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NOTES ON AGGREGATIONS OF *LEIOBUNUM* (OPILIONES) IN THE SOUTHERN U.S.A.

Aggregations of phalangids of the genus *Leiobunum* C. L. Koch are known from caves and mines (Holmberg et al. 1984; Mitchell and Reddell 1971), lake shores (Bishop 1950), rock overhangs (Newman 1917), buildings (McAlister 1962), and vegetation (Edgar 1971; Wagner 1954). Such formations may represent: (1) diurnal retreat aggregations (McAlister 1962; Wagner 1954), covering sometimes 25 ft^2 in area (Newman 1917); (2) overwintering aggregations, for which densities of nearly three individuals/cm^2 are reported (Holmberg et al. 1984); (3) smaller and more loosely organized groups apparently associated with mating (Edgar 1971).

Phalangids in retreat aggregations are quiescent except for movements associated with changes in microclimate (Holmberg et al. 1984; McAlister 1962). When disturbed, however, individuals move their bodies to-and-fro. This "bobbing" can quickly spread through an entire cluster of thousands, presumably by mechanical stimuli transmitted via legs (Newman 1917). This behavior is often accompanied by the release of volatile compounds (Holmberg et al. 1984; Ekpa et al. 1985), which may act to deter predators (Blum and Edgar 1971), although functions associated with intraspecific communication have been suggested for phalangid secretions (Bishop 1950).

While observing phalangids in the southcentral U.S.A., I noted both homospecific and heterospecific aggregations of *Leiobunum* species. Aggregations are reported for the first time for *Leiobunum flavum* Banks and *Leiobunum speciosum* Banks. Immatures of another species, *Leiobunum townsendi* Weed, whose prodigious aggregating habit is described elsewhere (McAlister 1962; Mitchell and Reddell 1971), are confirmed to form aggregations. Identifications of species are based on Bishop (1949) and Davis (1934) with reference to the nomenclatural changes proposed by Cokendolpher (1984).

Homospecific aggregations.—I removed an aggregation of *L. townsendi* from the duck blind at The University of Texas Brackenridge Field Laboratory, Austin, Travis Co., Texas at 1600 hours on 20 September 1985. This diurnal retreat aggregation was a single layer of 167 males and 157 females covering an area of 300 cm^2 on the underside surface of the wooden platform. This density (1.1 individuals/cm^2) has also been calculated by Holmberg et al. (1984) for the less tightly formed clusters of *Leiobunum paessleri* overwintering in caves and mines of British Columbia. He also reports equal proportions of the sexes.

I found late instars of *L. townsendi* in aggregation on the stone block restroom at the trailhead to the falls at Pedernales Falls State Park, Blanco Co., Texas. At 1200 hours on 18 April 1987, I counted 331 individuals of this species on the building, 282 within 14 aggregations (of from 6 to 70 individuals) and 49 outliers. All were in shade on the east, west, or north sides. The majority of them (64.3%) were in the window recesses, which are poorly exposed, the rest on the upper half of the walls. Two clusters of 19 and 21 were sampled and contained immatures, the ages of which were estimated morphometrically (Edgar 1971, table 3). A sample of seven individuals taken from one of these included one fourth, three sixth, and three seventh (penultimate) instars. I located two other clusters of *L. townsendi* along the trail to the falls. One of these contained 31 phalangids

loosely aggregated on the brick wall at the falls overlook. The second was more dense (like that on the duck blind), containing 150 individuals clinging to the underside of a rock ledge about 50 m upriver from the first. Both groups were composed largely of late instars. I found another cluster of this species at the boulder field above the falls. Within a shallow crevice in a large rock, 15 phalangids had formed a continuous single file. From this I sampled nine penultimates and one adult male. Another cluster on the smooth, lower face of the rock, just above the river, consisted of about 50 phalangids, at least nine of which were sixth or seventh instars.

I found two small clusters of *Leiobunum aldrichi* Weed in the late morning of 19 July 1986 at the summit of Mount Magazine, Logan Co., Arkansas. Both males and females were loosely grouped, making contact only with the tarsi. One cluster of about 20 had formed on the underside of a rock ledge just above the outflow of Brown Springs. Another group of six was seen about a kilometer from the first in a hollowed-out area on the rock face near the head of the Cove Lake Trail.

