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Sorting And Grading Warmwater Fish

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Commercial fish farming involves many steps between producers and end users of aquaculture products. One important step in this process is the sorting or grading of live fish. Grading allows the producer to maximize profits when prices vary with fish size. Large fish mixed with nailer ones can affect the appearance of a shipment of fish. Smaller fish may appear less attractive, and the shipment may be considered of poor quality. Fish should be graded for economic reasons either to increase the value of the crop, to increase fish yields or both. In some markets and production systems, however, there are no advantages to grading fish.

Many methods and types of equipment can be used successfully to grade fish. Sorting can be accomplished in ponds, holding vats, tanks and raceways. As with any live fish handling practice, there are safe ways and proper methods that will influence the success in sorting and maintaining live fish in good condition. When grading is required, proper equipment and techniques reduce scale loss, stress and mortalities.

Grading involves holding. It is essential that fish be in good health and condition prior to grading, and that the water and environment in the holding facility are of good quality to reduce stress and associated problems. Whenever possible, grading should be done in ponds to reduce the number of fish to be transported to holding facilities before returning them to ponds as unusable.

Advantages of grading

Many fish are sold by size or grade. Grading increases the crop's market value by supplying the sizes or grades of product desired by customers. For example, smaller minnows are worth more per pound than larger fish. Feeder fish of the same species may be worth twice the price of larger fish used for bait. Catfish are sold by the inch and categorized as small to large fingerlings just like redfish, striped bass and their hybrids. State laws may prohibit marketing certain fish species, especially game fish, that are longer than a specified length.

When fish of a similar size and age are stocked in a pond, differential growth among individuals produces fish of various sizes at the end of the grow-out cycle. This is more pronounced in ponds where fish are graded only at the time of harvesting. Some markets do not accept pond-run, ungraded fish of mixed sizes.

Some species are cannibalistic and periodic size grading is important to obtain good survival and yields and to eliminate runts. Largemouth bass and striped bass and their hybrids are examples of cannibalistic fish. These and other species may require frequent grading when maintained at high densities in tanks or troughs. Grading is also required during the various stages from fry to food-sized fish in outdoor pond culture. Frequency of grading depends on the growth rate of fish and their uniformity in size. The first 2 months are usually the most critical to minimize losses from cannibalism.

Grading also allows more accurate sample counting to estimate fish numbers from a weight-number relationship. This is important to baitfish retailers who sell fish of a uniform desired size by the number. Fish of mixed sizes make this counting method more difficult because of a wider size variation. The process of grading provides an opportunity to remove unwanted fish species, undesirable organisms, and nuisance aquatic plants that could become established in, or contaminate stocked waters. Species separation is required in polyculture systems where more than one species of fish are grown together in a pond. Each species may require sorting because of different market outlets or processing requirements.

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Often it is desirable to separate males from females, or to determine the numbers of each sex for breeding purposes. Sexes of fathead minnows can be effectively separated using a 15/64- to 16/64-inch bar spacing. Other species like channel catfish and tilapia exhibit growth differences between sexes. This fact can be important, depending on how fish are used after grading. Sometimes a special variety of fish species with unique breeding or market characteristics is desired, or fish with deformities or poor breeding traits may need to be culled. Accurate length, weight or size information may also be required for research purposes.

Food fish growers may want to grade fish to avoid harvesting fish too small for marketing or processing. Processors may want to have fish graded because of differences in the value or demand of fish by size. Grading requires additional labor, time and equipment but in many markets it is essential and may improve profits.

Grading and sorting equipment

A variety of commercial graders is available. Many producers construct grading devices specially designed for use in their facilities. Based on the market situation, know the size or sizes of fish that require sorting before purchasing or constructing a grader. Grader panels or grills can be purchased and inserted into homemade frames to save money. PVC pipe is a popular material used in making graders. Plastic netting is also available in various meshes and can be used for grading small fish when the material is strong and well supported. Fish are injured less if the grading material is smooth and non-abrasive, without any sharp edges or roughness.

Mechanical bar graders often have 3/16-inch parallel aluminum or bronze rods that are separated by measured distances in a frame. The spacing between the bars determines the size of fish retained or allowed to pass through (Figure 1). These graders may be vertical panel graders like those often used in holding vats and raceways, or grader panels may be mounted on rollers or wheels for easy movement across the tank bottom. The manually pulled panel graders should have handles for easier use (Figure 2).

