1975

Classification and Quantification of Invertebrate Activity and the Role of Invertebrates in Nitrogen Processing in Plants, Litter and Soil in Curlew Valley

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1974 PROGRESS REPORT

CLASSIFICATION AND QUANTIFICATION OF INVERTEBRATE ACTIVITY AND THE ROLE OF INVERTEBRATES IN NITROGEN PROCESSING IN PLANTS, LITTER AND SOIL IN CURLEW VALLEY

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US/IBP DESERT BIOME
RESEARCH MEMORANDUM 75-24

in

REPORTS OF 1974 PROGRESS
Volume 3: Process Studies
Invertebrate Section, pp. 1-6

1974 Proposal No. 2.3.3.6

Printed 1975

Citation format: Author(s). 1975. Title.
US/IBP Desert Biome Res. Memo. 75-24.
Utah State Univ., Logan. 6 pp.

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ABSTRACT

Insect sampling and identification were the major activities in this year's study, augmenting and correcting the listing begun in 1973. A program of weekly aerial sweep sampling was carried on from April 16 to August 17. Arthropods were collected from prominent plants on the south sagebrush and grass sites in Curlew Valley. Sorting and identification of the insects continued and will continue into 1975. These data indicate heavy species diversity with no significant change from 1973 except for the expected increase in species as identification work continues. There are now 761 species identified and listed. The toilet paper study for assessing termite feeding activity was continued; the year-old rolls being removed for study and replaced with new rolls. A new grid of 100 pretreated rolls was set up in July. These rolls were treated with either 10% glucose solution, 5% glucose solution, 10% ammonium nitrate solution, 5% ammonium nitrate solution or frozen orange juice. Twenty-five untreated rolls served as a control. These treatments were an attempt to determine if nutritional preference or attraction exists among the termites. These results are not available as yet. In August, 200 litter bags containing 3 g each of varied plant material were placed in the field. Some of the plant material was left untreated and the bags were left on the ground surface; others were treated with naptha balls or Dieldren and buried, while still others with Dieldren were left unburied. These bags will be removed after one year and the contents analyzed for total nitrogen. In July, two attempts were made to count scorpions at night by sighting of black light response. These attempts resulted in 13 sightings. These data will be compared with scorpion counts from pit traps in the validation study. An attempt was also made to determine if termites are capable of fixing nitrogen. Using the acetylene reduction method on the live-termite samples, no reduction activity was noted and it was assumed that no nitrogen fixation was occurring. These results, however, are not conclusive because there were too few trials and because the technique may not be sensitive enough.

INTRODUCTION

During 1974, insect sampling and identification continued as the major activity of this study. Purposes and intentions as stated in the 1973 progress report (Sferra 1974) remained the same; however, the study of the rôle of invertebrates in nitrogen processing in the litter did not progress as anticipated. Most of the efforts on this project were devoted to sweep sampling, identification of the insects captured, renewal of the toilet paper rolls on the termite study grids, addition of one new toilet paper grid with treated rolls of toilet paper, tests for nitrogen fixation within the termites found in Curlew Valley and placement of litter bags in a variety of situations on the south sagebrush site.

OBJECTIVES

As stated in the preceding progress report (Sferra 1974), the rationale for giving more attention to the determination of the kinds and numbers of arthropods on the prominent plants in the south test sites than to the determination of the fate of litter nitrogen as affected by the activities of invertebrates thereon, was based upon time limitations and "because the information gained would provide a sound foundation for study of the litter-processing phenomena" (Sferra 1974, p. 2). Such a foundation will be established when the results of the sweep sampling from this study and the results of the validation program for collection of invertebrates by means of D-Vac, soil sampling, emergence traps and pit traps are combined and evaluated. These efforts have not been completed as yet. In addition, litter nitrogen investigation is lacking valid and reliable methodology. No worthwhile technique has, as yet, emerged from this study.

METHODS

Sweep sampling techniques, identification methodology and the toilet paper experiment are described in Sferra (1974). During 1974 sweep sampling commenced on April 16 and continued weekly until August 27. A drier spring in 1974 (compared to 1973) resulted in few *Descurainia pinnata* and *Lepidium perfoliatum*; thus, no sweep samples were taken on the former and only one sweep sample was taken on the latter. Later in the season, there were too few *Salsola kali* to warrant sampling. Sweep samples were taken from *Agropyron cristatum*, *Artemisia tridentata*, *Atriplex confertifolia*, *Bassia hyssopifolia*, *Chrysothamnus viscidiflorus*, *Halogeton glomeratus* and *Sitanion hystrix* when they were abundant enough for sampling. Sorting and identification of the insects continued and corrections were made in the identifications of 1973. Table 1 lists species which have been added to DSCODE A3USE02 (established in 1973) and Table 2 lists species which have been deleted from the same DSCODE. These data are the result of continued identification and corrected identification. DSCODE A3USE02, at this writing, now contains 761 species. Sorting and identification of all samples have not been completed. In addition, work continues on DSCODE A3USE01 which will contain quantitative data.

