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Field studies and Conservation planning for the endangered Laguna Mountains Skipper *Pyrgus ruralis lagunae*

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Introduction

During 1997 and 1998 we conducted an exploratory program to elucidate natural history and demographic characteristics of the endangered Laguna Mountains Skipper (LMS) in order to outline a sound conservation plan. The species was apparently historically found throughout the wet subalpine meadows and forest openings of the Laguna, Palomar, and possibly Cuyamaca Mountains. Today it appears restricted to a few sites in the Palomar and Laguna Mountains where its populations have declined. Our assessment of decline is anecdotal, based on past collecting records and recollections of a few collectors, but unquestionably accurate in overall outline. Because the decline of the LMS, in parallel with most increasingly rare species, correlates with the general expansion of human enterprises, its ultimate conservation will require some management. Before a meaningful management plan can be designed, however, it is first necessary to understand the natural history of the target species and its place in the biotic community. Such data are virtually non-existent ~~for~~ the LMS.

We attempt to answer the following questions, which we briefly state with the results obtained, followed by our tentative management conclusions and plans for continued future efforts.

1. How many annual generations are there for the LMS?
2. What are the life history characteristics of the LMS that are important in defining its distribution and abundance?
3. Is the LMS restricted to *Horkelia clevelandii* as a larval foodplant?
4. How widely distributed are extant LMS populations?
5. Are populations distributed in a uniform, random, or aggregated pattern and what determines the pattern discriminated?
6. Are the populations of each meadow isolated, or is there dispersal among meadows?
7. Are extant population sizes cause for concern?
8. To what extent, and how, does grazing impact survivability of the LMS?
9. Will the hypothesized global climatic changes affect the LMS?
10. Can the LMS be bred in captivity, is captive breeding necessary, and what would a long range program cost?
11. Can a tentative managment plan be designed based on present knowledge?

1. How many annual generations are there for the LMS?

Although Levy (1994) claimed the LMS is bivoltine, that is has two discrete generations per year, John Emmel and Gordon Pratt asserted the species more likely had one attenuated generation. We conclusively determined that there are two discrete generations at Mendenhall Valley. In 1997 the first flight was from mid-April (15 adults and 2 eggs found April 26) to mid-May (2 adults, 20 eggs, and 12 early larvae found May 14; on May 21 no adults were seen but many hatched eggs and 16 - 1 to 3 instar larvae found). On June 3, 30 3 & 4 instar larvae and one pupa were found. On July 2, ten adults (six males, four females) were observed. No adults were seen on July 17, but many eggs and 2 fist instar larvae were found.

The second flight was of shorter duration and with an apparent lower density than the first. The latter conclusion was based on fewer early stage materials found per unit time searching (Pratt, pers. comm.). The general condition of *Horkelia* was different during adult flight times, with the plants in full flower for the July flight and the leaves somewhat drier. *Horkelia* provided the major nectar source, other nectar resources for the second generation were very much diminished, especially with senescence of goldfields, *Sidalcea*, and *Ranunculus*. Vegetative parts of *Horkelia* were drier with progression of summer, and the lush outer leaves on which most eggs are deposited had become hardened with some burnt edges.

Populations have not yet been found in the Laguna Mountains, but likely occur there. The flight period of the Laguna Mountains populations may vary from those of the Palomars because of the higher altitude (c. 1000 ft.), but data assembled from several collections resources by Levy (1994) imply there are likewise two generations with about the same flight spans.

2. What are the important life history characteristics of the LMS in defining its persistence?

General life history. Early stages have been collected and preserved for later detailed description. Superficially all stages closely resemble other members of the genus *Pyrgus* which have been described for several species. For example, Thust et al. (1997. Nachrichten Ent. Ver. Apollo 18:109-128) completed a thorough study of egg morphology of ten European species of *Pyrgus* and found no differences at the ultra-microscopic level using SEM. The eggs of all are large, white, and easily seen.

