FY 2007 LAKE TAHOE LICENSE PLATE PROGRAM BUTTERFLY INVENTORY PROJECT

An Inventory and Baseline Monitoring of the Butterfly Fauna of the Carson Range, with Emphasis on the Lake Tahoe Basin Nevada State and Adjacent Lands

FINAL REPORT

Principal Investigators:

T. Will Richardson, PhD.
and
Dennis D. Murphy, PhD.

Department of Biology
University of Nevada, Reno

Contact: Will Richardson
16810 Glenshire Dr.
Truckee, CA 96161
530.412.2792
trichard@unr.nevada.edu

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Introduction

Our recent research on Nevada State Park lands in the Carson Range on the east side of the Lake Tahoe basin brought us into frequent contact with a growing visitor population hungry for information about the conspicuous wildlife on state and adjacent lands. At the same time our studies of the ecology of bird communities in aspen forests, encroaching conifer forests, and forest stands that have been subjected to both fuels management treatments and efforts to enhance declining natural plant communities, indicates dynamic environmental changes on Nevada State Lands that are only narrowly understood. Throughout the Carson Range, environmental changes associated with succession, altered disturbance regimes, forest thinning using varied techniques, cessation of meadow grazing, and invasion of multiple plant and animal species combine to challenge the application of best management practices toward desired future conditions. To these combined interests we engaged in a distinctly cost-effective research and monitoring effort, summarized here and providing long-term value for the conservation and public appreciation of Nevada State Lands and adjacent public lands in the Lake Tahoe basin and surrounding Carson Range.

The value of baseline biological inventories and monitoring cannot be overstated. Toward the intention of establishing baseline information on the status of butterflies in the Carson Range of Nevada, it should be pointed out that butterflies have frequently been identified as a particularly effective taxonomic group that can indicate, hence be used to assess, environmental conditions (Dennis 1993, Fuller et al. 1998, Howard et al. 1998, Blair 1999, many others). Because insects make up the largest proportion of terrestrial wildlife (more than 50% of recognized species), the fate of select insect groups are fairly viewed as useful in monitoring the state of biodiversity more broadly (Howard et al. 1998, Lindenmayer et al. 2000). Indicator taxa should be 1) taxonomically well known, 2) have a well understood life history and be readily surveyed and manipulated, 3) distributed over a broad range of habitats and varying landscape types, 4) sensitive to ecological stressors and changes, and 5) responsive to and co-vary with diversity in co-occurring taxa (Noss 1990, Busch and Trexler 2002). Butterflies fulfill these criteria with their short lifecycles, early reaction to environmental changes, considerable dispersal ability, relatively well-known relationships with larval host plants, and sensitivity to weather and climate shifts that can be interpreted in the context of other environmental changes. Moreover the taxonomy of Nevada's butterflies is essentially fully understood. Most species are conspicuous and relatively easy to recognize, and finally, they occur in all vegetation communities found in the Carson Range. Thus the diverse butterfly fauna of the Carson Range has the potential to act as ready indicators and potential surrogates for a wide range of environmental concerns.

First, we sampled the butterfly fauna of the Carson Range across all vegetation and land cover types, from lake level to the summit peaks of the range, and along the eastern slopes of the range to moderate elevations (> 1800 m). Sampling was carried out across the early spring to late autumn flight period of the complete butterfly fauna, which we

expected to exceed 90 species. Toward a complete accounting and assessment of the Nevada butterflies of the Lake Tahoe region, our 2007 field inventory was supplemented with more than five decades of museum and private collector records. The annotated species list in this report describes general spatial and temporal distributions and natural histories of all recorded butterfly species. We will provide a pamphlet-size checklist treatment, easily adaptable for distribution to visitors of Lake Tahoe Nevada State Park and the Carson Range, elsewhere.

Methods

Focal sites

This study attempted to cover all vegetation types found in the Carson Range from Mount Rose to Stateline, emphasizing the Tahoe basin, and Lake Tahoe Nevada State Park lands in particular. Much of the Carson Range is covered with montane, mixed-conifer forests. As a group, butterflies are not adapted to exploit this vegetation type, and make poor indicators of forest condition as it relates to the trees themselves. Rather, most Carson Range butterflies occur in successional or otherwise open vegetation types, including alpine steppe, wet or dry meadows, steep canyons, open woodland, forest clearings and roadsides, and riparian corridors. They are thus better suited as tools to examine trends related to the health and distribution of such habitats across the greater forested landscape. Study sites were selected with this in mind. Candidate study sites were identified based on examination of vegetation maps and aerial photographs, knowledge of representative and target vegetation communities from extensive previous experience working in the Carson Range, and driving and hiking roads and trails throughout the range during spring and early summer 2007. We also attempted to identify and revisit historic collection sites of previous collectors, including Herlan, Austin, Scott, and others, although locality information from older museum specimens was typically too imprecise to identify exact locations. From these candidate locations, focal sampling stations were selected to meet criteria relating to logistical and accessibility constraints and capturing the complete range of relevant vegetation communities. As much as possible, we attempted to locate focal sites at ecotones between two (or more) otherwise well-expressed vegetation communities, since such sites typically had the highest species richness and increased sampling efficiency. Focal sites ultimately were designated on the bases of butterfly species richness, maintaining representation of key vegetation types, and logistical feasibility and efficiency.

Sampling methods:

Once identified, focal sites were censused every three to four weeks through the flight season, or as butterfly activity dictated, to capture faunal turnover and the phenology of individual species. Surveys were conducted when weather conditions were most conducive to flight (e.g. mostly sunny skies, light or no winds, warm temperatures), typically between 1000 and 1500 hours. At each focal station, we established a single fixed point with a GPS, and visually established a 50 m-radius count circle using a high-precision laser range finder. During each visit, either of the field biologists, Murphy or

Richardson, identified and recorded all butterflies seen in 20 minutes within the 50m-radius circle, slowly walking through the circle to flush or find any butterflies not on the wing. Preliminary surveys parsed data to determine if 10 or 15 minutes was sufficient to capture species richness, and we found that 20 minutes typically provided a more complete sample. Species observed before or after the count, but not during, or adjacent to, but not inside the count circle, were recorded as "off count." Plant use was recorded for each species, as were behavioral observations, weather data, and other relevant notes. Many species, particularly those difficult to identify in the field, were netted for quick examination and released, prior to, during, or after the count period. Voucher specimens were collected for each species and for individuals for which identification was uncertain or impossible in the field. Voucher specimens of butterflies will be deposited at the University of Nevada. Codes and UTM coordinates for focal sites are found in Table 1; descriptions and maps of focal sites are found in Appendix A.

Table 1. Transects, codes, sampling dates, and locations of Carson Range butterfly inventory focal sites, 2007. UTMs are NAD 27, Zone 11. See Appendix A for details of sites.

		Date Sampled							Elevation
Transect	CODE	1	2	3	4	5	UTM1	UTM2	(m)
Incline-Rose	IR1	5/28	6/16	7/12	7/29	8/14	249477	4354735	2664
Incline-Rose	IR2	5/28	6/16	7/12	7/29	8/14	248242	4354216	2609
Incline-Rose	IR3	5/28	6/17	7/12	7/29	8/14	249892	4353030	2764
Incline-Rose	IR4	5/28	6/16	7/9	7/29	8/14	247911	4348791	2103
Incline-Rose	IR5	5/28	6/16	7/9	7/29	8/14	247624	4348454	2119
Incline-Rose	IR6	5/28	6/16	7/9	7/29	8/14	246670	4348957	2068
Incline-Rose	IR7	5/28	6/16	7/12	7/29	8/14	247849	4353920	2558
Genoa Pk. Rd.	GPR1	5/25	6/22	7/9	7/20	8/13	248447	4331335	2131
Genoa Pk. Rd.	GPR2	5/25	6/20	7/6	7/20	8/13	250146	4331099	2266
Genoa Pk. Rd.	GPR3	5/25	6/20	7/6	7/20	8/13	250293	4329277	2399
Genoa Pk. Rd.	GPR5	5/25	6/20	7/6	7/19	8/9	248390	4329338	2232
Genoa Pk. Rd.	GPR7	5/25	6/20	7/5	7/19	8/9	247969	4327142	2332
Genoa Pk. Rd.	GPR9	5/25	6/18	7/5	7/19	8/9	250476	4325393	2722
Genoa Pk. Rd.	GPR10	5/25	6/18	7/6	7/20	8/13	249346	4330641	2252
Glenbrook	G2	5/30	6/8	7/7	7/25	8/15	245642	4333308	1925
Glenbrook	G3	5/30	6/8	7/7	7/25	8/15	246036	4334162	1942
Hwy28	28-2	5/30	6/13	7/7	7/23	8/14	248742	4345561	2173
Kingsbury	K1	5/31	6/13	7/9	7/25	8/14	245612	4317662	1916
Little Valley	LV1	5/31	6/15	7/12	7/27	8/13	251672	4348653	1970
Little Valley	LV2	5/31	6/15	7/12	7/27	8/13	251611	4347703	1977
Little Valley	LV4	5/31	6/15	7/12	7/27	8/13	253842	4348413	1767
LTNSP	SP1	5/29	6/14	7/8	7/26	8/16	248010	4333032	2119
LTNSP	SP2	5/29	6/14	7/8	7/26	8/16	249726	4336576	2339
LTNSP	SP4	5/29	6/14	7/8	7/26	8/16	251669	4338676	2529
LTNSP	SP5	5/29	6/14	7/8	7/26	8/16	251571	4338398	2560
LTNSP	SP6	5/29	6/14	7/8	7/26	8/16	250629	4338007	2728

General collection

Certain species of butterflies are found only in small, localized populations associated with specialized habitats (e.g. *Habrodais grunus*, *Satyrium tetra*, *Mitoura nelsoni*). These distinctive vegetation communities often do not support a high diversity of butterflies, and the occurrence of many of these species in the Carson Range was unknown. Thus, rather than establish focal sites at locations with specialized habitats, we attempted to find such species through directed searches of as much apparently suitable habitat as possible. Accordingly, general collection and observation was carried out opportunistically throughout the Carson Range, as time and logistics allowed. Codes, UTM coordinates, and elevations for an additional 28 collection locations are provided in Appendix B. These auxillary sites, together with the focal sites, are illustrated in Figure 1.

Throughout this report, taxonomy follows Austin (1998); checklist order follows Emmel et al. (1998).

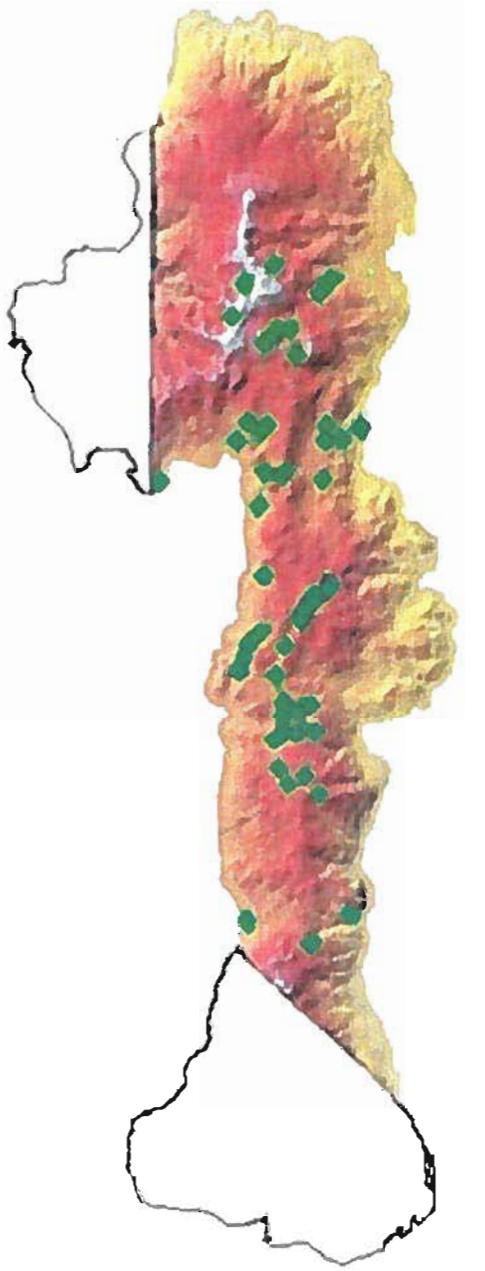

Figure 1. Locations of butterfly sampling sites in the Nevada Carson Range, 2007. See Table 1 and Appendices A and B for details.

Results and Discussion

The Carson Range Butterfly Fauna

Some of the richest butterfly faunas in temperate North America occur in the Sierra Nevada (Shapiro 1996). The Carson Range is especially well situated to have a very rich butterfly fauna, due to a mixture of Great Basin and Sierra Nevada elements. Of Nevada's 314 mountain ranges, the Carson Range surpasses the others for species richness, due to this mixture.

Considerable weather constraints leave Carson Range butterflies with something of a dilemma. The region is blessed with high pressure for most of the flight season; however, without precipitation, larval host plants quickly dessicate under the sun. This leads to shortened flight seasons, univoltinism, and reduced fecundity/recruitment. However, when we do get summer precipitation, it typically comes in the form of storms;

However, when we do get summer precipitation, it typically comes in the form of storms; such severe weather is not only unsuitable for flight, it can delay development of immatures and cause mortality of larvae and adults.

Many Carson Range butterflies roughly fall into one of two flight periods, or both, for multivoltine species. This bimodal flight period is apparent in Figure 2. The exact pattern displayed in Figure 2, however, is a bit misleading, as the data have not been standardized according to sampling effort or elevational coverage. Further, the pattern of this bimodal flight period is obfuscated by the large elevational and aspect gradient in the study area. In other words, the bimodal flight period would likely be more sharply observed for any one location, than for the region as a whole. For example, GPR3 demonstrates a coarse bimodal pattern (Figure 3), which would be more distinct if the site had been sampled several times per week.

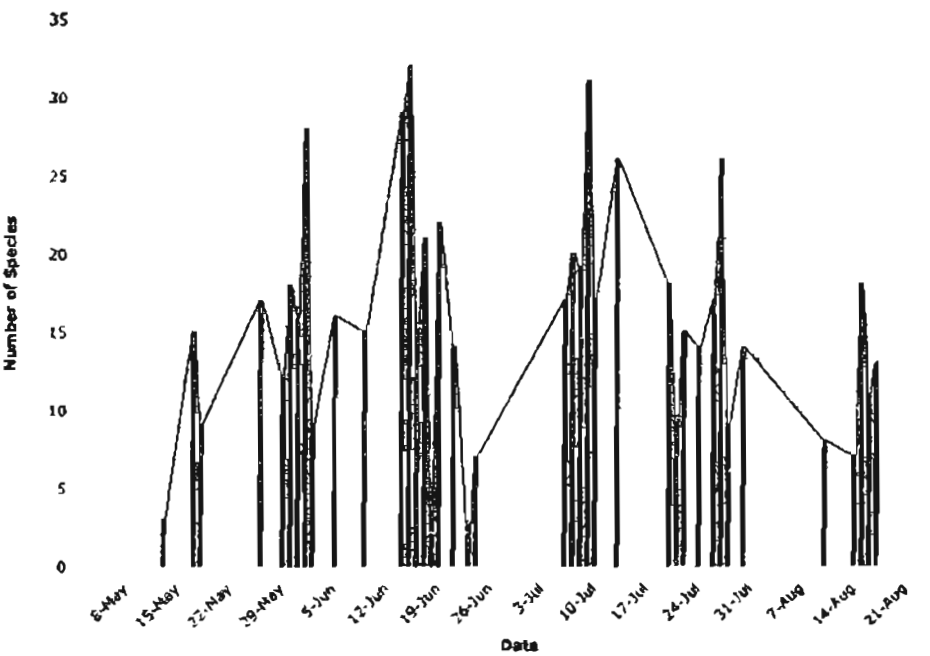

Figure 2. Butterfly species richness per sampling date. A bimodal flight season is apparent, with periods of peak richness in mid-June and mid-July.

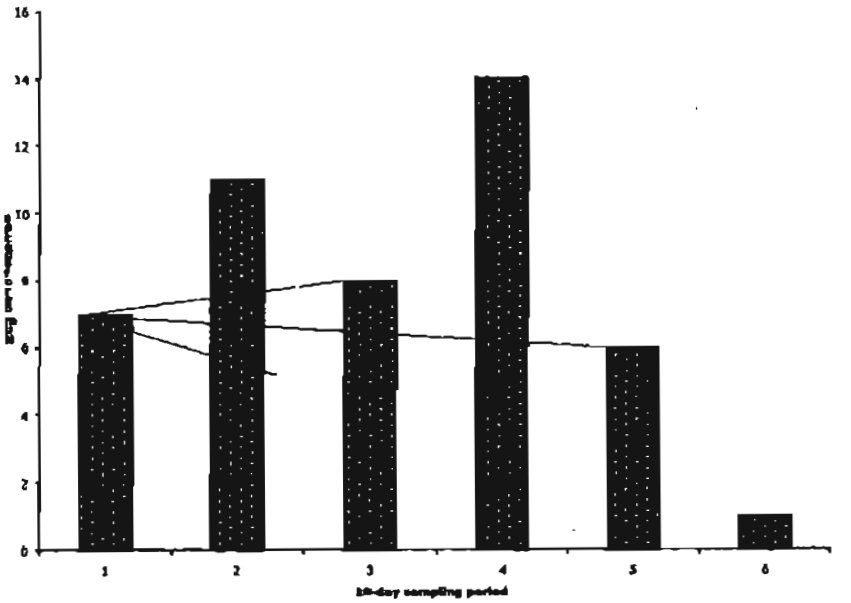

Figure 3.
Butterfly species richness recorded at GPR3 site per 10-day period. A coarse bimodal flight is apparent.

Focal Site Sampling

Our sampling methods performed well. Of the 103 species known to have occurred in the Carson Range above 1800 m, approximately 81 might now be considered to have currently, formerly, or periodically bred there; 17 as regular or historic non-breeding vagrants or passage migrants, and 6 as rare vagrants. In 2007 we recorded 79 species. This constitutes approximately 77% of the known Carson Range butterfly fauna, or approximately 81% of the regularly occurring fauna (currently, formerly, or periodically regular breeders or vagrants). Considering the relatively dry conditions in 2007, highly localized populations of many butterfly species, and large area and elevational gradient of the Carson Range, we believe that our sampling effort met our objectives and exceeded our expectations. Summary statistics for species recorded in 2007 are presented in Table 2.

We established 26 focal sites for systematic sampling (Table 1.) The most abundant species are presented in Figure 4. Of the 79 species observed in 2007, only six were not found at focal sites. These were *Adelpha bredowii*, *Vanessa annabella*, *Habrodais grunus*, *Glaucopsyche piasus*, *Erynnis icleus*, and *E. pacuvius*. A future focal site at or near Memorial (Kennedy) Point, and associated with *Quercus chrysolepis*, would sample *H. grunus*, and possibly breeding *A. bredowii*. *E. pacuvius* is likely to occur at many of the focal sites in the future. *G. piasus* is highly localized in the Carson Range; a future focal site in the meadow at the top of the Tunnel Creek aspen stand (SP-0) would sample *G. piasus*. as well as many additional high, wet meadow species. *Vanessa* spp. and *E. icleus* are harder to predict.

Of the 73 species found at focal sites, four were only recorded "off count." In other words, these species were recorded at focal monitoring stations, but either immediately adjacent to the 50 m-radius count circle or not during the actual count period. These were *Neophasia menapia* (twice), *Chlosyne hoffmanni*, *Speyeria cybele* (thrice), and *Satyrium saepium* (twice).

Summary statistics for focal sample sites are in Table 3. Nine focal sites had no butterflies present during sampling at least once, typically the last survey periods. These sites are as follows: GPR1, GPR2, GPR3, GPR9, GPR10, IR5, IR6 (twice), LV2, LV4 (thrice). This was likely due to the relatively dry conditions in 2007. Future efforts should consider sampling the LV4 site, our lowest site at just below 1800 m elevation, earlier in the season.

Table 2. Summary statistics for butterfly species recorded in the Carson Range, above 1800 m, mid-May through mid-August 2007. See Methods for sampling details.

CODE	Species	Date Range[a]	Span of Date Range[a]	No. of Focal Sites Recorded[b,c]	Focal Sites Cumulative[b]	Total Abundance[b]
PAZE	*Papilio zelicaon*	5/16 - 7/21	67	1	1	0
PARU	*Papilio rutulus*	6/8 - 7/23	46	7	11	9
PAEU	*Papilio eurymedon*	5/16 - 7/8	54	6	13	15
PACL	*Parnassius clodius*	6/16 - 6/23	8	2	2	3
NEME	*Neophasia menapia*	7/25 - 8/15	22	0	1	1
POOC	*Pontia occidentalis*	5/28 - 7/26	60	5	5	6
POSI	*Pontia sisymbrii*	5/16 - 6/17	33	5	6	8
PIRA	*Pieris rapae*	5/30 - 8/15	78	2	7	15
EUHY	*Euchloe hyantis*	5/28 - 6/14	18	2	2	3
ANST	*Anthocharis stella*	5/16 - 6/20	36	11	17	47
ANLA	*Anthocharis lanceolata*	5/31 - 6/18	19	3	3	3
COEU	*Colias eurytheme*	5/16 - 8/16	93	20	59	88
DAPL	*Danaus plexippus*	6/8 - 8/15	69	1	2	0
CEOE	*Cercyonis oetus*	7/5 - 8/16	43	3	4	4
OECH	*Oeneis chryxus*	6/23 - 7/29	37	1	2	4
LILO	*Limenitis lorquini*	6/14 - 8/15	63	1	6	9
ADBR	*Adelpha bredowii*	5/31 - 6/18	19	0	0	0
VACA	*Vanessa cardui*	5/17 - 7/12	57	1	2	2
VAAN	*Vanessa annabella*	7/23 - 7/23	1	2	0	0
VAVI	*Vanessa viginiensis*	6/15 - 7/27	43	1	1	1
POZE	*Polygonia zephyrus*	5/17 - 8/16	92	8	11	20
POPR	*Pontia protodice*	7/5 - 8/15	42	2	2	2
NYMI	*Nymphalis milberti*	5/16 - 7/29	75	9	14	14
NYCA	*Nymphalis californica*	5/16 - 7/26	72	18	39	162

Table 2 (cont'd). Summary statistics for butterfly species recorded in the Carson Range, above 1800 m, mid-May through mid-August 2007. See Methods for sampling details.

