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Part II

WATER MANAGEMENT UNITS AND SHORE LINE MODIFICATIONS USED IN MOSQUITO CONTROL INVESTIGATIONS

DON M. REES AND ROBERT N. WINGET

Center for Envirronmental Biology, University of Utah, Salt Lake City, Utah

Studies have been in progress in Utah for several years in which an attempt is being made to develop and field-test physical facilities and techniques to provide better water management practices applicable to the reusable water on the eastern shores of the Great Salt Lake. The management is designed to provide the greatest mutual benefits for those engaged in the multipurpose use of this water.

This study is being conducted on a strip of ground bordering the southeastern shore of the Great Salt Lake that is approximately 55 miles long and varies in width from 2 to 18 miles. This ground is adjacent to the most densely human populated area in the state.

The study is a cooperative effort conducted at the University of Utah in which seven federal and three state agencies are joining as active collaborators. In addition, officials of mosquito abatement districts, gun clubs, land development companies and other individuals engaged in the use of the water in this area are participating in this program.

The first substantial financial support for this study was received by the University of Utah in 1961 and was for four years' duration.[1] This study was conducted on three major areas. On each area the water management impoundment units contained from 20 to 100 acres or more. The large size of the units, the fluctuation in the available water supply and the interference in the management program by some water users made it difficult to conduct controlled experiments essential for obtaining continuing precise data.

The results obtained from this study of water management provided data from which some significant conclusions were derived concerning the kinds of physical facilities essential and the water management techniques required to improve the mutual benefits desired by the multipurpose water users in this area.

As the improvements of the marshland

[1] Research Grant WP–00027, Research and Training Grants Branch, Division of Water Supply and Pollution Control, Department of Health, Education and Welfare.

for waterfowl use and the reduction of mosquito breeding are two major programs involved in water management, the accompanying marsh profile (Fig. 1) indicates where improved water management can be applied to achieve these objectives.

This profile portrays the conclusions derived from four years of intensive study that were supported by this grant (Rees *et al.*, 1966). The four most significant aspects are: (1) larvae generally do not develop in water of a depth of 12 inches or more; (2) *Culex* and *Culiseta* larvae are most abundant in permanent water which is 4 to 8 inches in depth; (3) larvae of *Aedes dorsalis* (Meigen), the most abundant and annoying mosquito produced on the marshes, are confined largely to grassy margins of impoundments when they are reflooded to a depth of 4 inches or less; and (4) waterfowl use is most extensive at water depth from 4 to 8 inches and less critical in the shallow grassy margins.

These conclusions suggest that the production of mosquitoes in these impoundments could be eliminated by maintaining the water at a depth of 12 inches or more. Such a water management practice, if physically practical, would be decidedly detrimental to waterfowl and therefore should not be attempted as an extensive procedure.

As *A. dorsalis* larvae are confined to the shallow water in the grassy margins of impoundments and are present only following each successive flooding, a change in water depth, vegetative cover, or stabilization of the water level should eliminate mosquito production in this source. As this zone is apparently less critical to waterfowl, the modification of these grassy shore lines seems to be a promising possibility for water management that would greatly reduce or eliminate the production of this important species in these impoundments.

Christopher (1953) stated that by modifying shallow shore lines, by deepening and filling, the conditions favoring mosquito production are eliminated and the area is changed from a liability to an asset. With normal water level schedules, the application of costly repetitive control measures is no longer required in areas which have been modified.

Those involved in this cooperative study were of the opinion that to further test the validity of these conclusions, shore line modifications should be constructed to accomplish these objectives and the results observed. It was also proposed by these cooperators that the evaluation of these conclusions on the effects of water depth and vegetation on mosquito production should be continued in small controlled experimental plots from which more precise data could be obtained.

On application in 1966, the University of Utah was awarded a grant from the National Communicable Disease Center to support such a study for three years.[2] All cooperators engaged in the first study pledged their support to the new program.

Under this second grant, sampling was continued at representative stations on the large units used in the previous investigations. On the Lake Front Gun, Fur and Reclamation Club study area, the shore lines on two of the large units were modified in an attempt to eliminate the habitat apparently essential for the development of *A. dorsalis* larvae. The modifications were made on the shallow grassy margins of these impoundments where *A. dorsalis* larvae appear in great numbers when the water has receded and the margins are reflooded.

