Certification Issues for Channel Catfish Aquaculture in Alabama

<u>Introduction</u> <u>and</u> <u>General</u> <u>Discussion</u>

by

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and

a survey on

<u>Catfish</u> <u>Farming</u> <u>in</u> <u>Western</u> <u>Alabama</u>

by

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Introduction

Certification standards for aquaculture products should be developed through stakeholder dialogue about the important environmental and social issues related to the production of individual species or species groups. Before convening stakeholder meetings about aquaculture certification, practices and resources used in production should be assessed and the main environmental and social concerns identified. This information is necessary to assure that stakeholder meetings are conducted in a thorough and efficient manner. Time will be saved and discussions will be more meaningful if stakeholders have knowledge of the entire suite of issues and of the relative importance of each issue.

In the case of channel catfish farming in Alabama, considerable information on possible negative environmental impacts has already been presented (Boyd et al. 2000), and best management practices (BMPs) have been recommended for preventing or lessening the impacts (Boyd et al. 2003). Moreover, a recent discourse on certification issues for common aquaculture species included channel catfish (Boyd et al. 2005).

The environmental assessment of channel catfish farming in Alabama (Boyd et al. 2000) relied on data collected between 1970 and 1999, and the survey of farmers to obtain farm-level information for this study was conducted in 1997 and 1998. The Alabama catfish farming BMPs (Boyd et al. 2003) and the discussion of certification issues related to catfish (Boyd et al. 2005) relied heavily upon the environmental impact assessment published in 2000 and upon catfish farmer meetings convened in 2000 and 2001.

Practices in aquaculture can change rapidly depending upon technological developments, market demands, and economic factors. Most of the data used in drafting Alabama catfish farming BMPs (Boyd et al. 2003) and for identifying certification issues for channel catfish (Boyd et al. 2005) were obtained at least 7 years ago, and some of the data were from studies conducted 10 to 20 years ago. Therefore, World Wildlife Fund (WWF) desired more recent data on catfish farming in Alabama for use in the dialogue among stakeholders that will begin in late November 2005. It was decided that the most efficient way to obtain information on current practices used in Alabama catfish farming was to conduct personal interviews with a sample of catfish farmers. These interviews also could be used as a means of obtaining information on social issues in catfish farming in Alabama. The earlier efforts focused on environmental issues and did not touch on social issues aside from worker safety.

The WWF asked me to supervise a farm survey to be conducted by Dr. Mike Polioudakis. The survey instrument was initially designed by collaboration among M. Polioudakis, Aaron McNevin of WWF, and myself. It was revised based on comments made by Jason Clay of WWF, Jimmy Carlisle of ALFA, and Greg Whitis of the Alabama Catfish Farming Center. The interviews were conducted by M. Polioudakis during August 2005 and he prepared a summary of the survey that has been appended to this report. The purpose of the present report is to assess the 2005 survey, and in particular, to determine if there have been any recent changes in production practices used by Alabama channel catfish farmers that could effect the issues to be considered in the dialogue.

Environmental Assessment (1997-98)

The main points related to Alabama channel catfish farming and environmental issues reported by Boyd et al. (2000) were as follows:

1. catfish farming in Alabama is conservative of water, and excluding storm overflow, about two pond volumes are intentionally discharged from each pond in 15 years;

2. overflow from ponds following rains occurs mostly in winter and early spring when pond water quality is good and stream discharge volume is high;

3. total suspended solids concentrations in pond effluents were high, and the main sources of total suspended solids were erosion of embankments, pond bottoms, and discharge ditches;

4. concentrations of nitrogen and phosphorus in effluents were not high, but annual effluent loads of these two nutrients were greater than for typical row crops in Alabama;

5. ground water use by the industry is about 86,000 m^3/day, but seepage from ponds returns water to aquifers;

6. there is little use of medicated feeds;

7. copper sulfate is used to control blue-green algae and off-flavor in ponds, but copper is rapidly lost from pond water;

8. although sodium chloride is applied to ponds to control nitrite toxicity, stream or ground water salinization has not resulted from this practice;

9. fertilizers are applied two or three times annually to fry and fingerling ponds and occasionally to grow-out ponds;

10. hydrated lime is applied occasionally at 50 to 100 kg/ha but this does not cause high pH in pond waters or effluents;

11. accumulated sediment removed from pond bottoms is used to repair embankments and not discarded outside ponds;

12. sampling above and below catfish pond outfalls on eight streams revealed few differences in stream water quality;

13. electricity used for pumping water and mechanical aeration is only 0.90 kW·h/kg of production;

14. each ton of fish meal used in feeds yields about 10 tons of dressed catfish.