CODE	Species	Date Range[a]	Span of Date Range[a]	No. of Focal Sites Recorded[b,c]	Focal Sites Cumulative[b]	Total Abundance[b]
NYAN	*Nymphalis antiopa*	5/12 - 7/27	77	5	11	11
EUCH	*Euphydryas chalcedona*	5/16 - 7/5	51	2	3	16
EUED	*Euphydryas editha*	6/23 - 7/29	37	1	2	3
CHPA	*Chlosyne palla*	5/16 - 7/25	71	5	7	9
CHHO	*Chlosyne hoffmanni*	6/23 - 7/21	29	0	1	2
PHMY	*Phyciodes mylitta*	6/8 - 8/14	68	1	2	1
PHOR	*Phyciodes orseis*	6/4 - 7/26	53	8	18	110
PHPU	*Phyciodes pulchellus*	5/29 - 8/9	73	14	37	197
PHSP[d]	*Phyciodes* species	7/8 - 7/12	5	2	2	2
CLEP	*Clossiana epithore*	7/9 - 7/12	4	2	2	3
SPCY	*Speyeria cybele*	6/15 - 8/15	62	0	3	1
SPMO	*Speyeria mormonia*	7/6 - 8/16	42	6	12	34
SPEG	*Speyeria egleis*	6/18 - 8/14	58	5	8	15
SPEM[d]	*Speyeria egleis/mormonia*	7/8 - 8/16	40	6	10	40
SPZE	*Speyeria zerene*	6/15 - 7/23	39	3	4	8
SPCO	*Speyeria coronis*	5/16 - 7/26	72	3	3	2
SPCZ[d]	*Speyeria coronis/zerene*	6/13 - 8/16	65	8	14	18
SPEY[d]	*Speyeria sp.*	6/16 - 6/16	1	2	2	2
HAGR	*Habrodais grunus*	8/14 - 8/14	1	0	0	0
SACA	*Satyrium californicum*	7/6 - 7/26	21	3	4	8
SASY	*Satyrium sylvinum*	7/12 - 8/15	35	1	3	8
SASA	*Satyrium saepium*	7/12 - 8/16	36	0	2	1
SABE	*Satyrium behrii*	6/13 - 8/13	62	5	10	44
SAFU	*Satyrium fuliginosum*	7/5 - 8/9	36	4	6	42

Table 2 (cont'd). Summary statistics for butterfly species recorded in the Carson Range, above 1800 m, mid-May through mid-August 2007. See Methods for sampling details.

CODE	Species	Date Range[a]	Span of Date Range[a]	No. of Focal Sites Recorded[b,c]	Focal Sites Cumulative[b]	Total Abundance[b]
INER	*Incisalia eryphon*	5/16 - 6/14	30	3	4	4
INAU	*Incisalia augustinus*	5/16 - 7/5	51	5	6	6
CALE	*Callophrys lemberti*	5/25 - 7/8	45	2	4	5
LYCU	*Lycaena cuprea*	7/29 - 7/29	1	1	1	1
LYME	*Lycaeides melissa*	7/26 - 7/26	1	1	1	4
LYNI	*Lycaena nivalis*	6/18 - 8/14	58	10	16	33
LYHS	*Lycaena helloides*	5/29 - 8/16	79	7	14	27
LYHA	*Lycaena heteronea*	7/26 - 8/16	22	3	3	5
LYRU	*Lycaena rubida*	7/12 - 8/14	34	2	4	4
LYED	*Lycaena editha*	7/8 - 8/16	40	6	14	74
EVAM	*Everes amyntula*	5/29 - 6/14	17	1	2	14
CELA	*Celastrina ladon*	5/16 - 7/23	69	10	12	18
GLLY	*Glaucopsyche lygdamus*	5/25 - 7/25	62	3	4	4
GLPI	*Glaucopsyche piasus*	6/13 - 6/18	6	0	0	0
EUBA	*Euphilotes battoides*	6/13 - 7/8	26	1	2	2
AGPO	*Agriades podarce*	6/14 - 8/14	62	4	11	65
LYID	*Lycaeides idas*	7/6 - 8/16	42	3	5	5
PLSA	*Plebejus saepiolus*	5/25 - 7/26	63	16	47	508
ICIC	*Icaricia icariodes*	6/4 - 7/26	53	9	19	137
ICSH	*Icaricia shasta*	6/16 - 7/26	41	2	2	1
ICAC	*Icaricia acmon*	6/16 - 6/16	1	1	1	2
ICLU	*Icaricia lupini*	6/13 - 7/25	43	4	7	15
ICAL[d]	*Icaricia acmon/lupini*	6/18 - 7/19	32	0	0	0

Table 2 (cont'd). Summary statistics for butterfly species recorded in the Carson Range, above 1800 m, mid-May through mid-August 2007. See Methods for sampling details.

CODE	Species	Date Range[a]	Span of Date Range[a]	No. of Focal Sites Recorded[b,c]	Focal Sites Cumulative[b]	Total Abundance[b]
BLSP[d]	Unidentified Blue	6/13 - 6/15	3	1	1	1
HEJU	*Hesperia juba*	5/12 - 8/16	97	12	14	23
HENE	*Hesperia nevada*	6/14 - 7/21	38	2	3	4
POSA	*Polites sabuleti*	6/16 - 7/21	36	2	2	4
POSO	*Polites sonora*	5/31 - 8/16	78	7	12	25
OCSY	*Ochlodes sylvanoides*	7/23 - 8/15	24	2	3	4
THME	*Thorybes mexicana*	5/25 - 7/8	45	7	12	36
ERIC	*Erynnis icleus*	6/18 - 6/18	1	0	0	0
ERPR	*Erynnis propertius*	5/28 - 7/7	41	1	4	4
ERPA	*Erynnis pacuvius*	7/7 - 7/7	1	0	0	0
ERPE	*Erynnis persius*	5/25 - 7/8	45	4	8	17
ERPP[d]	*Erynnis pacuvius/persius*	5/31 - 6/20	21	2	2	2
PYRU	*Pyrgus ruralis*	5/12 - 6/16	36	10	12	26
PYCO	*Pyrgus communis*	6/13 - 7/9	27	2	3	4
HESP[d]	Skipper sp.	5/31 - 6/14	15	2	2	2

[a] Includes non-focal site records
[b] Focal sites only
[c] Includes "Off-count" records, see Methods
[d] Taxonomic assignment above species level

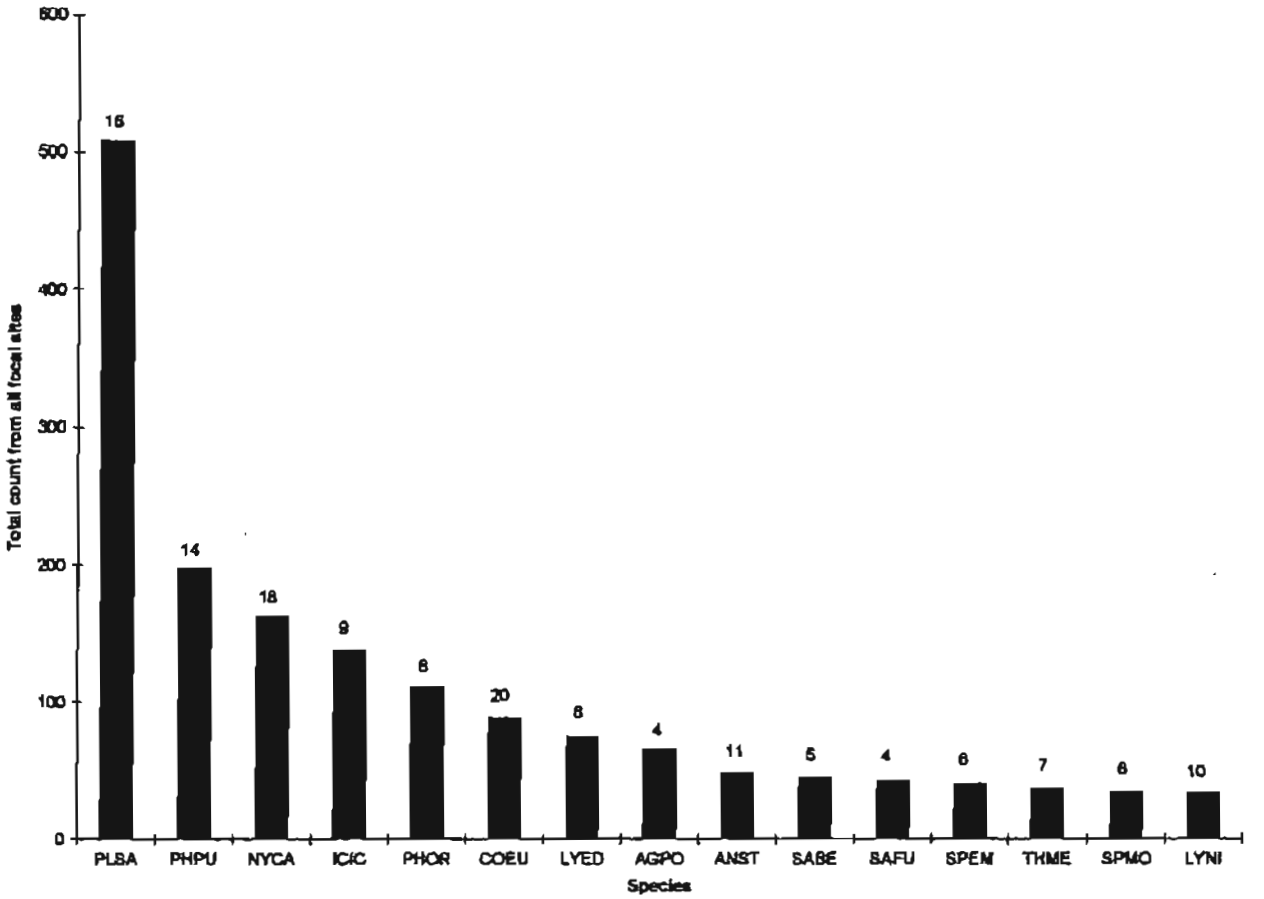

Figure 4. Cumulative abundance at focal sites for the 15 most abundant butterfly species at Carson Range focal sites. Numbers above bars represent the number of focal sites at which each species was recorded. See Table 2 for species codes.

The Specimen Record

Over the last nearly three decades, George Austin has examined the nation's major butterfly collections for butterfly specimens from the state of Nevada. We were fortunate to be able to use his database to help plan our sampling, to compare against our 2007 results, and to help prepare this complete and comprehensive fauna for the Carson Range. While the specimen record has been an invaluable resource, many of the compiled locality data are vague. Our plans of returning to exact localities of previous workers were quickly dashed, but worse, we cannot be certain whether many specimens, particularly those of the eastern canyons and foothills, were collected within the study area as we defined it (> 1800 m elevation). Some specimens from the 1800s that may have originated from the study area have location data that are unacceptably general. For example, there are specimens of *Parnassius clodius* (which occurs in Nevada only high in the Carson Range) from 1868-1872, but these are simply labeled "Reno" or "Nevada." The oldest records positively labeled from our study area in the Carson Range come from

Table 3. Summary statistics for focal butterfly sampling sites. See Methods for sampling details, and Table 1 and Appendix A for details of focal sites. BSR = Butterfly Richness (includes "Off Count" spp.);TBA = Total Butterfly Abundance.

	Sampling Period											
	1		2		3		4		5		Total	Total
SiteCode	BSR	TBA	BSR	TBA	BSR	TBA	BSR	TBA	BSR	TBA	BSR	TBA
28-2	11	35	10	38	9	17	5	4	1	1	36	95
G2	3	14	1	9	7	25	11	34	4	7	26	89
G3	4	11	12	23	6	27	6	8	7	7	35	76
GPR1	5	16	2	17	3	3	1	1	0	0	11	37
GPR10	10	30	6	27	4	4	2	2	0	0	22	63
GPR2	6	11	5	33	4	12	1	1	0	0	16	57
GPR3	7	13	8	90	10	54	6	17	0	0	31	174
GPR5	8	16	5	45	5	21	4	5	0	0	22	87
GPR7	8	17	8	17	9	22	8	34	5	9	38	99
GPR9	3	0	7	18	9	48	4	21	0	0	23	87
IR1	3	3	5	26	6	23	6	20	2	2	22	74
IR2	3	32	8	34	7	8	7	14	2	3	27	91
IR3	3	13	2	3	5	6	5	7	3	3	18	32
IR4	2	4	6	9	4	7	1	3	2	2	15	25
IR5	7	16	6	10	4	11	0	0	2	2	19	39
IR6	1	1	3	2	1	1	0	0	0	0	5	4
IR7	6	11	8	22	6	32	3	10	1	2	24	77
K1	2	2	4	11	7	25	5	16	7	11	25	65
LV1	12	8	10	20	6	26	4	4	3	10	35	68
LV2	6	14	4	11	0	0	1	1	1	2	12	28
LV4	7	20	3	3	0	0	0	0	0	0	10	23
SP1	7	24	8	20	10	58	7	58	6	30	38	190
SP2	8	46	9	53	10	77	3	3	1	2	31	181
SP4	6	13	8	21	9	42	10	27	3	7	36	110
SP5	1	1	11	21	9	118	8	10	1	2	30	152
SP6	4	11	8	26	5	10	7	9	1	0	25	56

Glenbrook, dating from 1915. Two more Glenbrook specimens date from 1931. A single specimen comes from Zephyr Point in 1938. Many specimens were collected from Glenbrook and Mount Rose areas from 1946 through the mid 1950s. Specimens from that period are labeled simply as "Lake Tahoe," and appear to be ascribable to the Glenbrook area. By the late 1950s, the specimen record suggests that visitation and collection efforts stepped up considerably in consistency and geographic breadth. Despite that greater sampling, collection in the Carson Range has remained highly variable and inconsistent. For example, there are only three specimens from 1998, one from 1994, and there are probably over 350 from the study area from 1981. Such

inconsistent sampling means that spatial and temporal distributions are poorly defined in the specimen record, even for the most heavily collected species. Ranges of sampling dates, in particular, probably reflect collector effort, as much as actual flight periods. For example, freshly emerged *Colias eurytheme* and *Vanessa* spp. are often found flying along Lake Tahoe's edge well into October, and northbound *Vanessa* spp. often can be found flying along the highest ridgetops in April or even March, but such phenomena are not reflected in the specimen record.

Older records may represent populations that no longer exist. Vegetation and physical conditions likely have changed at many localities with changes in land-use practices, succession, or climate change. Furthermore, populations of many species periodically disappear and reappear naturally, exhibiting metapopulation dynamics related to weather or cyclic changes in host plant populations, parasites, or other factors. In the Carson Range, this often takes the form of high-elevation populations dying out, and then becoming recolonized by migrants or dispersers from lower elevations to the east. For some species, this may be an annual pattern. From the specimen record we were able to acertain little obvious change in the fauna over time. For a few species where a change was detected or suspected, we have made comments in the species accounts. It is likely, however, that the Carson Range butterfly fauna has undergone significant changes since the Comstock-Era (approximately 1859 to 1890), when much of the range was denuded of trees for mine timbers. That event likely provided many successional species with a bonanza of new territory to exploit, and sunny, unimpeded flight conditions for many other butterflies to expand their respective ranges and link previously isolated habitat patches. Unfortunately, we do not have a comparative record of the butterfly fauna at that time, nor from the early years of reforestation.

Much of the specimen record was not available to us until after we made our focal site selection. Unfortunately, this and our focus on sites above 1800 m caused us to omit two foothill canyon locations at or just below the lower elevational limit of our study area, both of which are particularly well-represented in the specimen record. These locations are found in Kings and Clear Creek canyons, each approximately between 1700-1800 m. Although precise localities cannot be determined from most specimen labels, the representative fauna are likely to have been taken from various localities along Kings Canyon Road (between Custer Circle and the first main switchback at 1785 m) and the springs, riparian areas, and meadows (Snyder Meadows) of upper Clear Creek Canyon, respectively. As stated above, the focus of our study in 2007 was above 1800 m elevation. However, because these locations are so well represented in the specimen record, and because several lower-elevation species have only been found within the study area in these lower foothill canyons, we recommend that future monitoring efforts consider establishing focal monitoring stations at suitable sites there. The timing of sampling efforts at such sites would need to reflect the earlier flight seasons found at those lower elevations.

Status and distribution

Breeding and permanent residency status of many butterflies are obfuscated by annual migrations and colonizations as well as epigamic "hilltopping" movements and outright vagrancy. South-to-north and low elevation to high elevation movements far outnumber the opposite. For several species, populations of butterflies that have overwintered are often augmented, or even overwhelmed, by fresh summer phenotypes from lower elevations (Shapiro 1973, 1974). In the Carson Range, the vast majority of these immigrants come from the east. This is in part due to proximity, and the steep and often sparsely vegetated nature of the east slope, and occasionally amplified by periods of warm east wind or updrafts associated with mountain-wave induced rotors in the lee of the Sierra Nevada (Doyle and Durran 2002). In the autumn, downslope and southward movements, in combination with more favorable temperatures and viable resources, tend to aggregate butterflies along the edge of Lake Tahoe.

Thus, the Carson Range fauna comprises vagrants, breeders (whether resident or migrant), and non-breeding migrants. Vagrants might be parsed further according to degree of rarity or distance from the nearest breeding population. For example, *Pontia protodice* likely occurs as a regular vagrant from the lower foothills to the east. *Euphilotes pallescens* comes from further to east, and the occurrence of a few species (e.g. *Danaus gilipus*, *Euptoieta Claudia*, and *Euphyes vestries*) in the Carson Range is rather surprising and difficult to explain. It is important to keep in mind that butterflies, volant and often highly dispersive, can presumably inadvertently find themselves in places hundreds of miles from the nearest suitable habitat. It is also fundamental to acknowledge that the presence of a butterfly at a given location does not necessarily constitute habitat use by it, and it certainly does not equate to the presence of a breeding population. Such status determinations must be established based on observation of breeding behavior. Courtship among sexually monomorphic species easily might be confused with fighting over resources that might have nothing to do with breeding, but territorial fighting or courtship are both highly suggestive of local breeding. Copulation is stronger support, although some species, particularly hilltopping species, may lek and copulate considerable distances away from larval host plants. Nonetheless, lekking sites are an essential part of breeding habitat for those species. Observation of oviposition removes any doubt of attempted breeding, but it still does not guarantee the presence of a persistent breeding population, or even suitable host plants, for that matter. Consistent patterns of occurrence in appropriate habitat lend strong support for localized breeding. For some species, however, this may be obfuscated or misinterpreted by consistent upslope dispersal or metapopulation dynamics.

Annotated Species List

Papilionidae

The Papilionidae comprise many of the world's largest butterflies; certainly many of the larger butterflies of the Carson Range are swallowtails. This family includes large, conspicuous, yellow and black butterflies with tails on the hind wings, two of which are common fliers here. Most feed on plants of the Apiaceae. Our swallowtails overwinter as pupae. Also in this family are the Parnassians, smaller relatives with semi-transparent wings, that are found at upper middle elevations in the Sierra Nevada. Parnassians overwinter as eggs.

Papilio zelicaon Anise Swallowtail

Breeder

An early brood of *Papilio zelicaon* occurs at lower to mid elevations on the east side of the range, and this species was regularly found in Little Valley. In 2007, the last sighting at this location was 31 May, after which the only occurrences were of hill- and ridgeline-topping individuals in the Mount Rose area. In moister years, specimens have been collected at Little Valley through 8 September, but the species is believed to be univoltine in the Carson Range; thus it may be facultatively bivoltine at lower elevations. Likely host plants in the Carson Range include *Angelica breweri* and *Lomatium* and possibly *Conium maculatum* (lower elevations) and *Cymopterus* (higher elevations). The very similar Baird's (Old World) Swallowtail (*P. (machaon) bairdii*) occurs to the southeast, and could conceivably stray into the area, but easily might be overlooked.

Papilio indra Indra Swallowtail

Vagrant

Presumed vagrants have been collected at Glenbrook, and likely breeders at Tahoe Meadows, and near Spooner Summit; lower elevation specimens are from Clear Creek and Kings canyons, and along Kingsbury Grade. This species was observed once in the Carson Range in 2007 adjacent to a survey site above Tahoe Meadows. Sporadic local breeding might be hard to detect since pupal diapause can last several years.

Papilio rutulus Western Tiger Swallowtail

Breeder

This conspicuous species is primarily riparian or associated with stands of quaking aspen (*Populus tremuloides*). Such habitats can are widely distributed in the Carson Range, and because this species is a large, strong flier, it can be found almost anywhere throughout the range. It is not known to be a hilltopper, and thus is seldom seen lingering about the higher ridges and peaks. Records from the southwest Tahoe basin suggest that it has increased in the higher elevations of the Sierra Nevada in recent years. The specimen record suggest that they were firmly established in Incline and Glenbrook by the 1960s. By the early to mid 1980s, specimens had been collected across the length and breadth of the range. During large flights, fatalities from vehicle impacts can be conspicuous. Its usual host on the east slope of the Sierra is aspen, though many riparian deciduous trees

and shrubs may be used, including cottonwoods (*P. balsamifera trichocarpa*) and various *Salix* and *Alnus*. This species is probably univoltine in the Carson Range, although they may have partial second broods at the lowest elevations in the range. Several of the very similar yet larger *Papilio multicaudatus* have been collected in Davis Creek Park and at lower elevations along Clear Creek Canyon and Kingsbury Grade. Because *P. rutulus* can be so common and individuals seldom scrutinized closely, any *P. multicaudatus* that wanders upslope easily might be overlooked.

Papilio eurymedon — Pale Swallowtail

Breeder

This species is very closely related to *Papilio rutulus*, and they are often found flying, nectaring, or puddling together. The paler *P. eurymedon*, however, tolerates drier vegetation types, and typically outnumbers *P. rutulus* throughout most of the Carson Range. This species also generally experiences a slightly earlier flight period than *P. rutulus*; in 2007, the first *P. eurymedon* was recorded on 16 May, whereas the first *P. rutulus* was not recorded until 8 June. The last *P. eurymedon* was on 8 July; the last *P. rutulus* was 23 July. Larval host plants include *Rhamnus* and *Ceanothus*, and possibly *Prunus*. Elsewhere, females have been observed numerous times laying eggs on *Melilotus alba* (Shapiro and Manolis 2007), a Fabaceous, herbaceous weed naturalized in the Carson Range; such larvae are doomed to starve. This species is the only obligate univoltine swallowtail.

Parnassius clodius — Clodius parnassian

Breeder

Parnassians include some of the most cold-adapted alpine butterflies. Despite alpine vegetation and climatic conditions along the high ridges along the Carson Range, *Parnassius clodius* was found in 2007 only in the vicinity of Mount Rose, and the Diamond Peak Ski area. The distribution of this species is surely restricted by the limited distribution of its host plant, *Dicentra uniflora* (*D. formosa*, the favored host plant elsewhere in the Sierra, is not known from the Tahoe basin). In 2007, this species was only seen from 16-23 June; a single voucher specimen was collected from the Diamond Peak Chaparral site on the former date. The entirety of prior specimens definitively known from the study area comprise a pair taken collected 28 July 1967 at Marlette Peak, and specimens taken in 2004 by Austin on the Mount Rose highway. A few specimens from the 1800s exist, labeled simply "Reno" or "Nevada."

Pieridae

Pierids are mostly medium-sized and colored yellow, orange, or white with black markings. Sulphurs tend to feed on plants in the pea family (Fabaceae), while our whites and orange-tips feed on crucifers (Brassicaceae). Most species overwinter as pupae, and several have noticeable sexual dimorphism and seasonal polyphenisms (brood forms).

Neophasia menapia Pine White

Breeder

This is our most distinctive pierid, one whose life cycle revolves around pine trees (*Pinus*); thus, they are typically seen flitting among the canopy. This species flies late in the season in the Carson Range, with a somewhat protracted single brood flying around mid-August. The first individual in 2007 was observed 25 July, and specimen records exist into October. Unlike most pierids, this species overwinters as eggs. *Neophasia menapia* exhibit strong sexual dimorphism, with females exhibiting pinkish red along hindwing veins and margins. Larval host plants in the Carson Range likely include *P. jeffreyi*, *P. monticola*, and *P. ponderosa*, and possibly *P. washoensis*.

