OPERATIONAL AND SCIENTIFIC NOTES

AN EFFECTIVE AND ECONOMICAL MAPPING SYSTEM FOR THE MONITORING OF *PSORPHORA COLUMBIAE* IN RICE AND FALLOW FIELDS IN SOUTHWESTERN LOUISIANA

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In Calcasieu Parish there are approximately 50,800 acres of rice and 17,000 acres of fallow fields, which are unplanted rice fields used for pasture, annually. These areas are the most important breeding sites of *Psorphora columbiae* (Dyar and Knab), the dark rice field mosquito, due to the abundance of oviposition habitats such as tire tracks and hoofprints of cattle. Meek and Olson (1976) reported that these habitats provided optimum egg deposition sites for this species. The life cycle of *Ps. columbiae* is rapid during the summer months, usually only 5 days from egg to adult. *Ps. columbiae* adults are strong fliers and disperse several miles from their larval habitats in search of hosts. They are aggressive and vicious biters of man and livestock. Massive populations of *Ps. columbiae*, moving into urban and suburban areas, reduce the efficiency of industrial workers, the value of real estate, and attendance at outdoor recreational activities. Steelman et al. (1972, 1973, 1976 and 1977) showed that *Ps. columbiae* caused significant reductions in the average daily gain of steers. Because of the importance of this mosquito species in control operations, a surveillance system that is time efficient and economical was needed. Another desirable feature of such a system is that new employees can learn it in a minimum of time.

Several researchers, Gooley and Lesser (1975) and Kent and Sutherland (1977), have developed surveillance systems for *Aedes sollicitans* (Walker) which combined aerial surveillance and mapping in coastal areas. Adapting some of these techniques, a program was designed for our situation which required a minimum of time and personnel while providing maximum control.

The parish was divided into 72 spray areas and of this number 22 contained rice and/or fallow fields. The boundaries of these individual rural spray areas were determined by the number of fields and the existing roads in an area. Each spring while the farmers prepare the fields for planting, all the rice and fallow fields in the parish are located and mapped using aerial surveillance which is then followed by ground proofing. This information, along with the best entrance route into each field, is placed on a large composite map, 1 inch equals 1 mile. These composite maps were obtained from the parish governmental office and showed all rural roads and houses. Accompanying this map is a data card file composed of manila folders, which provide a slot for each day of the week. The fields in each spray area are color coded, red for rice and green for fallow, and numbered. Using the map information, inspector booklets are compiled which consist of: 1) a binder with the inspection area printed on the outside, 2) a directional map showing the inspection area in relation to nearby towns and/or major roads, 3) the inspection map showing all rice and fallow fields in the area and 4) 20 sheets of 0-bond paper for inspectors to record whether the field is positive for larvae as well as other pertinent information. The directional maps are composed of portions of small scale maps (½ inch equals 1 mile) and the inspection maps are made from the individual spray areas of a similar map corresponding to the composite map.

Our inspection system consists of 4 major phases: 1) aerial surveillance, 2) ground proofing, 3) followup inspection of reported positive areas and 4) treatment. The aerial surveillance aspect of our operation varies with the season of the year. During the spring the rice fields are the major producing areas when the flood water is applied and in the fall after harvest. In the summer there is a permanent flood of water 4–6 in. on the fields and *Ps. columbiae* are only produced due to water fluctuations around levees or in areas of the

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field having higher elevations. The size of these *Ps. columbiae* populations varies with the degree of water fluctuation (Chambers et al. 1979).

In conjunction with aerial surveillance the agricultural agent is contacted to determine the "general" flooding and harvesting schedules for the different rice growing areas in the parish. Fallow fields are surveyed during spring, summer and fall because of their potential to breed *Psorphora*. Breeding in the fallow fields depends on the availability of rainfall accumulation. The district entomologist consults with the area weather bureau daily during these seasons to determine which portions of the parish received rainfall.