On one of the large areas, (Fig. 2) seven modified units 90 feet wide and 90 to 100 feet long were constructed with average depths below the original ground level of 8, 12, 10, 6, 18, 9 and 6 inches respectively. These units were interspaced between seven undisturbed control units of approximately the same size.

On the other large area, (Fig. 3) three

[2] Public Health Service Grant CC-00171 from the National Communicable Disease Center, Atlanta, Georgia.

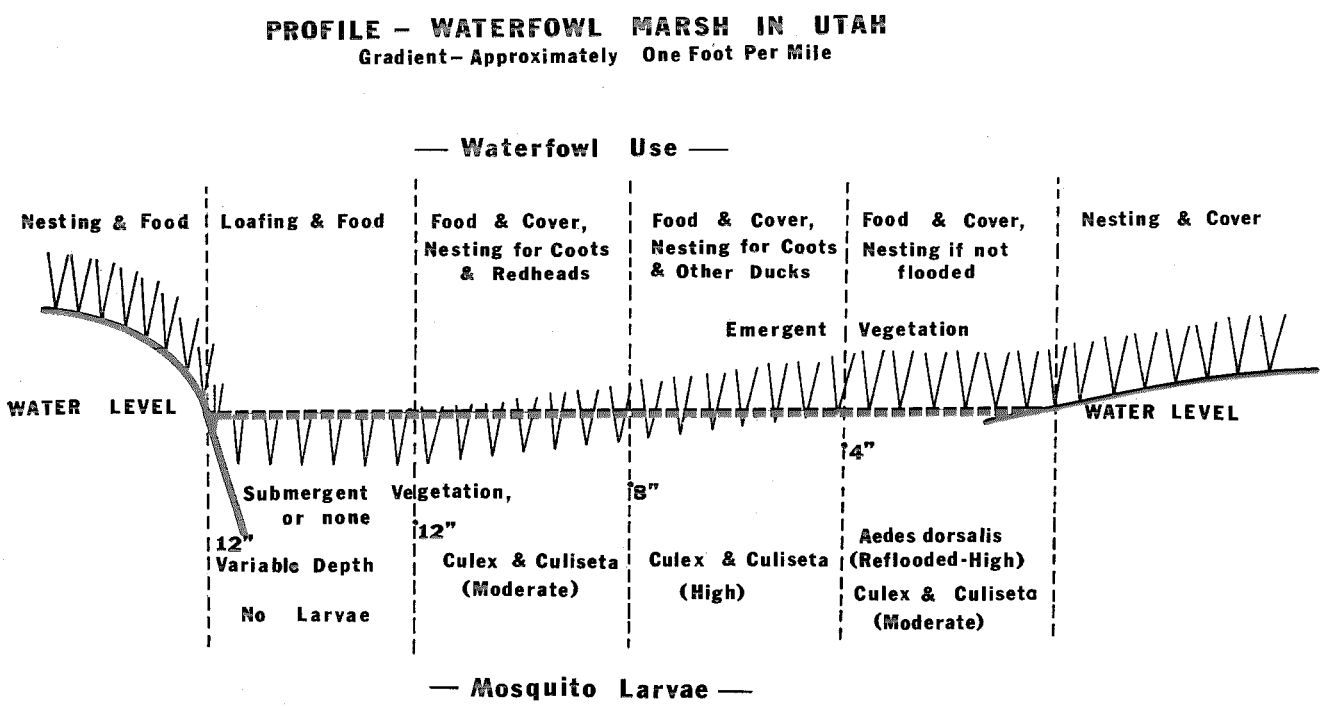

FIG. 1.—Profile of a typical fresh water marsh in Utah. Prepared as a result of a four-year study.

modifications of the shore line were similarly constructed with average depths below the original ground level of 8, 4 and 3 inches respectively. These units were divided by unmodified units. Water depths are fairly uniform in each modified unit. These depths are cut below the original ground level and terminate in vertical cuts at shore line and lateral margins.

Mosquito larval sampling and observations on waterfowl use are made each week during the mosquito producing season on each modified and unmodified unit. Periodic quantitative samples are also taken of tendipedid larvae and other aquatic insects present in the units. Measurements are also taken on vegetation types, densities and changes in the modified and unmodified control units. Deposition of sediment in the modified units is also measured in relation to time.

To date, *A. dorsalis* larvae have not appeared in the modified units regardless of water depth, while large numbers continue to develop in the adjacent unmodified control units following each successive flooding.

