Culex Mosquito Populations in the Catch Basins of Northern St. Joseph County, Indiana[1]

Leonard E. Munstermann and George B. Craig, Jr.
Vector Biology Laboratory, Department of Biology
University of Notre Dame, Notre Dame, Indiana 46556

Abstract

In the St. Joseph County Mosquito Abatement Program larval survey of 1976, numerous *Culex* encephalitis mosquitoes were discovered in the catch basins beneath street storm drains. Subsequently, a systematic inspection of catch basins was conducted in the communities of South Bend, Mishawaka, Notre Dame, Roseland, and Osceola. Presence of catch basins was found dependent on city sewerage construction policy, e.g., South Bend did not construct them (following modern sewerage practice), while Mishawaka maintained one to four catch basins at nearly every street intersection.

Collection and identification of 2200 larvae from 150 positive sites demonstrated two points. 1) Larval populations occurred in 37 to 66 percent of the catch basins, depending on previous rainfall patterns. 2) Early in the season, *Culex restuans* was the only species usually found, but by midsummer, *Culex pipiens pipiens* constituted approximately half of the collections. Proposed control measures were insecticide treatment or elimination of catch basins.

Introduction

Extensive mosquito development in catch basins, usually located beneath the storm drains at street intersections, has been recognized as a problem for many years. As early as 1915, the 5000 catch basins of Washington, D. C., were flushed and treated with mosquito oil (8). More recently, routine treatment of catch basins with insecticides has become a common practice in established mosquito abatement programs in Illinois (5, 14), New Jersey (10), Kentucky (2), Georgia (7) and California (4, 6, 13).

In response to the Indiana encephalitis epidemic in 1975, the St. Joseph County Mosquito Abatement Program was organized under the auspices of the County Department of Public Health by the Vector Biology Laboratory at the University of Notre Dame. In the first year of operation (1976), the primary objective was to locate larval sites and determine mosquito species diversity in the county. Details of the program and findings are published in these proceedings (12). Early in the survey, a significant amount of *Culex* production in catch basins was noted; consequently, a more intensive effort was made to assess them as major breeding sites.

Methods

The initial survey indicated that production potential was dependent on the construction of the system used for disposal of storm run-off. To aid in identifying the construction types, each is described below. The general term "storm drain" will be used to include any underground

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system for removal of rainwater from the surface. Storm drains were manifested on the surface by rectangular or circular metal gratings at street intersections, depressions in grassed areas, and in larger paved surfaces.

A. *Storm drains, direct drainage.* These drains were concrete funnels connected to pipes, 15-20 cm diam, which led 1) directly to the sewer mains located beneath the street center, or 2) to a catch basin located in the same intersection (Fig. 1).

B. *Catch basin, type I.* These were large brick basins which widened to a diameter of a meter and were one to two meters deep. An overflow pipe led to the sewer mains (Fig. 2) (7).

C. *Catch basin, type II.* These are typically concrete, cylindrical basins, 0.6 m diam, connected in series by a pipeline. Each basin had an inlet and outflow pipe, with water standing below the level of the outflow pipe (Fig. 3).

D. *Catch basin, type III.* These basins had no overflow pipes but relied on seepage through a stone or gravel base for water removal. They were usually small, 0.6 m diam, and 0.6 to 1.0 m deep (Fig. 4).

E. *Dry well.* The principle of construction was the same as the catch basin, type III, but much wider (2-3 m diam) and deeper (2-3 m). This type was built to contain run-off from parking lots and other paved areas.

Five communities in northern St. Joseph County were surveyed: Mishawaka, Notre Dame, Osceola, Roseland and South Bend. The data gathered were a) storm drain construction types, b) presence of standing water and larvae, and c) species of larvae.

