1979

Biology of Nematodes in Desert Ecosystems

R. Mankau

FINAL REPORT

BIOLOGY OF NEMATODES IN DESERT ECOSYSTEMS

R. Mankau
University of California, Riverside

US/IBP DESERT BIOME
RESEARCH MEMORANDUM 77-18

in

FINAL PROGRESS REPORTS
Process Studies, pp. 141-151

Proposal No. 2.3.3.2

Printed 1979

Citation format: Author(s). 1979. Title.
US/IBP Desert Biome Res. Memo.77-18.
Utah State Univ., Logan. 11 pp.

Ecology Center, Utah State University, Logan, Utah 84322

ABSTRACT

Nematode populations from soil taken in a standardized random sampling pattern around roots of dominant plants in five desert sites in California, Nevada, Arizona, Utah and New Mexico were compared and studied in relation to biomass, spatial distribution and trophic groups. The sampling program included three depths (10, 20 and 30 cm) at the plant bases, at the edge of the plant canopy and at three times the mean radius of the shrub canopy where applicable. Horizontal positioning of depth samples was altered for dominant grasses and, when dictated, by plant spacing. Nematodes were recovered by a modified sugar flotation method and counted, and the data were corrected to nematodes/1000 g soil. They were identified as microbivores, fungivores, predator/omnivores and plant-parasites/miscellaneous Tylenchida. They were then fixed and stored for taxonomic study. An examination of the effects of four levels of simulated rainfall applied in two different time sequences was made at the Rock Valley, Nevada site. Greatest numbers of all nematode groups occurred in the top 10 cm of soil near the plant bases and generally decreased significantly with depth and horizontal distance from the plants, but the rate of decrease varied between different deserts and appeared to be related to average annual rainfall and general plant biomass. Microbivores at all locations were composed almost entirely of Cephalobidae. Percentages of different trophic groups in populations varied considerably between sites as did species composition of groups. Added moisture had only very short-term effects on the population tested.

METHODS

Samples were received from each validation site and were collected and processed by methods reported in the 1974 and 1975 progress reports (Freckman et al. 1974; Freckman et al. 1975). The data are, however, reported as nematodes/1000 g soil, a more rapid and convenient calculation from the extraction method. Previous data, based on nematodes/500 cm^3 for Rock Valley, were calculated to be approximately ⅔ of the population present in 1000 g soil (excluding rocks). Extraction efficiency was estimated to be approximately 60%.

RESULTS AND DISCUSSION

Jornada Site

Sampling from the Jornada Validation Site (New Mexico) was at four dates in spring and summer from four dominant shrubs; tarbush (*Flourensia cernua*), mesquite (*Prosopis glandulosa*), Mormon tea (*Ephedra trifurca*) and creosotebush (*Larrea tridentata*). Some samples taken at the site were lost in transit. Population data are given in Tables 1-4. The nematode population, averaged from the samples of each of the four shrub samples (Fig. 1), does not decrease with depth and horizontal distance from plant bases as markedly as at Rock Valley and Silverbell (Arizona). The average population is characterized by a relatively small fungivore group and a relatively large proportion of nemas in the plant-parasitic and omnivore/predator groups. Plant-parasitic nematodes dominated the population below 10 cm and were much more varied in species composition than were populations at Rock Valley and Silverbell sites, where only *Tylenchorhynchus* spp. were present. Some species of the highly specialized endoparasitic Heteroderidae were associated mainly with *F. cernua* and *P. glandulosa*. Plant parasites were concentrated around the plant base under mesquite in the upper 20 cm of soil. Mesquite also had considerably larger total nematode populations, particularly at the plant base, than did other shrubs.

Silverbell Site

The data obtained from the Silverbell Validation Site in Arizona are, unfortunately, based on only one sample which was obtained in a pattern usable in this comparative study, but some additional samples were usable for taxonomic purposes. This site apparently has the least dense nematode population of all validation sites, which may be due to the extremely rocky soil and the fact that some of the dominant plants sampled were deep-rooted trees or large shrubs. The site is unique in the extremely small proportion of fungivores in the population, the small percentage of plant parasites, composed mainly of *Tylenchorhynchus* spp., and a relatively greater proportion of the omnivore/predator group. The distribugram of nematodes averaged over all plants sampled (Fig. 2) is similar in relative vertical and horizontal distribution of the total fauna to that obtained for Rock Valley (Fig. 3). Plant-parasitic nematodes were most abundant in the surface 10 cm of soil and microbivores exceeded all other types combined below 10 cm.

Curlew Valley

Samples from Curlew Valley (Utah-Idaho border) were taken at eight intervals from March through November from sagebrush (*Artemisia tridentata*), shadscale (*Atriplex confertifolia*), squirreltail grass (*Sitanion hystrix*), crested wheatgrass (*Agropyron desertorum*) and from plant interspaces. Data obtained are summarized in Tables 5-9. Because plants at this site were much more closely spaced, relative to other validation sites, samples could be taken only at the plant base and at the canopy edge for the shrubs. Samples from under grasses were taken only in one location through the plant base. All positions sampled were at the usual depths (10, 20 and 30 cm). A sample from bare interspace areas was roughly comparable to positions 7, 8 and 9 at other sites. When nematode data were averaged from all samples (Fig. 4), the population was characterized by a somewhat smaller proportion of microbial feeders than at some other sites, a much greater percentage of fungivores than at Silverbell and Jornada and the highest percentage of nematodes in the plant-parasite group of all sites. The latter group also had the greatest species diversity of all sites. Because the types of plants sampled fell into two groups, e.g., shrubs and grasses, the data for each group were averaged separately and are represented in distribugrams (Figs. 5 and 6, respectively).

