

JOURNAL

OF THE

Tennessee Academy of Science

VOLUME LXI

OCTOBER 1986

JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE

VOLUME 61, NUMBER 4, OCTOBER 1986

DIAPTOMUS CAROLINENSIS, A NEW SPECIES OF COPEPOD FROM NORTH CAROLINA

HARRY C. YEATMAN

The University of the South
Sewanee, Tennessee 37375

ABSTRACT

A new species of calanoid copepod, *Diaptomus (Skistodiaptimus) carolinensis* is described from the male and female specimens from Lake Ravenel, Highlands, North Carolina. It is most easily distinguished from the related *Diaptomus mississippiensis* in the shape and armature of the male right fifth leg terminal claw.

INTRODUCTION

On 23 July 1939, Dr. R. E. Coker collected plankton from Lake Ravenel, Highlands, North Carolina. He and the author dissected, drew, and studied the copepods. In the collection was a species of calanoid, morphologically similar to *Diaptomus mississippiensis*, but conspicuously different from that species in the shape of the male fifth leg. This leg is one of the most important taxonomic characters for this genus. World War II prevented our describing this species at that time. After the war, Dr. Coker's ill health prevented our completing the description, but in 1959, the author sent some specimens to Mrs. Mildred S. Wilson, the foremost authority on American calanoid copepods. She acknowledged their distinctiveness, and we planned to co-author the description. The collection of specimens was in Mrs. Wilson's laboratory in Anchorage, Alaska, when an earthquake destroyed them.

On 17 August 1985, the author collected plankton from Lake Burton, Rabun County, Georgia. This reservoir is only 40 kilometers from Lake Ravenel, N.C. The only calanoid copepod was the typical *Diaptomus mississippiensis*, and it was abundant. Here was the long-awaited chance to compare the undescribed species with it. Dr. Richard C. Bruce, Executive Director of the Highland Biological Station graciously and quickly collected an abundance of the undescribed *Diaptomus* for the author. The name and following description of the new species is given in honor of North Carolina (the type state), Dr. R. E. Coker, and Mrs. Mildred S. Wilson (who recognized the uniqueness of this copepod), and Dr. Richard C. Bruce (who furnished the type material from Lake Ravenel).

DESCRIPTION

Diaptomus (Skistodiaptomus) carolinensis new species. Fifteen males and fifteen females collected on 9 September 1985 and two males and three females collected on 23 July 1939 were mounted in glycerine jelly or in Masters CM-9AF mounting medium. Some copepods were mounted whole, others were dissected in the mountant, using minuten insect pins set in a thin stick. For comparisons, ten male and ten female *Diaptomus mississippiensis* Marsh (1894) from Lake Burton, Rabun County, Georgia and two males and three females of the same species from Merry brickyard pools, Augusta, Georgia were dissected and mounted. All drawings were made with a camera lucida. Eight slides of the new species have been deposited in the U.S. National Museum -- one male holotype, USNM 228138, one female allotype, USNM 228139; and six slides of paratypes, USNM 228140.

MALE.

The body length is 0.85 to 1.01 mm (average 0.95), not including caudal setae. *D. mississippiensis* males averaged 0.98 mm. The metasome (forepart of body) is long oval in outline, except for posterior wings, and consists of five well-defined segments, the fifth segment being partially divided (Fig. 1a). The metasomal wings are symmetrical and each is armed with a thorn-like sensillum. The urosome is tubular and five-segmented. The fourth segment is as long as the fifth segment, which is often telescoped into the former segment. The caudal rami are broad, armed with six nearly equal-length setae, and without hairs on the inner margins. The inner margins of the caudal rami of *D. mississippiensis* from Georgia and as described by Marsh (1894) also lack hairs, but Schacht (1897) described and drew hairs on the caudal rami of his Florida specimens and some specimens sent by Marsh from an unknown locality. The first antennae extend posteriorly beyond the ends of the caudal setae. The right one is geniculate (modified for grasping the female) and consists of twenty-two segments (Fig. 1b). Segments 10, 11, and 13 bear conspicuous spines,

