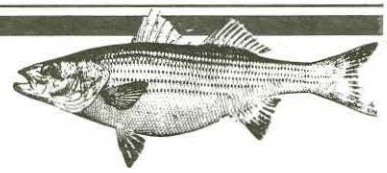
Maryland Sea Grant Extension Program

FINFISH AQUACULTURE
WORKBOOK SERIES



Cage Culture in Maryland

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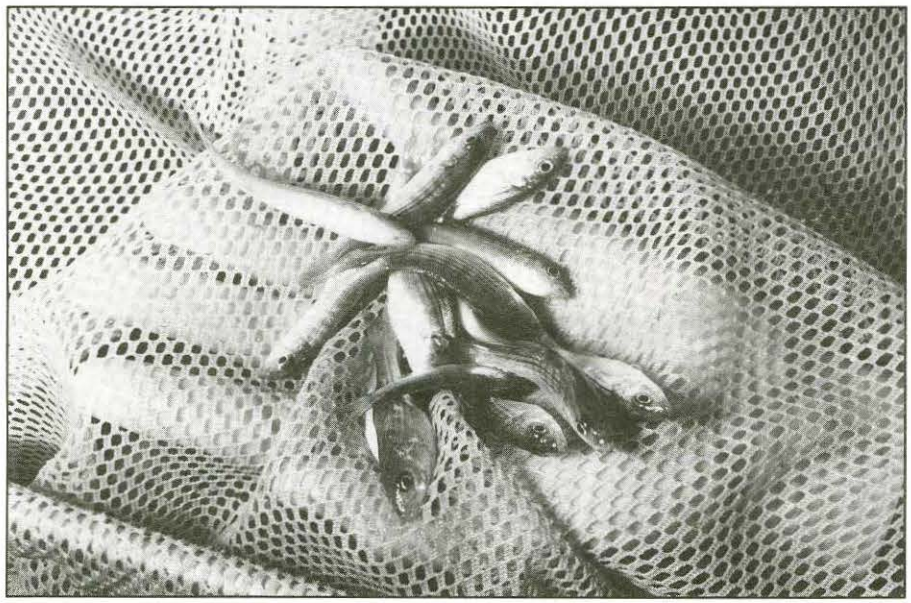


INTRODUCTION

Many farm ponds in Maryland have the potential to serve in a multiuse capacity. In addition to traditional uses, such as livestock watering, irrigation and recreational fishing, farm ponds can be integrated for aquaculture through the use of cage culture. Fish grown in cages in farm ponds can stretch the food budget by providing a good source of fresh fish for personal consumption or may supplement farm income through direct sales.

If done on a proper scale and with good planning, raising fish from cages can be treated as a separate farming enterprise. If properly approached, small fish (6-8 inches) can be raised to an edible size (3/4 pound or larger) in cages in one growing season, or six to seven months.

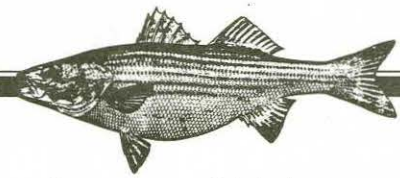
Many different species of fish can be raised in cages in Maryland farm ponds. Trout, for example, grow well in the colder waters of Western Maryland. Trout need water that does not exceed 70° F at any time of the year, though optimal growth occurs between 60 to 65° F.

In the warmer waters of Southern Maryland and on the Eastern Shore, catfish, striped bass, and hybrid striped bass can do well. These species can survive waters exceeding 85° F during the summer months, and tolerate temperatures near freezing during the winter. Optimal growth for both species appears to be in the 74 to 78° F range. Striped bass and their hybrids currently require proper permits from the Maryland Department of Natural Resources.

ADVANTAGES OF CAGE CULTURE

Raising fish in cages is relatively simple, especially when compared with raising fish in open ponds. Investment is relatively low if an existing body of water is available. Harvest is generally simplified because the entire cage can be taken from the water and the fish removed. Otherwise, the fish are simply dipped out of the cage with a net. These harvest techniques eliminate the need for expensive harvesting equipment and labor.

With cage culture, fish are easier to observe for general health and feeding behavior. Cages also facilitate treatment of diseased fish and reduce fish losses to bird and animal predation. Although not necessarily recommended, ponds may be used simultaneously for cage culture and for recreational fishing with bass and bluegill.



Cages can also be used for culturing fish in lakes, gravel pits, public ponds or streams. And there is good potential for large scale pen culture in the Chesapeake Bay and its tributary rivers. Bay net-pen culture could be undertaken on a scale paralleling such operations as the salmon industry in New England, the West Coast, Norway and Scotland. Undertaking cage culture endeavors in public waters, whether a large scale net-pen operation in the Bay or a couple of small cages off your private dock, requires permits. Maryland's Department of Agriculture can advise you regarding restrictions and permits.

