

of reduction was less for eggs which were flooded. Cumulative effects of temperatures at 32° F. or lower also had detrimental effects on hatch of conditioned eggs, whereas cumulative long term exposures at 20° F. were critical. However, short term exposures at 20° F. of both conditioned and unconditioned eggs under laboratory test conditions were not detrimental to egg viability, nor did icing conditions, similar to those encountered in the field, have a significant effect on egg viability.

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#### References Cited

- BAR-ZEEV, M. 1957. The effect of extreme temperatures on different stages of *Aedes aegypti* (L.). Bull. Ent. Res. 48:593-599.
- CHRISTOPHERS, S. R. 1960. *Aedes aegypti* (L.). The Yellow Fever Mosquito. Cambridge Univ. Press, 739 pp.
- HATCHETT, S. P. 1946. Winter survival of *Aedes aegypti* (L.) in Houston, Texas. Pub. Hlth. Rep. 61:1234-1244.
- MEOLA, R. 1964. The influence of temperature and humidity on embryonic longevity in *Aedes aegypti*. Ann. of Ent. Soc. Am. 57:468-472.
- ROZEBOOM, L. E. 1939. The overwintering of *Aedes aegypti* (L.) in Stillwater, Oklahoma. Proc. Okla. Acad. Sci. 19:81-82.
- WILTON, D. P., CLINE, R. E. and FAY, R. W. 1968. Two formulations effective in the laboratory as ovicides for *Aedes aegypti* (L.). Mosq. News 28(4):602-606.

## DISTRIBUTIONAL RECORDS OF MOSQUITOES ON THE SOUTHERN HIGH PLAINS WITH A CHECKLIST OF SPECIES FROM NEW MEXICO AND TEXAS

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One of the earliest works concerning the mosquito fauna of New Mexico was that of Theobald (1903) in which he described a new species. This was followed by the monograph of Dyar (1922) entitled "The Mosquitoes of the United States," which listed eight species for New Mexico.

An interest in the problem of malaria resulted in surveys of the anophelines of New Mexico and a list of the known mosquitoes of the state. (Barber, *et al.*, 1929; Barber and Forbrich, 1933, and Barber, 1939).

Ferguson and McNeel (1954) published a list of thirty mosquitoes known from New Mexico. With the omission of *Culex apicalis* Adams and *Aedes campestris* Dyar and Knab, these are the records given by Carpenter and LaCasse (1955). Possibly *A. campestris* was omitted because it was listed as a queried species in earlier works (Barber, 1939; Ferguson and McNeel, 1954).

Hill, Smittle and Philips (1958) recorded thirty-three species of mosquitoes from New Mexico but actually added five new records to the Ferguson and McNeel list as they omitted *Orthopodomyia signifera* (Coquillett) and the queried *A. campestris*.

Recent reports by Miller (1962) and Miller, *et al.*, (1964) listed *Orthopodomyia alba* Baker from the Rio Grande Valley, *Aedes thelcter* Dyar from the Pecos Valley and *A. pullatus* (Coq.) from Colfax County, New Mexico, as well as additional distributions of other species previously reported. Miller (1965) keyed the known larvae without giving localities.

Zavortink (1968) included a list of known records of the genus *Orthopodomyia* while Neilsen, *et al.* (1968) included known distribution of those species occurring in tree holes in New Mexico.

The nomenclature used in this paper is after Stone (1965).

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### DISCUSSION

In the present study New Jersey light trap samples from Tucumcari and Portales, New Mexico, and from Lubbock, Texas, were examined as background material for a research project on the limnology of playa lakes on the Southern High Plains (Sublette and Sublette, 1967).

Some 13,543 specimens were examined from 26 dates ranging from September 10, 1963, to November 9, 1964. Seventeen species were identified. The seasonal distribution and total number of the species are listed in Table 1.

The most abundant species taken was *Aedes vexans* Meigen which constituted 40 percent of the total number of specimens examined and occurred in every sample taken.