The eggs are almost entirely laid on the undersides of the larger outer green fresh leaves of robust *Horkelia* plants. Most plants selected for oviposition sites were situated among clumps of several plants with each individual consisting of a number of rosettes. The preferred sites were undersides of large fresh green marginal leafs. One particular "hot-spot" for eggs and larvae was on plants found on rocky, thin soil about 30 m from the forest edge. The plant community was entirely native with less than 50% cover such that the leaves of *Horkelia* projected over bare soil substrate and were neither shaded or undergrown by other plants. There was a high density of goldfields throughout the "hot-spot" that served as adult nectar source. During a two hour search period in April over 30 eggs and larvae were located within a 20 m circumference.

By the time of the second generation flight, drought and grazing substantially reduced optimal *Horkelia* tissue. Few large green marginal leafs were available in July. The goldfields had largely senesced and the only nectar source now was *Horkelia* itself. Some second generation eggs were found on flowerheads as well as the few acceptable leafs. Grazing removed substantial *Horkelia* flowerheads.

All *Pyrgus* species have similar larvae, cylindrical, yellowish- to greenish-white when mature, covered with fine hairs. Head black, width larger than thorax. Like most skippers they weave leaves of their foodplant together as a shelter. As the larvae grow they move to larger shelters and finally pupate within the shelter. Diapause to survive winter is in the pupal stage. There are five larval instars from egg to pupation in the LMS. From what data we have, following individuals from egg to disappearance, larvae are completely sedentary, remaining on a single plant or rosette, from egg to late instar.

Shelters woven together by the larvae of all instars are fairly distinctive even for neonates. When occupied, or very recently abandoned, shelters provide a valuable resource for efficiently monitoring population densities in contrast with adults (monitoring — see below).

Over 30 locations for eggs found in the field were flagged for key factor determination. However, most of the flags were knocked over by cattle. Of the two eggs actually seen oviposited on April 29, both hatched on May 8 (12 days for development in the field). On May 14 both had woven shelters, one by joining two large leafs, the second by joining several small leaves. When next observed on May 21, the first had presumably been eaten and the plant trampled, the second was in its second instar. Prior to the June 3 visit, the second larva, and flag, also disappeared.

Parasitoids. The few remaining flagged sites yielded several pupae, but the majority of over 30 positions were lost or the flags displaced. Several eggs were parasitized, presumably all by *Trichogramma brevicappelus,* which was determined from a few egg samples. *Trichogramma* parasitism accounts for 30-40% of egg mortality. An empty shelter was found with a dried dead larva and several characteristic braconid cocoons, probably *Apanteles*. None of the few larvae or pupae taken from the field produced parasitoids, although the sample was too small for other than general indications.

Adult behavior. In dealing with the biology of adults, no data have been collected that quantitatively define adult longevity in either the field or laboratory. Likewise mating behavior has not been observed, but likely involves male patrolling. Because of rapid flight and sensitivity to the human presence, the LMS is difficult to observe. Its only quiet times are when nectaring and during oviposition. The spring generation nectars on *Pentachaeta* (goldfields), *Ranunculus* (buttercups), and *Sidalcea* (checker) and the summer generation mostly *Horkelia*. Note these are the predominant blooming plants of the seasons. There have been insufficient observations of territoriality, and obviously there are no hilltopping correlations.

3. Is the LMS restricted to *Horkelia clevelandii* as a larval foodplant?

Horkelia clevelandii has always been the assumed foodplant, John Emmel (pers. comm.) noted the association and reared the species on the plant from specimens in the Laguna Mountains in the 1980s. The nominate subspecies is known to use *Potentilla glandulosa* and other alpine species. The related *Pyrgus xanthus* uses *Potentilla gracilis*. Since both *Potentilla* species occur across the upper altitude peninsular ranges, together with *Horkelia*, we attempted an oviposition choice experiment involving all three.

