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BEETLES FROM THE ENVIRONS OF LAKE POWELL IN SOUTHERN UTAH AND NORTHERN ARIZONA

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Abstract.— Sixty-eight species of beetles of 14 families were collected in pit traps in 12 major vegetative communities during environmental monitoring studies in the summers of 1971 to 1973 in southern Utah and northern Arizona. Seasonal and plant community differences and correlations in population and composition were noted for the 16 sites studied. Highest populations and the most species were found in a grass community, but occurred in different months in each of the three years. Lowest populations were found in a *Coleogyne* community, and fewest species in an *Artemisia*-grass community.

In June 1971 an ecological study was initiated by the Center for Health and Environmental Studies at Brigham Young University to establish baselines to determine the environmental effects of the Navajo Generating Station near Page in northern Arizona, and the proposed Kaiparowits Generating Station in southern Utah.[2] Field studies of arthropods were conducted from July to September in 1971, and from May to August in 1972 and 1973.

Can pit traps (an outer galvanized metal sleeve 18 cm in diameter and 36 cm long with a stainless steel, flanged inner can of slightly smaller size) were used to capture ground-dwelling arthropods. Five traps 30 m apart were placed on each of two transects, which were 45 m apart. These were left open, dry, and unbaited for a 72-hour period once each summer month. Of the 12 sites studied in 1971, the 16 in 1972, and the 12 in 1973, some were studied only one year, others two, and some all three years. Beetles, other arthropods, small rodents, and lizards were collected from the cans daily while they were open for trapping studies. The beetles were identified by Dr. Vasco M. Tanner.

Study Sites and Their Predominant Vegetation

Site 1. *Ephedra-Vanclevea-Sporobolus-Oryzopsis-Hilaria.* Base N slope Cedar Mtn, 5 km W Glen Cnyn City, Kane Co., Utah.

Site 2. *Juniperus-Ephedra-Muhlenbergia-Bouteloua-Hilaria-Oryzopsis.* Cedar Mtn, 6.5 km S site 1.

Site 3. *Ephedra-Hilaria-Bouteloua-Oryzopsis.* Cedar Mtn, 2 km S site 2.

Site 4. *Coleogyne-Ephedra-Atriplex-Chrysothamnus.* Cedar Mtn, 1.3 km SE site 3.

Site 6. *Artemisia-Hilaria-Aristida-Oryzopsis.* Smokey Mtn, 23 km from Last Chance Jnct, Kane Co., Utah.

Site 8. *Grayia-Ephedra-Coleogyne-Hilaria-Bouteloua-Oryzopsis.* Smokey Mtn, 14.5 km from Last Chance Jnct., Kane Co., Utah.

Site 10. *Ephedra-Yucca-Eurotia-Vanclevea-Oryzopsis-Streptanthella.* Ahlstrom Pnt Rd., 7.5 km S junct., Kane Co., Utah.

Site 13. *Grayia-Ephedra-Oryzopsis-Bouteloua-Hilaria.* Nipple Bench, 6.5 km SE Tibbet Spring, Kane Co., Utah.

Site 14. *Coleogyne-Grayia-Ephedra-Chrysothamnus-Hilaria.* 3 km S site 13.

Site 19. *Coleogyne.* 15 km S Page, Coconino Co., Arizona by Hwy 89.

Site 20. *Muhlenbergia-Bouteloua-Hilaria.* 19 km S Page, Coconino Co., Arizona by Hwy 89.

Site 22. *Coleogyne-Ephedra-Hilaria.* E Navajo Generating Station, SE Page, Coconino Co., Arizona.

Site 23. *Ephedra-Coleogyne-Grayia-Hilaria.* Cathys Flat, 2 km N Tibbet Spring, thence 2.5 km E, Kane Co., Utah.

Site 27. *Juniperus-Pinus.* Four-mile Bench, 5 km SE cow camp, head Wesses Cnyn, Kane Co., Utah.

