INVESTIGATION OF THE BIOLOGY AND CONTROL OF MIDGES IN FLORIDA (DIPTERA: TENDIPEDIDAE)

A PROGRESS REPORT

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INTRODUCTION. During recent years, midges have become an increasingly serious problem in many sections of peninsular Florida. Since the adults do not bite, transmit disease, nor are they known to take food, it may be difficult to realize the extreme annoyance and economic loss caused by these insects without personal observation of their emergence, which frequently occurs in phenomenal numbers. While species of other genera are present in Polk County, the predominant one is *Glyptotendipes paripes*. Biological data, reported herein, pertain only to this species, unless otherwise indicated.

SUMMARY OF LIFE HISTORY DATA. Oviposition. Oviposition occurs principally at night, while the caged females are resting on the water's surface, for deposition of the egg masses. The number of eggs comprising a mass varies considerably. They are encapsulated in a gelatinous substance, which apparently serves as the initial food of the newly hatched larvae. Being heavier than water, the egg masses sink to the bottom, where hatching occurs in approximately two to seven days, depending on the temperature of the water.

Larvae. Following initial feeding within the gelatinous material, the very small larvae leave the mass and burrow into the lake or river bottom. The burrow is then lined with silk-like threads, secreted by the larva, to join together particles of sand or other bottom material to form a tube-like structure, open at both ends, through which the water is circulated by rapid undulatory movements. The tubes are fashioned in a general "U" shape, only the tips protruding slightly above the lake bottom. Thus, the larvae live embedded in the lake bottom and are apparently provided a high degree of protection from fish predation.

FEEDING TECHHIQUE. A unique feeding technique is employed by the larvae, utilizing a net or filter of silk threads spun across the inside of the tube, which collects suspended food material carried into the tube by larval undulations. After forming the net, which requires only a matter of seconds, the larva reverses its direction within the tube and undulates its body for several minutes. Afterwards, the larva again turns around to consume the food retained by the net, which is then reconstructed for repetition of this routine. These undulating movements, which involve a considerable expenditure of energy, concurrently enhance oxygenation of the gills, through which oxygen is obtained directly from the water. Undulations and feeding are continuous except at low temperatures.

Bottom samples taken with an Ekman dredge indicate a marked heterogeneous larval population and all instars may be taken virtually throughout the year in heavily infested lakes. There is little uniformity in distribution of the larvae, which may be found in most areas of a lake. Bottom samples have yielded densities ranging up to 1436 larvae per square foot.

The duration of the larval stage may vary considerably, depending on conditions of food and temperature. In addition, some variation occurs between individuals which hatch simultaneously. Under favorable conditions, this stage may be completed in approximately three

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weeks or extended up to several months, under adverse conditions. Advanced instars are blood-red in color and attain a length of approximately three-quarters of an inch at maturity.

Larvae have been collected at depths ranging from less than one inch to more than thirty feet. This species is usually found in sand or a mixture of sand and other bottom material, although certain other species of *Tendipes* are most frequently taken in muck areas. Lakes in the study area are slightly alkaline and no significant difference in pH was noted between heavy and weak breeding lakes.

Reared larvae have been observed, on occasion, to feed outside the tubes, but apparently this is limited largely to situations where their food requirements are not being fully satisfied.

PUPAE. Transformation to the pupal stage occurs within the larval tube, and is usually completed within 72 hours at favorable temperatures. The pupae leave the tubes some hours prior to ascending to the surface, where the adults emerge and are almost immediately prepared to fly.

ADULTS. Regardless of which part of the lake emergence occurs, flight is generally with the wind and the adults evidence a strong attraction to most light sources. Following an emergence, the water or lee shore may be conspicuously covered with large numbers of pupal casts.

EMERGENCE. Emergence usually occurs at night and is most intense during the early part of the evening. During the colder months from about December through February, emergence is usually greatly minimized. Heavy emergence may result in a virtual blanketing of the down-wind shore, lawns, shrubs and structures near the shore, and illuminated buildings are especially attractive to the adults, which may enter through quite small openings.

MATING. Mating occurs principally, though not exclusively, during the night of emergence and the bulk of oviposition is apparently accomplished during the second or third nights, after which the females die. During the day, adults are sedentary unless disturbed, resting rather quiescently on vegetation, structures and other surfaces.

LONGEVITY. Longevity of the adults is influenced by temperature. During the summer, adults live only a few days, which may be extended by low temperatures to approximately one week. While the adults are not known to feed, there are indications water may be consumed.