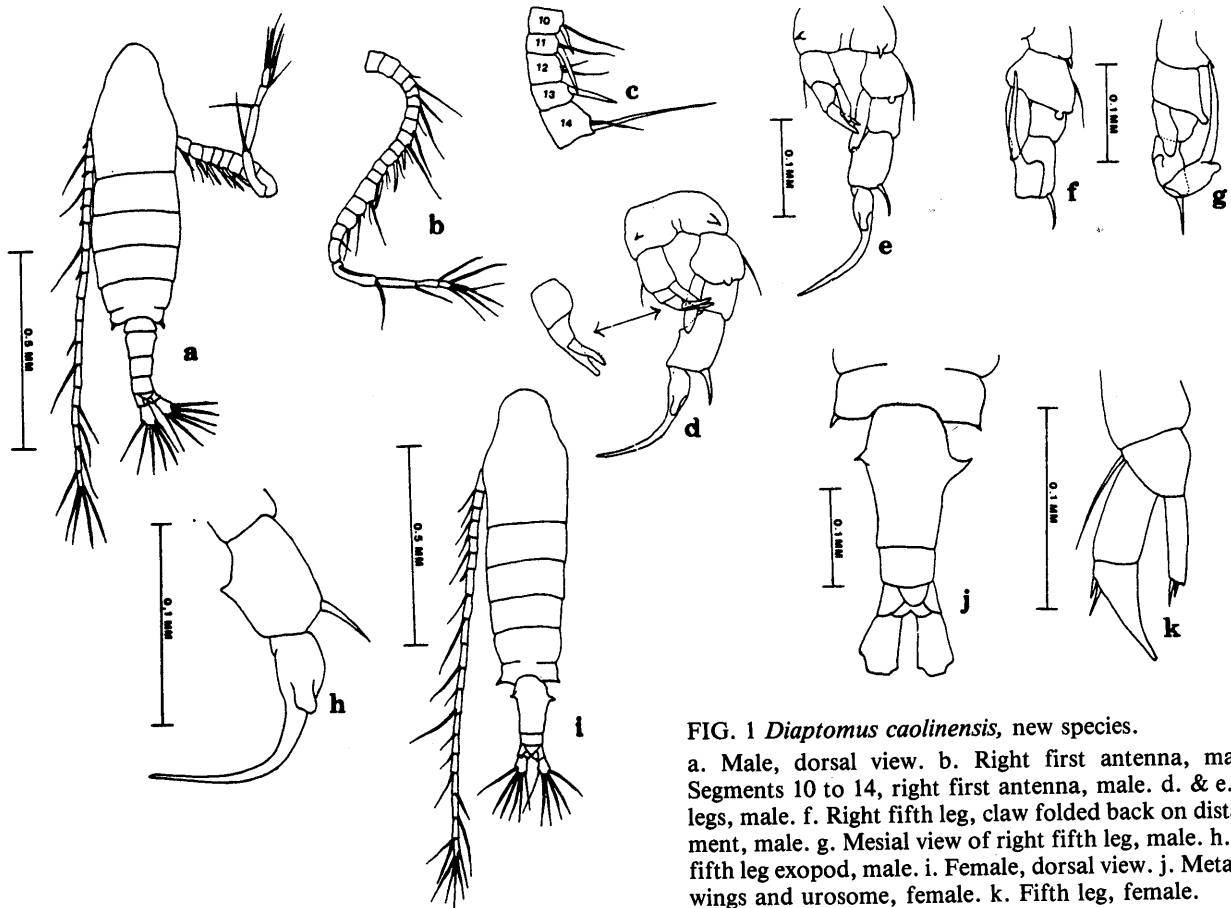


FIG. 1 *Diaptomus caolinensis*, new species.

a. Male, dorsal view. b. Right first antenna, male. c. Segments 10 to 14, right first antenna, male. d. & e. Fifth legs, male. f. Right fifth leg, claw folded back on distal segment, male. g. Mesial view of right fifth leg, male. h. Right fifth leg exopod, male. i. Female, dorsal view. j. Metasomal wings and urosome, female. k. Fifth leg, female.

those on 11 and 13 are equal in length and longer than the spine on 10 (Fig. 1c). In the male *D. mississippiensis* right first antennae, the spines on segments 10 and 11 are equal in length and much shorter than the spine on segment 13 (Fig. 2a). There is no hook or process, so characteristic of many species of *Diaptomus*, on the antepenultimate segment of the right first antenna. The left first antenna is like both first antennae of the female--twenty-five-segmented and unmodified. Ends of the antennal setae are not hooked. The mouthparts and swimming legs are like those of *D. mississippiensis*. As in the males of all species of *Diaptomus*, the fifth legs are greatly modified for grasping

and the right leg ends in a conspicuous claw. The shape, length, and armature of this claw is of great taxonomic significance. The claw of *D. carolinensis* is slightly longer than the two exopod segments, which it terminates. The claw is smoothly curved, non-angular, and bears a conspicuous knob near its expanded base. Figures 1d through 1h show the appearance of this knob from different angles of observation. The claw of *D. mississippiensis* is much longer than its exopod, is biangular, and lacks a knob (Fig. 2b & 2c). The left fifth leg and the segmented portion of the right fifth leg are alike in the two species.

