled in our area and in Colorado.

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We relied on ERO Resources' "Rapid Resource Assessment" of the Benjamin property for a very useful introduction to our research area. Bill Callahan was very helpful in providing information regarding weather data. Paul Opler, Department of Bioagricultural Sciences, Colorado State University, provided expert assistance with butterfly species identification.

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Appendices

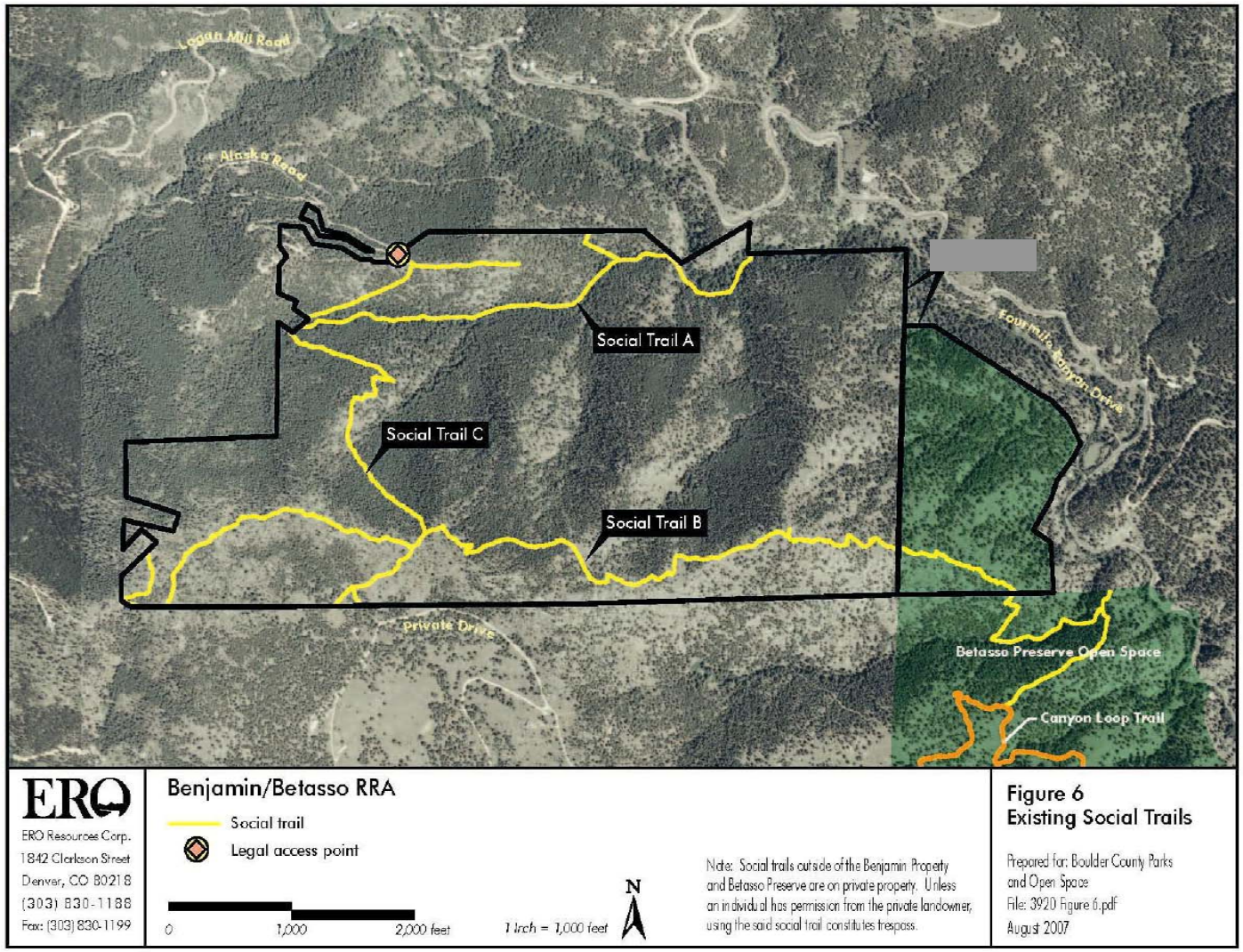
Appendix A: Map of Benjamin Property, showing social trails (from ERO Resources' "Rapid Resource Assessment")