Waterfowl use the modified units extensively for loafing and courting and for feeding as food plants become established. It apparently requires several months after modification for the desirable submergent and floating vegetation to become established in the modified units. After two years no emergent vegetation has appeared in the modified units. On the dikes adjoining the modified units, some waterfowl nesting has taken place. The unmodified control units are used to

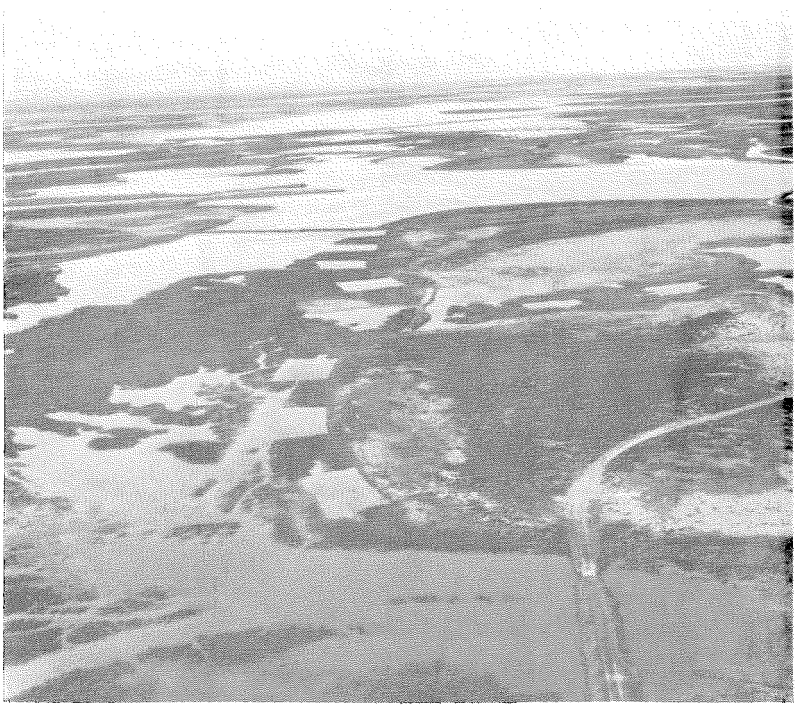

FIG. 2.—Shore line modifications—Station 11 on the Lake Front Gun, Fur and Reclamation Club.

some extent for resting, cover, feeding and nesting.

Deposition of sediment is rather rapid in the modified units immediately following modification but apparently is retarded as vegetation becomes established and the bottom becomes more firm.

It appears, after preliminary studies, that modification of the shore line, as outlined in this paper: (1) reduces mosquito production, especially *A. dorsalis;* (2) allows submergent and floating vegetation to replace less productive emergent forms; and (3) enhances the area for waterfowl nesting, loafing and feeding.

A segment of typical marsh on the Farmington Bay Waterfowl Management Area, with an adequate water supply, was chosen as a site for the construction of five small experimental ponds (Fig. 4).

The water was regulated and measured as it entered unit 1 from the canal. Spillboxes were used to regulate the flow of water from unit one into and out of the other units. Water was maintained at a constant level as indicated in units 1, 2, 3 and 4 except in the borrow pits in these units where it was 36 to 48 inches deep.

Units 2 and 3 were stocked with *Gambusia affinis affinis* (Baird and Girard) and *Lucania parva* (Baird and Girard), respectively, to test their relative effectiveness in mosquito larval control in a fairly typical fresh water marsh situation.

Unit 5 was periodically flooded and drained in an attempt to measure the maximum production of flood water species of mosquitoes on this fresh water marsh.