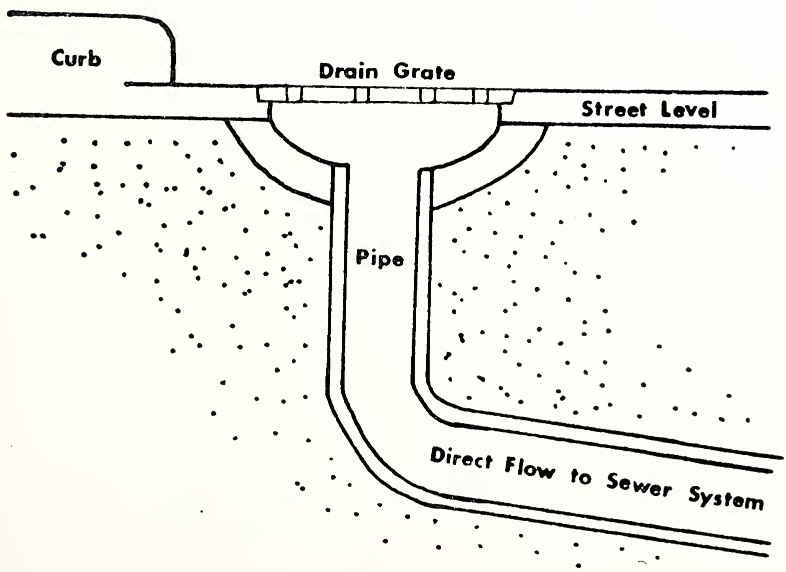

FIGURE 1. *Direct drainage storm drain, typical of South Bend storm drainage.*

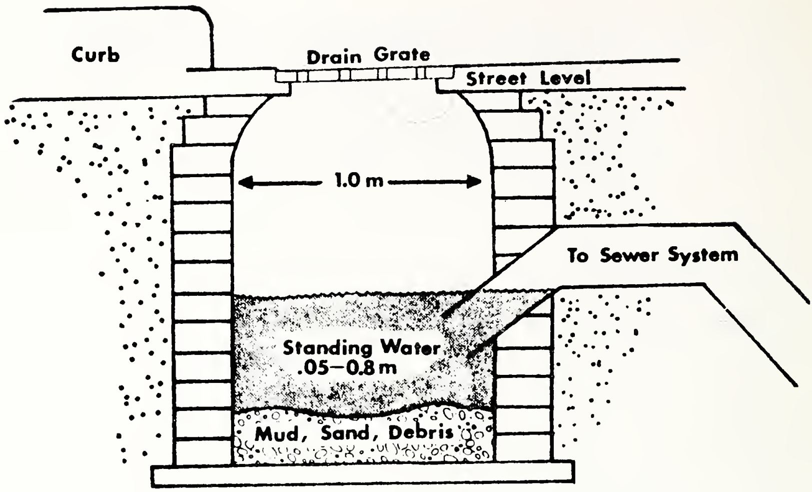

FIGURE 2. *Catch basin, type I, typical of those found below the storm drains of Mishawaka.*

Straight line, north-south (N-S) and east-west (E-W) transects were taken at the widest limits of Mishawaka and South Bend. The streets that the transects followed were

Mishawaka (N-S)—Normandy, Division, Union, and Main streets;
(E-W)—10th and 6th streets;

South Bend (N-S)—St. Louis and Fellows streets;
(E-W)—Randolf, Dubail, Indiana, and Ford streets.