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Site 28. *Artemisia-Bouteloua-Plantago.* 3 km E site 27.

Site 30. *Ephedra-Bouteloua-Hilaria-Sporobolus-Salsola.* Brigham Plains Flat, Kane Co., Utah.

ANNOTATED LIST OF FAMILIES AND SPECIES

BUPRESTIDAE

Acamaeodera lanata Horn: one specimen, 17 July 1972, site 14 (*Coleogyne-Grayia-Ephedra*-grass); 6 specimens, 2 June 1973, site 20 (grass).

CARABIDAE

Bembidion sp.: one specimen, 13 May 1973, site 27 (juniper-pinyon).

Calosoma triste Lec.: one specimen, 3 May 1973, site 8 (*Grayia*-grass).

Calosoma sp.: one specimen, 5 July 1973, site 10 (*Ephedra*-grass).

Celia sp.: one specimen, 5 June 1972, site 3 (*Ephedra*-grass); one specimen 6 June 1972, site 1 (*Ephedra-Vanclevea*-grass).

Harpalus corpulentus (Csy.): 6 specimens were taken 4 June 1973 at site 3 (*Ephedra*-grass); 2 specimens 6 June 1973, at site 8 (*Grayia*-grass); and one specimen 9 July 1973 at site 14 (*Coleogyne-Grayia-Ephedra*-grass). The apparent absence of this species in 1972 is unusual, inasmuch as sites 3, 8, and 14 were studied from May through August. Its absence in 1971 is also unexpected, even though collections were made only in July and August.

Harpalus furtivus (Lec.): 3 specimens, 21 August 1972, site 28 (*Artemisia*-grass); one specimen, 5 September 1972, site 3 (*Ephedra*-grass).

Harpalus lustrans Csy.: 2 specimens, 4 June 1973, site 3 (*Ephedra*-grass); one specimen, 14 June 1973, site 28 (*Artemisia*-grass).

Harpalus sp.: one specimen, 10 July 1973, site 23 (*Ephedra-Coleogyne-Grayia*).

Rhadine jejuna Lec.: one specimen, 12 June 1972, site 19 (*Coleogyne*).

Rhadine sp.: one specimen, 4 July 1973, site 8 (*Grayia*-grass).

Selenophorus aeneopiceus Csy.: 3 specimens, 12-13 June 1972, site 19 (*Coleogyne*); one specimen, 22 June 1972, site 30 (*Ephedra*-grass).

CERAMBYCIDAE

Moneilema obtusa Lec.: one specimen, 1 August 1973, site 10 (*Ephedra*-grass).

Prionus sp.: one specimen, 7 July 1973, site 30 (*Ephedra*-grass).

CHRYSOMELIDAE

Disonycha fumata (Lec.): 4 specimens, 12-13 July 1971, site 3 (*Ephedra*-grass).

Disonycha latifrons Schaffr.: one specimen, 3 May 1973, site 6 (*Artemisia*); one specimen, 6 May 1973, site 30 (*Ephedra*-grass).

CLERIDAE

Cymatodera fuchsi Schaffr.: one specimen, 12 August 1971, site 13 (*Grayia-Ephedra*-grass); one specimen, 10 July 1972, site 10 (*Ephedra*-grass).

COCCINELLIDAE

Hippodamia convergens Guer.: one specimen, 2 June 1973, site 20 (grass).

COLYDIIDAE

Bitoma sp.: one specimen, 26 September 1971, Glen Cnyn City.

CURCULIONIDAE

Cimbocera buchanani Ting: 3 specimens, 13-14 July 1971; one specimen, 10 November 1971, site 3 (*Ephedra*-grass); one specimen, 15 October 1971; one specimen, 9 May 1973, site 14 (*Coleogyne-Grayia-Ephedra*-grass); 3 specimens 14-15 July 1972; one specimen, 14 August 1972, site 20 (grass); one specimen, 10 May 1973, site 23 (*Ephedra-Coleogyne-Grayia*).