To facilitate aerial surveillance the parish was divided into 4 sections each consisting of the amount of land area that could be flown in one hour. The entomologist then consolidates the sectional maps which contain the regions that either received rain on the previous day or was receiving irrigation water with aerial surveillance maps which indicated fields that contained water. This information was then conveyed to the inspectors who would then ground proof these fields and record the mosquito population data in the back portion of the inspector booklets. If the field was positive for larvae a yellow pin was placed on the composite wall map, if it was negative a green pin was used. This system eliminated repeated and unnessary inspections. In addition to the presence or absence of larvae the date, temperature (air and water), number of larvae/dip and the stage of development was recorded and transcribed onto individual permanent data cards for each field. These cards were color coded similar to the composite map, and at the end of the season were filed as a permanent record, which provided background data for the next year. If the field was positive its card would then be placed in the data card file slot for the day of the week pupation was anticipated.

By grouping the fields by stage of larval development we were able to treat a maximum number of fields in a given area per unit of time. If we were not able to control the mosquitoes in the larval stage due to mechanical breakdown, lack of time, or poor weather conditions, the yellow pin on the composite map was changed to red. At this time the fields were resurveyed on the day the mosquitoes were to pupate in order to determine if sufficient water was still present to produce adults and in large enough numbers to cause a problem which would justify insecticide treatment. If the water had dried up or no immature stages were observed on this inspection the red pin was replaced with a green pin. If pupae were present and in sufficient numbers, pretreatment landing rate counts were taken on following days to determine the type of adulticiding operations that would be employed. Posttreatment counts were then made to determine the effectiveness of our control.

The initial cost of this inspection system was approximately $50.00 for card files (4), binders (50), small parish maps (2), large parish maps (2), index cards (500) and 0-bond paper (500). The recurring cost is only $12.00 for a new large parish map, index cards (500) and 0-bond paper (500) which is well within the budget of any mosquito control district. Using this system the adulticiding operations were kept at a minimum while maintaining maximum control of the rice field mosquitoes. The use of this

Table 1. Comparison of inspection time for ground vs. aerial plus ground inspection of rice and fallow fields for *Psorphora columbiae* in Calcasieu Parish, Louisiana during 1978.

Category	Time per inspection	Total time
Ground inspection		
a) Fallow field (summer)	28.5 hr. (2 inspectors 1.75 days)	484.5 hr.
b) Rice and fallow field (spring and fall)	84.0 hr. (2 inspectors 5.25 days)	672.0 hr.
Total		1,156.5 hr.
Aerial and ground inspection		
a) Fallow field	9.25 hr. (2 inspectors 4.1 hrs.)	157.3 hr.
b) Rice and fallow field	20.2 hr. (2 inspectors 1.25 days)	161.6 hr.
Total		318.9 hr.

system enabled the reduction of the cost and amount of time required for the surveillance of *Ps. columbiae* breeding habitats.

The conventional "ground only" surveillance system used by most mosquito districts in southwestern Louisiana was compared with the combination aerial plus ground surveillance system in terms of both cost and time expended. The southeastern portion of the parish was used for comparison. The area contained 64% of the rice and fallow fields in the parish and was in close proximity to the major urban areas which necessitated quick and effective control techniques. Table 1 shows the results of the inspection time comparisons between "ground only" vs. aerial plus ground inspection for this area. The time required to survey the fallow fields in summer and both the rice and fallow fields in the spring and fall using ground inspection only was 3 and 4 times, respectively, that required using the combination of aerial and ground. The greatest difference between the 2 methods in time required per inspection was that needed to survey the rice and fallow fields in the spring and fall. Using 2 inspectors it required 5.25 days to complete inspection of this area using conventional inspection methods, while it only required 1.25 days using the combination technique. This left 2 days in which to initiate larviciding operations which allowed the reduction or elimination of the problem before it occurred. Since in our area *Ps. columbiae* requires only 5 days to go from egg to adult, the conventional method which required 5.25 days to complete, elimated any chance of larviciding a large portion of this area and only allowed us the option of adulticiding the area. We term this situation "after the fact control" because we base our adulticiding of urban areas on the number of adults already present in an area.

