IMPROVED METHOD OF TREATING PONDS WITH ANTIMYCIN A TO REDUCE SUNFISH POPULATIONS

By
Ralph M. Burress,
Supervisory Fishery Biologist (Research)
Southeastern Fish Control Laboratory
P. O. Box 9
Warm Springs, Georgia 31830

ABSTRACT

A new method of using antimycin to thin overcrowded sunfish populations was tested in five ponds from 2.8 to 8.2 acres in surface area. Concentrations of 0.6 to 1.6 parts per billion of antimycin applied in the shallow upper ends of the ponds removed from 21.0 to 102.1 pounds per acre of sunfishes, but killed almost no largemouth bass of any size. The partial treatment method worked well in every pond in which it was tested despite some wide diurnal fluctuations in pH. Advantages of the new method are: 1) applications are based on easily obtained estimates of water volume in the treated area and if the estimate of pond volume is in error either way, this method is likely to give useful results; 2) higher concentrations of antimycin can be used in the treated area, with little likelihood of eliminating all of the small forage fishes from the pond; and 3) there is an increased safety factor and costs of treatment are lower than for whole pond treatments.

INTRODUCTION

A new method of treating ponds with antimycin to thin overcrowded sunfish populations has undergone a limited amount of testing, and appears to offer distinct advantages over other chemical methods of population control. The relative ease, efficacy, economy, and safety of the method makes it of special interest to fishery managers who have not been fully satisfied with the results achieved with previous techniques, but who find themselves faced with increasing need for this type of management.

The widely used technique of partial poisoning of overcrowded sunfish populations with rotenone to improve population balance was introduced by Swingle, Prather and Lawrence (1953). They and other investigators (Hooper and Crance, 1960; Bennett, 1962; Thomaston, 1962; and Byrd and Crance, 1965) have outlined the methods for determining whether reduction of sunfish populations is needed, precautions to be observed in using rotenone for this purpose, procedures for so treating ponds or lakes, and the benefits derived from such treatments. Although rotenone is effective in thinning forage fish populations, its use is circumscribed by weather and water conditions, and at times undesirably large numbers of catchable size bass, crappies, sunfishes, and channel catfish have been killed (King, 1953; Huish, 1957; Hooper and Crance, 1960).

Furthermore, when marginal applications of rotenone are used, it frequently is necessary to make from two to four applications to obtain the desired reduction in numbers of fish (Thomaston, 1962). The extra expense, time, and effort involved in making multiple treatments point up the need for a more effective toxicant and better methods of application.

Antimycin, a potent new fish toxicant, has been used effectively to thin sunfish populations. Burress and Luhning (1969) treated whole ponds with concentrations of antimycin ranging from 0.4 to 1.0 parts per billion, and found that it offered some distinct advantages over rotenone. The more important of these are its considerably greater selectivity among species and size groups of pond fishes, its lack of repellency, and its greater adaptability to use under a wide range of environmental conditions. However, the definite need for a careful measure of water volume when whole ponds are treated tended to limit the usefulness of the method, hence efforts to overcome this problem were initiated.

The objectives of this study were restricted to determining: 1) whether a single treatment of antimycin at a concentration about double that required for treating whole ponds could be applied in the upper end of ponds to remove large numbers of small and intermediate size forage fishes without undue harm to desirable fishes, and 2) whether such treatments could safely be based on easily obtained estimates of water volume in the areas to be treated. Attainment of these goals would demonstrate that the new method of applying antimycin affords a more effective and easier means of thinning sunfish populations than either the use of rotenone or the treatment of whole ponds with antimycin.

The premises upon which these tests are based are as follows: 1) the smaller forage fishes, which are more susceptible to antimycin, are generally considered to be more numerous in shallow and somewhat confined waters than in deep, open waters; 2) the comparatively shallow upper half of the pond usually contains a considerably smaller volume of water than the half of the pond nearest the dam, hence treatment of only the upper end should provide a better margin of safety; and 3) if a treatment for selective thinning does not accomplish the desired results, it is preferable to produce a light kill rather than an over-kill.

The tests reported here were conducted in five ponds during the period from March 26, 1968 to June 24, 1968. Fish populations in two ponds near Montgomery, Alabama, had been observed over a period of several years by Mr. Jerry B. Denton, former District Fishery Biologist with the State of Alabama Department of Conservation. The other three ponds near Woodbury, Georgia, were located through the assistance of Mr. P. A. Gantt, S.C.S. Work Unit Conservationist, Meriwether County, Georgia, who knew the history of their stocking and management.