Cimbocera conspersa Fall: 4 specimens were taken at site 2, one at site 3, one at site 6, 4 at site 14, 2 at site 23, and 12 at site 27. Plants of the genus *Ephedra* were common to four of the six sites where this beetle was found. However, greatest numbers were found in the juniper-pinyon community. Five specimens were taken in April and May 1972, and 19 from May to August 1973. Greatest numbers were found in May of both years. The activity of this species apparently is spring and early summer, for no specimens were taken in July or August of 1971, none after May in 1972, and only four after May in 1973.

Cimbocera petersoni Tanner: one specimen, 29 April 1973, site 2 (juniper-*Ephedra*-grass); one specimen, 30 April 1973, site 1 (*Ephedra-Vanclevea*-grass).

Dinocleus angularis (Lec.): one specimen, 4 May 1973, site 10 (*Ephedra*-grass).

Eucyllus unicolor Van Dyke: one specimen, 5 August 1972, site 3 (*Ephedra*-grass).

Eupagoderes varius (Lec.): one specimen, 12 July 1972, site 6 (*Artemisia*).

Eupagoderes sp.: one specimen, 3 June 1973, site 2 (juniper-*Ephedra*-grass).

Ophryastes sordidus Lec.: one specimen, 9 September 1971, site 7 (*Grayia-Coleogyne*-grass).

Ophryastes sulcirostris (Say): one specimen, 4 June 1973, site 2 (juniper-*Ephedra*-grass).

Ophryastes sp.: one specimen, 13 May 1973, site 28 (*Artemisia*-grass).

Histeridae

Saprinus discordalis (Lec.): one specimen, 20 July 1971, Navajo Mtn.

Saprinus lugens Et.: 6 specimens were taken at site 2, 4 at site 10, one at site 14, and 23 at site 22. Plants of the genus *Ephedra* were common to three of the four sites where this species was found. However, greatest numbers were found in the *Coleogyne* community. Twenty-three specimens were taken in July 1972, and 5 and 6 in May and July of 1973, respectively. Apparently July is the month of greatest activity of this species, even though none were taken in July of 1971. However, site 2 was the only one of the four sites where this species was found that was studied during July of 1971.

Saprinus oregonensis Lec.: 2 specimens, 2 August 1971, site 6 (*Artemisia*).

Meloidae

Pyrota mylabrina Cher.: 34 specimens, 24 August 1972, Cottonwood Cnyn, 9 mi N Hwy 89, ex *Chrysothamnus*.

Melyridae

Collops femoratus (Schaffr.): one specimen, 14 July 1971, site 15 (*Populus-Tamarix-Lycium*).

Trichochrons zionicus Tanner: 28 specimens, summer 1972, specific locality unknown.

Ptinidae

Ptinus sp.: 8 specimens were taken at site 1, one at site 2, 5 at site 14, 2 at site 17, 6 at site 22, and 8 at site 23. Plants of the genus *Ephedra* and grasses were common to four of the six sites. Significant differences between community types were not evident, although greatest numbers were found in those where *Coleogyne* was a predominant. Four specimens were taken in July and August 1971, 18 from April to August 1972, and eight in May and July of 1973. Greatest numbers were found in May of 1972 and 1973.

Salpingidae

Conotus lanchesteri Van Dyke: This was one of the more common beetles. Twenty-one were taken at site 1, 38 at site 2, one at site 7, 6 at site 9, one at site 13, 2 at site 19, 6 at site 22, 3 at site 23, and 2 at site 27. The plant *Ephedra* was common to four of the nine sites, and greatest numbers were found on sites 1 and 2, where it was present. Specimens were taken in July and August 1971, April to September in 1972, and May to August 1973. In 1971 about equal numbers were taken in July and August, in 1972 greatest numbers were found in August, and in 1973 greatest numbers in July and August. No significant differences were noted between the three years, although slightly more numbers were taken in July and August of 1972 than during those months in other years, and more were taken from May to August in 1972 than for comparative months of 1973.