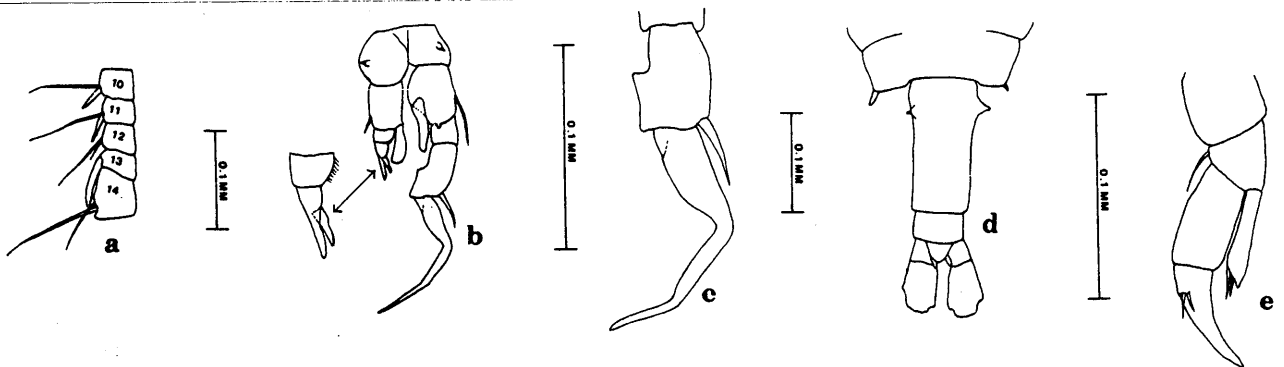


FIG. 2 *Diaptomus mississippiensis* Marsh, 1884.

a. Segments 10 to 14, right first antenna, male. b. Fifth legs, male. c. Right fifth leg exopod, male. d. Metasomal wings and urosome, female. e. Fifth leg, female.

FEMALE

The body length is 0.93 to 1.11 mm (average 1.02), not including caudal setae. *D. mississippiensis* females averaged 1.08 mm. The metasome is long oval, with expanded posterior wings and is five-segmented, with partially divided fifth segment (Fig. 1i). The sensillum on the left wing is slightly larger than the one on the right wing. The urosome is tubular and three-segmented. The genital segment is expanded into a prominent point or hook on the right side and into a less-conspicuous point on the left side (Figs. 1i & 1j). These projections are like those on the female *D. mississippiensis* genital segment (Fig. 2d). The second urosome segment is the same length as in the third segment. The caudal rami are like those of the male and lack hairs. Both first antennae are unmodified for clasping and twenty-five-segmented as in the male left first antennae. These antennae extend posteriorly beyond the ends of the caudal setae. None of their setae are hooked. The mouthparts and swimming legs are like those of *D. mississippiensis*. The fifth legs are alike, rudimentary, and are indistinguishable from those of the female *D. mississippiensis* (Figs. 1k & 2e). The females of several species of *Diaptomus* cannot be morphologically separated. For example, the females of *C. pygmaeus* Pearse and *D. reighardi* Marsh are alike (Wilson, 1959), but the males are easily distinguished.

DISCUSSION

D. carolinensis keys to *D. mississippiensis* in the subgenus *Skistodiptomus* in Wilson (1959). Males of the two species are readily separated on the length, shape and ornamentation of the right fifth leg claw. The author has observed this structure in hundreds of specimens of both species over forty-six years and there has not been any intergradation in characteristics of this claw. Mrs. Mildred Wilson has stated that the differences in the claws of these copepods is a very valid reason to consider them distinct species. Zooplankton associates of *D. carolinensis* were the copepods, *Tropocyclops prasinus mexicanus* and *Canthocamptus staphylinoides* Pearse, the cladocera, *Diaphanosoma brachyurum* (Lieven) and *Daphnia ambigua* Scourfield, and the rotifer, *Kellicottia longispina* (Kellicott).

LITERATURE CITED

- Marsh, C. D. 1894. On two new species of *Diaptomus*. Trans. Wis. Aca. Sci. Arts, and Letters. X:15-17.
Schacht, F. W. 1897. The North American species of *Diaptomus*. Bull. Ill. State Lab. Nat. Hist. 5:97-207.
Wilson, M. S. 1959. Calanoida. W. T. Edmondson (ed.) Freshwater Biology. John Wiley and Sons, Inc., N.Y. pp. 738-799.

THREE NEW SPECIES OF WATER MITES OF THE GENUS *Arrenurus*, SUBGENUS *Megaluracarus*
(Acarina: Arrenuridae) FROM THE SOUTHEASTERN UNITED STATES

JAMES L. WILSON
Tennessee State University
Nashville, Tennessee 37203

ABSTRACT

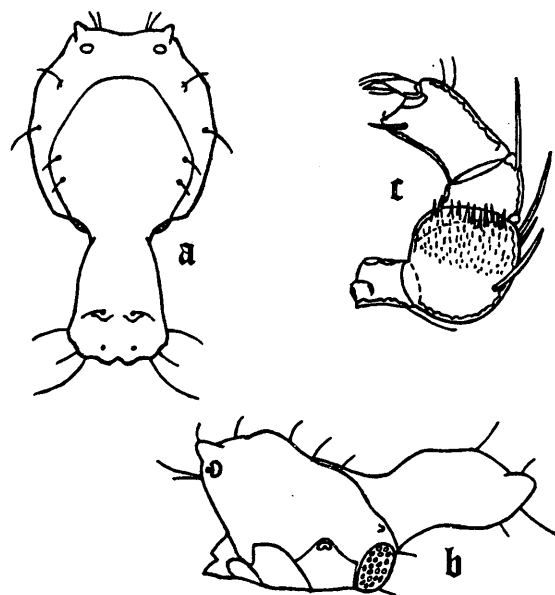
Three new species of water mites of the genus *Arrenurus*, subgenus *Megaluracarus* are described from several southeastern states. *Arrenurus neommarshallae* is described from specimens collected from Alabama, Florida, Louisiana, Mississippi, and South Carolina. *Arrenurus novimmarshallae* is described from specimens collected from Alabama, Mississippi, North Carolina, and South Carolina. *Arrenurus pseudobirgei* is described from specimens collected from Alabama, Florida, and Georgia.