Pontia protodice Checkered White

Presumed Vagrant, Possible Immigrant Breeder

Due to its similarity with *Pontia occidentalis*, this species may be overlooked regularly in the Carson Range. It is known to breed as high 2100 m at Donner Pass, but probably does not overwinter there, instead it likely colonizes from lower elevations from year to year (Shapiro 1975a); it is believed to be more sensitive to freezing temperatures than *P. occidentalis* (Scott 1992). It should be looked for breeding in disturbed areas wherever weedy peppergrasses (*Lepidium)* are abundant. During 2007, this species was collected on three occasions: 5 July (GPR9), 12 July (LV1), and 15 August (28-6). The third location was a weedy, moist, disturbed area with several species of potentially suitable Brassicaceous host plants, and the specimen was quite fresh. Prior specimens are from diverse locations throughout the Carson Range, dating back as early as 1960.

Pontia occidentalis Western White

Breeder

This is the most common white during the second half of the summer flight, and the specimen record confirms that this species far outnumbers *Pontia protodice* in the Carson Range, despite the range's arid nature. This species is probably necessarily univoltine in the Carson Range, but may be facultatively multivoltine under ideal conditions. The latter is suggested by a mid-July specimen record from Little Valley, as well as a few other late-season, mid-elevation records. To complicate matters, voltinism is somewhat clouded by the steady upslope dispersal of hilltopping individuals. *P. occidentalis* historically has been found down to lake level on the west, with many June specimens from Glenbrook, but seldom below Little Valley on the east. In 2007, however, this species was not observed below, or to the south of, Spooner Summit. High elevation specimen records exist into September. Larval host plants include a variety of mustards (Brassicaceae), particularly Lepidium, and adults nectar on pink and white composites (Asteraceae), and *Melilotis alba*.

Pontia beckerii Becker's White

Vagrant, Possible Breeder

This is primarily a species of the arid Great Basin, and occurs in lower elevations along the east slope of the Sierra Nevada. However, it has been found breeding on *Lepidium*

virginicum at as high and far west as Donner Pass, 2100 m (Shapiro 1975a). Very few specimens exist from the study area, but they occur regularly in the lower canyons to the east and occasionally wander upslope in mid to late summer. Vagrants were expected and looked for, but this species was not observed in the Carson Range in 2007.

Pontia sisymbrii Spring/California White

Breeder

This is the most common white butterfly during the first weeks of the summer flight. In 2007, adults were found on the wing almost as soon as sampling began, 16 May. Lower in the canyons on the east side of the range, they fly as early as late April in warm years. While a straggler was found 17 June, most were gone by the last days of May. This species is believed to be strictly univoltine, with obligatory pupal diapause, and pupae may remain dormant for four or more years (Shapiro and Manolis 2007). Mid-season specimen records, the latest being 21 July from Tahoe Meadows, are all from higher elevations, and this species is known to fly as late as early August above tree line.

Pieris rapae Cabbage Butterfly

Breeder

The is a semi-cosmopolitan species from Europe, and can be found dispersing widely to almost all vegetation types of the Carson Range. Despite its peregrinations, it prefers sunny, open spaces, and places that are disturbed and supporting weedy mustards. Whether this species overwinters or annually recolonizes the Carson Range is uncertain, but the first arrivals each year are spillover immigrants from lower elevations, occasionally reaching the lake by the first few days of May. Breeding appears to be most successful, and they are most reliably found, at lower elevation weedy areas and meadows, such as Rabe Meadows, Slaughterhouse Canyon, and Village Green/Third Creek in Incline. In 2007, most were gone by early August.

Euchloe ausonides Large Marble

Vagrant

This species was not observed in 2007 within the study area, but it was observed at lower elevations, at the bottom of foothill canyons to the east. Occasional upslope dispersal might be expected, but the species' similarity to *Euchloe hyantis* might make it easy to overlook. There is only a single specimen record for the study area (Tahoe Meadows, 10 July 1990).

Euchloe hyantis California/Edward's/Pearly Marble

Presumed Breeder

This single-brooded species is fairly uncommon in the Carson Range. Indeed, prior to 2007, there was no record of this species collected within the study area. It is unlikely that 2007 was unique or that this species has recently colonized the Carson Range, although the exact breeding and distributional status for this species in the Carson Range remains uncertain. It is a very enthusiastic hilltoppper, and all observations were made at or near topographical high points (e.g. Tahoe Meadows Ridge, high in North Canyon). *Euchloe hyantis hyantis*, to which our specimens are ascribable, is known from the west slope to tree line in open, rocky situations (e.g. sunny cliffs, granitic moraines, etc.), and

spills over to the east slope in montane chaparral. It should be looked for breeding wherever *Streptanthus tortuosus* is abundant. Other potential larval food plants include *Arabis*, among others. Attempts to confirm breeding in the Carson Range might be hindered by the fact that pupal diapause may last up to five years if conditions are less than ideal (Shapiro and Manolis 2007) – which may be a common scenario for this early season flier. Specimens from the foot of the Carson Range, below the elevation of our study area, are assignable to *E. h. lotta*, the "Desert Marble," which some taxonomists consider to be a separate species.

Anthocharis sara — Sara Orangetip

Breeder

Across a broad elevational spectrum, this butterfly (Figure 5) is one of the first non-hibernators to appear. This readily identified butterfly was common in open forests, as well as along riparian corridors and rocky canyons. Two subspecies occur in the Carson Range, and some taxonomists treat the two as separate species: *Anthocharis sara stella* and *A. s. pseudothoosa*. The specimen record suggests that both can be found widely throughout the range and may be sympatric in many places, perhaps making the Carson Range an ideal place to try to disentangle taxonomic issues in this group. There is one brood, early in the flight season. In 2007, the last observed were 20 June; a few July specimens exist. Likely larval host plants include *Arabis* and *Descurainia*.

Anthocharis lanceolata — Gray/Boisduval's Marble

Breeder

From the last days of May through mid-June (depending on elevation) this species was fairly common in 2007, in rocky canyons and adjacent sites. It was most abundant and between Glenbrook and Spooner Summit, but was found widely distributed across the range, and was observed several times just below 8000 feet elevation. The specimen record suggests that this species probably flies into early July in moister years, though this species is obligately single-brooded. Likely larval host plants include tall, native brassicaceous plants, especially taller *Arabis* (e.g. *A. glabra*).

Colias eurytheme — Orange Sulphur

Breeder

This is one of the most common butterflies of the Carson Range and adults can be found flying virtually anywhere in the range. It is also one of our more variable butterflies, in terms of both sexual dimorphism and seasonal polyphenism. To complicate matters, several different phenotypes may be seen at any one time, as upslope dispersal and immigration overlaps broods with overwintering resident populations. The extent to which *Colias eurytheme* overwinters in the Carson Range is unknown, but probably varies greatly from year to year and by elevation. In 2007, the first of this species were found on 16 (LV5) and 17 May (K1), and were early dispersers from lower elevations. Pale whitish females are commonly observed, and stragglers of this species may be observed well into October and even November in some years. Larval host plants in the Carson Range include many, if not most, Fabaceae available, but especially *Astragalus*, *Lotus*, *Lupinus*, and *Trifolium*.

Colias philodice Clouded Sulphur

Vagrant

This species is a common resident in alfalfa fields of the Carson Valley, but probably rarely strays to the Carson Range, though it may be overlooked due to its similar appearance to the abundant *Colias eurytheme*. It was not encountered in 2007, though several specimen records exist from North Canyon, Tahoe Meadows, and especially the lower foothill canyons to the east. Specimens from the study area span 26 Jun to 18 July.

Nymphalidae

This family rivals Lycaenidae for species richness. All of nymphalids have reduced forelegs that give rise to the name "Brush-footed Butterflies." Many are large, stout, and long-lived. Many of the larger species overwinter as adults, and many others make long migrations to escape winter. Smaller species and *Speyeria* overwinter as larvae. As a family, nymphalids exploit a wide variety of larval host plants.

Danaus plexippus Monarch

Non-breeding Migrant

The highly vagile and migratory nature of this species allows it to show up just about anywhere. The specimen record reflects this, with records scattered throughout the study area from late-May through mid-September. In 2007, the species was only encountered on three occasions, yet curiously two of these observations, over two months apart, were both in the vicinity of Lower Prey Meadows. This species feeds on *Asclepias*, which are not believed to exist in the study area, thus this butterfly is not believed to reproduce in the Carson Range. It is possible, however, that this species occasionally exploits exotic Asclepiadaceae in gardens. Native *A. cordifolia* is reported to be occasional below 2300m in elevation in the northwest Lake Tahoe basin (Graf 1999), and but was not noted in Incline Village, nor elsewhere in the Carson Range in 2007. *A. fascicularis* and *A. speciosa* are common eastern Sierra species, and may occur at lower elevations on the east side of the range.

Danaus gilippus Queen

Vagrant

A single specimen exists from Montreal Canyon, 5 July 1991. This is primarily a species from the southern deserts, though it regularly wanders its way up the east slope of the Sierra through Inyo and even Mono counties, and out into the Great Basin. It was not recorded in 2007, and is surely an extremely rare stray to the Carson Range.

Coenympha tullia California Ringlet

Breeder

No individuals were recorded from the study area in 2007, but there is a large specimen record from grassy meadows of the lower elevations, mostly below the elevation limit of our study area, but also from Little Valley. It has also been recorded at Spooner Summit and Montreal Canyon, though these may represent strays. All Carson Range specimens of this species are ascribable to *Coenympha tullia ampelos*, a distinctive subspecies from

the Great Basin and East Slope of the Sierra Nevada. This subspecies may demonstrate large-scale metapopulation dynamics, periodically disappearing, then recolonizing parts of the region. For example, C.F. MacGlashan did not record any around Truckee in the late 1800s (McGlashan 1914, Shapiro 1998). In the 1970s-80s it was abundant, only to disappear from Truckee again in the late 1990s (Shapiro 2006). As of the mid-2000s, it was once again common in eastern Truckee (Richardson, pers. obs.). When breeding, there is likely only one brood within the study area. Specimens from Little Valley span from the first days of June through late August, but the vast majority are from July. A second, autumn brood flies in Verdi, the Carson Valley, and the lower Carson Range foothills. These butterflies can occasionally been seen from the lower bounds of our study area in September and beyond; a few study area specimens exist from September. Adults will visit a variety of flowers; typical of Satyrines, larvae feed on grasses, and presumably overwinter prior to pupation.

Cercyonis sthenele — Great Basin Wood-Nymph

Vagrant

None was recorded in 2007, but several specimens exist from the eastern canyons just below the lower boundary of our study area (e.g. Kings Canyon, Clear Creek Canyon). Additionally, a single specimen exists from Tahoe Meadows, near Mount Rose Summit, suggesting that the species at least occasionally wanders up into higher elevations. These specimens all date from mid-July to mid-August.

Cercyonis oetus — Least Satyr

Breeder

This is the only expected satyr in the Carson Range, but it is not likely to be encountered away from its favored habitats. In 2007, this species was found only among high, volcanic outcrops, namely those on Genoa, South Camp, and Snow Valley peaks. However, specimens exist each from North Canyon and Marlette Lake, and there are also specimens from the eastern canyons at the lower elevational limit of the study area, where presumably separate populations are characteristic of the sagebrush steppe community. Observations from this study spanned from 5 July to 16 August, consistent with museum records from higher elevations (6 July-26 August), and it appeared to be one of the latest butterflies to emerge where it was found.

Oeneis chryxus — Chryxus Arctic

Breeder

Oeneis chryxus (Figure 6) is the Carson Range's quintessentially alpine butterfly, living only at the highest, most exposed ridges of the range, where it hilltops over rocky knobs and highpoints. Due to the short summer season and harsh conditions of its habitat, *Oeneis* butterflies typically diapause twice as larva, resulting in a two-year life cycle, Most populations in the Lower 48 States are synchronized to fly only in alternate years, and in the Carson Range, this species is typically only seen as adults in odd-numbered years (e.g. 2007, 2009, etc.). In 2007, this species was observed four times around Mount Rose, Relay Peak, and Tahoe Meadows area, from 23 June to 29 July. Specimens are likewise predominately from the Mount Rose area, although there are two specimens from the vicinity of the Heavenly ski area (Monument Peak) and one record each from

Marlette and Snow Valley peaks. All *O. chryxus* from the Carson Range belong to *O. c. ivallda*. the paler of two distinctive subspecies found in the Sierra Nevada.

Limenitis lorquini Lorquin's Admiral

Breeder

This species is closely associated with willows (*Salix*), its principal larval host plant, and typically is found along watercourses and wet meadows. In 2007, this species was observed from mid-June through mid-August. In favorable years, this species may exhibit a partial second brooded in the Carson Range, as specimens have been collected in appropriate habitat to 10 September. Other potential larval host plants in the Carson Range include *Populus*, and possibly *Prunus*.

Adelpha bredowii California Sister

Possible Breeder

Females of this species are known to be highly dispersive, and this species may show up just about anywhere. However, the larval host plants for this species are live oaks, so it is only likely to breed, if at all, wherever live oaks (*Quercus chrysolepis* or *Q. chrysolepis* x *vaccinifolia*) occur. Two specimens from Memorial (aka Kennedy) Point from two different dates in 1985 are suggestive of former breeding or attempted breeding at that location. Repeat specimens from Montreal Canyon and Little Valley, far from any *Quercus*, may simply represent a pattern of vagrancy. In 2007, this species was only encountered twice, but never at a focal sampling station, and not near oaks: once in Little Valley (5/31) and once along the Genoa Peak Road (6/18). Construction of the Memorial Point Overlook in 1998-99, and more recent fuels thinning in the Incline, Tunnel Creek, and Memorial Point areas may have impacted the distribution and breeding status of this species in the Tahoe basins.

Junonia coenia Buckeye

Possible Breeder

This multivoltine species hibernates as adults, yet they are intolerant of cold weather; therefore, this species cannot survive winters typical of the study area and must recolonize annually. None was observed in 2007, yet they can be relatively common in some years during mass spring migrations from the south, or in the fall during warm spells or periods of east winds. In California, they have been known to breed at elevations as high as Castle Peak (Shapiro 2006), using a variety of plants in the Scrophulariaceae and Plantaginaceae families; thus, they may breed sporadically in the Carson Range, when conditions are ideal. Most observations, however, presumably represent non-breeding migrants. Specimens from the study area were collected at Spooner Summit, Bliss Pond, and especially Little Valley. Larval host plants in the Carson Range would likely include Scrophulariaceae (*Mimulus*).

Vanessa atalanta Red Admiral

Possible Breeder

This species was not observed in the study area in 2007, but specimens exist from Little Valley, Glenbrook, Spooner Summit, Bliss Pond, Montreal Canyon, along Kingsbury Grade, and lower in the eastern canyons of the range. It might be assumed that these few

specimens represent vagrants or migrants from lower elevations, wandering through the study area. However, the Glenbrook specimens are each from 4 June in four consecutive years (from multiple collectors!), 1969-1972, suggesting the possibility of a persistent colony at that location, at least during that time. Additionally, the specimens from Montreal Canyon (1 July 1985, and 5 July 1989), Bliss Pond (1 July 1985), and Spooner (14 June 1978), easily might have drifted upstream from Glenbrook if a population was still viable in the late 1970s to late 1980s. To the best of our knowledge, this species has not been observed on the west slope of the Carson Range since 1989. Larval hosts are nettles (Urticaceae).

Vanessa cardui — Painted Lady

Breeder

This mass-migrant overwinters in the deserts along the US-Mexico border, breeding after the winter rains generate a crop of annual hosts in the Malvaceae, Boraginaceae, and Asteraceae (especially *Cirsium*, *Carduus*, and *Silybum*) families. In years with ample rain, the resulting adults migrate north by the billions. Many of these reach the Carson Range. After winters with little rain in the desert, however, this species can be hard to find at all. The earliest northbound migrants can be found by late March, occasionally following the very crest of the mountains. As breeders, the species has the most catholic larval diet of any butterfly known in the world (Shapiro and Manolis 2007), though most Carson Range larvae will be found on the abovementioned taxa or Fabaceae (*Astragalus*, *Lupinus*). Hilltopping males can be found along the higher ridges and peaks throughout the summer. Starting in late August, a southbound migration takes place. Unlike the spring migrants, which are packed with fat reserves, the southbound butterflies need to feed and large numbers exploit the blooms of *Chrysothamnus* available along the eastern slope of the Sierra, including the Carson Range. The flight in 2007 was quite weak, and only three were observed all season. In contrast, Richardson had observed many dozens by late March in 2008.

Vanessa annabella — West Coast Lady

Breeder

Like *Vanessa cardui*, this species migrates annually, but on much smaller scales in terms of both movement and numbers. Persistence of breeding populations in the Carson Range may depend upon upslope migration from either side of the Sierra Nevada. Although many specimens exist from multiple years at the same locations, hard winters may cause considerable mortality. The specimen record is interesting in this regard, with 28 specimens from Little Valley from 1995 (multiple collectors), but only one specimen from that location the following year. In 2007, this species was recorded only once, a specimen collected on 23 July (28-6). The specimen record suggests that this species could turn up just about anywhere in the Carson Range. Specimens from the study area span from 21 May to 10 September, although in some years migrating individuals can be observed along the shores of Lake Tahoe through October (Figure 7). Larval host plants in the Carson Range likely include members of the Malvaceae and Urticaceae, and possibly others.

Vanessa virginiensis American Painted Lady

Possible Breeder

In 2007, two individuals were recorded from two locations in Little Valley (15 June and 27 July). Scattered individual specimens from the study area are all from high elevation locations (e.g. North Canyon, Marlette Lake, Tahoe Meadows, Mount Rose Summit, Heavenly Ski Area) and from 29 June to 6 August. Whether these records represent migrant breeders or wandering vagrants is uncertain, but such is the case for this species throughout Nevada. According to George Austin, there is no locality where it may be found regularly. Whether the species breeds in the Carson Range or not, it almost certainly does not overwinter. Larval host plants in the Carson Range would include Asteraceae, especially *Gnaphalium*, *Antennaria*, and *Anaphalis*.

Polygonia satyrus Satyr Anglewing

Breeder

Polygonia satyrus specimens exist from across the Carson range, including Little Valley, North Canyon Road, Spooner Summit, Bliss Pond, Hobart Reservoir, Kennedy (Memorial) Point, Glenbrook, Heavenly Ski Area, Montreal Canyon, the southwest slope of Mount Rose (approx. 2450 m elev.), and the eastern foothill canyons. Thus, this species was expected and searched for exhaustively; however, it was not recorded in 2007, possibly due to a poor year for the species' larval host plant, stinging nettle (*Urtica dioica holosericea*). It is also noteworthy that, to the best of our knowledge, the species has not been collected in the Carson Range since 1989. Despite a superficial similarity to the extremely common *P. zephyrus*, the diagnostic brown underside of this species should make it difficult to overlook. As with all *Polygonia*, adults of this species overwinter, and then reproduce in the following spring. The six Montreal Canyon specimens range from 3 May to 25 July. This species should be looked for wherever *U. dioica holoserica* are locally common or abundant, especially in moist areas at lower elevations. Incidentally, the two Glenbrook specimens are two of the earliest specimens collected in the study area, dating from 1915.

Polygonia faunus Rustic Anglewing

Possible Breeder

This is a species of cool, moist forests, few pockets of which exist in the Carson Range. This species was not observed in 2007, but three specimens from early May 1987 (3 May, Montreal Canyon; 5 May, Glenbrook; 5 May, Incline Village) suggest that breeding may occur near lake level on Tahoe side of the range. (Alternatively, a large, dispersive event may have produced an extraordinary flight of migrants into the area that week, but that is unlikely.) An additional specimen exists from the vicinity of Bliss Pond, 17 June 1986. Probable larval host plants in the Carson Range include *Salix*, and possibly aspens, *Alnus*, and *Ribes*. Unfortunately, the locality data of these specimens were insufficient to determine exactly where they had been collected. Adults of this species emerge in mid- to late summer, overwinter, and then reproduce in the following spring. It is possible that the flight of adults was over by mid-May in 2007, when fieldwork began, but efforts to locate the species in appropriate habitat in May of 2008 were likewise unsuccessful. A fourth specimen exists from near Spooner Summit, 17 June 1987. In Nevada, this species is known only from the Carson Range.

Polygonia zephyrus Zephyr Anglewing

Breeder

This species (Figure 8) is one of the most consistently common and widespread butterflies in the Carson Range; it is also one the very few that can be seen in almost any month. As with all *Polygonia*, adults hibernate. Individual *P. zephyrus* occasionally emerge in mid-winter during prolonged warm spells, and pulses of emergence can be observed from late March through April in most years. The core of the flight period, however, is May through September, with two overlapping broods (may be univoltine at the higher elevations). Some years produce a large emergence in September, and the adults enthusiastically nectar at *Chrysothamnos* blossoms as they prepare to hibernate for the winter. Feeding at flowers is somewhat unusual for the genus, yet *P. zephyrus* readily nectar on a variety of blossoms, a behavior which may sustain adults for nearly a full calendar year (Shapiro and Manolis 2007). This is one of the few true forest-dwelling species in the Carson Range, and males are territorial in sunspots, often in roads or trails. Larval host plants are members of the genus *Ribes*.

Nymphalis milberti Milbert's Tortoiseshell

Breeder

This species is a strong elevational migrant. Adults hibernate at lower elevations and breed in the spring on *Urtica dioica*, especially in riparian areas, and much of the Carson Range's summer population is presumably derived from breeding that takes place in low on the west slop of the Sierra Nevada or in California's Central Valley. Because this species has to cross the Sierra crest twice in its annual cycle, it is regularly seen among the highest peaks and ridges. In the summer adults are enthusiastic visitors of *Monardella*, and as early as March this butterfly can be found emerging from the eastern foothill canyons or migrating over snowy terrain. They are most common from late May through July; by late August almost all have migrated from the area, returning to lower elevations to hibernate. Voltinism in the Carson Range is uncertain and complicated by migration, but the tortoiseshell may be bivoltine where *U. dioica* is abundant.

Nymphalis californica California Tortoiseshell

Breeder

Populations of this species in the Carson Range vary wildly, almost entirely due to large-scale migrations from the west slope of the Sierra Nevada (Shapiro 1975b). In the spring there is a large movement to the east, north, and upslope; this pattern is reversed in the Fall, occasionally bringing large numbers through the region in late September or early October. During large flights, mortality from vehicle impacts can be quite high and conspicuous to anyone driving over the passes. Southbound and downslope migration is most conspicuous along the edge of Lake Tahoe. During the period between movements, *Nymphalis californica* may disappear briefly from the Carson Range altogether. Typically, however, a small core population maintains a presence through the summer. Adults rarely visit flowers, but will sip resources from sap, sweat, rotting fruit, and mud. Larval host plants in the Carson Range include *Ceanothus*, likely *C. velutina*.

Nymphalis antiopa Mourning Cloak

Breeder

As with the other *Nymphalis*, this species is appears to be an altitudinal migrant (Shapiro 1986, Shapiro and Manolis 2007), and hibernates as an adult. Unlike the other Nymphalis, however, adults of this species will hibernate at elevations as high as Donner Pass (2000 m). They emerge in early in spring, about the time immigrants from spring broods are arriving from downslope, and like *Polygonia zephyrus*, may be seen flying in late winter following warm periods. Adults are long-lived, and populations in the Carson Range exhibit a single, protracted flight. The larval host plants are primarily *Salix*, and possibly *Populus*, though adults may be seen ranging widely over virtually any vegetation type. Adults seldom nectar, seemingly preferring sap, rotting fruit, dung, or mud; however spring individuals nectar at *Salix* catkins, and autumn adults feed on *Chrysothamnos*.

