

the killing properties in the solution used are to be found in the Diesel oil and kerosene.

(The DDT 1% solution is made up in 50 gallon lots, 15 gallons of Diesel oil, 4 gallons of kerosene, and 2 gallons of DDT 25% concentrate added to 29 gallons of water. Mechanical agitators are used in the tanks of the power sprayers.)

The killing effect of the DDT 1% solution has been fairly good, but a drop in mortality of larvae due to lessening of residual properties of the DDT has been noted.

Decision was made to experiment with a 1% solution of Toxaphene. Applications revealed a "slow" kill, and the use of it in areas daily flushed with water has proved to be unsatisfactory.

SALT MARSH MOSQUITO CONTROL EFFECTED IN SALT POND THROUGH CONSTANT LEVEL FLOODING

In the early Spring of 1953 the Leslie Salt Company dredged a new Salt Pond on the marsh lands of South San Francisco Bay in the area to the rear of Moffett Field. The Salt Company began flooding shortly after the 15th of July. By early August infestation (larval) developed in a portion of the Pond known as the "old Port Channel."

After consultation with the District, the Salt Company decided to continue flooding the Pond (nearly 500 acres in area) but not to put it into operation for a period of one year. This action resulted in a maximum inundation level of water for the balance of the Summer of 1953, and aside from a small amount of marginal emergence—all breeding in the Pond ceased.

INSTALLATION OF SANITARY FACILITIES AT THE DISTRICT GARAGE, INCLUDING SHOWER WITH HOT AND COLD WATER

In the month of October 1953, the City of Palo Alto excavated a trench between its outfall sewer line and the District Garage Building for a distance of approximately 700 feet and installed a sewer line.

At the Garage Building, the services of a licensed plumber were secured to install sanitary facilities including a shower with hot and cold water. The cost of complete installation for this Capital Outlay item will approximate \$1,400.00.

MOSQUITO CONTROL IN MATADERO DISTRICT FOR 1953 SATISFACTORY

In conclusion, in 1953 the over-all picture of mosquito control in the Matadero District has been satisfactory. The general absence of adult mosquitoes (particularly the Salt Marsh species) is credited in part to the excellent control activities carried on by the San Mateo County Mosquito Abatement District (to the north) and the Alameda County Mosquito Abatement District (to the east). Both of these regions profoundly affect the Matadero District due to the direction of the prevailing winds by day and the variable winds by night.

REPORT FROM ALAMEDA COUNTY MOSQUITO ABATEMENT DISTRICT

In 1953 we had a relatively successful year. The mild winter tended to produce an above normal prevalence of *Culex pipiens* and *Culex tarsalis* during the winter months, but the cool summer helped toward a below normal prevalence. Particularly noticed was the very low incidence of *Aedes squamiger* larvae; this species is apparently dying out on our marshes and may become extinct in a few more years. The cemeteries required mist spraying as early as mid-March. The first *Aedes varipalpus* adults

were observed on March 18, but this species was much below normal prevalence, particularly in Alameda and Oakland, as a result of our operations in filling tree holes with a sand-cement mixture. The first *Aedes nigromaculis* larvae appeared in April, but this species has been kept at a low incidence and confined within a few small areas. During the year there were a number of intense local nuisances due to faulty plumbing.

The District budget for 1953-54 is \$123,699 (excluding the Cash Basis Fund) the largest heretofore. Pay increases of about 5% were given to all employees July 1. Because of an appreciable increase in the assessed valuation of the District we were able to reduce the tax rate from 1.4 cents to 1.3 cents.

A new depot was constructed at Pleasanton by our own forces during the winter, to the point of usability, and in May a new Division was activated for Pleasanton Township. We are now (December) in the process of completing this construction. An additional Jeep and pickup truck were purchased for this new division.

Considerable difficulty was experienced in 1953 with the sewage lagoons at the Parks Air Force Base. The Base is now improving these lagoons to minimize the mosquito problem.

Our new policy toward the duck clubs has worked reasonably well. We now require the club operators to control the mosquitoes themselves.

We cooperated with the Camp Fire Girls' executives, and the Bureau of Vector Control, in mosquito abatement measures at Lake Vera in Nevada County. The control campaign was effective.

A major project has been the preparation of a Manager's Manual, setting forth the administrative practices of the District. It comprises over 400 pages of typed matter, but commits to record much of the experience and practice accumulated over the past 23 years by the present Manager, but up to now available only in his head. This Manual should be of considerable assistance to the new Manager, when the present Manager retires about the end of 1954.

SALT MARSH MOSQUITO SURVEY IN THE SAN FRANCISCO BAY AREA 1950-53

By THEODORE AARONS, ASSISTANT MANAGER,
Alameda County Mosquito Abatement District

Since the onset of organized mosquito control activity in the San Francisco Bay Area in 1903, regional workers have maintained the practice of gathering at frequent intervals for the purpose of evaluating their major problems. Natural and man-made changes affecting larval development on the salt marshes have been elaborated on in the many reports concerning mosquito control progress in this area, and accordingly, *Aedes squamiger* (Coq.) and *Aedes dorsalis* (Meig.), the two species co-inhabiting the salt marsh environment, are relatively well known.

Recently detailed attention has been given to both larval development (Bohart, et al., 1953) and adult dispersion (Aarons, et al., 1951) which aided in the understanding of certain ecological aspects of the species and dispelled or confirmed various theories held by workers which had not been demonstrated through field experimentation.