PONDS AND TREATMENT RATES

The ponds used in these tests are fairly representative of many ponds in Alabama and Georgia (table 1). They varied in size from 2.8 to 8.2 acres, in maximum depth from 6 to 14 feet, and pH at time of treatment ranged from 6.7 to 8.8. All were essentially devoid of higher aquatic vegetation, and fish populations differed considerably in species composition and structure (table 2). Factors such as fertilization, fishing pressure, and water supply varied widely among ponds. Youngerman Pond was unique in that it was a rather shallow, dug pond having a fairly uniform depth, and it consisted of three separate sections which were joined by narrow openings. The other ponds were constructed in the conventional manner.

The fish populations in all ponds were overcrowded with forage species, and fishing was poor. Seining revealed that largemouth bass reproduction was scant or non-existent, and intermediate sunfishes were present in large numbers. Sunfish reproduction was suppressed in Youngerman, Collins, and Morgan ponds. Youngerman Pond also contained thousands of unwanted white crappie fingerlings about an inch long.

Petrey Pond, the first in which this method was tested, was the only pond for which we prepared a contour map upon which to base detailed calculations of pond volume. The surface areas of the other four ponds were measured with transparent grids laid over S.C.S. aerial photographs. In each case inquiry was made to be certain that pond areas at the time of treatment were similar to those at the time that the photographs were made. Once the area was known, a line parallel to the dam was located so that the pond surface was bisected into two equal parts. The position of this line then was referenced with relation to landscape features around the pond, or established by measurements along the sides of the pond from each end of the dam. In the field, the location of this midline was marked by wooden stakes on each bank of the pond, and the maximum depth of water along the transect was measured by means of a sounding pole.

For all ponds except Petrey Pond and Youngerman Pond, the volume of water in the area to be treated was estimated by applying a locally used S.C.S. "rule of thumb" procedure in which average depth in ponds of conventional construction is assumed to be approximately 0.4 the maximum depth. Volume calculations for each section of Youngerman Pond were based on an average depth computed from a series of depth measurements in the different sections of the pond.

In the case of Petrey Pond, we calculated the volume of the upper end of the pond from our contour map, and treated with a concentration of 0.6 p.p.b. of liquid antimycin. This is a higher concentration than would have been selected for a whole pond treatment under the existing conditions. However, it was not so high that there was danger of producing an over-kill, because of the safety factor afforded by dilution in the much larger volume of water in the untreated lower end. The kill produced by the first application proved to be too small, hence a second treatment was made with a 1.0-p.p.b. concentration. Thereafter the upper ends of all ponds were treated with 1.0 p.p.b. or more of antimycin.

The main body of Youngerman Pond was roughly triangular in shape, and was about 5.1 acres in area. The two smaller sections of the pond, which were 1.7 and 1.4 acres in size, respectively, were closely connected to the straight lower edge of the main body of water by narrow openings about 15-20 feet wide. The shallower half of each of the three areas (the end at greatest distance from the connections) was treated with the following concentration of antimycin: 5.1-acre section, 1.2 p.p.b.; 1.7-acre section, 1.4 p.p.b.; 1.4-acre section, 1.6 p.p.b.

Prior to each test, from four to eight live cages containing a random sample of fish seined from the pond were placed in shallow and deep water in both treated and untreated areas. These were used to learn something of the distribution of antimycin in the pond and the extent of the kill produced in different areas.

The liquid formulation of antimycin, Fintrol-Concentrate, was used in all six tests. It was diluted in a 30-gallon barrel and spilled on the pond surface in front of the motorboat. Detoxification was effected by natural processes.

RESULTS OF TREATMENTS

Since there were substantial differences among ponds in species of fish present, in physical and chemical characteristics, and in number of treatments, the experimental results are presented on an individual pond basis. We must emphasize that in every case the kills of fish per acre are reported in terms of area of the entire pond rather than for the treated area only.

Petrey Pond

The first treatment, 0.6 p.p.b., was purposely made light to avoid killing adult bluegills and bass that the pond owner did not want to lose. Thus, the first kill, which amounted to 21.9 pounds per acre for the entire pond, was small and highly selective. About 98.3 percent of the sunfish removed were less than three inches long. Few golden shiners and no bass were killed (table 3). Part of the bluegills in one floating cage in the treated area were killed, but all caged fish in the untreated area survived.

