

DISTRIBUTION AND KEY OF THE NORTH AMERICAN  
COPEPODS OF THE GENUS DIAPTOMUS, WITH THE  
DESCRIPTION OF A NEW SPECIES

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Since the publication of the "Revision of the North American Species of Diaptomus" in the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters by Marsh in 1907, there have been many collections of material containing Diaptomi in various parts of North America and quite a number of publications have been issued by several investigators. There has been no other publication covering the genus as a whole except the synopsis by Marsh in Ward and Whipple's Fresh-Water Biology, and Tollinger's paper on distribution published in 1911.

In addition to the published material, the author has accumulated many data from collections belonging to the United States National Museum, and others which have been sent to him, and from numerous collections made by him personally. It is thought that a paper covering the present knowledge of the distribution of the species would be helpful to others.

It is understood, of course, that such a paper gives only the known distribution. In spite of the considerable number of collectors, only limited portions of the country have been studied with anything like thoroughness. Most of the collections have been of a sporadic character, sometimes in only one or two localities in a State; very few collections have been made in the whole region of Canada, and Mexico is almost an unknown territory. While it can ordinarily be assumed that a species is found in the regions intervening between its extreme limits, it can not now be known what the extreme limits are, so that it is probable that the distribution is much wider than is shown by the collections. In the charts, in nearly all cases, the actual places of collections are indicated rather than a region where the species may be found. Perhaps all the locations for such species as *D. oregonensis* and *D. minutus* are not indicated in Wisconsin

where they are widely distributed, but, generally speaking, the symbols represent definite locations where collections have been made.

It may be interesting to note that the species of *Diaptomus* have few variable characteristics. They are morphologically very distinct and maintain this distinctness even when widely separated geographically. Systematists have had little excuse for making varieties of the species of this genus.

It is noticeable, too, that North America has a *Diaptomus* fauna quite distinct from that of the other continents. *D. bacillifer*, which, curiously, has been found in only two localities in America is a common species in Europe and Asia. A variety of *D. eiseni* is said to have been found in Siberia. *D. castor* occurs in Greenland. With the exception of these three species all the North American Diaptomi are peculiar to the Western Hemisphere, and only one North American species has been found in South America.

Without doubt the principal controlling factor in distribution is temperature; while some species can live under a rather wide range of temperature, many of them are distinctly stenothermal.

For the convenience of those caring to make determinations of species a key is given which includes all the species now known. This key is based on the similar key prepared by the author for Ward and Whipple's Fresh-Water Biology with some corrections and additions.

Each species is followed by the date of original publication in order to facilitate reference to the bibliography which accompanies the paper.

DIAGNOSTIC KEY TO THE KNOWN NORTH AMERICAN SPECIES OF DIAPTOMUS

- 1 (20). Antepenultimate segment of the male right antenna without distinct appendage----- 2.
- 2 (3). Right and left fifth feet of male nearly equal in length, terminal hook of right foot symmetrical.....*Diaptomus oregonensis* Lilljeborg, 1889.
- 3 (2). Left fifth foot of male shorter than right----- 4.
- 4 (9). Left fifth foot of male reaching beyond first segment of right exopodite----- 5.
- 5 (8). Right endopodite of male fifth foot equal in length to first segment of exopodite----- 6.
- 6 (7). Terminal hook of second segment of right exopodite denticulate.  
*Diaptomus marshi* Juday, 1914.
- 7 (6). Terminal hook of exopodite of right fifth foot of male uniaangular.  
*Diaptomus reighardi* Marsh, 1895.
- 8 (5). Endopodite of right fifth foot of male longer than first segment of exopodite, terminal hook of right foot biangular.  
*Diaptomus mississippiensis* Marsh, 1894.
- 9 (4). Left fifth foot of male reaching end of first segment of right exopodite or only slightly exceeding it----- 10.
- 10 (13). Antepenultimate segment of right antenna of male produced at distal end into a blunt point----- 11.

- 11 (12). First segment of right exopodite of male fifth foot with marked quadrangular hyaline appendage.....*Diaptomus birgei* Marsh, 1894.
- 12 (11). First segment of right exopodite of male fifth foot with triangular projection.....*Diaptomus virginianus* Marsh, 1915.
- 13 (10). Antepenultimate segment of right antenna of male not produced into blunt point on distal end..... 14.
- 14 (15). Inner process of the terminal segment of exopodite of left fifth foot of male falciform, no hyaline appendage on first segment of right exopodite.....*Diaptomus pallidus* Herrick, 1879.
- 15 (14). Inner process of terminal segment of left exopodite of male fifth foot digitiform..... 16.
- 16 (17). Endopodites in both male and female fifth feet two-segmented, a hyaline process on second basal segment of right fifth foot of male.  
*Diaptomus castor* Jurine, 1820.
- 17 (16). Endopodites of both male and female fifth feet one-segmented, or in *D. tyrelli* the left endopodite of the male is sometimes indistinctly two-segmented, a hyaline appendage on inner distal angle of first segment of right exopodite of male fifth foot..... 18.
- 18 (19). Lateral spine of second segment of right exopodite nearly straight; no blunt spine on posterior surface of this segment.  
*Diaptomus tyrelli* Poppe, 1888.
- 19 (18). A second hyaline appendage on dorsal side of distal margin of first segment of right exopodite of male, lateral spine of second segment of right exopodite strongly curved, and a blunt spine on the posterior surface of this segment.....*Diaptomus coloradensis* Marsh, 1911.
- 20 (1). Antepenultimate segment of right antenna of male with lateral lamella or terminal process..... 21.
- 21 (30, 52). Antepenultimate segment of right antenna of male with hyaline lamella..... 22.
- 22 (25). Hyaline lamella broad, extending beyond the end of the segment, second basal segment of right exopodite of male fifth foot armed on the posterior surface with a small hook..... 23.
- 23 (24). In male fifth foot the right endopodite is about one-half as long as the first segment of the exopodite, the left endopodite reaches about the middle of the second segment of the exopodite; in the female fifth foot the exopodite is two-segmented, with two spines representing the third segment; the setae on the endopodites are of ordinary length.  
*Diaptomus leptopus* Forbes, 1882.
- 24 (23). In male fifth foot the right endopodite about equals in length the first segment of the exopodite, the left endopodite nearly reaches the end of the second segment of the exopodite; in female fifth foot the third segment of the exopodite is indistinctly separated, two spines on the third segment and one on the second, the setae of the endopodites are unusually long.....*Diaptomus piscinae* Forbes, 1893.
- 25 (22). Hyaline lamella antepenultimate segment of right antenna of male narrow, extending beyond the end of the segment slightly if at all... 26.
- 26 (27). Second basal segment of right fifth foot of male armed with a hook equal in length to the first segment of the exopodite.  
*Diaptomus clavipes* Schacht, 1897.
- 27 (26). Second basal segment of right fifth foot of male not armed with hook..... 28.
- 28 (29). First segment of exopodite of right fifth foot of male short and broad.  
*Diaptomus gatunensis* Marsh, 1913.

