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Big Springs Hollow Butterfly Monitoring Project

by Alan Myrup

Introduction

Understanding ecosystems and the impact of humans on them is crucial to the conservation and wise use of the natural resources found within them. Monitoring populations is one method that provides useful information to better understand the changes that occur within ecosystems. Because butterflies are highly mobile, conspicuous organisms, they have occasionally been used as bioindicators of change in these population studies (Tyler 1994; Asher 2001).

Butterfly populations are affected by many natural factors including temperature, precipitation, fire, competition, predators, parasites, and disease. Human factors that affect butterfly populations include the use of pesticides and

herbicides, grazing, introduction of exotic species of plants and animals, habitat damage and habitat loss (Asher 2001). In the United States, many populations of butterflies and at least one full species, *Glaucopsyche xerces* (Xerces Blue), have been extirpated due to human-caused environmental change or habitat loss (Pyle 1981). In Europe, the depletion of natural and semi-natural habitats has been going on for many centuries and is much further advanced than in the U.S. The United Kingdom Butterfly Monitoring Scheme (UKBMS 2006) in Great Britain receives annual data on butterfly populations from nearly 200 monitoring sites throughout the U.K. Many of these sites have more than 20 years of data. The primary goal of the UKBMS is to monitor changes in abundance of butterfly populations. This information can then be evaluated and used in guiding their conservation and management.

The purpose of this project is to establish a similar monitoring program in Big Springs Hollow in the South Fork of Provo Canyon, Utah County, Utah. This area is by no means pristine and has a history of human impact. The recent opening of an established trailhead has played a major role in the increased recreational use of the area. Information on species richness, annual index of abundance and flight periods have been gathered and evaluated using methods similar to those in the UKBMS.

Description of Transect Site

Big Springs Hollow is located in the South Fork of Provo Canyon (off US 189) on the back side of the Wasatch Front Range. Found in the lower portion of a wide, shallow canyon, it drains to the northeast (40°) off Cascade Mountain (3280 m). A small stream flows year around from Big Springs down to South Fork Creek. There are many small springs, seeps and bogs scattered throughout the canyon.

The trail on which the transect is located is used by hikers, mountain bikers, and horseback riders in the warmer months while cross-country skiers, snowshoers and sledders use the trail in winter. A dirt road to Big Springs parallels the trail. Provo City School District holds a weekly environmental camp for elementary students at Big Springs during the first four weeks of June. Provo City manages a new park (2004) at the trailhead with pavilions, tables, restrooms, bridges and paved trails. Many of the large poplars were cut down during the construction of the park.

The transect runs through property owned by Provo City (lower portion) and the Uinta National Forest (upper portion). In the past, some of the land was privately owned and was used for grass hay, alfalfa hay and cattle grazing. One large field of grasses (approximately 300 meters in length) through which the transect runs was cut and harvested by a local farmer for many years including the first three years of the transect (2001-2003).

Trees and shrubs found along the transect route include narrow-leaf poplar, quaking aspen, box elder maple, big tooth maple, serviceberry with occasional small thickets of chokecherry, willow, red-osier dogwood, and twinberry. The meadows contain both native and introduced grasses, spike rushes, sedges as well as a variety of herbaceous plants including lupines, vetches, clovers , alfalfa, nettles, horsetails, violets, thistles, mustards, and asters. The sides of the canyon consist mainly of gambel oak, big tooth maple, with a few scattered douglas fir and white fir.

Wildlife in the area includes several species of snakes, many songbirds, ruffed grouse, wild turkey, rabbits, beaver, weasels, bear, deer, and moose.

Transect Design

The transect begins at the trailhead at an elevation of 1753 m (5750 ft) and gently rises to an elevation of 1890 m (6200 ft). It is 1800 meters in length and divided into twelve 150 meter sections. At a slow, steady, walking pace, each section takes five minutes to complete, with the entire transect being completed in one hour. As the recorder walks the transect, every butterfly that comes within a "three dimensional box" 5 meters to either side of the trail, to 5 meters in front of the recorder, to 5 meters in height is identified, counted and recorded. No butterflies are counted behind the recorder. The recorder must be alert to butterflies that are flying along in and out of the box so as not to record them more than once.

