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Autumn Populations of Spiders and Other Arthropods in an Urban Landfill

Abstract

The study site, on Union Bay, Seattle, Washington, is a former wetland modified by dumping and earth fill. The present flora, mainly moss and grass clumps, dates from 1971. Analysis of Berlese funnel extracts from turf samples shows very low arthropod diversity and absence of taxa of low dispersal ability. In contrast to older grassland, Collembola outnumber mites by 3.7:1. The spider fauna of both ground and field layers is dominated by an introduced Theridiid, *Enoplognatha thoracica* (Hahn). The only centipeds are parthenogenic species of *Lamyctes* (Henicopidae). The site is set aside for ecological research so these data can be compared with future changes in the fauna.

The Montlake landfill is an area of about 53 ha on the east part of the University of Washington campus, adjoining Union Bay of Lake Washington and not exceeding 7.6 m in elevation. Originally natural wetland, the area was used from 1926 to 1965 as a dumping site for organic and inorganic refuse, with a surface layer of earth fill. The study site is the area of most recent fill, comprising 23 ha in the southeast part of the main landfill. In 1971 this area was covered with excavated mineral soil, primarily Vashon Till from the southwest part of the campus, and graded; the present vegetation and fauna dates from that time. Parking lots, housing, playfields, and some small remnants of the original marsh surround the site. The University currently plans to maintain the area in its present state for ecological research (Jones and Jones, 1976).

On 31 October and 4 and 6 November 1976, I collected turf samples (1160, 890, and 930 cm^2 in area) at random sites in the south central part of the study area. They were taken to a depth of 5-10 cm, below which the compacted till offers little habitat for microarthropods. The claylike till substrate (0 to 4 m thick) supports in most places a 1 to 2.5 cm deep covering of moss, primarily *Ceratodon purpureus* (Hedw.) Brid. Vascular plants include sparse clover (*Trifolium repens* L.) and plantain (*Plantago lanceolata* L.), with clumps of grass, mainly *Agrostis alba* L. and *Agropyron repens* (L.) Beauv. Other plants are present in relatively very small numbers. There is essentially no humus except within the bases of grass clumps, which occupy 30 percent of the area of the turf samples. Growth is curtailed in some parts of the landfill by methane escaping from subsurface decomposition, but this curtailment is not noticeable in the sample area.

The samples were processed in a large, standard Berlese funnel with a 150-watt light bulb as heat source. Doubtless the extraction efficiency was significantly below 100 percent as a result of mortality in the turf. Although this factor and the small number of samples limit the quantitative significance of the data, they may still be useful for comparison as changes in the landfill are observed over time. Table 1 pre-

sents the numerical results in terms of numbers of individuals per square meter.

Each taxon enumerated includes 10 or fewer species, often only one. Such low diversity is to be expected for such an austere and newly created habitat. Comparable studies of older and richer grassland and pasture habitats, such as those of Salt *et al.* (1948), Hairston and Byers (1954), and Morris (1968), show significant numbers of arthropod taxa of low dispersal ability, such as Diplopoda, Symphyla, Pauropoda, Geophilomorpha (soil centipeds), Chelonethida (pseudoscorpions), and Protura, none of which were found in the Montlake landfill, though present in nearby older habitats.

TABLE 1. Arthropod Populations in the Montlake Landfill.

Taxon	Population per m²	
	Mean	Range
INSECTA		
Total Collembola	48,828	29,930-60,936
Poduridae	9,222	1,629-21,033
Entomobryinae	690	169-1,367
Isotominae	25,799	14,736-34,413
Tomocerinae	31	11-65
Sminthuridae	13,104	4,080-25,562
Thysanoptera	39*	0-78
Hemiptera		
Lygaeidae (1 species)	1,122	86-2,847
Other Hemiptera	122	65-155
Homoptera		
Aphididae	38	22-69
Cicadellidae	30	11-45
Coleoptera adults		
Staphylinidae	182	124-293
Other Coleoptera	118	78-180
Coleoptera larvae	135	0-237
Lepidoptera larvae	78	0-183
Diptera adults	9*	0-17
Diptera larvae	494*	452-535
Hymenoptera adults	14*	11-17
ARACHNIDA		
Total Araneida	221	124-366
Total Acarida	13,331*	9,793-16,868
Phalangida (juvenile **Phalangium opilio** Linne)	20	0-43
CHILOPODA		
Total Lithobiomorpha	117	52-213

*Counted only in the first and third samples.