INTRODUCTION

Diagrams of the three new species described do not include the legs since these are much alike throughout the genus. Three diagrams are included for each species: dorsal view, lateral view, and median view of the right palp. Measurements for the holotype are given first followed by the range of size variations of the paratype series in parentheses. Holotype will be deposited in the Field Museum of Natural History (Chicago).

Arrenurus neommarshallae, new species

DESCRIPTION: Male: (See Figures 1a-c) Based on 15 specimens. Body length 0.903 mm. (0.839-0.968 mm.); body width 0.495 mm. (0.444-0.516 mm.); approximate cauda length 0.366 mm. (0.329-0.409 mm.); greatest cauda width 0.272 mm. (0.258-0.301 mm.); least cauda width 0.172 mm. (0.157-0.193 mm.); dorsal shield width 0.372 mm. (0.344-0.408 mm.).



LEGEND

FIG. 1: Dorsal and lateral view of body, and median view of right palp, respectively, of three new species of water mites. *Arrenurus neommarshallae* n. sp., male, a-c.

Body oval, widest near mid-region; anterior end of body with a prominent bulge in front of each eye, a horn-like projection over each eye (projections vary from short with rounded tips to long with pointed tips), a slight rounded concavity between the eyes; lateral humps present on dorsal portion of ventral shield; dorsal furrow passing ventrally at base of cauda immediately posterior to acetabular plates; acetabular plates extend only slightly up sides of body and may be partly visible from dorsal view; non-cauda portion of dorsal shield bearing two pairs of lateral glandularia; from dorsal view, cauda constricted at its base (some specimens more constricted than others), widening to the posterolateral corners (most specimens with slightly rounded sides near base), posterior end with two pairs of rounded projections (some specimens only slightly developed), posteromedial portion with slight indentation; from a lateral view, cauda arches dorsally, the dorsal portion flattened and somewhat elongated; cauda without petiole; palp segment two with three long setae plus numerous short setae on medial surface, segment three with one long seta; distal end of IV-leg-4 extending beyond insertion of fifth segment, swimming hairs present on all legs but fewer present on first leg.

HOLOTYPE: Adult male, collected from a drainage area near road culvert on Louisiana State Road 22, two miles west of junction with Louisiana State Road 16 (near Head of Island), in Ascension Parish, Louisiana, August 31, 1978.

PARATYPES: Two males, from a drainage area beside Florida State Road 20, one mile east of Florida State Road 267 (25 miles west of Tallahassee), in Gadsden County, Florida, August 4, 1963; one male, from a lake in Parsons Mountain Recreation Area of Sumter National Forest, six miles south of Abbeville, two miles east of South Carolina State Road 28 (west of Columbia), near Abbeville-McCormick County line, South Carolina, July 28, 1963; one male, from a pond on west side of Alabama State Road 125, six miles northeast of Elba (northwest of Dothan near U.S. 84), Coffee County, Alabama, June 13, 1963; one male, from a lake on west side of U.S. 31, one mile south of Greenville, Butler County, Alabama, June 16, 1963; four males, from a drainage pool near Big Black River, 17 miles south of Yazoo on U.S. 49 (26 miles west of Jackson), near Yazoo-Madison County line, Mississippi, August 14, 1963; four males, from a lake in Camp Wesley Pines, 1.5 miles west of Gallman and U.S. 51 (28 miles south of Jackson), Copiah County, Mississippi, August 15, 1963; one male, from Kenneth Ozborn Lake, one mile north of Decatur on west side of Mississippi State Road 15 (west of Meridian), Newton County, Mississippi, August 18, 1963.

HABITAT: Water lilies, algae, water cress and other water vegetation in ponds, lakes, and drainage pools.

RANGE: Collected from one location in northwest Florida; one location in southeast Louisiana; one location in eastcentral South Carolina; two locations in Alabama, from southeastern and southcentral parts of the state; and three locations in central Mississippi.

DISCUSSION: This species is closely related to the *Arrenurus marshallae*-group, which, along with a group of South American species, possesses a relatively long cauda and horn-like projections over the eyes. Of the species in this group, this new species seems more related to *A. marshallae*. The lateral view of the new species is very similar to *A. marshallae* differing primarily in that the cauda of the new species is not as thick dorsoventrally, and is not as strongly arched dorsally. When comparing the dorsal views, the body portions of the two are quite similar but the caudas quite different. The cauda in the new species is

