

DISTRIBUTION OF CALANOID COPEPODS (CALANOIDA, COPEPODA) IN OKLAHOMA

Andrew Robertson

Department of Zoology, University of Oklahoma, Norman, Oklahoma

Eight species of calanoid copepods have now been reported from Oklahoma. Two of these, *Diaptomus albuquerqueensis* and *D. dorsalis*, are reported here for the first time. The 8 species are all members of the genus *Diaptomus*, but 6 different subgenera are represented. No species has been found throughout the state, although *D. pallidus* seems to occur everywhere except in a small area in the northeast. *D. clavipes* is limited to central and western Oklahoma, and apparently reaches its eastern limit of distribution within the state, as does *D. albuquerqueensis* which, however, is restricted to the most westerly counties. Conversely, *D. reighardi* appears to reach its western limit in the eastern part of the state. *D. siciloides* has been found only in western and central Oklahoma, but its absence from the eastern areas probably is due to local conditions in the Ozark area. *D. dorsalis*, *D. sanguineus*, and *D. saltinus* have been reported sporadically; little or nothing is known of their distribution within the state.

Only two workers have contributed substantially to our knowledge of the distribution of species of calanoid copepods in Oklahoma. Duck (1) initiated the investigation of calanoids in the state, but his report is limited to species identification from relatively few bodies of water. Kingsbury (2) examined collections from 92 lakes and ponds and found calanoids in 87 of these. She attempted to distinguish distributional patterns on the basis of her data. She later expanded this work in her doctoral thesis (3) and presented maps summarizing the distributions of the different species, but included only records from lakes. Several other workers have identified the calanoids in one or two bodies of water.

The purpose of the present paper is to extend and summarize knowledge concerning the distribution of calanoids within Oklahoma. All previous distributional records are combined with records obtained from a series of collections made and analyzed recently by the author. The resulting distributional patterns are discussed and presented in a series of maps.

METHODS

Plankton samples were collected, from a variety of habitats throughout the state, with a fine (No. 20 mesh), 12-inch diameter plankton net. The net was either thrown out into the body of water and pulled to shore several times or, if conditions permit-

ted, it was towed through the water by a person wearing hip boots. The only exceptions to this are the samples from Canton Lake, which were taken from a boat. The samples were preserved with formalin in small screw-top vials.

Species of calanoids present in these samples were determined through the aid of the identification key presented by Wilson (4). To observe the characters used in this key, the first pair of appendages, the antennules, and the last pair of appendages, as well as the 5th pair of swimming legs had to be removed from an animal and mounted separately. One or two adult males were dissected from each sample in which they were found. In some samples, males of more than one size were detected, and in these cases males of each type were identified. After the identification of males of each obvious type, five or so representatives of each kind were examined closely under the highest power of a dissecting microscope (30X) but without dissection. An attempt was made to determine if any species other than those already identified were present, and if any such animals were noted, they were dissected for positive identification. This procedure permits the possibility that, when two or more quite similar species were present in a sample, not all of them were detected. However, it is unlikely that species went undetected very often, for it has been

observed (5) that coexistence of species is usually restricted to species of quite different sizes and quite different taxonomic positions.

In a few samples in which adult males were not present but adult females were, identifications were made using the females. In one sample no adults were present, but immature copepodids were found, and here no attempt was made to identify the species since the key can be used only with adults.

RESULTS

Approximate sampling locations and species found at these locations in the samples examined by the author are listed in Table 1. The micrages given in this table are approximate.

TABLE 1. Species of *Diaptomus* found in plankton samples from Oklahoma. A, *D. albuquerquensis*; C, *D. clavipes*; D, *D. dorsalis*; P, *D. pallidus*; R, *D. reighardi*; S, *D. siciloides*; Sa, *D. sanguineus*.