The experimental setup was a cylindrical clear plastic cage about 50 cm in diameter and 80 cm tall. The base was a plywood circle with three holes cut to accommodate one gallon plastic pots in which foodplants were growing. Specimens of *Horkelia clevelandii, Potentilla glandulosa,* and *P. gracilis* had been earlier transplanted from Mendenhall Valley. Three females were collected on July 3 and brought from Mendenhall Valley to the Geography Department Captive Breeding Laboratory. One was placed in the cage and fed 10% honey water solution once daily. The other two females were caged separately with *Horkelia* and *P. glandulosa.*

The first female laid 20 eggs on *Potentilla glandulosa*; 1 on *P. gracilis,* and none on *H. clevelandii.* The second female laid 3 eggs on *H. clevelandii,* The third female laid 6 eggs on *Potentilla glandulosa*. The females died after 5, 2, and 5 days respectively. The short life span was likely due to high temperatures and extreme dryness. The animals were placed outdoors to oviposit, and care was taken to screen them from direct sun. The females were not dissected to provide a count of remaining eggs for an estimate of fecundity potential because of their clearly premature deaths.

All eggs hatched, demonstrating 100% fertility, and 16 survived to pupation. The losses were all of neonate larvae, in part for unknown causes and in part from Argentine ants. All larvae were left to feed on the plant of their oviposition site except those from *P. glandulosa*, which were partitioned to several plants during the mid-instars to avoid feeding competition. The pupae are now in diapause. If they synchronously hatch we will attempt mating using several cage types that have been successful with other butterflies.

The significance of the experiment is to unequivocally show that the LMS potentially has three foodplants in the peninsular ranges with a concomitantly larger potential distribution both geographically and ecologically. In a following section we show that while *Horkelia clevelandii* has a clumped distribution and is a meadow species largely associated with the meadow - forest interface, *Potentilla glandulosa* narrowly overlaps at the interface with its distribution largely in the forest understory. *P. gracilis* on the other hand is mostly found in the meadow itself and by comparison is rare with a more random distribution.

A model of the LMS population must take into account the potential use of the three plants and how this may relate to movements and dispersal of the species.

4. How widely distributed are extant LMS populations?

Laguna Mountains. Pratt and Pierce made an initial trip to the Laguna Mountains on April 29, finding *Horkelia* abundant at El Prado Campground. In the nearby grazed meadows the plant was damaged by heavy grazing. Horse Heaven, Los Huercos, and Agua Dulce campgrounds were inspected with *Horkelia* variously present. Goldfields were common where grazing impact was minimal and the related western checkered skipper (WCS) *Pyrgus communis* likewise abundant. No LMS were sighted.

Pratt and George further explored the Laguna Mountains on June 17, examining *Horkelia* at El Prado Campground, across a random 10 km walk over the large meadow around Big Laguna Lake, and finally a small meadow above Crouch Valley. *Horkelia* were present everywhere, but patchy. In cattle grazed areas there was extensive damage to *Horkelia* along with the few other nectar sources. Insect foraging damage was seen on most patches investigated, with that most indicative of LMS at Crouch Valley. No LMS adults were sighted, although the similar WCS was common at all sites. If present, the LMS must occur at substantially lower densities than at Mendenhall Valley. Given the extent of *Horkelia* foodplant and presence of the likely used *Potentilla glandulosa* and *P. gracilis* throughout the area, we believe that the LMS remains extant in the Laguna Mountains and will be discovered given more than our one day effort in a dry year during what may be the pause between spring and summer generations.

Palomar Mountains. Although our major effort was concentrated in Mendenhall Valley, Pratt and George walked through Doane and lower French valleys on July 3. *Horkelia* was found at both sites, occurring in greater densities at lower French valley. No adult LMS were sighted, although earlier in the day at least ten were seen at Mendenhall Valley including four nectaring and three males mud-puddling. Levy (1994, 1997) reported a small colony from lower French Valley based on some 18 sightings on two visits in July 1994. One more was seen in 1996, but the site was never regularly visited.

The only sightings of the LMS outside Mendenhall Valley in 1997 were at Observatory campground. On May 21, Pratt and Pierce found 2 mature larvae and one egg on the small patch of *Horkelia.* The finds indicate that these early stages represent two brief, but independent sojourns by LMS females.