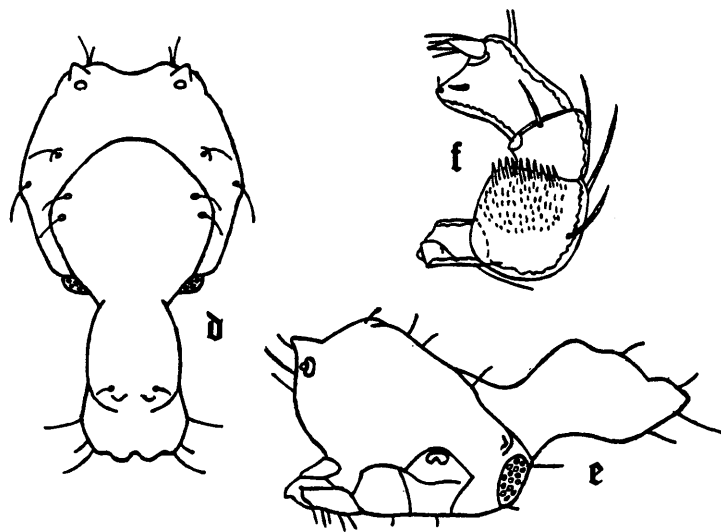
somewhat more constricted at its base, expanding laterally to the posterolateral corners, making it fan-shaped; posteriorly are two pairs of rounded projections, with a cleft between the medial pair. Although the size range in both length and width overlaps *A. marshallae*, the average size of the new species is somewhat smaller.

Variations occurring in the fifteen specimens collected should be noted: (1) horn-like projections over the eyes from short-rounded to longer-pointed, (2) dorsally, cauda appears more fan-shaped in some specimens than others due mostly to amount of constriction at its base, (3) posterolateral corners of cauda slightly rounded to having short-straight portions before curving medially, (4) two pairs of rounded projections posteriorly on cauda only slightly developed in some specimens to well developed in others, resulting in slight variations in the median cleft.

The new species differs mainly by the somewhat fan-shaped cauda along with the two pairs of rounded projections posteriorly and a median cleft.

Arrenurus novimmarshallae, new species

DESCRIPTION: Male: (See Figures 1d-f) Based on 10 specimens. Body length 1.054 mm. (1.011-1.097 mm.); body width 0.581 mm. (0.538-0.616 mm.); approximate length of cauda 0.387 mm. (0.366-0.444 mm.); greatest cauda width 0.272 mm. (0.245-0.287 mm.); least cauda width 0.172 mm. (0.158-0.201 mm.); dorsal shield width 0.430 mm. (0.387-0.452 mm.).



LEGEND

FIG. 1: Dorsal and lateral view of body, and median view of right palp, respectively, of three new species of water mites. *Arrenurus novimmarshallae* n. sp., male, d-f.

Body oval, widest near mid-region; anterior end of body with a prominent bulge in front of each eye, a horn-like projection over each eye, a rounded concavity between the eyes; dorsal portion of ventral shield with humps anterolateral to dorsal furrow and smaller humps lateral to mid-portion of dorsal furrow; dorsal furrow passing ventrally at base of cauda immediately posterior to acetabular plates; acetabular plates extend only slightly up sides of body but are easily seen from a dorsal view; non-cauda portion of dorsal shield bearing two pairs of lateral glandularia.

dularia; from dorsal view, cauda constricted at its base, becoming wider posteriorly, being slightly rounded about two-thirds of its length, at which point it constricts slightly (posterior to constriction, cauda is depressed ventrally becoming more concave medially), past constriction cauda widens gradually to posterolateral corners, then narrows to form two pairs of rounded projections, the more medial pair more rounded and better developed between which is a medial, usually somewhat rounded, indentation; from a lateral view, the cauda arches dorsally, with the dorsal portion having a distinct rounded hump; cauda without petiole; palp segment two with two long setae plus numerous short setae on medial surface, segment three with two long setae; distal end of IV-leg-4 extending beyond insertion of fifth segment, swimming hairs present on all legs but fewer present on first leg.

HOLOTYPE: Adult male, collected from a quarry pond next to a stream on U.S. 421, 28.5 miles west of Winston-Salem, in Yadkin County, North Carolina, July 16, 1963.

PARATYPES: One male, from a lake in Parsons Mountain Recreation Area of Sumter National Forest, six miles south of Abbeville, two miles east of South Carolina State Road 28 (west of Columbia), near Abbeville-McCormick County line, South Carolina, July 28, 1963; four males, from a lake in Barnwell State Park, two miles south of Blackville and U.S. 78 (about 50 miles east of Augusta, Georgia), in Barnwell County, South Carolina, July 31, 1963; three males, from Rickard Branch, 4.5 miles north of Monroeville on Alabama State Road 47 (about halfway between Montgomery and Mobile), in Monroe County, Alabama, June 14, 1963; one male, from Pine View Lake, six miles north of Bay Springs on west side of Mississippi State Road 15 (east-southeast of Jackson), in Jasper County, Mississippi, August 18, 1963; one male, from Lake Tiak O'Khata, southwest of Louisville and west of Mississippi State Road 15 (north-northwest of Meridian), in Winston County, Mississippi, August 18, 1963.

HABITAT: Water lilies, algae, including *Chara*, and other water vegetation in a quarry pond, lakes, and a branch.

RANGE: Collected from one location in northwestern North Carolina; two locations in South Carolina, from westcentral and southcentral parts of the state; one location in southern Alabama; and two locations in eastcentral and southcentral Mississippi.

