SUMMARY

1. Small fingerling flathead catfish (1.5 to 2.0-inch) were unable to survive (0 to 1.5%) in satisfactory numbers in the presence of relatively high concentrations of adult sunfishes.

2. Tests conducted in plastic-lined pools indicated an order of decreasing vulnerability to predation by flathead catfish of largemouth bass, white catfish, green sunfish, and goldfish.

3. Tests conducted in earthen ponds indicated an order of decreasing vulnerability to predation by flathead catfish of white catfish, largemouth bass, green sunfish, and goldfish.

4. Adult flathead catfish (14 to 16-inch) stocked at a rate of 50 per acre into a stunted bluegill population reduced but did not completely correct crowding within a 320-day period.

5. Two ponds stocked with *Tilapia spp.* and large flathead catfish did not result in desirable populations since at the time of draining fish larger than the 5-inch group made up less than 13.4 percent by weight of the tilapia.

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PARAFORMALDEHYDE FOR CONTROL OF *GYRODACTYLUS* AND *DACTYLOGYRUS*

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The external worm parasites *Gyrodactylus* spp. and *Dactylogyrus* spp. are among the most frequent-occurring and damaging parasites that infect fishes produced under fish farming conditions in the United States. At many fish farms annual treatment for the control of these parasites is a necessity. Formaldehyde has been established as an effective control for *Gyrodactylus* spp. and is also recommended for the control of certain other external parasites including *Scyphidia, Costia, Chilodon, Trichodina,* and *Trichophyra.* To date the source for formaldehyde has been the 38-percent aqueous solution used in industry. As a pond treatment, not involving subsequent removal of the chemical by flushing, the 38-percent formaldehyde solution is effective at 25 ppm. (Lewis and Lewis, 1962).

The aqueous solution of formaldehyde has certain undesirable features. Its storage characteristics are poor, the volume required results in high shipping cost and the cost of the material itself is relatively high.

In the present work, the use of paraformaldehyde, a powder which when dissolved in water disassociates to yield an aqueous solution of formaldehyde, was investigated as a substitute for the commercial aqueous formaldehyde solution. The evaluation procedure involved preliminary trials in aquaria and subsequent treatments of 19 ponds. In the aquaria treatments, the effectiveness of the material was tested against gyrodactylids infecting the golden shiner. In pond trials, the tests were made against known infections of *Gyrodactylus* in 14 populations of the golden shiner and one population of goldfish and against infections of *Dactylogyrus* in five populations of fingerling channel catfish.

The degree of control obtained by the treatments was evaluated by microscopic count of the organisms removed from samples of 10 or 20 fish. To facilitate counting, the parasites were removed from the fish by subjecting the sample to a 1:4000 solution of formalin for a period of 45 minutes during which time the sample was agitated at 15-minute intervals. Following this treatment sufficient formalin was added to produce a preserving solution of 10 percent. The samples were left in the preserving solution until it was convenient to count the parasites. Since the dactylogyrids occur on the gills of the host, it is necessary to clip off the opercula of each fish prior to placing it into the treatment solution.

To make a count of the parasites, the fish were removed from the preserved sample, and all but 100 ml. of the formaldehyde solution was decantered off. The remaining 100 ml. was agitated and then pipetted into two Petri dishes with grids marked on the bottom. The parasties were counted under a steroscopic microscope at a magnification of 9X. In each test, samples were taken before treatment and at intervals following treatment.

Dissolution of the paraformaldehyde prior to use was accomplished by dissolving two pounds of sodium carbonate (monohydrate) per gallon of water at or above 65° F. This solution was then diluted with 10 parts water without regard to temperature and paraformaldehyde was added to this mixture at the rate of one pound per gallon. At temperatures of 40° to 50° F. and the solution being agitated at 30-minute intervals, a two-hour period was required for complete dissolution. After the material was dissolved, the solution was applied to the ponds either by pump or dipper.

The paraformaldehyde treatments done under aquarium conditions and involving the treatment of golden shiners infected with *Gyrodactylus* spp. resulted in control in 48 hours at a rate of 15.8 pounds per acre foot and in 24 hours at 22.2 pounds. Subsequently, in pond trials involving the treatment of fingerling catfish infected with *Dactylogyrus*, a rate of 22 pounds per acre foot failed to give complete control but a rate of 26.7 pounds was effective (Table 2). Pond treatment at 22.2 and 26.7 pounds per acre foot against *Gyrodactylus* spp. on the golden shiner gave satisfactory control (Table 3). It was anticipated that control would be attained at a lower concentration in aquaria than in ponds. Formaldehyde appears to be affected by suspended material.

This work demonstrated that paraformaldehyde is a highly satisfactory source of formaldehyde for treatment of ponds for the control of *Gyrodactylus* and *Dactylogyrus*. Paraformaldehyde is easily stored, shipping weight is one-third that of the aqueous solution of formaldehyde presently used, and the cost of attaining a given concentration of formaldehyde in a pond is less than one-half the cost when the aqueous material is used.