Populations around shrubs were dominated by plant parasites at the edge of the canopy at all depths. *Heterodera* sp. and *Meloidogyne* sp. (more than one species of each of these genera may be present) were mainly associated with the two shrubs but were also observed under the grasses on occasion. As root systems of shrubs and grasses probably overlapped, it cannot be determined with certainty whether a particular species was limited to one species or type of plant. Under shrubs, the population decreased gradually with depth and much larger populations occurred at 20 and 30 cm than at the other sites. Plant-parasitic nematodes observed, in addition to those above, include *Xiphinema* sp., *Tylenchorhynchus* spp., *Paratylenchus* sp. and a number of miscellaneous Tylenchidae. The fungivore group was composed mainly of *Aphelenchus avenae* and *Ditylenchus* sp.

Under the two grasses sampled, larger numbers of nematodes were associated with *S. hystrix* than with *A. desertorum*. Almost twice as many nematodes occurred at 0-10 cm under *S. hystrix* as under *A. desertorum*. The percentage of plant parasites was also much higher under the former grass at all levels and made up more of the population than all other groups combined (Fig. 6).

Populations in the plant interspaces were also dominated by plant parasites, probably indicating a large amount of root mass in these areas. Largest numbers in these areas occurred at 11-20 cm, but the trophic composition of the population very closely paralleled that at the edge of the canopy of the shrubs and that under *S. hystrix*. The data indicate a considerable uniformity of population throughout the area sampled (Fig. 7).

Table 1. Nematode populations of *Flourensia cernua* at the Jornada Validation Site, New Mexico

Position	Fungivores				Microbivores				Omnivores				Plant Parasites				Total			
	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30
1	0	188	358	91	255	2368	922	455	474	4850	1025	1227	291	300	615	1091	1056	7704	2920	2955
2	31	0	33	35	802	250	358	352	617	143	98	246	1543	142	195	1619	3116	535	684	2252
3	30	0	37	37	364	0	112	110	334	198	37	110	749	264	75	184	1669	462	261	478
4	29	99	0	40	734	330	394	357	441	297	39	40	235	264	197	198	1528	990	630	635
5	0	0	0	0	1278	128	103	220	361	160	103	439	417	192	34	769	2306	480	240	1428
6	0	0	0	0	234	33	76	98	234	0	0	98	469	66	76	163	1037	99	152	358
7	29	69	356	32	58	104	277	255	349	347	316	287	261	35	198	64	727	624	1147	637
8	60	0	68	67	30	0	135	368	30	139	169	100	90	0	68	133	210	174	440	735
9	28	36	0	0	0	0	177	123	0	0	35	41	505	0	106	123	618	36	318	328

Table 2. Nematode populations of *Prosopis glandulosa* at the Jornada Validation Site, New Mexico

Position	Fungivores				Microbivores				Omnivores				Plant Parasites				Total			
	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30
1	0	123	281	955	1537	1434	883	455	3823	1721	1565	1909	3073	697	1645	1819	8505	4221	4374	5411
2	0	64	111	0	353	255	297	227	706	479	669	182	1216	1532	1189	591	2316	2299	2303	1091
3	0	0	70	0	175	94	174	223	455	94	766	445	664	1097	800	519	1259	1316	1810	1187
4	442	0	221	0	736	234	699	625	2320	527	368	382	37	59	0	729	3903	908	1288	1736
5	0	90	0	0	336	0	97	253	299	482	162	72	410	331	454	325	1045	934	713	650
6	0	0	0	0	0	184	65	131	441	257	0	65	161	258	65	229	602	736	130	425
7	272	72	0	0	756	901	0	69	574	648	300	242	211	0	100	311	1935	1621	400	623
8	105	0	165	0	70	34	923	0	70	372	198	0	35	134	66	40	279	541	1352	160
9	0	0	39	35	253	63	39	70	253	125	118	282	32	63	118	282	538	251	315	669

Table 3. Nematode populations of *Ephedra trifurca* at the Jornada Validation Site, New Mexico

Position	Fungivores				Microbivores				Omnivores				Plant Parasites				Total			
	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30
1	269	285	37	63	538	601	959	474	731	443	221	695	423	190	221	222	2077	1519	1438	1549
2	38	355	45	34	302	161	446	610	189	258	89	508	718	226	134	373	1246	1034	714	1627
3	0	329	0	40	207	99	102	317	138	164	102	277	346	132	170	713	830	296	375	1387
4	192	0	69	0	639	0	450	395	511	122	208	143	351	92	173	251	1820	245	900	789
5	0	62	357	33	263	189	1823	200	33	94	396	466	428	126	594	965	757	472	3209	1697
6	0	34	0	0	0	137	100	67	0	34	200	167	34	205	67	569	34	890	367	803
7	0	0	36	0	462	30	181	137	36	576	36	174	142	0	36	0	640	606	289	313
8	0	102	119	109	102	103	119	272	136	207	198	54	0	275	278	82	272	898	794	544
9	0	32	109	0	311	0	217	68	346	65	181	0	345	97	398	136	1037	226	905	204

Table 4. Nematode populations on *Larrea tridentata* at the Jornada Validation Site, New Mexico

Position	Fungivore				Microbivores				Omnivores				Plant Parasites				Total			
	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30	3/26	4/20	5/30	7/30
1	300	33	535	0	700	767	2561	292	367	567	1835	876	230	200	1223	182	1797	1567	6154	1423
2	0	64	516	0	34	321	516	346	546	256	1254	423	581	481	627	0	1195	1154	2913	807
3	0	329	0	38	0	526	277	228	31	164	233	190	63	230	156	38	94	1249	661	532
4	34	0	35	38	135	216	519	491	101	493	622	680	135	123	380	869	305	832	1625	2191
5	0	0	34	75	0	35	241	261	127	383	207	224	95	801	103	448	286	1288	585	1008
6	31	32	72	0	0	195	216	96	61	195	180	159	215	162	72	96	368	747	539	415
7	0	0	650	68	206	67	514	512	66	133	959	477	0	733	137	1944	409	1000	2466	3103
8	0	0	0	32	1236	270	71	288	343	135	107	64	1511	203	71	288	4395	642	249	736
9	0	0	32	93	0	32	225	280	92	64	257	124	61	32	322	311	245	160	868	808