The second treatment was increased to 1.0 p.p.b. to kill greater numbers of fish, and to compensate for an increase in pH from 6.7 to 8.8. This treatment,

Table 1. — Some physical and chemical characteristics of ponds at time of treatment with antimycin.

Pond characteristics	Petrey Pond 1st trial 3/26/68	Petrey Pond 2nd trial 4/09/68	Youngerman Pond 5/14/68	May Pond 6/17/68	Morgan Pond 6/19/68	Collins Pond 6/24/68
Surface area (acres)	2.8	2.8	8.2	3.9	3.9	3.9
Maximum depth (feet)						
In treated area	5.5	5.5	5.0	7.0	12.0	7.0
In entire pond	8.0	8.0	6.0	9.0	14.0	9.5
Volume (acre-feet)						
In treated area	4.1	4.1	16.4	4.3	8.8	5.4
In entire pond	10.9	10.9	32.8	11.7	21.8	14.8
Percent of volume treated	37.8	37.8	50.0	36.8	40.4	36.5
Secchi disk transparency (inches)	11	11	7	15	13	15
Surface temperature (° F.)	57	74	80	83	86	83
pH at time of treatment	6.7	8.8	7.2	8.2	8.5	7.0

which was applied in water having a surface temperature of 74° F., killed 42.6 pounds of sunfish per acre, or nearly twice as much as the first. About 98.6 percent of the sunfish eliminated by this application were less than three inches long, but they were larger than those killed in the first trial (4.56 pounds per 1,000 as compared to 3.61 pounds per 1,000). The numbers of intermediate and adult sunfish killed were very small, and 9.6 pounds of golden shiners per acre were removed. The only bass killed was a 4.5-pound fish in emaciated condition. Greater numbers of caged fish were killed in the treated area than were killed in the first test, and a few fish were killed in one submersed cage in the untreated area.

Youngerman Pond

This shallow, fertile pond supported a dense phytoplankton bloom. Its pH rose from about 7.2 in the morning to 8.9 by mid-afternoon, and its surface temperature reached a level of 90° F. by midday. Under these conditions, inactivation of the antimycin would be rapid, hence concentrations of 1.2, 1.4, and 1.6 p.p.b. were used in treating the three sections.

Within 2 hours after treatment was completed, a strong south wind arose and blew almost steadily for the next 24 hours. So many dead fish were blown into the main body of the pond from the smaller sections that we could not assess the effects of differential treatments. Over-all, the treatment removed 63.2 pounds per acre of sunfishes. More than two-thirds of the weight was comprised of intermediate size sunfish. About 4.1 pounds of golden shiners per acre, 0.8 pounds of grass pickerel, and 3.5 pounds of large spotted suchers were removed. Far more significant was the destruction of at least 7,050 fingerling crappies per acre, plus about 23 larger crappies from 4 to 8 inches long. A few

Table 2. — Species of fish present in each pond

Species	Petrey Pond	Youngerman Pond	May Pond	Morgan Pond	Collins Pond
Golden shiner *(Notemigonus crysoleucas)*	X	X	—	X	—
Spotted sucker *(Minytrema melanops)*	—	X	—	—	—
Mosquitofish *(Gambusia affinis)*	—	X	—	—	—
Pirate perch *(Aphredoderus sayanus)*	—	X	—	—	—
Warmouth *(Chaenobryttus gulosis)*	—	X	—	—	—
Green sunfish *(Lepomis cyanellus)*	X	X	—	—	—
Bluegill *(Lepomis macrochirus)*	X	X	X	X	X
Redear sunfish *(Lepomis microlophus)*	X	X	—	—	X
Largemouth bass *(Micropterus salmoides)*	X	X	X	X	X
White crappie *(Pomoxis annularis)*	—	X	—	—	—

Table 3. — Numbers and pounds per acre of fish killed and percentages (in parentheses) of the kill comprised by various size groups of sunfishes