In summary, paraformaldehyde is recommended for pond treatment for the control of gyrodactylids, dactylogyrids, and other formaldehyde - sensitive fish parasites. A treatment rate of 27 pounds of paraformaldehyde per acre foot is recommended. The paraformaldehyde should be prepared for use by dissolving it in alkaline solution as described above.

The procedure outlined here, or for that matter formaldehyde in general, should not be used for pond treatment when the water temperature is above 60° F. As has been shown by Helms (1963), the amount of formaldehyde required for control of parasites is sufficient to dangerously reduce the limited amount of dissolved oxygen present at high temperatures. It should be noted that this reduction in dissolved oxygen is due to chemical reaction between the oxygen and formaldehyde and will take place in the absence of plankton growth.

The gyrodactylids and dactylogyrids that are most troublesome in the culture of the golden shiner and channel catfish reach a peak of abundance during the winter and early spring. Parker (1965) has called attention to the feasibility of late fall treatment as a preventive measure. The lower cost of the paraformaldehyde makes this recommendation quite practical.

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TABLE 1. PARAFORMALDEHYDE AQUARIUM TREATMENT OF GOLDEN SHINERS INFECTED WITH *GYRODACTYLUS* SP.

Trial Number	Water Temp. (°F)	Average number of gyrodactylids per fish[1]			
		Before Treatment	Hours following treatment 24	48	72
		15.84 lbs. per acre foot			
1	59	18.3	0.7	0	0
2	59	18.3	0.2	0	0
3	59	18.3	1.1	0.3	0
		22.18 lbs. per acre foot			
1	60	27.8	0.5	0	0
2	60	27.8	0.1	0	0
3	60	27.8	0.0	0	0

[1] Average count per 10 fish.

TABLE 2. PARAFORMALDEHYDE POND TREATMENTS OF FINGERLING CATFISH INFECTED WITH *DACTYLOGYRUS* SP.

Trial Number	Water Temp. (°F)	Average number of Dactylogyrids per fish[1]				
		Before Treatment	Days following treatment 1	2	3	7
		20 lbs. per acre foot				
1	41	1.3	0	—	—	0.3
		22 lbs. per acre foot				
1	34	20.9	0.3	0.3	0.8	3.2
		26.70 lbs. per acre foot				
1	45	0.3	—	—	0	0
2	45	3.2	—	—	0	0

[1] Average count per 20 fish.

TABLE 3. PARAFORMALDEHYDE POND TREATMENTS OF GOLDEN SHINERS AND GOLDFISH INFECTED WITH *GYRODACTYLUS* SP.

Trial Number	Water Temp. (°F)	Average number of gyrodactylids per fish[1]						
		Before Treatment	Days following treatment 1	2	4	5	20	40
		12.67 lbs. per acre foot[2]						
1	38	50.2	25.6	11	17			
2	38	11.2	4.6	6	13.2			
3	39	34	28	27.4	31			
4	39	34	23	24	30.1			
		22.18 lbs. per acre foot[2]						
1	39	6	3.2	1	0	0	0	0
2	40	8.1	—	—	0	0	0	0
3	40	10.3	—	—	—	0	0	0
4	40	13.7	—	—	0.2	—	—	0
5	36	31.5	—	0	—	0	0	0
6	39	51.5	—	0	—	0	0	0
7	35	71	26.5	2.4	0	0	0	0
8	42	50.7	29.4	3.2	0	0	—	—
9	42	31.2	14.8	0.3	0	0	—	—
		26.7 lbs. per acre foot[3]						
1	40	98.9	11	0.8	0	0	0	

[1] Average count per 20 fish.
[2] Golden shiners.
[3] Goldfish.

SOME EFFECTS OF CULTURAL PRACTICES ON AQUATIC ENVIRONMENTS AND NATIVE FISH POPULATIONS

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ABSTRACT

Cultural practices which either contribute nutrient materials to the ecosystem or accelerate detrition by induced recirculation of nutrients within the system result in environmental changes which persist after the practices have been discontinued. The effects of environmental modification were found to be reflected in species structure of native fish populations. The percent of centrarchids within the total population was found to occur in direct proportion to the percent of productive bottom.

Macroinvertebrate organisms used as food by centrarchids were found to be restricted to certain bottom types. These studies confirm the conclusion of Eggleton (1933) that forces inherent in the substratum itself bend and shape all other forces and thus condition the reaction of both plants and animals. The role of submersed and floating vegetation as a substrate for invertebrate organisms is discussed.

The harvest of fish as a means of reducing lake fertility (Thomas, 1965) was found to have merit. An estimated 24,352 pounds of phosphates as PO_4 was removed in the 1,151,161 pounds of fish harvested from Lake Harris, Lake County, Florida, during a 15 month population control study. Phosphorous removed from the lake in the harvested fish would have been equivalent to removing all phosphates from 91,207 acre feet of water at a 0.1 ppm concentration.