Table 5. Nematode populations of *Artemisia tridentata* (sagebrush) at the Curlew Valley Validation Site, Utah

1976:	4/27	5/11	5/25	6/24	7/27	8/27	10/5	11/10
				FUNGIVORES				
1	602	1676	444	3440	0	805	1319	253
2	2217	1443	29	719	686	203	503	0
3	367	1211	67	189	0	189	404	112
4	835	1019	474	240	423	154	971	0
5	88	549	843	190	0	723	424	124
6	44	0	185	192	0	114	656	0
				MICROBIVORES				
1	538	432	698	3899	1393	1739	565	2120
2	493	527	116	850	1475	542	251	2183
3	149	338	167	0	362	341	221	3172
4	791	331	148	0	684	513	1128	1529
5	88	244	77	190	417	337	392	994
6	11	179	494	128	529	171	250	900
				OMNIVO-PREDATORS				
1	86	568	286	1911	763	72	754	538
2	591	250	116	392	1852	0	395	800
3	69	253	33	126	316	0	0	827
4	264	357	59	361	1497	770	0	924
5	88	92	306	506	209	530	196	1118
6	22	238	62	320	298	143	188	533
				PLANT PARASITES				
1	65	1459	63	1606	630	1087	565	2342
2	1386	83	207	916	549	711	1329	1200
3	252	309	133	126	813	1477	698	1381
4	1362	1275	326	300	977	2464	1504	2866
5	1056	732	693	253	876	2938	881	1025
6	132	447	340	384	496	1686	813	2200
				TOTAL				
1	1302	4351	1523	10856	2786	3732	3204	5253
2	5666	2331	465	2876	4561	1491	2478	4182
3	837	2168	399	441	1491	2159	1324	5485
4	3472	3160	1038	1021	3581	4004	3603	5318
5	1320	1709	207	1329	1502	4624	1697	3261
6	230	1013	1173	1152	1323	2143	1907	3633

*Note: Nematodes counted in the Unidentified category were not included in the tables.

Table 6. Nematode populations of *Agropyron* sp. (crested wheatgrass) at the Curlew Valley Validation Site, Utah

1976:	4/27	5/11	5/25	6/24	7/27	8/27	10/5	11/10
				FUNGIVORES				
1	31	2052	910	841	0	145	133	29
2	20	481	116	180	538	36	150	97
3	0	715	54	0	320	0	96	62
				MICROBIVORES				
1	225	1399	1517	1127	889	1570	233	517
2	109	192	116	420	1853	692	225	778
3	22	372	192	179	931	172	193	839
				OMNIVO-PREDATORS				
1	82	155	667	280	1204	116	167	201
2	98	96	267	120	1106	109	374	130
3	22	29	27	179	524	29	129	373
				PLANT PARASITES				
1	245	964	910	392	1433	174	467	489
2	142	168	0	240	3559	0	823	357
3	34	29	27	179	1164	0	225	248
				TOTAL				
1	603	4581	4278	2634	3526	2209	1000	1236
2	480	1131	494	1020	6456	873	1572	1394
3	78	1141	385	597	2939	375	643	1522

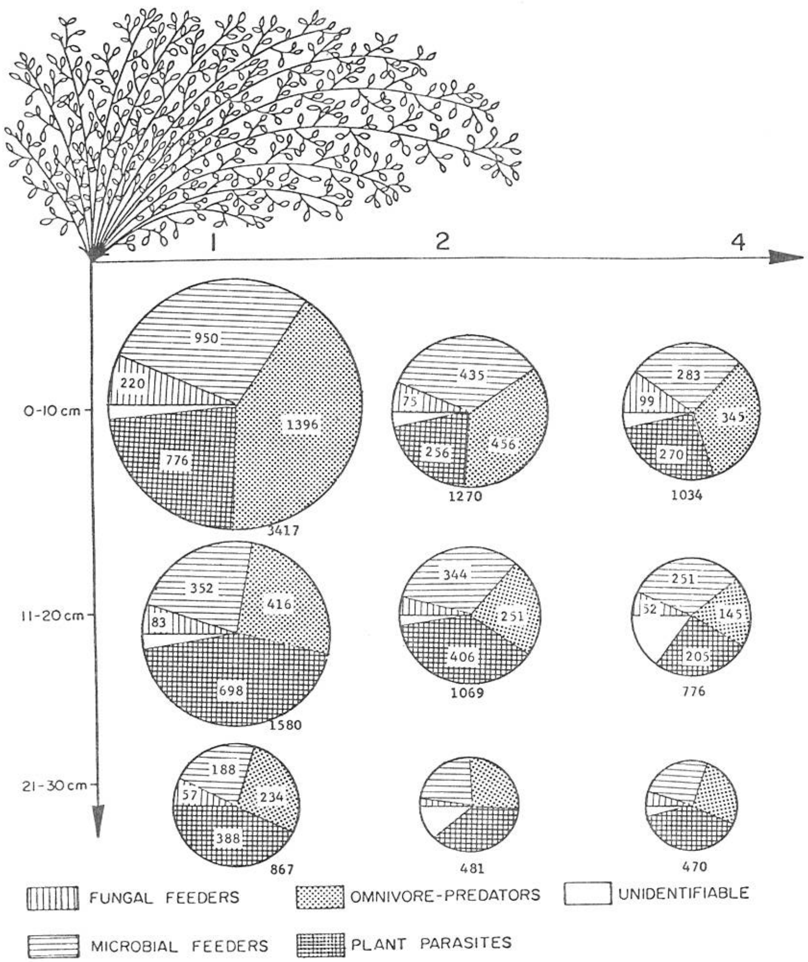

Figure 1. Trophic group distribugram of nematodes per 1000 g soil at the Jornada site, Las Cruces, New Mexico -- averages of four shrubs: *Flourensia*, *Prosopis*, *Ephedra* and *Larrea*.