Figure 1. Vertical panel grader in holding vat used to sort minnows. Rubber stripping on the sides aids a tight fit.

To compensate for any slight difference in the widths of holding vats, some type of flexible sheeting, like rubber stripping, can be placed around the frame to provide a snug fit. To sort fish into a variety of sizes, multiple panel bar graders of various spacings work well.

Grading boxes are used to sort large numbers of minnows or fingerling fish. These boxes vary in size from small units for use in tanks to larger ones designed to handle more fish in ponds. The boxes usually float. Both pond and tank grader boxes can be constructed with frames that accommodate standard sized grader panels with various bar spacings. Some commercial boxes have simple adjustable or interchangeable bar graders. Polyethylene fish baskets have a square mesh of 5/16 inches and can grade out small fish.

A series of grading baskets with various bar spacings can be used to sort mixed sizes of fish. The grading boxes can be enclosed on the sides and bottom with galvanized hardware cloth, but plastic coated wire cloth is preferred because of greater durability and less injury to fish. The series can be built as nest boxes and should have long handles that permit easy use and support by the walls of the holding vat (Figure 3).

Sorting or grading tables work well when hardy species require accurate processing for research or breeding purposes. Tables can be portable or

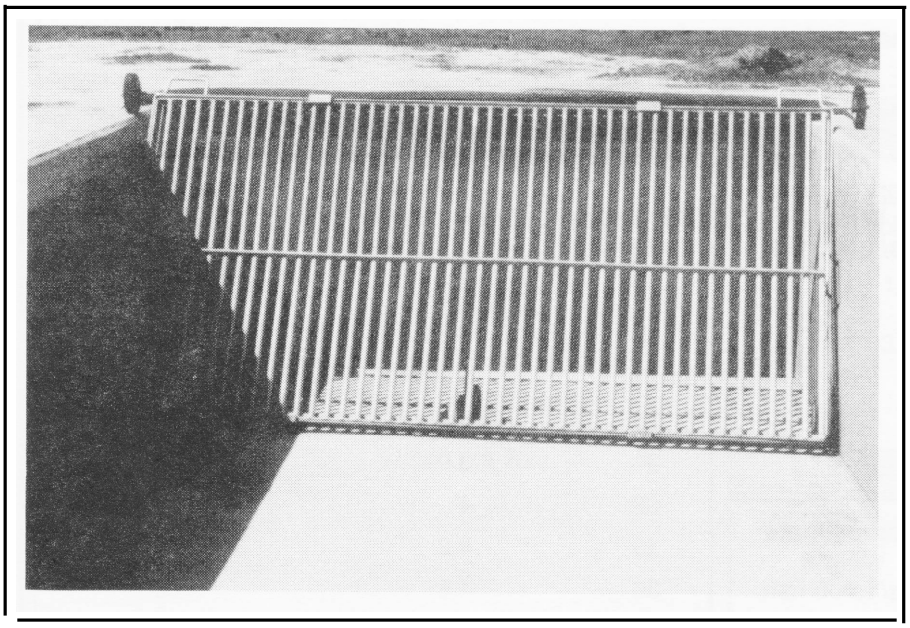

Figure 2. Large panel with wheels on top and bottom to move device in holding tank.

permanent. The tables are of various dimensions but all have smooth surfaces and slots in at least the corners and sometimes sides. Slots should be large enough to allow passage of fish sizes anticipated. Fish can be collected in containers filled with fresh, oxygenated water. A chute from the slots properly directs fish to containers. If fish are sorted by length, reference length measurements can be inscribed into the table surface, or rulers can be located on the sides.

Every time fish are crowded with a harvesting seine, some rough grading occurs. Net graders of various types can be used to sort fish. Fish of a minimum desired size can be harvested by selecting a harvesting seine of the proper mesh size. Nylon nets should be treated with a net coating material. Polyethylene nets require no special treatment. Seines can be ordered or made with end panels of a desired mesh for grading. This means fewer seines for storage and use.

Live cars or socks can be used to further grade fish after they are seined. These grading or holding nets, usually 10 to 20 feet wide, 10 to 60 feet long and4to41/2 feet deep, are commonly used by catfish producers to sort and hold both fingerlings and food-sized fish.They usually have an 18-inch wide skirt inside the net with floats to prevent fish from jumping out of the enclosure. These devices are equipped with a 3-foot by 5-foot tunnel and metal frame attached to the harvesting seine by a drawstring.

