Hooper, A. D., and J. H. Crance. 1960. The use of rotenone in restoring balance of overcrowding fish populations in Alabama lakes. Trans. Am. Fish. Soc., 89(4): 351-357.

Schnick, R. A. 1974. A review of the literature on the use of antimycin in fisheries. U. S. Fish and Wildlife Service, Fish Control Lab. La Crosse, Wisconsin, Typewritten. 85 pp.

Swingle, H. S. 1945. Improvement of fishing in old ponds. Trans. N. Am. Wildl. Conf., 10: 299-308.

Swingle, H. S. Experiments with combinations of largemouth black bass, bluegills, and minnows in ponds. Trans. Am. Fish. Soc., 76: 46-62.

1951. Experiments with various rates of stocking bluegills *(Lepomis macrochirus)* (Rafinsque), and largemouth bass *(Micropterus salmoides)* (Lacepede), in ponds. Am. Fish Soc., 80: 218-230.

1952. Farm Pond Investigations in Alabama. J. Wildl. Manage. 12(3): 243-249.

1956. Determination of balance in farm fish ponds. Trans. N. Am. Wildl. Conf., 21: 298-322.

E. E. Prather, and J. M. Lawrence. 1953. Partial poisoning of overcrowded fish populations. Ala. Poly. Inst. Agri. Exp. Sta., Circ. 113. 15 pp.

Thomaston, W. W. 1965. The results of population alteration and factors affecting balance in farm ponds in Georgia. Proc. Southeast. Assoc. Game Fish Comm. 16: 361-370.

Walker, C. R. R. E. Lennon, and B. L. Berger. 1964. Laboratories and methods for screening fish-control chemicals. U. S. Bur. Sport Fish. Wildl. Invest. Fish Control. Circ. 185. 15 pp.

THANITE (ISOBORNYL THIOCYANOACETATE) AS AN AID FOR LIVE COLLECTION OF FISHES IN FLORIDA PONDS

by

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ABSTRACT

Applications of 1.5 mg/l of Thanite were made in a 0.68-hectare hard-water pond and a 3.64-hectare soft-water pond in Florida. The 19 species of fishes collected alive represented the following families: Lepisosteidae; Anguillidae; Esocidae; Cyprinidae; Catostomidae; Ictaluridae; Aphredoderidae; Cyprinodontidae; Poeciliidae; Atherinidae; and Centrarchidae. The treatment was not effective for collecting bowfin (*Amia calva*), yellow bullheads (*Ictalurus natalis*), or brown bullheads (*I. nebulosus*). Thanite eliminated all but 20 fish (0.4 percent) in the small pond and 100 (1.4 percent) in the large pond.

INTRODUCTION

During the past 35 years, American fishery workers have tested not less than 66 compounds or combinations of compounds to determine their potential as aids in the live collection of fish. To date, none have been registered with the U.S. Environmental Protection Agency for use as a collecting aid. With the exception of Thanite, an insecticide of low mammalian toxicity, each of the compounds has proved to have disadvantages or limitations such as high cost, undesirable effects on target and nontarget organisms, or distinct hazards to users.

Field tests of Thanite (82 percent isobornyl thiocyanoacetate and 18 percent other active terpenes) during the past 6 years have yielded encouraging results. Lewis (1968) reported excellent success in using it to collect adult largemouth bass (*Micropterus salmoides*) in two ponds (0.12 and 1.82 hectares) in southern Illinois. C. J. Perkins (International Paper Company, Bainbridge, Georgia, personal communication, December 1969) used Thanite in about 25 ponds in southwestern Georgia to remove large numbers of largemouth bass and bluegills (*Lepomis macrochirus*) and a small number of striped bass (*Morone saxatilis*). Experiments conducted at the Southeastern Fish Control Laboratory (Annual Report 1971) showed that sedation of adult largemouth bass and bluegills with a 2-mg/l concentration of Thanite at monthly intervals for 5 months before spawning time did not impair reproductive success. Burress (1972), who treated a blocked off 0.61-hectare section of a 2.83-hectare pond in northeastern Illinois, found that use of Thanite was about 2.6 times more effective than electrofishing for live recovery of several species of sport fishes (38.6 versus 14.7 fish per hour). The cost of materials used in the Thanite spray mixture was $0.26 per pound of fish recovered alive. Cumming, Burress, and Gilderhus (1975) used a 5-mg/l concentration of Thanite to treat two 0.04-hectare experimental ponds in east central Arkansas at water temperatures of 0.5-2.5 C; green sunfish (*Lepomis cyanellus*), channel catfish (*Ictalurus punctatus*), and large grass carp (*Ctenopharyngodon idella*) were effectively collected.

