EFFECTIVENESS OF DITCHING IN CONTROLLING SALT-MARSH MOSQUITOES

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The degree of effectiveness of ditching in controlling salt-marsh mosquitoes is dependent on many factors, but the most important is the planning and forethought given to the problem before the ditches are constructed. Ditches, if they are to be effective, must be planned and designed to fit the problem area. The plans of any project must take into consideration all the factors which will affect the outcome and determine the economy. To ditch any given area is one thing, but properly to place the minimum length of ditches, to give the maximum control at a minimum of cost is a well-designed source reduction project.

We all realize that the problem is the rains and tides which cause intermittent flooding on the marsh. The question whether it is more economical to keep the water on the marsh or to get it off, must be decided in arriving at a solution. If the ground conditions, pumping cost or some other factor prohibits the use of flooding, the use of ditching will most probably be the method most economically feasible. The engineering design of a ditching problem must be preceded by an entomological survey of the area in question. A complete entomological survey showing where the mosquitoes are breeding under various conditions should be the governing factor in any well-designed project. For example, the salt-marsh mosquitoes have been observed breeding in the salt flats which separate the mangrove areas from the higher palmetto land when no breeding was occurring in the mangroves, and vice versa. When the area is flooded by tide, some areas may breed; and when flooded by rain, other areas may be involved. This knowledge of an area should determine where in the marsh the ditching efforts should be concentrated. I have read somewhere a statement which said that only one-fifth of the salt-marsh

area in Florida breeds mosquitoes. If this statement is true, then four-fifths of our problem is eliminated by the entomological survey, and time, money, and ditches can be put into the areas where they will do the most good.

Having defined the problem area brings up many questions the mosquito control director must answer before the program gets under way. First, what type and kind of equipment to use? In Florida our problem is so varied that we range from ball-bearing sand in northern and western Florida to soft rock in Dade County, where the ditches can be cut 18" wide and 6 ft. deep and will hold up satisfactorily. The equipment must conform to the type of terrain in which it is to work. The most typical in Florida is the mangrove swamps with salt flats. Experience has shown us in Florida that the most economical piece of equipment to use in this type area is a ¾ cubic yard dragline. A dragline of this size has the endurance and power needed to work in the mangroves—yet it is light enough to work on mats in areas where it is impossible to walk. Mr. Stutz, in Dade County, has been using a ditching machine and getting good results, but the conditions must be just right in order to obtain peak productivity. The type and size of equipment selected should be governed by productivity and economy of that equipment when operated in the problem area.

The width, depth and location of ditches is also subject to much discussion on what is needed or what is best. A mosquito control ditch in a salt marsh should be wide enough to function properly not only when constructed but years later when the vegetation has readjusted itself to the new surroundings. During the days of WPA, many ditches were small and hand-constructed; they have now grown over or filled up. The effectiveness of the ditches is lost, and in many cases they themselves are breeding mosquitoes.

Ditch maintenance is an expensive undertaking and frequently costs as much as, or more than the original ditch. It is anticipated that by the use of larger ditches, maintenance cost can be eliminated or reduced. In mangroves, for instance, no ditch should be constructed less than 10 feet wide and preferably 12 feet under heavier conditions. The mangroves will grow back on the ditch banks and will block approximately 3 feet on each side with their vast root systems and overhanging boughs. This would leave a 4 to 6 foot open channel that could function properly for years as a mosquito control ditch.

In areas where vegetation is light, a smaller ditch could be dug, but it should always be large enough to prevent it from being stopped up by debris and logs. Large ditches are indicated where large quantities of water must be drained from incoming and outgoing tides and where heavy rainfall must be immediately drained. The larger channels do, however, increase the cost and also provide another problem in the placement of the spoil dirt. The spoil dirt should be piled and staggered in its placement, first on one side of the ditch and then the other and small laterals constructed between the spoil piles to prevent blocking the water from the ditch. The utilizing of the spoil dirt to fill low areas adjacent to the ditch line is not only a costly operation but a dangerous one, from a mosquito control standpoint. If proper grade is not maintained in leveling the spoil, new breeding areas can be created; also the leveled spoil can prevent the surface water from reaching the ditch and lessen the effectiveness of the ditch.

