THE TIMING AND QUANTITIES OF EFFLUENT DISCHARGED FROM COMMERCIAL CATFISH FARMS IN MISSISSIPPI

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INTRODUCTION

The culture of fish has a long history. According to Hickling (1968), fish culture in ponds was being practiced in China in 1100 B.C. Fish culture has experienced a relatively steady growth through history and is likely to continue to grow as the demand for fish continues to increase in conjunction with the steady decline in the supply of "wild" fish available for capture.

Significant commercial culture of channel catfish in the U.S. dates back to the 1950s and early 1960s. The first documented sale of "farm-raised" catfish for food in Mississippi occurred in 1966. The fish were grown in an open pond. With this meager beginning, the industry experienced many problems and failures on the way to being classified as an "industry" in 1974 by those involved in breeding, producing, processing, and marketing channel catfish, primarily in the states of Mississippi, Arkansas, Alabama, and later Louisiana. The industry designation was based on the condition that fish were available for sale throughout the year in 1974. Prior to that year, the supply of farm-raised catfish was seasonal, that is, stocked in the spring and harvested in the fall.

The year-round supply of fish proved to be a very important (if not the critical) aspect in developing markets. For the first time, the supply of fish did <u>not</u> depend on the "catch" of wild fish during the "fishing season." One of the most valuable attributes of farm-raised catfish is their availability every day of the year over a wide marketing region including limited exports to foreign countries.

The current state of the industry is shown in Table 1. The 91,000 acres in Mississippi account for 60% of the total. It is a widely held belief that Mississippi accounts for even more than 60% of the pounds produced.

THE PROBLEM

The following excerpt from the justification section of a comprehensive regional research project funded through the Southern Regional Aquaculture Center provides the setting for the need for the kind of information provided in this report:

> The Federal Water Pollution Control Act was amended in 1972 to require the establishment of effluent standards for all point sources of pollutants permitted to discharge into waterways (U.S. Congress 1972). The amendments created the National Pollutant Discharge Elimination System (NPDES) program which required that anyone discharging wastewater apply for a discharge permit. The permits were to require limitations on effluent quality. The amendments also required that effluent guidelines for certain "critical" industries be developed, which included fish hatcheries. The Environmental Protection Agency (EPA) began to issue NPDES discharge permits shortly after the promulgation of regulations pursuant to the Federal Water Pollution Control Act Amendments of 1972 (Harris 1979).
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> NPDES permit program regulations promulgated in 1973 moved fish hatcheries from critical industry status to that of an agricultural facility. As such, fish hatcheries no longer required a permit provided the facility discharge fewer than 30 days per year and the facility produced less than 20,000 pounds of fish per year (Harris 1979). Any facility, however, that was causing a water quality problem could be issued a permit.
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> In 1974, the EPA published tentative effluent limitation values for aquaculture systems (USEPA 1974). The principal restriction was the maximum instantaneous concentrations of stable solids in effluents could not exceed 3.3 ml/liter. The Federal Water Pollution Control Act was amended in December 1977 and renamed the Clean Water Act of 1977 (U.S. Congress 1977). The aquatic animal production category was revised so as to

continue to exempt from regulation coldwater facilities producing less than 20,000 pounds of fish per year, but it raised the limit to 100,000 pounds for warm water facilities. The current status of the effluent guidelines for aquatic animal production facilities presently leaves most EPA regions and states without adequate guidance to issue and enforce discharge permits.

In addition to Federal regulations, a broad range of state laws and regulations also apply to aquaculture (Zieman et al. 1990). These laws often constrain the development of aquaculture in these states. In 1978, The National Research Council reported that the orderly development of aquaculture is constrained due to political and administrative, rather than scientific and technological, problems. The 1983 National Aquaculture Development Plan reaffirmed this statement.