We conclude that there is only a single significant place where the LMS occurs — Mendenhall Valley in the Palomar Mountains. The butterfly likely still exists in the Laguna range, and may be widely distributed across the whole sub-alpine region of the Palomars, but it is rarely visible beyond Mendenhall.

5. Are LMS populations distributed in a uniform, random, or aggregated pattern and what determines the pattern discriminated?

Adults. Prior to the 1997 season our reasoned that the most effective approach for monitoring the LMS population that could provide comparative data over a period of years would be to set out permanent transects as described by Pollard for the now well documented butterfly surveys in England. In addition to producing quantitative data, the results might reveal patterns of distribution. The FWS adopted this approach and it was agreed J. Levy would be responsible for its implementation.

Levy (1994, 1996, 1997) reported his total sighting of LMS adults for the years 1994, 1995, 1996 and 1997 for the region. Altogether he sighted approximately 40 specimens in 1994, 30 in 1996 and 15 in 1997. Of the latter, only 5 were sighted on the transect. During 1997 we (observations mostly by Pratt) sighted about 47 adult LMS, all at Mendenhall Valley (see summary below). Details of their positions were not noted, but repeatably high densities occurred in a few "hot-spots" with general highest frequency along the meadow forest interface on the south. This pattern of adult LMS distribution appears highly correlated with larval foodplant distribution, modified on a micro scale by nectar sources — at least in the spring generation.

Under the best of circumstances, quantitative monitoring adult LMS is of dubious management value, is inefficient, is not repeatable, has unreliable individual biases, and not cost effective. Knowing that in general early stages of most non-tree feeding skippers can be found, we began searches to ascertain whether these stages could be reliably found by expert personnel. A caveat was that the adults had been heretofore reported in very low densities in the presence of a large quantity of (*Horkelia*) foodplant. A suggestion of LMS $N_t < 500$, in the presence of 10,000 -100,000 foodplant rosettes, would likewise not be efficient.

Early Stages. Our first searches for early stages were on our first spring visit, April 26. These were in conjunction with preparing test plots for estimating grazing effects which we planned to census using early stages. During our stay a female was seen laying two eggs on the undersides of *Horkelia* leafs (see above). Both eggs were highly visible, white, on the dark green leaf underside.

We measured and flagged two transects that extend across Mendenhall Valley from north to south. From the south they start in foodplant rich shade of the forest then running across the valley and up on the dry north (south-facing), almost barren, slope. The transects are two meters across and 250 meter long. We censused and tabulated each foodplant by one meter segments, but for convenience counted each meter segment as eight 50 cm square quadrats arranged 2x4. Foodplant was quantified by rosette number. We chose the number of rosettes as the best simple index of both biomass availability and plant spatial distribution. Mature rosettes are all about the same size, while individual plants (genets) may have from one to thirty or more rosettes (ramets) and substantially vary in cover area.

We subsequently counted foodplant along a north south transect along the south meadow - forest interface. The transect extends from the easternmost point of the Valley to the point where the road into the valley, along the south side, abruptly turns north across the meadow to the Mendenhall residence . Plants along this transect were censused in 50 meter increments. The transect was 4200 meters long.

The data for plant counts and early stages are given in tables 1 and 2. Table 1 shows the number of rosettes per 50 meter segment from east to west over 4.2 km. *Horkelia* distribution is obviously patchy, but in spite of high variance plant (rosette) density was similar over the whole range of the peripheral transect. The greatest gap between plants was 300 meters (6 segments with no plants). The greatest number of rosettes in a segment was 156. We did not search for early stages at any point except where the transverse transects intersect and at the extreme western end where we found several 2-4 instar larvae on August 7.

Foodplant numbers and egg or first instar larvae counts for the two transverse transects are given in Table 2. *Horkelia* distribution is highly skewed toward the forest edge ($p < 10^{-7}$).