Scarabaeidae

Aphodius rubidus (Lec.): 4 specimens were taken at site 2, 13 at site 3, 3 at site 6, 6 at site 8, 6 at site 10, 4 at site 13, 31 at site 14, 2 at site 20, 3 at site 22, and 17 at site 30. The plant *Ephedra* was common to 6 and grasses to 8 of the 10 sites where this beetle was found. Greatest numbers were found on sites 14 and 30, where *Ephedra* and grasses were common. Specimens were taken in April and from June to September in 1972, and from May to July in 1973. Greatest numbers were found in April of 1972 and May of 1973. From May to August, populations were 24 times higher in 1973 than in 1972.

Diplotaxis subangulata (Schaffr.): 2 specimens, 16 June 1972, site 13 (*Grayia-Ephedra-*

grass); one specimen, 21 July 1972, site 27 (juniper-pinyon).

Diplotaxis sp.: one specimen, 6 April 1971; one specimen, 6 June 1971, site 3 (*Ephedra*-grass); one specimen, 5 June 1971, site 1 (*Ephedra-Vanclevea*-grass).

Polyphylla diffracta (Csy.): 3 specimens, 20 July 1971, Navajo Mtn.

Polyphylla 10-lineata (Say): one specimen, 12 June 1973, site 23 (*Ephedra-Coleogyne-Grayia*).

Serica sp.: one specimen, 11 June 1973, site 13 (*Grayia-Ephedra*-grass); 4 specimens, 19 June 1972; 5 specimens, 20 June 1972, site 27 (juniper-pinyon).

TENEBRIONIDAE

Araeoschizus dicipiens (Horn): one specimen, 7 April 1972, site 1 (*Ephedra-Vanclevea*-grass); one specimen, 13 June 1972, site 19 (*Coleogyne*); one specimen, 9 August 1973, site 30 (*Ephedra*-grass).

Chilometopon abnorme Horn: 13 specimens were taken at site 1, one at site 2, 9 at site 4, one at site 6, 2 at site 7, one at site 8, 56 at site 10, 2 at site 13, 4 at site 14, 8 at site 17, and 2 at site 18. These beetles were taken from a variety of vegetative types, but significantly greater numbers were found at site 10, an *Ephedra*-grass community. Specimens were taken from July to September in 1971, May to August in 1972, but only in August of 1973. Beetles in July and August of 1971 were twice as abundant as in 1972, and 48 times as abundant as in 1973. From May to August, they were 30 times as abundant in 1972 as in 1973.

Coniontis opacus Horn: one specimen, 13 July 1971, site 4 (*Coleogyne*).

Coniontis sp.: one specimen, 6 May 1972, site 4 (*Coleogyne*).

Edrotes leechi Doyen: one specimen, 4 June 1972, site 2 (juniper-*Ephedra*-grass); one specimen, 14 July 1971, site 3 (*Ephedra*-grass); one specimen, 12 July 1971, site 4 (*Coleogyne*); one specimen, 11 July 1972, site 6 (*Artemisia*); one specimen, 19 July 1971, site 18 (*Coleogyne*); 2 specimens, 14 August 1972, site 20 (grass); 2 specimens, 12 April 1973; one specimen, 12 May 1972, site 22 (*Coleogyne*).

Eleodes caudifera Lec.: 7 specimens were taken at site 1, 2 at site 3, 6 at site 10, 7 at site 13, 3 at site 14, and one at site 19. *Ephedra* and grasses were predominant plants at 5 of the 6 sites. No site had significantly greater numbers of beetles than another. Specimens were taken in July and August 1971, May to July 1972, and May and June 1973. In 1973, greatest numbers were found in May, but no significant differences were noted between months of other years except from May to August, when eight times as many beetles were found in 1973 as in 1972.