Pond	Concentration of antimycin (p.p.b.)	Total sunfish killed/acre[1]		Number and pounds per acre, and percentage (in parentheses) of sunfish in each size group: Less than 3"		3-5"		Over 5"	
		No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Petrey (2.8 acres)	0.6	5,521.7	21.9	5,429.3 (98.3)	19.6 (89.5)	88.1 (1.6)	2.1 (9.6)	3.6 (0.1)	0.2 (0.9)
Petrey (2.8 acres)	1.0	8,899.3	42.6	8,777.9 (98.6)	40.0 (93.9)	120.7 (1.4)	2.6 (6.1)	0.7 (TR.)[3]	(TR.)[2] (TR.)
Youngerman (8.2 acres)	[4]	2,302.3	63.2	947.0 (41.1)	8.6 (13.6)	1,278.0 (55.5)	43.3 (68.6)	77.3 (3.4)	11.3 (17.8)
May (3.9 acres)	1.0	7,281.3	47.4	7,024.1 (96.5)	24.0 (50.6)	203.1 (2.8)	9.2 (19.4)	54.1 (0.7)	14.2 (30.0)
Morgan (3.9 acres)	1.2	3,506.7	32.6	3,417.2 (97.4)	28.2 (86.5)	66.7 (1.9)	1.4 (4.3)	22.8 (0.7)	3.0 (9.2)
Collins (3.9 acres)	1.0	2,393.8	102.1	464.1 (19.4)	3.1 (3.0)	1,753.3 (73.3)	80.1 (78.5)	176.4 (7.3)	18.9 (18.5)

[1] Kills of fish per acre are reported in terms of total pond area, rather than for treated portions only.
[2] Less than 0.1 pounds per acre.
[3] Less than 0.1 percent
[4] Concentrations of 1.2, 1.4 and 1.6 p.p.b. used in different subsections of pond.

pirate perch also were removed, but no bass were killed. All of the caged bluegills under three inches long and well over half of the larger caged bluegills in the treated areas were killed. In contrast, most of the caged bluegills outside the treated areas survived.

May Pond

This poorly managed, infertile pond contained large numbers of small bluegills, and the bass population was in poor condition. Sunfish less than three inches long made up 96.5 percent of the fish killed, and comprised half the 47.4 pounds per acre of fish removed. The number of intermediate sunfish killed was comparatively small, but the fish were considerably larger than those removed from Petrey, Youngerman and Morgan ponds. We killed more adult sunfish here than in any other pond (54.1 fish per acre weighing 14.2 pounds), probably because the choice nesting sites were in the treated area. Prior to the application of antimycin we had been unable to find bass reproduction, but we recovered a half dozen gaunt fingerlings 1.25 inches long and a 1-pound adult following the treatment. The total mortality of caged bluegills which occurred in this soft-bottomed pond was felt to have resulted in part from stress induced by the adverse conditions under which they were captured by seining.

Morgan Pond

This pond also was rather infertile and poorly managed, and bass apparently had not been able to reproduce successfully for two years prior to treatment. The procedure followed in treating this pond was changed slightly in that the application was made in early afternoon to learn how well the elevated pH of 8.5 could be compensated for by using a 1.2-p.p.b. rather than a 1.0-p.p.b. concentration of antimycin. Surface temperature when the antimycin was applied was 86° F.

The treatment killed 32.6 pounds per acre of sunfishes and a surprisingly small number of golden shiners (about 0.13 pounds per acre). About 97.4 percent of the sunfish removed were large fingerlings (8.25 pounds per 1,000), which were rather gaunt and unthrifty in appearance. The kill was selective, but it would have been even more beneficial if we had used a slightly higher concentration of antimycin and removed greater numbers of sunfish per acre. The kill of caged bluegills was as follows: nearly all fish in floating cages were killed; all fish in the submersed cage in the treated area died; and half of the fish in the submersed cage outside the treated area succumbed.

Collins Pond

This 3.9-acre pond was more fertile than the two preceding ponds, and contained a large population of intermediate bluegills. Reproduction success of the bass and forage fish was depressed, and the relatively few fingerling bass present had little to eat. The 1.0-p.p.b. concentration was applied late in the morning at a water temperature of 83° F. and a pH of 7.0. It removed 102.1 pounds of sunfish and 0.15 pounds of small bass per acre. The sunfish kill per acre consisted of 3.1 pounds of fingerlings, 80.1 pounds of intermediates and 18.9 pounds of adults. The comparatively high kill of adults again resulted from the fact that they were nesting in the treated area. Thus, in circumstances where minimizing the kill of adult bluegills would be beneficial, treatments should be made when the fish are not spawning. The complete kill of caged bluegill in this pond was attributed to two factors: 1) the adverse conditions under which they were collected; and 2) the diurnal elevation in pH was small in this pond, and detoxification of the antimycin occurred more slowly.