Euphydryas chalcedona Chalcedon Checkerspot

Breeder

In the Carson Range, this is principally a butterfly of chaparral and canyon habitats, found from the lower to middle elevations on the east slope of the range. However, the species does occasionally wander higher and to the west slope of the Carson; in 2007, it was recorded along Genoa Peak Road (GPR7) at approximately 2300 m elevation, and specimens exist from Spooner Summit and Snow Valley Peak. The appearance of specimens from the Carson Range is a mix of *Euphydryas chalcedona macglashanii*, which flies from Truckee north, and *E. c. sierra*, which flies at high elevations in the western Lake Tahoe basin. Butterflies matching classic *E. c. sierra*, have been recorded from Kingsbury Summit, and should be looked for at high elevations in the southern portion of the Carson Range. The species has a single brood and was recorded in 2007 from 16 May to 5 July. Specimen records from the lower elevational limit of the study area extend to approximately 20 July. In the Carson Range, larval host plants include *Castelleja*, and possibly other Scrophulariacea; *E. c. sierra* from the western Lake Tahoe basin oviposit on *Penstemon newberryi*.

Euphydryas editha Edith's Checkerspot

Breeder

This is species is considerably more local and patchy in distribution than *Euphydryas chalcedona*. Two subspecies occur in the Carson Range, though only one is regular in the study area. *E. editha tahoensis* can be found at very high elevations on the slopes of the Mount Rose, Mount Houghton, Relay Peak, Rose Knob complex. Multiple specimens exist for "Tahoe Meadows," from the 1980s, and in 2007 it was found at the Tahoe Meadows Ridge site (IR3). Larval host plants of *E. e. tahoensis* include *Castellja nana*. Specimens exist from early June through mid-September, though a brood typically only flies for 3-4 weeks in a given location. In 2007 they were observed 23 June to 29 July. This subspecies is univoltine, and may spend two years as a larva if necessary. Scattered colonies of *E. e. monoensis* exist in the lower foothill canyons to the east (e.g. Clear Creek), and specimens of vagrants twice have been collected in the study area: Little Valley (7 May 1981), and as far afield as Glenbrook (26 July 1950). Larval host plants of *E. e. monoensis* include *Collinsia* and perhaps *Orthocarpus*.

Chlosyne palla — Northern Checkerspot

Breeder

This species occurs thinly across a broad spectrum of locations in the Carson Range. The largest and perhaps most reliable populations are at lower elevations. Females exhibit trimorphism elsewhere in the Sierra Nevada, but *Chlosyne palla* in the Carson Range are all bright orange. This species is univoltine, and 2007 records span from 16 May to 25 July, depending on elevation. *C. palla* overwinters as half-grown larvae, and likely larval host plants in the Carson Range include *Aster*, *Solidago*, *Senecio*, and *Chrysothamnus*.

Chlosyne acastus — Sagebrush Checkerspot

Vagrant

Several specimens from the Kings Canyon and Kingsbury Grade probably were taken below the elevational limit of our study area, but two specimens from Spooner Summit 4 and 27 June 1974 suggest that this species may occasionally wander upslope from the east. Due to its similar appearance to *Chlosyne palla*, it easily might be overlooked. Larval host plants at the foot of the Carson Range would include *Chyrsothamnos viscidiflorus* and possibly *C. nauseosus*.

Chlosyne hoffmanni — Hoffman's Checkerspot

Breeder

This species (Figure 9) can be found in association with Red Fir (*Abies magnifica*) forest, thus it is largely restricted to cooler, higher, and often north-facing forested locales in the Carson Range. Perhaps because these are not areas frequented by lepidopterists, there are only three prior specimens from the study area: Brown's Creek (1 August 1963), Hobart (13 July 1960), and high in North Canyon (12 July 1960). However, between 2001-2006, Richardson regularly found it nectaring on *Monardella* in aspen stands at Marlette Lake, Tunnel Creek, high in North Canyon, and along Logan House Creek, and it was present at those locations in 2007. In 2007, it was also found along the road to Relay Peak. Larval host plants likely include woodland species of *Aster*; *A. breweri* has been identified at Donner Pass (Emmel and Emmel 1962).

Phyciodes mylitta — Mylitta Crescent

Breeder

The Carson *Phyciodes* comprise a very similar-looking group of crescentspots that often co-occur in the same meadows, and are only reliably identified by examination of both dorsal and ventral wing surfaces. *P. mylitta* has a fairly distinctive dorsal surface, but its ventral surface is quite similar to that of *P. orseis*, although typically more heavily marked. The specimen record would suggest that this is the most abundant and widespread *Phyciodes* in the Carson Range, but many of the records are from below the elevational limits of our study area. In 2007, *P. mylitta* was only recorded five times, from three locations (G3, SP7, K1). Despite occurring at lower elevations, this species has a preference for slightly wetter meadows, as evidenced by the specimen record; the relatively dry conditions of 2007 may have depressed numbers considerably. Under favorable conditions, this species may produce multiple broods. Likely larval host plants in the Carson Range include *Cirsium*.

Phyciodes orseis Orseis Crescent

Breeder

The dorsal surface of this species (Figure 10) typically looks very much like that of *Phyciodes pulchellus*, but the ventral surface appears similar to that of a muted *P. mylitta*. Thus, examination of both surfaces is often necessary to be certain of identification. This species has a patchier distribution than the other two *Phyciodes*, but it seems to always co-occur with one of the other species. Indeed, it has been hypothesized that our *P. orseis herlani*, the distribution of which is a relatively small area centered around the Lake Tahoe basin, may simply represent a hybrid swarm between the other two Phyciodes (Shapiro 1996). We found them to be common in meadows and grassy clearings along the Genoa Peak Road transect and North Canyon, and in the Lower Prey Meadows-Slaughterhouse Canyon area. This species is likely univoltine in the Carson Range, and larval host plants include *Cirsium*.

Phyciodes pulchellus Field Crescent

Breeder

This was the most widely distributed *Phyciodes* in the Carson Range in 2007. Indeed, of all the locations where *Phyciodes* was recorded, Rabe Meadows (K1) was the only that did not have *P. pulchellus* (the other two species were present). This species also occurred more reliably at higher elevations than the other two species. It occurred principally at meadows, but was also found at small clearings or roadside seeps in forested areas. It was recorded in 2007 from 29 May through 12 July. Depending upon elevation and conditions, this species may produce a partial second brood.
Larval host plants in the Carson Range include various species of *Aster*.

Clossiana epithore Western Meadow Fritillary

Possible Breeder

None was observed in 2007. This species occurs in moist mountain meadows or in mixed-mesic forests, possibly in association with *Arctostaphylos nevadensis* (Emmel and Emmel 1962), and many of our focal sites and other locations we visited were seemingly appropriate and comparable to occupied habitats found in the western Tahoe basin. The dry conditions of 2007 may have contributed to our lack of observations, although the specimen record only contains three individuals constituting two records. These could easily be dismissed as vagrants, except for the fact that two of the specimens were collected together, and all three were collected within approximately 4 kilometers of one another. At this time, the true status of this species in the Carson Range remains unresolved. Larval host plants include *Viola*.

Speyeria cybele Leto Fritillary

Breeder

This is the largest and most diagnostic *Speyeria* found in the Carson Range. It is also highly sexually dimorphic. This species prefers grassy riparian meadows or open aspen stands, but seems to be always found with aspen trees nearby. It also seems to occur at very low densities, wherever it is found. In 2007 it was only found at three localities (LV6, G2, G3), but Richardson has found it in the aspens along Logan House Creek and at Marlette Lake, in previous years. Within the study area, additional locations from the

specimen record include Swifts and Montreal canyons, and the Heavenly Valley ski area. Larval host plants for all members of the *Speyeria* are *Viola*.

Speyeria mormonia Mormon Fritillary
Breeder

Speyeria egleis Great Basin/Egleis Fritllary
Breeder

These two species are extremely similar in appearance. Because *Speyeria* seldom pause to be studied, and because they can be quite difficult to net, many small fritillaries from 2007 were simply assigned to the species pair. Both species fly from mid-June through mid-September. *S. egleis* outnumbers *S. mormonia* slightly in the specimen record, but no clear pattern of distribution can be ascertained. Indeed, the two co-occur throughout most of the Carson Range. Positive identifications from 2007 were generally based on specimens or netted individuals.

Speyeria callippe Callippe Fritillary
Former Breeder

This species was not recorded in 2007, and it is doubtful that it was overlooked. It is fairly easily recognizable for a *Speyeria*, with a distinctive green sheen on the ventral side of the hind wing, and we netted a large sample of *Speyeria* whenever they were encountered. Three specimens exist from Montreal Canyon and Mount Rose Summit; presumably these are strays. The specimen record does suggest a breeding population in Glenbrook during the late 1960s and early 1970s, but the bulk of the specimen record comes from Kings Canyon, from the lower foothills all the way up to Snow Valley Peak. Most of these Kings Canyon records are from the 1960s, and to the best of our knowledge *S. callippe* has not been recorded in that area since 1981 (Snow Valley Peak, 25 July).

Speyeria atlantis Atlantis Fritillary
Vagrant

There is one specimen of this species from the Carson Range, from Montreal Canyon on 1 August 1988. The specimen is ascribable to the paler *Speyeria atlantis irene* subspecies of the central Sierra Nevada.

Speyeria zerene Zerene Fritllary
Breeder

Speyeria coronis Coronis Fritillary
Breeder

As with the *Speyeria mormonia/egleis* species pair, *S. zerene* and *S. coronis* are extremely difficult to separate in the field. Members of this species pair are larger, stronger fliers, and even less apt to allow close inspection (or be netted). Because of this, a majority of the medium-sized fritillaries observed during counts were simply identified to this species pair. Both species are equally represented in the specimen record, and they appear to co-occur throughout the Carson Range. However, *S. coronis* begins and ends its flight period a few weeks earlier; *S. coronis* flies from mid-May through August,

and *S. zerene* flies from early June through late September. Positive identifications from 2007 were generally based on specimens or netted individuals.

Euptoieta claudia — Variegated Fritillary

Rare vagrant

This species was not observed in 2007. Regionally, this species typically is restricted to the very southern tip of Nevada and southeastern California, yet occasional dispersal events take this species far north of their usual range (Shapiro et al. 1990). Only one record exists for the Carson Range, a specimen labeled simply from "Spooner," 26 July 1981.

Lycaenidae

Lycaenidae is a species-rich family, and new species still are being discovered. Locally, *Agriades cassiope* was described from the Lake Tahoe basin in 1998 (Emmel and Emmel 1998). Many of the world's threatened butterflies are lycaenids, due in part to their typically sedentary nature, which ultimately results in highly-localized populations and specialization on larval host plants. Discreet populations and specialization on host plants result in ecotypes or host-races that can ultimately diverge into full species. The Lycaenidae, thus, contain many of the most difficult taxonomic issues in western North America. Lycaenids are mostly small with frail-looking wings and dainty bodies and legs. Many species have tails and eyespots at the angle of the hindwing, giving the appearance of a head on both end, presumably to confuse predators. Most lycaenids associate with ants (Formicidae) as larvae, and a few have evolved complex relationships: mutualistic, parasitic, or even predatory.

Habrodais grunus — Golden Hairstreak

Breeder

See Figure 11. The larval host plants of this unique species are *Quercus chrysolepis* or *Q. chrysolepis* x *vaccinifolia* (though not known from pure *Q. vaccinifolia*), and they are thus restricted to wherever these oaks occur. There are reports of it possibly breeding on Chinquapin (*Chrysolepis*) as well, though this is unconfirmed for the Carson Range. While not found at any focal sites in 2007, it was reliably found among the *Quercus* at Stateline and Memorial (aka Kennedy) points, and along the Tunnel Creek road (28-1). These and a few other locations along the shoreline of lake Tahoe, plus a few specimens from along Kingsbury Grade (below the elevational limit of our study area) and a single specimen from Spooner-Kings Canyon Road (elevation not specified), represent the only known localities for this species in Nevada. The area around Memorial Point supports the largest and best-known population in the state, though much of the area was highly disturbed in 1998-99 by construction of restrooms, trails, and an associated parking lot. More recently, fuels thinning in oak chaparral, particularly in the Incline, Tunnel Creek, and Memorial Point areas, may have serious impacts on the distribution and continued persistence of this species in the Lake Tahoe basin and Nevada. On the west slope of the Sierra Nevada, *Habrodais grunus* emerges in late spring to early summer, but then estivates until autumn to breed. It is unlikely that if *H. grunus* estivates in the Carson Range, where it flies from mid-July through August (one specimen is from 10 September).

Satyrium californicum California Hairstreak

Breeder

This species was found on dry hillsides in canyons, where it was typically found nectaring from white or pinkish flowers (e.g. *Melilotis alba*, *Apocynum androsaemifolium*, Figure 12). This species has one brood; in 2007, observations were from 6-26 July, though specimen records for the study area extend from 1 July through 23 August. Known larval host plants for this subspecies in Nevada are *Ceanothus velutinus* and *Purshia tridentata*, and may also include *Quercus vaccinifolia*.

Satyrium sylvinum Woodland Hairstreak

Breeder

All prior specimen records are from the eastern foothill canyons below the elevational limit of our study area. In 2007, however, we found healthy breeding populations from a broad spectrum of locales below 1950 m elevation: Little Valley and along its approaching road, lower Slaughterhouse Canyon, and Village Green/Third Creek in Incline. This species closely resembles *Satyrium californicum* (cf. Figs. 12,13), but is usually separable by habitat, as *S. sylvinum* is closely associated with willows, and is typically found in riparian contexts or wet meadows. Also, *S. sylvinum* tends to emerge slightly later than *S. californicum*. In 2007, observations were made 12 July through 15 August. The two were found together, however, along the southwest flank of Snow Valley Peak in late July. This *S. sylvinum* specimen is notable in that it was from a location that is more than 650 meters higher than any other *S. sylvinum* observations, and may represent a stray or pioneering on the front of upslope range expansion. This species is univoltine, and overwinters as eggs. In Nevada, the subspecies *S. s. sylvinum* is restricted to the Carson Range.

Satyrium saepium Hedge-row Hairstreak

Breeder

In 2007, the single brood of *Satyrium saepium* was recorded from mid-July to mid-August, but specimens extend to mid-September. This species was recorded from a wide range of locations, but always in the immediate vicinity of chaparral (Figure 14) or open forest with *Ceanothus* in the understory. Adults were frequently seen nectaring from *Apocynum* or *Melilotus*. Larval host plants in the Carson Range include *Ceanothus velutinus* and possibly other *Ceanothus*.

Satyrium behrii Behr's Hairstreak

Breeder

In 2007, this was the most prevalent *Satyrium* in the Carson Range. Amazingly, no prior specimens exist from the study area, though there are a few from below 1800 m to the east. It occurred from a wide range of locations, but always in, adjacent to, or near chaparral or open forest with a shrubby understory, and below 2400 m. *S. behrii* is univoltine and overwinters as eggs. Adults frequently nectar at *Apocynum*, *Eriogonum*, and *Melilotus*. Larval host plants in the Carson Range include *Purshia tridentata* and possibly *Cercocarpus ledifolia*. Amazingly, no prior specimens exist from the study area, though there are a few from below 1800 m to the east.

Satyrium fuliginosum Sooty Hairstreak

Breeder

This is a species of the high sagebrush community found at the highest elevations of the Carson Range. In 2007, it was recorded from 5 July to 9 August (specimens exist from 30 June to 12 August), from Genoa (GPR9), South Camp (GPR11), and Snow Valley peaks (SP6), and the Mount Rose/Houghton/Relay Peak area (IR3, IR12). Interestingly, a few were recorded near, but below, appropriate ridgeline habitat (SP4, GPR3). Larval host plants include *Lupinus* (Figure 15). The species is univoltine and overwinters as eggs.

Incisalia eryphon Western Pine Elfin

Breeder

This species is one of very few "forest butterflies" found in the Carson Range, and it can be found in small edges and openings of pine forests and pine woodlands throughout the range. This elfin appears slightly little later than *Incisalia augustinus*, and may be found through the month of July in some years. In 2007, records are from 16 May to 15 June. The species is univoltine and overwinters as pupae. Larval host plants in the Carson Range include *Pinus jeffreyi, P. lambertina, P. ponderosa*, and *P. washoensis*.

Incisalia augustinus Western Brown Elfin

Breeder

This species can be commonly encountered in shrubby forest clearings and chaparral, and was one of the earliest species to emerge in 2007; almost all observations were in May, with one from early July. The specimen record contains individuals through mid-July. In the Carson Range, larval host plants of *Incisalia augustinus* are known to include *Arctostaphylos*, and may also include *Ceanothus*, especially *C. velutinus*. *I. augustinus* diapause as pupae.

Callophrys lemberti Lembert's Hairstreak

Breeder

This species is only found in the highest alpine communities, rocky slopes in the upper sagebrush zone (SP4, SP6, GPR9). The single brood was recorded from 25 May to 8 July, though most had disappeared by mid-June. This is quite early for the elevations where this species is found. There is only one prior specimen from the Carson Range, perhaps due to its early flight period, or possibly due to recent colonization. This specimen is from Mount Rose, 24 June 2002. *Callophrys lemberti* overwinters as pupae. Larval host plants in the Carson likely include *Eriogonum umbellatum*.

Loranthomitoura spinetorum Thicket Hairstreak

Possible Breeder

This species was not observed in 2007, despite much effort searching in appropriate habitat, conifers infested with dwarf mistletoe (Loranthaceae). These mistletoes comprise the species' larval host plant. There are a few specimens from foothill canyons along the lower elevational limit of our study area (e.g. Kings and Clear Creek canyons)

and many specimens from below 1800 m along Kingsbury Grade. Additionally, there are two specimens from the Memorial (Kennedy) Point/Sand Harbor area (9 June 1941 and 28 June 1985), suggesting that a breeding population may have occurred there. Males perch in the tops of trees for most of the day, awaiting females. Females are known to take nectar at *Prunus andersonii*, a species now considered extirpated in the Tahoe basin (Graf 1999), but still occurring at lower elevations on the east slope of the Carson Range; but females likewise spend the majority of their time in the treetops. It is easy to imagine how a small, drab butterfly sequestered in the canopy might be overlooked.

Strymon melinus — Gray Hairstreak

Vagrant

This species is catholic in its plant use, known to nectar from a vast array of flower types and utilizing plants in more than twenty different families as larval hosts. Despite this versatility, and a range that spans much of United States and the Neotropics, it is not particularly common in northern Nevada. It was not recorded in 2007, and there are only four specimens from the study area. One is from the vicinity of Bliss Pond (27 June 1988); one is from near Mount Rose Summit (10 July 1990); two are from Little Valley (21 July and 8 September, 1995).

Lycaena cuprea — Lustrous Copper

Breeder

Univoltine. Lower elevation populations are found in the foothill canyons below our study area (e.g. Clear Creek Canyon). Within the study area, *Lycaena cuprea* has been found at higher elevation meadows, such as Tahoe Meadows, but most specimens come from a population in Little Valley. In 2007, only one was recorded in the study area, from 29 July (IR3). That this Little Valley population was not found in 2007, may reflect the dry conditions that year, or may by symptomatic of the increasingly hostile conditions of that meadow due to lodgepole pine (*Pinus contorta*) encroachment and the general drying of the Sierra Nevada (Dettiner and Cayan 1995, Cayan et al. 2001). Larval host plants include *Rumex.*

Lycaena nivalis — Lilac-bordered Copper

Breeder

This species was found at more focal sites than any other *Lycaena* (16 of 26). As this species is restricted to riparian areas and wet meadows, this simply may reflect a bias in our sampling towards those vegetation associations. The species is univoltine, and in 2007, the species was recorded from 18 June to 14 August; specimens exist from 11 June to 1 September. In the Carson Range, larval host plants for *L. nivalis* include *Polygonum.*

Lycaena helloides — Purplish Copper

Breeder

This species closely resembles *Lycaena nivalis*, and worn individuals may be difficult to separate, as both species occupy similar habitats, montane meadows. *L. helloides* seems slightly more tolerant of drier meadows, and exploits a wider range of host plants, but the two species were found flying together at five focal sites, and co-occur at many additional locations throughout the range. *L. helloides* appears to have two broods in the

Carson Range, and was recorded in 2007 from 29 May to 16 August. Specimens from the study area show that flight can occur into the first week of September. While specimens of this species are entirely from Little Valley, we found this species to be widespread on the west slope of the Carson Range. Of the *Lycaena*, *L. helloides* and *L. editha* were only surpassed in focal site occurrence by *L. nivalis*. In the Carson Range, larval host plants for *L. helloides* include *Rumex*, *Polygonum*, and probably *Potentilla.*

Lycaena gorgon Gorgon Copper

Presumed Breeder

This species was not observed in 2007, and only one record is known for Nevada. In 2004, George Austin took a few specimens along the state line above Stateline Point. The species is more typical of foothill canyons of the west slope of the Sierra Nevada, where it inhabits rocky sites, open woodland, or chaparral, and rarely strays to higher elevations. Larval host plants include *Eriogonum* spp., which serve as nectar sources for adults as well.

Lycaena heteronea Blue Copper

Breeder

This large copper resembles several of the larger species of Blues (Figure 16). In 2007, it almost entirely restricted to the highest flanks of Snow Valley Peak (SP3, SP4, SP6). Richardson visited these sites 9 August 2006 while scouting potential study sites, and found *Lycaena heteronea* to be considerably more abundant than in 2007. Richardson also collected this species as Tunnel Creek (28-2) in 2006. In 2007, individuals were recorded at the bottom of North Canyon (SP1), as well, representing a low-elevation record for the study area. One individual was seen along Genoa Peak Road (GPR7), and a specimen exists from Montreal Canyon (27 June 1988). Larval host plants in the Carson Range include *Eriogonum umbellatum* (breeds on *E. nudum* in the Donner Pass area, Emmel and Emmel 1962), and *L. heteronea* is univoltine.

Lycaena rubida Ruddy Copper

Breeder

In the Carson, *Lycaena rubida* is typically found in wet meadows, especially those bordering streams. In 2007, all observations of this species occurred in the greater Mount Rose/Tahoe Meadows area. Records spanned 12 July to 18 August. The few specimens exist are from August from the same area, with the exception of a Little Valley record from September 1 1995. In the Carson Range, larval host plants for this univoltine copper include *Rumex* and possibly *Polygonum*.

Lycaena editha Edith's Copper

Breeder

In the Carson Range, *Lycaena editha* (Figure 17) is found locally throughout the range, in meadows, typically wet, but some weedy, drier locations as well. In 2007, this species was recorded from 8 July to 16 August. Specimens from the study area span 26 June to 1 September. Larval host plants for this univoltine copper likely include *Polygonum* and especially *Rumex*.

Lycaena arota Tailed Copper

Possible Breeder

This species was not encountered in 2007, and there are few specimens from the study area. The specimen record contains two from Mount Rose Summit (21 July, 2 August), one from Third Creek (26 June), and several from the lower foothill canyons, below the elevation limit of our study area. Despite the paucity of specimens, the Carson Range contains much seemingly appropriate habitat for this species, and an abundance of larval host plants (*Ribes*); *Ribes montigenum* has been identified in the Donner Pass area (Emmel and Emmel 1962).