Appendix B: Map of Benjamin Property, showing areas surveyed for butterflies

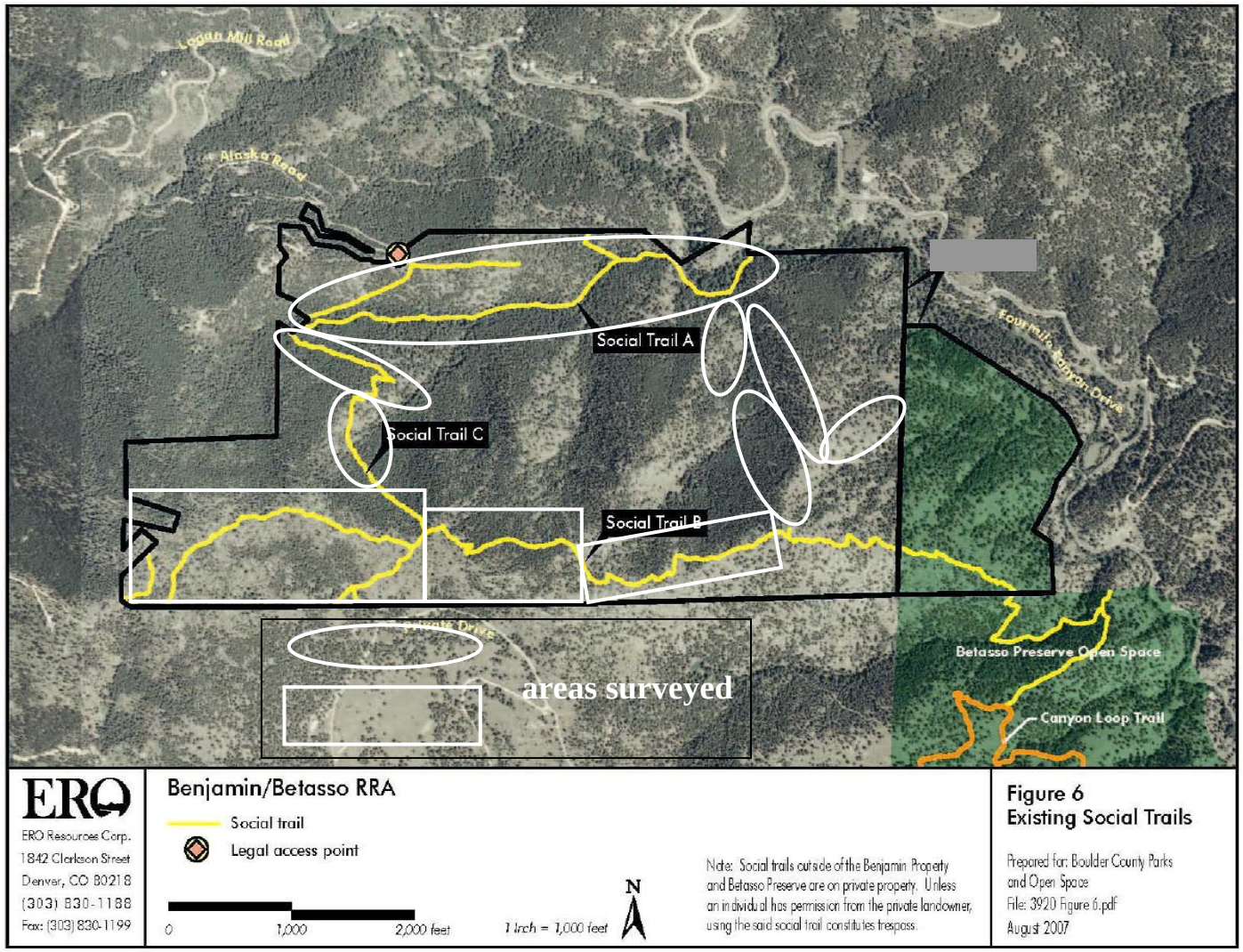
Appendix C: Map of Benjamin Property, showing three areas of primary butterfly habitat

Appendix D: Photos of selected butterflies from survey season, as well as other photos of interest (all photos taken by Mike Sportiello)