- 29 (28). First segment of exopodite of right fifth foot of male elongate.  
*Diaptomus leoninicollinus* Marsh, 1913.
- 30 (21, 52). Antepenultimate segment of right antenna of male bears a slender straight process ----- 31.
- 31 (36, 43). Process much shorter than the penultimate segment ----- 32.
- 32 (35). Right endopodite of male fifth foot rudimentary ----- 33.
- 33 (34). Lateral spine of second segment of right exopodite of male fifth foot terminal ----- *Diaptomus lintoni* Forbes, 1893.
- 34 (33). Lateral spine of second segment of right exopodite of male fifth foot nearer the proximal end of the segment.  
*Diaptomus trybomi* Lilljeborg, 1889.
- 35 (32). Right endopodite of male fifth foot about equal in length to the first segment of the exopodite; lateral spine of second segment of the exopodite located near the center of the segment. First segment of the female abdomen has a process extending backward from the posterior margin of the right side ----- *Diaptomus judayi* Marsh, 1907.
- 36 (31, 43). Process nearly or fully equals penultimate segment ----- 37.
- 37 (38). Right endopodite of male fifth foot equals in length first segment of exopodite, spines of first basal segments large.  
*Diaptomus tenuicaudatus* Marsh, 1907.
- 38 (37). Right endopodite of male fifth foot exceeds length of first segment of exopodite, spines of first basal segments small ----- 39.
- 39 (40). Endopodites of male fifth feet two segmented.  
*Diaptomus arcticus* Marsh, 1920.
- 40 (39). Endopodites of male fifth feet one segmented ----- 41.
- 41 (42). Inner process of terminal segment of left fifth foot of male falciform.  
*Diaptomus bacillifer* Kölbel, 1884.
- 42 (41). Inner process of terminal segment of left fifth foot of male digitate.  
*Diaptomus sicilis* Forbes, 1882.
- 43 (31, 36). Process exceeds in length penultimate segment ----- 44.
- 44 (49). Lateral spine of second segment of exopodite of right fifth foot of male terminal or nearly so, antennae reach proximal end of furca ----- 45.
- 45 (46). Process of antepenultimate segment of right antenna of male only slightly longer than penultimate segment, antennae equal in length to cephalothorax ----- *Diaptomus shoshone* Forbes, 1893.
- 46 (45). Antennal process of male exceeds ultimate segment, antennae reach furca ----- 47.
- 47 (48). Endopodites of male fifth clavate, a small tooth about midway of inner border of second segment of the exopodites of the female fifth feet ----- *Diaptomus augustaensis* Turner, 1910.
- 48 (47). Endopodites of male fifth feet slender and straight, no tooth on inner border of second segment of exopodite of female fifth foot.  
*Diaptomus wardi* Pearse, 1905.
- 49 (44). Lateral spine of second segment of right exopodite of male fifth foot on proximal half of segment, antennae reach beyond furca ----- 50.
- 50 (51). Lateral spine of second segment of right exopodite of male fifth foot short, right endopodite rudimentary, endopodites of female fifth feet rudimentary ----- *Diaptomus minutus* Lilljeborg, 1889.
- 51 (50). Lateral spine of second segment of right exopodite of male fifth foot long, right endopodite equals in length first segment of exopodite.  
*Diaptomus ashlandi* Marsh, 1893.

- 52 (21, 30). Antepenultimate segment of right antenna of male bears curved process ----- 53.
- 53 (58). Process equals or exceeds in length penultimate segment ----- 54.
- 54 (55). Process about equals in length last two segments, second basal segment of right fifth foot of male dilated on inner margin, endopodites of fifth feet in both sexes indistinctly two-segmented.  
*Diaptomus eiseni* Lilljeborg, 1889.
- 55 (54). Process slightly exceeds in length penultimate segment ----- 56.
- 56 (57). Appendage of antepenultimate segment of male antenna broad, in male fifth foot outline of second segment of right exopodite convex, with lateral spine nearly terminal, terminal hook sinuate.  
*Diaptomus franciscanus* Lilljeborg, 1889.
- 57 (56). Appendage of antepenultimate segment of male antenna slender, in male fifth foot outline of second segment of right exopodite biconcave, lateral spine distad of center of segment, terminal hook symmetrical.  
*Diaptomus mexicanus*, new species.
- 58 (53). Process shorter than penultimate segment ----- 59.
- 59 (70, 73). One or both terminal processes of last segment of left exopodite of male fifth foot distinctly falciform ----- 60.
- 60 (67). Right endopodite of fifth foot of male small, shorter than first segment of exopodite ----- 61.
- 61 (64). In right fifth foot of male the terminal segment of the exopodite is slender and elongate; the terminal hook is stout; the endopodite is rudimentary ----- 62.
- 62 (63). The lateral spine long and slender; the left endopodite is spatulate.  
*Diaptomus spatulocrenatus* Pearse, 1906.
- 63 (62). Lateral spine stout; left endopodite long and slender.  
*Diaptomus conipedatus* Marsh, 1907.
- 64 (61). Terminal segment of right exopodite of male is of usual proportions; the terminal hook is not markedly broad; the endopodite is distinct ----- 65.
- 65 (66). Left fifth foot of male reaches end of second basal segment of right foot, lateral spine of second segment of right exopodite at about two-thirds its length ----- *Diaptomus sanguineus* Forbes, 1876.
- 66 (65). Left fifth foot of male exceeds second basal segment of right foot, lateral spine of second segment of exopodite nearly terminal, dorsal process on fifth cephalothoracic segment of female.  
*Diaptomus saltillinus* Brewer, 1898.
- 67 (60). Right endopodite of fifth foot of male distinctly longer than first segment of exopodite ----- 68.
- 68 (69). First segment of right exopodite of male fifth foot has transverse ridge on the posterior surface, the lateral spine of the second segment is about one-half as long as the segment, the first segment of the female abdomen has a prominent swelling on the right side.  
*Diaptomus asymmetricus* Marsh, 1907.
- 69 (68). First segment of right exopodite of male fifth foot has two curved processes on posterior side, the lateral spine of the second segment equals or exceeds in length the segment, the fifth cephalothoracic segment of the female is armed with two dorsal processes.  
*Diaptomus dorsalis*, Marsh, 1907.
- 70 (59, 73). One of the terminal processes of the left exopodite of male is a straight or nearly straight sharp spine ----- 71.

- 71 (72). In male fifth feet the lateral spine of the second segment of the right exopodite is short, one-third the length of the segment, the terminal hook is broad and saber-like, the left endopodite is marked with transverse striae; the endopodites of the female fifth feet are two-segmented-----*Diaptomus stagnalis* Forbes, 1882.
- 72 (71). In male fifth feet the lateral spine of the second segment of the right exopodite is long, equaling in length the two segments of the exopodite, the terminal hook is long and slender, the left endopodite is not marked with transverse striae; the endopodites of the female fifth feet are one-segmented-----*Diaptomus floridanus* Marsh, 1926.
- 73 (59, 70). Terminal processes of left exopodite of fifth feet of male are digitiform----- 74.
- 74 (78). The right endopodite of the male fifth foot equals or exceeds the first segment of the exopodite----- 75.
- 75 (76, 77). The endopodites of the fifth feet of male are one-segmented.  
*Diaptomus novamexicanus* Herrick, 1895.
- 76 (75, 77). In both male and female fifth feet the endopodites are two-segmented. The exopodites of the female fifth feet are three-segmented.  
*Diaptomus bakeri* Marsh, 1907.
- 77 (75, 76). In male fifth feet, right endopodite two-segmented, left one-segmented, first segment of female abdomen has a digitiform process on right distal border-----*Diaptomus washingtonensis* Marsh, 1907.
- 78 (74). Right endopodite of male fifth foot shorter than first segment of exopodite----- 79.
- 79 (80, 83). In male fifth feet, second basal segment and first segment of exopodite of right foot without hyaline appendages, lateral spine of second segment of exopodite nearer proximal end of segment.  
*Diaptomus nudus* Marsh, 1904.
- 80 (79, 83). In male fifth feet a hyaline appendage on first segment of right exopodite----- 81.
- 81 (82). In male fifth feet a hyaline appendage on inner distal angle of first segment of right exopodite, right endopodite nearly equal in length to first segment of exopodite, digitiform process on right distal margin of female abdomen-----*Diaptomus signicauda* Lilljeborg, 1889.
- 82 (81). In male fifth feet a quadrangular hyaline appendage on inner distal half of first segment of right exopodite, right endopodite much shorter than the first segment of the exopodite.  
*Diaptomus siciloides* Lilljeborg, 1889.
- 83 (79, 80). In male fifth feet second basal segment of right foot with one or hyaline appendages, an oblique ridge on the posterior surface of the second segment of the right exopodite----- 84.
- 84 (85). In male fifth feet the lateral spine of the second segment of the right exopodite equals in length the segment, there is a dorsal process on the fifth cephalothoracic segment of the female.  
*Diaptomus albuquerquensis* Herrick, 1895.
- 85 (84). In male fifth feet the lateral spine of the second segment of the right exopodite equals in length one-half of the segment, there is no dorsal process on the fifth cephalothoracic segment of the female.  
*Diaptomus purpureus* Marsh, 1907.