Diurnal retreat aggregations have not yet been reported for *L. aldrichi* and there is both field and laboratory evidence that northern populations show diurnal activity (Bishop 1950; Edgar and Yuan 1968; Fowler and Goodnight 1974). Bishop (1950) observed clusters of this species forming late in the day at the edge of a lake in a New York beech-hemlock forest. These were apparently associated with relief from unfavorable microclimate and lasted until the next morning. Edgar (1971) observed gatherings of this species (on tree trunks in a Michigan woodland) that were suggestive of prenuptial behavior. These consisted of groups of from 3 to 58 males and females which remained together for a few days until males began attempting to copulate. I kept records of activity for this species in an oak-pine forest in Tennessee from May through August, 1981. During 46 sample days, I observed five copulation attempts (between 1935 hours and 0150 hours) but none were associated with clusters. During the daytime, when *L. aldrichi* is inactive on trunks, I never observed more than three individuals spaced closely enough to contact legs. It is, therefore, impossible to identify this species with a single, regularly occurring type of aggregation.

An aggregation of about 100 phalangids was found on the wall of a wooden shelter on the morning of 21 July 1985 near Lake Seminole, Jackson Co., Florida (L. Hribar, pers. comm.). I identified a female specimen from the aggregation as *L. speciosum*. (Voucher specimen is deposited at the Texas Memorial Museum). A photograph showed that this was probably a single species group but sexes could not be distinguished.

Heterospecific aggregations.—At Caddo Lake State Park, Harrison Co., Texas, I found a highly clumped distribution of three species of *Leiobunum* under the eaves of a campground shelter. On 25 June 1986 at 2100 hours, 12 well defined aggregations were present, separated from one another by rafters. Single individuals were seen crawling along the edges of the roof. By visually comparing the area covered by each cluster to that for one I counted, I was able to estimate the numbers of phalangids within clusters. Starting at the NE corner and moving counterclockwise around the shelter, I estimated clusters of 25, 30, 250, 100, 175, 225, 300, 150, 20, 50, and 25 individuals. (The one at the SW corner was too loosely formed to estimate.) The majority of phalangids were on the north and west sides of the shelter. Density within groups was less than one phalangid/cm^2.

A sample from the cluster of 50 showed 18 males and four females of *L. flavum*. (Voucher specimens are deposited at the Texas Memorial Museum). This species accounted for at least 90% of all phalangids in any given cluster. The rest were *Leiobunum vittatum* (seen in four clusters) and *L. townsendi* (seen in two). The cluster at the SW corner contained all three species. Aggregations of *L. flavum* have not previously been reported. Small bisexual clusters of *L. vittatum* were seen in summer by Edgar (1971).

In checking the aggregations for activity at 2200 hours, I saw three phalangids at the perimeter of the loose cluster feeding together on an insect. I did not see copulating pairs in or near any of the groups. When I disturbed one large cluster by moving my pencil through it, a chain of phalangids dropped and hung by the legs from those above. Within seconds, the suspended ones became disentangled, fell to the ground, and began to crawl toward the shelter and up the wall.

At 2300 I noted no changes in the aggregations, but at 0900 hours there was a marked difference in their dispersion. The loosely formed aggregation had disbanded, while another group had decreased in numbers from 100 to 50 individuals. Two clusters had increased in size, one from 150 to 250, the second from 20 to 125. All clusters were more dense ($>$ one individual/cm^2) than at night and showed no activity. No solitary phalangids could be found on the shelter. I made a final check of the aggregations at 1230 hours but saw no change.

I observed aggregations consisting of both males and females of *L. flavum* and *L. vittatum* at two locations in western Arkansas, each occurring beneath the eaves of campground buildings. These sightings were made at 1000 hours on 20 July 1986 at Cove Lake, Logan Co. and at 1100 hours on the following day at DeQueen Lake, Sevier Co.

Conclusion.—Aggregations of *Leiobunum* are more common than has been reported. I here add *L. flavum* (in Arkansas and Texas) and *L. speciosum* (in Florida) to the list of *Leiobunum* species forming diurnal retreat aggregations. Clusters of more than one phalangid species are also reported for the first time.

Aggregations were observed in spring (when immatures may be present in them) and in summer, primarily on structures providing considerable shade. All were diurnal except for a group of nocturnal clusters at one location, which were more active and loosely organized.

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