The goal is to walk the transect once a week for 26 weeks, beginning the first week in April and ending the last week in September. Due to weather conditions and personal schedule the transect may not be walked on the same day every week. In 2001, the first year of the study, intervals between walks ranged from 5 to 9 days. Rainfall during the month of April seems to be the norm causing at least one or two weeks to be missed during April each of the first five years of the transect. Occasionally, a week has been missed at other times due to the personal schedule of the recorder. When this has occurred, the numbers from the week before and the week after have been averaged and used for the missing week. The same person has acted as recorder for all weekly counts.

Transect Conditions

1. Counts are started no earlier than 11:00 A.M. local time and completed no later than 5:30 P.M.
2. Counts are not made when the temperature is below 13 °C. The temperature is recorded at the beginning of each transect walk.
3. Counts are not made when the wind is above a "5" on the Beaufort scale. This is estimated at the end of each transect walk.
4. Counts are not made when there is less than 60 % sunshine. This was determined by recording the following during each of the 12 sections along the transect: An "S" (100% sun) for sunny conditions, "FS" (50% sun) for filtered sun from high thin clouds, or a "C" (0% sun) for clouds blocking direct sunlight. The average was calculated to determine whether the transect qualified above 60% sunshine.
5. With very few exceptions, no voucher specimens are collected while walking the transect.
6. Problem butterflies can be netted and released for identification purposes as long as this can be done without difficulty or active pursuit.
7. No attempt is made to flush butterflies hidden from view.
8. Where identification is a problem, identification to the lowest recognizable taxonomic level is recorded. The data is not included in the species counts but is included in the total butterfly counts.

Results and Discussion

Species Richness

Eighty-two species have been recorded from Big Springs Hollow, with seventy-eight recorded during transect walks (See Species List, Appendix). At least two more species, *Oeneis chryxus,* and *Parnassius phoebus*, have been found higher up on Cascade Mountain but are not included in the Big Springs Hollow list. The year with the highest number of species was 2004 with sixty-two species while the lowest year was 2005 with forty-six species (Table 1).

During 2001, sixty species were recorded, with seven species on 17 April, increasing to a high of thirty-two species on 6 June, and ending with just four species on 24 September (Figure 1, Appendix). New additions were added to the species list each week until the end of July, with seven new additions being the highest for one week. This was reached three times, 17 April, 30 May, and 6 June (Figure 2). Only two more species were added during August, *Adelpha bredowi* and *Hesperia comma*. None were added in September. The highest count for a single transect walk was on 6 June 2001with thirty-two species.

References used for identification include: Howe (1975), Ferris (1980), Pyle (1981), and Brock (2003). References used for scientific names and English common names include: Gillette (1990, 1998), Brook (2003) and Opler (2003)

Index of Abundance

The "index of abundance" for an individual species is defined as the total number of butterflies counted for that species per year. It is calculated by adding together the individual species counts from all twenty-six weeks. This information can be used to compare the butterfly populations from year to year. Although the index of abundance is not an estimation of population size, it can reflect changes in population levels (Pollard and Yates 1993).

This number may not reflect the actual number of individual butterflies along the transect because the same butterfly may be counted during consecutive weeks. Species that endure as adults for longer periods may show higher indices than a species with a short adult life even though their numbers on a given week may be quite high (Pollard and Yates 1993). Also, more active species may show higher indices than sedentary species simply because they are not observed (Pollard and Yates 1993). However, as long as transect walks are completed in a consistent manner, the yearly index of abundance for each species should be comparable.

Misidentification of similar appearing species is a source of inaccuracy in the results. Flying individuals present a greater problem than perched individuals. With an experienced recorder, most species can be identified with few errors. Troublesome individuals were netted and examined when possible. A few closely related species groups presented problems such as the fritillaries (*Speyeria*), duskywings (*Erynnis*), blues (Lycaenids) and whites (*Pieris* and *Pontia*). A knowledge of their flight periods from 2001 was helpful in identification during later years.

Only three species showed a definite increase in their index of abundance from 2001 to 2005, while thirty species showed a definite decrease. Eighteen remained relatively stable, and thirty-one fluctuated from year to year.

Butterfly Totals

During 2001, the first year of the transect, a total of 2937 butterflies were counted beginning with 13 butterflies on 17 April, increasing to a peak of 213 butterflies on 6 June, then declining and peaking again with 255 on 7 August, and ending with 6 butterflies on 24 September (Figure 3). The majority of butterflies on 7 August (197 of 255) were *Ochlodes sylvanoides* (western skipper). The total yearly butterfly count was greatly affected by large numbers of

puddling and nectaring western skippers, 2032 of this species alone in 2003. Large areas of grasses, the larval foodplant for the western skipper, seems to have made Big Springs Hollow quite favorable for the butterfly.

