

METHODS USED IN UTAH FOR SAMPLING TABANID POPULATIONS

A. BRUCE KNUDSEN AND DON M. REES

Center for Environmental Biology, University of Utah, Salt Lake City, Utah

In Utah, vast marshlands extend for approximately 510 square miles along the southeastern shore of the Great Salt Lake (Rees and Andersen, 1966). Most of these marshes were developed as waterfowl habitat by various interested groups. The development of these marshes has increased the habitat for mosquitoes, gnats, deer flies and horse flies. These insects are at times extremely annoying to livestock, stockmen, sportsmen and people in adjacent suburban areas.

This paper describes and evaluates the methods used in collecting deer flies and horse flies on these marshes, and is part of a study of these insects which is now in progress.¹ The study was begun in 1964.²

Knudsen and Rees (1967) determined that a gravid deer fly, *Chrysops discalis* Williston, selects an oviposition site on vegetation or any fixed object located above water. On such an object she lays approximately 400 eggs. Two to five days later the eggs hatch and the larvae fall into the water where they live in the bottom mud until the following season. During the last instar the larvae migrate from the water-covered habitat to the surface of moist soil near the shoreline where they pupate. If the water is removed, the larvae pupate on the surface of the bottom mud.

The following methods were used to collect horse flies and deer flies during this study.

COLLECTION OF LARVAE AND PUPAE

MOIST AREAS. During the 1964 and 1966 seasons, larvae were obtained from areas from which the surface water had receded. The moist soil, exposed as the water receded, was examined for immature tabanids by removing soil samples. Where the soil surface had dried and cracked, the resulting irregular clods were removed and examined. When the clods were broken, tunnels similar to those made by burrowing worms were often encountered. Larvae and pupae were readily found by following these burrows.

For examination, soil samples one-tenth of a square meter in surface area and 4 inches in depth were taken at 5-foot intervals. The sampling started at vegetation, the possible oviposition site, and extended onto the dry pond bottom. The number of immature specimens found, the depth at which they were located, and the distance from emergent vegetation were determined.

DRYING CHAMBER. Teskey (1962) reported that tabanid larvae can be obtained by drying vegetative matter taken from washed sod samples. During the 1967 season this method was modified and used as follows. Unwashed samples one-tenth of a square meter in surface area and 8 inches deep were taken semiweekly from quadrants along the margins of water impoundments. These samples were taken at 5-foot intervals on transects starting from emergent vegetation, considered as the potential oviposition site, thence to the water edge. The samples were placed into 2-gallon buckets, each numbered to correspond to the site at which the sample was obtained.

At the laboratory the samples were placed in a drying chamber. The chamber

¹ This project is supported in part by funds provided by Research Grant No. 12-14-100-8070 (33), Agricultural Research Service, Entomology Research Division, United States Department of Agriculture.

² Supported by a National Science Foundation Undergraduate Fellowship.

was 3'4" wide by 4'6" long by 2'6" high. The frame and top were made of wood and the inside was covered with black plastic material. The bottom of the chamber, constructed of 1/2"-square galvanized screen, was elevated 12" above the floor and was divided by wood strips into 12-foot-square compartments. Each compartment contained one-half of a soil sample. Six 200-watt incandescent light bulbs provided heat for drying the soil in order to force the larvae from the sample. Plastic funnels beneath each compartment channeled the larvae into pie tins 10" in diameter which had been placed on the floor beneath each compartment. The tins were filled with 1 inch of mud and water to retain the immatures. Counts of the larvae in each tin were made daily and the length of each larva measured in millimeters.

COLLECTION OF ADULTS

UTILITY INSECT NET. A standard utility insect net was used for collecting adult tabanids during the 1964 and 1966 seasons. Sampling was conducted to determine species composition, relative numbers, adult resting sites, and whether a correlation existed between adult activity and air temperatures.

Sampling consisted of 100 sweeps above vegetation at shoulder height. The flies collected were placed in cyanide killing jars, identified, and counted.

EMERGENCE TRAP. During the 1966 season, emergence traps consisting of clay flower pots 6" in diameter were inverted on transects at 5-foot intervals. In this position, plastic vials were attached to the holes located at the narrow end of the pots. The purpose of these traps was to cover potential emergence sites and capture the flies in the vials as they emerged.

The transects extended from slightly elevated pond margins several hundred feet onto the moist pond bottom. Weekly examinations of the traps were made and the adult tabanids removed.