DISCUSSION

The basic purpose of this experiment was to develop a simpler, safer way of using antimycin to thin overcrowded sunfish populations in ponds with minimum risk of decimating the adult sunfish or significantly reducing the populations of largemouth bass. The previously described method whereby whole ponds are treated with low concentrations of antimycin is effective, but a more accurate measure of water volume is required than is readily available for most ponds. When it is used in ponds in which there is a pronounced diurnal fluctuation in pH, there is a considerably greater likelihood that a somewhat light treatment will produce little, if any, kill. Conversely, in ponds having soft water and low pH values, a somewhat heavy treatment will more likely produce too great a kill.

The new method of partial treatment tends to minimize these difficulties for several reasons which can best be illustrated by the following examples and considerations.

1. A 1.0-p.p.b. application of antimycin in the upper end of a pond (commonly 35-40 percent of the total pond volume) could yield a maximum concentration of only 0.35 to 0.40 p.p.b. if the antimycin were mixed thoroughly in the entire pond. In actual practice, however, the concentration could not possibly reach these theoretical levels throughout the whole pond, because antimycin begins to degrade immediately upon application and mixing never is complete. As a result, many fish in the untreated area are exposed to lower concentrations, and target fishes in the treated half of the pond are exposed for several hours to considerably higher concentrations of antimycin than if the same amount of material were distributed uniformly throughout the pond. The presence of these areas of relatively low concentrations of antimycin thus affords a safety factor that lessens the likelihood of excessive reduction of populations of desirable fishes in case pond volume were overestimated and too much antimycin applied. This margin of safety allows private pond owners to treat their ponds with the confidence and with a minimum of technical assistance.

2. When whole pond treatments were done, we consistently removed nearly all of the smallest size groups of forage fishes. Although good selectivity was achieved, an unnatural distribution of size groups in the population resulted, and fingerling and intermediate size bass were left with virtually no forage fish upon which they could prey. These conditions are not so likely to occur when partial treatments are used, because the lower concentration of antimycin in some of the untreated areas tends to permit survival of some of the smaller fish. At the same time, a satisfactory reduction in the numbers of intermediate sizes of fish quite likely will be accomplished.

3. Successful treatment is dependent upon both the concentration of the toxicant and the length of exposure. In ponds such as Youngerman Pond in which pH rises from near neutral in early morning to about 9.0 by mid-afternoon, effective and economical treatments can be made with relatively little risk of either an unacceptably small or an undesirably large kill. Target fish in the treated area are exposed to sufficient antimycin to get a lethal dose in the few hours before the toxicant is degraded, yet degradation is rapid enough that the danger of an over-kill is almost negligible.

The treatment of Youngerman Pond was of special interest in that apparently the young-of-the-year white crappie were decimated, and some of the intermediate size crappie were killed. Previously there was no satisfactory method for accomplishing this purpose, because even small crappie seldom are found close enough to the shoreline to be killed by marginal treatments with rotenone.

There is still another advantage of the partial treatment method that should be mentioned. If the total amounts of antimycin used in each of the applications had been applied as whole pond treatments, the resulting concentrations would have ranged from 0.23 to 0.66 p.p.b. Under the existing conditions of temperature and pH, I am almost certain that they would have failed with the possible exception of Collins Pond where the pH was 7.0, the temperature was 83° F. and the concentration would have been 0.36 p.p.b. Thus, the method of partial treatment is less expensive, which is a worthwhile consideration to cost-conscious fishery managers. The total cost of the antimycin used in these tests (based on the retail price of $38.00 per unit of toxicant) ranged from $2.40 for the first light treatment of Petrey Pond to $21.20 for Youngerman Pond.

In conclusion, the partial treatment method worked well in every pond in which it was tested despite some wide diurnal fluctuations in pH; partial treatments were less expensive than whole pond treatments would have been; the kill of adult sunfishes was well within acceptable limits, and almost no largemouth bass of any size were killed; if the estimate of pond volume is in error either way, this method is more likely to give useful results than would the previous method of treating whole ponds. I recommend that additional experimental work be done: 1) to evaluate the possibility of controlling year classes of crappie by this method, and 2) to test this new technique in ponds both smaller and larger than those we used in order to define its range of applicability.