Comparison of Farm Survey Findings (1997-98 versus 2005)

By comparing the information about major issues from the 1997-98 study (Boyd et al. 2000) with findings of the 2005 survey, it should be possible to decide if issues identified earlier should be revised in preparation for stakeholder dialogue. Each of the 14 points listed in the section above will be considered.

1. *Pond draining*. The 2005 farm survey suggested that producers seldom drain ponds. The farms in the survey had a total of 559 ponds, and only five of these ponds had been drained in the last 5 years. Most farmers had not drained a pond on their farm in 15 to 20 years. Thus, the frequency of pond draining appears to be less than in the 1997-98 survey. In that survey, farmers indicated that they intentionally discharged water in an amount equal to about two pond volumes in 15 years.

2. *Timing of discharge*. Because ponds are seldom drained and water exchange is not employed, discharge occurs primarily as a result of rainfall events. The basic rainfall patterns in the catfish production area of Alabama have not changed since the earlier study.

3. *Total suspended solids*. High concentrations of total suspended solids are a common characteristic of pond effluents (Boyd and Tucker 1998). These solids result primarily from erosion of embankments, pond bottoms, and discharge ditches. The 2005 survey found that some farmers had installed stone rip-rap or vegetative cover to avoid erosion of embankments as recommended in the catfish farming BMPs. A high total suspended solids concentration in pond discharge is still an issue, but the 2005 survey suggests that the producers are aware of this problem and are implementing control measures.

   It is important to recognize, as set forth in the report of the 2005 survey, that ponds are settling basins. Therefore, the installation of many catfish ponds on a catchment area probably reduces the natural total suspended solids load to the stream into which the catchment drains. Nevertheless, the discharge of ponds may be higher in suspended solids than typically recommended for effluents entering directly into streams.

4. *Nitrogen and phosphorus*. Nitrogen and phosphorus loads in pond effluents are important, for pollution of water bodies with these two nutrients can cause eutrophication. A study of water quality in Big Prairie Creek revealed that effluents from channel catfish farms increased concentrations of nitrogen and phosphorus in the stream (Silapajarn and Boyd 2005). Nevertheless, the creek has not been seriously impacted by nutrients from catfish farms, and water quality in this creek still complies with the water quality criteria of its stream classification level.

5. *Ground water use*. The survey done in 2005 revealed that catfish farms had dedicated about one well for each seven ponds. However, most producers indicated that these wells had not been used since the drought years of 2000 to 2002. The interviews suggested that producers rely much less on ground water now than in the past. To my knowledge, there have not been any conflicts between catfish farmers and others over ground water

depletion. However, the issue of ground water use is important for there is a finite supply of this valuable resource.

Three of the farms used saline ground water (1 to 3 ppt salinity) in ponds. Of course, these farms rely heavily on ground water. Saline well water has no other uses outside of aquaculture, for it is too salty for humans and livestock to drink or for use in irrigation. Thus, use of saline ground water for aquaculture will not cause conflicts with other water users. Saline ground water use in aquaculture is, nevertheless, an environmental issue for it can cause salinization.

6. *Medicated feeds*. The use of antibiotics in catfish farming is low, and usage is declining rather than increasing. Nevertheless, antibiotic use in aquaculture is a topic of great concern, and it must be considered in the catfish dialogue.

7. *Algal control*. Catfish farmers rely heavily on copper sulfate treatment to control blue-green algae and to lessen the frequency of off-flavor in fish at harvest. Eighteen of 22 producers had used copper sulfate in 2005. About 50% of ponds represented in the study had been treated with copper sulfate one or more times in 2005. The usual dose in milligrams per liter is one one-hundredth of the total alkalinity. McNevin and Boyd (2004) found that copper from copper sulfate was quickly bound in sediment, and pond water concentrations fell to pre-treatment levels within 72 hours. Copper concentrations were not elevated in fillets of fish from treated ponds (McNevin and Boyd 2004). Thus, copper sulfate treatment appears to be environmentally safe.

Copper sulfate was used by 92% of farmers interviewed in the 1997-98 survey as compared to 82% in 2005. However, the four farmers in the 2005 study who had not used copper sulfate may do so before the year is over. The use of copper sulfate for algal control has been approved by the United States Food and Drug Administration and the United States Environmental Protection Agency (EPA).