DISCUSSION: This species is closely related to the *Arrenurus marshallae*-group, which, along with a group of South American species, possesses a relatively long cauda and horn-like projections over the eyes. Of the species in this group, this new species resembles both *A. marshallae* and *A. pseudotenuicollis*. The dorsal view of the new species is very similar to *A. marshallae* in the shape of the body and general shape of the cauda, except the posterior end of the cauda, which is very similar to *A. pseudotenuicollis*. The lateral view of the new species is very similar to *A. pseudotenuicollis* in the amount of dorsal arching of the cauda (both arching dorsally somewhat less than *A. marshallae*), but the new species has a very distinct rounded hump dorsally. The average length of the new species is greater than either *A. marshallae* or *A. pseudotenuicollis* although it slightly overlaps both.

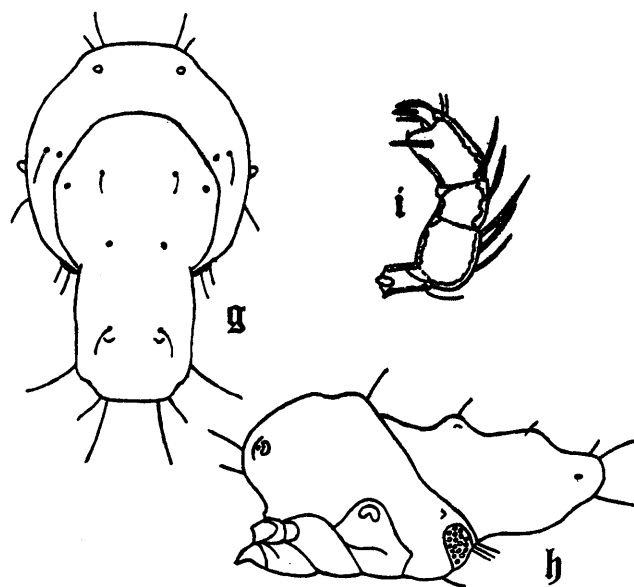
The new species differs from the above two species most noticeably by having a distinct mid-dorsal hump on the cauda.

Arrenurus pseudobirgei, new species

DESCRIPTION: Male: (See Figures 1g-i) Based on 28 specimens. Body length 0.840 mm. (0.817-0.927 mm.);

body width 0.516 mm. (0.502-0.559 mm.); approximate cauda length 0.315 mm. (0.301-0.344 mm.); cauda width 0.280 mm. (0.258-0.287 mm.); dorsal shield width 0.373 mm. (0.367-0.430 mm.).

Body oval, widest near mid-region; anterior end of body slightly projecting but not concave between the eyes (a few specimens have a very slight concavity); lateral humps present on dorsal portion of ventral shield; dorsal furrow passing ventrally at base of cauda immediately posterior to acetabular plates; acetabular plates extend only slightly up sides of body and may be partly visible from dorsal view; non-cauda portion of dorsal shield bearing two pairs of glandularia; the more posterior pair of glandularia are closer together medially, occurring on either side of a hump located on the medial posterior portion of the non-caudal region of the dorsal shield; lateral regions of dorsal shield somewhat depressed anteroposteriorly giving rise to a low ridge medially; cauda with sides almost parallel when viewed dorsally although most specimens are slightly wider anterior to mid-portion, a pair of setae present on dorsal humps, posterolateral corners slightly indented in most specimens with posterior end mostly straight across or only very slightly rounded in some specimens; cauda without petiole; palp segment two with three setae, segment three with one seta, and segment four with one seta; distal end of IV-leg-4 extending beyond insertion of fifth segment, swimming hairs present on all legs but fewer present on distal segments of first leg.



Arrenurus pseudobirgei n. sp., male, g-i.

HOLOTYPE: Adult male, collected from a swamp, 18 miles southwest of Jesup on U.S. 82 in Pierce County, Georgia, August 2, 1963.

PARATYPES: Six males, from a pond on west side of U.S. 221 and north limits of Harlem, near junction of U.S. 278, 22 miles west of Augusta, Columbia County, Georgia, July 30, 1963; eight males, from a swampy area next to Georgia State Road 177 (entrance road to Okfevonee Swamp Park), 1.5 miles south of U.S. 1 and 8 miles southeast of Waycross in Ware County, Georgia, August 2, 1963; five males, from a lake in Little Ocmulgee State Park, north of McRae (U.S. 341 and 441 junction) on or near

Telfair-Wheeler County line, Georgia, August 3, 1963; two males, from a lake on south side of U.S. 280, 8 miles west of Cordele and just east of Georgia Veterans Memorial State Park entrance in Crisp County, Georgia, August 3, 1963; three males, from a swampy area on north side of U.S. 90, just west of Alabama-Florida state line in Baldwin County, Alabama, August 25, 1978; one male, from a swampy area beside U.S. 27, about 7 miles south of Lake Wales (east of Tampa) in Polk County, Florida, July 1, 1963; two males, from a pond on west side of Florida State Road 47, 16 miles northeast of Trenton (west of Gainesville) in Gilchrist County, Florida, July 5, 1963.