*Culex tarsalis* Coquillett was the second

most common species constituting 34 percent of the total catch and was taken at all sampling dates. This mosquito is of particular interest since both Hess and Hayes (1967) and Reeves (1968) have shown a direct relationship between populations of vectors of western equine encephalitis and disease transmission. The relative abundance and seasonal distribution of this species is shown in Figure 1.

The third most abundant species taken was *Culiseta inornata* Williston which comprised 8 percent of the individuals identified. This mosquito was generally taken in the spring or fall. It was taken quite regularly in May and June and again in September, October and November (see Table 1) and only occasionally in July.

The relative abundance of the remaining species of mosquitoes taken is as follows: *Culex pipiens quinquefasciatus* Say, 5 percent; *Psorophora signipennis* (Coquillett), 4 percent; *Aedes nigromaculis* Ludlow, 4 percent; *Culex erythrothorax* Dyar, 2 percent; *Culex peus* Speiser, 1 percent; *Aedes dorsalis* (Meigen), *A. campestris* Dyar and Knab, *Uranotaenia syntheta* Dyar and Shannon, *Psorophora confinnis* (Lynch-Arribálzaga), *P. ciliata* Fabricius,

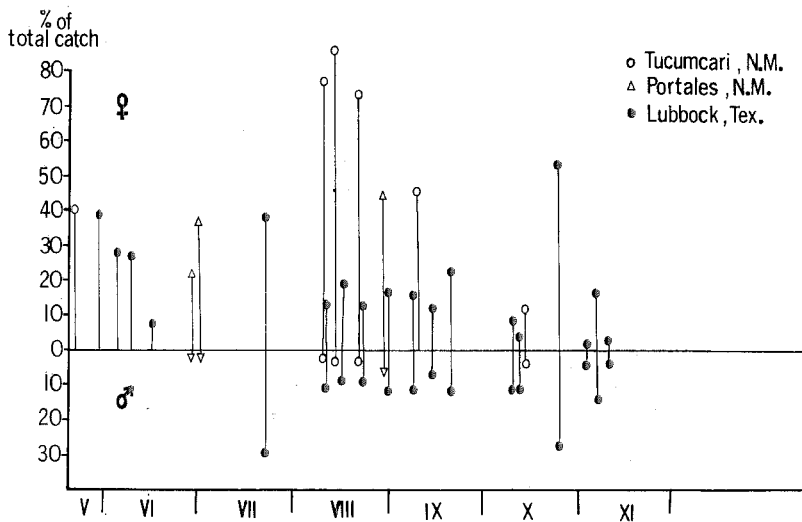


FIG. 1.—Relative abundance and seasonal distribution of *Culex tarsalis* Coquillett in the 3 areas sampled.

TABLE I.—Seasonal distribution and total numbers of mosquitoes collected on the high plains.

Species	Date and Locality	
	Date	Locality
<i>Aedes vexans</i>	L 9-XI-64	X
<i>A. nigromaculis</i>	L 3-XI-64	X X X
<i>A. dorsalis</i>	L 12-X-2-XI-64	X X X
<i>A. campestris</i>	L 26-X-64	X X X
<i>Culex tarsalis</i>	T 14-X-63	X X X X X X X
<i>C. erythrothorax</i>	L 12-X-64	X X X X X
<i>C. peus</i>	L 5-19-X-64	X X X X X X X
<i>C. pipiens quinquefasciatus</i>	L 21-XI-64	X X X X X X X
<i>Psorophora confinis</i>	T 14-X-64	X X X X X X X
<i>P. signipennis</i>	T 10-IX-63	X X X X X X X
<i>P. ciliata</i>	L 8-IX-64	X X X X X X X
<i>Culiseta inornata</i>	L 1-X-64	X X X X X X X
<i>Uranotaenia anhydrosyntheta</i>	P 30-VIII-64	X
<i>Anopheles p. pseudopunctipennis</i>	L 24-VIII-64	X X X X X X X
<i>A. pseudopunctipennis franciscanus</i>	L 21-VIII-64	X X X X X X X
<i>A. punctipennis</i>	L 17-VIII-64	X X X X X X X
<i>A. freeborni</i>	T 13-VIII-64	X X X X X X X
	T 10-VIII-64	X X X X X X X
	L 10-VIII-64	X X X X X X X
	L 20-27-VIII-64	X X X X X X X
	P 2-VII-64	X X X X X X X
	P 1-VII-64	X X X X X X X
	T 15-19-VI-64	X X X X X X X
	T 8-11-VI-64	X X X X X X X
	T 1-5-VI-64	X X X X X X X
	T 7-V-29-VI-64	X X X X X X X
	T 15-22-V-64	X X X X X X X
Total Numbers	All Dates	
5529		
572		
86		
3		
4634		
279		
115		
627		
2		
596		
1		
1025		
16		
3		
49		
5		
1		