The total number of butterflies have fluctuated widely during the five years of the survey (Table 1). After removing western skippers from the yearly counts and then comparing the remaining number of butterflies for all five years, a very low count (552) was observed in 2005 when compared to the other years (Table 1). I believe this large difference was primarily due to the cool, wet weather during most of May and June in 2005 (WRCC, Deer Creek Dam Station 2006). Although counts were taken on days when temperatures and cloud cover were within the transect guidelines, I believe the overall cool, wet weather may have caused a higher than normal mortality of adults and/or larvae. By contrast, weather conditions in May and June of 2001 (WRCC, Deer Creek Dam Station 2006) were the complete opposite with lots of sunshine and very little rain. These conditions may have improved the survival of larvae and adults which resulted in much higher butterfly counts that year. Weather conditions, particularly precipitation patterns, seem to have a large impact on butterfly numbers in Big Springs Hollow.

Individual Species Results and Flight Periods

In April of 2001, the migratory species *Vanessa cardui* (Painted Lady), entered Utah Valley in large numbers. Their index of abundance for Big Springs Hollow in 2001 was 197.5, the third highest count for any species that year. Their numbers on the transect in Big Springs Hollow peaked on 8 May 2001 with thirty butterflies (Figure 4). Then decreased each week until the end of May. The remaining butterflies were well worn and ragged. A fresh brood began to emerge by the first of June and peaked at forty-two butterflies on 20 June. By early July their numbers had dropped sharply. They appeared to have left the area. Few even worn specimens remained. Because of its migratory habits, the index of abundance for the painted lady has fluctuated widely from year to year, with higher numbers some years(2001, 2003, 2005) and totally absent (2002) or very low numbers other years (2004)(Figure 5).

One of the more common species of late Spring is *Coenonympha tullia brenda* (Common Ringlet). The weekly averages for all five years confirms that the Common Ringlet is single-brooded in Big Springs Hollow (Figure 6). The yearly index of abundance was fairly stable for the first four years (around seventy) and then dropped to thirty-two in 2005 (Figure 7). Again, I believe the wet weather in May and June of 2005 playing a role in the reduced numbers that year.

The beautiful all white, *Pieris marginalis pallidissima* (Pure White) is fairly common in Big Springs Hollow with an index of abundance of 51.5 in 2005. The weekly averages for all five years clearly shows the pure white to be bivoltine, peaking in late May and again in late July (Figure 8). Its index of abundance has shown an increase over the last two years (Figure 9).

Each year, *Ochlodes sylvanoides* (western skipper) consistently has the highest index of abundance of any butterfly (Table 1). Its late season fight period is quite long, ranging from the first week in July to the last week in September (Figure 10). However, fresh specimens did not replace worn ones after the first few weeks. Instead worn specimens seemed to endure, slowly becoming more faded and tattered. Their numbers dropped drastically in September, possibly due to killing frosts and/or loss of nectar sources.

Everes amyntula (western tailed blue) is the most common Lycaenid in Big Springs Hollow. It's flight period ranges through all weeks in May and June peaking the last week of May (Figure 11). *Plebejus melissa* (orange-bordered blue) is the only blue that is bivoltine in Big Springs Hollow, with smaller counts in May and June and much larger counts in early August (Figure 12). It is also the only blue to fly during August and September.

Three species of crescents occur in Big Springs Hollow. The common species *Phyciodes cocyta* (northern crescent) is the only one that is univoltine with numbers peaking in late May to early June (Figure 13). *Phyciodes mylitta* (thistle crescent) and *Phyciodes pulchella* (field crescent) are both bivoltine. Figure 14 illustrates the consistency of the two flight periods of *Phyciodes pulchella* for 2001-2003.

Seven species of *Speyeria* (fritillaries) have been netted and verified along the transect in Big Springs Hollow (See Species List). Most are more common at higher elevations in the canyon. Identifying *Speyeria* on the wing, particularly as they began to fade, has proven to be too difficult to acquire any accurate species counts. One species that can be identified in flight is the deep orange-colored *Speyeria leto letona* (western spangled fritillary). Due to its sexual dimorphism, transect counts for both males and females were obtained. In 2001, the index of abundance for the males was 56, while the females was 14. The males first appeared on 25 June, peaking on 10 July and persisting into late August. The females appeared later on 10 July and peaking much later on 14 August (Figure 15).