HABITAT: Water lilies, algae, and other water vegetation in swamps, ponds, and lakes.

RANGE: Collected from one location in southern Alabama, next to Florida panhandle; two locations in Florida, from midcentral and northcentral parts of the state; and five locations in Georgia from midcentral to southern portions of the state.

DISCUSSION: This species is closely related to the *Arrenurus birgei*-group. Of the species in the group, this species seems more related to *A. birgei* and *A. veracundus*. This species differs from *A. birgei* by having a relatively longer cauda which is more apparent from a lateral view in that the ventral portion of the cauda extends more

posteriorly before curving dorsally; the dorsal non-cauda portion of the dorsal shield does not project dorsally as much and contains a smoothly rounded hump; and the dorsolateral portions of ventral shield contain rounded projections. This species differs from *A. veracundus* by having a cauda with almost parallel sides as seen dorsally which results in the posterior end of the cauda being almost straight across instead of rounded; and with the non-cauda portion of the dorsal shield being somewhat more depressed ventrally.

The new species differs from all others of the *A. birgei*-group by being larger; the non-cauda portion of dorsal shield more depressed ventrally and possessing a more prominent rounded hump; and by having more prominent dorsolateral humps on the ventral shield.

LITERATURE CITED

- Cook, David. 1976. Contributions to the water mite fauna of North America. New North American species of the genus *Arrenurus*, mostly from Florida (Acarina: Arrenuridae). *Contrib. Amer. Ent. Inst.*, 2(4):1-58.
- Lundblad, O. 1944. Die Hydracarinfauna Sudbrasilien und Paraguays. *Funfter Teil. Svensk. Vetensk.-akad. Handling.*, Stockholm, 20(13):1-182.
- Marshall, Ruth. 1903. Ten species of arrenuri belonging to the subgenus *Megalurus*. *Thor. Trans. Wisconsin Acad. Sci.*, 14:145-172.
- Wilson, James L. 1961. Water mites of the genus *Arrenurus* of middle Tennessee (Acarina: Hydracarina). *Jour. Tennessee Acad. Sci.*, 36:171-242.

PUBLIC RECORDS REVEAL LOCATION OF OLD GASOLINE STORAGE TANKS

JOHN T. MASON III

Tennessee Technological University
Cookeville, Tennessee 38505

ABSTRACT

Because of the potential environmental hazards associated with underground storage tanks, owners of existing underground storage tanks must notify the state or local agency designated of their age, size, type, location, and use. If they were taken out of operation after January 1, 1974 the information must still be provided in addition to the date taken out of service.

This research addresses those locations where the presence of tanks are no longer obvious and may be "forgotten". Previous research on locating environmental problems through old records revealed that lease records are a valuable source of information.

A review of lease records maintained at the Putnam County Registrar's Office was extremely helpful in locating past and present commercial underground gasoline storage tanks. This review was supplemented by on-site identification to develop a complete list of gasoline stations in Putnam County.

Approximately 66% of all gasoline stations within the corporate limits of the four major population centers are listed in the lease records. Of those stations where there is no indication of past activity, 75% are in the lease records.

INTRODUCTION

The Hazardous Waste Amendments of 1984 to the Resource Conservation and Recovery Act (RCRA) were signed into law on November 8, 1984 (Hazardous Amendments, 1984). These amendments include specific provisions for LUST (Leaking Underground Storage Tanks) because of a nationwide problem. There are an estimated three to five million underground storage tanks in the United States that contain either hazardous substances or petroleum products. An estimated 100,000 tanks are presently leaking, and another 350,000 are expected to leak within the next

five years (Hopson, 1985).

In May, 1986 owners of existing underground storage tanks were to notify the state and local agency designated of their age, size, type, location, and use. If they were taken out of operation after January 1, 1974 the information must still be provided in addition to the date the tank was taken out of operation and the type and quantity of substance left in the tank (Hazardous Amendments, 1984).

Regulation of currently active underground storage tanks was designed to conserve our natural resources by reducing pollution, but what about those sites where the presence of tanks is no longer obvious and the tanks may be "forgotten"? Part of this can be resolved. As part of related research on the use of public records to find environmental problems (Mason, 1984), recent efforts have proven the value of certain documents for locating gasoline storage tanks at old gasoline service stations (Mason, 1985).

For one county (Putnam) in Middle Tennessee, approximately 66% of all gasoline stations within the corporate limits of the four major population centers are listed in lease records maintained by the County Registrar. Only 53% of the stations identified outside the corporate limits have been leased, however.

Active gasoline stations are easily located through bulk distributors while some stations that have closed can be identified by sight. Those locations which have no visible indication of past activity may also have tanks buried that may be hazardous. If the tanks still contain gasoline the potential for leakage exists.

During the original research in April 1984, two gasoline storage tanks were unearthed in downtown Cookeville and said to contain over 4,000 liters (1,000 gallons) of gasoline (Moore, 1984). Although many people indicated that they knew the tanks were

there after excavation, there was no public record of their existence except in the Putnam County Lease Books.

The research on this problem was conducted in three basic phases: Identification, Location, and Consolidation.