Species	Date	Sampling location	County
None	3/31/69	3 miles E Hugo	Choctaw
None	"	3 miles E Hugo	"
None	"	Separated embayment of Lake Raymond	"
None	"	Gary	"
None	"	Near US 70, 3 miles E Fort Towson	"
P	"	Near US 70, just E Idabel	McCurtain
P	4/1/69	Kull Lake, Ouachita Nat. Forest	"
P	"	Same general location, pond	"
None	"	Near US 259, 3 miles S Idabel	"
None	"	S Idabel 5 miles	"
None	"	Near US 259, 3 miles N Broken Bow	"
R	"	Broken Bow Reservoir	"
Immatures	"	Near US 259, near McCurtain Co. line	LeFlore
None	"	Near OK 63, just W of Muse	"
P	"	Near OK 63, 3 miles W Muse	"
None	"	NW Whitesboro 5 miles	"
None	"	NW Whitesboro 6 miles	"
None	"	Near US 271, 2 miles N Summerfield	"
None	"	Water Reservoir	"
P, Sa	4/2/69	Near US 59, 1 mile N Panama	"
P	"	Spiro Lake	"
None	"	Near US 59, 10 miles S Sallisaw	"
R	"	Near US 59, 12 miles N Sallisaw	Sequoyah
None	"	Near OK 100, 3 miles W Stillwell	Adair
R	"	Near OK 100, by Adair Co. line	Cherokee
D, P, S*	4/10/67	Canton Reservoir, in middle 1 mile from dam	Blaine
D, P, S*	5/25/67	Pond at Durant Fish Hatchery	Bryan
C, S*	7/10/67	Canton Reservoir, on shore	"
None	10/1/68	1 mile from dam	Blaine
P	"	Near US 259, 3 miles S of Idabel	McCurtain
P	"	Same general location	"
P, S	11/9/68	Pond near The Point Area, Lake of the Arbuckles	Murray
P, S	"	Lake of the Arbuckles, at The Point Area	"
C**	1/23/69	In R. 2 W, T. 9 N, Sec. 24	Cleveland
C, S**	"	Same general location	"
S, Sa	3/28/69	Near US 62, in NW Lawton	Comanche
None	"	Near OK 5, 1 mile W Tipton	Tillman
None	"	Near OK 5, 2 miles E Tipton	"
None	"	Near OK 5, 3 miles E Tipton	"
S, Sa	"	Near US 183, 3 miles N Manitou	"
C, S	"	Near US 183, 5 miles N Manitou	"
Sa	"	Near US 183, 2 miles S Snyder	Kiowa
C, S	"	Near US 62, 6 miles E Snyder	"
None	"	Crater Lake, Wichita Mts. Wildlife Refuge	Comanche
None	"	Foot of Mt. Scott, Wichita Mts. Wildlife Refuge	"
None	3/31/69	Near OK 3, 2 miles E Lane	Atoka
P	"	SE Lane 3 miles	"
None	"	Near US 70, 5 miles E Hugo	Choctaw
None	"	Near US 270, 2 miles E of Beaver Co. line	Harper
None	"	Near US 270, just N Logan	Beaver

Species	Date	Sampling location	County
None	6/2/69	S Clear Lake 1 mile	Beaver
S	"	SW Elmwood 8 miles	"
C.S	"	Near OK 2, 8 miles E Hardesty	Texas
P	"	Lake Schultz	"
None	"	Same general location, stock tank	"
None	"	S Hardesty, 4 miles	"
None	6/4/69	Near US 54, 5 miles SW Guymon	"
P	"	Just W of Goodwell	"
C.S	"	N Griggs, 2 miles	Cimarron
A	"	W Griggs, 5 miles	"
None	"	N Sampsel, 2 miles	"
C.P	"	Lake Etling, Black Mesa State Park	"
C.S	"	Near Lake Etling, pond	"
S	"	Same general location	"
None	"	S Lake Etling, 2 miles	"
None	"	S Lake Etling, 5 miles	"
None	"	Same general location	"
None	"	E Windless, 6 miles	"
C	"	Near US 56, 1 mile E Boise City	"
C.S	"	Near US 56, 2 miles E Boise City	Texas
None	6/5/69	Near US 64, just NE Hooker	"
None	"	Near US 64, 3 miles E Hooker	"
A.C.S.	"	Near US 64, 5 miles NE Turpin	Beaver
C.S	"	Near US 64, 8 miles NE Turpin	"
S	"	Near US 64, 1 mile E Forgan	"
A	"	Near US 64, 4 miles E Forgan	"
C.S.	"	Near US 64, 2 miles W Knowles	"
C	"	Near US 64, 3 miles E Gates	Beaver & Harper
None	"	Near US 64, just W Rosston	Harper
Ss	"	Near US 283, 5 miles N Laverne	"
None	"	Near US 270, just over Woodward Co. line	Ellis
S	"	Near US 183, 5 miles SE Woodward	Woodward
None	"	Near US 270, 10 miles W Watonga	Blaine
None	"	Near US 270, just W Watonga	"

