OPERATIONAL AND SCIENTIFIC NOTES

PSOROPHORA COLUMBIAE LARVAL DENSITY IN SOUTHWESTERN LOUISIANA RICE FIELDS AS A FUNCTION OF CATTLE DENSITY[1]

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The dark rice field mosquito, *Psorophora columbiae* (Dyar and Knab), is the most abundant mosquito in rice fields in the rice producing areas of Texas (Kuntz et al. 1982) and Louisiana (Chambers et al. 1979). Farming in the rice culture agroecosystem consists of a rice-soybean rotation on crop land coupled with cattle ranged on both permanent pasture and fallow crop land. Abundant rainfall provides breeding areas for mosquitoes in ditches, low areas of pasture, soybean fields and fallow rice fields. Riceland irrigation provides additional breeding habitat for both the permanent water mosquito species and the temporary pool species such as *Ps. columbiae* in southwestern Louisiana.

Cattle have been identified as a major and preferred blood source for adult *Ps. columbiae* (Kuntz et al. 1982). Cattle and a few head of horses were the dominant large animals in our riceland study area. Woodland habitat was limited to narrow bands of tall shrubs and mixed conifer and deciduous trees along one river on the western edge of the study area and even narrower bands of smaller shrubs along untended irrigation canals and small streams interspersed throughout the study area. As a result there were no deer, and cattle were the most abundant source of blood for *Ps. columbiae.*

Female *Ps. columbiae* tend to oviposit in the nearest suitable moist soil. This may occur amongst the cattle or in the nearest vegetated sloping soil. Cattle hoofprints, sloping levees, ruts, ditch banks and edges of swales all provide suitable oviposition sites when moist and vegetated. However, dry weather in late summer often restricts oviposition to the deep ruts in rice fields created by harvesting machinery after drainage of the fields. Meek and Olson (1977) showed the impact of ruts in the rice fields on the number of *Ps. columbiae* larvae when those fields were reflooded after harvest for the production of a second crop from the stubble. Thus, the existence of large tracts of moist rutted soil in the drained rice fields at a time when dry hot weather restricts the availability of other oviposition sites leads to a concentration of oviposition. The subsequent compressed duration of reflooding for second crops of rice results in massive outbreaks of *Ps. columbiae.*

Al-Azawi and Chew (1959) reported similar circumstances in a study of adult densities that ranged from $0.16/m^2$ in the absence of cattle to $9.8/m^2$ when cattle were in the vicinity. Kuntz et al (1982) underscored the major role of cattle in *Ps. columbiae* population dynamics by recommending chemical treatment around cattle herds to kill adult *Ps. columbiae* females. The importance of rice fields as adult sources was further emphasized by Fleetwood et al. (1981) with development of a system for mapping and monitoring rice fields near urban areas. However, no direct relationship has been established to quantify the relationship between cattle density and proximity to active rice fields and the resultant larval densities. The objective of this study was to develop a quantitative relationship between larval counts and cattle density. Such information could lead to further improvement in survey and treatment methodology.

The study was conducted in an area approximately 4.8 km (3 miles) in radius around the town of Jennings, in Jefferson Davis Parish, Louisiana, in 1982 and 1983. In 1984 the intensity of sampling was reduced, but the area was expanded to include active rice fields around the towns of Iota, Midland, Morse and Estherwood in the neighboring parish of Acadia. Rice production practices included reflooding of harvested stubble for regrowth and production of a

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second crop. Reflooding usually commenced during the last week in July and ceased at the end of the first week in September. This second-cropping season coincides with the major outbreaks of *Ps. columbiae* in this area.