*DIAPTOMUS ALBUQUERQUENSIS* Herrick, 1895

*D. lehmeri* Pearse 1904 is *D. albuquerquensis* of Herrick published in 1895. *D. albuquerquensis* Schacht 1897 is *D. floridanus* Marsh.

*D. albuquerqueensis* was first found, as the name indicates, in New Mexico. It has been collected at various places in eastern Colorado by Dodds 1915*a*, 1917, 1920, and 1924, and by the author, and was reported by Juday 1915 from Lake Amatitlan, Guatemala, and from Mexico City. Its distribution is shown in Figure 1.



FIGURE 1.—DISTRIBUTION OF *DIAPTOMUS ALBUQUERQUENSIS* HERRICK ( $\Delta$ ), *D. BACILLIFER* KÖLBEL, (+), *D. BIRGEI* MARSH ( $\bullet$ ), *D. CASTOR* JURINE ( $\circ$ ), AND *D. EISENERI* LILLJEBORG ( $\square$ )

#### *DIAPTOMUS ARCTICUS* Marsh, 1920

*D. arcticus* was named from material collected by Frits Johansen on Herschel Island, and up to this time has been found in no other locality.

#### *DIAPTOMUS ASHLANDI* Marsh, 1893

*D. ashlandi* occurs in the Great Lakes, in Round Lake, and Pine Lake, in Michigan, these lakes being connected with Lake Michigan;

in Yellowstone Lake, in Flathead Lake, Mont.; in Lake Pend d'Oreille, Idaho; in Washington Lake, Seattle; and has been reported by Schacht, 1897, in Indiana and Oregon. Its distribution is shown in Figure 2.

**DIAPTOMUS ASYMMETRICUS** Marsh, 1907

This species has been reported only from Habana, Cuba, in a collection sent by Prof. C. F. Baker.

**DIAPTOMUS AUGUSTAENSIS**, Turner, 1910

Turner's original description of his material, from a temporary pond in a marsh at Augusta, Ga., constitutes the only known record of this species.



FIGURE 2.—DISTRIBUTION OF *DIAPTOMUS ASHLANDI* MARSH (●), *D. CLAVIPES* SCHACHT (+), *D. DORSALIS* MARSH (□), AND *D. LEPTOPUS* FORBES (○)

**DIAPTOMUS BACILLIFER** Kölbel, 1884

The distribution of *D. bacillifer* in North America is shown in Figure 1. It was first found in America in collections made by Frits Johansen at Bernard Harbor on the Arctic coast of Canada, March, 1920, and later in collections made by Professor Parker on St. Paul Island, off Alaska. An examination of the description of a species found in the mountains of Colorado by Dodds 1915*b*, and called by him *D. arapahoensis*, makes it evident that this is *D. bacillifer*.

This species is found in many localities in northern Europe and Asia, in the islands north of Siberia, and in the mountains of southern Europe and central Asia. It is a stenothermal form confined to the colder waters. While it has been found in America in only the three localities, and those far apart, it is probable that further collec-



tions will show its presence in other localities in northern Canada and at high altitudes farther south. The occurrence of this species in America is of special interest, as it is the first instance of a species of *Diaptomus* being found in both the Eurasian and American continents.

**DIAPTOMUS BAKERI** Marsh, 1907

*D. bakeri* has been found in only two localities, both in the State of California, Stanford University and Monterey.

**DIAPTOMUS BIRGEI** Marsh, 1894

*D. birgei* was first found near New Lisbon, Wis. Since the original description in 1894 it has been found in Eagle Lake, near Warsaw, Ind.; in Richmond, Ind.; Cold Spring Harbor, on Long Island; several localities in the immediate vicinity of Washington, D. C.; by Coker, 1926, in lakes at the headwaters of the Catawba, N. C., and has been reported by Klugh, 1926, at Barriefield, Ontario, and St. Andrews, New Brunswick. The distribution is shown in Figure 1.

**DIAPTOMUS (MONOCULUS) CASTOR** Jurine, 1820

*D. castor* is widely distributed in Europe and has been reported by Stephenson, 1913, and Haberbosch, 1920, on the western coast of Greenland. Its distribution is shown in Figure 1. It does not occur on the continent of America.

**DIAPTOMUS CLAVIPES** Schacht, 1897

This species was first described from material collected in the Okoboji Lakes in northwestern Iowa. Brewer, 1898, found it in temporary pools in Nebraska, calling it *D. nebraskensis*. Beardsley, 1902, reported it from Greeley, Colo. The author found it at Hugo, Colo., and in lakes near Pikes Peak, in the same State. Dodds, 1908, 1915a, 1917, 1920, 1924, reported it from La Junta and several other localities in Colorado. A letter to the author from C. I. Alexander stated that he had found it near Fort Worth, Tex. The distribution is shown in Figure 2.

**DIAPTOMUS COLORADENSIS** Marsh, 1911

*D. coloradensis* was originally described from material collected at Mount Carbon, Kremmling, Corona, and Tolland, Colo. It occurred in a number of small bodies of water near Mount Carbon. Later it was repeatedly found by the author near the Salina Experiment Station of the United States Department of Agriculture in Utah, and in the summer of 1928 it was found in the lake at Palisade Park, about 6 miles south of Manti, Utah. All of these locations except the last are 8,000 feet or more in altitude; Palisade Park is 5,900 feet. It

is a matter of considerable interest that its altitudinal distribution is so restricted. It has been collected at different times from June until late in September. Its distribution is shown in Figure 7.

**DIAPTOMUS CONIPEDATUS Marsh, 1907**

*D. conipedatus* has been found in only one locality—Slidell, La.

**DIAPTOMUS DORSALIS Marsh, 1907**

*D. dorsalis* has been found only in the States of Florida and Louisiana. In Florida it occurred in Little Lake George, Lake Monroe, Middle Lake, and the St. Johns River. In Louisiana it has been found at Slidell and Guzman. Its distribution is shown in Figure 2. It is probable that it will be found in other States bordering on the Gulf of Mexico.

**DIAPTOMUS EISENI Lilljeborg, 1889**

The distribution of *D. eiseni* is shown in Figure 1. It was originally found near Fresno in California. Brewer in 1898 reported it from Lincoln, Nebr. Cushman in 1908 found it at Battle Harbor, Labrador. In 1922 Rylov found what he considers a variety of *D. eiseni* and which he has named *D. eiseni* var. *orientalis* in Siberia. This is a remarkable distribution, the three localities in America being about as far apart as they could be and be on the continent, and the fourth locality being on the opposite side of the world.