The research reported here was performed to provide efficacy data needed to support efforts toward obtaining EPA registration of Thanite as an aid in the live collection of fish. Wide-scale testing must be done under a variety of ecological conditions to 1) evaluate the efficacy of Thanite in waters having different physical, chemical, and biological characteristics, 2) evaluate the susceptibility to Thanite of different sizes of as many fish species as possible in static waters, and 3) observe any readily discernible adverse effects on macroscopic nontarget organisms. The isolated freshwater ponds selected for these tests are near Steinhatchee (Taylor County) and Durbin (St. Johns County), Florida, and were treated in November 1973.

MATERIALS AND METHODS

Ponds used in this study consisted of two old rectangular borrow pits with distinctly different chemical and physical characteristics (Table 1). Tide Swamp Pond had average and maximum depths at the time of treatment of about 2.3 and 3.8 m. The water was hard and the bottom was composed of sand and mud over dolomite. Short, dense growths of *Chara* sp. extended to a depth of about 1.2 m around much of the pond margin, and the fairly clear water facilitated collection of the treated fish. McCormick Pond had average and maximum depths of 0.9 and 1.5 m. The water was very soft, and the bottom was hard mud. Dense stands of aquatic weeds were present in certain areas. The darkly stained water, in combination with the vegetation, hindered collection of sedated fish. Both ponds are steep-sided and subject to overflow from adjacent creeks during periods of high water.

Table 1. Physical and chemical characteristics of Tide Swamp Pond and McCormick Pond at the time of treatment with Thanite in November 1973.

Characteristic and unit of measurement	Tide Swamp Pond	McCormick Pond
Surface area (hectare)	0.68	3.64
Depth (m)		
Average	2.29	0.91
Maximum	3.81	1.52
Volume (m^3)	15,541.7	33,303.7
Temperature (°C)		
Surface	19.0	18.0
Bottom	19.0	18.0
Secchi disk transparency (cm)	100.0	50.0
pH (diurnal range)	7.3-8.3	6.7-7.2
Dissolved oxygen (mg/l)		
Surface	6.6	9.6
Bottom	6.2	---
Total alkalinity (mg/l)	148	15
Conductance (mhos)	230	33

Stock solutions of Thanite, kerosene, and the emulsifier Atlox 1045-A were mixed in a ratio of 70:20:10 parts by volume just prior to pond treatment. The stock then was diluted with water and applied in water areas less than 2 m deep with venturi pumps (boat bailers). A 4-m-long siphon hose terminating in a 1-m-long section of perforated 1.27-cm pipe was used to treat deeper waters. To avoid overly rapid sedation of small fishes, we first applied enough Thanite to yield a 1-mg/l concentration in each of the ponds, and less than an hour later added enough of the chemical to increase the concentration to 1.5 mg/l. After each application of Thanite, the crews of pickup boats operated outboard motors at full throttle for a few minutes to ensure thorough vertical distribution of the chemical. Live collection of fish was accomplished by two crews of two persons each in 0.68-hectare Tide Swamp Pond and by four crews in 3.64-hectare McCormick Pond. Most of the fish that could be collected alive were captured within 5 hours after the second application of Thanite was completed, and collection efforts were terminated.