The authors noted above and many others studying older grasslands found mites to be the largest component of the fauna, outnumbering Collembola in ratios from around 2:1 to the extreme of 17.3:1 found by Hairston and Byers (1954) in a disused pasture in Michigan. In the Montlake landfill the Collembola outnumbered mites by about 3.7:1, and in addition their population density is distinctly greater than that found for most long-established grassland habitats. This is in accord with the finding of Baweja (1939) that during re-invasion of sterilized soil, Collembola soon surpassed their original numbers; mites did not readily regain them. In the present case this effect may reflect both the greater dispersal ability of Collembola and the small depth of habitable soil available to mites. Few previous studies have enumerated species of mites, but Hairston and Byers (1954) found 79 species, of which 20 in the Oribatoidea formed 69 percent of the total number of mites. Two to three of the 10 or fewer mite species in the Montlake landfill were Oribatoids, a similar proportion, but these formed less than 10 percent

of the total number. The lack of success of Oribatoid mites may be another reason for the low abundance of mites as a whole in the landfill habitat.

The spider fauna is dominated by juvenile, mainly penultimate, *Enoplognatha thoracica* (Hahn), Theridiidae ($147/m^2$), identified with reference to adults collected in spring at the study site. This circumstance is unusual and probably temporary; Erigonidae usually predominate in temperate ground spider faunas. Other spiders include *Erigone olympias* Crosby and Bishop, Erigonidae ($29/m^2$); juvenile *Xysticus* sp., Thomisidae ($15/m^2$); juvenile *Pirata* sp., Lycosidae ($12/m^2$, but some probably escaped when samples were taken); indeterminate Theridiids and Erigonids, each $7/m^2$; and juvenile *Clubiona* sp., Clubionidae ($4/m^2$). In the first two species, sex ratios were nearly 1:1.

Non-quantitative sweep samples, taken at the study site on 28 May 1975 by N. Cimino and on 6 November 1976 by me, show the composition of the spider fauna in the field-layer. These samples are equally dominated by *Enoplognatha thoracica*, followed by *E. ovata* (Clerck), *Tetragnatha* spp., and *Lepthyphantes tenuis* (Blackwall), with occasional specimens of *Xysticus* sp., *Tibellus* sp., *Erigone olympias*, *Montilaira ksenia* (Crosby and Bishop), and *Theridion bimaculatum* (Linné). *Enoplognatha thoracica* is known from two localities in southwestern Washington but may have been introduced on the landfill, since it seems to be absent elsewhere in the vicinity. A European species, its only previous North American records are from towns in Northwestern Oregon (Levi, 1957). The other spiders appear to have invaded the landfill from the surrounding area. The *Pirata* sp. probably came from the small areas of undisturbed marsh along Union Bay, offshore and southeast of the landfill, where the ground spider fauna also includes *Erigone* spp., *Pachygnatha* sp., and others.

All the Lithobiomorph centipeds are Henicopidae, mainly *Lamyctes* sp. near *pinampus* Chamberlin ($113/m^2$), with occasional *L. fulvicornis* Meinert. Most *Lamyctes* populations are parthenogenic, and indeed all of these were females or juveniles. Parthenogenesis is thought to enhance greatly dispersal ability in *Lamyctes* (Eason, 1964, p. 22). This occurrence would explain their abundance on the landfill, though Lithobiidae are much more common in the surrounding area.

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