**DIAPTOMUS FLORIDANUS Marsh, 1926**

*D. floridanus* has been found only in Florida, in ponds in Polk County.

**DIAPTOMUS FRANCISCANUS Lilljeborg, 1889**

In the original description of this species by DeGuerne and Richard, it is stated that it was common in the neighborhood of San Francisco, Calif. It has not been reported in any other locality.

**DIAPTOMUS GATUNENSIS Marsh, 1913**

*D. gatunensis* was first found in the Panama Canal Zone, in the "Black Swamp" near the old line of the Panama Railroad, and in a pond at Bohio. Dodds later reported it in several localities in the Canal Zone.

**DIAPTOMUS JUDAYI Marsh, 1907**

*D. judayi* has been found in only one locality, Twin Lakes, in the Rocky Mountains of Colorado.

**DIAPTOMUS LEONNICOLLINUS** Marsh, 1913

*D. leonnicollinus* has been found only near Lion Hill in the Panama Canal Zone.

**DIAPTOMUS LEPTOPUS** Forbes, 1882

*D. leptopus* was found by Forbes near Normal, Ill., and at Woods Hole, Mass. Herrick and Turner 1895 reported it from Minnesota. Pearse 1906 found it at Cambridge, Medford, and Wellesley, Mass. Stromsten 1920 found it in the Okoboji region in Iowa. The author has found it near Ripon, Wis., at Marquette, Mich., at Hammond and Gary, Ind., at Kremmling, Colo., and in Panguitch Lake in southern Utah. Juday in correspondence states that he has found it in Devils Lake, N. Dak. Its distribution is shown in Figure 2.

**DIAPTOMUS LINTONI** Forbes, 1893

Forbes' original description of *D. lintoni* was from material collected in the lakes of Yellowstone Park. Dodds 1915*a*, 1915*b*, 1917, found it near Tolland, Colo., and the author found it in Buffalo Horn Lake in the Gallatin Valley, Mont., and in material collected by Prof. Chancey Juday in Laguna Canyon, Calif. Its distribution is shown in Figure 8.

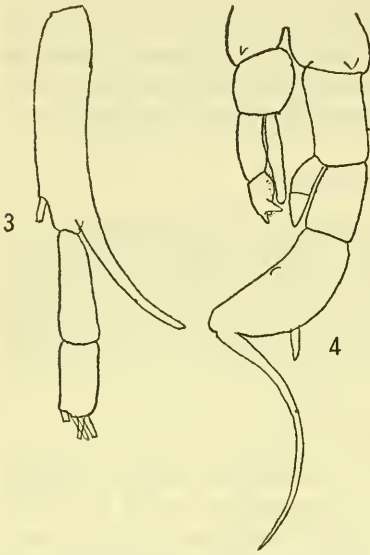
**DIAPTOMUS MARSHI** Juday, 1914

Juday's original description was from collections made at Puerto Barrios and Los Amates, Guatamala. The author found it in the Comacho and Mindi Reservoirs and the Rio Trinidad in the Canal Zone, and in collections made by F. J. Dyer at La Ceiba, Honduras. Pearse 1915 collected it at Fundacio, Colombia. *D. colombiensis* Thiebaud 1914, found in Laguna de Ubaque, Colombia, is *D. marshi*. Dodds 1926 reported it in several localities in the Canal Zone. Its distribution is shown in Figure 6.

**DIAPTOMUS MEXICANUS**, new species

Many years ago a single specimen of a *Diaptomus* was found in a collection made by Rev. C. D. Campbell near Mexico City. The specimen was a mature male evidently allied to *D. franciscanus* Lilljeborg, but with characteristics which clearly distinguished it from that species. Of course, a new species should be founded on a considerable number of individuals; therefore the notes on this animal were kept in readiness for use when further material should come to hand. In spite of a generation or so of delay, the creature has not again shown up. It is, however, so distinctly different from others that it seems wise to give it a name. Very little collecting of Copepoda has been done in Mexico, and it seems highly probable that others may find it later.

The descriptive notes which follow apply, of course, only to the male. Length, 1.2 mm. The antennæ do not quite reach the furca. The furca is ciliated on the inner margins. The antepenultimate segment of the right antenna has a slender, curved appendage which slightly exceeds in length the penultimate segment, Figure 3. The first basal segments of the fifth foot, Figure 4, have rather large spines. The second basal segment of the right foot is quadrangular, its length about twice its width. The first segment of the right



FIGURES 3-4.—3, *DIAPTOMUS MEXICANUS*, NEW SPECIES, TERMINAL SEGMENTS OF RIGHT ANTENNA OF MALE;  $\times 607$ . 4, *DIAPTOMUS MEXICANUS*, NEW SPECIES, FIFTH RIGHT FOOT OF MALE;  $\times 307$

exopodite is also quadrangular and is about four-fifths as long as the second basal segment; the second segment is about twice as long as the first, is strongly curved outwardly, and has the lateral spine distad of the middle of the segment, while opposite the spine, near the inner margin, there is a small cuticular protuberance on the posterior surface; the terminal hook is symmetrically curved and its length equals that of the exopodite and second basal segment combined. The right endopodite is broad, pointed, two-segmented, and reaches the end of the first segment of the exopodite. The left fifth foot about reaches the end of the first segment of the right exopodite; the terminal segment is setose on the inner margin and bears two digitate processes; the endopodite

is slender, one-segmented, and is nearly as long as the two segments of the exopodite.

#### *DIAPTOMUS MINUTUS* Lilljeborg, 1889

*Diaptomus minutus* was described from collections made in Greenland and at St. Johns, Newfoundland. DeGuerne and Richard, 1892, reported it from Iceland. Marsh found it in many lakes in Wisconsin and northern Michigan. It occurs in the Great Lakes, the Finger Lakes of central New York, and in two localities in Maine. It has been found at Dalhousie, New Brunswick, was reported by Willey from the Shubenacadie River, Nova Scotia, and occurred in collections made by Professor Mackay from Nipigon Lake. While it is a very abundant species in the regions where it is found, it is, so far as the continent of North America is concerned, somewhat

limited in its distribution. With the exception of a single specimen reported by Schacht from the Yellowstone National Park it does not occur west of Wisconsin, nor south of the southern borders of Wisconsin, Michigan, and New York, except in Lake Maxinkuckee in northern Indiana. New Brunswick and Lake Nipigon limit its continental distribution in the north. It is typically a cold-water form and in the more southern parts of its range is largely confined to the deeper lakes. Its distribution is shown in Figure 5.