Fish pumps equipped with grader boxes can be used both to load or transfer and grade fish simultaneously. Fish pumps are used in the salmonid industry where fish are commonly grown in concrete raceways. They are also used in some other countries. Until now, fish pumps have not been widely used with warmwater fish. Specially designed dewatering towers are required to separate water from fish. Fish weights are also determined by water displacement rather than by weighing scales. They may move fish well, but simultaneous mechanical

Figure 3. A variety of grading baskets and boxes used for sortingandgrading.

Table 1. Boxes, Baskets or Vertical Panels with Bar Graders

Species: Fathead Minnows

Bar Space (64th inch)	Approximate Total Length Held (inches)	Approximate Weight lbs/1,000 fish
13-15	1 3/4	3
15-17	2 1/4	4
More than 17	2 3/4	6

Species: Golden Shiner

Bar Space (64th inch)	Approximate Total Length Held (inches)	Approximate Weight lbs/1,000 fish
12-14	1 3/4	3
14-16	2 1/2	5
16-18	3	8
18-21	3 1/2	13.5
21-23	4	20-25
23-25	4 1/2	30
25-27	5	40
More than 29	5 1/2	60

Species: Channel Catfish

Bar Space (64th inch)	Approximate Total Length Held (inches)	Approximate Weight lbs/1,000 fish
27	3	8-10
32	4	18-20
40	5	32-35
48	6	60
56	7	93
62	8	112-140

Note: A bar grader space of 11/2 inches retains channel catfish between 3/4 and 1 pound or 11 inches long.

Species: Striped Bass

Bar Space (64th inch)	Approximate Total Length Held (inches)	Approximate Weight lbs/1,000 fish
12	1.0	--
19	2.75	--
21-27	3	10
29	3.5	15
31	3.9	20
32	4	23
33	4.2	25
36	4.5	35
38	4.8	40
40	5	45
42	5.2	50
44	5.4	55
46	5.6	60
52	6	78
58	6.3	95
62	6.5	100

Species: Hybrid Striped Bass

Bar Space (64th inch)	Approximate Total Length Held (inches)	Approximate Weight lbs/1,000 fish
13	1	0.63
15	2	4.8
19	3	16.3
32	5	75
72	9	500
96	11	1,000
104	13	1,333

Table2. Fish Nets, Live Cars or Grading Seines

Species: Bluegill		Species: Catfish	
Square Mesh Size (inches)	Approximate Fish Length Held (inches)	Square Mesh Size (inches)	Approximate Fish Length Held (inches)
1/4	3/4	1/4	1 - 2
1/3	1 1/2	3/8	3 - 4
1/2	2	1/2	4 - 5
1	4 1/2	3/4	7 - 8
		11	8 - 10
			Fish Weight Held (pounds)
		1 3/8	3/4
		1 5/8	1
		1 3/4	1 1/2

Note: Square mesh size equals one-half stretched mesh size.

grading of catfish has proved difficult. When handled, catfish often lock their pectoral spiny fins in an extended position. New innovations in fish pump and grading technology may remedy this problem in the future. Other species should grade well.

Recommended bar and mesh spacings

Bar spacings or mesh sizes should conform with the desired sizes of fish to grade. Commercial grader basket spacings range from 12/64 to 74/64 inches. Net or seine square mesh sizes normally range from 1/4 to 3 inches. Whether or not a fish is retained by a grading device depends on its body shape and dimensions. Another factor is the number of days off feed before grading. The condition factor of fish will also determine lengths of fish retained; thin or fatter than normal fish will affect lengths graded.

The following tables are recommended dimensions or guidelines to grade various fish species to different desired sizes. There is always a range between the largest and smallest fish in a length group; the fish sizes reported are approximate values. The length-weight relationship of catfish and other species varies depending on the condition of individual fish. Differences are greater with smaller fish because a l-inch length increment can result in a big difference in weight between different populations or lots of fish. Repeated trials are required to determine bar spacings or mesh sizes required to grade other species to desirable sizes.