* Sample provided by Mr. J. T. Yacovino.

** Sample provided by Mr. R. K. Harkey.

A series of maps summarizes the distribution of calanoids in Oklahoma, and combines the author's records with those already in the literature. No attempt has been made to indicate locations of collection in any more detail than as to county. When a species is recorded from a body of water that overlaps into two or more counties, the species is indicated as occurring in all the counties involved.

Diaptomus (*Skistodiaptomus*) *pallidus* Herrick, 1879, (Figure 1) occurs generally throughout the state with the exception of

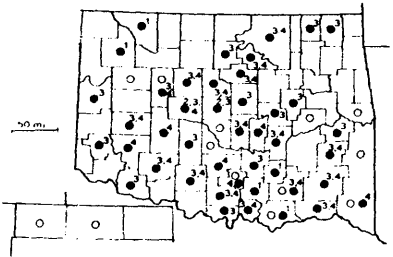


FIGURE 1. Distribution of *Diaptomus pallidus*. Previously reported ● by: 1, Duck, 1937 (1); 2, Ophel, 1950 (17); 3, Kingsbury, 1966 (2); 4, Kingsbury, 1968 (3). Reported in this paper ○.

a group of counties in the eastern corner. Kingsbury (3) recognized this distributional pattern and found that the area in which this species was not present closely approximated one of the limnological regions she had delineated, the Ozark Province. She suggested that the absence of *D. pallidus* in the Ozark Province may be related to competition with a member of the same subgenus, *D. (S.) reighardi*, which has been found much more commonly here than elsewhere in the state.

D. pallidus has been reported previously in all states bordering Oklahoma, except New Mexico. As it has now been found within a few miles of that state, at Lake Carl Etling in Cimarron County, it seems likely it also occurs there, at least in some of the northeastern counties.

Diaptomus (*Leptodiaptomus*) *sciloides* Lilljeborg, 1889, (Figure 2) is generally dis-

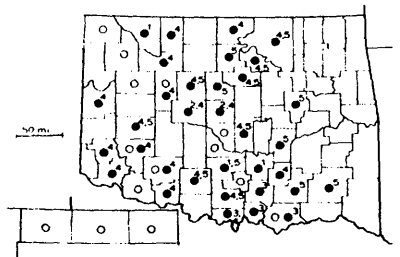


FIGURE 2. Distribution of *Diaptomus sciloides*. Previously reported ● by: 1, Duck, 1937 (1); 2, Ophel, 1950 (17); 3, Sublette, 1953 (6); 4, Kingsbury, 1966 (2); 5, Kingsbury, 1968 (3). Reported in this paper ○.

tributed in the western and central parts of the state but excluded from the eastern counties. Kingsbury (2) did not find the species in the southern part of the state east of Carter, Murray, and Garvin Counties. Her later work plus that of Sublette (6) in Lake Texoma and the record presented in this paper from Bryan County make it clear that the species is, in fact, found in much of the southeastern area.