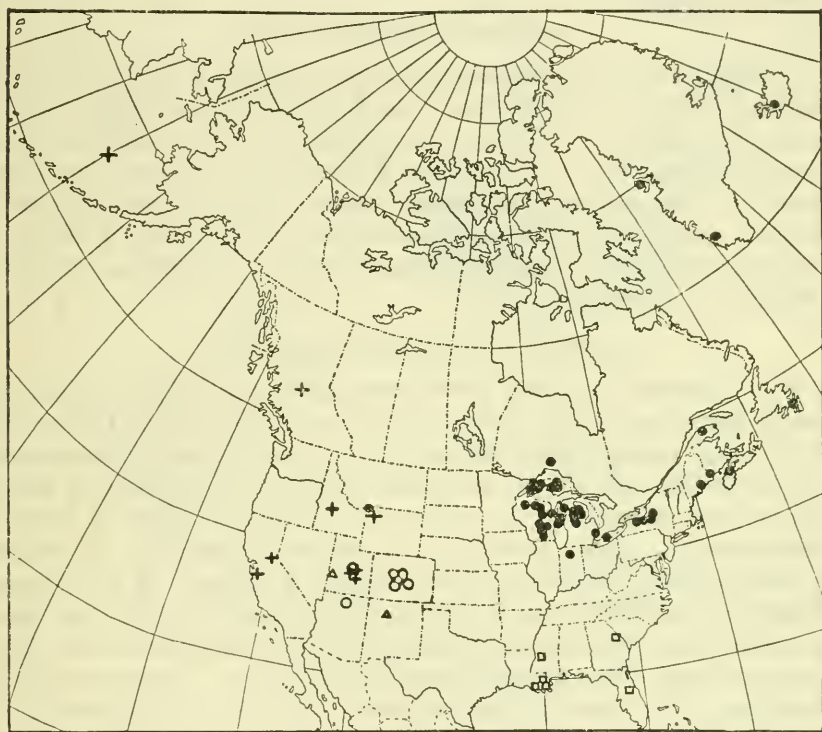


FIGURE 5.—DISTRIBUTION OF *DIAPTOMUS MINUTUS* LILLJEBORG (●), *D. MISSISSIPPIENSIS* MARSH (□), *D. NOVAMEXICANUS* HERRICK (Δ), *D. NUDUS* MARSH (○), AND *D. TYRELLI* POPPE (+)

#### *DIAPTOMUS MISSISSIPPIENSIS* Marsh, 1894

*D. mississippiensis* was described from material collected by Professor Birge at Jackson, Miss.; it was later found in collections made by him at Guzman and Slidell in Louisiana. Turner, 1910, found it at Augusta, Ga., and Schacht, 1897, reported it from Lake Maitland, Fla. Mr. E. Foster has written to the author that he found it in two localities near New Orleans, but not in any numbers. Its distribution is shown in Figure 5.

## DIAPTOMUS NOVAMEXICANUS Herrick, 1895

*D. novamexicanus* was described by Herrick from material collected at Albuquerque, N. Mex. It has been found in only one other locality—Burbank, Utah. It may be noted that in Herrick's description it was stated that the second segment of the exopodite of the fifth foot of the female bears two spines. In the material examined by the author there has been a third minute spine on this segment in some individuals. The distribution of the species is shown in Figure 5.

## DIAPTOMUS NUDUS Marsh, 1904

*D. nudus* was described from collections made by Prof. H. B. Ward in lakes in the vicinity of Pikes Peak, Colo.; Dead Lake, Lake Michigan, Lake Rocks, and Mirror Lake. Dodds, 1908, reported it at Boulder, Colo., and in 1915<sup>a</sup> from Tolland, Colo. It has also been found in Colorado, at Kremmling, and in a pond in the city park, Denver. Quite recently it has been collected in Utah Lake, Utah, and in Jacobs Lake in the Kaibab National Forest in Arizona. Its distribution is shown in Figure 5.

## DIAPTOMUS OREGONENSIS Lilljeborg, 1889

*D. oregonensis* was first found near Portland, Oreg. It has recently been reported by Brehm from Vancouver, British Columbia. It is rather strange that these are the only reports of its occurrence on the Pacific side of the continent. Herrick collected it in Lake Minnetonka, Minn., and it was found in collections made by Doctor Hemingway in Lake Vermilion in northern Minnesota. It occurs in many lakes in Wisconsin and northern Michigan. It is in Lake Superior, Lake Michigan, the Detroit River, and Lake St. Clair and in Lake Erie. Without much doubt it is in Lakes Huron and Ontario, although it has not been reported from them. Stromsten, 1917, found it in the Okoboji Lakes in Iowa. It occurs in northern Illinois and Indiana. Pearse's *pygmaeus*, which is without doubt *oregonensis*, was found in eastern Massachusetts. Klugh, 1926, found it in New Brunswick and the Province of Ontario. Doctor Congdon collected it at Kinistino, Saskatchewan, the most northern point of its known range. In the region of the Great Lakes it is the most common species of the genus. Its distribution is shown in Figure 6.

## DIAPTOMUS PALLIDUS Herrick, 1879

*D. pallidus* is widely distributed in the general region of the Mississippi Valley. Herrick, in his original description, speaks of it as abounding in the larger lakes of Minnesota and later says that it is in the entire Mississippi Valley. Stromsten, 1917, found it in the Okoboji Lakes and Brewer, 1898, and Pearse, 1905, found it

abundant in eastern Nebraska. It occurs as far west as Pueblo, Colo., and as far south as New Orleans. E. Foster has reported to the writer that it is the most common form near New Orleans, occurring through the year. The most eastern locations are Ohio, where it was found by Turner, and Alabama; there may be some doubt about the Alabama situation—it is based on a statement by

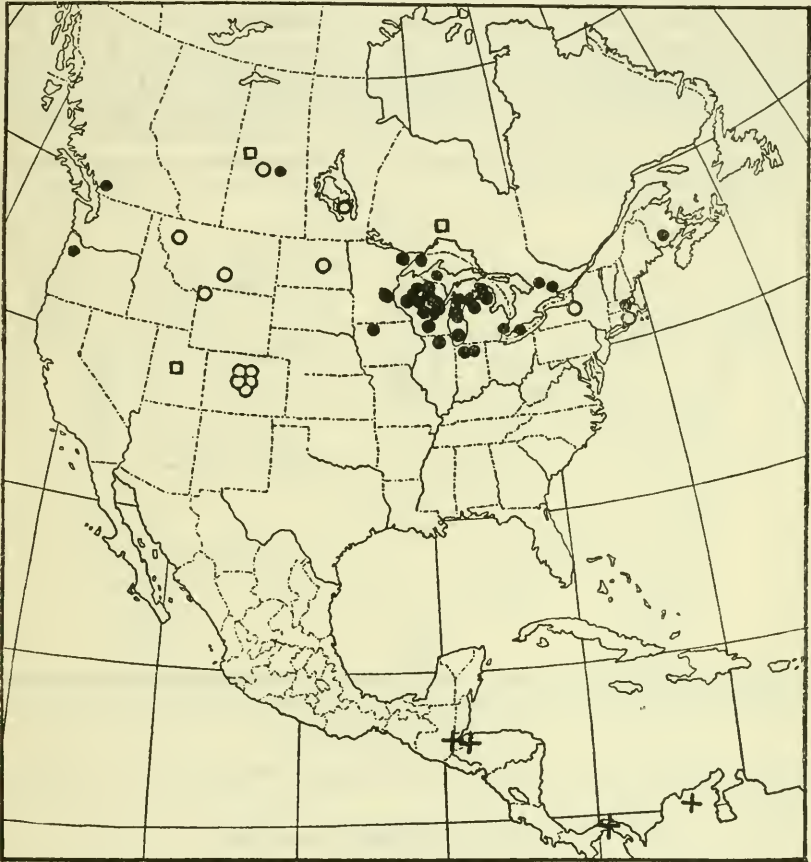


FIGURE 6.—DISTRIBUTION OF *DIAPTOMUS OREGONENSIS* LILLJEBORG (●), *D. MARSHI* JUDAY (+), *D. TENUICAUDATUS* MARSH, (□), AND *D. PISCINAE* FORBES (○)

Herrick that he had found there a form "like *pallidus*." It is a little strange that it has been found in only one place in Wisconsin, in Heart Lake, Marquette. Its distribution is shown in Figure 8.