DISADVANTAGES OF CAGE CULTURE

Cage culture carries with it several potential problems, most of them biological. An additional concern — one that is not biological — is theft. Precautions should be taken to protect your crop by putting fish in private ponds only, or by locating them in an area where they can be watched.

The cost of cages can be relatively expensive because strong, rust resistant materials are required. Fish grown in cages may be more susceptible to bacterial disease than fish in an open pond because they are in close quarters and in constant contact with each other. In addition, caged fish must be fed daily with a nutritionally complete diet; this means added costs for labor and feed. It is generally better to use a floating feed instead of one that sinks. Though such feeds are more expensive, you can better observe if your fish are feeding actively — very rarely will a fish that is sick continue to feed.

Confinement and high density cage culture can also lead to declines in dissolved oxygen levels and then to fish mortality. Similarly, uneaten feed and fish waste immediately beneath the cage or pen may accumulate, causing a high biological oxygen demand (BOD) from the bacteria that break down the fish wastes. A direct result of high BOD can be oxygen depletion and the production of the toxic compound hydrogen sulfide (generally detected by a smell similar to rotten eggs).

Solutions to oxygen depletion problems involve a number of options: (1) reducing stocking densities, (2) holding food back when the fish are not eating, (3) aerating the cage area, or (4) locating your cages in a tributary stream or river to ensure adequate flow to "flush" away wastes. In pond situations, these wastes can act as a fertilizer to cause plankton blooms so dense that they deplete the oxygen supply in the pond at night or on cloudy days through the natural process of respiration. Some of these solutions can be expensive and can significantly reduce profitability.

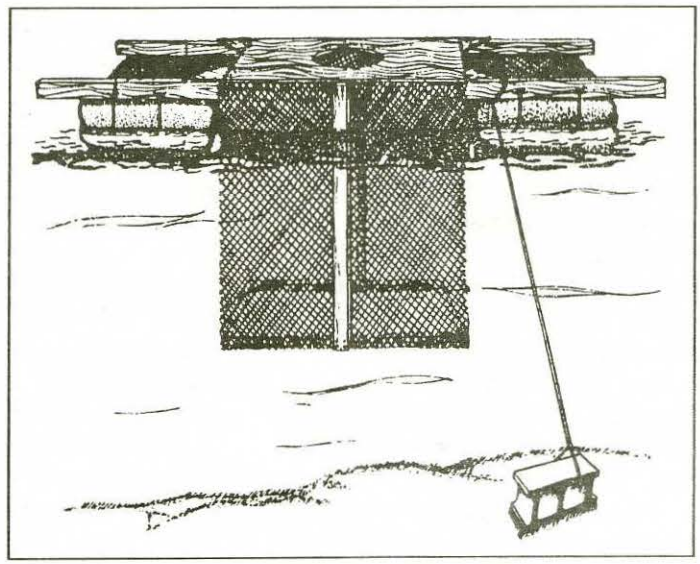
CAGE CONSTRUCTION

A fish cage is simply a screened enclosure of plastic-coated wire, plastic extruded mesh, nylon, or polyethylene netting. The mesh must be small enough to hold the smallest fish yet large enough to allow freshwater (or salt water) to flow through to remove waste products and bring in fresh, oxygenated waters. One-half inch mesh or larger usually works best for fish five to eight inches or larger. Mesh sizes smaller than one-half inch can foul with algae buildup and restrict water flow.

Fish cages or small net-pens can either be purchased from commercial dealers or made at home. In general, for small scale operations, these enclosures are rectangular, 3 x 4 x 3 feet in size (Figure 1), or any variation that can be adapted to a pond, including circular designs (Figure 2). Size and design options are limited to the imagination, and the practicality and suitability for the intended purpose. Obviously you would not build a cage that would hold several thousand fish if you're culturing fish for personal consumption. Frames for these small net-pens can be made of rot resistant wood (cypress or redwood), steel, plastic, or aluminum, but not copper or zinc, which can be toxic to fish.

Large scale culture net-pens that would be found in very large ponds, lakes, rivers or the Bay are usually made of a type of netting that is coated to be resistant to fouling and are often very large (50 ft x 50 ft or larger). These systems can be purchased commercially and require considerable investment, labor and time commitments.

For smaller cages, it is usually best to have a hinged mesh or solid cover over the top of the cage to prevent birds or other animals from preying on the fish. If the cover is sturdy enough you may be able to put a lock



on the cage to hinder would-be thieves. A fine mesh collar, or feeding ring, should be suspended inside the cage to prevent feed from floating outside of the cage where the fish cannot feed. Ideally the feeding ring should be a least one half the size of the surface area of the cage.

