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Fauna and Distribution of Free Living Chiggers (Acarina: Trombiculidae) in Arkansas

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APPLICATION OF GELIGAM SOFTWARE TO THE ANALYSIS OF X-RAY SPECTRA

In 1986 a feasibility study (H. B. Eldridge, "Testing Treated Posts Using X-Ray Fluorescence-A Feasibility Study." Paper presented at the Forty-Second Arkansas Transportation Research Committee Meeting April 1986.) was conducted to determine if X-ray fluorescence energy dispersive techniques could be used as a timely and nondestructive means of testing the quality of treatment of wood products. This project was of interest to and was funded by The Arkansas Highway and Transportation Department (AHTD), which uses the preservative Copper-Chrominum Arsenate (CCA).

The X-ray fluorescence energy dispersive techniques currently being investigated uses an ^{241}Am isotopic X-ray source with an ADCAM system consisting of a model 918 Multichannel Buffer, and Lithium-Drifted Silicon X-ray Detector. The software used for analysis of the spectrum colected with this system was the Geligam Gamma-ray Analysis (Geligam is a Software program developed by EG&G ORTEC 100 Midland Road, Oak Ridge, TN 37831-0895) package. Geligam is a modular software package designed for analysis of Gamma-ray spectra collected with a germanium gamma radiation detector. The modules of Geligam which were used for the X-ray analysis project were A18-BI Application Manager and A30-BI Gamma-Ray Analysis. A18-BI Application Manager program allows the user to collect data with the ADACAM, transfer spectral data, create, modify, delete or transfer bookkeeping data, print spectral or bookkeeping data, or convert emulator output files to the form needed for the analysis program to be able to use them. The emulator program is the software part of the ADCAM system which allows the PC to be used to collect spectra.

The A30-BI Gamma-ray analysis module is designed to analyze Gamma-ray spectra collected with a germanium solid state detector. The gamma analysis software is designed to work with files produced by the A18-BI application manager, in order to produce a report containing the intensities of Gamma-rays found and the concentrations of the radioactive nuclide present.

The first program to be run from the Geligam software package is the Gerpar file. This file allows the user to set initial parameters. The most important of these parameters are the MCA number, which makes sure the same set-up is used during the entire analysis, and the analysis version number, which tells the type of analysis to be performed. The only other parameters changed from the program defaults were the start and stop channels (200 and 500 respectively) and the intermediate print-out.

The next program run should be the library program which creates, modifies, or prints a library of the nuclide that the user would like the analysis program to find. In our case, the elements were Copper, Chromium and Arsenic. Only Copper and Chromium were entered into the library, due to the effect of the Compton edge of ^{241}Am on the counting statistics of Arsenic. There are three possible types of libraries which may be used. These are GAMMA, NAAA, and NAAC. The type of library used was the GAMMA simply because it fit the needs of the analysis performed.

The GAMMA library needs the following information; the half life, which was chosen to be large enough so as not to interfere with the calculations, the branching ratios, determined to be the fractional area under each of the peaks as compared to the total area of the peaks in the library. The Gammas/100D were chosen to be 100 times the branching ratio. All data entered into the library was taken from experimental data.

The Convert file must then be run in order to change the CHN file into a spectrum file and combine the outputs of the library and analysis parameter files with the spectrum. Next to calibration file must be run. This file serves three purposes. One, to calibrate the file, secondly, to adjust for the detector's efficiency knee, and third, to find the efficiency of the spectrum. The calibration file produced is then combined with the spectrum file with the use of the Convert file. The first analysis file (AN1) is then run. This file produces a UFO file which is needed in the final analysis. It also allows the user to modify any parameters set in Gerpar. The second analysis file (AN2) analyzes the UFO file formed by the first analysis program and makes a report which is placed in this file. The final program to be run is the report file, which will print a report of the file to the monitor, printer, or save it as a disk file. The report this file creates shows the energy of the peak found, the corresponding channel, the corresponding nuclide, and the peaks found that are not in the library.

As stated, the Geligam analysis software package is for the analysis of Gamma-ray spectra collected with a germanium solid state detector. The X-ray spectra which is analyzed with this study is collected with a Silicon lithium solid state detector using a ^{241}Am isotopic X-ray source. The spectra which has been collected thus far is from liquid CCA. There were 10 samples made. The samples ranged from 10% CCA to pure CCA at 10% increments. The samples were then placed in standard liquid sample containers that provided a 0.15 mil thick Mylar entrance window to the incident X-ray beam.

The background continuum and Compton edge of ^{241}Am interfered with the counting statistics of the Cr and As peaks at low concentrations of CCA. The Compton edge of ^{241}Am is approximately 9 Kev. Another X-ray (^{109}Cd) source, which is being purchased, has no appreciable Compton edge, and should not interfere with any of the peaks. However, since the As peak has good counting statistics through the range of CCA concentrations, a graph was constructed of the concentration of As versus its activity. The resulting curve was linear, as was expected.

Geligam Gamma-ray analysis program found the peaks in the X-ray spectra of the elements in the library and reported their activity. Although this is not a true activity, as in Gamma-ray analysis it may be used to find the amounts of elements in a sample. In the study underway, Geligam will be used to find the amount of CCA in a sample and the concentrations of the elements involved.