Eleodes extricata (Say); Beetles of this species were some of the most common and widespread of those taken. A total of 164 specimens was taken from 15 of the 19 sites studied. Greatest numbers were found at sites 3, 19, 20, and 22, which are predominantly *Coleogyne* or grass habitats. Specimens were taken in July and August of 1971, April to September in 1972, and May to August in 1973. Greatest numbers were taken in August and September of 1972, and July of 1973. In July and August of 1972 and 1973 these beetles were about equally abundant, but only one-tenth as abundant in 1971. For the period of May to July, they were about equally as abundant in 1972 as in 1973.

Eleodes hispilabris sculptilis Blais.: Beetles of this species were common and widespread; 105 were taken from 13 study sites. Greatest numbers were found at site 10, an *Ephedra*-grass community. In 1971 they were found from July to September, most abundantly during the latter month; in 1972 during April and from June to September, also most abundantly during September; and in 1973 from May to August, mostly in July. In July and August, they were half again as abundant in 1971 as in 1972 and 1973. They occurred in about equal numbers for the period of May to August in 1972 and 1973.

Eleodes immunis interstitralis Blais.: one specimen, 18 July 1971, site 17 (grass); one specimen, 19 July 1971, site 1 (*Ephedra-Vanclevea*-grass).

Eleodes leechi Tanner: one specimen, 20 July 1972; one specimen, 22 July 1972, site 28 (*Artemisia*-grass); one specimen, 11 July 1973, site 27 (juniper-pinyon); one specimen, 3 August 1973, site 14 (*Coleogyne-Grayia-Ephedra*-grass); 2 specimens, 4 August 1973, site 2 (juniper-*Ephedra*-grass).

Eleodes obscura sulcipennis Mann.: These

beetles were relatively abundant and widespread and were found on 15 sites. They were most abundant at sites 2, 3, 8, 14, and 19, principally where grasses were predominant. Beetles were taken from July to September, mostly August in 1971; from April to September in about equal numbers each month in 1972; and from June to August, also in about equal numbers each month in 1973. In July and August, populations were three times as high in 1971 as in 1972 and 1973. From May to August about equal numbers were taken in 1972 and 1973.

Eleodes omissa pygmaea Blais.: 14 specimens, July and August 1971, site 3 (*Ephedra*-grass); one specimen, 1 August 1971, site 6 (*Artemisia*); one specimen, 11 August 1971, site 13 (*Grayia-Ephedra*-grass); 2 specimens, 11, 13 August 1971, site 14 (*Coleogyne-Grayia-Ephedra*-grass); one specimen, 18 July 1971; 2 specimens, 27 August 1971, site 17 (grass); one specimen, 17 July 1971; one specimen, 17 August 1971, site 18 (*Coleogyne*).

Eleodes porcata Csy.: one specimen, 8 August 1973, site 39 (*Ephedra*-grass).

Embaphion glabrum Blais.: 3 specimens were taken at site 1, 3 at site 2, 6 at site 3, 2 at site 19, 4 at site 22, one at site 23, 17 at site 27, and 14 at site 28. Greatest numbers were found at sites 27 and 28. Beetles were taken in July and August of 1971, April to September of 1972, and May, July, and August of 1973. During July and August about equal numbers were found in each of the three years. For the period of May to August, twice as many beetles were taken in 1972 as in 1973.

Exchatomoxys tanneri Sorenson and Stones: one specimen, 15 August 1971, site 3 (*Ephedra*-grass).

Glyptasida sordida (Lec.): one specimen, 13 August 1971; one specimen, 17 August 1972, site 13 (*Grayia-Ephedra*-grass); one specimen, 12 August 1971; one specimen, 16 July 1972, site 14 (*Coleogyne-Grayia-Ephedra*-grass); 3 specimens, 13-14 August 1972, site 19 (*Coleogyne*); 24 specimens, July and August 1972, site 20 (grass).

