Components and Use of an In-Pond Fish Grading System

David Heikes

The production of most cultured fish species requires that they be graded for size periodically throughout the life cycle. Maintaining uniform size is important because it reduces cannibalism, increases growth rates, and improves overall production efficiency. Producers of fingerlings and stocker-size fish grade fish so they can provide a uniform product to their customers. Size grading is also important at harvest to ensure that only market-size fish are removed from the production pond.

Traditional methods of grading catfish use net pens called live cars. These are made from various sizes of mesh that retain the desired size fish while allowing smaller sizes to escape back to the pond. Typical live cars are 9 feet wide and 40 to 80 feet long and are loaded with about 500 pounds of fish per running foot. Aerated water is circulated through the live car throughout the typical 12- to 16-hour grading period. Live car grading requires minimal handling of the fish, but is often inefficient because it is a passive process. Live car grading is particularly inefficient in cold water because fish are lethargic. These inefficiencies in grading can reduce overall yield and increase processing costs. Live car grading does not allow the small fish that pass through the net to be retained. Various mechanical grading systems have been used successfully with trout, redfish, tilapia, striped bass and others. These systems usually have parallel bars or a gradually widening v-belt mechanism to sort fish into various groups. Fish must be pumped or otherwise loaded into the grading system and are de-watered in the process. Catfish have pectoral spines that have always caused problems in these grading systems. When de-watered, catfish often extend these spines, which causes them to hang up rather than fall through the grading apparatus.

The in-pond, horizontal bar grading of food-size channel catfish was first described by Greenland and Gill (1972). This method was effective, but the early design was cumbersome because it required manual loading of the grading platform. Thus, it was not widely adopted by the industry. The original design was modified into a portable, adjustable, horizontal, in-pond grading system (UAPB grader), described below, that can be integrated into typical harvesting oper-
ations for commercial catfish, striped bass, redfish, and possibly others (Fig. 1).

**System design**

The in-pond fish grading system has three major components: a trailer with an integrated 8-inch, re-lift style water pump; a fish eduction chamber; and a floating, adjustable, horizontal bar grader (Fig. 2). When grading through this device, fish never fully leave the water. Once fish are landed by the traditional method of seining them into a live car, the net is attached to the eduction chamber. A stream of water pumped through the eduction chamber directs fish and water up onto the horizontal grading surface.

Once in the grader, fish try to escape by swimming down through the parallel bars. Smaller fish that escape can be returned to the pond or caught in a live car under the grader. Fish too large to fit through the bars simply swim off the end of the grader and are collected in another live car positioned off the end. The bar spacing is fully adjustable (typically from 2-inch to 0.5-inch) by distorting the rectangular shape of the grader panel to a diamond or parallelogram shape.

**Trailer/pump**

The UAPB grader was designed for use in earthen ponds and can be transported easily between ponds with the trailer/pump unit. The backbone of the trailer is an integrated 8-inch, re-lift style water pump that can pump more than 3,000 gallons per minute. The water pump is PTO-driven (540 RPM) and can be powered by most small tractors used on fish farms (minimum 30-hp tractor recommended).

A standard 8-inch, bell-end, irrigation starter fitting is situated directly above the pump bowl as an attachment point for the 8-inch hose that connects to the grading system’s eduction chamber. A 3-inch, type F, cam-lock-style fitting is positioned at the top back of the pump bowl (just below the 8-inch outlet) as an attachment point for a 3-inch hose that powers the water jet on the grading system.

Surrounding the water pump is a heavy duty, boat-style trailer frame with axle-protecting mud skids. The trailer frame carries a rack and 1,800-pound marine winch system that accommodates the fish grading platform.

**Fish eduction chamber**

The fish eduction chamber is essentially a fish cage with a water jet shooting through it. It operates on the principle of an eduction pump, where a liquid or gas under pressure is jetted through an open chamber and into a larger diameter pipe. This creates a negative pressure in the open chamber, where various materials can be introduced to the water stream.

The system described here uses pond water under pressure created by the 8-inch, re-lift pump. The 8-inch stream of water is directed through an open chamber and toward a 14-inch, urethane, flex-duct assembly that connects to the fish grading platform (Fig. 3). A standard 4-foot by 6-foot sock tunnel is fastened to the eduction chamber as an attachment point for a traditional fish live car.

When fish are crowded into the eduction chamber, they are pulled into the water stream and directed through the 14-inch, urethane, flex-duct assembly to the grading platform.

**Horizontal bar grader**

The horizontal bar grader design was adapted from and improved on an earlier design described by Greenland and Gill (1972). The grading system also incorporates a unique parallel bar panel design developed by David Heikes at the University of Arkansas at Pine Bluff (United States Patent No. 6,015,049) (Heikes, 2000). This panel design maintains the spacing of the parallel grading bars with fully threaded, 4-inch, tap bolt “pins” positioned at precise increments along six cross braces. This configuration allows the grading bars to be positioned well above the cross braces. Fish can travel the length of the grading surface without bumping into the

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Figure 2. Components of the in-pond fish grading system: A) a trailer with an integrated, 8-inch, re-lift style water pump; B) a fish eduction chamber; and C) a floating, adjustable, horizontal bar grader.
cross braces, which is crucial in keeping fish moving across the grading surface unimpeded.