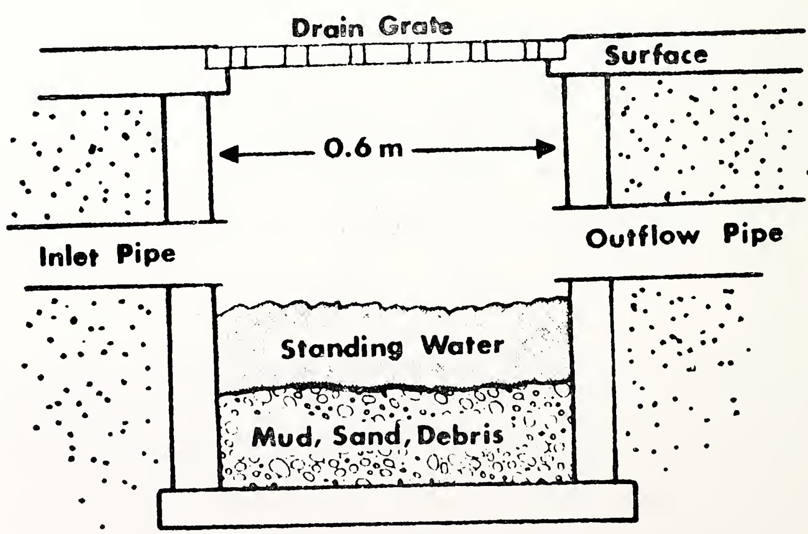

FIGURE 3. *Catch basin, type II, used on the Notre Dame campus.*

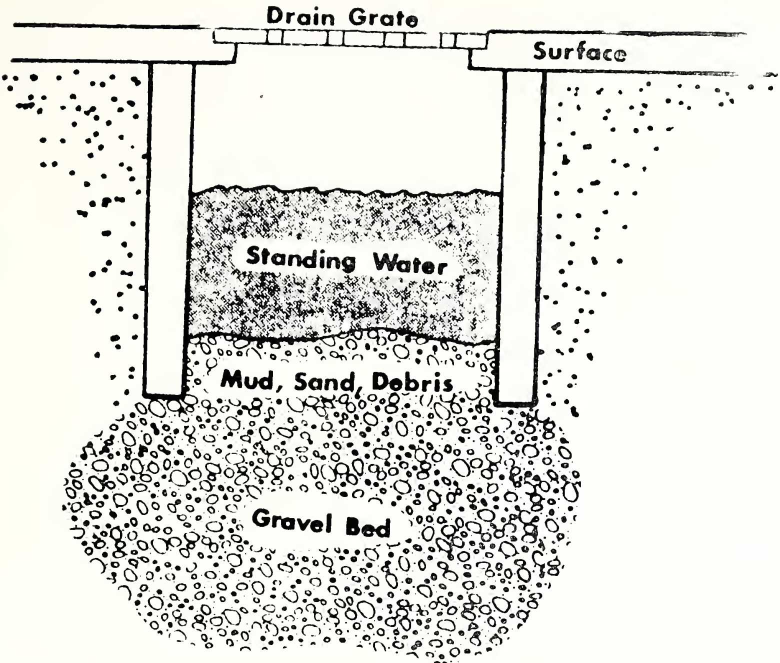

FIGURE 4. *Catch basin, type III, found along the streets of Osceola and Roseland.*

The transects in Mishawaka were repeated to detect possible seasonal and rainfall effects on population numbers. In the communities of Notre Dame, Osceola, and Roseland, nearly all of the storm drains were examined.

Whenever standing water was detected in a storm drain catch basin, the cast iron grating was removed and 6 to 10 dips were taken with a standard 0.45 liter enamel dipper. Larvae were collected into polyethylene bottles for later identification in the laboratory. Samples from dry wells and sewer mains were taken with a one-liter tin can attached to a long nylon cord.

The number of larvae found was probably underestimated for two reasons. Firstly, when the storm drain covers were lifted, debris dropping into the water caused the larvae to descend to the bottom of the basin, making collection difficult. Secondly, some catch basins were found sealed shut due to street resurfacing or were too deep to be effectively sampled.

Results and Discussion

Construction of storm drainage systems determined to a large degree the amount of standing water available for mosquito development. In South Bend, where storm run-off flowed directly into the sewer mains, few positive or potential sites were found. In the other communities, where catch basins were utilized (Table 1), most contained standing

TABLE 1. *Percent of storm drains with catch basins in five northern Indiana communities, St. Joseph County.*

Community	Storm drains	No. with catch basins	(%)	Catch basin type
South Bend	13,600a	27b	(0.2)	I
Mishawaka	2,860b	1,300a	(46)	I
Notre Dame	120	92	(77)	II
Osceola	12	12	(100)	II
Roseland	10	10	(100)	III

a Estimates provided by community officials.
b Extrapolated from transect counts.