Collected fish were placed in 113-liter containers of fresh water carried by each pickup boat, then transferred periodically to larger tanks of fresh water on the shore, where they were allowed to recover. Water in the 113-liter cans was changed at least once during the period of fish collection, and water in the tanks was aerated by means of battery-powered agitators to hasten recovery of the fish and minimize losses.

Because of the lack of adequate holding facilities and the limited time available, assessment of mortality of treated fish held in the recovery tanks was made in late afternoon on the day of treatment. Most fish recovered rapidly. The fish remaining in the ponds were killed by the Thanite treatment and were collected over a period of 3 days. We then treated with rotenone to determine the completeness of the Thanite-induced kill.

Throughout the treatment and collection period, we tried to observe the effects of Thanite on nontarget organisms.

RESULTS

Tide Swamp Pond

As the Thanite began to take effect, fish tended to surface briefly, but they were still too alert to be captured. As sedation deepened, they swam about in an increasingly

disoriented manner. Some fish attempted to hide in vegetated areas or sought other cover, while others floated listlessly at the surface or settled to the bottom. In general, small fish were affected first and died sooner than larger ones. Occasionally, a large fish that was not in good condition surfaced well before healthy young fish of the same species were sedated.

The fish population of this infertile pond included 13 species, only 4 of which were important in both number and weight. Application of the 1-mg/l concentration was begun at 1100. By 1120 fingerling sunfishes began to surface in collectible condition, and by 1140 adult sunfishes began to appear. The application of the additional 0.5-mg/l treatment at 1200 brought up the first juvenile largemouth bass and adult lake chubsuckers (*Erimyzon sucetta*). By mid-afternoon largemouth bass (up to 572 mm) began to appear, but it was 1730 before the first American eels (*Anguilla rostrata*) were collected.

Collecting efforts were largely directed toward intensive collection of large specimens of largemouth bass, bluegill, and lake chubsucker (Table 2). Large lake chubsuckers were particularly easy to collect due to their habit of struggling at the surface for as long as 30 seconds at a time. We also were able to net several species of small fishes, including the bluespotted sunfish (*Ennaecanthus gloriosus*), mosquitofish (*Gambusia affinis*), pirate perch (*Aphredoderus sayanus*), and tadpole madtom (*Noturus gyrinus*), but did not transfer them to the recovery tanks. On the other hand, no yellow bullheads (*Ictalurus natalis*) or brown bullheads (*I. nebulosus*) were seen until dead specimens surfaced some 72 hours after treatment. At that time, a few American eels were observed, but they were too alert to permit capture.

Table 2. Numbers, percentages, and weights of fishes collected alive or recovered dead in Tide Swamp Pond following treatment with Thanite.

Species, size group, and total length (mm)	Fish collected alive			Fish collected dead		Total	
	No.	Percent of size group	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)
Largemouth bass							
Small (<101)	12	(27)	0.12	32	0.32	44	0.44
Juvenile (101-202)	25	(60)	1.16	17	0.45	42	1.61
Large (>202)	20	(71)	11.41	8	2.89	28	14.30
TOTAL	57	(50)	12.69	57	3.66	114	16.35
Bluegill							
Small (<76)	12	(0)a	0.03	2,899	8.80	2,911	8.83
Juvenile (76-127)	89	(6)	2.13	1,350	16.63	1,439	18.76
Large (>127)	455	(69)	22.08	206	8.09	661	30.17
TOTAL	556	(11)	24.24	4,455	33.52	5,011	57.76
Warmouth							
Small (<76)	8	(1)	0.06	702	3.29	710	3.35
Juvenile (76-127)	5	(4)	0.17	114	1.68	119	1.85
Large (>127)	--	--	--	6	0.31	6	0.31
TOTAL	13	(1)	0.23	822	5.28	835	5.51
Spotted sunfish							
Small (<76)	--	--	--	1	Tb	1	Tb
Juvenile (76-127)	9	(18)	0.37	42	0.91	51	1.28
Large (>127)	--	--	--	6	0.31	6	0.31
TOTAL	9	(16)	0.37	49	1.22	58	1.59
Lake chubsucker							
Small (<101)	7	(22)	0.20	25	0.38	32	0.58
Juvenile (101-202)	13	(87)	0.97	2	0.20	15	1.17
Large (>202)	30	(94)	14.02	2	0.43	32	14.45
TOTAL	50	(63)	15.19	29	1.01	79	16.20