6. Are the populations of each meadow isolated, or is there dispersal among meadows?

At present the global population status of the LMS can best be described as consisting of a large reservoir population situated in Mendenhall Valley that disperses regularly into adjacent forest patches where any of its three foodplants occur. Thus sites as Observatory campground, where there is insufficient foodplant to support more than a dozen skippers, are routinely repopulated as part of a net of vaguely interconnected demes. Similarly, the earlier observed lower French Valley inhabitants may part of this likely metapopulation that connects across the whole of the Palomar range alpine region. The small forest openings and meadows are all now incapable to supporting isolated viable populations. Our findings of two age cohorts of egg and mid-growth larvae at Observatory very clearly demonstrates only occasional LMS visits. The butterfly travels through the forest.

7. Are extant population sizes cause for concern?

The sum of observations of flying adults, including those of Levy, indicated that the standing adult population of the LMS of any one generation, at least at Mendenhall Valley, has been in the hundreds. Levy (1994) in fact extrapolated the spring 1994 Mendenhall Valley maximum population at N_t=240. Based on our findings from early stage and foodplant distribution on the transects, it is now possible to estimate a reasonably accurate total standing population size from egg and larva census. Extrapolating transect counts in both directions, total rosette population of the part of the valley censused is on the order of 651,000 (average 310 T-1 and T-2). Now taking the average number of eggs per rosette (14 eggs/619 rosettes on transects A and B), assuming an average fecundity of 40 eggs per female, equal sex ratios, and a 50% efficient search efficiency (probably too high), $N_t \sim 1470$. N_e is at least half the total because of low density (inefficient mate locating) and short life span relative to flight duration of any generation.

The close agreement with Levy's differently based N_t is of interest, but also indicative of the compromised status of the LMS. Population viability is problematic from the standpoint of classic population viability analysis, especially bearing in mind fact that this population is the only reservoir remaining. There is no room for error should any local disaster happen, as an intense fire during critical life stages in summer or the more likely hydrologic change resulting from groundwater removal on changing the ecology of the forest and meadows. The latter event would be devastating to cattle grazing as well. Apparent loss, or at least extreme reduction, of the Laguna Mountains LMS population is an additional cause for concern because of potential wider scale ramifications.

These causes for concern give ample reason to rapidly explore management procedures that might prevent further deterioration.

8. What impacts provide the greatest threat to the continued existence of the LMS?

The obvious agents of change in the alpine peninsular ranges have been 1) introduction of cattle grazing, 2) fire suppression, and 3) hydrological change from groundwater mining. Subtle interactions and unidentified factors attendant to increasing occupation of the ranges may be important, but few have been identified.

Extensive work on butterflies in the U.K. has shown sward height to be a critically important factor for many meadow species (Thomas, 1989; Oates, 1995). From our observations on oviposition preference sites, foodplant placement on open soil is a key factor. Densely shaded plants seem unsuitable for LMS. Accordingly there is likely some grazing regime that is optimal for the LMS. Defining this objective is not simple, however, because of the dynamics of the system.

Undergrazing was suggested by Levy (1997) for the disappearance of the LMS on some State Park land where grazing has been prohibited. Conversely, we noted overgrazing at El Prado and the visible portions of Dyche Valley has seriously damaged meadow plant communities by increased erosion, extensive invasions by non-native weed species, and likely modified hydrological processes (Trimble, 1994. The cow as a geomorphological agent). Ironically the invasive weeds do not provide economic benefits for grazing.

There is no simple analysis for ranking impacts at this time, other than to call attention to changes that have ramifying effects on the entire biota of the region, native or husbanded.

9. Will the predicted global climatic changes affect the LMS?

Atmospheric warming is widely accepted as entrained, with variable biological consequences forecast. High altitude temperate biota will all be seriously impacted, following a model recently presented by K. A. McDonald and J. H. Brown (1992, Conservation Biology 6:406-415) for alpine species in the great basin mountain ranges. Species of the peninsular range aubalpine meadows would be expected to follow the same path — with increasing temperatures, biotic communities would necessarily move to higher altitudes to remain in a cool climate. Given a 3° C global temperature rise, the only direction that the LMS could move would be oblivion.

Unpredictable regional variance and general uncertainty make likelihood of extinction from global warming an elusive problem. Barring conclusive evidence, habitat management should proceed using the best science to enhance the LMS.