In July 1974 all rolls of toilet paper on the test grids were replaced with new rolls. Some modifications were made to prevent deterioration of the rolls due to weathering and plant abrasion. The insides of the cores of the new rolls were coated with a clear polyurethane varnish to keep them from unraveling and a piece of 8-mil polyethylene film was wrapped tightly around the outside circumference of each roll and secured with duct tape. The outer wrapper did not cover the flat end surfaces and was applied to keep the paper from unraveling and to prevent damaging abrasion when plant branches rubbed against the roll due to wind action. Each new roll was placed with one flat end flush with the ground and with adjacent soil scraped against it to seal it off. Of the year-old rolls which were removed from the grids, five contained working termite colonies and were saved for quantitative study.

One new grid was set up in July, adjacent to the grid just off-site in a dead sagebrush area. This grid consists of 100 rolls in a 10 x 10 arrangement with the rolls placed 3 m apart. These rolls were pretreated as follows: 15 rolls, each treated with 100 ml of 10% glucose solution; 15 rolls, each treated with 100 ml 5% glucose solution; 15 rolls, each treated with 100 ml 10% ammonium nitrate solution; 15 rolls, each treated with 100 ml 5% ammonium nitrate solution; 15 rolls, each treated with 100 ml frozen orange juice; and 25 untreated rolls. The treatments were allowed to dry and the 100 rolls were distributed randomly (for treatment) on the grid. Five untreated rolls were placed randomly outside the grid. The treatments were an attempt to determine whether or not some kind of nutritional preference or attraction exists among the termites.

In August 1974, 200 litter bags were placed in several locations under varied conditions on the south sagebrush site. Each bag, a 5 inch x 5 inch envelope of 16-mesh fiberglass screening sewn with Dacron-cotton thread, contained 3 g of dry plant material in six categories: *Atriplex* leaves, *Atriplex* light twigs, *Atriplex* dark twigs, *Artemisia* leaves, *Artemisia* plain twigs and *Artemisia* twigs with bark. Forty bags were buried with no treatment, 50 bags were placed on the ground surface with no treatment, 30 bags were buried with naphtha balls, 65 bags were buried with Dieldrin treatment and 15 bags treated with Dieldrin were placed on the ground surface. All burials were just under the cryptogamic crust with three bags placed in each excavation. Each bag had a cotton cord attached with a numbered Dymo label stapled to the end for identification. Surface bags were tied to *Artemisia* or *Atriplex*, depending on the location. Burials were with the label end of the cord just above the surface of the ground. All bags are to be removed from the site after one year, the litter weighed and then analyzed for total nitrogen.

In July 1974, two attempts were made to count scorpions at night by sighting of black light response. Two transects were laid out with upright lath strips spaced 10 m apart for guidance. One transect, a square 100 m on a side, was laid out in the south sagebrush site and the other, an L 100 m on a side, was laid out on the south grass site. The lamp used was a Burgess Safari battery-powered lantern fitted with an 8-inch ultraviolet tube. This had an effective sighting width of approximately 1 m when held at about knee height. The first attempt resulted in no scorpion sightings; however, on the second night at between 10:00 p.m. and 12:00 a.m., the equivalent of twelve 100-m walks along the transects yielded a total of 13 scorpion sightings. These results will be compared with the scorpion counts from pit traps in the validation study.

Finally, through the cooperation of Mr. Robert Reichert, some attempts were made to determine if the termites active on the south sites are capable of fixing atmospheric nitrogen. Using the acetylene reduction method, three samples of 50 live termites each and one large sample of 500 live termites showed no reduction activity in the acetylene atmosphere and it was assumed that no nitrogen fixation was occurring. These results are not considered conclusive, partly because there were not enough trials and because the technique may have been lacking in sensitivity. Some refinement in holding container design is recommended if this is to be repeated.