There are few laws designed to promote and protect aquaculture. That is, aquaculture does not explicitly fit into existing agricultural programs and, as a result, is regulated at each level of government by a number of agencies having their own range and scope through different state and federal programs. The number of agencies participating in permitting an individual aquaculture facility is often large. Regulations are complicated and often require legal expertise to understand them (Shireman and Lindberg 1989).

Most aquaculturists have a poor understanding of the regulatory process and have a difficult time determining the regulatory flow chart. On the other hand, regulators are perceived to have little concern and knowledge about the aquaculture community. In order for the aquaculture industry to flourish, cooperation must be fostered between regulators and aquaculturists. This is especially true in the area of effluent quality and discharge. Data pertaining to effluent quality is needed from commercial fish farms in order that permit restrictions can be relaxed or modified. This study should help to provide coordination and data to the regulating industries in order that regulatory agencies have a better understanding of the industry.

Aquaculture is largest in the South and particularly the southeastern states of Arkansas, Florida, Alabama, Mississippi, Louisiana, and Texas. Aquaculture in this area of the U.S. is a major agricultural endeavor. The principal species cultured include channel catfish (Ictalurus punctatus), red swamp crawfish (Procambarus clarkii), golden shinners (Notemigonus crysoleucas), fathead minnows (Pimephales promelas), and a variety of ornamental fish. Federal and state fish hatcheries propagate largemouth bass (Micropertus salmoides), bluegill (Lepomis macrochirus), striped bass (Monroe salitrix), and other finfishes.

The potential exists for aquaculture to be both a point and non-point source of pollution. Although trout hatchery effluents have been studied, the number of studies pertaining to warm water aquaculture are not as numerous.

The discharge of effluent from any commercial activity should be in a form that has little, if any, undesirable impacts on the environment. Because commercial catfish farms discharge excess water from production ponds, they are not exempted from this requirement.

In order to assess the environmental impact of water discharged from commercial catfish farms, data on the amount discharged, the time of year of discharge, contents of the discharged water, and the state of the receiving stream at the time of discharge must be collected and summarized for food fish and fingerling producing units. This report details the discharge of water from commercial food fish and for fingerling production ponds and the typical timing of the effluent discharges.

PROCEDURES

A systematic sample was drawn from an alphabetized list of members of the Catfish Farmers of Mississippi in early 1992. Subsequent personal interviews resulted in 15 complete, usable schedules that included 10,413 water surface acres of food fish production, 6 fingerling units with 1,261 water surface acres of fingerling production and 4 hatcheries.

RESULTS AND DISCUSSION

Discharge from Food Fish Ponds

Food fish producers discharged water from ponds for reasons that include: management practices, overflow of excess rainfall over evaporation and seepage during some parts of the year, pond repair where the water level is lowered in most cases or drained after long periods in production, and "other" reasons. Examples of "other" reasons include flushing ponds because of disease and irrigation of other crops (rice, soybeans, etc.) with water from catfish ponds.

The acre weighted average discharges from food fish ponds, by reason for the discharge, and the time of year when the discharge occurred, are shown in Table 2.

Discharge of excess rainfall in the first quarter of the year accounts for almost 10 acre-inches or 63% of the total discharge, followed by pond repair and management practices. More than 80% of the total discharge occurs from January through June, with 63% occurring in the three months of highest rainfall. It should be noted that these ponds have not been fed any significant amount of feed for the previous three months and contain less undesirable compounds than the receiving water draining from cropland in the areas where catfish are produced.

Discharge from Fingerling Ponds

Data on discharge from fingerling ponds were collected for a total of 1261 water surface acres or approximately 10% of the total sample area in the study. This percentage is approximately the same percentage that is devoted to fingerling production in the industry as a whole.

All of the reasons fingerling producers gave for discharging water were classified as management practices. Fingerling production requires that ponds be drained each year prior to stocking fry. The ponds are flooded just prior to moving fry from the hatchery to ponds in May, June, and part of July for a typical year. As with food fish ponds, when drained the ponds have not been fed for several months and they are drained at a time when the receiving streams are at near maximum flow.