The depth most commonly used in mosquito control ditches in Florida is one foot below mean low tide. This provides a ditch which has water in it at all times and provides a reservoir for the minnow population during low tides. The ditches in many areas are referred to as "minnow access canals." Where there is only a small variation between high and low tides, the function of the ditch for tidal flushing action is decreased, but it is still effective as a minnow access ditch. By

constructing the ditch to this depth, the water from the surrounding marsh not only is removed from the surface, but a lateral movement of underground water flows into the ditch. This lowers the water table in the marsh and makes the marsh capable of receiving more rain water without ponding and presenting a breeding problem.

The ditches that are now being constructed in Florida are located from an effectiveness point of view. Very few straight canals are laid out at various intervals to give a mass coverage of an area. The ditches are placed in the lowest areas of the marsh and follow the swales and natural runs through the marsh. All low areas and outlying pockets of water are tied into the canal system. This may present a maze of ditches over the marsh area, but it has proven to be the most effective in eliminating the greatest percentage of breeding. In designing a ditching layout of this type, aerial photos and actual flights over the project area are very helpful. The more outlets connecting the ditching system to open water, the more effective and long lasting the effects that can be expected from the control project. Utilization of the natural streams for outlets prevents costly constructions which might otherwise be necessary to keep the mouths of the ditches open. Care in selecting the position of the ditch opening into an open body of water is necessary. The opening should avoid subjection to wave action where possible.

In designing a ditching system connecting all the swales and natural low areas, the director can only lay out his main canals and so-called "skeleton" ditches. These ditches will bring the tide into the marsh, and also take the tide and rain water off the marsh. Many small laterals will have to be constructed from this original skeleton of ditches to tie in the aforementioned outlying areas. The most important man in selecting and placing of these laterals is the dragline operator. His ability to perform this duty will greatly increase the effectiveness of the ditching system. The dragline operator should be trained not only to operate his machine but to be able to locate prime breeding areas within the marsh. Time spent by any director to train his operators in this way will be reflected in the effectiveness of his program. An operator trained in locating the breeding areas can connect these areas into the ditching system so as to eliminate completely the area as a breeder. He can also relocate the ditches when conditions in the field indicate that more effective control would result.

There are many factors in dragline ditching which govern the quantity of work performed. The care and maintenance given a machine results in fewer breakdowns and less time lost. The enthusiasm of the operator and his knowledge of the problem increase productivity. In the battle of man versus mosquito, time is important. Many districts have set up goals to eliminate a large percentage of their salt-marsh breeding area in a given number of years. Some districts are able to produce a larger quantity of work under similar conditions than others, but all directors should strive to obtain maximum production with the equipment they have.

In the last three years, approximately 1,000 miles of mosquito control ditches have been constructed in Florida. These ditches were dug in salt-marsh areas in the manner described above and have eliminated better than 25,000 acres of prolific salt-marsh breeding area. True, it is a slow job and a seemingly endless one in some areas. In one county in Florida, approximately 90 percent of the salt-marsh breeding has been controlled by ditching operations in a four-year period. Other counties and districts are making similar progress. By carefully selecting the projects producing the most mosquitoes which are affecting the most people, the effects of permanent control methods are being noticed. In one of the distircts in Florida last year, a large build-up of mosquitoes had the county declaring itself a disaster area, which brought help from local, State,

and Federal agencies. In the area in this district which had been ditched, no mosquito larvae could be found, but the unditched areas were producing the hordes of mosquitoes. In a recent release by Mr. Mulrennan, he made the statement that where salt-marsh areas have been ditched, the mosquito breeding has been reduced to zero in most areas. All directors of mosquito control districts where machine ditching has been in operation for a year or two can vouch for the reduction of mosquitoes in the areas worked.

Mosquito light trap collections have been recorded by the Bureau of Entomology for the past eight years. The permanent control program emphasis began in Florida four years ago, so we have collections for four years before and four years after the program began. Many factors are to be considered in comparing one trap collection with another or even one area with another. For comparison, I have taken an average count of salt-marsh mosquitoes per collection for each year. There has been a steady decline in salt-marsh mosquitoes per collection. The four years since the permanent program began, show a 42 percent reduction in salt-marsh mosquitoes over the four years prior to its start. This reduction is based on the results of about 6,000 collections each year during the period and was confined to the coastal counties and districts where salt-marsh mosquitoes are a problem. This, in my opinion, is proof positive of the effectiveness of ditching in controlling salt-marsh mosquitoes.

Research is now being planned and carried out whereby our present methods can be improved, and methods of speeding operations and productions are being integrated into the programs. If the present pace of eliminative control is maintained, many areas in Florida will find themselves virtually free of salt-marsh mosquitoes.