MALAISE TRAPS. During the 1966-67 seasons, a Malaise insect trap, as described by Juillet (1963), was employed in one locality to collect insects. From this trap tabanids were periodically removed for study. "Vapona insecticide strips," produced by Shell Chemical Company, were used as the insecticide in the collecting chamber. During the 1966 season an attractant was used with the trap, similar to that described by Olkowski and Andersen (1967). The attractant was CO₂ produced from 10-15 pounds of dry ice placed in a styrofoam chamber at the base of the trap. The CO₂ was used two days a week; during the remainder of the week no attractant was used.

STICKEM SPECIAL TRAP. Wall and Doane (1960) made weekly collections of tabanids using "Tanglefoot," a slow-drying adhesive substance, applied to masonite boards. A similar material, "Stickem Special," manufactured by Mitchell and Pelton Company, Emeryville, California, was used during the 1967 season to trap flying tabanids. The traps consisted of 12" squares of quarter-inch plywood nailed vertically on both sides of 24"-long stakes. The stakes were driven into the ground until the bottoms of the traps were approximately 12" above the ground. The sticky material was spread on the squares to a thickness of one-sixteenth of an inch.

Fourteen traps, all facing north and south, were placed in seven areas. Within each area traps were established in two predominant vegetation zones: saltgrass, *Distichlis stricta* (Torr.) Rybd., and greasewood, *Sarcobatus vermiculatus* (Hook) Torr. This was done to determine if a correlation existed between type of vegetation and adult activity. Adult tabanids which became entangled in the sticky material were identified, counted, and removed with forceps regularly three times each week. If left for longer periods, the flies became dry and difficult to remove. The Stickem was reapplied semi-weekly.

RESULTS AND EVALUATION OF SAMPLING METHODS

LARVAL AND PUPAL COLLECTIONS. In 1966, 200 immatures were collected by examining soil obtained from the bottoms of ponds from which the water had been removed. The greatest concentrations of larvae and pupae were located in the immediate vicinity of saltgrass and within a radius of 30 feet. The immatures were located in the soil at depths ranging from $\frac{1}{4}$ " to 4". The average time required to examine each sample was approximately one-half hour.

In 1967, 409 *Chrysops discalis* larvae were obtained over a three-month period by drying mud samples in the drying chamber. The larvae were identified by laboratory rearing. The number of larvae obtained from a single sample ranged from 0 to 14. The larvae averaged 2.76 per one-tenth of a square meter sample, or 27.6 per square meter. The greatest concentrations of larvae were obtained from samples taken between 5 and 15 feet and from as far as 35 feet from potential oviposition sites (see Fig. 1).

hours. The average time required to obtain and place each sample in the chamber was approximately 10 minutes.

COLLECTION OF ADULTS

During 1964 and 1966, 2,000 adult tabanids consisting of eight species were collected with a utility insect net. These flies, as determined by Dr. C. B. Philip,³ are listed in order of their relative abundance: *Chrysops discalis* Will.; *Hybomitra sonomensis* Osten Sacken; *Tabanus punctifer* O. S.; *Tabanus productus* Hine; *Tabanus similis* Macquart; *Chrysops aestuans* van der Wulp; *Chrysops fulvaster* O. S.; and *Atylotus incisuralis* (Macq.).

The number of adult flies collected per 100 sweeps averaged 12.19. The tabanids, primarily *C. discalis*, were collected at temperatures ranging from 62° to 100° F. The greatest activity observed occurred between 88° and 98° F. See Fig. 2.

The use of clay flower pots as emergence traps was considered ineffective as only 23 *C. discalis* adults were captured in 188 traps during the 1966 season. Adult emergence, as determined by these traps,

1967 SEASON

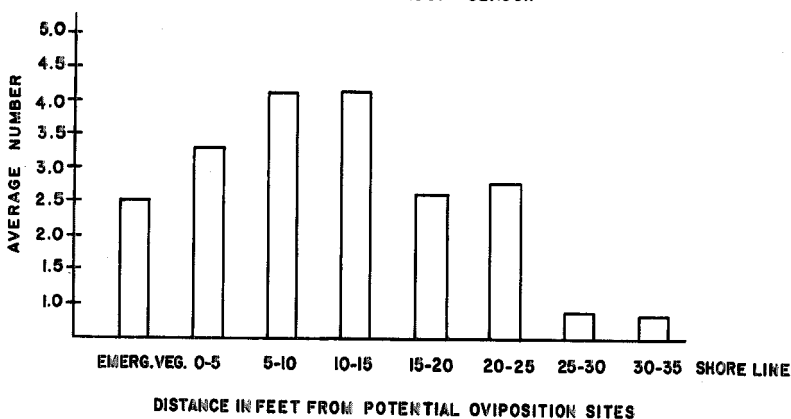


FIG. 1.—Average number of *Chrysops discalis* larvae obtained by drying chamber from $\frac{1}{10}$ square meter soil sample.