The index of abundance for all fritillaries combined dropped drastically from 149.5 in 2001 to eight in 2005, then recovered with 121 in 2006 (Figure 16). One hypothesis for the decline may be drought-related (WRCC, Deer Creek Dam Station 2006). The drought years from 2001-2004 may have decreased soil moisture at lower elevations affecting the growth of the violets (larval foodplant for the fritillaries) and the mortality of the butterfly larvae. Cool,

wet weather in May and June of 2005 may have reduced the butterfly numbers even further. However, this may have actually helped the growth of violets that Spring which in turn may have helped the butterfly numbers increase the following year in 2006. Although no data has been taken from higher elevations in Big Springs Hollow, fritillaries are more common higher up than they are along the transect. Soil moisture may be an important abiotic factor that determines the elevation range of the fritillaries with populations receding to higher elevations during drought periods, then increasing in numbers at lower elevations after wet years. This hypothesis, is worth further study.

One species that seems to have disappeared from Big Springs Hollow is *Colias occidentalis wasatchia* (Golden Sulfur). Its index of abundance has slowly dropped from twenty in 2001 to zero in 2005 and 2006 (Figure 17). Big Springs Hollow seems to have been a fringe habitat for *C. occidentalis wasatchia* because of its lower elevation and isolation from neighboring colonies.

Thirteen species of Hesperiidae (skippers) have been recorded on the Big Springs Hollow transect (See Species List). The most interesting is *Amblyscirtes vialis* (roadside skipper)(Figure 19). Its distribution in Utah is confined primarily to Utah County, with Big Springs Hollow being the focal point. Its flight period is shown in Figure 18.

The five years of data collected at the transect site provides valuable information about the butterfly populations found in Big Springs Hollow. Continued monitoring will help us better understand factors that affect changes in populations within ecosystems. I feel that not only this study, but similar studies elsewhere will give much insight into population dynamics and the effect of human impact on our environment.

For more information including complete results, please contact Alan R. Myrup at: alanm@provo.edu

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12. Western Regional Climate Center (WRCC), June 2006; www.wrcc.dri.edu

Table 1 - Total Butterfly Counts 2001-2005

Year	Total Species	Total Butterflies	Total Western Skippers	Total without Western Skippers
2001	60	2937	1035	1902
2002	59	1950	902	1048
2003	60	3447	2032	1415
2004	62	1715	625	1090
2005	46	2314	1762	552

Appendix

Big Springs Hollow Butterfly Species List (82 Species)