Glyptasida sp.: one specimen, 15 August 1971, site 3 (*Ephedra*-grass).

Hylocrinus delicatulus Csy.: 6 specimens were taken at site 1, 2 at site 14, 9 at site 19, 2 at site 20, and 18 at site 22. Most specimens were found at sites 19 and 22, which are *Coleogyne* communities. Beetles were taken from June to August in 1972, and May to August in 1973. None were found in 1971. In 1972, highest numbers were taken in July, but populations were not significantly different between months in 1973. About twice as many beetles were taken in 1972 as in 1973.

Metaponium sp.: one specimen, 17 July 1972, site 14 (*Coleogyne-Grayia-Ephedra*-grass).

Pelecyphorus haruspex Csy.: 2 specimens, 28 August 1971, site 1 (*Ephedra-Vancleveа*-grass); 2 specimens, 6 August 1972; one specimen, 6 September 1971, site 2 (juniper-*Ephedra*-grass); 4 specimens, 14 August 1971; one specimen, 25 August 1971; one specimen, 1 August 1973, site 3 (*Ephedra*-grass); 5 specimens, 18, 20 August 1971; 7 specimens, 11-12 August 1972, site 10 (*Ephedra*-grass); one specimen, 28 August 1971, site 18 (*Coleogyne*).

Sphaeriontis muricata Lec.: 65 beetles were taken from 11 study sites. They were most abundant on sites 10 (*Ephedra*-grass), 19, and 22 (*Coleogyne*). Specimens were taken in July and August of 1971, May to September of 1972, and in May, June, and August of 1973. Greatest numbers in 1972 were found in July, but in 1971 and 1973 the populations were about equal each month. In July and August twice as many beetles were taken in 1972 as in 1971, and five times as many as in 1973. From May to August four times as many beetles were taken in 1972 as in 1973.

Steriphanus sp.: one specimen, 7 April 1972, site 3 (*Ephedra*-grass).

Triorophus lariversi Blais.: one specimen, 14 August 1971, site 2 (juniper-*Ephedra*-grass).

Triorophus tenebratulus Csy.: 77 beetles were taken from 10 sites, most abundantly from site 22, a *Coleogyne* community. Only two specimens were found in August 1971; most were taken from April to August in 1972, and May to August in 1973. In 1972 and 1973, greatest numbers were found in May. From May to August, only a few more specimens were taken in 1972 than in 1973.

Trogloderus tuberculatus Blais: Beetles of this species were the most abundant and widespread of all species collected. A total of

510 specimens was taken from all 19 study sites. Greatest numbers were found on site 19, a *Coleogyne* community. Specimens were found every month that field studies were conducted. In 1971, greatest numbers were found in July, and in 1972 and 1973 in June. In July and August, from two and one-half to three times as many beetles were taken in 1972 as in either 1971 or 1973. From May to August, half again as many beetles were taken in 1972 as in 1973.

DISCUSSION

An initial objective was to select study areas in the major vegetative types within a 48-km perimeter of the proposed sites of the electric generating stations. Retention of study plots beyond the first year was based on vegetative type, direction from the potential source of pollution, and especially the species and relative abundance of organisms present that could be used as indicator species to monitor environmental changes. Some sites were discontinued after one season because of inaccessibility, discontinuous vegetative analyses, and specific climatic and edaphic data.

In order to compare populations and seasonal changes, the numbers of beetles collected were adjusted to the number of trapping attempts. The normal variability in seasonal and annual populations, slightly different dates of collection each month, and the influence of periodic and abrupt climatic changes on the activity of the beetles during the trapping periods were ignored. Nevertheless, the method used adequately determined relative abundance and distribution within the limitations of time, economy, and logistics. The number of trapping attempts is shown in Table 1.