Larval sizes ranged from 2 to 22 mm. in length. The average size was 10.12 mm. Very few pupae were obtained. The average time for chamber drying was 48

³ C. B. Philip, Principal Medical Entomologist, National Institute of Allergy and Infectious Disease, Rocky Mountain Laboratory, Hamilton, Montana.

was within a radius of 55 feet of emergent vegetation, with the greatest concentration nearest the vegetation.

During the 1966 season 39 tabanids consisting of six species were collected in a Malaise insect trap; no attractant was used. During the 1967 season, using CO₂ as an attractant, 297 tabanids comprising seven species were collected, averaging 15.63 flies per sample. During the same weekly periods when no attractment was used, 13 adults were collected comprising five species. The "Vapona insecticide strip" was considered ineffective on tabanids.

The adhesive material, "Stickem Special," was used for a 3-month period during 1967. Six species, totaling 8,777 adult tabanids, were collected. Flies counted from a single trap over a 48-hour period ranged from zero to 251. The daily single-trap average from the combined vegetative types was 17.99 flies, while the average from the greasewood traps was 26.13, and 11.51 in saltgrass. See Fig. 3.

This trap was highly effective for the purpose of this study as it was easy to operate and more adult tabanids were collected than with other methods used. The adhesive material's effectiveness was reduced following occasional rains, and re-application was necessary. Occasionally it was difficult to remove and identify adult tabanids due to the large numbers of gnats and other flies which became entrapped. When an excessive amount of stickem was applied, the flies were engulfed and were difficult to remove and identify.

CONCLUSIONS

1. The examining of moist soil samples by hand to obtain tabanid larvae and pupae is fairly productive but impractical because it is laborious and time-consuming.
2. The drying of mud samples in a heated chamber is the most practical and successful method used during this study to obtain *C. discalis* larvae.

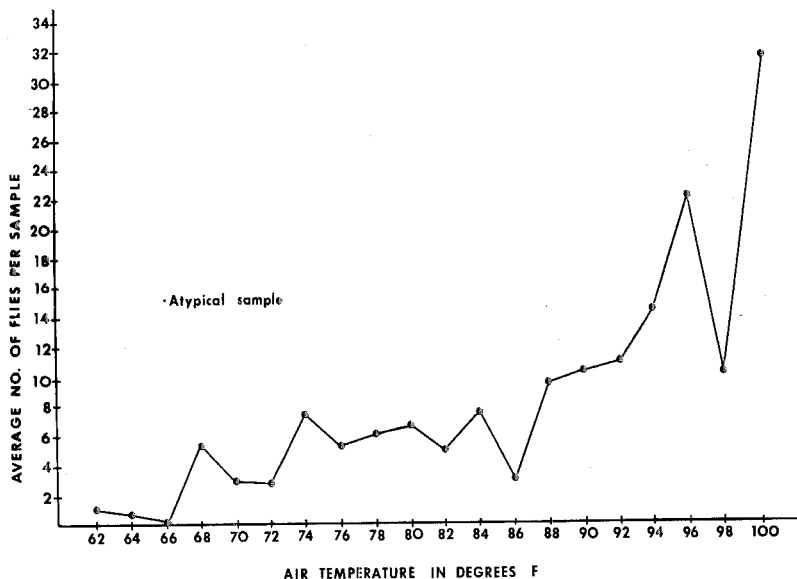


FIG. 2.—The influence of temperature upon the activity of adult *C. discalis* Will. during 1964–1966 as determined by utility net collections.