The grading panel is 6 feet wide by 16 feet long (Fig. 4). Panels designed to grade fingerlings and stocker-size fish (4 inches to 0.33 pounds) are fashioned from thirty 0.75-inch, schedule 40 aluminum pipes. Food-fish panels are made with twenty 1-inch, schedule 40 aluminum pipes. Each grading bar is drilled and tapped and is attached to the cross brace by threading the tap bolt “pins” into the threads of the grading bar. This allows the entire panel to pivot slightly on the threads when the bar spacing is adjusted. The bars remain parallel, but get closer together as the rectangular shape of the grader is distorted to a diamond shape.

The side panels of the grader are 16 feet long by 1 foot high and are fabricated from 0.125-inch x 1.5-inch square tubing with a 0.063-inch aluminum skin fastened to the inside. The outside of the two side panels has adjustable attach-
Table 1. Bar spacing (width between bars) and corresponding length and weight of channel catfish retained by the in-pond grader.

<table>
<thead>
<tr>
<th>Bar spacing (inches)</th>
<th>Length (inches)</th>
<th>Weight (lbs/1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.500</td>
<td>4</td>
<td>19.1</td>
</tr>
<tr>
<td>0.625</td>
<td>5</td>
<td>35.3</td>
</tr>
<tr>
<td>0.750</td>
<td>6</td>
<td>58.8</td>
</tr>
<tr>
<td>0.875</td>
<td>7</td>
<td>91.0</td>
</tr>
<tr>
<td>1.000</td>
<td>8</td>
<td>133.3</td>
</tr>
<tr>
<td>1.125</td>
<td>9</td>
<td>187.1</td>
</tr>
<tr>
<td>1.250</td>
<td>10</td>
<td>333</td>
</tr>
<tr>
<td>1.375</td>
<td>11</td>
<td>432</td>
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<tr>
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<td>12</td>
<td>573</td>
</tr>
<tr>
<td>1.625</td>
<td>12.5</td>
<td>650</td>
</tr>
<tr>
<td>1.750</td>
<td>14.25</td>
<td>1000</td>
</tr>
<tr>
<td>1.875</td>
<td>15</td>
<td>1180</td>
</tr>
<tr>
<td>2.000</td>
<td>15.35</td>
<td>1260</td>
</tr>
</tbody>
</table>

Values are approximate and can vary slightly with fish condition, water temperature and fish strain.
Advantages and disadvantages of the in-pond grader

To date, 19 catfish production facilities in Arkansas, Mississippi, Alabama and Oklahoma and at least four hybrid striped bass production facilities in Mississippi and North Carolina have adopted the UAPB in-pond fish grading technology. Most of these producers raise and sell graded fingerlings. Other producers raise stocker-size fish for their own production ponds. Producers who have adopted the system for grading fingerlings and stocker-size fish report significant improvement in the quality of grading (over net grading) and a major reduction in seining labor when more than one size fish is marketed from the same pond.

The standard method of net [live car] grading to sort fish into two sizes would require an initial seining, with fish being held overnight in a live car with a mesh size that allows the small fish to escape back to the pond. The pond then has to be seined a second time on the following day to capture the smaller fish. The in-pond grader allows a producer to seine the pond once and immediately separate the fish into two or more size groups. This allows the producer to fine-tune the grading to make certain the customer receives the size fish requested; it also eliminates the guess work and multiple seinings involved with passive overnight grading.

Another major advantage of the in-pond grader is that it can sort fish that could not be sorted by net grading. Hybrid striped bass, channel x blue hybrid catfish, tilapia and various other fishes have been graded successfully with the in-pond grader. To date, the only fish that has not responded well to the in-pond grader is the largemouth bass (Micropterus salmoides), as they do not swim downwards as an escape response.

Research has shown that using the in-pond grader on commercial catfish operations is economically feasible (Trimpey, 2005). Partial budget analyses indicate positive net returns for all farm sizes adopting this grading system, with payback periods ranging from 0.1 to 2.0 years depending on the farm scenario. An additional benefit of the better grading of food-size catfish is the reduction of size variation at the processing plant. Keeping more sub-marketable fish in the production pond benefits the producer and markedly increases processing plant efficiency.

The primary disadvantage of the in-pond grading system is that it requires more labor than the passive sock grading of food fish. Grading large quantities of food-size fish is time consuming (typically 400 to 500 pounds per minute) and physically difficult. Some producers may not be willing to adopt the in-pond grading system for food-size catfish until they are offered a greater incentive to provide well-graded fish to the processing plants.

Vendors

Complete in-pond fish grading systems and/or grader components can be manufactured by contacting the following vendors:

- Gatlin Services, Inc.
  430 Grider Field Rd.
  Pine Bluff, AR 71601-9795
  870-536-3828

- Geddes Machine and Repair Shop
  223 Bailey Drive
  Hollandale, MS 38748
  662-827-2572

- Delta Net and Twine
  3148 Hwy. 1 South
  Greenville, MS 38701
  662-332-0841

Selected Bibliography


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