10. Can the LMS be bred in captivity, what would a long range program cost, and is captive breeding necessary?

We have determined that the LMS is simple to rear and maintain in diapause in captivity. We have not yet demonstrated whether adults will mate in captivity, however. The latter may be possible using the small population of diapausing pupae we are holding. This April we will remove these pupae from the refrigerator, where they are being held for synchronized emergence, and attempt matings. We have several cage types, light sources, and adequate foodplant for the purpose. We have not attempted to use synthetic diet, but such a diet can probably be formulated. Foodplant availability is a problem should mass rearing be attempted because of slow growth of both the native *Horkelia* and *Potentilla* foodplants.

Cost of a breeding program depends on whether the effort can be combined with existing programs with infrastructure and trained personnel in place. Setting up a specific facility with dedicated personnel would be prohibitive. For planning purposes we estimate a program for maintaining ten stock lines of 50-100 individuals each would cost $4000–7000 per year at the UCLA rearing facility.

The purpose of captive rearing is twofold: 1) as an emergency to save a species reduced to a few individuals as consequence of catastrophe or impending catastrophe or 2) for re-introduction into sites from which the species was extirpated. Neither purpose need be addressed for the LMS immediately, unless 1) the Laguna Mountains can be shown to be depopulated and a management goal set forth for re-introduction and/or 2) the Mendenhall Valley reservoir population is largely destroyed by a catastrophic event.

In either case it would be prudent to have a protocol established to implement a mass rearing program. We can document a protocol if the program continues another year. Information is needed on synthetic diets and mating inducement techniques.

Management Recommendations

The present situation for the LMS has been discussed above. Our work in 1997, although limited, provided important insights into the life and population structure of the LMS in the peninsular ranges. The species remains endangered because its viability appears to depend on a single reservoir population of marginal size. At such time as the species may be enhanced (or re-introduced) in the Laguna Mountains, steps should be implemented to assure population viability in the Palomars. Most immediately the experimental plot protocol we started in Mendenhall Valley should be expanded and modified to include our new insights, especially with regard to sampling. In particular, provision should be made to allow for longer term grazing rotation than two years, and another exclosure constructed to test for a different microclimate effect.

At present, although some grazing is beneficial, overgrazing is clearly deleterious for the LMS (and possibly other meadow organisms). In addition, the location of grazing is important. There may be some microsites — as the "hot-spot" for our early stage censuses which are on thin soils with remnant cryptobiotic crusts — that should not be grazed at all. Such sites are small and few. Other areas, including the major part of the meadow where there is little foodplant, may be grazed without concern for the LMS. Lastly, there were sections along the peripheral transect where the sward was over a foot high and the *Horkelia* nearly buried by this overstory. Here grazing intensity appears too light.

An emerging scenario suggests that cattle grazing is compatible with the alpine meadow communities of the peninsular ranges, as indicated by LMS populations. Grazing intensity becomes the critical management parameter, however, and requires definition both with respect to time cycle and duration, but also specific sites which have individual requirements.

A meaningful management plan will require several years of study. In the meantime searches should continue for distribution of early stages on the alternate *Potentilla glandulosa* through forest openings and small meadows in the Palomar range. Some effort should also be made to define whether the Laguna Mountains populations are extirpated, including foodplant sampling as well as adult sighting. The Mendenhall Valley population need be sampled for indications of critical size fluctuations, most efficiently by random observations of adults twice during the flight peaks of both generations but with two careful early stage censuses along the transects.

The experimental plots should be augmented for longer term studies to optimize grazing rotation and modified to provide arenas of augmented LMS early stage densities. The Services should consider mitigation measures that would permit temporary retirement of some small areas, to be defined by the study, that would permit their recovery. In the long run this would be beneficial to maintaining the meadow resources for economic as well as ecological optimization.