DESCRIPTION. The adults of *G. paripes* are dark with clear wings and although they have a mosquito-like appearance, they lack the proboscis and characteristic wing scales of mosquitoes. Males are readily recognized by their plumose antennae. The body length of the females approximate one-quarter inch and the males about five-sixteenths inch in length. Adults of *Tendipes spp.* are somewhat larger. When disturbed or otherwise active, they emanate a distinct wing-beat "hum."

DISPERSAL. While extreme annoyance is usually confined to areas proximate to the shore, dispersal in relatively small and diminishing numbers may occur up to at least one mile from their source.

PREDATORS. Known predators of midges include fish, birds, certain predaceous insects and spiders. Many species of fish feed to some extent on the various forms of midges, when available to them. The principal limiting factor in midge predation by fish appears to be in the high degree of protection provided the larvae by their unique tube dwellings embedded in the lake bottom. Under conditions favorable for the development of midges in large numbers, it appears unlikely that fish alone can provide effective control.

FACTORS CONDUCIVE TO MIDGE PRODUCTION. LARVAL FOOD. Of the nearly one hundred lakes in the Winter Haven area, some sixteen are inter-connected by canals navigable by small craft. These are referred to as the Chain-O-Lakes, encompassing over four thousand acres. The vast majority of these lakes are heavy breeders of midges. Most other lakes in the area are "weak" or relatively non-breeders of these insects. The latter are generally clear and evidence a very low, or absence of, plankton turbidity. The critical difference between heavy and weak breeding lakes, under otherwise favorable conditions, appears to be in the fertility of the lake and quantity of larval food.

Dissection and examination of the intestinal tract contents of midge larvae indicated that the identifiable food material could be collectively termed plankton, principally algae and to some extent protozoa. The balance of the material was considered organic detritus.

In addition to natural organic matter present in, or that being washed into the lakes, other sources of nutrients, certain of which may be of much greater importance in the production of larval food, include domestic sewage either treated or untreated, organic industrial wastes from canneries, dairies, etc., leaching by rainfall of fertilizer following agricultural and domestic use, and herbiciding activities such as hyacinth control. From a standpoint of fish production, these insects can be considered beneficial and their presence in large numbers is indicative of a fertile and productive body of water.

Control. Adulticiding techniques have provided temporary relief from adult annoyance in localized areas. Either thermally produced aerosols of a DDT-oil solution or BHC dusts have been used with varying degrees of success.

Periodic larviciding has been employed extensively in many lakes in Polk County since the spring of 1953. Only suspensions of wettable powders have been used, since this formulation, among other considerations, is deemed safer from standpoint of fish mortality. Application is accomplished from surface craft by introduction of the toxicant into the turbulent wake of the boat, while travelling in a pattern conducive to maximum distribution of the insecticide.

Initially, suspensions of benzene hexachloride at dosages ranging from approximately 0.16 to 0.20 lb. of gamma isomer per acre provided dramatic temporary control of midge immatures. However, considerable resistance was encountered in all lakes treated, within a period of several months. Thereafter, EPN at dosages of 0.1 to 0.125 lb. of active material per acre has been used periodically in some twenty-four lakes in the county since March of 1954. Each of these has been treated from at least once to as many as fourteen times with this chemical. During the spring of 1955, apparent resistance to EPN was encountered in two lakes most frequently treated with this chemical, eleven and thirteen times respectively. Doubling the usual dosage and a combination of BHC-EPN failed to provide satisfactory control. In addition to other tests, this supply of EPN was subsequently used to treat two other lakes, previously treated two and four times respectively with EPN, and apparent complete larval control was obtained. Subsequent laboratory comparisons utilizing larvae from treated and untreated lakes also indicated physiological resistance to EPN.

Thereafter, a considerable number of insecticides were tested including inorganics, chlorinated hydrocarbons, experimental and commercially available organic phosphorus compounds and certain botanicals. None of these was entirely satisfactory or there were contraindications for use under the conditions which existed from the standpoint of either mammalian toxicity or cost.

Other approaches currently being explored include the possible use, under certain conditions, of a weakly emulsified oil, possessing a specific gravity greater than water, which enables the oil to settle out on the lake bottom. Pollution control, when feasible, supplemented by algicidal treatments and subsequent heavy stocking with such desirable bottom-feeding fish as bluegill bream are also being explored.

Relatively large light-traps, equipped with a 20 watt fluorescent blacklight, have provided an encouraging degree of protection to small areas. The principal limiting factor of this technique is accelerated wind velocity, the deterring effects of which can be minimized by judicious location of the traps.

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