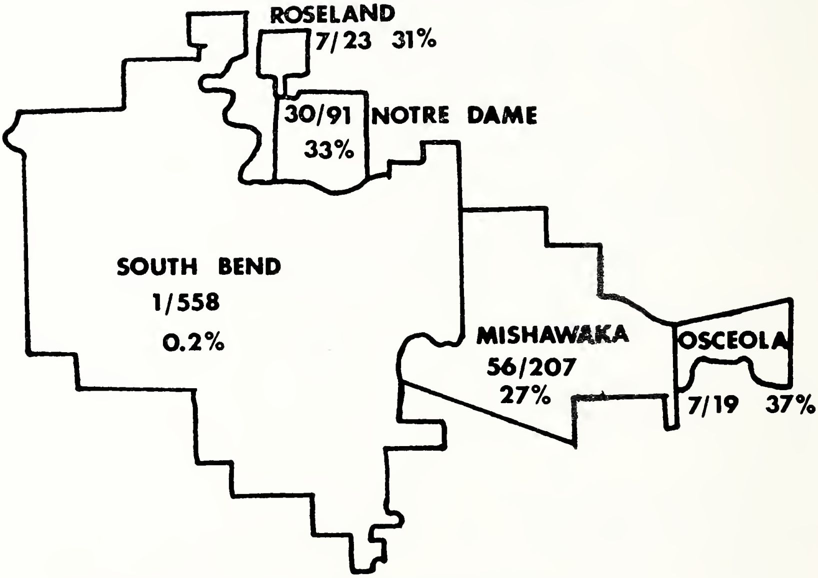

FIGURE 5. *Number of street drains and percent found with standing water and positive for* Culex *mosquito larvae in five communities of St. Joseph County, Indiana.*

water and provided excellent habitats for *Culex* mosquitoes. In Figure 5, the non-producing, direct drainage drains were included in calculating the percent positive for *Culex* larvae. However, if catch basins only were considered, 37 to 66 percent contained larvae.

In addition to catch basins, type II and III, dry wells were commonly used in Osceola and Roseland parking lots and in other paved properties. Although 19 of 25 examined contained standing water, low density larval populations were found in only two of them. Though difficulty in sampling can account for this, accumulation of oils and poisons may also prevent larval growth there.

Over 2200 larvae from 150 positive sites were collected in the five communities. All larvae were identified as *Culex pipiens pipiens* or *Cx. restuans*, with only one exception. Two *Aedes triseriatus* were taken from a catch basin on the east-west transect of Mishawaka. This probably represented an accidental introduction from an overflow of this species normal treehole habitat.

In the six-week period of collecting, a distinct trend of an increasing number of *Cx. pipiens* was noted (Table 2). When the east-west and north-south transects of Mishawaka were repeated later in July, *Cx. pipiens* had increased from 11 to 46 percent and 29 to 66 percent of the totals, respectively. This trend was noted for other larval sites of these *Culex* as well (12). In the catch basin study by Covell and Resh (3) in Louisville, Kentucky, the increase of *Cx. pipiens* began at mid-June and reached nearly 100 percent by the first week in July. If the species shift was due to a temperature threshold as they contended, then possibly the cooler seasonal temperature accounted for the later appearance of *Cx. pipiens* in St. Joseph County.

TABLE 2. *Seasonal changes in relative numbers of* Culex restuans *and* Culex p. pipiens *in catch basins in two Indiana communities, St. Joseph County, summer, 1976.*

Date Collected	Collection Area	No. Sites	No. Larvae	*Culex restuans*	(%)	*Culex pipiens*	(%)
14 June	Mishawaka (south)	9	140	137	(98)	3	(2)
6 July	Mishawaka (E-W)	24	218	193	(89)	25	(11)
12 July	Mishawaka (N-S)	26	464	331	(71)	133	(29)
20 July	Notre Dame campus	30	704	311	(44)	393	(56)
22 July[a,b]	Mishawaka (N-S)	15	89	30	(34)	59	(66)
28 July[a]	Mishawaka (E-W)	31	401	216	(54)	185	(46)

[a] Exact repeat of earlier transect.
[b] Sampled after a 8.1 cm rainfall.

The impact of heavy rains on larval populations was considerable. In the repeat of the Mishawaka (N-S) transect (Table 2), the rains reduced the positive sites from 26 to 15. The average number of larvae per positive site was reduced by 67 percent. However, because of the flushing action of run-off in the catch basins, the survival of even this number of larvae was surprising. In Savannah, Georgia, continued heavy rains virtually eliminated larval *Cx. pipiens quinquefasciatus* from catch basins, but these populations reappeared within a week after the rains stopped (1, 7).