	Common Name	Scientific Name	Date Observed
		Papilionidae	
1.	Cliff Swallowtail	*Papilio indra*	23 June, 1998
2.	Anise Swallowtail	*Papilio zelicaon*	25 April, 2001
3.	Western Tiger Swallowtail	*Papilio rutulus*	30 May, 2001
4.	Great Western Swallowtail	*Papilio multicaudatus*	30 May, 2001
5.	Pale Tiger Swallowtail	*Papilio eurymedon*	6 June, 2001
6.	Western Black Swallowtail	*Papilio bairdi* fm. *brucei*	23 July, 2001
7.	American Red Pearl	*Parnassius clodius*	4 July, 2002
		Pieridae	
1.	Sara Orangetip	*Anthocharis sara browningi*	17 April, 2001
2.	Creamy Marblewing	*Euchloe ausonides*	25 April, 2001
3.	Common Sulfur	*Colias philodice*	25 April, 2001
4.	Cabbage White	*Pieris rapae*	30 April, 2001
5.	Pure White	*Pieris marginalis pallidissima*	17 May, 2001
6.	Western White	*Pontia occidentalis*	17 May, 2001
7.	Golden Sulfur	*Colias occidentalis wasatchia*	30 May, 2001
8.	Sagebrush White	*Pontia beckeri*	20 June, 2001
9.	Checkered White	*Pontia protodice*	6 June, 2001
10.	Alfalfa Butterfly	*Colias eurytheme*	6 June, 2001
11.	Desert White	*Pontia sisymbrii*	6 May, 2002
12.	Dwarf Yellow	*Nathalis iole*	23 April 2005
		Lycaenidae	
1.	Clover Blue	*Plebejus saepiolus*	23 June, 1998
2.	Spring Azure	*Celastrina ladon*	17 April, 2001
3.	Silvery Blue	*Glaucopsyche lygdamus*	30 April, 2001
4.	Western Tailed Blue	*Everes amyntula*	8 May, 2001
5.	Orange-bordered Blue	*Plebejus melissa*	17 May, 2001
6.	Acmon Blue	*Plebejus acmon lutzi*	4 July, 2002
7.	Boisduvals Blue	*Plebejus icarioides*	20 June, 2001
8.	Dotted Blue	*Euphilotes enoptes ancilla*	27 June, 2003
9.	Grey Hairstreak	*Strymon melinus*	25 June, 2001
10.	Colorado Hairstreak	*Hypaurotis crysalus*	10 July, 2001
11.	Willow Hairstreak	*Satyrium sylvinum*	30 July, 2001
12.	Brown Elfin	*Incisalia augustinus*	29 April, 2002
13.	Purplish Copper	*Lycaena helloides*	23 May, 2001
14	Blotched Copper	*Lycaena editha*	3 July, 2001
15.	Lilac-bordered Copper	*Lycaena nivalis*	3 July, 2001
16.	Solitary Blue	*Hemiargus isola*	22 June, 2004
		Nymphalidae	
1.	Golden Anglewing	*Polygonia satyrus*	17 April, 2001
2.	Green-Spotted Anglewing	*Polygonia faunus*	17 April, 2001
3.	Thistle Crescent	*Phyciodes mylitta*	17 April, 2001
4.	California Tortoiseshell	*Nymphalis californica*	17 April, 2001
5.	Painted Lady	*Vanessa cardui*	17 April, 2001
6.	Rusty Anglewing	*Polygonia zephyrus*	25 April, 2001
7.	Red Admiral	*Vanessa atalanta*	8 May, 2001
8.	Mourning Cloak	*Nymphalis antiopa*	8 May, 2001
9.	Field Crescent	*Phyciodes pulchella camillus*	17 May, 2001
10.	Pearl Crescent	*Phyciodes cocyta*	30 May, 2001
11.	Sagebrush Checkerspot	*Charidryas acastus*	30 May, 2001
12.	Middlerockies Bolorian	*Boloria kriemhild*	30 May, 2001
13.	Utah Egleis Fritillary	*Speyeria egleis utahensis*	6 June, 2001
14.	Western Admiral	*Limenitis weidemeyeri*	6 June, 2001
15.	American Tortoiseshell	*Nymphalis milberti*	6 June, 2001

16.	Variegated Fritillary	*Euptoieta claudia*	20 June, 2001
17.	Northern Checkerspot	*Charidryas palla*	25 June, 2001
18.	Western Spangled Fritillary	*Speyeria leto letona*	25 June, 2001
19.	Western Lady	*Vanessa carye*	10 July, 2001
20.	American Painted Lady	*Vanessa virginiensis*	10 July, 2001
21.	Zerene Fritillary	*Speyeria zerene platina*	10 July, 2001
22.	Coronis Fritillary	*Speyeria coronis snyderi*	10 July, 2001
23.	Dark Fritillary	*Speyeria atlantis wasatchia*	23 July, 2001
24.	California Sister	*Adelpha bredowi*	28 Aug. 2001
25.	Callippe Fritillary	*Speyeria callippe harmonia*	28 June, 2002
26.	Anicia Checkerspot	*Euphydryas anicia*	10 July, 2002
27.	Mormon Fritillary	*Speyeria mormonia*	16 July, 2002
28.	Buckeye	*Precis coenia*	7 July, 2005
		Danaidae	
1.	Monarch	*Danaus plexippus*	8 July, 2004
		Satyridae	
1.	Common Ringlet	*Coenonympha tullia brenda*	17 May, 2001
2.	Small Woodnymph	*Cercyonis oetus*	16 July, 2002
3.	Great Basin Woodnymph	*Cercyonis sthenele*	1 Aug. 2003
		Hesperiidae	
1.	Gambel Oak Duskywing	*Erynnis telemachus*	30 April, 2001
2.	Checkered Skipper	*Pyrgus communis*	8 May, 2001
3.	Jagged-border Skipper	*Hesperia juba*	8 May, 2001
4.	Northern Cloudywing	*Thorybes pylades*	17 May, 2001
5.	Hairy Duskywing	*Erynnis persius*	23 May, 2001
6.	Roadside Skipper	*Amblyscirtes vialis*	30 May, 2001
7.	Western Skipperling	*Oarisma garita*	6 June, 2001
8.	Dreamy Duskywing	*Erynnis icelus*	15 June, 2001
9.	Mountain Cloudywing	*Thorybes mexicana*	15 June, 2001
10.	Russet Skipperling	*Piruna pirus*	3 July, 2001
11.	Golden Skipper	*Poanes taxiles*	3 July, 2001
12.	Western Skipper	*Ochlodes sylvanoides*	10 July, 2001
13.	Common Branded Skipper	*Hesperia comma*	28 Aug. 2001
14.	Buckthorn Duskywing	*Erynnis pacuvius*	16 July, 2002
15.	Two-banded Checkered Skipper	*Pyrgus ruralis*	2 July, 2003