American eel							
Juvenile (254-381)	4	(9)	0.23	21	1.16	43	2.43c
Golden shiner							
Large (>127)	1	(50)	0.03	1	0.06	2	0.09
Bluespotted sunfish							
Large (>51)	--	--	--	8	0.06	2	0.09
Pirate perch							
Large (>101)	--	--	--	1	0.06	1	0.06
Mosquitofish							
Large (>36)	--	--	--	13	Tb	13	Tb
Yellow bullhead							
Small (76-127)	--	--	--	3	0.09	3	0.09
Large (>304)	--	--	--	1	0.51	1	0.51
TOTAL	--	--	--	4	0.60	6	0.74c
Brown bullhead							
Large (>304)	--	--	--	1	0.79	1	0.79
Tadpole madtom							
Juvenile (51-76)	--	--	--	39	0.79	39	0.79
TOTALS	690	(11)	52.98	5,500	47.49	6,210	101.65

aLess than 1 percent.
bT=trace (less than 0.01 kg).
cTotals include the following fish killed with rotenone after treatment with Thanite (weight in kilograms in parentheses); American eel—18 (1.04); yellow bullhead, 127-202 mm long—2 (0.14).

Over a period of 5 hours the following percentages by number and weight, respectively, of various size groups of fishes were collected (Table 2): juvenile largemouth bass—60 and 72; adult—71 and 80; adult bluegills—69 and 73; juvenile lake chubsuckers—87 and 83; and adult lake chubsuckers—94 and 94. The following percentages of the fish collected alive survived: largemouth bass, 100; adult bluegills, 92; juvenile chubsuckers, 92; and adult chubsuckers, 100. All of the small numbers of golden shiners (*Notemigonus cyrsoleucas*), warmouths (*Lepomis gulosus*), American eels, and spotted sunfish (*Lepomis punctatus*) that were collected alive survived. Fingerling bass and subadult bluegills were not collected until the more desired fishes had been netted and transferred to fresh water. Consequently, 58 percent of the fingerling bass and 24 percent of the subadult bluegills died because the time of exposure was too long.

On the day after treatment we observed glass shrimp (*Palaemonetes* sp.), dragonfly nymphs (*Progomphus* sp.), backswimmers (*Notonecta* sp.), and whirligig beetles (*Gyrinus* sp.) behaving normally. However, a few adult predacious diving beetles (*Dytiscus marginalis*) were found dead.

A 2-mg/l concentration of rotenone was applied about 2 weeks after the Thanite treatment. Collections of fish for 3 days yielded only 2 subadult yellow bullheads, 135 and 187 mm long, and 18 American eels, 230 to 305 mm long. Only 20 (0.4 percent) of the 5,500 fish not collected alive from the pond survived the Thanite treatment.

McCormick Pond

Because of the much larger size of this pond, we did not attempt to collect live fish in quantity. Our primary objective was to determine the effect of the 1.5-mg/l concentration of Thanite in the much softer water and on species of fishes not present in Tide Swamp Pond. We also wanted to see whether less favorable environmental and operational conditions would reduce the efficiency of the operation appreciably.

The response produced by the 1-mg/l treatment seemed to be slow, so the supplemental 0.5-mg/l application was added only 30 minutes later. Because sedation occurred more gradually, there was a definite tendency for fish to hide in weedy areas before the Thanite took full effect. Juvenile bass, especially, tended to seek cover. Other factors that hindered fish collection included the very dark color of the water, wind rippling of the pond surface, glaring reflections, and the large area (0.91 hectare) each crew had to cover.