Significance for Control Programs

Catch basins of Mishawaka and Notre Dame are major sources of *Culex restuans* and *Culex pipiens pipiens* mosquitoes. Because of the role of these species in the transmission of Eastern Equine Encephalitis anl St. Louis Encephalitis, catch basin mosquito production must be an important consideration in a control program. Two control alternatives to be considered are 1) elimination of the site, and 2) treatment with chemical insecticides.

Elimination of catch basins by conversion to a direct drainage system (Fig. 1) is a permanent solution. Many years ago, catch basins were designed solely for preventing grit and debris from entering and clogging sewerage systems. For more than 40 years, however, building of catch basins has been discouraged by sewerage engineers. This is because the more modern sewers are built to move sewage at "self-cleaning velocities" of 0.6 m per second in pipes of 30 cm or greater in diameter (9), obviating the need for catch basins.

The use of insecticides is a temporary and less satisfactory solution. Until banned, residual insecticides such as DDT had been used with success (2, 5, 6). Recently, organophosphorus compounds such as Abate (American Cyanamid, Princeton, NJ) and Dursban (Dow Chemical, Midland, MI) (11) and pyrethrin Toss-Its (WYCO International, Cleveland, OH) (2) have proved effective in catch basin larval control. These insecticides do not remain effective over longer periods and must be reapplied after every rainfall. The use of dichlorvos (DDVP, Vapona) (Shell Chemical, Fresno, CA) impregnated resin plastic strips has been successfully used against both larval and adult mosquitoes for an entire season (1, 13), though this method is much more expensive than others. In addition, special spray nozzles and vehicles have been developed and deployed for insecticide application in catch basins by several abatement districts (2, 10, 14).

Literature Cited

1. BROOKS, G. D. and H. F. SCHOOF. 1964. Field evaluation of five types of dichlorvos dispensers against *Culex pipiens quinquefasciatus* in catch basins. Mosquito News. 24(2):144-148.
2. COVELL, C. V. 1968. Mosquito control and survey in Jefferson County, Kentucky. Mosquito News. 28(4):526-529.
3. COVELL, C. V. and V. H. RESH. 1971. Relative abundance of *Culex pipiens* and *Culex restuans* in catch basins in Jefferson County, Kentucky. Mosquito News. 31(1):73-76.
4. GRAY, H. F. 1946. The control of mosquito breeding in street inlets (catch basins), underground utility vaults and similar structures, by DDT residual sprays. Calif. Mosquito Control Assoc., 14th Ann. Conf. Proc. and Papers:61-63.
5. HEDEEN, A. A. 1963. The use of DDVP for the control of mosquitoes breeding in catch basins. Mosquito News. 21(3):255.
6. LAURET, T. H. 1953. Problems in the treatment of residential catch basins. Calif. Mosquito Control Assoc. Proc. 22:73-74.
7. MADDOCK, D. R., C. M. ELMORE, JR. and H. F. SCHOOF. 1963. Preliminary tests with DDVP vapor for the control of *Culex pipiens quinquefasciatus* in catch basins. Mosquito News. 23(2):69-74.
8. METCALF, L. and H. P. EDDY. 1915. American sewerage practice. II. Construction of sewers. McGraw-Hill Book Co., New York. 564 p.
9. METCALF, L. and H. P. EDDY. 1930. Sewerage and sewage disposal. McGraw-Hill Book Co., New York. 783 p.
10. NELSON, C. and R. E. DORER. 1964. A scooter equipped for catch basin spraying. N. J. Mosquito Extermin. Assoc. Proc. 51:103-104.
11. SELF, L. S. and M. M. TUN. 1968. Evaluation of organophosphorus oil sprays against *Culex pipiens fatigans* in polluted drains and septic tanks. WHO/VBC/68.81. 7 p.
12. SHROYER, D. A., R. F. BEACH, L. MUNSTERMANN, J. PELOQUIN, R. P. SMITH and D. B. TAYLOR. 1976. Mosquito diversity in St. Joseph County, Indiana (Diptera: Culicidae). Proc. Indiana Acad. Sci. *In press.*
13. SILVEIRA, S. M., G. W. FORCE and D. J. WOMELDORF. 1964. Field test of dichlorvos-resin strips for controlling mosquito larvae in catch basins in Turlock, California. Calif. Vector Views. 11(10):57-59.
14. WRAY, F. C. 1954. Catch basin spraying. Mosquito News. 14(3):119-120.