Brephidium exile Western Pygmy Blue

Vagrant

This is the smallest butterfly in North America, and from its year-round breeding range to the south, it undergoes massive, annual colonization migrations to alkali deserts in the Great Basin. As a result of these movements, it occasionally turns up as a vagrant on the East slope and in the high country of the Sierra. This species was not encountered in 2007, and there is but one specimen known, from Mt. Rose 18 July 1993. Additionally, Murphy observed it in October 2008 at a disturbed area of sage at 1800 meters above extreme southwest Reno.

Everes amyntula Western Tailed Blue

Breeder

This species was only recorded from three locations in 2007 (28-0, LV3, SP6), and was only reliably found at Snow Valley Peak (SP6). This population belongs to a distinctive ecotype that occurs above treeline and breeds on *Astragalus whitneyi*, which is common at that location. Specimens exist from many areas where the species was not detected in 2007; although, because *Everes amyntula* populations can be quite localized, and locality data from specimens vague, it is possible that we did not sample the exact localities of the specimens. Records from 2007 span from 29 May to 14 June, though specimens from the study area extend from early May through July, but it is likely single-brooded at any one location. Below treeline, larval host plants likely include *Vicia*, and larvae of both ecotypes diapause within the seedpods of their host plants.

Celastrina ladon Spring Azure

Breeder

This species, as its name implies, is among the earliest of butterflies to emerge at any given location, and it may be found virtually anywhere in the Carson Range. In 2007 this species was recorded consistently from mid-May to mid-June. Two additional individuals were recorded from 6 and 23 July. The 23 individual was large, bright, and fresh and represents a partial second brood. The specimen record for the study area suggest that partial second broods may be common, with scattered specimens through July. Larval host plants for the Carson likely include *Ceanothus*, and possibly *Quercus*.

Glaucopsyche lygdamus Silvery Blue

Breeder

In 2007, this species was recorded from a few scattered locations on the west slope of the range. Numerous specimens also exist from the east slope, including the lower foothill canyons, and elsewhere in the range where it was not detected in 2007. This species often appeared just prior to the emergence of the similar *Icariodes icariodes*, though the two co-occurred in several locations. Dates from 2007 spanned 25 May to 25 July. There is one brood, and larval host plants in the Carson Range likely include perennial *Lupinus*.

Glaucopsyche piasus Arrowhead Blue

Breeder

This is a very localized species, apparently restriced in the Carson Range to mesic forest clearings. This species was found breeding (Figure 18) from two locations in 2007, along the Genoa Peak Road (GPR8), and in a meadow near the top of Tunnel Creek (28-0), but never at a focal sampling station. Additionally, it is worth noting that these observations occurred during a very narrow window of time (13-18 June), perhaps related to the dry conditions in 2007. Additional specimens are known from Montreal Canyon, Glenbrook (collected annually from 1969-1972), Spooner Summit, Hobart Reservoir, and at approximately 2070 m along Osterman Grade. Larval host plants include perennial *Lupinus*.

Euphilotes battoides Square-spotted Blue

Breeder

In 2007, this species was only collected from three locations (28-2, SP3, SP6), 13 June through 8 July; specimens from the study area extend to 1 August. Most of the specimens are from the lower elevation canyons, though these populations appear to reach well into the study area. Scattered specimens come from diverse locations throughout the Carson Range, however, up to the highest peaks, and the 2007 specimens are from approximately 2150 and 2700 m elevation, respectively. The species is strictly associated with *Eriogonum umbellatum*, its sole larval host plant and principal nectar source. See *Euphilotes ancilla*, below.

Euphilotes enoptes Dotted Blue

Breeder

This species is very similar in appearance to *Euphilotes battoides*. The two are best separated by determination of which *Eriogonum* species the butterflies are using. *Euphilotes enoptes* exploit, and are seldom seen more than a few meters away from, *Eriogonum nudum*. Specimens of *Euphilotes enoptes* are perhaps more widely distributed at middle and high elevations than *E. battoides*, though equally colonial and circumscribed. The specimen record suggests that the single brood has a protracted flight period, with dates ranging from mid-May through mid-September. None was observed in 2007.

Euphilotes ancilla Rocky Mountain Dotted Blue

Vagrant

There is just one specimen from the study area, from Mount Rose, 15 July 1976. A few specimens exist from Kingsbury grade, but elevations are not given. In the Carson Range, this species is not reliably separated from *Euphilotes battoides glaucon* without dissection of genitalia, as both use *Eriogonum umbellatum* and overlap in flight period. In 2007, individuals from this species-pair were assumed to be *Euphilotes battoides*, the expected species.

Agriades podarce Arctic/Gray Blue

Breeder

This species is highly localized, only occurring along streamsides and wet meadows where its host plant, *Dodecatheon*, grows among sedges. Such habitats were found at the top of North Canyon (SP2, SP7) and Tunnel Creek (28-0), and in the Tahoe Meadows area (IR1,IR2, IR7, IR11). The species was quite common where found. In 2007 the single brood spanned from 14 June to 14 August, consistent with the specimen record.

Lycaeides idas Northern Blue

Breeder

In 2007, this species (Figure 19) was recorded from a number of locations along the Genoa Peak Road (GPR3, GPR4, GPR5) and LTNSP (SP3, SP6, SP7) transects, a narrow elevational belt (approximately 2250-2650 m). The species is unvoltine, and 2007 records were from 6 July to 16 August. In the Carson Range, likely larval host plants include *Lupinus*, *Lotus*, or possibly other Fabaceae.

Lycaeides melissa Melissa Blue

Breeder

Regionally, this species is restricted to east of the Sierra crest. This species was recorded only once in 2007, from high in Ash Canyon (SP4) on 26 July, nectaring from *Monardella odoratissima*. Specimens from the study area come from relatively high elevations: Marlette Lake, Snow Valley Peak, and the Mount Rose-Tahoe Meadows area. Larval host plants from the Carson Range include *Lupinus* or *Astragalus*.

Plebejus saepiolus Greenish Blue

Breeder

Plebejus saepiolus was the most widespread and common lycaenid in 2007, recorded at 16 focal sites (Figure 4). The species was often abundant in moist meadows, and occurred from the full range of elevation that was sampled. Records from 2007 spanned from 25 May to 26 July. Specimens from the study area extend this flight to 16 September, though there is only one brood at any given location. Larval host plants for *P. saepiolus* include native *Trifolium*; the species was observed ovipositing on *T. monanthum* var. *monanthum*, at Ash Canyon (SP5) on 14 June 2007.

Icaricia icariodes Boisduval's Blue

Breeder

This large and variably marked blue was recorded from throughout the middle and higher elevations in the central portion of the range. In the northern portion of the study area, it was only recorded once, high on Mount Houghton (21 July). Many specimens, however, come from the Mount Rose area, and there are specimens from the cool foothill canyons at lower elevations to the east, as well. In 2007, this species was recorded from 4 June to 26 July; scattered specimens from the study area extend to 27 August (Kingsbury Summit). *Icaricia icarioides* is univoltine, and larval hosplants in the Carson Range may include a variety of perennial *Lupinus*. At Genoa Peak (GPR9), this species was observed ovipositing on *Lupinus argenteus* on 18 June 2007.

Icaricia shasta Shasta Blue

Breeder

This small, high-elevation blue was recorded from high, open habitats in the northern portion of the study area (IR4, IR12, IR13, SP6). This is consistent with the specimen record; a single specimen also exists from the Heavenly Ski area (28 June 1985). In 2007, records spanned 16 June to 26 July, though specimens extend this flight period to 16 September, likely in years where spring and snowmelt arrive later in the summer. In the Carson Range, larval host plants likely include *Astragalus whitneyii*, alpine *Trifolium*, or *Lupinus*.

Icaricia acmon Acmon Blue

Breeder

This species and *Icaricia lupini* are very similar in appearance, and often impossible to identify positively without handling. At focal sites, every attempt was made to determine specific identification. However, a few individuals recorded at auxillary sites were assigned to the species pair. *I. acmon* was recorded only once during 2007, a specimen from the Diamond Peak Chaparral site (IR5), 16 June. This typically is a species of roadsides and bare soils, and is known to employ a wide variety of larval host plants, including *Eriogonum* or various Fabaceae (*Lotus, Astragalus, Trifolium*). Many of the fabaceous host plants are ephemeral, which disallow multivoltinism in any one location. This, in turn, can lead to within-year metapopulation dynamics at the lower elevations, as subsequent broods disperse to find alternate host plants (Shapiro and Manolis 2007). Specimens come from a variety of locations throughout the Carson Range, including the lower foothill canyons, Little Valley, Glenbrook, and Montreal and North canyons. Specimen dates from the study area span 29 May to 8 September. The species overwinters as larvae, which, when active, are tended by ants.

Icaricia lupini Lupine Blue

Breeder

In 2007, *Icaricia lupini* was recorded from a diverse range of locations, mostly through the central portion of the Carson Range; a single individual was recorded from the Tahoe Meadows Ridge site (IR3), 12 July. This distribution is consistent with the specimen record. Within the study area, specimens come from Glenbrook, North Canyon, Snow Valley Peak, Marlette Lake, and Little Valley. Dates from 2007 span 13 June o 25 July;

specimens span 4 June to 28 July. Despite the name, this species always oviposits on *Eriogonum*; it is also obligately univoltine.

Hesperiidae

The hesperiids comprise a large family of mostly small butterflies with a decidedly different look from the other butterflies. They have large heads, squat bodies, and hooked clubs at the end of their antennae. They also fly in a manner reminiscent of moths, hence the name "skippers." Many species closely resemble one another in our area, and they often hold their wings in a position that makes it difficult for diagnostic patterns to be viewed. In-hand examination or specimen collection is often necessary to be certain of identification, and we netted or collected skippers extensively during the 2007 season.

Hesperia juba — Yuba Skipper

Breeder

This was the most widely distributed skipper recorded in 2007, recorded at 12 focal sites. Voltinism and diapause have been debated for this species (Shapiro 1979). In 2007, seemingly fresh adults were found in the early spring (12 May – 4 June, depending on elevation), and then again late in the season, starting in mid-August (specimens exist through September). None was observed in-between those dates, though many specimens exist through June and into early July, typically from moist places (especially Glenbrook). This bimodal pattern has led some to believe that there are two broods, but the species appears to emerge late in the season as adults, just as *Chrysothamnos* are coming into bloom. The adults nectar heavily before hibernating until the following spring (Shapiro 1979). Adults in spring commonly nectar on dandelions (*Taraxacum officinale*); larval host plants include perennial bunchgrasses.

Hesperia comma — Comma Skipper

Presumed Breeder

This species is quite similar in appearance to *Hesperia juba* and several other skippers. Surprisingly, it was not recorded in 2007, despite extensive collection or in-hand examination of related skippers wherever and whenever members of this difficult group were encountered. This lack of records may have been due to the dry conditions of the 2007 season, but it is perhaps more likely that it was simply overlooked. A number of specimens from the study area exist, spanning from mid-June through late August, and covering a broad array of locations and elevations (including several from Mt. Rose Summit). Likely larval host plants for *H. comma* in the Carson Range include needlegrasses (*Stipa*) and other Poaceae.

Hesperia nevada — Nevada Skipper

Breeder

This species was only encountered in the highest alpine contexts (GPR9, IR12, SP6), and was recorded 14 June to 21 July (a few specimens exist to 8 August). The species is univoltine, and larval host plants in the Carson Range likely include *Stipa occidentalis*, and possibly *Sitanion hystrix*.

Polites sabuleti Sandhill Skipper

Breeder

The subspecies found in the Carson Range, *Polites sabuleti tecumseh* (Figure 20), may be a genetically distinct species, and was the smallest skipper recorded in 2007. It was only recorded in the greater Mount Rose/Tahoe Meadows area, although specimens exist from mid- to high elevation places throughout the range (Glenbrook, Spooner Summit, Kingsbury Summit, Marlette, Hobart, North Canyon, East Peak, Big Meadows), and was found at lake level at South Lake Tahoe (Upper Truckee River Marsh) in 2007. Larval host plants in the Carson Range likely include a variety of grasses, depending upon location, and they are known to exploit Bermuda grass (*Cynodon dactylon*).

Polites sonora Sonora Skipper

Breeder

Polites sonora was found widely in moist meadows throughout the Carson Range in 2007, with records from 31 May to 16 August, depending upon elevation. A handful of specimens extend the flight period in the study area to 8 September. Despite the protracted flight period, the species is believed to be univoltine, and larval host plants in the Carson include various grasses.

Atalopedes campestris Sachem

Presumed Vagrant

This species can be common and widespread in urban and suburban associations with horticultural plantings at lower elevations to the west, and recent expansion has founded populations in Sierra Valley, Verdi, and Carson Valley. It has been expected that this range expansion may soon include the populated areas of the Carson Range. Late season migrants and vagrants are expected to occur with increasing frequency. To date, however, the only record for the Carson Range is an old specimen from Glenbrook, 19 June 1931.

Ochlodes sylvanoides Woodland Skipper

Breeder

This was one of the smaller skippers recorded in the Carson Range in 2007, and it occurred from a variety of locations and habitats. It was typically found at moist locations, either wet, grassy meadows or moist, shady clearings and seeps in forest. Notable to Richardson was that this species was not detected at a seep along Genoa Peak Road (GPR10), where it had been quite common in August 2006. *Ochlodes sylvanoides* flies late in the summer, with 2007 records spanning 23 July to 15 August (specimens span through August). Larval host plants in the Carson Range include perennial grasses.

Euphyes vestris Dun Skipper

Presumed Vagrant

This inconspicuous, nondescript denizen of sedge wetlands was not found during 2007 sampling. Within the study area, one specimen exists for Brown's Creek, along the Mt. Rose Highway (12 July 1963). A few specimens also exist from the lower foothill areas of the range, from the Verdi area and from Davis Creek Park. Vagrants may occasionally

be found elsewhere in the sampling area, but this species is likely a very rare stray to the Carson Range.

Thorybes mexicana Mexican Cloudywing

Breeder

This species (Figure 21) was commonly found along roadside ditches and low spots in meadows, from a broad range of locations. Where it was found, this species emerged early, with one protracted flight. At a few locations along Genoa Peak road, *Thorybes mexicana* appeared to have a staggered emergence, being abundant one visit, nearly absent the next, and then relatively common again. In 2007, it was recorded from 25 May through 8 July, but specimens from moisture years extend to 19 August. Larval host plants in the Carson likely include *Trifolium* and *Vicia*.

Erynnis icleus Dreamy Duskywing

Vagrant

This species was recorded once in 2007, on 18 June, from along the Genoa Peak Road (GPR8), but never at a focal sampling station. The specimen record contains one from Spooner Summit (4 June 1974) and several from the lower foothill canyons, below the elevation limit of our study area. Records above 1800 m presumably represent upslope strays from lower on the east slope.

Erynnis propertius Propertius Duskywing

Breeder

This is the largest skipper in the Carson Range, and occurs thinly distributed at lower and middle elevations wherever oaks occur. Strays are occasionally found higher in the range. In 2007, we recorded this species from 31 May through 7 July, and specimens exist from the study area through 20 July. This species is obligately univoltine, and larval host plants in the Carson Range likely include *Quercus chrysolepis*, *Q. vaccinifolia*, and hybrids between the two.

Erynnis pacuvius Pacuvius Duskywing

Breeder

This species was recorded with certainty only once in 2007, in a meadow near the top of Tunnel Creek (28-0), but never at a focal sampling station. It is possible that this species was overlooked during 2007, and due to the difficulty of separating it from *Erynnis persius*, many observations made during focal counts were only identifiable to the species pair: *E. pacuvius/persius*. Specimens were collected whenever this species pair was found, but all specimens but the one were identifiable to *E. persius*. This species is obligately univoltine, and larval host plants include various species of *Ceanothus*, common throughout the Carson Range. However, the species is an avid visitor to mudpuddles, and within the study area specimens of *E. pacuvius* exist from a wide array of mesic locales: Montreal and North canyons, Heavenly Ski Area, "Mount Rose," Spooner Summit, Sky Tavern, and especially Glenbrook. It is quite possible that the dry conditions of 2007 failed to draw *E. pacuvius* out of the chaparral.

Erynnis persius Persius Duskywing

Breeder

In 2007, we found this species to far outnumber *Erynnis pacuvius*. The historical specimen record, however, suggests a more even split. As mentioned above, many observations made during focal counts were only identifiable to the species pair: *E. pacuvius/persius*. Larval host plants are Fabaceae, especially *Lotus*. At lower elevations, this species can have multiple broods. In 2007, the species was recorded from 25 May-8 July, but specimens from the study have been collected through July. It is doubtful that multiple broods could fly in the Carson Range within such a short period.

Pyrgus ruralis Two-banded Skipper

Breeder

This is one of the earliest emerging butterflies in the Carson, often only 2-4 weeks after snowmelt. In 2007, this species was first observed 12 May, and the last recorded was 16 June. Its larval host plants are members of the genus *Horkelia*, in the Carson Range most likely *H. fusca* (and possibly closely related *Potentilla*). *Pyrgus ruralis* can be found wherever that upper montane perennial occurs, particularly at forest-meadow ecotones.

Pyrgus communis Common Checkered Skipper

Breeder

In 2007, this species (Figure 22) was only recorded from Tahoe Meadows (IR2) and Rabe Meadows (K1). Additional specimens exist from Little Valley, Hobart Reservoir, Montreal and North Canyon, as well as the foothill canyons below the elevational limit of our study area. This species flies much later than *Pyrgus ruralis*, with the earliest observation on 13 June. In 2007, the latest observations were from 9 July, though specimens for the study area have been collected through 18 August. The larval host plant of *P. communis* in the Carson Range is *Sidalcea glaucescens*, though introduced weeds in the Malvaceae may also be used.

Philosora catullus Common Sootywing

Vagrant

Several specimens exist from just below the elevational limit of our study area, but one specimen has been collected at Little Valley (3 July 1995). Typically a low-elevation species, it has wandered upwards in elevation elsewhere in the Sierra. For example, there is a single record from Donner Pass, late July 1974 (Shapiro 2006). None was observed in 2007, however, and it is likely a very a rare vagrant to the study area.

Hypothetical

The following species were not found in the study area in 2007, and their occurrence within the Carson Range, above 1800 m elevation, should be considered hypothetical for various reasons.

Colias alexandra Queen Alexandra's Sulphur

There are no records for the Carson Range, although this species has been found in sagebrush steppe immediately to the east and below the study area. *Colias alexandra* has strayed to Donner Pass, and occasional vagrants to the Carson Range might be expected.

Cercyonis pegala Common Wood-Nymph

There is a single specimen with locality data that are precise enough to determine its location as immediately adjacent (below) our study area: from approximately 1730 m along Kingsbury Grade, 1 September 1963. Two additional specimens from Kingsbury Grade exist from August, 1993. These specimens are ascribable to *Cercyonis pegala carsonensis*, which is restricted to the Carson Valley, and probably came from Scossa Ranch just two miles south of the intersection of that road and the road to Genoa.

Apodemia mormo Mormon Metalmark

This species was not observed in 2007. A single brood flies in late summer and fall. Larval host plants include *Eriogonum*. In the Carson Range, this species is known from scattered and localized populations lower in elevation than our study area (e.g. lower Daggett Creek, Davis Creek Park), but individuals may wander upslope into the study area. The type specimen for *Apodemia mormo mormo* comes from Davis Creek Park, just below the study area.

Satyrium tetra Mountain Mahogany Hairstreak

This species was not observed in 2007, although a great deal of effort was expended searching for appropriate habitat (areas of abundant mountain mahogany, *Cercocarpus ledifolius*). About ten specimens exist from the lower elevation canyons and the foot of the range to the east. Several specimens are from locations between 1700-1800 meters, and thus it is probable that individuals from these populations occasionally wander above 1800m. A single specimen from 3 August 1977 was simply labeled "Carson Range, rd. to Big Meadows." The Big Meadows area on the northwest flanks of Mount Rose is accessible by several roads, but the principal conduit is Garson Road. Most of this road is above 1800 m, and some of the Carson Range's largest areas of mountain mahogany can be found on Mount Rose's northern flanks at middle elevations. However, the Garson Road drops all the way to Hirschdale, CA to the west (approx. 1600 m, and well west of the state line) and Boomtown/Verdi, NV to the east (approx. 1525 m), and it is impossible to know exactly where this specimen was collected. Areas of abundant mountain mahogany are rare in the study area, and are patchily distributed in rocky areas, often at or near tree-line (e.g. east ridge of Genoa Peak). A few small pockets can also be found along the southern half of Nevada's Lake Tahoe shoreline. Along the eastern foot of the range, adults are known to nectar at *Melilotus* and *Apocynum*.

Callophrys perplexa Bramble Hairstreak

Specimens exist from the base of the Carson Range at Kingsbury Grade and Verdi. None has been seen since 1963, despite more recent attempts to relocate a Kingsbury Grade population. While these localities fall below the elevational limits of our study area, they represent the only known locations for this species in Nevada. If future monitoring

efforts expand the area of coverage, the species should be looked for at low elevations in late spring (April-May).

Mitoura nelsoni Nelson's Hairstreak

Specimens exist from the foothill canyons along the lower elevational limit of our study area (e.g. Kings and Clear Creek canyons, Kingsbury Grade); no specimens are known from above 1800 m, and the species was not recorded in the study area during 2007. However, the larval host plant of *Mitoura nelsoni* is Incense Cedar (*Calocedrus decurrens*), which occurs in pockets, containing up to 200 trees, throughout the Carson Range (but does not occur in Nevada away from the Carson Range and Peavine Peak, Charlet 1996). These vegetation types were surveyed extensively in hopes of finding this species, but isolated populations of *M. nelsoni* may yet be found within the study area.

Chlosyne whitneyi Whitney's/Rockslide Checkerspot

There is a single specimen from Clear Creek Canyon, 1 June 1992. Elevation was not specified, but this is a low foothill canyon to the east of the study area, where the very similar *Chlosyne acastus* might be expected. *C. whitneyi*, on the other hand, is a species of the central high Sierra Nevada mountains, associated with high elevation rockslides and scree slopes. We find the identification of this specimen questionable, although it is possible that *C. whitneyi* might ultimately be found on the highest summits of the Carson Range.

Euphilotes pallescens Pallid Dotted Blue

This is a species of desert flats and dunes in the Great Basin, and is highly unexpected from the Carson Range. Nonetheless, there is supposedly one specimen from the study area, from the vicinity of Bliss Pond, 17 July 1969.

Figure 5. Copulating *Anthocaris stella*, Genoa Peak Road (GPR7) 20 June 2007.

Figure 6. *Oeneis chryxus ivallda*, tattered but well camouflaged in its alpine environment, Relay Peak (IR11), 23 June 2007.