The *Ps. columbiae* larval populations in reflooded rice fields were sampled between 0800 and 1600 hr with a 400-ml dipper following a routine method of moving around the periphery of the pans within a field. This method involved entering the field along an earthen levee and taking 2 dipper samples at each stop. Samples were usually taken within 5 m of the levees (see Andis et al. 1983) at intervals of 20 to 70 steps apart until the entire pan had been sampled or 20 samples had been taken. Each sample consisted of the sum of larvae collected in 2 dips. Sampling was conducted in each pan that held 2nd instar or older larvae. Irrigation of a field usually continued for 3 to 7 days, requiring that a field be revisited several times in order to sample all the pans and obtain the mean larval count per sample for the field. The observational unit for the study was the entire rice field because the statistical inference was to the area of the rice field that was sampled.

Spatial references for the distance between the sampling area and the cattle were determined from maps prepared from aerial photographs and ground verification of the location and size of cattle herds. The central point of the sampling area of each field was recorded and used as the reference point from which the cattle proximity measurements and cattle density values were calculated. The density of cattle within a 1.6 km radius of the center of each sampling area was determined by counting the cattle within this circle and converting the observation to the number of cattle/km^2.

Data were analyzed by least squares estimate for fit to the linear regression model of $y = B0 + B1\ X1 + B2\ X2$, with cattle/km^2 and year as the independent variables and the mean number of larvae/sample/field the dependent variable, after rejection of the hypothesis for no difference between means by an F-test (alpha = 0.05). The number of fields, number of pans, average number of larvae and average cattle density for each of the 3 study years are presented in Table 1. The larval data are based upon 11,865 samples.

The analysis for the effect of the independent variables on the mean number of larvae/sample/field showed that the year had no effect upon larval density ($P > F = 0.93$), but the cattle density was highly significant ($P > F = 0.0001$). The correlation coefficient ($r = 0.78$) suggests that 78% of the variation in larval density was associated with cattle density in a linear relationship between the mean number of larvae and cattle density.

The data were then pooled without regard to year, and a linear regression model ($y = a + bX$, where y = no. larvae/sample, a = intercept, b = slope and X = no. cattle/km^2) was used to determine the estimates of the parameters. The intercept (estimate of the larvae/sample/field without cattle) was 1.11 (STDEV = 0.20). The slope (estimate of the effect of the cattle density upon the number of larvae/sample/field) was 0.08 (STDEV = 0.01). The r-square value was 0.59.

The intercept value suggests that a mean density of 1.11 larvae/sample would be expected when cattle are not present within a 1.6 km radius of center of the field. The slope suggests that the presence of 70 cattle within the 1.6 km radius (13.9 cattle/km^2) would increase the expected larval count by 1.1 ($= 0.08 \times 13.9$), which would be twice the number expected without cattle. Such an increase is indicative of the huge population potential of any field within close proximity to large herds of cattle.

The results of this study suggest that control agencies might be able to use cattle concentration maps as a guide to detection of high larval density rice fields. Such an approach might lead to more efficient larvicidal treatments. Fleetwood et al (1981) presented an inspection method using aerial surveys and mapping breeding sites of *Ps. columbiae*; this system could be extended to include observations on the flooding of the fields and on cattle herd size and locations. Although the movement of deer or other natural hosts into open pastures or meadows to

Table 1. Summary of density of *Psorophora columbiae* and cattle within a 1.6 km radius for 1982–84.

Year	No. fields	No. pans	No. larvae/sample/field Mean	No. larvae/sample/field Range	No. cattle/km^2 Mean	No. cattle/km^2 Range
1982	22	170	2.5	0.1–7.7	8.6	1.2–30.4
1983	35	238	2.5	0.2–7.6	5.4	0.0–30.4
1984	18	57	2.6	0.2–7.6	8.0	0.0–18.5

graze during nighttime hours might reduce the relationship between cattle and mosquito abundance, the rice fields which *should* have the greatest numbers of mosquito larvae could be inspected and treated first, thus further prioritizing potential control actions. In addition to this immediate possible practical application, these results also provide a quantitative basis of densities for development of *Ps. columbiae* population models in this agroecosystem. Models based on sound ecological data will greatly enhance the development of integrated management systems.

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