Moss Springs. Inundation of this site by mud flows was the second course change for Pine Creek in less than 15 years. The upper flow route was altered by an earthquake in the late 1960s which allowed the formation of Moss Springs. This site was especially rich in bat diversity and roost sites.

Rerouting of water courses north and south of the mountain will probably redistribute remaining non-colony summer bat populations. Survival of these individuals will be heavily dependent on adequate roost sites near new water courses and/or insect populations.

Hibernacula and other bat activity sites outside the blast/mud flow paths are relatively intact. Populations appear to be at pre-eruption level, at least for P. townsendii. Myotis sp. has been at Little Red River Cave since the eruption. No other sightings have been reported to me.

A positive note is the return of a nursery colony of about 20 P. townsendii to Powerline Cave this spring. Red Zone closures probably resulted in a lower disturbance factor allowing the bats to re-occupy the roost which was abandoned about 1967. Continued human exclusion here may result in continued use of this site.

It will be interesting to note if large numbers of Myotis sp. will again swarm at the Ape Cave entrance this fall.

CONCLUSION

Bat losses due to the May 18, 1980 eruption and subsequent activities include at least three nursery colonies, one forage site, and one probable hibernacula. Unaffected were two nursery colonies, two forage sites, and four hibernacula. Further protection of bat populations surrounding the mountain may be necessary for populations to grow enough to repopulate extirpated areas.

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A COMPARISON OF THE TROGLOBITIC HARVESTMEN FROM LAVA TUBES AND LIMESTONE CAVES

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Some of the harvestmen known from lava tubes in the states of Washington and Idaho are comparable to the world's most specialized limestone cave troglobites. These lava tube species include Speleomaster lexi, Speleomaster pecki, and Speleonychia sengeri described by Briggs (1974) and discussed in Peck (1973). In order to apply a measure of cave adaptation to these harvestmen, the important troglomorphisms have been quantified and shown to be reduced or absent in related epigean species.

The harvestmen troglomorphisms selected for this comparison include increased tarsal segment counts, loss of the retina and lens, loss of the eye tubercle, depigmentation, relative lengthening of the second leg, and smoothening of the scute (carapace). All but the latter troglomorphism were applied to Australian cave harvestmen by Hunt (1972). An additional troglomorphism used by Hunt, the elongation of tarsal claws, was not used in this study because claw measurements are seldom reported by taxonomists. A specialization score for a troglobite was obtained by assigning numerical values to the troglomorphisms and selecting the most closely related epigean so that a difference between the sums for these species could be determined. The more objective values used were the sum of the tarsal segments for legs one to four and the ratio of the second leg length to the body length. A less objective score had to be assigned for relative depigmentation, loss of the eye tubercle, and scute smoothness. The maximum score for these troglomorphisms was set as follows: no pigment- 5, no eye tubercle - 20, and smooth scute - 10. Relative loss of eyes was not used in the specialization score because only harvestmen with a complete loss of eyes were considered sufficiently troglobitic for this study. If the related epigean is assumed to resemble the ancestral stock from which the troglobite evolved, subtracting the specialization score for the epigean gives emphasis to derived troglomorphisms.

A world-wide literature search yielded ten cave harvestmen more specialized by this measurement than the least specialized of the above three lava tube species (see Tables 1 and 2). These were found in limestone caves in Europe, Venezuela, Mexico and United States. The European troglobites include: Dinaria vjetrenicae Hadzi, Travunia troglodytes (Roewer), Travunia anophthalma (Absolon and Kratochvil), and Arbasus caecus (Simon), which are redescribed in Roewer (1935); Buermarina patrizii (Roewer[1956]); and Paralola buresi (Kratochvil, Balat and Pelikan [1958]). The venezuelan troglobite is Phalangozea bordoni (Munoz Cuevas [1975]) and the Mexican troglobite is Hoplobunus inops (Goodnight and Goodnight [1971]). From the United States, the troglobites are Phalangodes armata (Tellkampf [1844]), and Tolus appalachius (Goodnight and Goodnight [1942]). The lack of highly specialized harvestmen from Africa, Asia and Australia may be due to insufficient collecting, but the lack from islands is probably related to land mass size and youth. Lava tube harvestmen in this study are listed with locality data and related epigean species.