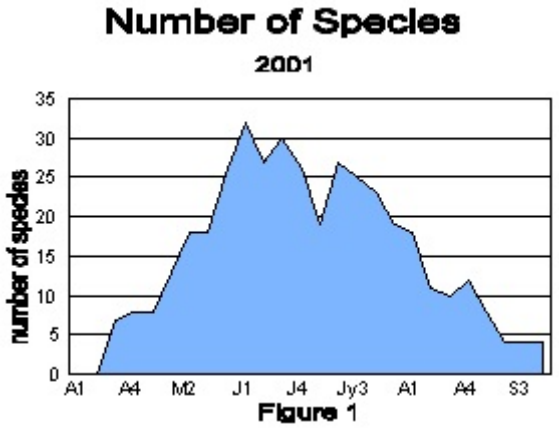


Figure 1

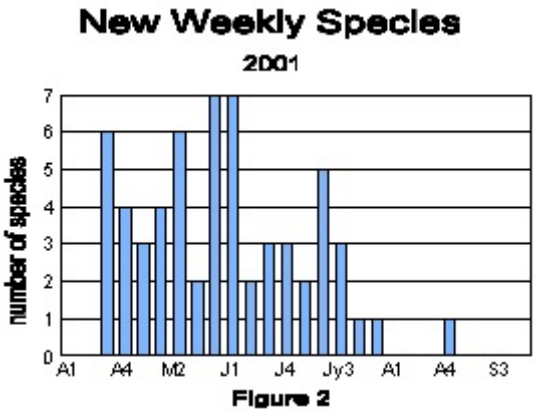
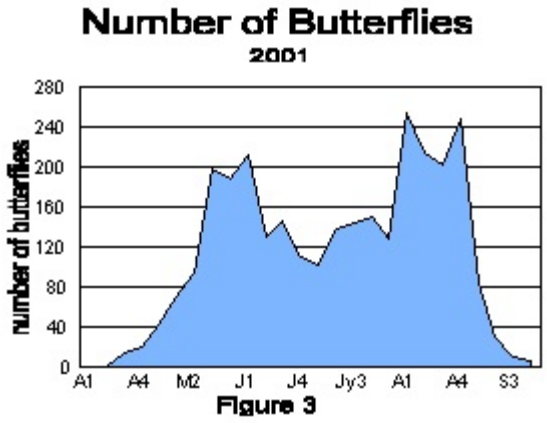


Figure 2



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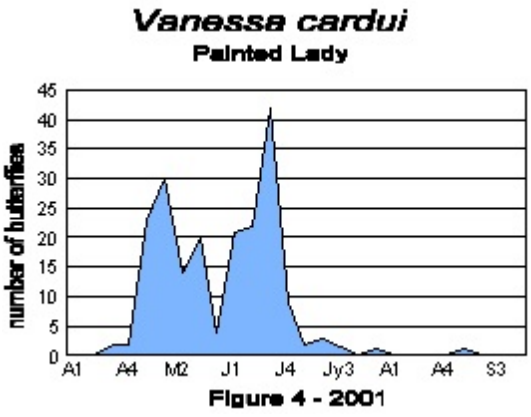