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Appendix, LMS observations summary field data
Abbreviated list of field observations of Laguna Mountain skippers and western checkered skippers in the Palomar Mountains, 1997, 1998

1997

April 16, Mendenhall Valley

15 sighted total. 2 eggs seen laid flagged for key factor notes

May 1, Mendenhall Valley

4 sighted total

May 8, Mendenhall Valley

4 adults sighted. ~20 eggs

May 14, Mendenhall Valley

2 adults sighted, 5 eggs & ~12 larvae found

May 21, Mendenhall Valley

~12 adults sighted, 4 eggs, 2 larvae, 9 eggs or neonate larvae

2 western checkered skipper (WCS) adults (first seen)

Observatory Campground

1 egg, 2 late instar larvae

June 3, Mendenhall Valley

No adults, 14 instar 2-4 larvae, 1 pupa (transects)

~10 larvae on plots and hot-spot

several WCS sighted (no LMS!)

July 3, Mendenhall Valley

6 male, 4 females sighted, nectaring or mud sipping

No WCS !

French and Doane Valleys, *Horkelia* present, no LMS adults

July 17, Mendenhall Valley

no adults, 6 eggs, many hatched eggs

several WCS sighted

August 8, Mendenhall Valley

1 - II and 1 - V instar larvae, 1 pupa

1998

May 25, Palomar Mountain, too cold to continue

June 3, Mendenhall Valley

2 males, 2 females

No WCS sighted (compare to 1997 date)

no eggs or larvae, searched c. 300 plants, transect and "hot-spot"

Table 1
Number of ***Horkelia*** rosettes found per 50 m along the forest-meadow ecotone in Mendenhall Valley. Location of the two cross-meadow transects indicated by T 1 and T 2 .

m	# ***Horkelia*** rosettes
0-50	26
50-100	1
100-150	1
150-200	23
200-250	142
250-300	68
300-350	18
350-400	97
400-450 (T 2)	156
450-500	33
500-550	15
550-600	84
600-650	26
650-700	27
700-750 (T 1)	96
750-800	64
800-850	17
850-900	70
900-950	22
950-1000	1
1000-1050	11
1050-1100	11
1100-1150	160
1150-1200	0
1200-1250	0
1250-1300	105
1300-1350	17
1350-1400	58
1400-1450	22
1450-1500	69
1500-1550	75
1550-1600	15
1600-1650	9
1650-1700	51
1700-1750	110
1750-1800	31
1800-1850	67
1850-1900	75
1900-1950	60
1950-2000	78
2000-2050	43
2050-2100	5
2100-2150	14
2150-2200	0
2200-2250	70
2250-2300	38
2300-2350	0
2350-2400	7
2400-2450	55
2450-2500	8
2500-2550	0
2550-2600	12
2600-2650	75
2650-2700	0
2700-2750	0
2750-2800	29
2800-2850	3
2850-2900	0
2900-2950	17
2950-3000	0
3000-3050	130
3050-3100	29
3100-3150	75
3150-3200	23
3200-3250	140
3250-3300	21
3300-3350	0
3350-3400	0
3400-3450	0
3450-3500	0
3500-3550	0
3550-3600	0
3600-3650	10
3650-3700	22
3700-3750	0
3750-3800	0
3800-3850	0
3850-3900	0
3900-3950	40
3950-4000	10
4000-4050	5
4050-4100	2
4100-4150	8
4150-4200	95

Table 2

The following two transects are 2m wide, and divided into 4 50 cm square quadrats. The number of rosettes of *Horkelia clevlandii* for each quadrat is recorded, with totals given in the last column. The transects begin at the tree line and extended east through the meadow to the opposite side. Asterisks (*) in the first column represent Laguna Mountains Skipper 2-4 instar larvae found on the transect, number given in (). Transects censused June 3.