CONCLUSIONS

1. Selective thinning of overcrowded sunfish populations was accomplished by making comparatively heavy applications of antimycin in the upper ends of five ponds which ranged in size from 2.8 to 8.2 surface areas.
2. Antimycin concentrations ranging from 0.6 to 1.6 p.p.b. in the treated areas removed from 21.0 to 102.1 pounds of sunfishes per acre, decimated young-of-the-year white crappie in one pond, but killed almost no largemouth bass of any size.
3. In comparison with the previous method of whole pond treatment, application of comparatively high concentrations of antimycin in the shallow upper half of the pond exposes target fishes to higher, longer lasting concentrations of antimycin in the treated area while tending to permit survival in untreated areas of more of the small forage fishes that are needed for food by fingerling and intermediate sizes of largemouth bass.
4. With one exception, applications were based on rather gross estimates of water volume in the treated areas which were obtained quickly and easily.
5. Only 36.5 to 40.4 percent of the total volume was treated in four ponds of conventional construction, hence less antimycin was needed and treatment costs were cut.
6. This method of treatment lends itself to practical use by inexperienced pond owners.

ACKNOWLEDGEMENTS

Our thanks are expressed to the following whose cooperation made these field trials possible: Mr. Jerry E. Moncrief and Mr. Leslie E. Chew, who assisted with all phases of the field work; Dr. J. E. Collins, Messrs. C. R. May, E. B. Morgan, C. M. Petrey, and G. C. Youngerman, who permitted us to use their ponds for experimental purposes; Mr. Jerry B. Denton, who located two ponds for us and rendered much needed assistance on several occasions; Mr. P. A. Gantt, who located three ponds for us and secured permission for us to use them; and Ayerst Laboratories, New York, who supplied the toxicant.

REFERENCES

Bennett, George W. 1962. Management of artificial lakes and ponds. Reinhold Publishing Corporation, London, England. 382 p.

Burress, Ralph M., and Charles W. Luhning. 1969. Use of antimycin for selective thinning of sunfish populations in ponds. U. S. Bureau of Sport Fisheries and Wildlife, Investigations in fish control: 28, 10 p.

Byrd, I. B., and Johnie H. Crance. 1965. Fourteen years of management and fishing success in Alabama's state-owned public fishing lakes. Transactions of the American Fisheries Society, vol. 94, no. 2, p. 129-134.
Hooper, Archie D., and Johnie H. Crance. 1960. Use of rotenone in restoring balance to overcrowded fish populations in Alabama lakes. Transactions of the American Fisheries Society, vol. 89, no. 4, p. 351-357.
Huish, Melvin T. 1957. Gizzard shad removal in Deer Island Lake, Florida. Proceedings of the Eleventh Annual Conference of the Southeastern Association of Game and Fish Commissioners, Mobile, Alabama, October 20-23, p. 312-318.
King, John E. 1953. Growth rates of fishes in Lake Hiwassee, Oklahoma, after two years of attempted populations controls. Proceedings of the Oklahoma Academy of Science, vol. 34, p. 53-56.
Swingle, H. S., E. E. Prather, and J. M. Lawrence. 1953. Partial poisoning of overcrowded fish populations. Agricultural Experiment Station of Alabama Polytechnic Institute, Circular No. 113, 15 p.
Thomaston, W. W. 1962. The results of population alteration and factors affecting balance in farm ponds in Georgia. Proceedings of the Sixteenth Annual Conference of the Southeastern Association of Game and Fish Commissioners, Charleston, South Carolina, October 14-17, p. 361-370.

DREDGING, FILLING, AND THE INALIENABLE PUBLIC TRUST - THE FUTURE OF FLORIDA'S SUBMERGED ENVIRONMENT

by

John W. Bellinger
Bureau of Sport Fisheries and Wildlife
Vero Beach, Florida

ABSTRACT

Dredging and filling, especially to create waterfront property, has had serious adverse effects on Florida's submerged environment. Primary adverse effects of dredging and filling are disturbance or elimination of established aquatic habitats. Dredging and filling peaked in Florida from the 1920's through the 1950's when large tracts of submerged land were sold to attract outsiders. Submerged lands are generally considered to be held in inalienable public trust and legal questions arise concerning sale of these publicly-owned lands. First controls over sale of submerged bottoms and dredging-filling were in the 1957 Bulkhead Act. In 1969 the State established a system of aquatic preserves and the 1970 Legislature passed a bill prohibiting the sale of submerged lands except when clearly in the public interest.

The State of Florida and the Army Corps of Engineers share concurrent jurisdiction in the issuance of dredge-fill permits. The State is authorized under the Bulkhead Act and the Corps under the 1899 River and Harbor Act. Public concern over dredging and filling led to passage of several federal bills, including the National Estuary Study Act of 1968, the National Environmental Policy Act of 1969, and the Water Quality Improvement Act of 1970. The Corps of Engineers have announced they are no longer concerned only with navigation aspects and will give greater consideration to effects on natural resources.