Figure 4 - 2001

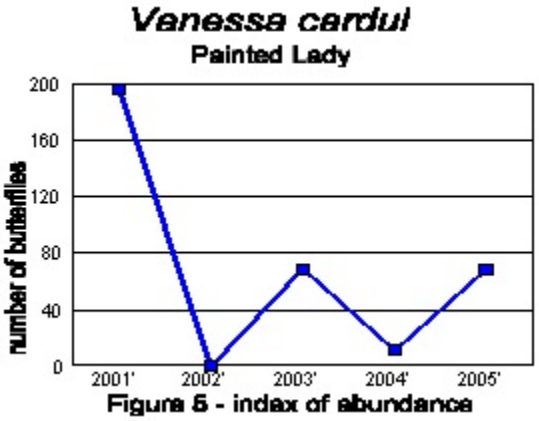

Figure 5 - index of abundance

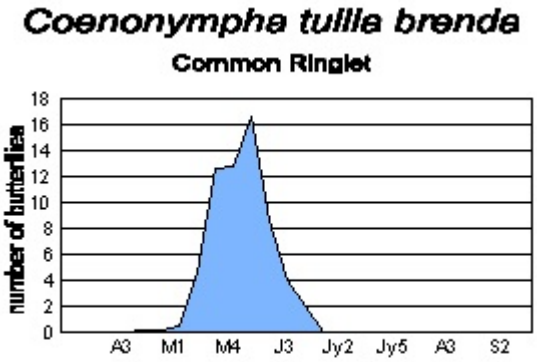

Figure 6 - Average 2001-2005

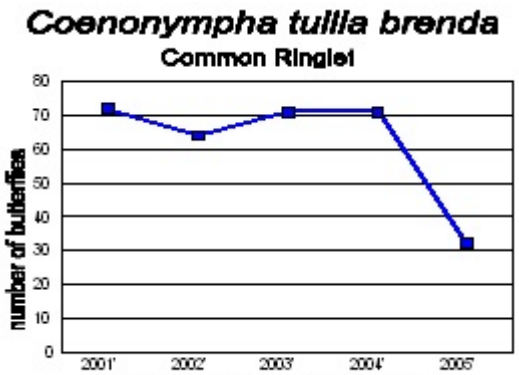

Figure 7 - Index of Abundance

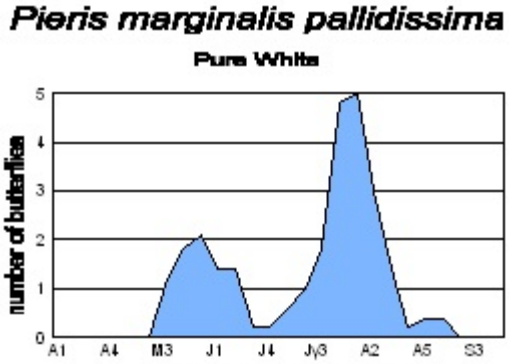

Figure 8 - Average 2001-2005

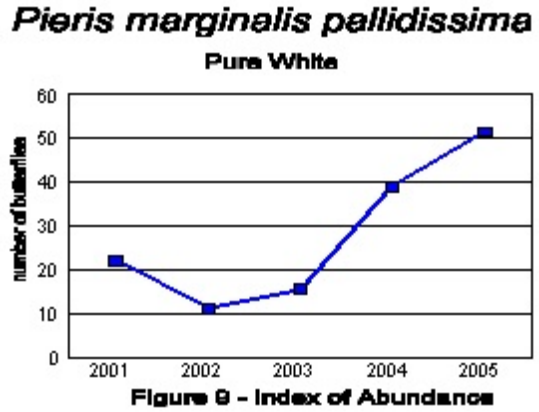

Figure 9 - Index of Abundance

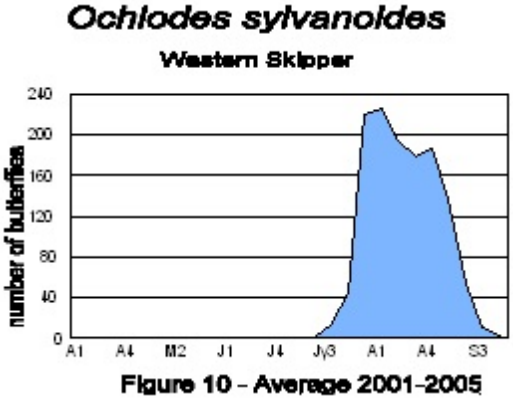

Figure 10 - Average 2001-2005

Everes amyntula

Western Tailed Blue

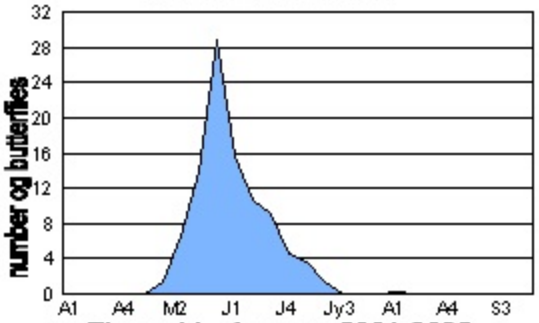

Figure 11 - Average 2001-2005

Plebejus melissa

Orange Bordered Blue

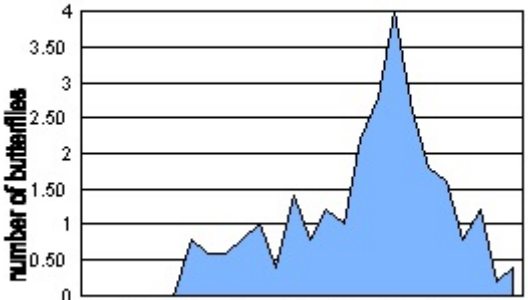

Figure 12 – Average 2001-2005

Crescents 2001

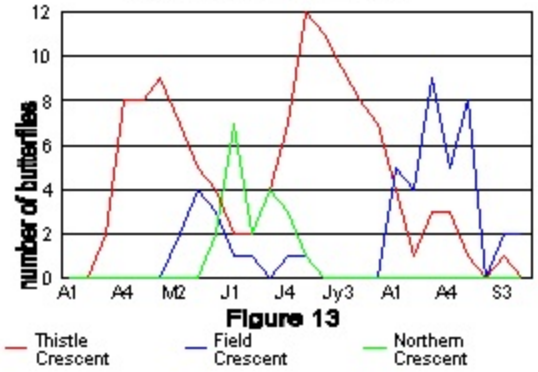