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FAUNA AND DISTRIBUTION OF FREE LIVING CHIGGERS (ACARINA:TROMBICULIDAE) IN ARKANSAS

In the southern United States, the pest chigger *Eutrombicula alfreddugesi* (Oudemans), is widely distributed and medically important (Jenkins, 1949; Crossley and Proctor, 1971). Infestive larvae of this mite cause dermatitis in man and some animals, resulting in economic losses (Wharton and Fuller, 1952). Dense populations of this chigger may have an adverse effect on forestry operations, recreation, and military training (Martinko, 1974; Anonymous, 1976). In the Pacific, other Trombiculid mites have long been known to transmit scrub typhus or Tsutsugamushi disease. *E. alfreddugesi* is the most common and abundant chigger on the Georgia piedmont (Ludwig, *et al.*, 1984). No previous extensive survey in the state of Arkansas has been undertaken.

A three year study of the fauna and distribution of the free living Trombiculidae of Arkansas was initiated in the fall of 1984. At this date, the authors feel that the survey has been fairly complete, but some additional work needs to be done.

Free living chiggers were collected throughout the state using "chigger samplers" as described by Wicht and Crossley (in manuscript). This method consists of placing 7 x 14 centimeter (about 100 cm^2) black vinyl baseboard rectangles on objects and placed where chiggers might occur. From previous experience in the field, the authors have learned that chiggers are most likely to be found on logs, stumps, and rocks, where lizards might sun themselves, where birds might land, or where some mammal might walk.

Localities were sampled in all hours of daylight, in temperatures ranging from 22 to 40 degrees Celsius, and in a wide variety of weather conditions including overcast, partly cloudy, and sunny. The earliest successful sampling date was May 4 and the latest successful sampling date was September 28. Even though sampling was conducted under various weather conditions, previous experience has also taught the authors that chiggers are most apt to respond to the chigger sampler if it is placed on an object, partially shaded, on a bright sunny day (Wicht and Crossley; field notes, summer of 1982) with the incident sunlight being on the order of 1000 foot candles.

Others have used small black objects to collect unengorged chiggers. Wharton and Fuller (1952) used black bakelite caps removed from reagent bottles. Loomis (1956) used rigid black plexiglass-acrylic rectangles to locate chiggers. Using his type of "chigger sampler," Loomis recoverd a total of eight different species of chigger in the state of Kansas (*Eutrombicula alfreddugesi, Trombicula sylvilagi,* and *Trombicula gurneyi* being common; *Eutrombicula lipovskyana, Trombicula lipovskyi,* and *Neoschongastia americana* in small numbers; *Euschongastia diversa* and *Euschongastia jonesi,* a single specimen each). Crossley and Proctor (1970) reported the use of small rectangles of prepainted masonite material.

Mounted specimens were identified using taxonomic keys provided by Brennan and Jones (1959). Further identifications were confirmed by D. A. Crossley (personal communication).

To date, 124 localities in 55 of Arkansas' counties have been identified in which chiggers occur. Over 2500 specimens have been collected from these localities and over 1500 of these specimens have been mounted and identified to species. Three species thus far have been identified. They are *Eutrombicula alfreddugesi, Eutrombicula splendens,* and what appears to be a new species heretofore not described.

Eutrombicula alfreddugesi is by far the most pominent species in the state. It is the most prevalent and occurs in greatest numbers in habitats where a mixture of oak-hickory pre-climax forest exists mixed with conifers. This species appears throughout all parts of the state but occurs in much less numbers and is much harder to find in areas of poor drainage and little forest such as in the delta and eastern counties. There appears to be a definite association between pine and the occurrence of this species. Boone County, for example, has a significant amount of oak, hickory, and other hardwoods, but much less than a county such as Cleburne. *E. alfreddugesi* also occurs in much greater numbers in Cleburne and like counties than in Boone County; however, there was also a great deal of variation in numbers of chiggers found in the individual sampling sites. A woods environment is not the only habitat in which chiggers were found, however. Numerous specimens were collected from such examples as stumps in state parks, logs and boards near pasture fence lines, large stones in the middle of fields or on road banks, and in one instance, from a slab of concrete in a grassy area in the middle of town.

Eutrombicula splendens is the second most prevalent free living chigger in the state. Numerous specimens of this species were recovered, but it is much less prevalent than *alfreddugesi.* It is concentrated, like *alfreddugesi,* mostly in the central and western counties. The authors believe that succinct populations of *splendens* occur; however, numbers of this species were never collected without *alfreddugesi* being found within a few meters. Both these chiggers, in fact, have been collected from the same spot on the same log at the same time. This is not to suggest that they are the same species or that they are two different species occupying the same ecological niche.

According to Jenkins (1949), *E. alfreddugesi* and *E. splendens* have sympatric ranges but tend to be concentrated in different habitats. *E. alfreddugesi* is more abundant in drier, upland habitats, while *E. splendens* is more abundant in mesic to moist situations. Our observations support those of Jenkins'.

Numerous specimens which we are calling "variants" were collected from Perry, Marion, Searcy, Pulaski, and White Counties. These chiggers keyed out to be either *alfreddugesi* or *splendens* but had either unusual or uneven setation. Both arrangement and numbers of setae in particular are important taxonomic characteristics in this family. The cause of the variation in these specimens needs to be investigated further.

A single specimen of an unknown species was taken from Scott County. Personal communication with D. A. Crossley indicates that this is probably a new species. Regrettably, efforts to obtain additional specimens from this site have proven unsuccessful.

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