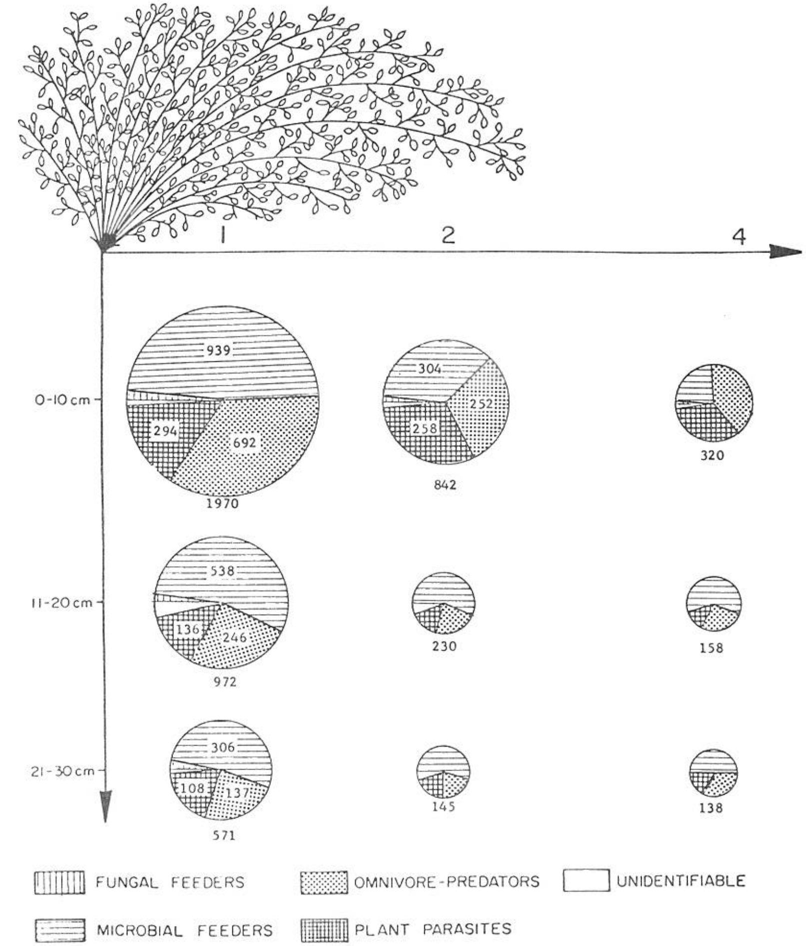

Figure 2. Trophic group distribugram of nematodes per 1000 g soil at Silverbell, Arizona.

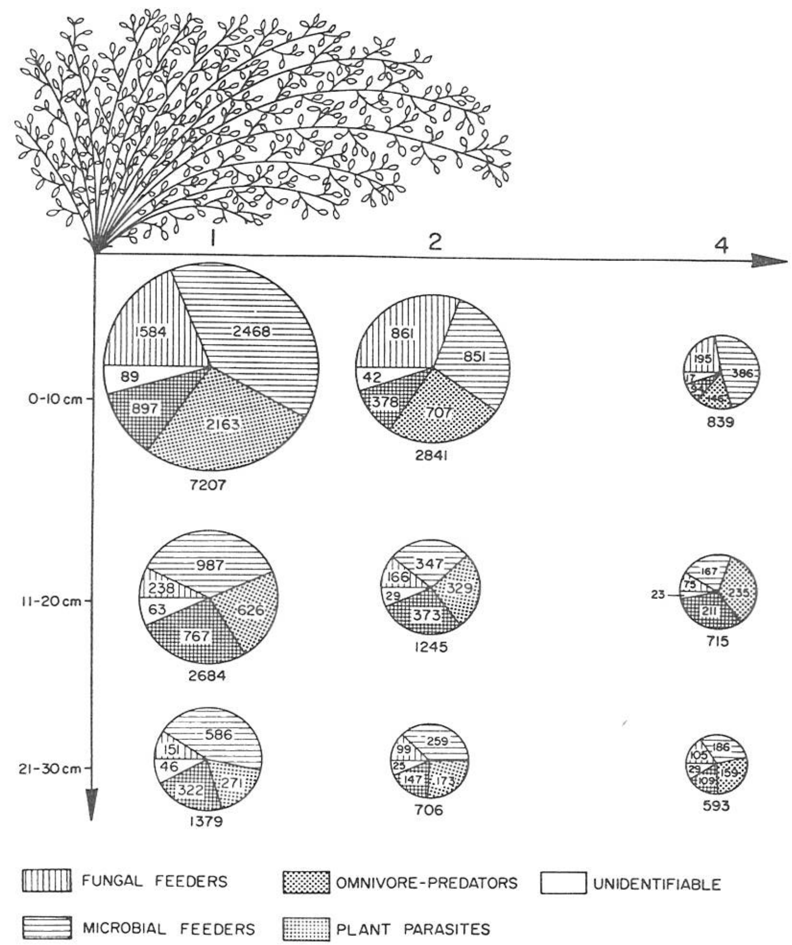

Figure 3. Trophic group distribugram of nematodes per 500 cc soil from four desert shrubs at Rock Valley, Nevada.