Diuron also is used to control blue-green algae, and 13 of 22 farmers in the 2005 survey reported using this chemical. Six of the farmers apparently used diuron more frequently than copper sulfate. Diuron use has increased, because in the 1997-98 survey, little use of diuron was reported. The use of diuron to manage blue-green algae in channel catfish ponds is allowed through an emergency exemption (Section 18) of the Federal Insecticide, Fungicide, and Rodenticide Act. A study of diuron residues in catfish from farms in Mississippi revealed a maximum concentration less than half the maximum tolerance level of 2.0 mg/kg. No traces of diuron were present in fish by 4 months after treatment.

The emergency approval to use diuron ends in 2005. However, according to Dr. Craig Tucker, Director, Southern Regional Aquaculture Center, the Catfish Farmers of America and the DuPont Corporation have applied to obtain permanent clearance to use diuron for algal control in catfish farming. Approval of the application is expected soon. Obviously, diuron use will require careful discussion by stakeholders.

As in the earlier survey, a few farmers used potassium permanganate and formalin for algal control and for fish parasite and disease treatment. Also, farmers still use herbicides such as 2, 4-D and Round-up to control weeds around the edges of ponds. These uses are thought to be environmentally responsible (Boyd et al. 2000), but they will deserve discussion by stakeholders in the catfish dialogue

8. *Salinity*. Nearly all producers treat ponds with sodium chloride to counteract nitrite toxicity. The treatment rates do not appear to have changed since the earlier studies by Boyd et al. (2000) and Tavares and Boyd (2003). Chloride concentrations in ponds seldom exceed 100 mg/L, and the in-stream chloride standard for streams in Alabama is 230 mg/L.

   Three catfish farms in the 2005 survey used saline ground water in ponds. With implementation of the new aquaculture effluent regulations by the EPA (Federal Register 2004), these farms must comply with the Alabama Department of Environmental Management (ADEM) chloride standard. Effluents must not cause stream water to have more than 230 mg/L chloride (Tavares and Boyd 2003).

9. *Fertilizers*. The use of fertilizers is restricted mostly to fry and fingerling ponds as has been the case for many years. The main input of nutrients to ponds is feed, and fertilizer use is not a major concern.

10. *Lime*. Catfish farmers still treat ponds with lime. However, the application rates are low, and dangerously high pH will not result. The main factor causing elevated pH in ponds is phytoplankton photosynthesis, and it is common for pH to rise to 8.5 or 9 in the afternoon (Boyd and Tucker 1998).

11. *Sediment removal*. This topic was not included in the 2005 survey. However, sediment normally is removed from the deeper parts of ponds when they are completely drained. The excavated sediment is used to repair eroded places on embankments. Ponds are drained less frequently now than in the past, so sediment is removed less often. Sediment removal does not appear to be an issue for consideration in the dialogue.

12. *Effects on streams*. The environmental assessment by Boyd et al. (2000) did not reveal water quality changes in small streams between reaches above and below catfish farms. However, Silapajarn and Boyd (2005) conducted a water quality study of Big Prairie Creek, a stream with 7.5% of its catchment area covered with catfish ponds. Catfish farm effluents were a contributor to moderate increases in concentrations of total dissolved solids, biochemical oxygen demand, total nitrogen, total phosphorus, and chloride that occurred between a station near the headwater of the creek and a station near its mouth. Big Prairie Creek and its tributaries also had higher concentrations of chloride, biochemical oxygen demand, total nitrogen, and total phosphorus than control streams in the same ecoregion but without catfish farms on their watershed. The large number of catfish ponds on the catchment of Big Prairie Creek did not cause a reduction in average, annual discharge measured in the 1940s and 1950s before the beginning of catfish farming in the area (Silapajarn and Boyd 2005).

13. *Energy use*. There are few reliable data on energy use in catfish farming, but it is certain that aerators and well pumps are the major consumers of energy at the farm level. The 2005 survey indicated a declining use of ground water, so energy use for this purpose is less than in the past. Aeration was not considered in the 2005 survey, but mechanical aeration is used more intensively now than even 5 years ago. Thus, energy use for

aeration is increasing, but according to the 2005 survey, many producers are installing automated control systems to make aeration more energy efficient.

14. *Feeds*. The feed conversion ratio (FCR) averaged 2.21 in the 2005 survey. This indicates that 2.21 kg of feed are used to rear 1 kg of fish from stocking to marketable size. In the 1997-98 survey, an average FCR of 1.88 was reported. This suggests that farmers are using feed less efficiently, and the primary reason for the rising FCR may be the tendency towards higher stocking densities.