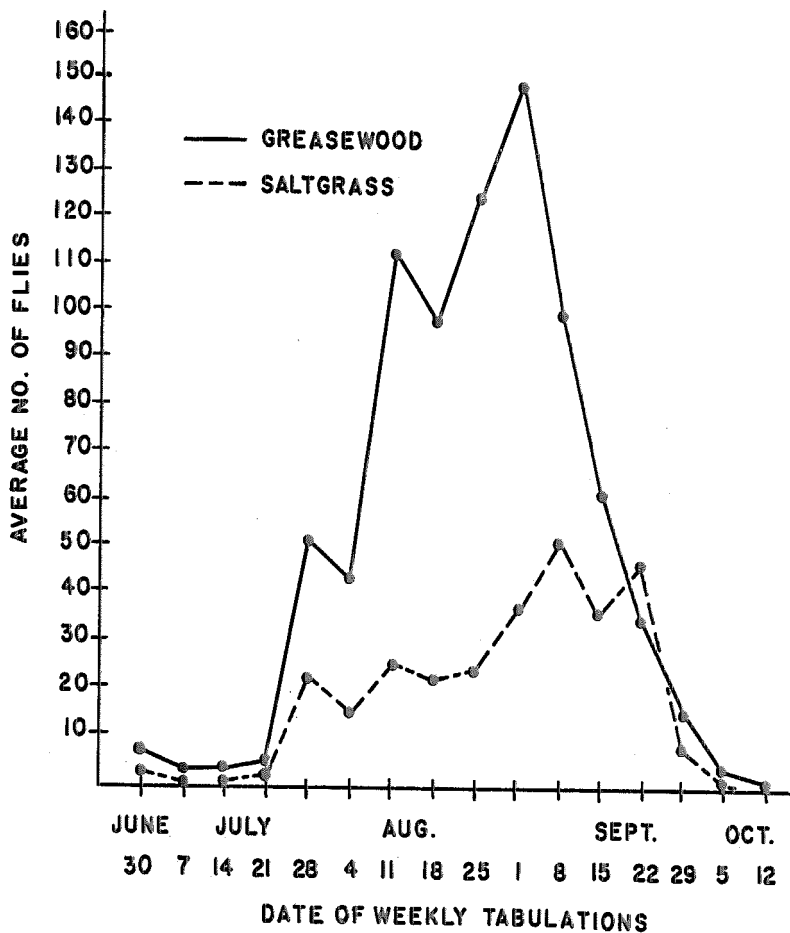


FIG. 3.—Weekly totals of tabanids collected from “stickem special” traps in two types of vegetation, 1967 season.

3. Collecting adult tabanids with a utility insect net requires considerable time and effort but it is very productive during certain seasons when adult flies are abundant, air temperatures high and wind velocity low.

4. The clay flowerpot traps used to capture emerging adult tabanids are ineffective, possibly because of the small ground surface covered and/or due to the repelling effects of heat and humidity which build up in the trap during the day.

5. The Malaise insect trap, used without CO₂ attractant, collects very few tabanid adults compared to the population present in the area. When CO₂ attractant is used, it is fairly effective. However, many flies are attracted but do not enter the trap; others entering the trap do not enter the killing chamber. Others that enter the chamber escape due to the slow action of the insecticide.

6. The “Stickem Special” traps are the most effective method used for collecting

adult tabanids for the purpose of this study. They are not difficult to prepare and service, and are functional at all times when adults are active. The flies are apparently attracted to the trap and upon coming in contact with the stickem rarely escape.

References Cited

JULLIET, J. A. 1963. A comparison of four types of traps used for capturing flying insects. *Canadian J. Zool.* 41(2):219.

KNUDSEN, A. B., and REES, D. M. 1967. Egg laying habits of the deer fly *Chrysops discalis* Williston in marshes bordering the Great Salt Lake, Utah. *Proc. 35th Ann. Calif. Mosq. Cont.*

Assoc. and 23rd Ann. Mtg. Am. Mosq. Cont. Assoc., pp. 103-106.

OLKOWSKI, W., and ANDERSON, J. R. 1967. Relationships between host attack rates and CO₂ baited Malaise trap catches of certain tabanid species. *Proc. 35th Ann. Calif. Mosq. Cont. Assoc. and 23rd Ann. Mtg. Am. Mosq. Cont. Assoc.*, p. 77.

REES, DON M., and ANDERSEN, D. M. 1966. Results of multipurpose water management studies on marshes adjacent to the Great Salt Lake, Utah. *Mosq. News* 26(2):160-168.

TESKEY, H. J. 1962. A method and apparatus for collecting larvae of Tabanidae (Diptera) and other invertebrate inhabitants of wetlands. *Proc. Ent. Soc. Ontario.* 92:204-205.

WALL, W. J., and DOANE, JR., O. W. 1960. A preliminary study of the bloodsucking Diptera on Cape Cod, Massachusetts. *Mosq. News* 20(1): 39-44.