#### *DIAPTOMUS PISCINAE* Forbes, 1893

In the paper by Marsh, 1907, *D. piscinae* was considered a variety of *D. leptopus*. Further collections make it probable that the differences which distinguish this from *D. leptopus* are constant, and it

seems desirable to consider it a distinct species. Forbes described the species from material gathered at Gardner, Mont. Schacht, 1897, found it in collections from Portage Slough, Manitoba. Dodds, 1908, 1915*a*, 1915*b*, 1924, found it in Colorado in Red Rock Lake, Boulder, Tolland, and in several lakes in the Pikes Peak region. It has also been found in Colorado at Mount Carbon, in a lake between Kebler Pass and Floresta, and in Twin Lakes. It has been collected in the Birch Hills, Saskatchewan; in Flathead Lake and at Red Lodge in Montana; in Devils Lake, N. Dak.; at Ithaca, N. Y.; and at Woods Hole, Mass. Its distribution is shown in Figure 6. It is noticeable that while, like *D. leptopus*, it occurs in both the East and



FIGURE 7.—DISTRIBUTION OF *DIAPTOMUS REIGHARDI* MARSH (●), *D. COLORADENSIS* MARSH (○), AND *D. SALTILLINUS* BREWER (+)

West, it has not been collected in the Central States where *D. leptopus* is fairly common.

**DIAPTOMUS PURPUREUS** Marsh, 1907

*D. purpureus* was described from material collected by Prof. C. F. Baker at Habana, Cuba, and no other collections have been made up to the present time.

**DIAPTOMUS REIGHARDI** Marsh, 1895

The original description of *D. reighardi* was made from collections made in Intermediate Lake in northern Michigan. It has since been found in Crooked Lake in northern Michigan; in a lake on Beaver Island in Lake Michigan; at Zion, Ill.; Hammond and Gary, Ind.; and at Sodus Bay, N. Y. Its distribution is shown in Figure 7.



**DIAPTOMUS SALTILLINUS** Brewer, 1898

Brewer described *D. saltillinus* from collections made in the vicinity of Lincoln, Nebr. It was found by Pearse, 1905, in other locations in Nebraska, and Mr. C. I. Alexander has written that he has found it in the neighborhood of Fort Worth, Tex. Its distribution is shown in Figure 7.

**DIAPTOMUS SANGUINEUS** Forbes, 1876

Forbes's description was from material obtained near Normal, Ill., where he said it occurred rather abundantly. Herrick, 1884, found it near Minneapolis, Minn.; Brewer, 1898, reported it in Nebraska;

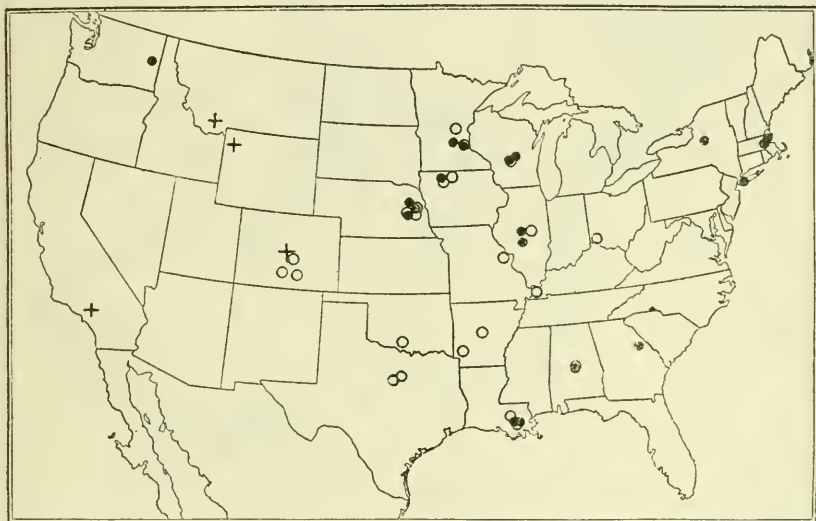


FIGURE 8.—DISTRIBUTION OF *DIAPTOMUS SANGUINEUS* FORBES (●), *D. PALLIDUS* HERRICK (○), AND *D. LINTONI* FORBES (+)

and Pearse, 1905, reported it in Nebraska and Spokane, Wash. Pearse, 1906, also found it at Wellesley and Medford, Mass. Gissler, 1881, found it at Glendale, Long Island. Herrick reported it in Alabama; and Turner, 1910, from Augusta, Ga. Foster found it near New Orleans, La.; and Stromsten, 1920, in the Okoboji Lakes. It has also been found near Ripon, Wis., and at Saranac Inn, N. Y. It is probable that more complete collections will show that it is common to all the Eastern States. Its distribution is shown in Figure 8.

**DIAPTOMUS SHOSHONE** Forbes, 1893

*D. shoshone* was named from the place where it was first found, Lake Shoshone, in the Yellowstone National Park. Forbes said that

it was found in other lakes in the park and it was later collected there by others. It was in collections made by H. B. Ward in several small lakes near Pikes Peak; by Thacker at Hope, Yale, and Laidlaw, British Columbia; by Young in Devils Lake, N. Dak.; and by Johansen near Toronto, Canada. The writer has collected it at Wheat Meadows in the Sierras, California; at Irwin and Corona, Colo.; and at a number of places in the neighborhood of the Salina Experiment Station, east of Salina, Utah, in the Wasatch Mountains. It was found in a collection made on Vancouver Island and in one

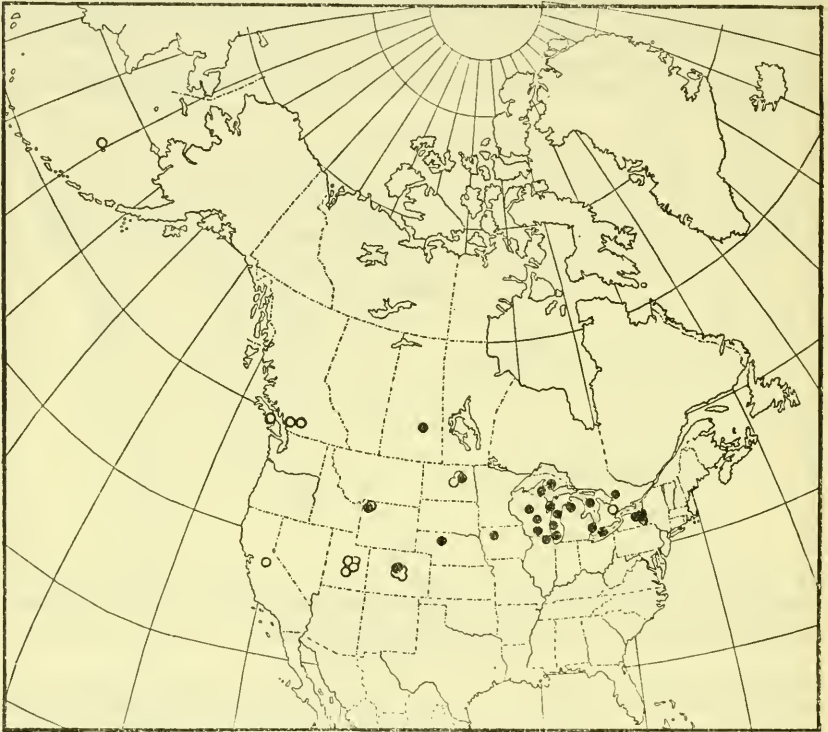


FIGURE 9.—DISTRIBUTION OF *DIAPTOMUS SHOSHONE* FORBES (○), AND *D. SICILIS* FORBES (●)

made in Lake McDonald on St. Paul Island, west of Alaska. Its distribution is shown in Figure 9.