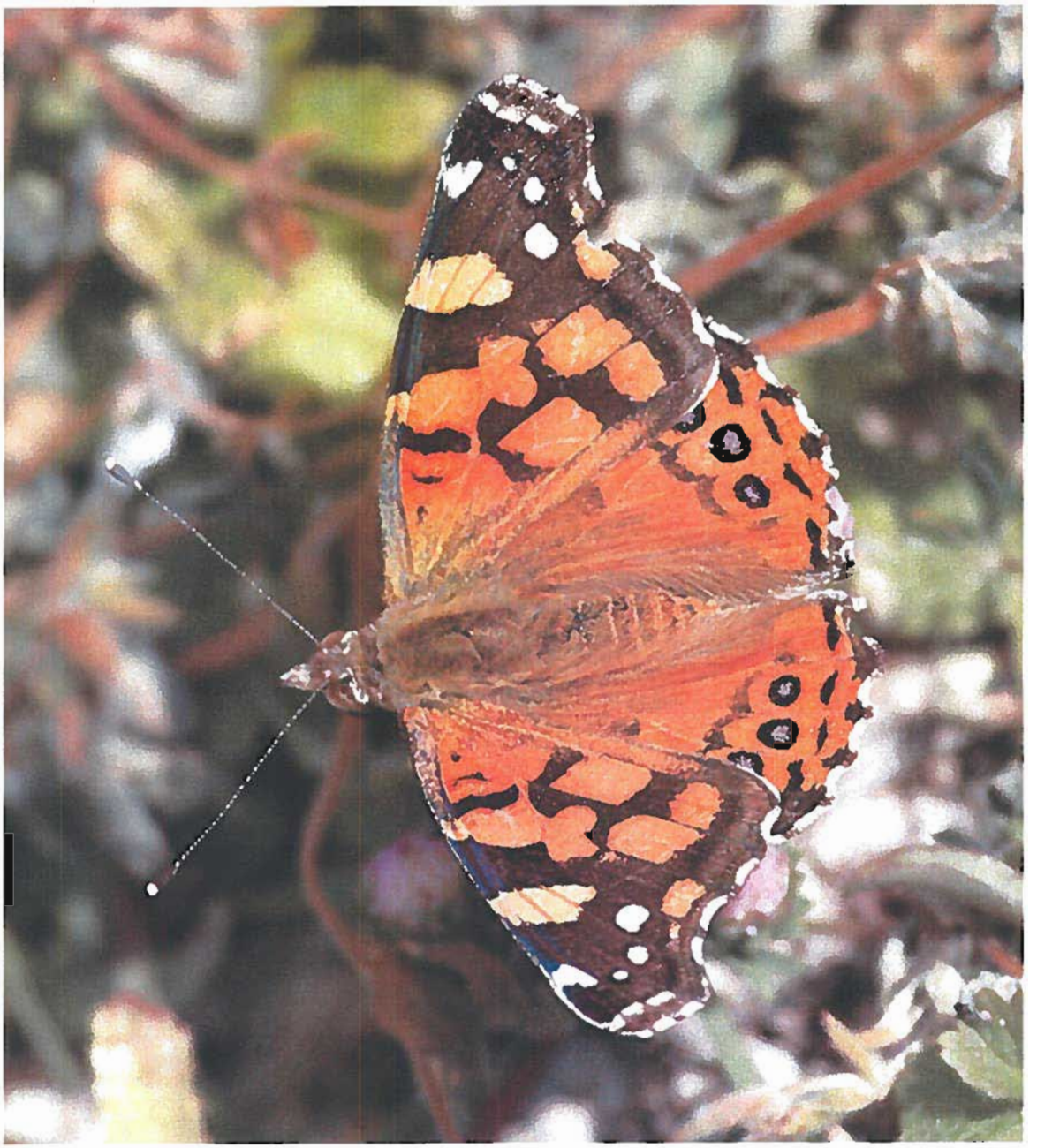

Figure 7. *Vanessa annabella*, shore of Lake Tahoe near Third Creek, 18 October 2008.

Figure 8. *Polygonia zephyrus*. Tunnel Creek (28-2), 23 July 2008.

Figure 9. *Chlosyne hoffmanni* taking nectar from *Monardella odoratissima*, Tunnel Creek (28-2), 7 July 2007.

Figure 10. *Phyciodes orseis* nectaring on *Achillea millefolium*, top of Glenbrook Creek (GPR3), 19 June 2007. Note that in the Carson Range, successful identification of *Phyciodes* often requires examination of both dorsal and ventral wing surfaces.

Figure 11. *Habrodais grunus* perched on *Quercus chrysolepis*, Memorial (Kennedy) Point, 25 July 2007.

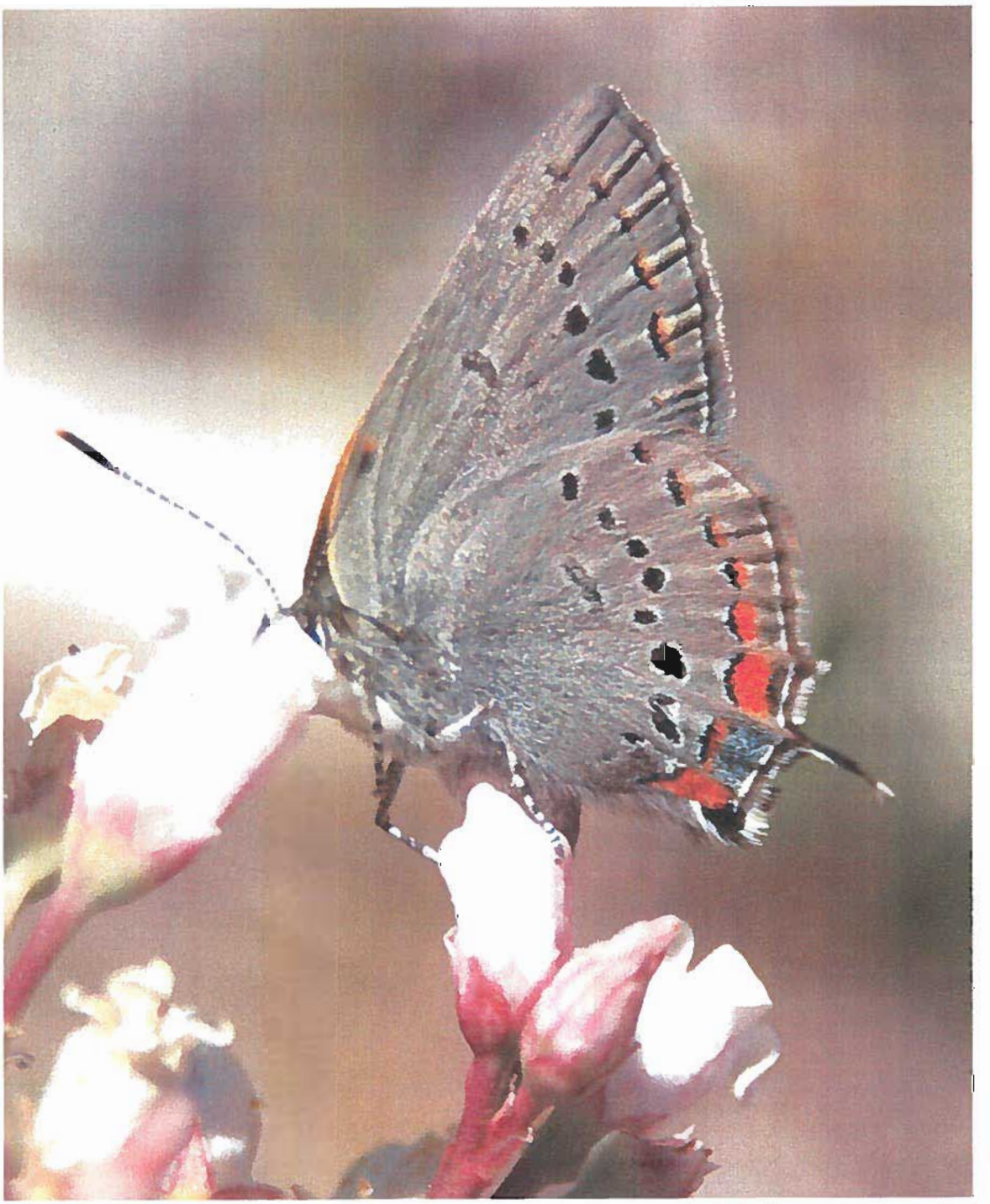

Figure 12. *Satyrium californicum*, nectaring deeply from *Aponcyum androsaemifolium*. Road to Little Valley (LV3), 7 July 2007.

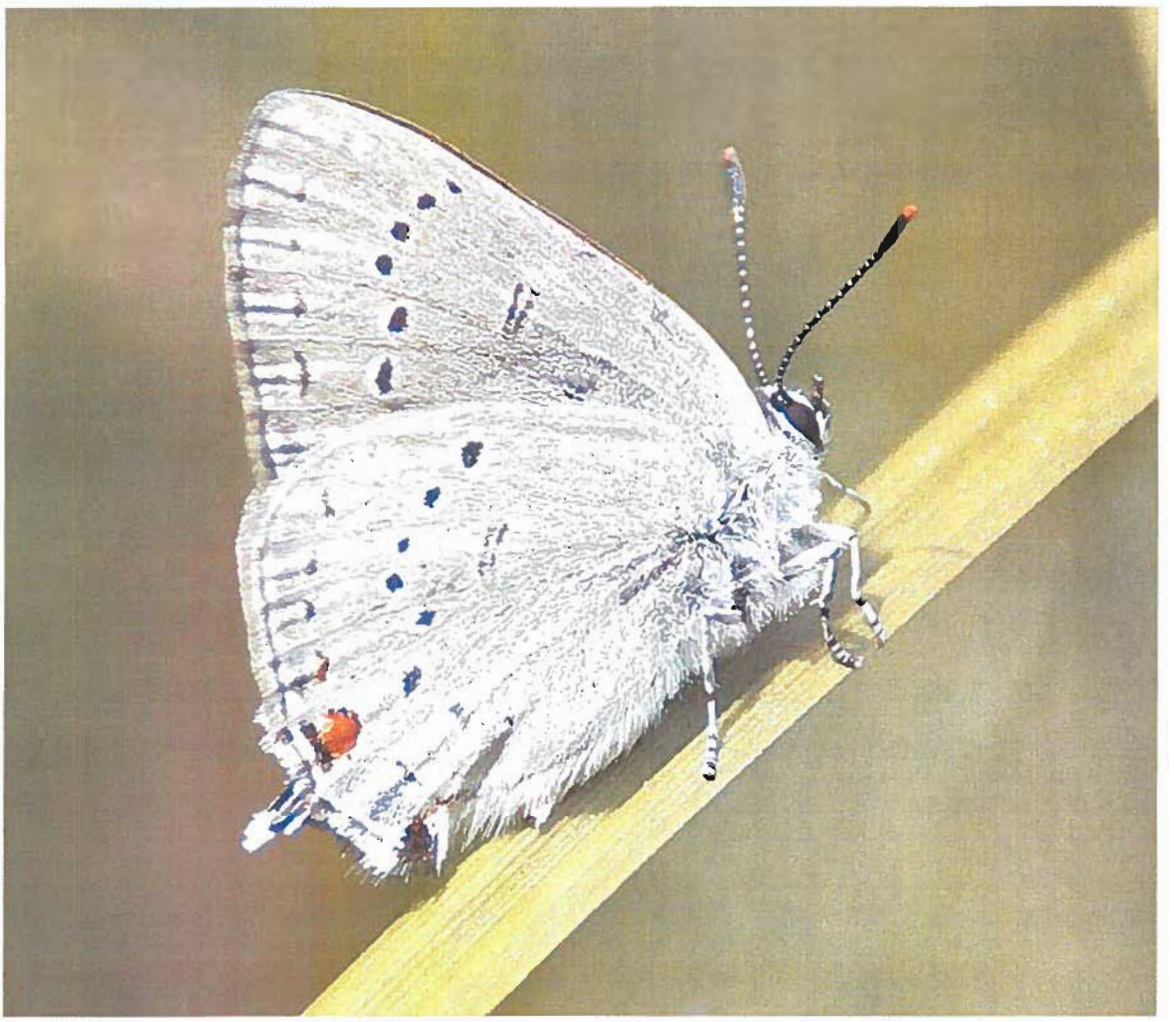

Figure 13. *Satyrium sylvinum*. Third Creek (28-6), Incline Village, NV 23 July 2007.

Figure 14. *Satyrium saepium* with worn tails, Tunnel Creek Road (28-1), 23 July 2007.

Figure 15. *Satyrium fuliginosum* on *Lupinus* sp., Genoa Peak, 8 July 2007.

Figure 16. *Lycanea heteronea* nectaring from *Eriogonum umbellatum*, Snow Valley Peak Pass (SP6), 26 July 2007.

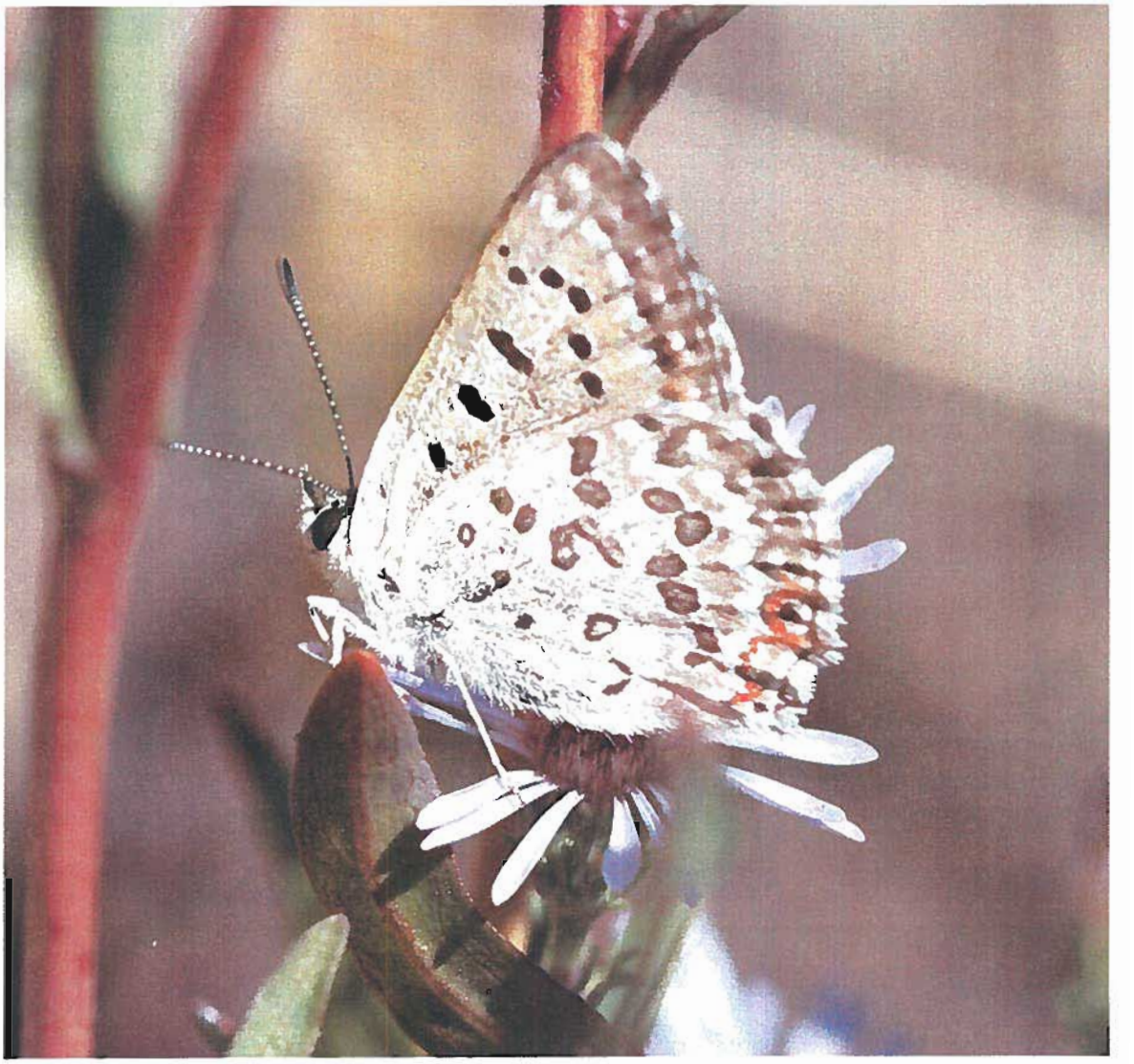

Figure 17. *Lycanea editha*, Spooner Meadows (SP1), 16 August 2007.

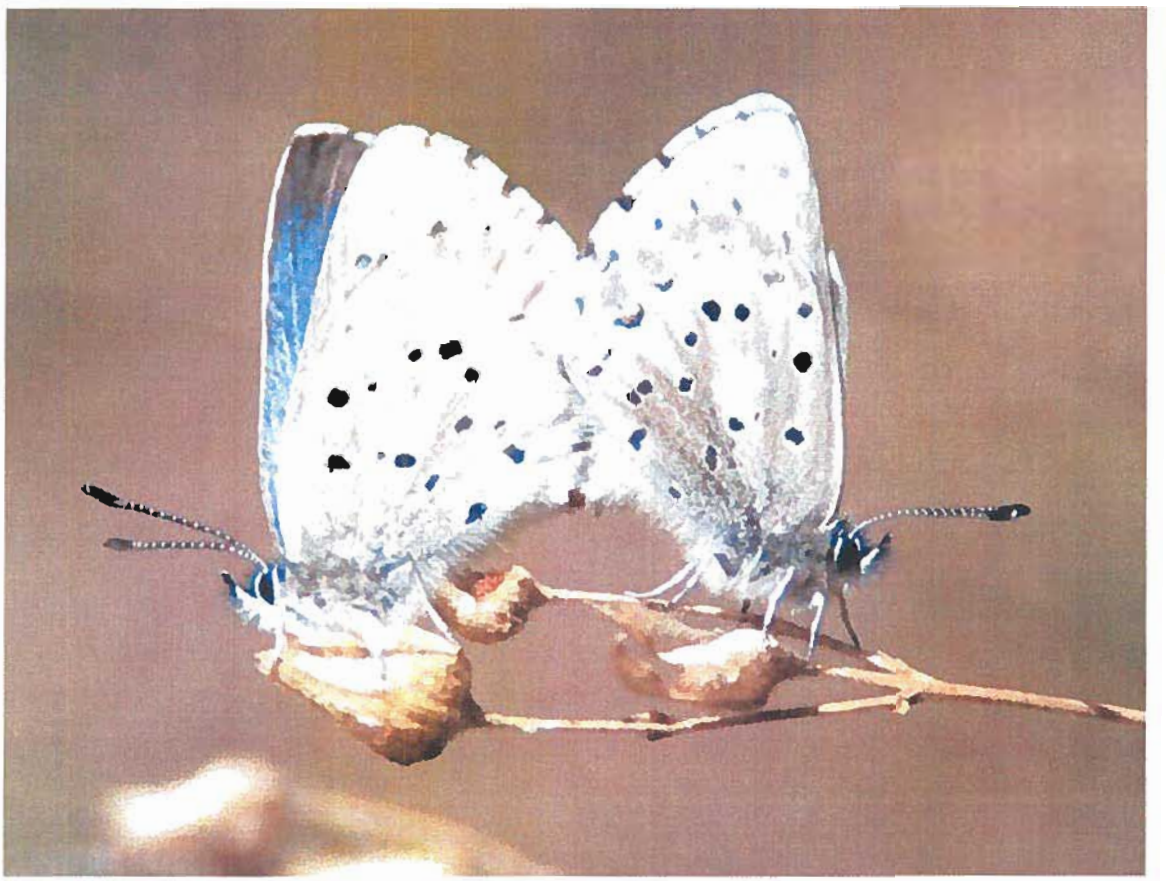

Figure 18. Copulating *Glaucopsyche piasus* along Genoa Peak Road (GPR8), 18 June 2007.

Figure 19. *Lycaeides idas*, nectaring on *Senecio*, Snow Valley Peak (SP3), 26 July 2008.

Figure 20. *Polites sabuleti tecumseh*, Upper Truckee River Marsh, CA, 3 August 2007.

Figure 21. *Thorybes mexicana*. Road to Relay Peak (IR11), 23 June 2007.

Figure 22. *Pyrgus communis* copulating, Rabe Meadows (K1), 28 June 2006.

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APPENDIX A. Descriptions and Maps for Focal Sites

Sampling dates, UTM Coordinates, and elevations for focal sites are listed in Table 1. Here we describe landscape and vegetation attributes, and provide topographic maps to pinpoint their locations.

CODE: IR1 — Upper Tahoe Meadows

This site was adjacent to the Tahoe Meadows nature trail. It consisted of grassy meadow with scrubby Pinus contorta, patches of Salix in a narrow riparian strip. Drier upland meadow had bunchgrasses. Wetter areas contained a rich mix of higher elevation grasses and alpine forbs. See Figure A-1.

CODE: IR2 — Lower Tahoe Meadows

This focal site was an approximately 50:50 split between low *Artemesia tridentata* dry upland meadow, and wet grassy meadow. *Pinus contorta* bounded the site to the west, and dense *Salix* in a riparian context downslope. There was a very rich forb community in both meadow types. The dry type was dominated by *Wyethia, Lupinus,* and *Castilleja.* See Figure A-1.

CODE: IR3 — Tahoe Meadows Ridge

This site was on a fairly exposed ridge on the south side of Tahoe Meadows, with *Pinus contorta* providing a thin woodland. *Lupinus* and *Calyptridium monospermum* were conspicuous butterfly plants at an otherwise sparsely vegetated site. See Figure A-1.

CODE: IR7 — Incline Lakes Meadow

This site was accessed by driving the road to Incline Lake a short distance off of Hwy 461. A spring at the site provided sheet flow of surface water across a very wet meadow. This site had a lush herbaceous component, with large *Veratrum californicum* and many patches of *Salix*, and *Pinus contorta* providing a thin overstory. Adjacent to the road was a mix of *Eriogonum* and *Lupinus*. A few dry spots along the road had *Calyptridium monospermum.* See Figure A-1.