L—Lubbock, Texas.  
 T—Tucumcari, New Mexico.  
 P—Portales, New Mexico.

TABLE 2.—Species of Mosquitoes Occurring in New Mexico

Note: Numbers refer to the bibliographic citation of the paper in which the species is listed; \* denotes species reported from the high plains of New Mexico; S refers to the present study.

*Anopheles*

- crucians* Wiedemann (4, 5, 7, 10, 17)
- barberi* Coquillett (19)
- \* *freeborni* Aitken (1, 2, 3, 4, 5, 7, 10, 11, 17, S)
- \* *pseudopunctipennis franciscanus* McCracken (5, 7, 10, 17, S)
- \* *pseudopunctipennis pseudopunctipennis* Theobald (1, 2, 3, 4, 5, 7, 8, 10, 11, 17)
- \* *punctipennis* (Say) (3, 4, 5, 7, 10, 12, 17)

*Uranotaenia*

- \* *anhydor syntheta* Dyar and Shannon (4, 5, 7, 10, 17, S)
- \* *sapphirina* (Osten Sacken) (5, 7, 10, 17)

*Orthopodomyia*

- alba* Baker (7, 16, 17, 19, 25)
- kummi* Edwards (19)
- signifera* (Coquillett) (5, 7, 17, 19, 25)

*Psorophora*

- \* *ciliata* (Fabricius) (10, 17, 18, 24, S)
- \* *cyanescens* (Coquillett) (5, 7, 10, 14, 17, 18)
- confinis* (Lynch Arribáizaga) (5, 7, 10, 17, 18)
- \* *discolor* (Coquillett) (5, 7, 10, 17, 18)
- \* *signipennis* (Coquillett) (4, 5, 6, 7, 10, 17, 18, S)

*Aedes*

- aegypti* (Linnaeus) (4, 5, 7, 10, 17, 23)
- \* *atropalpus* (Coquillett) (4, 5, 6, 7, 10, 17)
- \* *campestris* Dyar and Knab (4, 7, S)
- canadensis canadensis* (Theobald) (5, 7, 10, 17)
- \* *dorsalis* (Meigen) (4, 5, 6, 7, 10, 17, 18, S)
- hendersoni* Cockerell (19)
- incredulus* Dyar (5, 6, 7, 10, 13, 15, 17)
- melanimon* Dyar (10)
- \* *mitchellae* (Dyar) (5, 7, 10, 17)
- monticola* Belkin and McDonald (19)
- muelleri* Dyar (19)
- \* *nigromaculis* (Ludlow) (5, 6, 7, 10, 17, S)
- pullatus* (Coquillett) (17, 18)
- sollicitans* (Walker) (4, 5, 7, 10, 17, 18)
- spenceri idahoensis* (Theobald) (17)
- tacniorhynchus* (Wiedemann) (10, 17)
- thelcter* Dyar (17, 18)
- \* *trivittatus* (Coquillett) (5, 6, 7, 10, 17)
- \* *vexans* (Meigen) (4, 5, 6, 7, 10, 17, 18, S)
- zoosophus* Dyar and Knab (10, 17)

*Culiseta*

- \* *incidens* (Thomson) (4, 5, 6, 7, 10, 17)
- \* *inornata* (Williston) (4, 5, 6, 7, 10, 17, S)