In Kingsbury's thesis (3), which deals only with calanoids from lakes, she does not report the species in any northwestern county. However, her earlier work and that reported here show that this species is well represented in these counties. It may be that this species is restricted to small bodies of water in the western and northwestern parts of the state, although this suggestion needs verification.

This species has been reported from all states bordering Oklahoma except Arkansas, which coincides with its exclusion from the eastern part of the state and suggests that Oklahoma represents a part of the eastern or southeastern limit of its distribution. This seems unlikely for the species has been reported from Tennessee (7) and Louisiana (8). It may be that the species is excluded from the Ozark Plateau region, but not from the surrounding lowlands.

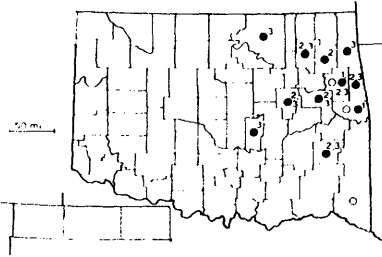


FIGURE 3. Distribution of *Diaptomus reighardi*. Previously reported ● by: 1, Summers, 1961 (18); 2, Kingsbury, 1966 (2); 3, Kingsbury, 1968 (3). Reported in this paper ○.

Diaptomus (*Skistodiaptomus*) *reighardi* Marsh, 1895, (Figure 3) is limited to the eastern part of the state. Kingsbury (2, 3) found it to be restricted to the east-central

counties, but the present work extends this to include McCurtain County in the south-east. As mentioned earlier, Kingsbury remarked on the fact that the distribution of this species seems to complement that of the closely related *D. pallidus*.

D. reighardi has not been reported from any of the states bordering Oklahoma. However, it has been found in Louisiana (9), western Tennessee (10), and southern Illinois (11) and will very possibly be found in Arkansas and Missouri with further collecting. Oklahoma is the farthest west the species has ever been reported, and it seems likely that the eastern part of the state marks part of the western limit of this species.

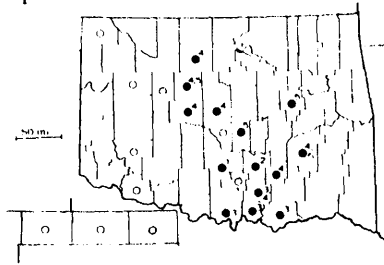


FIGURE 4. Distribution of *Diaptomus clavipes*. Previously reported ● by: 1, Duck, 1937 (1); 2, Wilson, 1941 (19); 3, Sublette, 1953 (6); 4, Kingsbury, 1966 (2); 5, Kingsbury, 1968 (3). Reported in this paper ○.

Diaptomus (*Aglaodiaptomus*) *clavipes* Schacht, 1897, (Figure 4) has been reported previously only from the central part of the state. It is reported here in several western counties, including the Oklahoma panhandle. Apparently the species is generally distributed throughout the central and western areas, although this needs to be verified through further collecting.

D. clavipes has been reported from all the surrounding states except those on the eastern boundary, Arkansas and Missouri. This fits in well with the exclusion of the species from eastern Oklahoma and suggests that the most easterly records reported here mark a part of the eastern limit for this form.

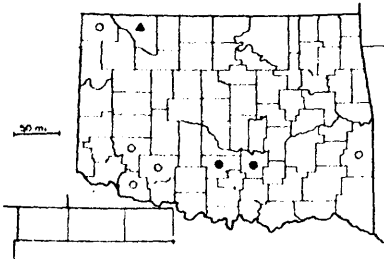


FIGURE 5. Distribution of *Diptomus sanguineus* and *D. saltillinus*. *D. sanguineus* previously reported ● by: 1, Duck, 1937 (1); 2, Wilson, 1941 (19). Reported in this paper ○. *D. saltillinus* previously reported ▲ by: Duck, 1937 (1).