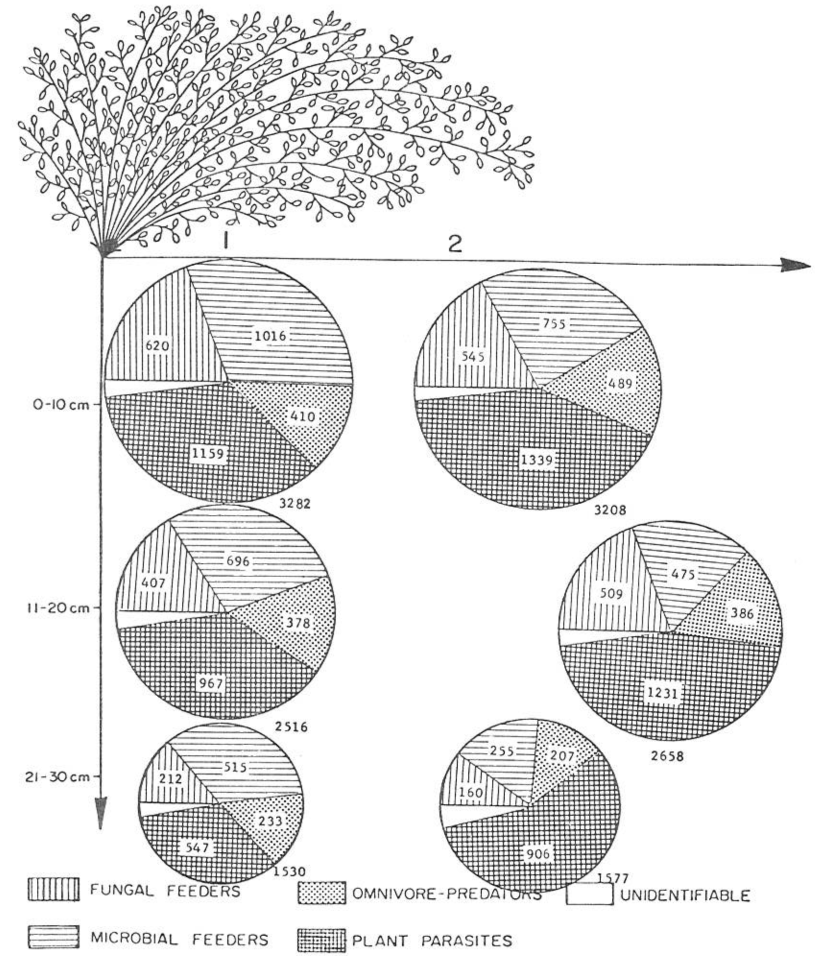

Figure 4. Trophic group distribugram of nematodes per 1000 g soil at Curlew Valley, Utah -- averages of all samples.

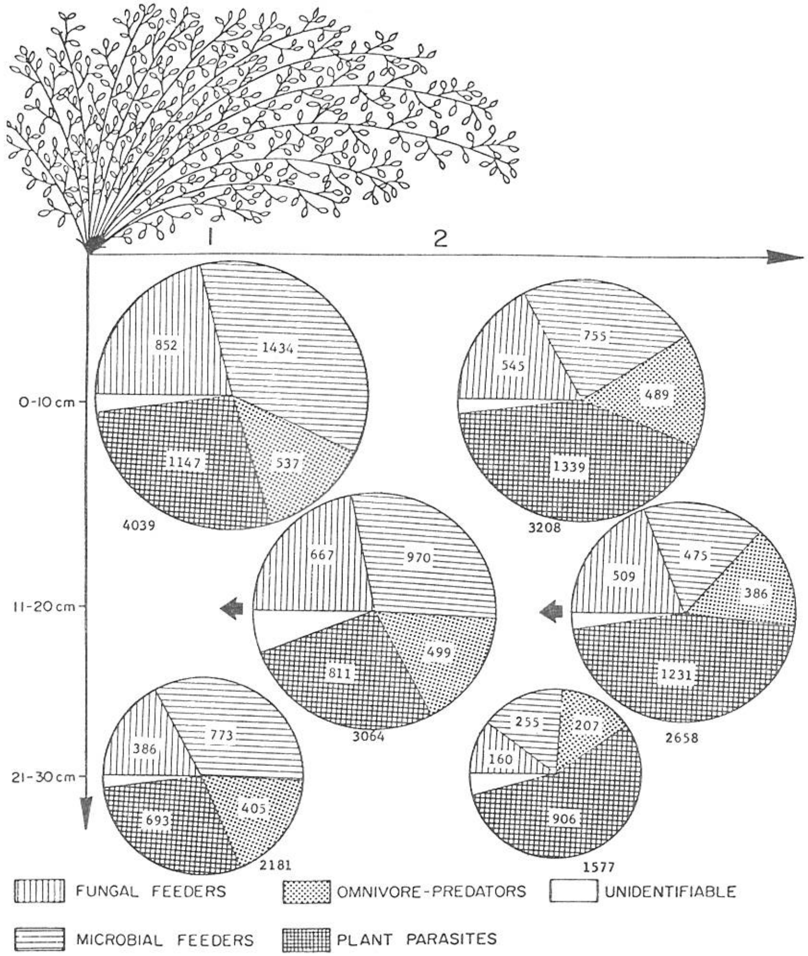

Figure 5. Trophic group distribugram of nematodes per 1000 g soil at Curlew Valley, Utah -- shrub averages (*Artemisia, Atriplex*).