Transect 1

meters	1	2	3	4	total
0.5					0
1					0
1.5					0
2					0
2.5					0
3					0
etc	3				3
4	4	1	1		6
	2	2	4	1	9
5	2	2	1		5
*	2 (1)				2
6	1				1
	6	4			10
7	2	5	2		9
	10	4	3	1	18
8		8	8	2	18
	1	5	2	10	18
9	8	1	4	1	14
*	4		4 (1)		8
10	3	1	1		5
					0
11					0
					0
12					0
					0
13					0
					0
14*	1	1 (1)	2	1	5
		7	4	3	14
15		4	2	1	7
		4	3		7
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	2	2		1	5
17	3	1		2	6
	2	3			5
18		2	4	4	10
	2	1	5	4	12
19		3	6	6	15
	1	3	3	1	8

20*	3		1 (1)	1	5
	2	6			8
21	3	1	1		5
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22	1	3	4	2	10
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23	4				4
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24			1		1
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27				1	1
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28*	1			2 (1)	3
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Transect 2

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5*		10 (1)			10
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May 28, 98

mendenhall valley trip (notes by Roodie). left LA c. 645 w. erika romano, picked up mike vergeer at cole canyon rd. c. 845, reached palo. mt store c. 915 to meet kirsten winter and sharon.

weather clear all day temp. c 65-70 F, wind < 10 mph am, none pm

didnot call in advance to gate locked, fortunately ms Mendanhall met on road and opened gate. said cannot take road to east end of valley (USFS land) because of water in meadows. parked by mendenhall homes and walked and got wet. meadow very green and in dense bloom. sharon said heavy freeze and snow two weeks ago, so current floral display all since then.

Predominant flowering: Chaetopappus and Linanthus on drier sites Sidalcea (bloom stalks several times the best of last year) Ranunculus dense in wet with Sidalcea some Viola, patches of Lasthenia on drier slopes along with numerous patches of P. erecta (latter esp. on south facing slope). very few Limnanthes, Calendrinia. Cryptantha Astragalus lush but no bloom, as Lotus hermannii and Lupines Grass and sedge dense and robust, in most places concealing Horkelia (and Potentilla) All wet meadow sections (high density of sedges/Ranunculus) very wet/boggy, with surface running water many places. the east end pond full and overflowing its wier at several cu. ft /sec. all rills flowing down from north facing slope running well. vehicles could not cross meadow without causing substantial damage. Note vehicle tracks across wet areas completely overgrown with sedge/grass (but no Ranunculus) and tracks over drier areas ~~also~~ supporting annuals.

Horkelia plants showing robust growth, flower stalks just forming and a few flowers notes. Potentilla, both spp. with flower stalks. Spent c 45 minutes at site last year where Cissy Pratt made observations for eggs and larvae. Dense Horkelia in a dry aspect (north facing slope c 300 M west of transect no. 1). This year many Chaetopappus and Linanthus (few in 1997), a characteristic of all the dry slopes - thus providing ample nectar. Romero, Vergeer and Mattoni examined undersides of several hundred Hork leaves (including those flagged in 1997. No signs, eggs, shells or webbing. The small green Chrysomelid present, (3 found w. some leaf damage).

On south facing slopes Ruddie sighted 1 ruralis? here. Mike saw 1 blue on Astragalus (melissa female?) and 1 M. gabbii. Ruudie noted 3 C. eurytheme (no harfordii!!).

Transect 1 only was inspected, most flag markers gone, must restake. Exclosure w dense sedge/grass/Ranuncula/Sidalcea growth, wet, could not discriminate treatments. Also could not clearly see Hork (looks like Levy was right about this part). Must rethink exp design.

On return walk to car sighted five ruralis, incl. 1 male and 2 female (these verified by netting) 1 female retained for oviposition. Mike caught first one (promising sign). All fresh emrged. The second female seen attempting ovipositing on Sidalcea, but egg not found (did she catch a last minute mistake or ??). All easy to sight/collect because of cool day. Hyothesize only saw ruralis on north slopes because of higher temps (Murphy's topoclimate). Should do exp. N vs S slope patterns. Actually quite a bit of Hork here and some Potentilla glabra. The community struct N/S slopes striking different.

Otherwise saw 3 Hesperia juba (v. fresh) and 3 S. melinus. (butterflies poor)

Time to survey for early stages at least ten days.

The (fresh, no scuff or tears) female was placed on Pot. glabra (robust specimen in gal pot) didn't lay a single egg over 3 days in confinement. Appeared in good condition,