Data for the amounts of discharges and the timing of these discharges are shown in Table 3. More than 80% of the water is discharged in the first 4 months of the year. Fry are typically stocked beginning in May. Water discharges from fingerling ponds is almost 280% of that discharged from food fish ponds; however, only 10% of ponds used by the industry are devoted to fingerling production.

Discharges from Hatcheries

The four hatcheries from which data were collected ranged in size from 15 to 50 million fry per year. Water discharge from these hatcheries (and to my knowledge all others) are divided into two kinds -- production water and "clean-up" water.

On an average, the four hatcheries discharged production water at the rate of 280 G.P.M. This water was returned to production ponds and was used for that purpose. Water used to clean the hatchery equipment, troughs, etc. was discharged into holding ponds designed for that purpose. The water was retained in the pond until its quality was adequate for release into the environment and does not present environmental problems.

CONCLUSIONS

Data were collected from commercial catfish farms with 10,413 water surface acres devoted to fish food production, 1,261 water surface acres devoted to fingerling production and hatcheries that hatch more than 100 million catfish fry annually. These data indicate that the following conclusions are warranted:

- The cost of pumping (economics) tends to minimize the amount of water used on catfish farms (The 6"/3" Scheme: Pote et al. 1988)
- Food fish and Fingerling production results in only about 20 inches of water per acre per year being discharged into the environment.
- Discharge of water from excess rainfall for food fish producers and management practices (draining ponds prior to stocking fry) for Fingerling producers account for most of the water released.
- The time of discharge is such that the water in ponds is most free of potential pollutants when discharged.
- The time of discharge is such that the receiving streams are at, or near, their maximum flow.
- Hatchery "clean-up" water is treated in holding ponds prior to release and presents few, if any, potential problems.
- Based on these data and analysis, the commercial catfish industry presents no significant environmental pollution problems from effluent discharge.

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Table 1. Water Surface Acres Used for Farm-raised Catfish Production, by State, January 1, 1994

STATE	WATER SURFACE ACRES
AL	17,100
AR	19,000
CA	2,300
FL	400
KY	250
LA	11,800
MS	91,000
MO	2,500
NC	1,200
OK	800
SC	1,500
TN	500
TX	1,700
Others	1,600
All States	151,650

*Includes GA and KS
Source: Mississippi Agricultural Statistics Service, U.S.D.A., Jackson, MS.

Table 2. Water Discharge from Commercial Channel Catfish Ponds by Reason for Discharge, by Quarter and Total Per Year, 10,413 Acres, 1994

TIME OF YEAR	ACRE WEIGHTED AVERAGE INCHES PER ACRE	% OF TOTAL
	Management Practices	
First Quarter	0.42	20
Second Quarter	0.32	15
Third Quarter	1.06	50
Fourth Quarter	0.32	15
Average for Year	2.12	100
	Excess Rainfall	
First Quarter	8.66	80
Second Quarter	1.78	16
Third Quarter	0.00	0
Fourth Quarter	0.39	4
Average for Year	10.83	100
	Pond Repair	
First Quarter	1.59	40
Second Quarter	1.60	40
Third Quarter	0.12	3
Fourth Quarter	0.70	17
Average for Year	4.01	100
	Other	
First Quarter	0.11	100
Second Quarter	0.00	0
Third Quarter	0.00	0
Fourth Quarter	0.00	0
Average for Year	0.11	100
	All Reasons	
First Quarter	10.78	63
Second Quarter	3.70	22
Third Quarter	1.18	7
Fourth Quarter	1.41	8
Average for Year	17.07	100

Table 3. **Water Discharge from Channel Catfish Fingerling Ponds, by Quarter and Total Per Year, 1261 Acres, 1994**

TIME OF YEAR	ACRE WEIGHTED AVERAGE INCHES PER ACRE	% OF TOTAL
First Quarter	5.31	11
Second Quarter	33.69	71
Third Quarter	0.00	0
Fourth Quarter	8.58	18
Average for Year	47.59	100