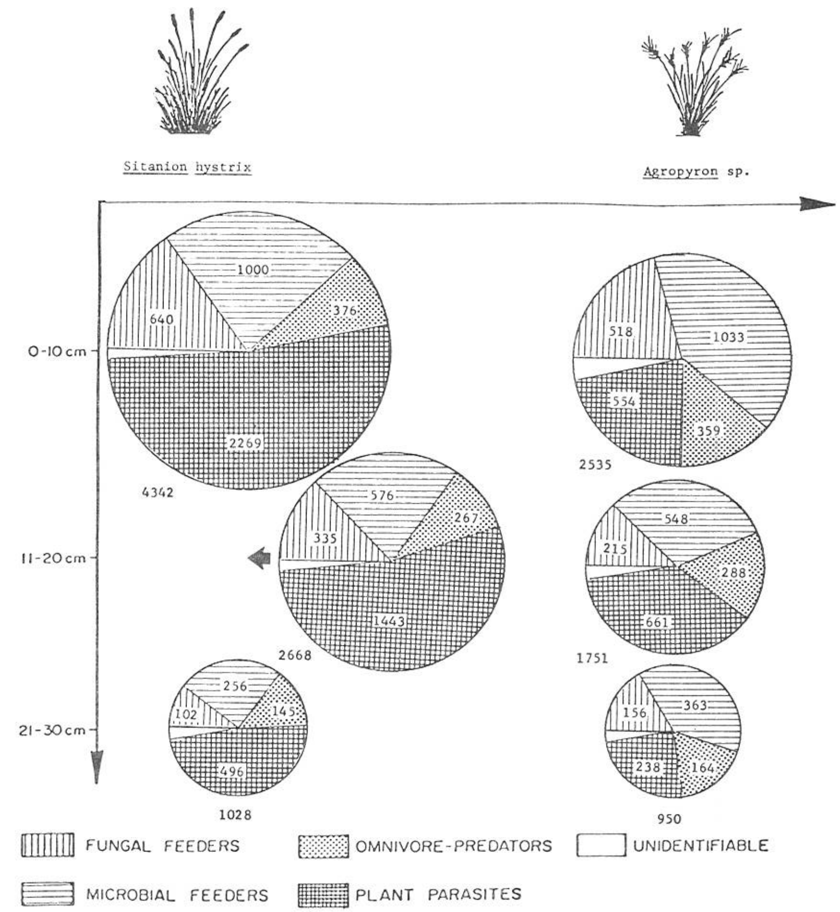

Figure 6. Trophic group distribugram of nematodes per 1000 g soil at Curlew Valley, Utah -- grasses.

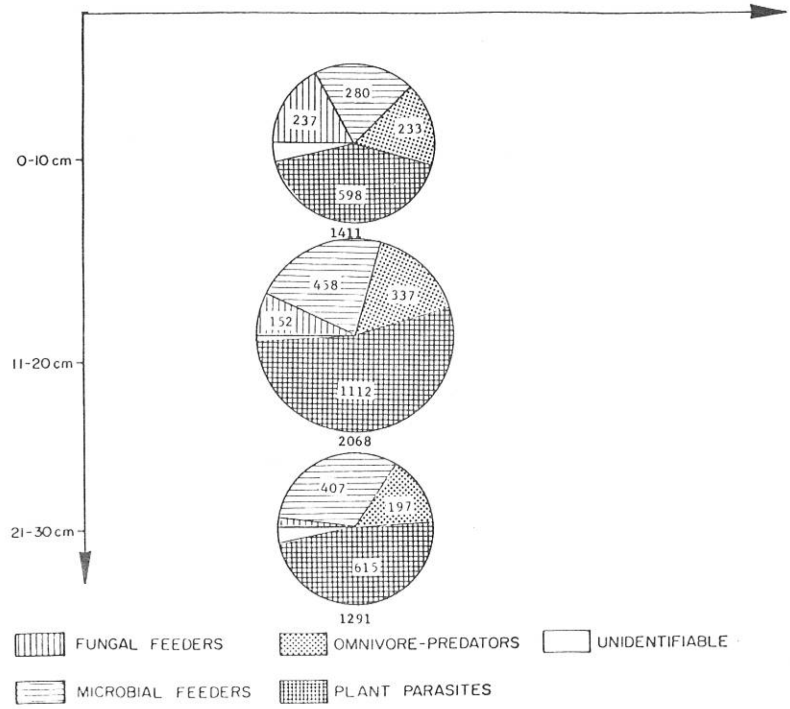

Figure 7. Trophic group distribugram of nematodes per 1000 g soil at Curlew Valley, Utah -- plant interspace.

Table 7. Nematode populations of *Atriplex confertifolia* (shadscale) at the Curlew Valley Validation Site, Utah

1976:	4/27	5/11	5/25	6/24	7/27	8/27	10/5	11/10
				FUNGIVORES				
1	584	1200	272	1087	229	1015	294	411
2	1955	307	803	236	90	315	352	706
3	523	442	774	128	164	142	422	1044
4	202	796	725	719	205	795	1170	0
5	186	949	320	2273	286	188	1002	0
6	57	168	179	337	200	405	31	0
				MICROBIVORES				
1	215	3471	516	2494	1203	800	771	2089
2	989	985	843	825	1079	710	915	2733
3	125	470	355	449	2457	709	994	2089
4	111	354	221	419	380	2809	2063	595
5	93	475	192	1455	350	471	1240	568
6	46	168	107	56	280	203	126	433
				OMNIVO-PREDATORS				
1	20	261	435	448	458	154	514	1329
2	56	27	452	236	480	237	377	1720
3	102	221	129	0	1048	35	482	1617
4	30	44	315	838	673	341	523	833
5	82	326	64	1455	445	157	191	410
6	0	28	36	224	360	34	126	700
				PLANT PARASITES				
1	46	1200	905	2813	831	985	1064	2689
2	630	684	723	944	510	158	914	2027
3	318	414	484	792	1278	212	813	1583
4	1353	797	378	1078	526	1248	3109	1865
5	505	475	576	2455	3212	345	1336	2242
6	644	1928	72	730	2200	608	220	1600
				TOTAL				
1	1005	6394	2364	6906	2721	2986	2643	6519
2	4090	2188	3102	2359	2098	1420	2535	7187
3	1068	1657	1839	833	5013	1135	2711	6334
4	1727	2259	1639	3114	1784	5420	6927	3294
5	897	2313	1247	7729	3499	1162	3865	3220
6	758	5112	393	1577	3040	1284	534	2733