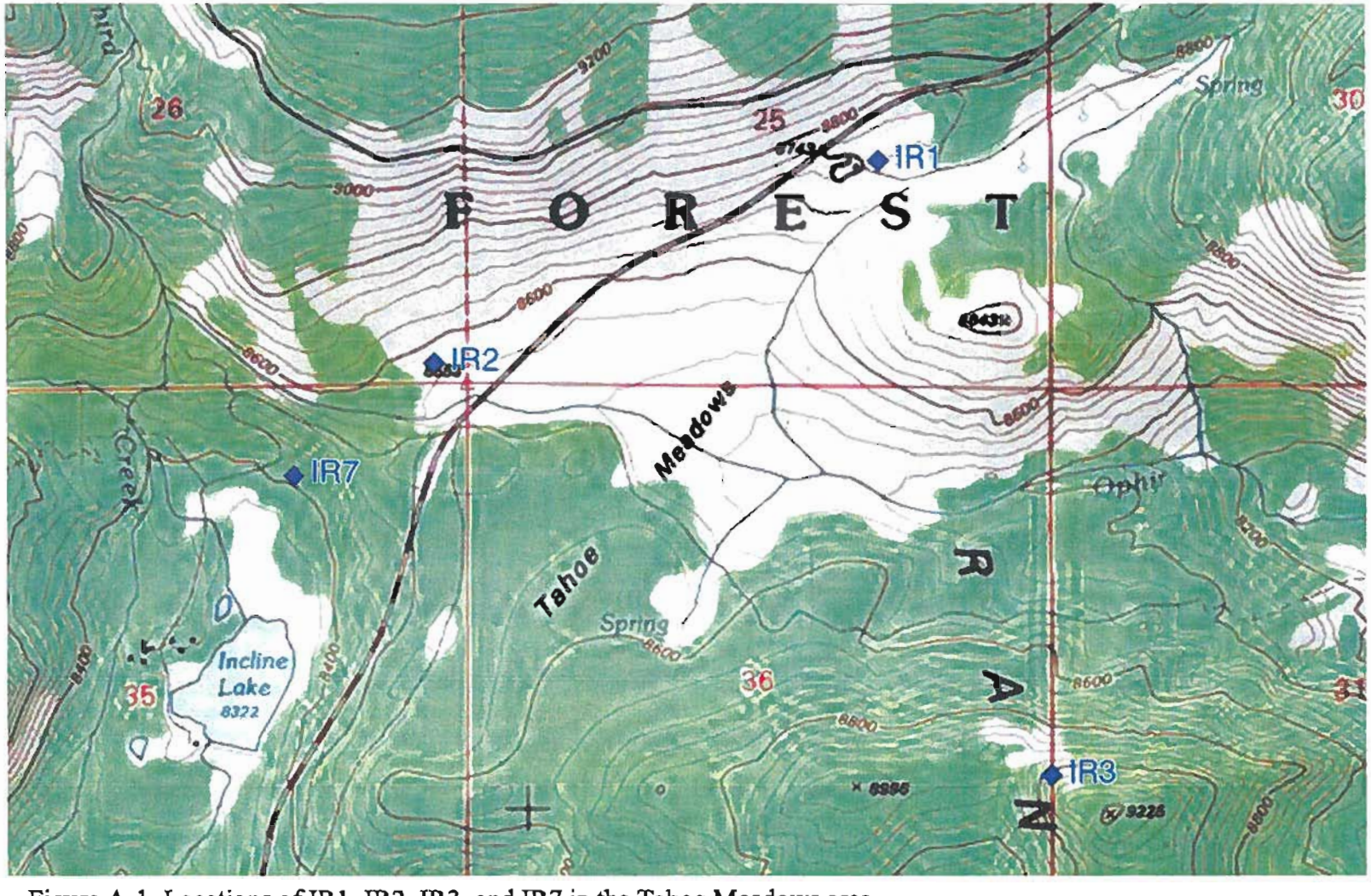

Figure A-1. Locations of IR1, IR2, IR3, and IR7 in the Tahoe Meadows area.

CODE: IR4 Diamond Peak Administration

This site was patchy, with a seep adding moisture to bare ground and grassy patches through the flight season. It was bound on two sides by *Abies concolor* and *Pinus jeffreyi* forest, with *Salix scouleri* and *Chrysothamnos* along the edges of the clearing. Much of the site was dominated by native and non-native grasses, interspersed by a decent mix of flowering forbs. See Figure A-2.

CODE: IR5 Diamond Peak Chaparral

This site comprised mixed *Ceanothus* and *Arctostaphylos* with early season scrub-associated, flowering forbs and *Monardella* later in the season. The site is bounded on two sides by *Abies concolor*, *Pinus jeffreyi*, and a few *Salix scouleri*. See Figure A-2.

CODE: IR6 Driver Lane Woodlands

This site is a public landholding nestled amid single family housing off of Driver Lane in Incline Village. The overstory comprised *Abies concolor*, *Pinus jeffreyi*, and *Calocedrus decurrens*. The understory consisted of *Ceanothus velutina*, *C. prostratus*, *Arctostaphylos*, *Purshia tridentata*, and *Quercus vaccinifolia*. Approximately 2/3 of the shrubs and smaller conifer stems were hand-thinned and cleared after the first sampling cycle. Forbs under the conifer canopy were few and scattered; disturbed roadside weeds and residential landscaping provided adjacent plant resources. See Figure A-2.

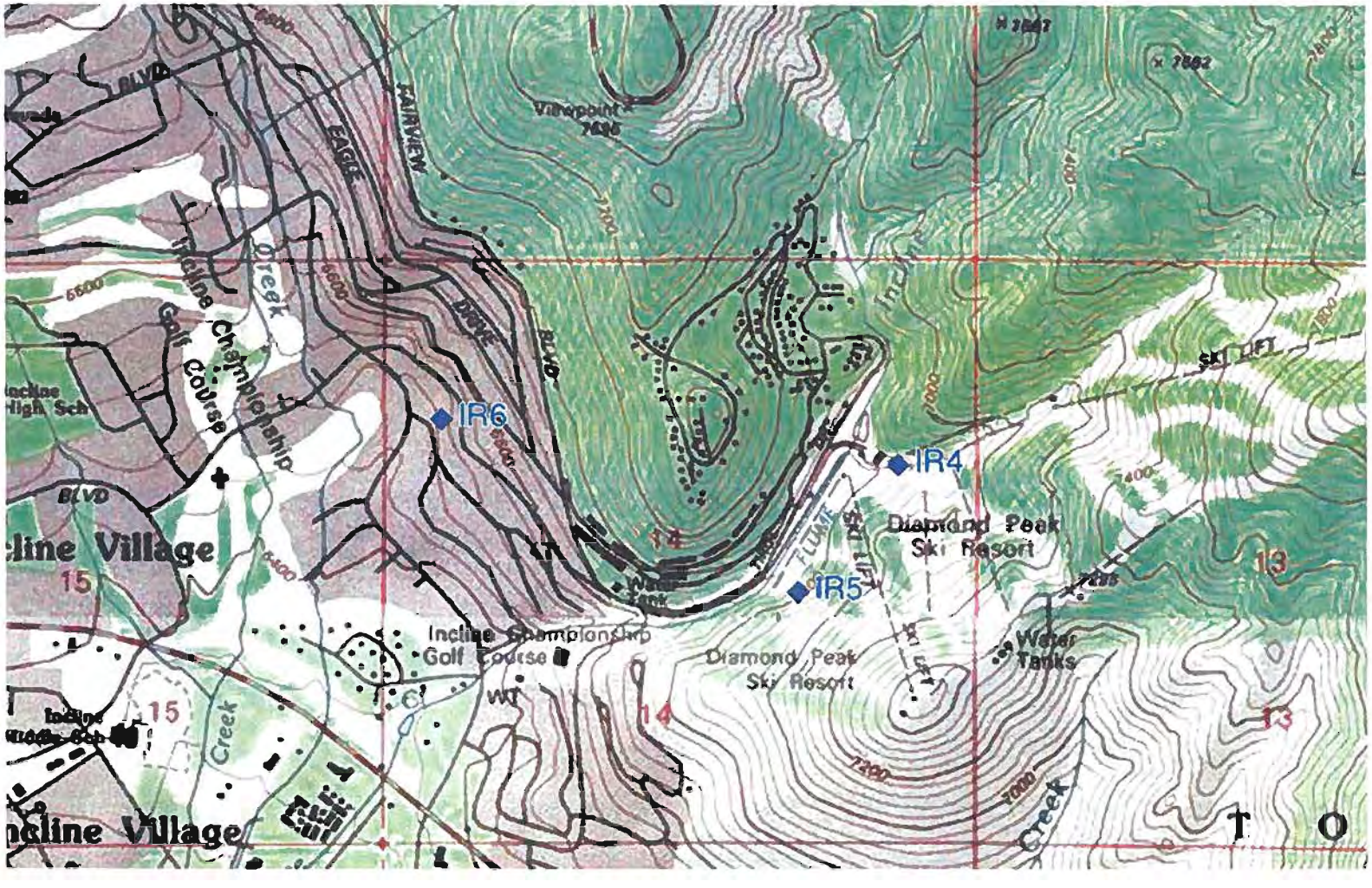

Figure A-2. Locations of IR4, IR5, and IR6 in Incline Village.

CODE: GPR1 NDOT Meadows

This site is located in the small meadow between the NDOT transfer station and the Spooner Summit fire station. Low spots in the meadow are dominated by grasses and sedges. To the east, the meadow is bounded by open East Side pine and chaparral, and weedy mustards and other plants line the disturbed soils along the frontage road. Near this site, the lawn in front of the fire station hosts many dandelions in the early spring, providing some of the earliest nectar sources at this elevation. See Figure A-3.

CODE: GPR2 Snowmobile Staging

This site is centered along the road that connects the Genoa Peak Road to Hwy 50, and is on the east side of the range. The site is a patchwork, containing, or adjacent to, a variety of vegetation types, including forest meadow, mixed conifer, aspen, and chaparral. A small, vernal creek flows through the site, providing some moisture during the first sampling periods, and sustaining several *Salix*, but it was mostly dry during 2007. See Figure A-3.

CODE: GPR3 Top of GLEN

This site is centered at a small meadow where Genoa Peak Road crosses the top of Montreal Canyon, near the top of the North Fork of Glenbrook Creek. Most of the count circle is located on the uphill side of the road. A perennial spring provides moisture through most summers, and roadside ditches contribute seeps during part of the flight season. The meadow itself is mostly dry, however, and bounded by mixed conifers (mostly *Abies*) and aspen. The meadow below the road can be quite lush and moist towards the bottom, and often can provide additional "off count" species. See Figure A-3.

CODE: GPR5 Sagebrush Meadow

This is a dry meadow of grass and sagebrush, bordered by mixed conifer (mostly *Abies* and *Pinus contorta*), and some chaparral. Two drainages converge at the bottom of the meadow, and provide deep ditches and some moisture for butterflies to patrol. Conspicuous nectar sources were few in 2007, but included *Potentilla gracilis*, *Trifolium longipes*, *Achillea millefolium*, and *Sidalcea* spp. See Figure A-3.

CODE: GPR10 Intersection (of GPR and 14N32A)

This site was chosen for the roadside seep that occurs at the intersection of these two roads. The site itself is an intersection of vegetation types as well, including open East Side pine woodland with chaparral understory, mixed conifer, and forest riparian. The two roads and riparian drainage provide linear features for butterflies to patrol. The riparian drainages are typically dry during most of the summer; the seep was dry by mid-season in 2007, but attracted butterflies throughout the 2006 and 2008 flight seasons. See Figure A-3.

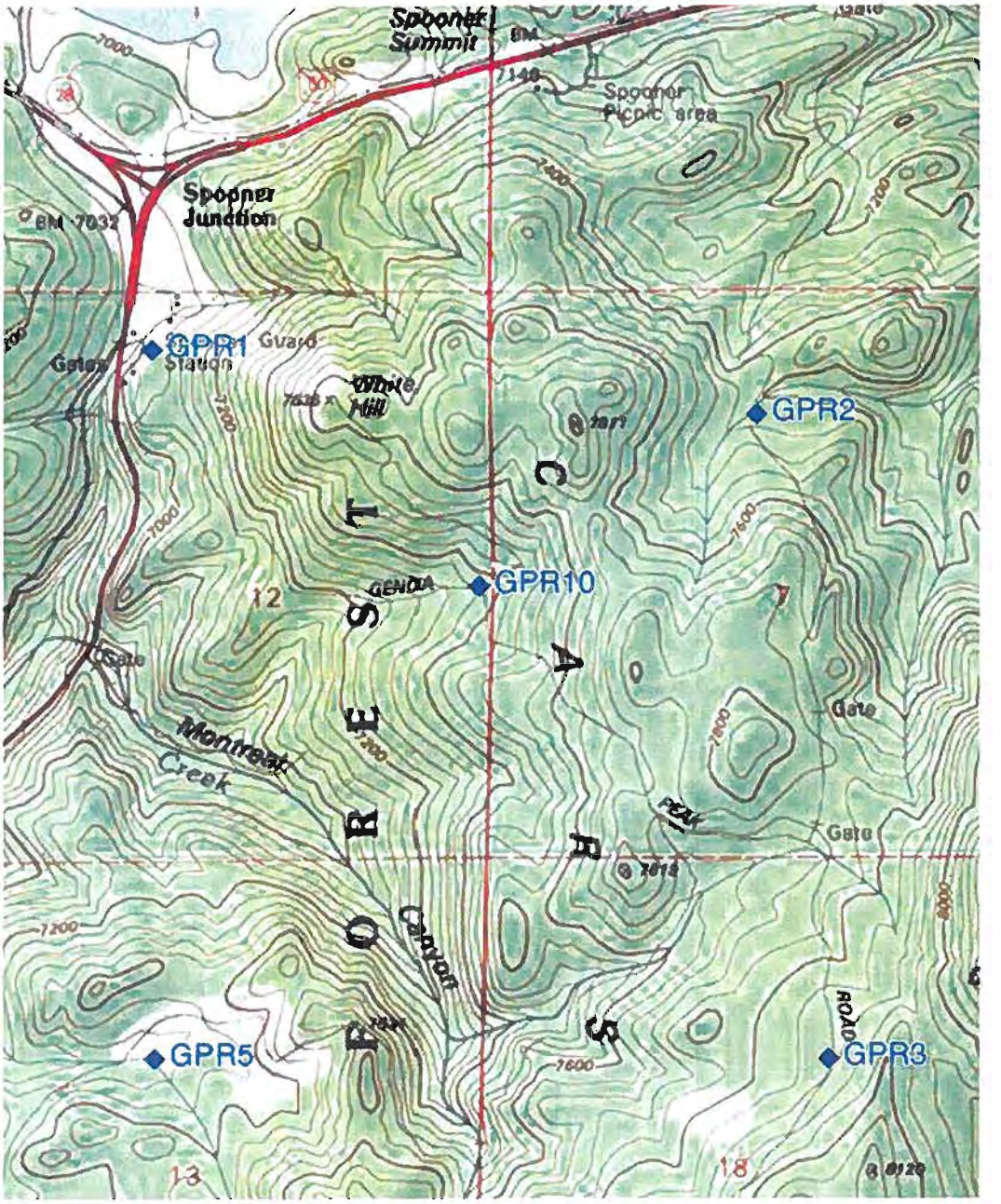

Figure A-3. Locations of GPR1, GPR2, GPR10, GPR3, and GPR5 along the Genoa Peak Road (14N33) system.

CODE: GPR 7 Logan House Creek Meadow

This site is located in the northern of two meadows, which are immediately to the north of Logan House Creek, along Genoa Peak Road. The forest surrounding the meadow is predominately *Populus tremuloides*, and *Abies concolor*., and the meadow itself contains extensive, and often large, *Ribes*. Several of the herbaceous, flowering plants in this meadow grow to be quite tall, including *Solidago*. Weedy mustards line the road. There are also a number of junipers (*Juniperus occidentalis*) in the immediate vicinity. See Figure A-4.

CODE: GPR9 Genoa Peak

This site is on the western flank of Genoa Peak, on the north side of the of the access road. Due to its exposed position, wind can be an issue for sampling. The site is rocky with an alpine sagebrush community, and *Chrysothamnos* flowering late in the season. A few junipers are interspersed, but the open area is mostly bounded by *Pinus contorta*. Below this site, at where the road enters the woodland, is often productive, as it is more sheltered than the exposed, rocky count circle above. *Phlox*, alpine *Lupinus*, and *Eriogonum umbellatum* were the dominant butterfly plants in 2007. See Figure A-4.

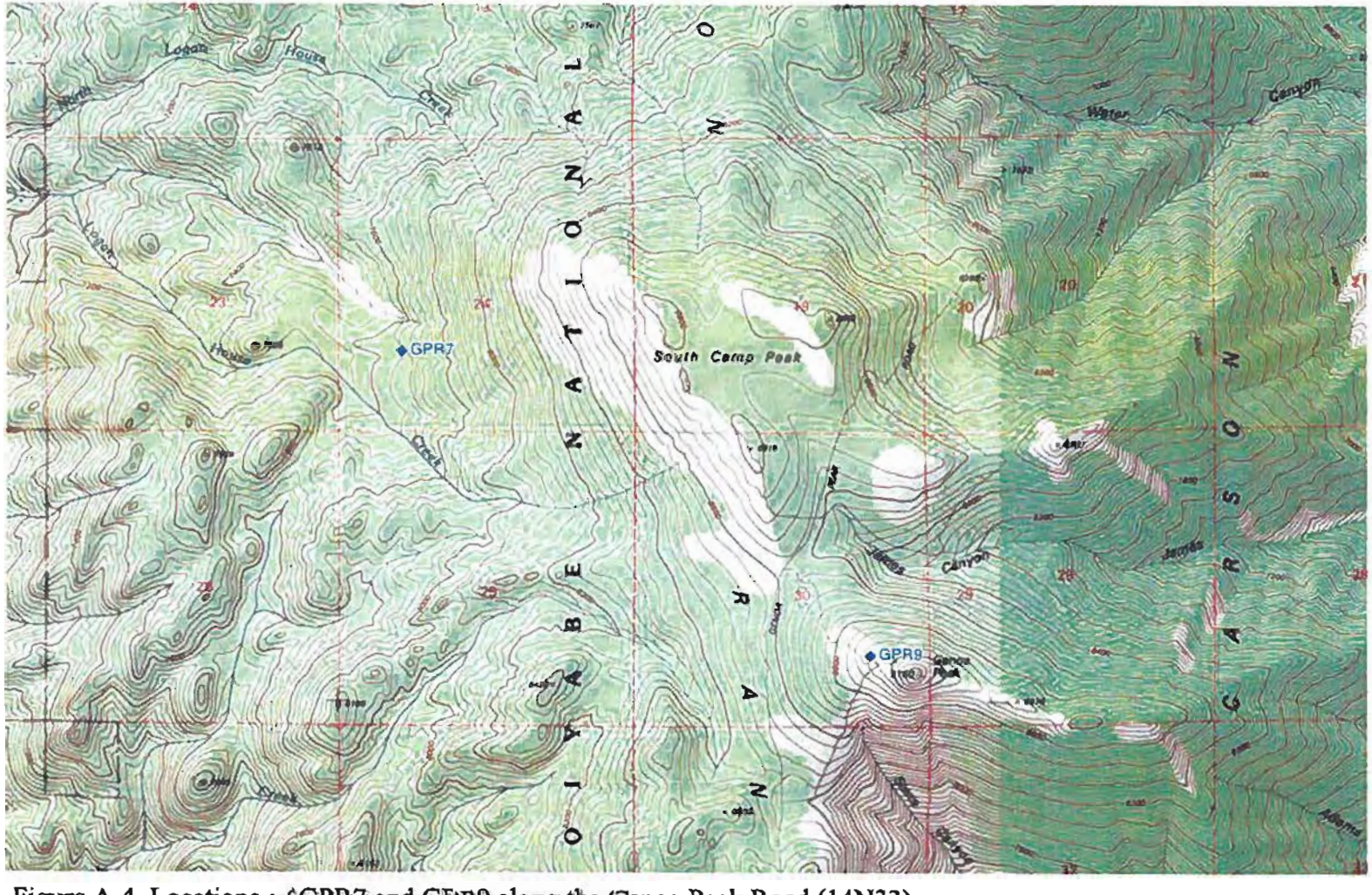

Figure A-4. Locations of GPR7 and GPR9 along the Genoa Peak Road (14N33).

CODE: LV1 Little Valley, North

This site is located in a narrow section of the Little Valley meadow, and thus butterflies transiting up or down the meadow fly through the count circle. The site is situated in a more mesic section of the Little Valley meadow than LV2, although in 2007 the site was quite dry by June. Ongoing clearing of *Pinus contorta* from the meadow edge and riparian zone should help restore a higher water table. Portions of the count circle fall within the drier, shrubby understory of *P. contorta* woodland, but most of the circle is in the meadow itself. Conspicuous nectar sources include *Penstemon rydbergii, Senecio, Achillea millefiora, Caliptridium monospermum,* and *Aster*. See Figure A-5.

CODE: LV2 Little Valley, South

This site is located near the southern edge of the main Little Valley meadow, near the edge of the UNR/USFS property boundary (within Whittel Forest and Wildlife Area). The site is centered near the eastern edge of the grassy meadow, along the meadow-forest ecotone. In 2007, *Polygonum bistortoides* and *Camassia quamash* were the most conspicuous flowers in this section of meadow, though the latter do not provide nectar. The understory of the forest is largely grassy as well, with many Fabaceae. See Figure A-5.

CODE: LV4 Hager Traps

This site is among the chaparral on the south side of the Little Valley Rd, on the north-facing slope of a small highpoint. A few Pinus jeffreyi are scattered nearby, but the slope is dominated by chaparral. Conspicuous, early-season nectar sources included *Ceanothus velutina, Phlox diffusa,* and *Eriophyllum lanatum*. This was our lowest elevation site, and the site's low elevation and position on the arid east slope meant that the butterfly flight here was much earlier than at any other sites. This site had very little nectar to speak of by the middle of June (*Monardella odoritissima*), and none by July. See Figure A-5.

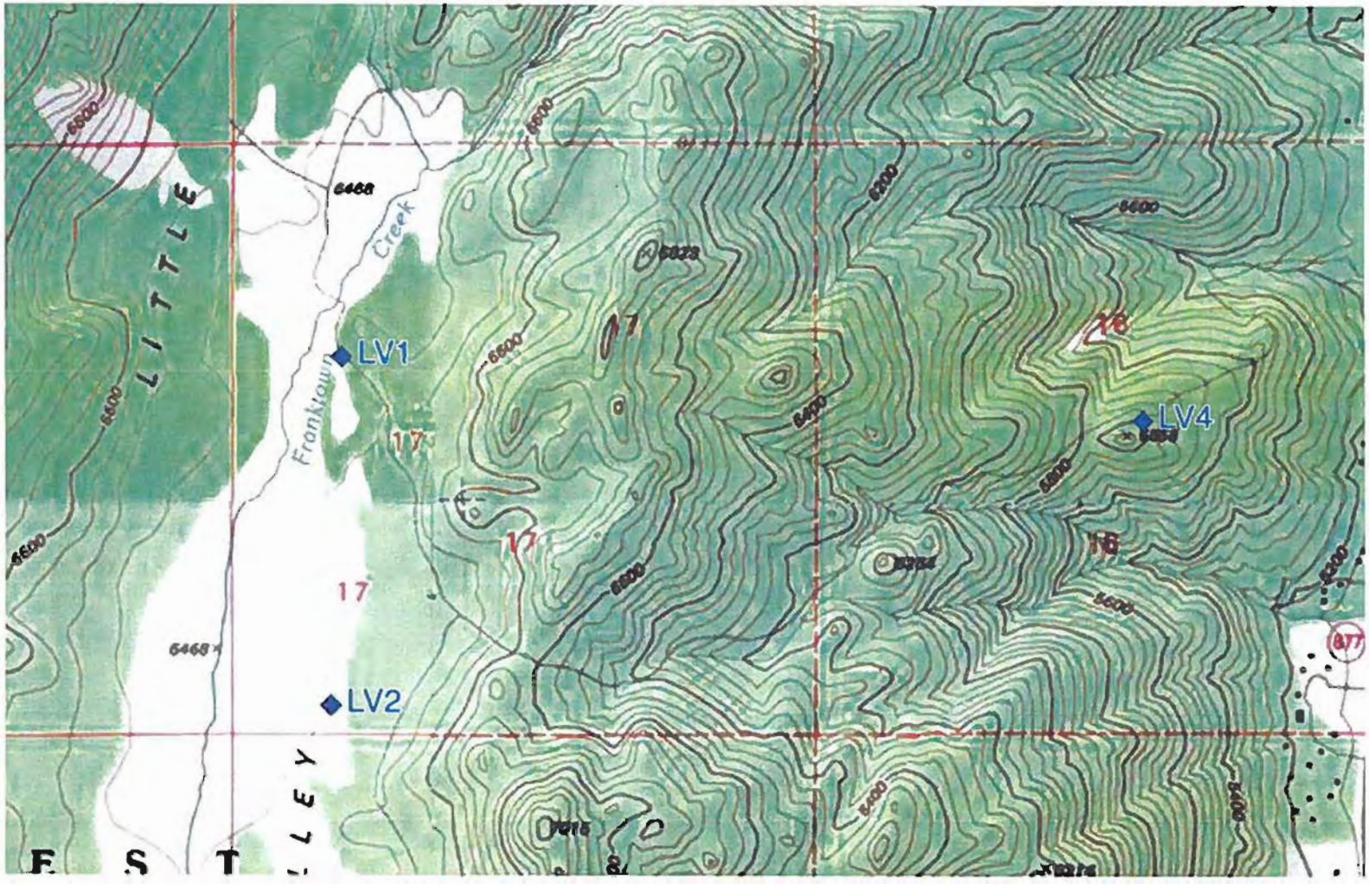

Figure A-5. Locations of LV1, LV2 in Little Valley, and LV4 along Little Valley Road.