Table 1. Additions to DSCODE A3USE02. Insects collected from sweeps of aerial parts of plants, 1973 and 1974. Weekly samplings on south sage and grass sites from June 7, 1973. Plants sampled: *Agropyron cristatum, Artemisia tridentata, Atriplex confertifolia, Bassia hyssopifolia, Chrysothamnus viscidiflorus, Descurainia pinnata, Halogeton glomeratus, Lepidium perfoliatum, Salsola kali, Sitanion hystrix*

Order, Family	Genus & Species
Coleoptera	
Buprestidae	*Agrilus gibicollis*
Carabidae	sp #1
	Technophilus croceicollis
Chrysomelidae	*Psylliodes punctulata*
Cleridae	sp #1
Coccinellidae	*Exochomus septentrionis*
	Hyperaspis sp #1
	Hyperaspis lateralis
	Hyperaspis nevadica
	Scymnus sp #1
	Scymnus uteanus
Curculionidae	*Cercopeus artemisiae*
	Cleonis quadrilineatus
	Epimechus sp #1
Meloidae	*Epicauta normalis*
	Gnathium sp #1
Mordellidae	*Mordellistena* sp #1
	Mordellistena sp #2
Phalacridae	*Phalacrus* sp #1
Staphylinidae	sp #2
Tenebrionidae	sp #99
Diptera	
Agromyzidae	sp #98
	sp #99
	Melanagromyza sp #99
Anthomyiidae	sp #98
	sp #99
	Hylemya sp #1
	Schoenomyza sp #1
Bombyliidae	*Conophorus* sp #1
	Conophorus obesulus

Table 1, continued

Order, Family	Genus & Species
Diptera	
Cecidomyiidae	sp #7
	sp #97
	sp #98
	sp #99
Ceratopogonidae	sp #99
	Leptoconops furens
Chironomidae	sp #1
	Chironomus sp #1
Chloropidae	sp #99
Conopidae	Zodion sp #1
Empididae	Platypalpus sp #1
Ephydridae	sp #98
	sp #99
Pipunculidae	Pipunculus sp #99
Sarcophagidae	Miltogrammini sp #1
	Miltogrammini (Tribe) sp #1
Sepsidae	Sepsis sp #1
Stratiomyidae	Odontomyia sp #1
Syrphidae	Eupeodes volucris
Tachinidae	Hyalomya sp #1
	Leucostoma simplex
	Peleteria sp #1
Tephritidae	Trupanea sp #99
Therevidae	sp #99
Ephemeroptera	sp #1
Hemiptera	
Lygaeidae	Nysius sp #2
Miridae	sp #98
	sp #99
	Lygus sp #2
	Orectoderus obliquus
Pentatomidae	Chlorochroa sp #1
Reduviidae	Zelus socius
Homoptera	
Aphididae	Aphis sp #1
	Epimeebaphis sp #1
	Obtusicauda sp #1
Cicadellidae	sp #97
	sp #98
	sp #99
	Aceratagallia sp #1
	Ceratagallia sp #1
	Empoasca sp #99
Coccidae	sp #99
Delphacidae	sp #2
Fulgoridae	sp #1
Membracidae	sp #1
Psyllidae	Aphalara sp #99
Hymenoptera	
Andrenidae	Andrena scurra
Braconidae	sp #97
	sp #98
	sp #99
	Adialytus sp #1
	Agathis sp #1
	Agathis gibbosa

Table 1, continued

Order, Family	Genus & Species
Hymenoptera	
Braconidae	Apanteles sp #5
	Apanteles sp #7
	Bracon sp #1
	Bracon sp #2
	Bracon sp #3
	Bracon sp #4
	Bracon sp #6
	Bracon sp #7
	Bracon sp #10
	Bracon sp #99
	Bracon gelechiae
	Chelonus (Microchelonus) sp #1
	Chelonus (Microchelonus) sp #2
	Chelonus (Microchelonus) sp #3
	Chorebus sp #1
	Cantharoctonus sp #1
	Creonops vulgaris
	Dacnusa sp #1
	Dacnusa sp #2
	Dacnusa sp #3
	Dacnusa sp #4
	Dacnusa sp #99
	Hormius sp #1
	Lysaphidus sp #1
	Lysiphlebus sp #1
	Meteorus leviventris
	Microctonus sp #1
	Microplitis sp #1
	Microplitis brassicae
	Opius sp #1
	Opius sp #2
	Opius sp #3
	Opius sp #5
	Opius sp #6
	Orgilis sp #1
	Orgilis sp #2
	Orgilis ferus
	Tetrasphaeropyx sp #1
	Trioxys sp #1
Chrysididae	sp #1
	Hedychridium sp #99
Cynipidae	sp #99
Encyrtidae	sp #18
	sp #93
	sp #94
	sp #95
	sp #96
	sp #97
	sp #98
	sp #99
Eulophidae	Emersonopsis #59
	sp #98
	sp #99
	Tetrastichus sp #64
	Tetrastichus sp #72
	Tetrastichus sp #98
	Tetrastichus sp #99