TABLE 1. Leading cavernicolous harvestmen.

	Maximum Tarsal Segment Count	2nd Leg to Body Length Ratio	Eye Tubercle	Scute	Pigment	Related Epigean Total	Relative Score
Peltonychia leprieuri (Italy)	3-5-4-4	3	0	0	0	19	epigean
Dinaria vjetrenicae (Yugoslavia)	5-12-4-4	10	10 (very low)	10 (smooth)	5	19	41
Travunia anophthalma (Dalmatia)	6-14-4-4	Unreported--assume 10	20 (none)	10	5	19	54 (?)
Travunia troglodytes (Dalmatia)	4-9-4-4	8	20	5 (faint areas)	5	19	40
Arbasus caecus (Pyrenees)	3-11-4-4	Unreported-assume 8	20	10	5	19	46 (?)
Buemarina patrizli (Italy)	3-6-3-4	6	10	10	5	61	28
Vima sp. and *Trinella* sp. (Trinidad)	9-24-7-9	12	0	0	0	61	epigean
Phalangozeabordoni (Venezuela)	12-28-8-8	15	20	5	5	61	40
Hoplobunus barretti (Morelos)	5-9-7-7	2	0	0	0	30	epigean
Hoplobunusinops (Tamaulipas)	8-15-8-8	10	5 (small)	5	5	30	34
Hypothetical ancestor	3-5-4-4?	2?	0	0	0	18	epigean
Paralola buresi (Bulgaria)	4-6-5-5	6	20	10	5	18	27 (?)
Bishopelia lacinosa (Southeastern USA)	4-7-5-6	3	0	0	0	25	epigean
Phalangodes armata (Kentucky)	5-8-5-6	9	5	10	5	25	28
Tolus appalachius (Tennessee)	5-10-5-6	8	0	10	5	25	24

Speleonychia sengeri Briggs 1974:207. **Known Localities:** lava tubes near Trout Lake, Skamania County, Washington. **Related Epigean Species:** *Yuria pulchra* Suzuki of Japan. This is the nearest known representative of the family Travuniidae to which *Speleonychia sengeri* belongs.

Speleomaster lexi Briggs 1974:210. **Known Localities:** lava tubes near Shoshone, Lincoln County, Idaho. **Related Epigean Species:** *Cryptomaster leviathan* Briggs of the Oregon Coast is the nearest known representative of the family Erebomastridae to which *Speleomaster lexi* belongs.

Speleomaster pecki Briggs 1974:212. **Known Locality:** Boy Scout Cave, Craters of the Moon National Monument, Butte County, Idaho. **Related Epigean Species:** as for *Speleomaster lexi*.

In conclusion, comparing these highly specialized lava tube harvestmen with the most specialized limestone troglobites strengthens the argument that "the internal environmental conditions (of lava tubes) have attracted, isolated and supported faunas in the same way as have those of limestone caves." (Peck, 1973) Other recent workers have made similar suggestions (for example, see Howarth, 1972). This comparison study also shows the necessity of including the related epigean and presumably ancestral stock in measuring the derived aspect of cave adaptation. Tropical troglobites, such as those in Mexico and Venezuela, would have much higher specialization scores were it not for the pre-existing troglomorphisms in tropical epigeans. As expected, the Travuniidae in European caves, characterized by Vandel (1965) as "living fossils," produced the highest specialization scores.

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TABLE 2. Lava Tube Harvestmen.

	Maximum Tarsal Segment Count	2nd Leg to Body Length Ratio	Eye Tubercle	Scute	Pigment	Related Epigean Total	Relative Score
Yuria pulchra(Japan)	4-6-4-4	3	0	0	0	21	epigean
Speleonychia sengeri (White Salmon, Washington)	4-17-4-4	5	10	10	5	21	38
Cryptomaster leviathan (Oregon Coast)	5-15-5-6	3	0	5	0	39	epigean
Speleomaster lexi (Shoshone, Idaho)	9-22-8-8	7	5	10	5	39	35
Speleomaster pecki (Craters of the Moon, Idaho)	7-16-5-7	7	5	10	5	39	23