CODE: G2 Slaughterhouse Canyon

This site is located along the Slaughterhouse Canyon road in a small meadow clearing in the forest. Below the road is principally riparian meadow, with *Salix*. Above the road is a drier meadow type. The surrounding forest comprises *Pinus jefferyi, P. contorta, Abies concolor*, and *Populus tremuloides*. See Figure A-6.

CODE: G3 Lower Prey Meadows

This site is found at the intersection of mesic sedge meadow and wetland (the boundaries of which are likely to vary according to beaver activity), dry meadow, and open *Pinus contorta* forest with a shrubby understory. Conspicuous nectar sources included *Potentilla gracilis, Leucantheumum vulgare, Polygonum bistortoides*, and *Sialcea oregana*. See Figure A-6.

CODE: SP1 N. Canyon, Bottom

This site is found in the meadow to the west of the North Canyon Road. The count circle overlaps an intersection of different meadow types, including mesic sedge meadow with standing water through much of the summer, and drier meadow with a rich community of flowering forbs. A spring is found along the northern edge of the count circle, providing continued moisture through the flight season. This site is on the North Canyon transect, but is mapped in Figure A-6.

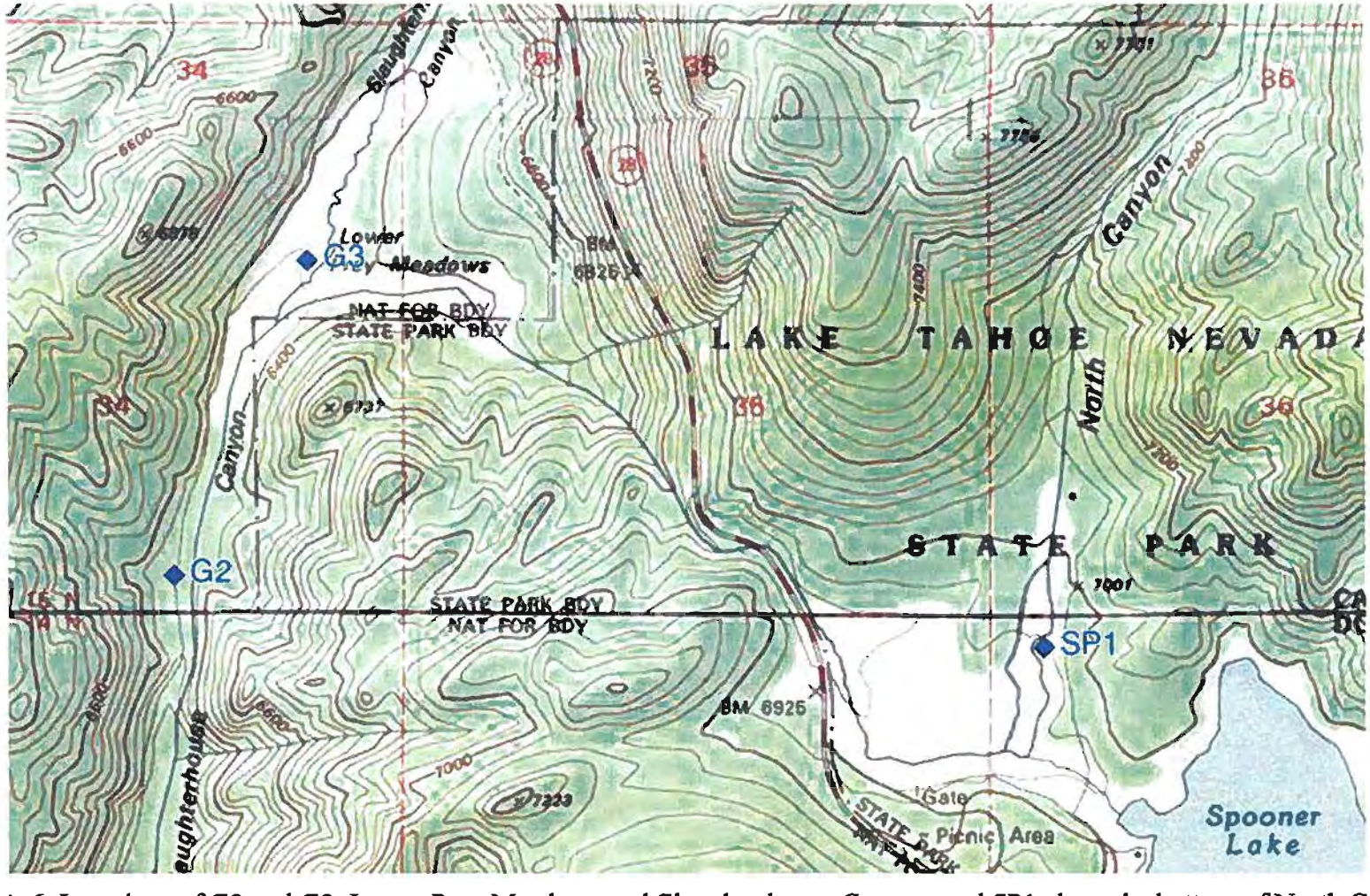

Figure A-6. Locations of G2 and G3, Lower Prey Meadows and Slaughterhouse Canyon, and SP1 along the bottom of North Canyon Road.

CODE: SP2 N. Canyon, Top

This focal site is adjacent to the North Canyon Road, where the road crosses North Canyon Creek. The site is characterized by sagebrush (*Artemisia*) and grassy meadow, with a large riparian strip and roadside ditches intersecting through the middle. The riparian component dominates the site. See Figure A-7.

CODE: SP4 Ash Canyon Meadows (dry)

This site is adjacent to the Ash Canyon Road, amid sagebrush (*Artemisia*) steppe and adjacent to *Pinus contorta* forest, with a very narrow riparian strip in between the two vegetation types. This site hosts a rich diversity of butterfly plants, predominately nectar sources, including *Phlox, Viola*, a few large *Ribes*, *Caliptridium umbellatum*, *Eriogonum umbellatum*, *Monardella odoritissima*. See Figure A-7.

CODE: SP5 Ash Canyon Meadows (wet)

This site is adjacent to the road, at the bottom of a grassy meadow. In 2006, this site was extremely wet through the summer; in 2007 the bulk of meadow was dry by June. A few muddy channels and seeps provide moisture through the season, however. The meadow is bounded by *Pinus contorta*, and *Salix* can be found in a clearing to the northeast. See Figure A-7.

CODE: SP6 Snow Valley Peak Pass

This site is centered just south of the Snow Valley Peak road, as it crests the pass. The site is a rocky, exposed, alpine sagebrush community. Because of its location at the pass, dispersing butterflies are often seen transiting from the east to west slope, and vice versa. Its exposed location at the pass also means that wind can be an issue for sampling. Conspicuous butterfly plants include *Astragalus whitneyii*, *Phlox*, *Phoenicaulis*, *Eriogonum umbellatum*, *Chrysothamnos*, and *Ericameria*. See Figure A-7.

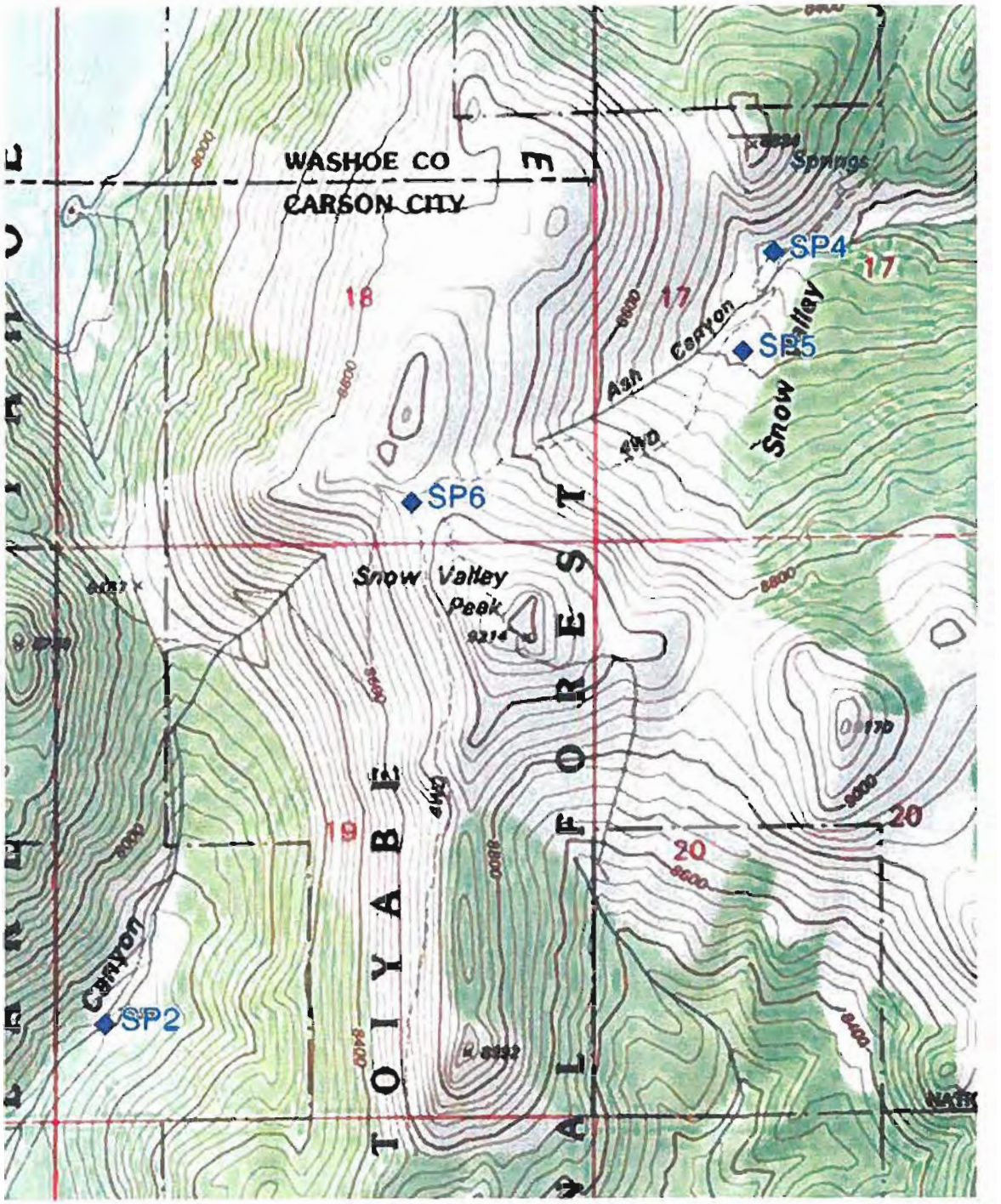

Figure A-7. Locations of SP4, SP5, SP6, and SP2, along the North Canyon-Ash Canyon road system.

CODE: 28-2 Tunnel Creek Seep

The Tunnel Creek Seep site was located at a wet seep along the Tunnel Creek Road, just prior to where the road turns north away from the bottom of the aspen stand. This was a unique forested site at the convergence of a patchwork of many different vegetation types: aspen, mature mixed-conifer, east side pine/chaparral, and riparian. A combination of moisture at the seep and abundant nectar sources in clearings in the aspen and riparian attracted many butterflies to this one spot. See Figure A-8.

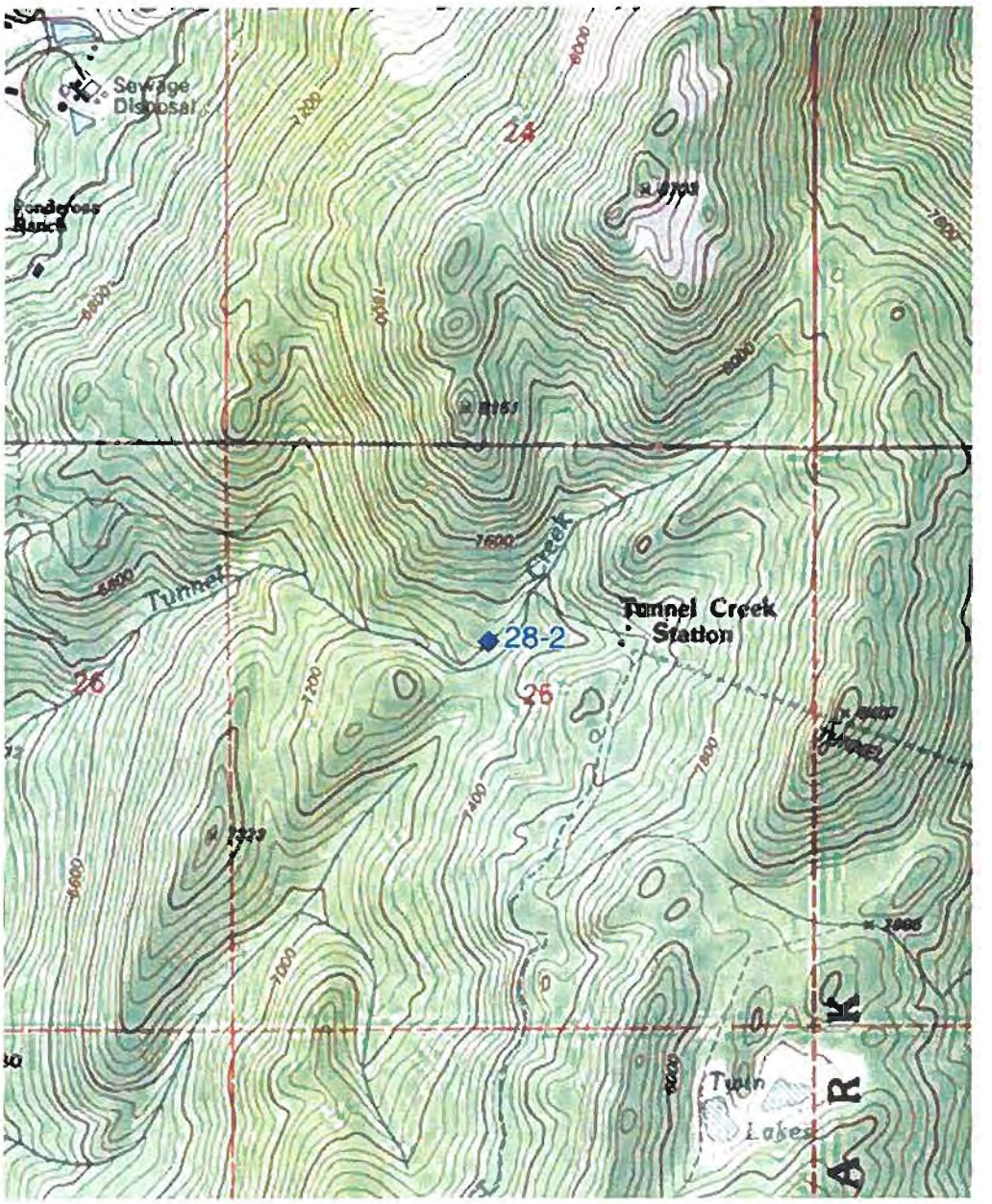

Figure A-8. Location of 28-2, along the Tunnel Creek Rd.

CODE: K1 Rabe Meadows

This is site was centered on a perennial stream choked with *Cardamine cordifolia*. Park at the pond trailhead. *Achillea, Sidalcea, Potentilla, Arabis*, and *Descuriana* were conspicuous butterfly plants. There is a small pocket of aspen upstream, and *Chrysothamnos* is abundant on the other side of the pond. See Figure A-9.

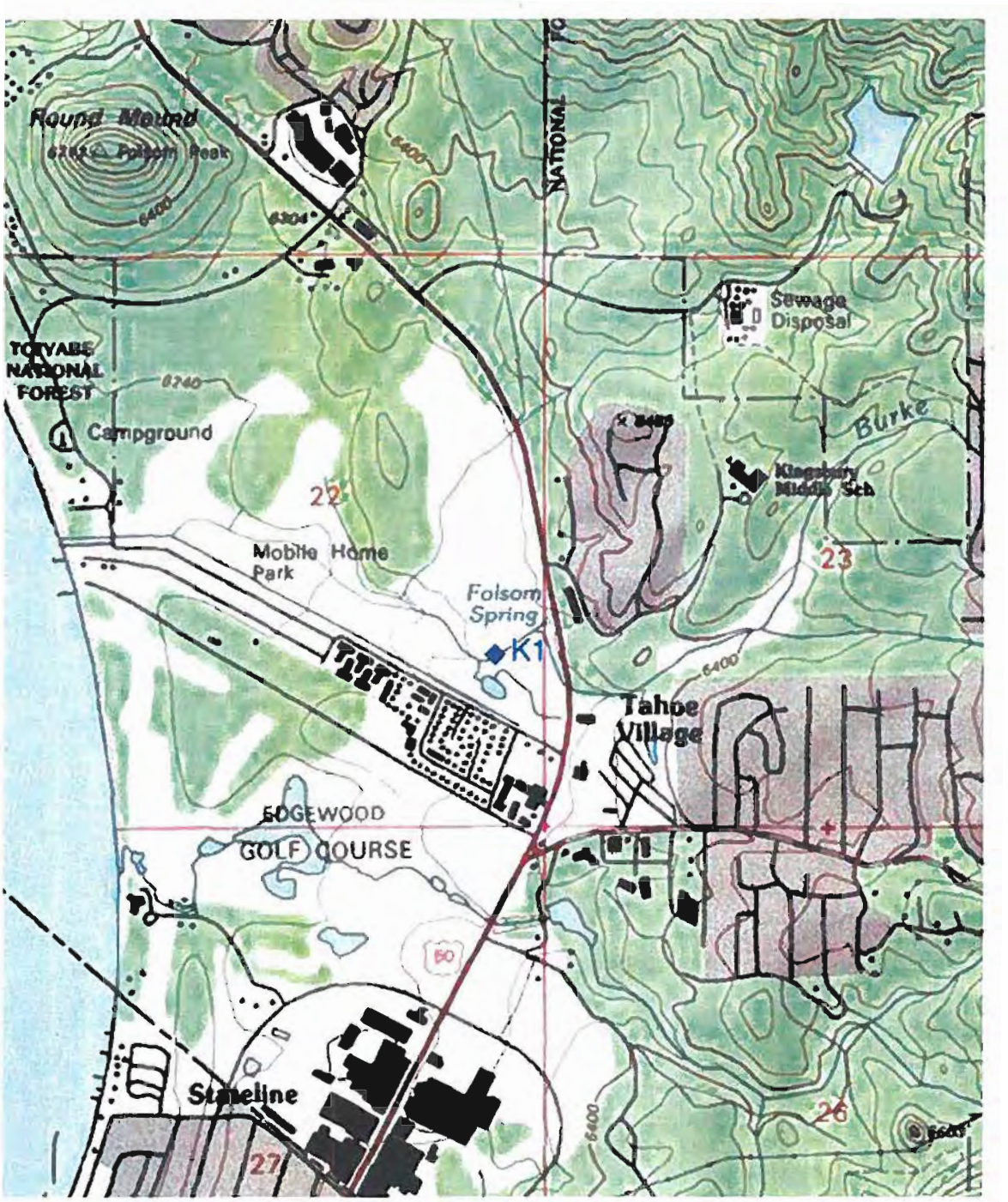

Figure A-9. Location of K1, in Rabe Meadows.

APPENDIX B. Codes and UTM coordinates for auxillary collection localities. UTMs are NAD 27, Zone 11.

CODE	Description	UTM1	UTM2	Elev. (m)
28-0	Tunnel Creek Meadow, top of aspen stand	249005	4345899	2303
28-1	Lower Tunnel Creek	247676	4345855	2099
28-3	Oaks and chapparal above Memorial Pt. Overlook	247295	4343775	1950
28-4	N. Chimney Beach Lot and "restored" area	247471	4339335	1975
28-5	Bliss Pond	247189	4335825	1182
28-6	Village Green/Third Creek	245962	4347824	1917
28-7	Bottom of Montreal Canyon at Hwy 50	248354	4330373	2086
28-8	Stateline Pt.	241009	4345439	1899
G1	Trail to Lower Prey Meadows from Hwy 28	246360	4335021	2005
GPR6	Along Genoa Peak Road (GPR)	247699	4328911	2212
GPR4	"Cherry Lane" - stretch of *Prunus* along GPR	249043	4329238	2288
GPR8	"Deer Meadow" - small meadow along GPR	248496	4326078	2459
GPR11	South Camp Peak	249580	4326551	2685
IR8	Mount Rose Ski Area	251477	4356924	2605
IR9	Sky Tavern	252157	4357809	2606
IR10	West flank of Relay Peak	245901	4355612	2637
IR11	Road to Relay Peak	248690	4354837	2768
IR12	Mount Houghton ridge	246719	4357743	3197
IR13	Mount Rose	248614	4358795	3285
K3	Kingsbury pull-off	252259	4317819	1923
K4	Heavenly Ski Area - Bull Run	249528	4316128	2312
K5	Heavenly Ski Area - Stagecoach Express	249712	4316004	2314
LV3	Road to Little Valley (seeps/*Apocynum*)	252539	4347825	1930
LV5	Little Valley, general	251579	4347680	1983
LV6	Aspen stringer well south and above LV proper	251317	4345333	2046
SP3	SW flank of Snow Valley Peak	250483	4337550	2637
SP7	North Canyon "Tip-top" - wet meadow s. of road	249963	4337206	2402
SP8	Mid - North Canyon	248683	4334859	2260

Addenda:

Polygonia satyrus Satyr Anglewing

Breeder

An individual was observed and photographed high on south fork of Marlette Creek on 27 August 2009, at approximately 2250 m elevation. There are two specimens from 26 August 1915 (both from Glenbrook), but it is uncertain whether these late dates represent a second brood or a protracted, single brood.

Lycaena arota Tailed Copper

Breeder

A female was collected on 25 August 2009, ovipositing on *Ribes cereum* var. *cereum* in the Incline Creek drainage.

Apodemia mormo Mormon Metalmark

Possible Breeder

An extremely fresh individual was observed on 4 September 2009, along the East Ridge of Genoa Peak (~ 100m below the summit). The butterfly was seen late in the day following strong southeast winds, and may have been blown up from the Carson Valley. However, a population at Donner Summit flies from September through early October, so this sighting may represent a resident population.