**DIAPTOMUS SICILIS** Forbes, 1882

*Diaptomus sicilis* was first found in Lake Michigan, where it is a very common species. It was found in Tomahawk Lake, Green Lake, and Lake Geneva in Wisconsin; in Pine Lake, a lake connected with Lake Michigan in the northern part of the southern peninsula of Michigan; and in Lake Michigamme, in the northern peninsula of Michigan. Forbes, 1891, found it in Lake Superior, Miss H. B.

Merrill collected it in Lake Huron, Reighard in the Detroit River, and Wickliffe in Lake Erie. It occurs in Seneca, Cayuga, and Keuka Lakes, in central New York. Stromsten, 1917, found it in the Okoboji Lakes; Pearse, 1905, in Cherry County, Nebr., and the Muskoka Lakes, Ontario. Beardsley, 1902, found it in Seeley Lake, Colo.; Willey, 1923, in Quill Lakes, Saskatchewan; and it was present in collections made by Young in Devils Lake, N. Dak. Schacht,

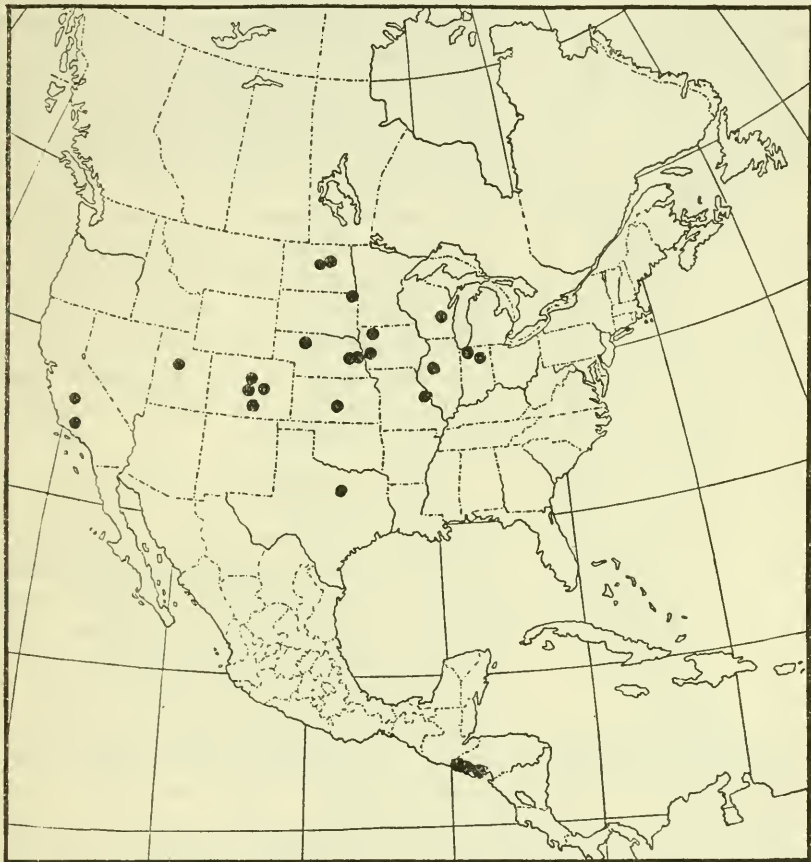


FIGURE 10.—DISTRIBUTION OF *DIAPTOMUS SICILOIDES* LILLJEBORG

1897, reported it from Cedar Lake and Fox Lake, Ill. Its most western location is Yellowstone Park, where Forbes collected it. Its distribution is shown in Figure 9.

**DIAPTOMUS SICILOIDES** Lilljeborg, 1889

The type specimens of *D. siciloides* were collected in Lake Tulare, Calif. Schacht, 1897, found it abundant in the Illinois River near Havana. Brewer, 1898, found it at Lincoln, Nebr.; and Pearse, 1905,

found it not only at Lincoln but at Omaha and in Cherry County, and in Council Bluffs, Iowa. Schacht, 1897, and later, Stromsten, 1920, reported it from the Okoboji Lakes in Iowa. Dodds, 1908, 1915a, 1917, 1920, 1924, found it in Palmer Lake and La Junta, Colo. The writer has found it in Colorado at Hugo and in lakes about

Pikes Peak; in Gunnison Reservoir, Utah; at Los Angeles, Calif.; in Devils Lake, N. Dak., in collections made by Young; in Big Stone Lake between South Dakota and Minnesota; in Cedar Lake, Wis.; in a collection made by Shelford at Medora, Kans., in Turkey Lake and at Hammond, in Indiana; in Crève Coeur Lake and other localities near St. Louis, Mo.; and in a collection made by Birge at Hutchins, Tex. Juday, 1915, collected it at Coatepeque and Lake Ilopango, San Salvador, and it was found in a collection made by Hildebrand in Lake Chamico, in San Salvador. It has not been found north of the United States. Figure 10 shows its distribution.

*DIAPTOMUS SIGNICAUDA* Lilljeborg, 1889

In the description of this species it was said to have been collected in the Sierras, Calif. It was found in collections made by C. F. Baker in Marlette Lake, Nev., and in collections made by H. B. Ward in several small lakes near Lake Tahoe. It was contained in material gathered by Juday in Hocketts Lakes, Calif., and Boulder, Colo. Stromsten, 1917, noted its occurrence in the Okoboji Lakes

in Iowa, and the writer found it in Wheat Meadows and Duck Lake in Calaveras County, Calif. Its distribution is shown in Figure 12.

*DIAPTOMUS SPATULOCRENATUS* Pearse, 1906

Pearse found *D. spatulocrenatus* on Nantucket Island. The writer found it in a collection made by A. A. Doolittle from Lake Sebago, in Maine. In a comparison of the Lake Sebago material with the original description certain minor differences were noted. The presence of lateral spines on the first abdominal segment of the female was not mentioned by Pearse. The second basal segment of

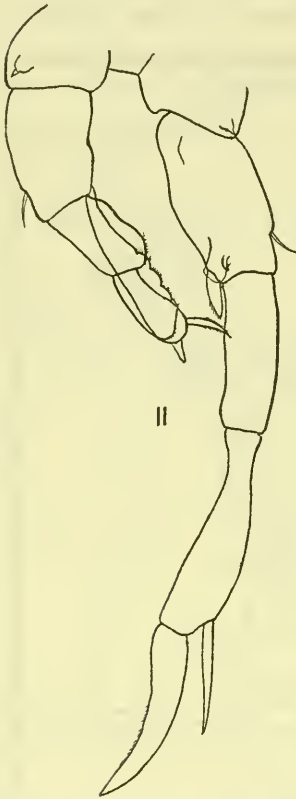


FIGURE 11.—*DIAPTOMUS SPATULOCRENATUS* PEARSE, FIFTH LEFT FOOT OF MALE,  $\times 424$

the right fifth foot of the male has, as shown in Figure 11, in addition to the small tubercle mentioned by Pearse, a hyaline appendage near the inner distal angle and at the base of this appendage a small recurved hook. The left endopodite of the male fifth foot was one-segmented instead of two-segmented as in the Nantucket specimens.