Diptomus (*Onychodiptomus*) *sanguineus* Forbes, 1876, (Figure 5) has been found previously mostly in temporary ponds. Restriction to these habitats would partially explain why the species has been reported only twice before in the state. Most of the previous studies have been on fairly large, permanent bodies of water.

The species is now known to occur in northwestern, southwestern, and southeastern Oklahoma, as well as in the two south-central counties previously reported. However, it is known at present only from a few scattered records and seems to be relatively uncommon in occurrence. Thus, although present indications are that it is quite generally distributed in the state, further collections are needed before any definitive statements can be made.

This form has been reported from only two of the bordering states, Missouri (12) and Kansas (13). It has been reported sporadically throughout the United States, and the absence of reports of its occurrence in other states around Oklahoma probably represents nothing more than a lack of thorough collecting.

Diptomus (*Arctodiptomus*) *saltillinus* Brewer, 1898, (Figure 5) was not found during the present study. It has been reported from the state only once, by Duck (1). It seems to be very sporadic in occurrence and has been found only in the southern Great Plains states, from Nebraska

south, and then most commonly in temporary spring or fall ponds. Further collecting in these environments will probably turn it up again.

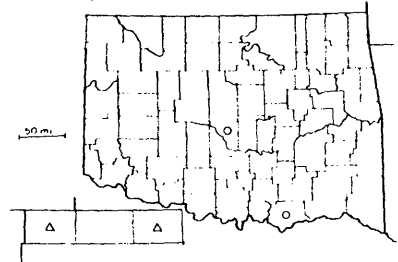


FIGURE 6. Distribution of *Diptomus dorsalis* and *D. albuquerqueensis*. Reported in this paper: *D. dorsalis* ○; *D. albuquerqueensis* △.

Diptomus (*Arctodiptomus*) *dorsalis* Marsh, 1907, (Figure 6) is reported here for the first time from Oklahoma. It has been found in samples from two locations, one in Bryan County and one in Cleveland County. Both collection sites are ponds used primarily for raising fish. Possibly this form has been recently introduced to the state in connection with fisheries work. It is impossible to say anything concerning the distribution of this species in the state except that it seems to be relatively rare.

Most previous records of *D. dorsalis* have been from either Florida or Louisiana, and it has been assumed to be limited to states around the Gulf of Mexico (4). Cole (5) expanded the known distribution greatly when he found the species in Arizona. The Arizona records plus those in this paper show that this species is probably widespread in the southern part of the United States. It may be quite rare in the western section of its range. The record given here for Cleveland County represents the farthest north this species has been found and shows it can live in areas that experience quite cold winters.

Diptomus (*Mastigodiptomus*) *albuquerqueensis* Herrick, 1895, (Figure 6) is also reported here for the first time in Oklahoma. It was found in only two of the counties of the panhandle, Cimarron and Beaver. It

would appear that its distribution is limited to the extreme western counties of the state, possibly only to those in the panhandle.

Wilson (4) listed the area of distribution of this form as the Rocky Mountain states. Previous records have not all been from mountainous areas; several previous authors have found it in the high Great Plains areas of Colorado (14) and New Mexico (15). The locations in this paper are the farthest east the animal has been found in the United States but are at altitudes comparable to those of previous records from eastern Colorado and New Mexico. Since it is found on the high plains as well as in mountain areas, it is very likely that further collecting will extend its known range into western Kansas and Texas.

Diaptomus (*Arctodiaptomus*) *floridanus* Marsh, 1929; *Diaptomus* (*Skistodiaptomus*) *mississippiensis* Marsh, 1894; and *Diaptomus* (*Leptodiaptomus*) *trybomi* Lilljeborg, 1889. These three species have been reported from the state from only two adjacent ponds in Hughes County by Keeton (16). He did not find any of the species that other authors have reported from the state. None of his species have ever been reported by anyone else in Oklahoma or even in a state bordering Oklahoma. A consideration of these facts raises grave doubts as to the validity of his identifications. Thus, it seems prudent to consider Keeton's records of these three species as erroneous until they are verified by some other investigator.

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