Pit traps are effective primarily for ground-dwelling arthropods that move on the ground more frequently than they fly. The traps involve minimum effort and time and can be used effectively for those species which may be so trapped. In this study about half of the beetles caught were in the families Carabidae and Tenebrionidae, whose members are primarily ground-dwellers. Nineteen of the species collected were sufficiently abundant to be used as indicators, and 14 of these belonged to the Tenebrionidae, the darkling beetles (Table 2).

Highest populations of beetles of all species occurred in August 1971, July 1972, and June 1973 (Table 3). These annual differences likely are related to climatic and vegetational variations, and when such data are available, multiple regression analyses may show specific correlations.

TABLE 1. Number of trap-days[1] for pit traps on 16 major study sites, 1971–1973.

Site	1971	1972	1973	Total
1	60	120	90	270
2	60	180	90	330
3	60	180	90	330
4	60	120	*	180
6	60	90	90	240
8	60	90	90	240
10	30	120	90	240
13	60	150	90	300
14	60	150	90	300
19	*	90	*	90
20	*	90	*	90
22	*	150	*	150
23	*	120	90	210
27	*	120	70	190
28	*	120	70	190
30	*	150	90	240
Total	510	2,040	1,040	3,590

[1]Number of traps multiplied by number of days operated.
*Not operated during year indicated.

TABLE 2. Numbers and distribution of beetles[1] on 16 major study sites, 1971–1973.

Species	Total number taken	No. sites where found
Trogloderus tuberculatus	510	16
Eleodes sulcipennis	192	12
Eleodes extricata	164	14
Eleodes hispilabris sculptilis	105	10
Chilometopon abnorme	100	8
Aphodius rubidus	89	10
Conotus lanchesteri	80	7
Eleodes obscura sulcipennis	78	7
Triorophus tenebratulus	77	9
Sphaeriontis muricata	65	11
Embaphion glabrum	50	6
Hylocrinus delicatulus	37	6
Saprinus lugens	34	4
Glyptasida sordida	31	4
Ptinus sp.	30	5
Eleodes caudifera	26	6
Pelecyphorus haruspex	25	4
Cimbocera conspersa	24	6
Eleodes omissa pygmaea	23	4

[1]Only those species are included of which more than 20 specimens were taken.

The number of species of beetles which occurred on each study site was not consistent for each of the three years (Table 4). Even between sites with the same predominant species of plants, variations occurred between sites and years. This is expected because the presence, abundance, and vigor of plants, especially annual grasses and forbs, varies from year to year as influenced by the local climate. Comparison of these sites showed some significant differences. Sites 4, 19, and 22, primarily *Coleogyne*, had only one species of darkling beetle in common. Sites 19 and 22 had three additional species in common. Site 4 had two species not found on the other two sites, site 19 had two unique species, and site 22 had one unique species. Sites 14 and 23, which also contain *Coleogyne* as a predominant shrub, had one species in common with the other *Coleogyne* sites.

Ephedra-grassland sites 3, 10, and 30 had no species in common. One species was common to sites 10 and 30, one to sites 3 and 30, and one to sites 3 and 10. Three species were unique to site 3, and four to site 10. Comparison of sites 1 and 20 (which also had grass as a predominant component) with sites 3, 10, and 30 showed one species in common, one common to sites 1, 3, and 30, one common to sites 1 and 10, one common to sites 3 and 20, and one species unique to site 20.

Artemisia sites 6 and 28 had one species in common, two unique for site 6, and one unique to site 28.

Grayia-grass sites 8 and 13 had two species in common, and two unique to site 8.

Juniper woodland sites 2 and 27 had one species in common, two unique to site 2, and one unique to site 27.

Species composition differed during the

TABLE 3. Total number of beetles of all species collected in pit traps at 16 major study sites, 1971–1973.

Month	No. beetles collected					
	1971		1972		1973	
	Actual	Adjusted[1]	Actual	Adjusted[1]	Actual	Adjusted[1]
April	*		88	141	*	
May	*		74	111	192	250
June	*		208	250	121	290
July	83	332	367	367	118	236
August	232	394	239	287	114	228
September	25	200	49	157	*	

[1]Numbers adjusted to number of trap days.
*Traps not operated.