    Catfish feeds contain 3 to 6% fish meal. Assuming a fish meal content of 6%, the feed required to produce 1,000 kg of fish at an FCR of 2.21 contains 132.6 kg of fish meal. The conversion of live marine fish to fish meal has a ratio of about 4.5:1. Thus, about 597 kg of live marine fish are required to produce the fish meal needed in feed to produce 1,000 kg of channel catfish. The benefits of reducing the fish meal content of catfish feed and using feed more efficiency in conserving "fish meal" fisheries is obvious.

Watershed Versus Embankment Ponds

In Alabama, channel catfish are produced in watershed ponds and in "four-sided" embankment ponds. There is no difference in production techniques used in the two types of ponds. The main differences in the two systems have to do with construction and water use as listed below:

- Watershed ponds usually require less earthfill for construction;

- Watershed ponds are filled by runoff while embankment ponds must be filled from wells or streams – usually wells;

- There is much more overflow from watershed ponds than embankment ponds because the catchment area associated with watershed ponds.

Of the 559 ponds in the 2005 survey sample, 510 or 91% were watershed ponds. Watershed ponds may be of less environmental concern than embankment ponds because they require less energy to build and are not totally dependent on water from wells (or sometimes streams). Of course, these advantages possibly are negated by the fact that watershed ponds have more discharge and possibly export greater loads of nutrients, organic matter, and suspended solids to streams than do embankment ponds. Thus, the dialogue possibly should consider the desirability of watershed ponds versus embankment ponds.

Settling Basins for Effluents

Settling basins are commonly used to treat wastes from concentrated terrestrial animal production facilities, and ponds are similar to settling basins. Coarse solids settle and discharge from aquaculture ponds usually contains only fine solids consisting of living plankton, dead organic matter, and suspended clay particles (Boyd and Queiroz 2001; Ozbay and Boyd 2003). An analysis based on pond overflow volumes and settling times for solids revealed settling basins would not be a feasible means of treating effluent from catfish farms in Alabama. Because of the long hydraulic retention time necessary for removal of fine particles by sedimentation, settling basin areas would have to be as large as the area of production ponds on a farm to treat all discharge (Boyd and Queiroz 2001).

The 2005 survey revealed that effluents from most farms passed through vegetated ditches, across pastures, or through wetlands before finally reaching streams. Water quality in effluents improves while passing through such areas (Tucker and Hargreaves 2003). Stakeholders should consider the most acceptable practices for releasing pond overflow and draining effluents.

Removal of Dead Fish

The environmental assessment by Boyd et al. (2000) did not consider removal of dead fish. However, when the Alabama catfish farming BMPs were developed, ADEM requested a BMP sheet for the disposition of dead fish. The BMPs call for the installation of a screen over drain structures to prevent dead fish from exiting ponds in discharge (Boyd et al. 2003). They also indicate that when mass mortalities occur, the carcasses should be removed and disposed in an ecologically-responsible manner. Farmers interviewed in the 2005 survey did not think that it was reasonable to expect them to remove all of the dead fish from ponds as a requirement for certification. Removal of dead fish is a ripe issue for discussion by stakeholders.

Bird Control

The topic of bird control has not been covered in earlier studies of the environmental impacts of channel catfish farming in Alabama. Farmers interviewed in 2005 felt that bird control was necessary. They indicated that they had tried many techniques, but the most effective means of frightening birds away from ponds was to shoot at them and to kill some of them. According to US Fish and Wildlife Service (USFWS) regulations, cormorants can be killed at will on catfish farms, but nesting areas cannot be disturbed. Permits for killing a certain number of pelicans, egrets, and herons also can be obtained from the USFWS when especially severe predation of fish occurs. Wood storks and most other species of birds cannot legally be destroyed or harassed. Obviously, bird control will be an issue of lively discussion between producers and environmentalists.

Other Regulations

Stakeholders should be aware of a few other state and federal regulations that were not directly considered in the interviews.

Siting

The site for a new pond must be evaluated by a person qualified to verify the presence of absence of hydric soils and hydrophyllic vegetation. If either of these conditions exists, a wetland delineation must be made by the United States Department of Agriculture Natural Resources Conservation Service (NRCS) or by the United States Army Corps of Engineers (USACE). The developer must apply for a permit from the USACE pursuant to Section 404 of the Clean Water Act. It may be possible to locate a pond partially or totally in a wetland area provided mitigation is done at the site or another nearby site. No permit is necessary for location of ponds in non-wetland areas.