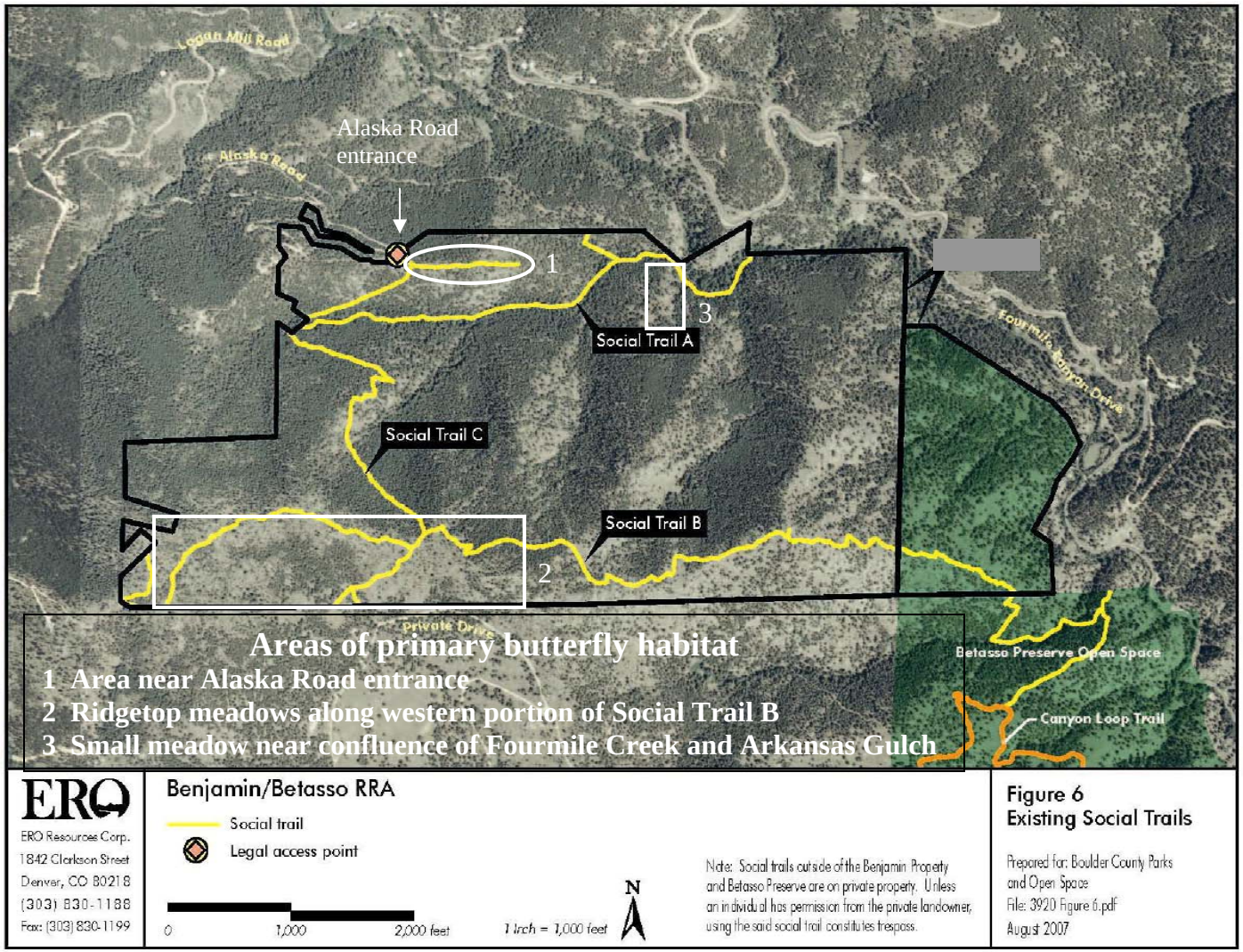
Appendix A: Map of Benjamin Property, showing social trails (from ERO Resources' "Rapid Resource Assessment")



Appendix B: Map of Benjamin Property, showing areas surveyed for butterflies



Appendix C: Map of Benjamin Property, showing three areas of primary butterfly habitat



Appendix D: Photos of selected butterflies from survey season, as well as other photos of interest

Juniper Hairstreak

Hedgerow Hairstreak

Behr's Hairstreak

Gray Hairstreak

California Tortoiseshell

Northern Checkerspot

Rocky Mountain Dotted Blues Mating (male on right)

Clouded Sulphur

Western Green Hairstreak

Long Dash

Rocky Mountain Dotted Blue (female)

Long Dash

Aphrodite Fritillary

Calippe Fritillary

Physaria bellii

View of Mt. Audubon from outcrop above Social Trail