In 5 hours of selective collecting we netted a total of 104 fish comprised of 16 species. These included 8 species not present in Tide Swamp Pond: redear sunfish (*Lepomis* microlophus); flier (*Centrarchus macropterus*); black crappie (*Pomoxis nigromaculatus*); redfin pickerel (*Esox americanus americanus*); chain pickerel (*Esox niger*); Florida gar (*Lepisosteus platyrhincus*); brook silverside (*Labidesthes sicculus*); and golden topminnow (*Fundulus chrysotus*). However, only the small gar (less than 254 mm total length) were collected alive, and they were the last species to be affected. American eels, bowfin (*Amia calva*), yellow bullheads, and brown bullheads were not seen until dead specimens appeared 1 or 2 days after treatment.

Numbers of whirligig beetles were observed on several days after treatment, and all appeared to behave normally. Live glass shrimp were collected 3 days posttreatment.

A 2-mg/l concentration of rotenone applied on the third day after the Thanite application killed the remaining gar, eels, bowfin, and bullheads. Of the 7,018 fish not collected alive from the pond, only 100 (1.4 percent) survived the Thanite treatment (2 of 6 bowfin, 6 of 11 eels, 17 of 38 gar, 29 of 46 brown bullheads, and 46 of 51 yellow bullheads). Twelve greater siren (*Siren lacertina*) and 12 congo eels (*Amphiuma means*) were collected, but not all of these amphibians were killed.

DISCUSSION

Our data indicate that Thanite is potentially an effective, safe, and relatively inexpensive tool for the live collection of various fishes. Bluegills, fliers, bluespotted sun-

fish, and brook silversides appear to be more sensitive to Thanite than other fishes of similar length. Redear sunfish, warmouth, largemouth bass, and lake chubsuckers are somewhat less sensitive. Golden shiners, tadpole madtoms, and the two species of pickerel definitely are more tolerant than most species, but are not as resistant as Florida gar, American eels, and bowfin. Bullheads are more resistant still, and yellow bullheads appear to be most resistant of all.

The response of centrarchids was regarded as good in Tide Swamp Pond where the Thanite application appeared to be close to optimal. Sedation occurred quickly enough that more than two-thirds of the larger bass and bluegills were collected within 2 hours, and their recovery and survival in tanks equipped with agitators was excellent. The percentage of the populations collected in both ponds undoubtedly would have been greater if it had been possible to lower the water level before treatment to prevent the loss of fish in dense stands of aquatic weeds. Summerfelt and Lewis (1967) reported that Thanite has a repellant effect. As additional research with Thanite is conducted, it might be well to pump strong concentrations into weedy areas when treatment is initiated to determine whether fish can be driven from such areas.

Our observations suggest several guidelines and possibilities regarding the use of Thanite. Small fishes are sedated fairly quickly and die sooner than larger ones. Thus, if the target fishes are small, it probably would be well to use an initial dose lower than 1 mg/l and to employ more pickup crews to shorten the time between sedation and collection. Conversely, when the target species are more resistant fishes such as bowfin and gar, the concentration must be increased accordingly to cause them to surface. Otherwise, many of them may succumb while lying in a torpid condition on the pond bottom or under cover.

Although the same concentrations of Thanite and methods of application were used for both tests, the response of fish was quicker and sedation was more nearly optimal in Tide Swamp Pond. The major differences in water quality were that the diurnal pH of Tide Swamp Pond was higher (7.8-8.3 vs. 6.7-7.2) and total alkalinity was higher (148 vs. 15 mg/l). Whether these factors were responsible for the better results achieved is not known. Additional paired tests will be required to evaluate the effects of various physical-chemical factors.

Since Thanite is selective by size and species, it may be useful for thinning overcrowded populations of sunfishes or for selective removal of scalefishes from catfish population where high pH precludes the use of antimycin. However, before the use of Thanite is sanctioned, it will be necessary to demonstrate complete safety data and to obtain registration from EPA.