Water use

There are no federal regulations related to wells or use of surface water in aquaculture. Nevertheless, in Alabama, the Alabama Office of Water Resources requires that all withdrawals from wells or streams greater than 70 gallons per minute (265 L/min) must be registered. This agency cannot deny the use of water by a farmer, but the farmer must report annual water use.

Construction permits

The EPA National Pollution Discharge Elimination System (NPDES) requires a construction permit for disturbances of 5 acres or more. The program is administered at the local level by state water pollution control agencies. In Alabama, ADEM issues the permit and the responsible person receives a package consisting of best management practices (BMPs) to follow during construction. A registered engineer must be hired to inspect the site and periodically submit reports to ADEM. There also may be site inspections by ADEM personnel.

Discharge permits

If a pond or group of ponds discharge into a steam, the streambed and bank area on the property must be measured. If the area is greater than 0.5 acre (2,000 m^2) or the stream travels for more than 300 ft (91 m) below the outfall, an individual permit must be obtained from the USACE as pursuit to Section 404 of the Clean Water Act. If the area is less than 0.5 acre and the length less than 300 ft, a general permit (NWP 39) usually is issued by the USACE.

According to federal regulations, effluents from concentrated aquatic animal production facilities in the United States are subject to permitting under NPDES of the Clean Water Act. For warm water, a hatchery fish farm, or other facility is a concentrated aquatic animal production facility if it contains, grows or holds aquatic animals in ponds, raceways, or other structures which discharge at least 30 days per year. However, closed ponds that discharge during periods of excess runoff and facilities that produce less than 45,454 kg (100,000 lb) per year are excluded (Federal Register 2004). An aquaculture effluent rule will soon be developed by ADEM. The main feature of this rule is expected to be the application of the catfish farming BMPs (Boyd et al. 2003).

Flood plain rule

The NRCS restricts development in flood plains. Developments such as catfish farms cannot block flooding on more than 60% of the flood plain on a given property.

Social Issues

The 1997-98 survey did not consider social issues. The current survey revealed that catfish farming in Alabama was largely a family business and relied primarily on the labor of family members. The average number of full-time hired laborers was 0.95 workers per farm, and nine of 22 farms did not have any full-time hired workers. The number of part-time workers averaged 1.0 per farm. A few of the hired laborers were women.

Producers find it difficult to find reliable workers, so they tend to treat workers well in order to encourage them to remain. Hired workers tend to be paid in excess with local standards, and most catfish producers assisted hired workers with medical care costs.

There is little competition among users of land and water resources in the catfish farming area of Alabama. Therefore, land and water use conflicts are rare. The catfish farms fit into the rolling landscape of the Blackland Prairie. They do not generate much noise and bad odors are rare. Therefore, neighbors do not object to the farms.

In summary, it does not appear that social issues will be critical concerns in catfish certification at the farm level. Of course, most of the hired labor in the catfish industry is in the processing plants. Therefore, social issues may be of more concern in this sector of the industry.

Issues for Catfish Dialogue

The most important issues that should be discussed by stakeholders in relation to certification are listed below:

- Production ponds – watershed versus embankment ponds
- Water use – well water versus runoff
- Feeds and feeding – fish meal use, FCR, and feeding practices
- Chemical use – lime, fertilizers, copper sulfate, potassium permanganate, diuron, sodium chloride, herbicides, etc.
- Antibiotic use
- Effluents
- Effects on biodiversity – wetlands, bird control, and genetic modifications of fish
- Removal of dead fish from ponds
- Social responsibility

The WWF effort on catfish certification focuses on Alabama because the producers in this state have been especially proactive. The producer association, Alabama Catfish Producers, has provided more than $160,000 to Auburn University to conduct environmental studies of catfish farming. They also have collaborated with Auburn University, ADEM, and NRCS to develop best management practices.

Catfish farming in other states also is becoming more environmentally responsible. Therefore, if the catfish certification trial in Alabama is successful, it will no doubt spread to the other major catfish producing states (Arkansas, Louisiana, and Mississippi). Production methods in the other three states are similar to those in Alabama. In the Blackland Prairie region of eastern Mississippi, pond systems are like those in Alabama. However, in western Mississippi, Arkansas, and Louisiana, embankment ponds supplied by ground water from wells are used almost exclusively. The other major difference is that production per acre tends to be higher in Alabama than in other states.

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