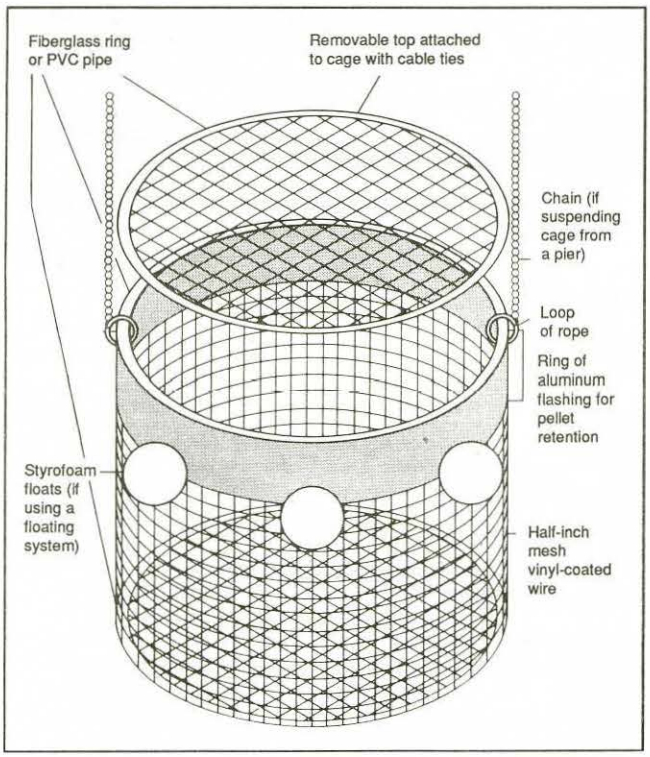
Flotation can be a variety of materials, from plastic and steel barrels to styrofoam to commercially available cage or net-pen systems. Styrofoam is generally used in smaller systems. The amount of styrofoam needed will depend upon the size of the cage. As a rule, one cubic foot of styrofoam will support about 30 pounds. You would want to balance the flotation on opposite sides to prevent the cage from tipping over if strong winds are common on your pond.

POND SIZE AND CAGE LOCATION

Pond size is important, especially if commercial culture is the goal. Usually a pond should be five acres or larger to be considered a good size for commercial culture. Smaller ponds can be used (primarily for personal consumption culture) but are more likely to have oxygen problems unless closely managed.

It is important to stress that the same poundage of fish that can be raised in an open pond usually cannot be reared in cages. This is primarily because in an open pond the fish are spread out and have free-ranging access, while in cages they are confined and consume a large amount of oxygen in a small area. There have been cases in Maryland where cages had fish dying because of oxygen depletion while six feet away in the open pond bass and bluegill appeared perfectly healthy.

As a general rule, an open pond may support as much as 3,000 pounds of fish per acre without aeration; cages in the same pond will only support 1,500 pounds of fish per acre per year. And a pond with no supplemental aeration may well do better at a stocking density of 1,000 pounds of fish per acre per year in cages.



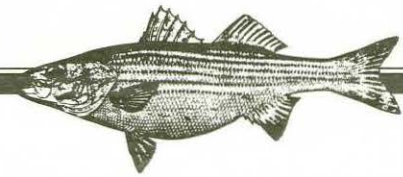
In terms of feeding rates, a pond without supplemental aeration should be fed no more than 30 pounds of feed per day. For example, 667 fish at a marketable size of 1.5 pounds being fed three percent of their body weight per day, would equal a stocking density of 1,000 pounds and a feeding rate of 30 pounds per day. Indeed, this amount can be increased, but it requires intensive management and aeration. With aeration or adequate waterflow, feeding rates can be increased to as much as 100 pounds of feed per day.

Each pond is different and you will have to learn what your pond can support. Start with reasonable numbers and work up, not the reverse (i.e., 667 fish with an ultimate weight of 1.5 pounds each or 1,000 pounds per acre).

As far as a cage site is concerned, they are best located in the open water of a pond or lake where the prevailing winds allow water movement through the cages. Even slight breezes can cause wave and current action that can assist in water movement through a cage, bringing in oxygenated waters and helping to remove metabolic and food wastes. If the water is stagnant, severe oxygen depletions and fish kills are more likely to occur. If dissolved oxygen falls below 1.5 parts per million, then emergency aeration with paddle-wheel or impeller pumps is recommended and/or fresh water added, if available.

You should allow a minimum of at least two feet between the cage and the pond or river bottom. This allows for a buffer between the fish and the wastes associated with culture. Cages are best placed with the width of one cage located between adjacent cages. If this is not reasonable, then there should be a minimum of three feet between cages to allow for water flow between them. All cages should be securely anchored to prevent wind or water flow from moving them around and possibly destroying them, or if placed in public waters, causing them to become a hazard to navigation.

Ideally, cages should be placed in an area away from activity such as swimming or boating to prevent stress to the fish.



SPECIES AND STOCKING DENSITY

Although the basic concepts are similar for all fish, each species has its own unique traits and is best addressed individually. Therefore, in deciding what species are best for you, you should contact either your county extension agent, the state Department of Natural Resources, the United States Department of Interior's Fish and Wildlife Service, Office of Information and Publications, Washington, D.C., or the Aquaculture Information Service at the United States Department of Agriculture's National Agriculture Library, Beltsville, Maryland.

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