TABLE 4. Number of species captured in pit traps on 16 major study sites, 1971–1973.

Site	Predominant vegetation	1971	1972	1973	Total
1	*Ephedra-Vanclevea*-Grass	9	12	11	18
2	*Juniperus-Ephedra*-Grass	6	10	12	20
3	*Ephedra*-Grass	14	11	11	26
4	*Coleogyne*	7	6	*	9
6	*Artemisia*	5	8	5	13
8	*Grayia*-Grass	3	4	8	9
10	*Ephedra*-Grass	6	9	10	15
13	*Grayia-Ephedra*-Grass	7	9	8	15
14	*Coleogyne-Grayia-Ephedra*-Grass	7	13	15	20
19	*Coleogyne*	*	13	*	13
20	Grass	*	9	*	9
22	*Coleogyne*	*	11	*	11
23	*Ephedra-Coleogyne-Grayia*	*	8	9	12
27	Juniper-Pinyon	*	5	7	10
28	*Artemisia*-Grass	*	4	5	7
30	*Ephedra*-Grass	*	4	7	10

*Not trapped during year indicated.

TABLE 5. Percentage composition[1] of beetles on 16 major study sites, 1971–73.

Site	Species of beetle													
	Aph rub	Chi abn	Con lan	Ele his	Ele ext	Ele obs	Ele sul	Emb gla	Gly sor	Hyl del	Sph mur	Tri ten	Tro tub	Other[2]
1		12	19		3	3	17	3		5	3	6	17	(8)
2	*	*	28		10	13	4	*		5	*		20	(10)
3	6			*	23	11	16	*			*	*	11	(17)
4		17		19		4	4				4	7	40	(2)
6	7	*		11	*	19	20						26	(6)
8	10	*		18	*	30	15						24	(2)
10	3	27		16	*		3				11	5	24	(7)
13	4	*	*	6	8		36		*		4	4	24	(5)
14	18	*		5	5		27		*	*	4	11	19	(10)
19			*		18	5	*	*	*	6	5		57	(4)
20	4			*	5		*		45	4			15	(4)
22	*		3		13			*		11	6	9	38	(3)
23			*	8	5			*			*	9	69	(5)
27			4					36			3	3	25	(5)
28					4			52					22	(4)
30	35			21	*		15						9	(5)

[1]The nearest whole percentage is listed for those which constitute at least 3 percent of the specimens collected. However, percentage is relative to all species of beetles collected. An asterisk indicates presence in numbers less than 3 percent.

[2]Number in parentheses indicates number of other species present, each one less than 3 percent of the total composition.

three years. Four of the 19 species that occurred in relative abundance in 1972 and 1973 were not present in 1971. One species present in 1971 was not taken the other two years, one was present only in 1972, and another only in 1973.

Relative abundance of individuals differed between years. Two species were more abundant in 1971 than in other years, 12 were most abundant in 1972, 6 were most abundant in 1973, and 2 were about equally abundant in 1972 and 1973. In 1972, *Chilometopon abnorme* was 30 times as abundant, *Embaphion glabrum* 2 times as abundant, *Hylocrinus delicatulus* 2 times as abundant, and *Sphaeriontis muricata* 4 times as abundant as in 1973. In 1973, *Aphodius rubidus* was 24 times as abundant, *Cimbocera conspersa* 4 times as abundant, and *Eleodes caudifera* 8 times as abundant as in 1972. In 1972 and 1973, *Eleodes extricata* was 11 times as abundant as in 1971.

In July and August, *Chilometopon abnorme*, *Eleodes caudifera*, *Eleodes hispilabris*, and *Eleodes sulcipennis* were most abundant in 1971. *Eleodes extricata* was more abundant in 1972 and 1973 than in 1971. *Cononotus lanchesteri* and *Embaphion glabrum* were about equally abundant all three years.