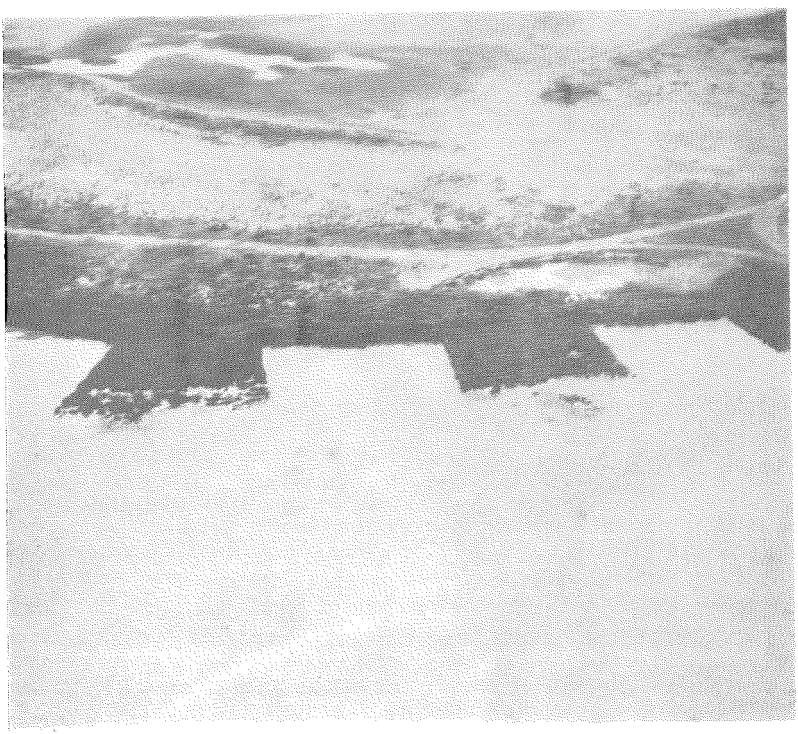

FIG. 3.—Shore line modifications—Station 10 on the Lake Front Gun, Fur and Reclamation Club.

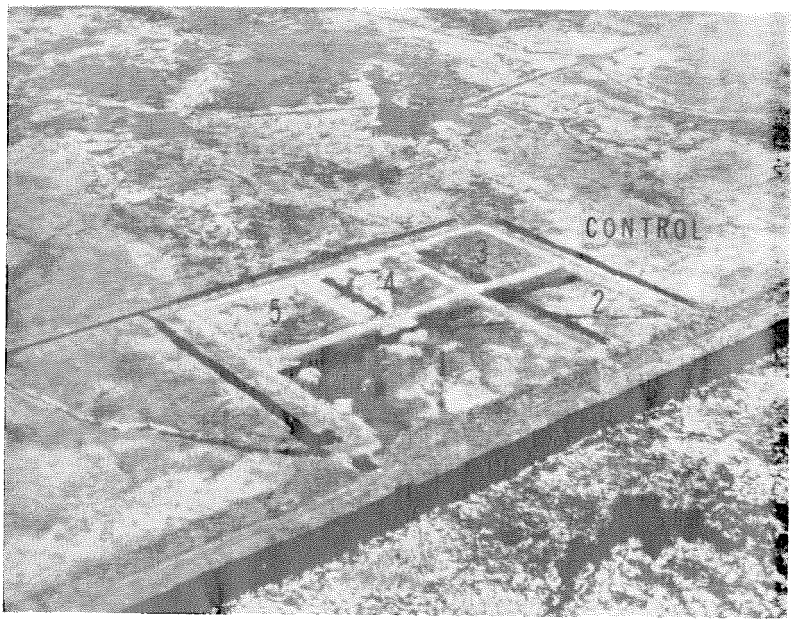

FIG. 4.—Experimental ponds—Farmington Bay Waterfowl Management Area.

Experimental Ponds (Units)

Unit	Size in Acres	Water Depth Variation (Inches)	Predominant Vegetation	Use
1	0.85	8–12	Bulrush and Cattail	Control water level constant
2	0.41	4–6	Saltgrass	Stocked with *Gambusia affinis*
3	0.24	4–6	Bulrush	Stocked with *Lacania parva*
4	0.24	4–6	Bulrush	Control unit Water level constant
5	0.24	0–6	Saltgrass and Cattail	Periodically drained and flooded
Control	1.0	0–4	Saltgrass	Typical marsh serving as a control for the experimental units

Mosquito larval sampling and observations on waterfowl use are made regularly twice each week during the mosquito producing season on each experimental and control unit. Periodic quantitative samples are taken of tendipedid larvae and other aquatic insects present in the units. Measurements are also taken on vegetation types, densities and changes. The fish in units 2 and 3 are sampled twice weekly. They are counted according to sex and stage of development. Vegetation type and water depth are recorded for each sample.

Information obtained to date is inadequate to make definite conclusions at this time. At the end of the 1968 season hopefully more definite conclusions will be derived. So far the data seem to substantiate conclusions obtained from the previous study as presented in figure 1.

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