**DIAPTOMUS STAGNALIS Forbes, 1882**

*Diaptomus stagnalis* was described by Forbes in 1882. His description was not complete but was sufficient to clearly identify the species. Herrick, in 1882, proposed a provisional name of *giganteus* for a form for which he gave no description, but his figures show that it is identical with Forbes's *stagnalis*; in 1884 he acknowledged that

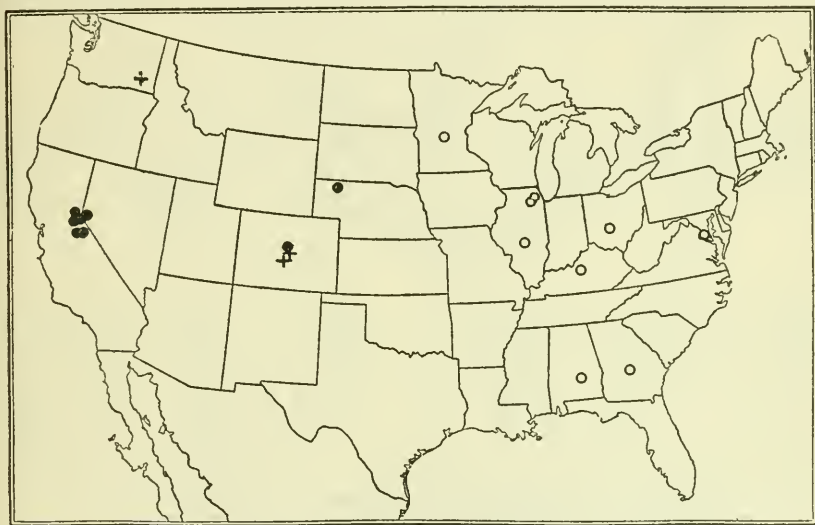
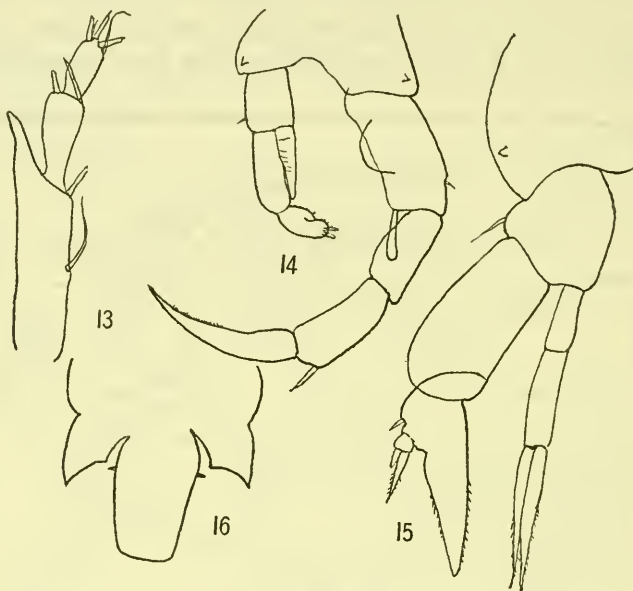


FIGURE 12.—DISTRIBUTION OF *DIAPTOMUS STAGNALIS* FORBES (○), *D. SIGNICAUDA* LILLJEBORG (●), AND *D. WASHINGTONENSIS* MARSH (+)

Forbes's name had the right of priority and gave a somewhat careful description with figures of the wing of the last cephalothoracic segment and of the fifth foot of the male. In 1895 Herrick and Turner again described the species with a number of figures. The most complete description is that by Schacht in 1897, but he gave but one figure, the terminal segments of the right antenna of the male. Marsh in 1907 reproduced the description of Schacht, using figures from Forbes, and Herrick and Turner. More recently the species has been found in Virginia, near Washington, and from this material figures are given of the terminal segments of the right antenna of the male, Figure 13; the fifth feet of both sexes, Figures 14 and 15;

and the "wings" of the last cephalothoracic segment, Figure 16. The material has shown certain minor differences from Schacht's description. The lateral spines of the first segment of the female abdomen are not "large" but of moderate size. The furcal rami are ciliate on outer as well as inner margins.

There is considerable variation in the form of the endopodite of the left fifth foot of the male. In the figure of Herrick, in 1882, cross striae or partitions are shown. In 1884 Herrick says that the "inner ramus is marked with oblique ridges," and these are shown in his figure. Herrick and Turner, in 1895, say that "it is corrugate inter-



FIGURES 13-16.—13, *DIAPTOMUS STAGNALIS* FORBES, TERMINAL SEGMENTS OF RIGHT ANTENNA OF MALE;  $\times 307$ . 14, *DIAPTOMUS STAGNALIS* FORBES, FIFTH FOOT OF MALE;  $\times 109$ . 15, *DIAPTOMUS STAGNALIS* FORBES, FIFTH FOOT OF FEMALE;  $\times 307$ . 16, *DIAPTOMUS STAGNALIS* FORBES, SHOWING WINGS OF LAST CEPHALOTHORACIC SEGMENT OF FEMALE;  $\times 55$

nally," and their figures show corrugations on the *outer* margin. Schacht, in 1897, says "inner margin rugose." In the specimens examined by the author these markings which are striations rather than corrugations vary in their distinctness and in number. Sometimes there are not more than three or four; at others there may be six or more. In some cases they cross the endopodite at right angles, while in others they are oblique. In none of the individuals examined were they distinct enough to warrant the use of the words "rugose" or "corrugations." The appendages of the terminal segment of the left exopodite consist of an outer

digitate process and an inner spine which is nearly straight. In many of the females there are only two ova.

Forbes found it in central Illinois. Herrick and Turner, 1895, reported it in Minnesota, Ohio, Kentucky, and in 1887 Alabama. Turner, 1910, found it in Georgia. The author has found it in Jackson Park, Chicago, and in collections made by H. E. Barber in a temporary pool near Great Falls, Va. It is an early spring form. Its distribution is shown Figure 12.

**DIAPTOMUS TENUICAUDATUS Marsh, 1907**

*D. tenuicaudatus* was described from material collected by Dr. Russell T. Congdon in Glen Lake, Saskatchewan. It was found in collections made by Prof. H. H. Mackay in Lake Nipigon, north of Lake Superior, and recently the author has collected it from Utah Lake, Utah. Its distribution is shown in Figure 6.

**DIAPTOMUS TRYBOMI Lilljeborg, 1889**

*D. trybomi* has not been reported by any one since the original description in DeGuerne and Richard's monograph. It was said to have been collected by M. Trybom at "Multrooma Falls, Oregon." It is to be presumed Multnomah Falls is the locality.

**DIAPTOMUS TYRELLI Poppe, 1888**

*D. tyrelli* was described from collections made in Summit Lake, British Columbia. It was described in manuscript under the name *D. fresnanus* by Lilljeborg from material obtained near Fresno, Calif. From collections made in the Pribilof Islands, Alaska, Juday and Muttkowski in 1915 described it calling it *D. pribilofensis*. It was found in collections made by the United States Bureau of Fisheries in Alturas Lake, Idaho. It has also been found in Yellowstone National Park and in localities in southeastern Utah. Its distribution is shown in Figure 5.

**DIAPTOMUS VIRGINIENSIS Marsh, 1915**

*D. virginiensis* has thus far been found in only one locality, in Black Pond near Great Falls, Va.

**DIAPTOMUS WARDI Pearse, 1905**

*D. wardi* was described from material collected near Spokane, Wash. Juday and Muttkowski 1915 reported from St. Paul Island, near Alaska, and the author has found it in collections from the same locality.

## DIAPTOMUS WASHINGTONENSIS Marsh, 1907

*D. washingtonensis* was first found in collections made by Prof. B. H. Brown at Walla Walla, Wash. Later it was found in collections made by Dr. H. L. Shantz in Portland Reservoir and Palmer Reservoir at Colorado Springs, Colo. Its distribution is shown in Figure 12.

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