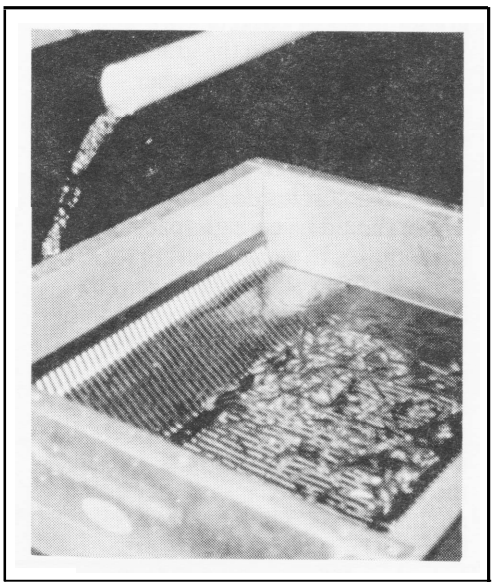

Figure 4. Floating grader box with interchangeable bar panels used to sort hybrid striped bass.

Grading and sorting techniques

There are various methods for using different types of grading devices. The technique should be compatible with the species of fish and grading situation, and should consider the behavior and water quality requirements of the fish. For example, baitfish grade well through the sides of a grader box, while catfish grade more efficiently through the bottom. Golden shiners are very excitable and more difficult to handle when water temperatures are above 60° to 65° F. Fish are especially delicate to handle for sorting purposes during July through September when pond temperatures are highest. Striped bass and its hybrids should preferab-

ly be handled and graded at water temperatures less than 60° to 70° F. The risk of mortality is greater if fish are graded in soft water with low chlorides at higher water temperatures. Fish should be allowed at least 2 hours to recover after seining or transport before they are graded.

Fish stomachs should be empty and any unwanted debris that hampers sorting should be removed either before or during grading. Fish are crowded during grading and oxygen can be depleted quickly in a localized area. It is essential to maintain dissolved oxygen levels at least 5 ppm to 6 ppm in the grading or holding area at all times. If large fish are held overnight, the top of the vat should be covered to prevent loss of fish from jumping. To minimize stress, all sorting should be conducted in a shaded area to prevent brightness from direct sunlight or warming effects from radiation.

Factors that influence the grading process are the degree of fish crowding, fish condition (normal, thin or plump), water temperature, level of fish activity and grading time. Fish require crowding for efficient grading, and most are more active and grade faster at higher temperatures. During colder winter temperatures catfish, especially, require more time for pond grading to prevent many small, off-sized fish being harvested. Use of larger than normal mesh sizes also helps grading when temperatures are cold. Some fish can be attracted through a grader by a flowing water current. This is most applicable when a pond is drained into an outside harvest basin.

Select graders by visually estimating the sizes of fish. Use a test sample of fish in the selected grader or graders, and examine fish for uniformity in size. An additional grader is needed if there is an excessive or unacceptable size difference among fish graded to one size. If no fish or very few fish remain in a grader then that grader should not be used. Occasional large fish can be sorted manually.