Figure 13

Thistle Crescent — Field Crescent — Northern Crescent

Phyciodes pulchella camilla

Field Crescent

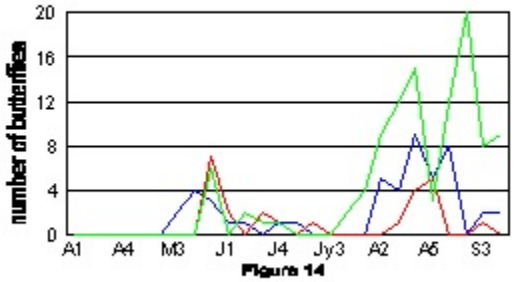

Figure 14

2001' — 2002' — 2003'

Speyeria leto letona

Western Spangled Fritillary 2001

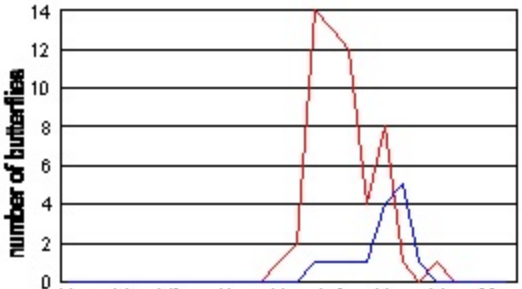

Figure 15 — Males — Females

All Fritillaires Combined 2001-2006

Figure 16 – Index of Abundance

Colias occidentalis wasatchia

Utah Golden Sulfur

Figure 17 – Index of Abundance

Amblyscirtes vialis

Roadside Skipper

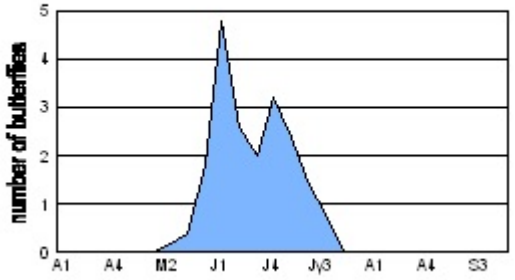

Figure 18 – Average 2001-2006

Contents Of This Issue

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Figure 19 - *Amblyscirtes vialis* (Roadside Skipper) from Big Springs Hollow.