The possibility of employing Thanite for fish salvage in connection with pond renovation is well illustrated by our experience at Tide Swamp Pond. Treatment with a 1.5-mg/l concentration of Thanite eliminated all of the scalefishes. Thus, ponds which do not contain resistant species such as catfishes, bowfins, and gars are likely to be left free of fish and ready for restocking after the Thanite has detoxified.

Although Thanite is somewhat more expensive than rotenone, the benefits of salvaging valuable fish with Thanite may more than compensate for the initial difference in price. Emulsifiable rotenone currently costs about $2.11 per liter, and requires no adjuvants. Thanite costs about $2.50 per liter, and requires the addition of kerosene and the emulsifying agent Atlox 1045-A when the stock solution is prepared. The total cost of materials per liter of Thanite applied is about $2.83. The use of Thanite in Tide Swamp Pond cost about $68.00 whereas an application of rotenone cost only $51.00. However, the $17.00 cost differential was more than offset by the recovery of nearly 34 kg of larger sizes of largemouth bass and bluegills that could have been used for various purposes.

Fish that are killed by Thanite have an unpalatable flavor. However, laboratory experiments have shown that fish sedated with Thanite and placed in fresh water lose the objectionable flavor in about 5 days. Until approval has been obtained from the EPA, no Thanite-treated fish should be eaten. Because of potential taste and toxicity

problems, the use of Thanite in sources of potable water should not be considered until methods for counteraction or removal of Thanite are developed.

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REFERENCES

Burress, R. M. 1972. Field trial of Thanite as an aid for live collection of sport fishes at Max McGraw Wildlife Foundation, Dundee, Illinois on October 16-20, 1972. U.S. Fish Wildl. Serv., Southeast. Fish Control Lab., Warm Springs, Georgia, December 1972, typewritten. 27pp.

Cumming, K. B., R. M. Burress, and P. A. Gilderhus. 1975. Controlling grass carp (*Ctenopharyngodon idella* Val.) by chemical and physical means. Prog. Fish-Cult. (In press)

Lewis, W. M. 1968. Isobornyl thiocyanoacetate as a fish drugging agent and selective toxin. Prog. Fish-Cult. 30(1):29-31.

Southeastern Fish Control Laboratory. 1971. Annual report of progress for 1971. U.S. Fish Wildl. Serv., Southeast. Fish Control Lab., Warm Springs, Georgia, December 1971, typewritten. 23pp.

Summerfelt, R. C., and W. M. Lewis. 1967. Repulsion of green sunfish by certain chemicals. J. Water Pollut. Control Fed. 39(12):2030-2038.

THANITE: A FISH MANAGEMENT TOOL IN SOUTHLANDS EXPERIMENT FOREST PONDS

by

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ABSTRACT

Thanite (82% isobornyl thiocyanoacetate) has been used as a fish management tool on International Paper Company's Southlands Experiment Forest since 1968. Annually, Experiment Forest personnel successfully move 2,000 to 4,000 largemouth bass (*Micropterus salmoides*) with an 0.8 to 1 ppm (active ingredient) mixture of 80% Thanite - 20% Atlox 1045-A. Collection and survival percentages are higher when water temperatures are less than 70° F. Collected fish are placed in cans of untreated water in collection boats and later transferred to an aerated holding tank. Recovery in the tank is usually rapid and survival exceeds 90%.

INTRODUCTION

Thanite (82% isobornyl thiocyanoacetate) is an insecticide manufactured by McLaughlin Gormley King Company of Minneapolis, Minnesota. Thanite is not soluble in water but becomes emulsifiable when used in a mixture of 80% Thanite and 20% Atlox 1045-A, a commercial emulsifier manufactured by ICI America, Inc., Wilmington, Delaware.

Lewis (1968) first reported that Thanite had an anesthetizing effect on fish. Hunn (1972) described the drugging action as cyanide poisoning.

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