*Culex*

- apicalis* Adams (4, 7, 10, 17)
- \* *erythrothorax* Dyar (17, S)
- \* *peus* Speiser [17 (as *stigmatosoma* Dyar), S]
- \* *pipiens quinquefasciatus* Say (4, 5, 7, 10, 17, S)
- restuans* Theobald (5, 7, 10, 17)
- \* *salinarius* Coquillett (4, 5, 7, 10, 11, 17)
- \* *tarsalis* Coquillett (4, 5, 7, 10, 17, 21, S)
- \* *thriambus* Dyar (10, 17)

TABLE 3.—Species of mosquitoes occurring on the High Plains of Texas

Note: This table was prepared, for the most part, from data taken from Hill, Smittle and Philips (1958). The dagger (†) indicates records from the present study.

*Anopheles*

- crucians* Wiedemann
- † *freeborni* Aitken
- † *pseudopunctipennis franciscanus* McCracken
- † *pseudopunctipennis pseudopunctipennis* (Say)
- † *punctipennis* (Say)

*Uranotaenia anhydor syntheta* Dyar and Shannon*Psorophora*

- ciliata* (Fabricius)
- † *confinis* (Lynch Arribáizaga)
- cyanescens* (Coquillett)
- discolor* (Coquillett)
- † *signipennis* (Coquillett)

*Aedes*

- atropalpus* (Coquillett)
- † *dorsalis* (Meigen)
- mittellae* (Dyar)
- † *nigromaculis* (Ludlow)
- sollicitans* (Walker)
- thelcter* Dyar
- triseriatus* (Say)
- † *vexans* (Meigen)

*Culiseta*

- incidens* (Thomson)
- † *inornata* (Williston)

*Culex*

- erraticus* (Dyar and Knab)
- erythrothorax* Dyar
- † *peus* Speiser
- † *pipiens quinquefasciatus* Say
- restuans* Theobald
- salinarius* Coquillett
- † *tarsalis* Coquillett
- thriambus* Dyar

*Anopheles punctipennis* Say, *A. pseudopunctipennis franciscanus* McCracken, *A. pseudopunctipennis pseudopunctipennis* Theobald and *A. freeborni* Aitken, less than 1 percent.

Of the 17 species found, 14 are reported for New Mexico and 13 from Texas. Of these, the presence of *Aedes campestris* is confirmed for New Mexico.

*Anopheles pseudopunctipennis franciscanus* is reported from the high plains of Texas for the first time. Previously it has been known in Texas only from El Paso.

The reported mosquito fauna of New Mexico comprises 46 species (see Table 2) and of these 27 are known from the high plains region (Hill, Smittle and Philips, 1958). Two more species, *Aedes increpitus* Dyar and *Culex apicalis* Adams are reported from New Mexico with no locality given.

Twenty-eight species of mosquitoes have been reported by Hill, Smittle and Philips (1958) from the Llano Estacado in Texas (see Table 3).

Two species, *Aedes trivittatus* and *Uranotaenia sapphirina* are found on the

high plains of New Mexico but have not been reported from the high plains of Texas.

The two species which are recorded from New Mexico with no locality data given are found in Texas but not in the high plains region.

*Aedes triseriatus* (Say) and *Culex erraticus* (Dyar and Knab) have been recorded from the high plains of Texas but not from that region in New Mexico. With more intensive collecting it is probable that these species could be found in New Mexico also.