Table 8. Nematode population data; plant interspace at Curlew Valley, Utah

1976:	4/27	5/11	5/25	6/24	7/27	8/27	10/5	11/10
				FUNGIVORES				
1	104	1006	123	70	0	68	319	208
2	87	207	182	0	0	330	31	382
3	92	0	0	57	0	0	90	0
				MICROBIVORES				
1	57	363	307	210	421	473	255	149
2	55	207	2073	251	352	396	125	208
3	39	63	964	230	1351	357	150	103
				OMNIVO-PREDATORS				
1	9	84	0	210	632	34	32	863
2	0	563	37	0	469	726	0	903
3	13	126	0	0	1126	65	180	69
				PLANT PARASITES				
1	179	838	184	350	391	912	1245	685
2	186	711	902	752	352	4517	187	1285
3	1881	126	720	287	1164	357	180	206
				TOTAL				
1	349	2570	706	910	1444	1486	2299	1905
2	350	1683	3018	1003	1174	6069	374	2778
3	2026	315	1929	631	3641	812	600	378

Table 9. Nematode population data; *Sitanion hystrix* (squirreltail) at Curlew Valley, Utah

1976:	4/27	5/11	5/25	6/24	7/27	8/27	10/5	11/10
				FUNGIVORES				
1	154	1327	490	578	0	245	1961	361
2	236	701	0	184	0	75	1126	349
3	57	119	300	0	0	32	32	276
				MICROBIVORES				
1	58	569	272	463	2905	1258	2083	394
2	303	286	158	491	1067	338	1389	572
3	79	268	67	65	593	161	96	725
				OMNIVO-PREDATORS				
1	77	433	190	1157	571	307	276	0
2	56	156	0	307	686	301	473	159
3	57	119	0	325	56	97	129	380
				PLANT PARASITES				
1	58	460	950	3473	5571	1872	2880	2887
2	180	494	95	794	3201	827	3128	2827
3	23	268	234	390	960	97	96	1899
				TOTAL				
1	365	2790	2038	5670	9048	3712	7414	3675
2	774	1817	285	1963	4954	1541	6419	3907
3	216	804	769	780	1610	420	353	3280

The Effect of Water on Nematode Population Dynamics

Edney et al. (1975) devised an experiment to help interpret the effect of added moisture on the relationships of arthropod density to a desert shrub over time. A cooperative arrangement allowed us to sample simultaneously, in all but one treatment (c), for effects on nematode population dynamics. The field experiments were carried out to measure effects of different total amounts of water, frequency of application and the time relations of any such effects. Details of the treatments were given by Edney et al. (1975), but are outlined here for clarity in presentation of results. The data were collected in 1975, but were analyzed and interpreted in 1976.

Water was applied from above the plots by "Rainbird" sprinklers and two water regimes were followed: A) *Repeated application*—Five 10-m radius plots were watered for a duration of 0 (control), 0.5, 1.0, 2.5 or 5 hr, twice a week or two weeks. Soil samples were taken from 0-10 cm depth at the usual three distances, immediately before each treatment (day 0) and on days 4, 7, 11, 14, 21 and 28 following treatment; B) *Single application*—Five plots were watered for 0, 0.5, 1.0, 2.5 and 5 hr on a single occasion. Samples were taken as in regime A.

Samples were taken from shrubs all within 3-5 m from the center of the circle to ensure that, as far as possible, all samples (within each treatment group) would have had similar amounts of water. Measurements of the amount of water applied showed that 1-hr sprinkling delivered about 31 mm ($n = 54$; $\overline{X} = 31$; s.e. $= 2.0$, range: 7.0-80.5). This is equivalent to 3.1 ml water·cm^{-2}. For comparison, the maximum precipitation during one event in 1974 was 21 mm and total rainfall in 1974 was 130.1 mm (Turner 1975). Two 500-cc samples of soil were taken from each position as required; samples being taken always from the north side of shrubs because the prevailing southerly wind tended to concentrate the water there.

Samples from treatments A and B are tabulated in Tables 10 and 11. Sampling was begun from treatment B after the experiment had been in progress for 14 days and the data therefore represent only effects observed at 21 and 28 days after the single application of water treatments. Except for the ½-hr water regime, which had far fewer numbers, none of the treatments differed substantially from the controls. Any marked effect of the watering had probably occurred earlier.

No clear results were obtained from treatment A, except that natural precipitation, which occurred just before and after day 11, appeared to have a much greater effect on the nematode population than any imposed by the watering regimes. The natural precipitation increased numbers rapidly and markedly in the controls as well. Highest total populations occurred in the lightest watering regime (½ hr, 4X).

Both treatments A and B were repeated for a second series. Again, there were no really significant differences from controls, but some of the treatments had considerably larger populations at 21 days than controls; however, by 28 days all were about the same as controls.

In general, it appeared that watering caused small, rapid increases in the nematode population which were entirely dissipated by 28 days. Fungivores and plant parasites generally declined in the populations of all irrigation treatments relative to controls and the microbivores increased. The two former groups may have become closely associated with active roots and were not picked up as readily in sampling. The controls had very stable nematode populations. The weekly sampling of the nonirrigated control areas over a period from late June to early October permitted the observation of natural fluctuations of nematodes associated with *Atriplex confertifolia*. Populations very gradually declined over this period as the soil dried, but increased considerably for brief periods following natural precipitation. Populations appeared to remain remarkably stable. It appears that desert nematode populations are in very close balance with available substrates in the soil and an abundance of water has relatively little immediate effect on the population.

Comparisons with Data from Nondesert Nematode Populations

Several samplings for comparative purposes were made in a variety of nondesert soils. The sites included soil around a shrub, *Encelia farinosa*, in low chaparral in a southern California area of about 27 cm average annual precipitation, from ornamental bermuda grass turf and from irrigated agricultural crops (citrus and a row crop, cabbage). Samples from the agricultural crops were in one vertical probe (0-45 cm) within the root systems, while *E. farinosa* was sampled in the same manner as desert samples were taken but at 15-cm increments to 45 cm.