Prior to World War II, *A. squamiger* was considered one of the region's more important species in terms of population density, flight dispersion and general annoy-

ance. Larvae are found primarily in salt marsh pools that have been diluted by fresh water from the winter rains. The species may be recovered from water half as salt as sea water, although its optimum aquatic conditions are much less saline. The larval development period ranges from about November to March, major hatches having been observed following early heavy rains. A marsh site, observed in 1950 at Lakeville, Sonoma County, was estimated to contain over 1,600,000 larvae per acre. Some uncontrolled larval sources have contained populations ranging from 5 to 10 million per acre. The minimum development period for the aquatic phase has been noted by Bohart being 48 days at Bolinas Bay, Marin County. Successive larval hatches may occur through the winter and early spring but evidence thus far indicates that only a single generation occurs each season.

Aedes squamiger adults appear from approximately March to May and have a longevity of about three weeks. During this time the species has a tendency to disperse many miles and cause considerable discomfort. The report of Gray (1936) established this mosquito as the longest flighted species in California.

The mosquito control agencies of the San Francisco Bay Area in 1950 organized a cooperative dispersal study, gathering data that had not been analyzed regionally for a number of seasons. Throughout the entire area a thorough check was made of larval sources. This was followed later in the year by an area-wide adult distribution survey.

All larval and adult data of the 1950 survey have been compiled from the respective counties and assembled on Map A. Larvae were rather abundantly distributed over salt marshes in Marin, Sonoma, Napa, Solano and Contra Costa counties and in eastern San Mateo and Santa Clara counties.

The four bays north of San Francisco bordering the Pacific Ocean: Bolinas, Drakes, Tomales and Bodega were positive for larvae as were a few isolated marshes along the coast of San Mateo County.¹

A direct relationship can be seen between the 1950 dispersion pattern of adult mosquitoes and the distribution of larval sources. *A. squamiger* adults were recovered in Saratoga, Santa Clara County, some ten miles from the nearest known larval source.

Aedes squamiger development in 1950 was considered to be about that of an average recent year. Since 1949, however, a definite population reduction was noted throughout the entire region. This trend was attributed principally to an increase in emphasis on salt marsh mosquito source reduction and accordingly more and more marshes became "non-productive." The general progress of operations directed against salt marsh mosquitoes had reached the threshold of control on a regional basis and had been established along lines that insured a continuation of this favorable condition within economically feasible limits.

Survey data were again obtained from records of the control agencies in 1953 for the purpose of making a population trend evaluation. It became strikingly apparent

that *A. squamiger* had been all but extirpated from some marsh regions, particularly in Alameda and San Mateo Counties. The situation, in the San Pablo Bay region, as illustrated in Map B, was somewhat similar but still contained a moderate number of larval sources.

The explanation for the reduction of *A. squamiger* included at least in large part in the following groups:

1. Primary emphasis of mosquito control programming has been directed toward source reduction through drainage practices. The consequent separation of salt water from the marsh has drastically altered the environmental balance required for the species.
2. The economic development of the Bay region has included reclamation of many marshes which formerly constituted mosquito production sources. This improvement has been more advanced in the southern San Francisco Bay area.
3. Remedial spray operations properly timed have been an important adjunct to source reduction. The single generation characteristic increases the vulnerability of *A. squamiger*.
4. Since *A. squamiger* populations have been on the decline, *Culiseta inornata* has become more common in the salt marsh environment. It appears that this latter species is now successfully competing for dominance in this environment.
5. Predators and various algae were more conspicuous in 1953 than in the few previous years. Cyclic reduction trend.

The Bolinas marsh in Marin County had, in 1953, an *A. squamiger* larval density which was approximately half that of the previous year. On this marsh, which was used for observational purposes, insect predators, algae and scum were extremely conspicuous.

In summary, the *A. squamiger* population surveyed in 1953 by the mosquito control agencies in the San Francisco Bay region showed a drastic decline as compared with a similar survey in 1950. This is attributed largely to the "drainage source reduction" program carried out on a long term continuing basis. Another similar survey is proposed in two years. At that time there may be an opportunity to review the concept of applied species sanitation.

REFERENCES CITED

- Bohart, R. M., Mezger, E. C., and Telford, A. D., 1953. Observations on the Seasonal History of *Aedes squamiger*. Pro. and Papers 21st Ann. Conf. Calif. Mosq. Cont. Assoc. pp. 7-9.
- Aarons, T., Walker, J. R., Gray, H. F., and Mezger, E. G., 1951. Studies of the Flight Range of *Aedes squamiger* (Coquillett). Pro. and Papers 20th Ann. Conf. Calif. Mosq. Cont. Assn. pp. 65-69.
- Gray, H. F., 1936. Control of Pest Mosquitoes for Comfort. Civil Engineering, 6(10):685-688.

Mr. Grant: We will now have the report from the San Joaquin Valley region.

Dr. W. D. Murray: In the interest of saving time, I will not make my general summary of regional operations in the San Joaquin Valley, and will submit the following reports for presentation in the Proceedings:

COSTS OF OPERATING SOURCE REDUCTION HEAVY EQUIPMENT

LLOYD E. MYERS, JR., MANAGER
Merced County Mosquito Abatement District

Questions have been asked concerning whether or not heavy equipment, such as tractors and draglines, can be

1. A survey of the north coastal marshes between Jenner, Sonoma County, and Humboldt Bay was carried out by J. R. Walker, E. G. Mezger and T. Aarons during February 1952. The survey followed a heavy rainfall period which resulted in a flushing action on many marshes. Various mosquito species were collected, however *Aedes squamiger* was not found. The northern-most established range of the species is Bodega Bay, Sonoma County.