Table 1, continued

Order, Family	Genus & Species
Hymenoptera	
Eupelmidae	sp #1
Eurytomidae	*Eurytoma* sp #99
	Harmolita sp #1
	Harmolita sp #2
	Harmolita sp #3
Eutrichosomatidae	*Eutrichosoma* sp #99
Formicidae	sp #98
	sp #99
	Leptothorax sp #1
	Myrmica americana
	Tapinoma sessile
Ichneumonidae	sp #98
	sp #99
	Anomalon sp #3
	Campoplex sp #1
	Cratichneumon sp #1
	Cremastus sp #1
	Cremastus sp #2
	Diadegma sp #1
	Diaparsis sp #1
	Enicospilus sp #1
	Exetastes dichromus
	Gelis (Winged) sp #1
	Gelis (Winged) sp #2
	Glypta sp #1
	Glypta sp #3
	Netelia sp #1
	Temelucha sp #1
	Temelucha sp #2
	Vulgichneumon sp #1
Mymaridae	sp #99
Platygastoridae	*Inostemma* sp #99
Proctotrupidae	sp #2
	Proctotrupes sp #1
Pteromalidae	sp #55
	sp #95
	sp #97
	sp #98
	sp #99
	Habrocytus sp #87
	Habrocytus sp #99
Scelionidae	sp #99
	Scelio sp #99
Torymidae	*Torymus* sp #99
Trichogrammatidae	sp #99
Lepidoptera	
Hesperiidae	*Hesperia nevadensis*
Lycaenidae	*Mitoura siva*
Orthoptera	
Acrididae	sp #2
	Melanoplus sp #2
Psocoptera	sp #99
Strepsiptera	
Halictophagidae	sp #1
Thysanoptera	sp #99

Table 2. Deletions from DSCODE A3USE02 (see Table 1, Sferra 1974)

Order, Family	Genus & Species
Coleoptera	
Buprestidae	*Agrilus* sp #1
Chrysomelidae	sp #1
	sp #4
Curculionidae	sp #4
	Lixus sp #1
Meloidae	*Epicauta* sp #1
	Gnathias sp #1
Mordellidae	sp #1
	sp #2
Scaphidiidae	sp #1
Anthomyiidae	*Hylemyia* sp #1
	Schoenomyza sp #1
Hymenoptera	
Braconidae	sp #2
	sp #3
	sp #4
	sp #5
	sp #6
	sp #7
	sp #8
	sp #9
	sp #10
	sp #11
	sp #12
	sp #13
	sp #14
	sp #15
	sp #16
	sp #17
	Apanteles sp #1
	Chelonus sp #1
	Chelonus sp #2
	Chelonus sp #3
	Meteorus sp #1
	Microbracon sp #1
	Microbracon sp #2
	Microbracon sp #3
	Microbracon sp #5
	Microbracon sp #6
	Microbracon sp #7
	Microbracon sp #8
	Microplitus plutellae
	Opius sp #4
	Triaspis sp #1
Eulophidae	sp #45
	sp #64
	sp #90
	Euderus sp #72
	Tetrastichus sp #77
Formicidae	sp #1
	sp #3
	Pogonomyrmex sp #1
Ichneumonidae	sp #1
	sp #2
	sp #4
	sp #5

Table 2, continued

Order, Family	Genus & Species
Hymenoptera	
Ichneumonidae	sp #6
	sp #7
	sp #8
	sp #9
	Ichneumon sp #1
	Ophion sp #1
	Paniscus sp #1
Proctotrupidae	sp #1
Pteromalidae	sp #9
	sp #23
	sp #53
	sp #83
	Sphegegasterinae
Lepidoptera	*Mitoura siva*
Strepsiptera	sp #1

DISCUSSION

The data of DSCODE A3USE02 continue to indicate a heavy species diversity with 14 orders of Class Hexapoda represented. Order Hymenoptera was represented by 366 species. There were 167 species of Diptera, 60 species each of Hemiptera and Homoptera and 70 species of Coleoptera. No significant changes, except for an increase in the number of species as identification work continues, appear in the 1974 data regarding representation of species among the orders, dominance of small parasitic Hymenoptera, and distribution of species according to plant type sampled when these data are compared with those of 1973. Not enough of the 1974 samples have been analyzed to determine whether or not the insects of 1973 differed in any way from those of 1974.

EXPECTATIONS

DSCODE A3USE02 which is taxonomic, and DSCODE A3USE01 which will be taxonomic and quantitative, should be completed in the spring of 1976. At that time there sould also be data on the termite activity in the toilet paper and data on the fate of the plant material in litter bags.

LITERATURE CITED

Sferra, P. R. 1974. Classification and quantification of invertebrate activity and the role of invertebrates in nitrogen processing in plants, litter and soil in Curlew Valley. US/IBP Desert Biome Res. Memo. 74-28. Utah State Univ., Logan. 8 pp.