Table 2 contains the data which shows a comparison of the costs of these 2 techniques for the control of *Ps. columbiae*. The total cost for conventional ground surveillance was 2.4 times that of the combination method. Spring and fall inspection was the time of year having the greatest difference, with the conventional method costing more than 3 times that of our technique.

In conclusion, the combination of aerial plus ground inspection for control of *Ps. columbiae* allowed: 1) improved inspection by increasing the area surveyed, 2) reduced the time required to survey these areas and 3) reduced inspection costs almost 2.5 times what they were using the conventional ground surveillance. One of the main concerns was the better utilization of personnel, and using this method of surveillance allowed the release of inspectors to carry out other jobs. Thus, the incorporation of a mapping system for special problem areas within mosquito control districts is highly recommended.

Table 2. Economic comparison of ground vs. aerial plus ground inspection of rice and fallow fields for *Psorphora columbiae* in Calcasieu Parish, Louisiana during 1978.

Category	Cost per inspection	Total cost
Ground inspection		
a) Fallow field (summer)	$115.52	$1,963.84
b) Rice and fallow field (spring and fall)	376.74	3,013.92
Total		$4,977.76
Aerial and ground inspection		
a) Fallow field	66.43	1,129.31
b) Rice and fallow field	119.05	952.40
Total		$2,081.71

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PRELIMINARY NOTE ON THE STERILIZATION OF THE MALES OF *CULICOIDES NUBECULOSUS*

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In recent years, chemosterilization of insects has been investigated extensively as a new method of insect control. It appears that the use of chemosterilants, in contrast to gamma or X-ray irradiation, offers numerous advantages (Mulla 1964). Studies on the competitiveness of chemosterilized and gamma-ray sterilized males of *Aedes aegypti* showed the former to be more competitive with normal males than males sterilized by gamma radiations (Weidhaas and Schmidt, 1963).

Many studies on mosquito sterilization have been made (Patterson et al. 1971) (Grover et al. 1979) . . ., but *C. nubeculosus*, like most *Culicoides*, has not been very thoroughly studied. However, some irradiation studies have been made for *C. variipennis* (Jones 1967). Three chemosterilants (tepa, metepa and thiotepa) have been used in the evaluations against mosquitoes. Several methods of sterilization have been tested: by exposing the pupae of *A. aegypti* (White 1966), or the third or early fourth instar larvae until pupation (Dame et al. 1964) in the chemosterilizant solution. The present note reports that thiotepa is an effective sterilant of the pupae of *Culicoides nubeculosus*.

METHOD. Male pupae, 2–16 hours old, of *C. nubeculosus* were immersed in a solution of thiotepa (0,9 and 1%) for a period of 1 to 4 hours at a temperature of 26+2°C. The pupae were rinsed twice in water and transferred into vials (7×5m) for emergence.

Untreated adult females were put with the treated males and at the end of the mating period, the females were fed on mice; after 2 days, the eggs laid were deposited in the water. The number of eggs laid by each group of females was recorded (control and experimental), and after 6 days the number of eggs which had not hatched was counted and the percentage of sterile eggs determined.

Result: shown in accompanying Table.

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T ♂♂ × N ♀♀ N° exp	1				2
Concentration of Thiotepa	0,9%				1%
Laying	1st		2nd		1st
Exposure period (hr)	2	4	2	4	4
N° ♀ or ♂	35	35	32	31	65
Total N° of eggs laid	741	890	840	650	1900
N° of eggs hatched	34	54	33	60	19
% sterile	95,4	93,9	97	90,8	99
Control N ♂♂ × N ♀♀					
N° ♀	35		32		65
Total N° of eggs	619		500		2000
N° eggs hatch	491		394		1600
% sterile	20,7		21,2		20

T = Treated
N = Normal

Sterilizing effect of Thiotepa on males of *Culicoides nubeculosus*, after the exposure of 2–16 hours old pupae to a solution of Thiotepa for 2 to 4 hours.