IDENTIFICATION

During identification the 18 Lease Books maintained by the Putnam County Registrar were reviewed page by page to identify which leases pertained to gasoline stations. These 18 books covered the period from 1946 thru 1985. Prior to 1946 the leases were maintained with Chattel Mortgages so that a review requires the proper documents to be identified and then reviewed for specific application. A review of the seven counties surrounding Putnam revealed that all use a different filing system and although indexed by document type, none have lease books as such. This will make identification of gasoline stations by lease records somewhat more difficult. However, the technique will still be effective with one additional step to identify the document type as a lease.

Identification of a gasoline station lease was not always immediate. Normally, the lease indicated that the facility sold gasoline. Often, however, it was only mentioned incidentally in the body of the lease. Sometimes the name of the lessee or lessor known to be associated with other gasoline stations was the only indication the facility had been a gasoline station.

Once an older lease identified a facility as a gasoline station, the specific location was often difficult to determine. Property leased was often identified as bounded on each side by property belonging to individuals. If the owners were current it was relatively easy to identify the location. However, many times most of the surrounding property had changed owners and the original description alone was not useful. An additional problem surfaced because of physical changes to the area such as a change in road location or name.

Approximately 20% of the stations identified in the lease records could not be correlated with the specific property parcel at this stage of the research.

LOCATION

To optimize the location phase, tax maps were marked with the sites identified and a logical plan developed to visit each site with a minimum of travel. As each site was visited the current status was recorded. During the location phase, as expected, more sites were discovered than were listed in the lease records. This became so prevalent that it was considered necessary to traverse all major

county highways to insure the record of gasoline stations was as complete as possible.

Outside the corporate limits many of the stations are simply convenience stores that have buried tanks which are not normally considered as gasoline stations in the lease records. As these stores go out of business, the probability that the tanks will be emptied and removed is low. With time the presence of the tanks will be forgotten. The potential for environmental contamination increases as the tank deteriorates. The only method of locating these former sites seems to be visual inspection.

There are gasoline stations which were leased that have ceased operation and have been remodeled. Their present appearance does not indicate the site was once a gasoline station. Lease records can be used to identify the former gasoline stations even after the tanks are forgotten.

Retired distributorship owners provide another source of information relative to the older gasoline stations. Several stations were identified in this way. However, as the research progressed and the new laws became more publicized a marked decrease in willingness to discuss the problem was noticed.

CONSOLIDATION

The final phase of the research consisted of consolidating the information into some usable record. Table 1 summarizes the information compiled for Putnam County. The stations were categorized as Current Stations, Non-Active stations with evidence of past activity, and stations with No Indication of past activity. Some of the stations with no indication of past activity were identified by lease record, personal interview, or recognizing the construction of the building as that of a typical gasoline station.

A list of all 184 stations was compiled and indexed by tax map/parcel, current activity, and general location. Finally, maps of the county and all incorporated towns were marked with the stations coded by current activity.

SIGNIFICANCE

As indicated in Table 1, only 95 of the 184 stations (52%) are currently active. Of the 32 stations with no indication of past activity 72% were identified through the lease records. This seems to justify pursuit of this method to aid in identifying all old sites if lease records are available.

Both the Tennessee Department of Health and Environment and the Federal Environmental Protection Agency have indicated an interest in this research and the methods involved. This is a technique for finding underground storage tanks which would go undetected by other methods.

Table 1. Commercial gasoline distributors/stations in Putnam County Tennessee (May, 1985).

Location	Current Stations (CS)			NonActive (NA)			No Indication (NI)			Total		
	Number	In Lease Records	Percent In Lease Records	Number	In Lease Records	Percent In Lease Records	Number	In Lease Records	Percent In Lease Records	Number	In Lease Records	Percent In Lease Records
Algood	5	4	80.0	3	1	33.3	3	3	100.0	11	8	72.7
Baxter	4	3	75.0	4	1	25.0	0	0	0	8	4	50.0
Cookeville	43	24	55.8	26	21	80.8	24	18	75.0	93	63	67.7
Monterey	9	5	55.5	4	3	75.0	1	0	0	14	8	57.1
Within Corporate Limits	61	36	59.0	37	26	70.3	28	21	75.0	126	83	65.9
County	34	9	26.5	20	3	15.0	4	2	50.0	58	14	24.1
TOTAL	95	45	47.4	57	29	50.9	32	23	71.9	184	97	52.7

LITERATURE CITED

Hazardous Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act, November 8, 1984.
Hopson, R. Keith, "The Underground Storage Tank Requirements of the 1984 Amendments to the Resource Conservation and Recovery Act," Presented to the Semiconductor Safety Association, May 2, 1985.

Mason, John T. III, "Environmental Record Search," TTU Faculty Research conducted Fall 1983 thru Spring 1984.

"Locating Commercial Gasoline Storage Tanks in Putnam County, Tennessee," TTU Faculty Research conducted Fall 1984 thru Spring 1985.

Moore, Marion, "Old Tanks Unearthed," Herald-Citizen, Cookeville, Tennessee, April 12, 1984.