Populations in the bermuda grass turf were quite similar to populations under the grasses at Curlew Valley with respect to trophic group composition, but were over eight times greater in total numbers than that measured under *A.*

Table 10. Nematode densities in numbers per 1000 g soil and soil moisture (percent dry weight of soil; underlined). Watering by applications of approximately 3 mm/hr on days 0, 4, 7 and 11; sampling on the days indicated. Each entry is a single sample

Date (1975)	Day #	Duration of each watering: 5 hr, Positions			2.5 hr, Positions			1 hr, Positions			0.5 hr, Positions			Control (No watering), Positions		
		1	4	7	1	4	7	1	4	7	1	4	7	1	4	7
7-17	0	7.0	5.5	4.5	7.0	5.5	4.5	7.0	5.5	4.5	7.0	5.5	4.5	Ø 1.80	776 2.22	0 1.94
7-21	4	979 8.42	635 8.78	0 7.16	49 6.14	0 5.41	58 5.67	5946 1.44	2101 2.32	0 2.48	12838 1.74	605 1.48	0 3.17	1212 1.35	0 1.45	Ø 1.38
7-24	7	2236 5.49	872 6.36	0 4.92	1218 1.23	1000 1.87	945 4.19	2158 1.65	184 2.36	270 3.25	8781 1.30	5015 1.56	264 2.10	Ø 1.26	614 1.86	0 1.73
7-28*	11	5418 3.70	3494 5.24	241 5.09	10710 2.85	2087 2.24	369 4.91	5020 1.80	1026 1.15	306 2.28	4758 2.19	346 3.16	213 2.85	9000 1.60	1930 2.05	0 2.08
7-31	14	1073 3.29	1172 4.22	800 5.88	8288 2.85	5553 1.74	811 2.29	7054 1.21	1939 1.54	133 1.94	14270 1.18	2007 1.50	118 2.31	9178 0.77	1930 1.13	71 1.35
8-7	21	25020 0.98	658 1.86	117 2.47	9588 1.22	1930 1.12	270 1.78	6946 1.35	203 2.04	0 1.97	45303 1.03	6052 1.02	361 1.62	10828 1.44	8987 1.79	201 1.85
8-14	28	1803 2.46	2789 2.50	88 2.33	198 1.48	459 1.57	140 1.82	4627 0.99	4821 1.28	357 1.59	1783 1.54	383 1.43	215 1.49	4926 1.28	2764 1.19	215 1.45

*Natural precipitation on this date.

0 = Count of zero.

Ø = no data.

Table 11. As in Table 10, except that watering occurred once only, on day 0

Date	Day #	5 hr, Positions			2.5 hr, Positions			1 hr, Positions			0.5 hr, Positions			Control, Positions		
		1	4	7	1	4	7	1	4	7	1	4	7	1	4	7
7-3	14													2233 1.36	143 1.51	47 2.02
7-10	21	3918 1.69	1129 1.74	595 1.45	2619 1.60	903 1.73	43 2.11	4125 1.41	171 2.12	89 1.93	706 2.20	115 1.00	40 1.75	5676 1.21	949 1.69	90 2.03
7-17	28	3379 1.32	842 1.19	63 1.68	818 2.30	Ø 2.33	0 2.29	2490 1.24	Ø 1.07	364 1.70	277 2.33	163 1.93	47 2.61	2732 1.64	852 1.76	99 1.59

desertorum, and over five times greater than that under *S. hystrix*. The bermuda grass populations totaled 12,253, 13,152 and 11,060 per 1000 g of soil at 0-15, 16-30 and 31-45 cm, respectively. The population was composed of approximately 10% fungivores, 20% microbivores, 20% omnivore/predators and 50% plant parasites throughout the entire vertical profile, with somewhat more microbivores and fewer plant parasites in the surface 15 cm. Populations from desert shrubs were very different in composition and spatial distribution from the turf sample.

An average population from a citrus grove was characterized by uniformity throughout most of the profile and greater total numbers below 15 cm than at the surface with little decline in numbers, even below 30 cm. Almost 75% of the population samples was composed of a single plant-parasitic species, the citrus nematode. This population had virtually nothing in common with any of the desert populations studied.

The annual row crop example also had greater total numbers below 15 cm and fewest at 0-15 cm. It had fewer fungivores and more microbivores than the perennial citrus and grass, but was also dominated by plant-parasitic forms (approximately 50%) below 15 cm.

Table 12. Total numbers of nematodes around the base of *Encelia farinosa*

	Position 1	4	7
0-15 cm	8,998	5,472	14,534
16-30 cm	6,793	6,335	6,371
31-45 cm	11,287	8,309	2,423

The shrub, *E. farinosa*, had much greater proportions of plant parasites at all positions. The populations also extended much deeper without diminution than was common for desert soils (Table 12).

Nematode populations around desert plants occur mainly in the surface 10 cm of soil and are generally concentrated around the bases of shrubs or grasses. They have a large proportion of microbial feeders (secondary decomposers) and fewer primary decomposers that feed directly on the plant. The proportion of the omnivore/predator group in the population is also generally larger than that found in agricultural soils. The total populations are many times less numerous per unit area than observed in nonarid soils. The trophic composition of desert populations indicates they are primarily involved with cycles associated with the decomposition of plant litter. Areas with greater total precipitation have comparably greater proportions of plant-parasitic species.

LITERATURE CITED

Edney, E. B., J. F. McBrayer, P. J. Franco, and A. W. Phillips. 1975. Abundance and distribution of soil microarthropods in Rock Valley, Nevada. US/IBP Desert Biome Res. Memo. 75-29. Utah State Univ., Logan. 8 pp.

Freckman, D. W., R. Mankau, and S. A. Sher. 1975. Biology of nematodes in desert ecosystems. US/IBP Desert Biome Res. Memo. 75-32. Utah State Univ., Logan. 11 pp.

Freckman, D. W., S. A. Sher, and R. Mankau. 1974. Biology of nematodes in desert ecosystems. US/IBP Desert Biome Res. Memo. 74-35. Utah State Univ., Logan. 10 pp.

Turner, F. B., ed. 1975. Rock Valley Validation Site report. US/IBP Desert Biome Res. Memo. 75-2. Utah State Univ., Logan. 53 pp.