#### Literature Cited

1. AITKEN, T. H. G. 1945. Studies on the anopheline complex of Western North America. Univ. Calif. Publ. Ent. 7:273-364.
2. BARBER, M. A., W. H. W. KOMP and C. H. KING. 1929. Malaria and the malaria danger in certain irrigated regions of the southwestern United States. Pub. Health Rep. 44(22):1300-1315.
3. BARBER, M. A. and LOUIS R. FORBRICH. 1933. Malaria in the irrigated regions of New Mexico. Pub. Health Rep. 48:610-623.
4. BARBER, M. A. 1939. Further observations on the anophelines of New Mexico. Amer. Jour. Trop. Med. 19:345-346.
5. CARPENTER, STANLEY J. and WALTER J. LACASSE. 1955. Mosquitoes of North America (North of Mexico). Univ. Calif. Press, Berkeley and Los Angeles. 360 pp.
6. DYAR, H. G. 1922. The mosquitoes of the United States. U.S. Natl. Mus. Bull. 62:1-119.
7. FERGUSON, F. F. and T. E. MCNEEL. 1954. The mosquitoes of New Mexico. Mosquito News 14:30-31.
8. FREEBORN, S. B. 1949. Anophelines of the Nearctic Region. In Boyd, Malariology, 1:379-398.
9. HESS, A. D. and R. O. HAYES. 1967. Seasonal dynamics of western encephalitis virus. Amer. Jour. Med. Sci. 253:333-348.
10. HILL, SAMUEL O., BURRELL J. SMITTLE and FLOURNOY M. PHILIPS. 1958. Distribution of mosquitoes in the Fourth U.S. Army area. Fourth U.S. Army Medical Laboratory, Fort Sam Houston, Texas, 155 pp.
11. HOFF, C. C. and H. CAMPBELL. 1957. A new artificial breeding place for mosquitoes in New Mexico. Mosquito News 17:314-315.
12. KING, W. V. and G. H. BRADLEY. 1941. Distribution of the Nearctic species of *Anopheles*. Amer. Assoc. Adv. Pub. 15:71-78.
13. MATHESON, ROBERT. 1944. A handbook of the mosquitoes of North America. Ithaca, N.Y.: Comstock Pub. Assoc., 314 pp.
14. MCNEEL, T. E. and F. F. FERGUSON. 1952. *Psorophora cyaneescens* (Coquillett) new to the mosquito fauna of New Mexico. Mosquito News 12:241.
15. MCNEEL, T. E. and F. F. FERGUSON. 1954. Mosquito distribution and abundance in the Arkansas-White-Red River Basins. Pub. Health Rep. 69:385-390.
16. MILLER, BRYAN E. 1962. The occurrence of *Orthopodomyia alba* Baker in New Mexico. Mosquito News 22(3):309-310.
17. MILLER, BRYAN E. 1965. A key to the mosquito larvae of New Mexico. N. Mex. Dept. of Public Health, Publ. No. EF-VC-3, 8 pp.
18. MILLER, BRYAN E., J. M. DOLL, and J. R. WHEELER. 1964. New records of New Mexico mosquitoes. Mosquito News 24:459.
19. NEILSEN, LEWIS T., JAY H. LINAM, J. HAL ARNELL and THOMAS J. ZAVORTINK. 1968. Distributional and biological notes on the tree hole mosquitoes of the Western United States. Mosquito News 28:361-365.
20. REEVES, WILLIAM C. 1968. A review of developments associated with the control of western equine and St. Louis encephalitis in California during 1967. Proc. and Papers 36th Ann. Conf. Calif. Mosquito Control. Assn. 65-70.
21. SUBLETTE, JAMES E. and MARY F. SUBLETTE. 1967. The limnology of playa lakes on the Llano Estacado, New Mexico and Texas. Southwestern Nat. 12:369-406.
22. STONE, ALAN. 1965. Family Culicidae. In: A Catalog of the Diptera of America North of Mexico. Agri. Handb. No. 276:105-120.
23. THEOBALD, F. V. 1903. Notes of Culicidae and their larvae from Pecos, New Mexico, and description of a new *Grahamia*. Canad. Ent. 35:311-316.
24. U.S. Public Health Service. 1955. Arkansas-White-Red River Basins, Part II, section 10, Mosquito control and allied problems (non viso, Hill, Smittle, and Philips, 1958).
25. ZAVORTINK, THOMAS J. 1968. Mosquito Studies VIII. A prodrôme of the genus *Orthopodomyia*. Contr. Amer. Ent. Inst. 3:1-221.