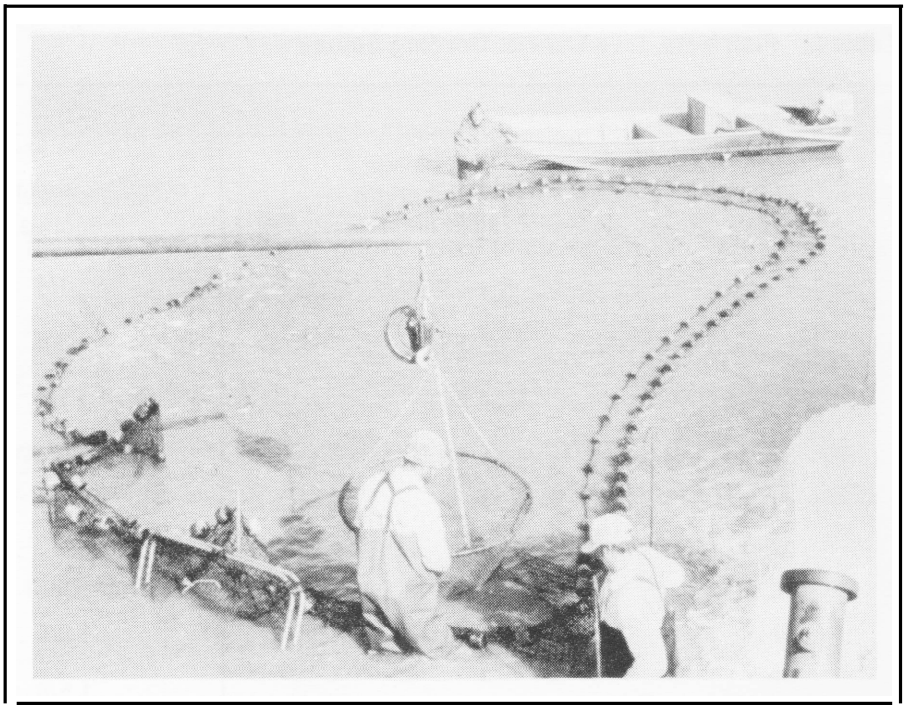

Figure 5. A live car or sock commonly used in the catfish industry to grade fish. Note metal loading frame that attaches the sock to the harvestingseine.

For grading in vats or tanks, floating grader boxes or baskets work well. Fish are dipped into the graders and are retained or pass into other graders or the tank. A simple method to grade fingerlings uses a series of two, three or four grading boxes that nest inside each other. There should be enough space between boxes to accumulate 10 to 30 pounds of fish of a similar size. The inner box may have l-inch mesh with other boxes having l/2-inch, l/3-inch and l/4-inch meshes. The nested boxes are put in the tank, and ungraded fish are dipped or poured into the inner box. Fish pass through the different meshes until they can no longer pass. The smallest sized fish may be collected outside the outer box. When enough fish of a given size accumulate, the boxes are separated and fish can be processed by counting, weighing or passing to another tank or compartment (Figure 4).

Splashing inside the grader box speeds grading time. Minnows grade faster when thumping sounds are made on the water surface by snapping the fingers. The loading rate of fish in a grader box should not exceed 5 pounds per cubic foot of water.

When using a sorting table, a thin sheet of water should be kept on the surface for easy movement of fish. A short block of wood or other material can be placed in front of the slot opening to avoid accidental entry of unwanted fish if the table is heavily loaded. Fish should be worked up quickly. Sorting during cooler months of the year greatly reduces handling stress. Catfish withstand this type of handling and are less active during colder temperatures. Other more delicate species can suffer severe losses after processing on a sorting table. Whether or not the fish require restocking or will be killed should be considered before this method is used.

In ponds, large floating grader boxes or a net device can be used. Larger fish are easiest to remove when a grading or cutting seine of the appropriate mesh is pulled inside a har-

vesting seine of smaller mesh. Much labor and time are required to sort fish manually. In other cases, a harvesting seine may have end panels of various meshes and the seine ends can be used like grading seines once the fish are crowded. One problem with any net grader is the possibility of gilling fish or trapping fish in the mesh net. Bass and their hybrids snag easily in nets by their fins and operculum, or gill flap, if a seine with an improperly sized mesh is used to grade widely mixed sizes.

Live cars or socks work well for in-pond crowding and grading of catfish. Provide adequate aeration during grading or holding, especially during summer. It is important to secure the net enclosure firmly into the pond bottom. Support it with harvesting stakes to prevent rolling up the sock and killing fish from currents created by an aerator or water well. The live car can also be used to hold two lots of sorted fish by putting the center of the sock over the harvesting boat to form two separate compartments. This works well to select and sort males and females. Fish loading rates in live cars should not exceed 5,000 pounds per 10-foot length; lower fish loads are recommended at temperatures above 60° F (Figure 5).

Handling of fish in tanks is reduced by using vertical panel graders that are built to fit the holding tank. To use this type of grader simply move it from one end of the tank to another. This forces the fish to either pass through the bar space or be trapped. at the other end of the tank. Disturb the water in the confined area to move as many fish as possible through the grader. Sorting more than one size is accomplished by repeating the process with panels of desired bar spacings. The vertical panel graders require less handling of fish and cause less stress compared to forcing fish through hardware cloth grading boxes.

Different lots of fish in tanks can be separated by transferring them to another tank or by using blocking screens to form several compartments in the same tank. Blocking screens can be placed in recessed grooves in the tank wall or wedged tightly between the side walls and bottom. Suspended nets inside wooden frames (hapas) can also be used to segregate fish.

Be patient when grading and check to be sure that your efforts produce the desired results. Remember that fish are crowded and excited and maintaining good water quality is essential.

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