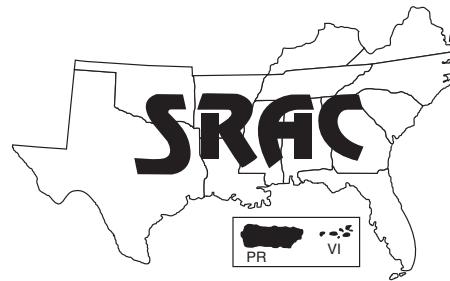


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What is Cage Culture?

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Fish can be cultured in one of four culture systems—ponds, raceways, recirculating systems or cages. A cage or net pen is a system that confines the fish or shellfish in a mesh enclosure. By strict definition, a cage and a net pen differ based on their construction. A cage has a completely rigid frame (on all sides) and a net pen has a rigid frame only around the top. However, the terms "cage" and "net pen" are often used interchangeably. Marine cages are often called net pens, even though they have completely rigid frames, and vice versa. Structural differences have little effect on production practices or the environmental impact of these systems. This fact sheet will use the term "cage" collectively. Cage culture uses existing water resources (ponds, rivers, estuaries, open ocean, etc.) but confines the fish inside some type of mesh enclosure. The mesh retains the fish, making it easier to feed, observe and harvest them. The mesh also allows the water to pass freely between the fish and surrounding water resource, thus maintaining good water quality and removing wastes.

Cage culture probably originated with fishermen who used cages to accumulate fish for market. Over time, they learned to feed the fish in these cages to increase their size and improve their overall health. The first cages used for culturing rather than just holding fish were probably developed in Southeast Asia about the end of the 18th century. These cages were

constructed of wood or bamboo and the confined fish were fed trash fish and food scraps.

Modern cage culture in the U.S. began in the 1950s with the advent of synthetic materials suitable for cage construction. Universities in the U.S. began conducting cage culture research in the 1960s. Freshwater cage research in the U.S. has been limited because large-scale, open-pond culture was more economically viable and received most of the research focus. There has been little research on marine cage systems because of regulatory issues, a limited number of good quality sites, and the high cost of research. Currently, however, there is renewed interest in marine cage or net pen culture in the U.S. Federal and state regulations are being re-examined in an effort to streamline permitting processes and define rules, oversight and liabilities. These issues have not been resolved at the time of this writing. Therefore, this series of fact sheets will be devoted to freshwater cage culture and not address unresolved marine cage culture issues.

Today, freshwater cage culture is practiced to a limited extent in the southern U.S., usually as an alternative type of agriculture for small and limited-resource farmers. Freshwater cage culture also allows farmers to use existing water resources that may or may not be used for other purposes. The fish produced are usually sold to local niche markets. As wild-capture fisheries have declined and aquaculture has expanded, these niche markets have also

grown. The result may be opportunities to increase cage production.

Freshwater cage culture is not fool-proof or simple. On the contrary, it is more intensive in many ways than pond culture and probably should be considered as an alternative commercial enterprise only where open-pond culture is not practical because of excessive depth, obstructions that prevent harvest, or predator problems.

Advantages of Cage Culture

Resource use flexibility

Cage culture can be established in any suitable body of water, including lakes, ponds, mining pits, streams or rivers with proper water quality, access and legal authority. This flexibility makes it possible to exploit underused water resources to produce fish. (Specific state laws may restrict the use of public waters for private fish production. Contact your state Extension service or natural resource agency for regulatory information.)

Low initial investment

Relative to the cost of pond construction and its associated infrastructure (electricity, roads, water wells, etc.), cage culture in an existing body of water can be inexpensive. At low densities (relative to pond surface acreage) cages often do not require aeration or any electrical source. Cage materials are not especially expensive and many kinds of cages can be constructed with little experience. (See SRAC #162, *Cage Culture: Cage Construction and Placement*.)

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Simplified cultural practices

Cages lend themselves to straightforward observation of the fish. The observation of fish behavior, especially feeding behavior, is critical to anticipating and avoiding problems with stress and diseases, which often occur in cage culture.

Simplified harvesting

Cages are usually harvested by moving them into shallow water, crowding the fish into a restricted area, and simply dipping the fish out of the cage. Or, the cage can be lifted partially out of the water so that the fish are crowded into a smaller volume, and then the fish dipped out. This makes it possible to partially harvest fish from cages as needed for local niche markets or personal consumption.

Multi-use of water resources

The confinement of fish in cages should not hinder other uses of the water resource, such as fishing, boating, swimming, irrigation or livestock watering.

These advantages are appealing, particularly the low capital investment required. A farmer could try producing fish in an existing pond or other water resource with minimal financial or environmental risk. If successful, the farmer could expand production with additional cages or intensify production by increasing aeration or fish densities.

Disadvantages of Cage Culture

Complete diets needed

Feed must be nutritionally complete and kept fresh. Caged fish will get no natural food and so depend on the manufactured diet for all essential nutrition. Feed must provide all necessary proteins (down to specific amino acids), carbohydrates, fats (including essentially fatty acids), vitamins and minerals for maximum growth. Nutrients start to deteriorate quickly when exposed to heat and moisture.

The shelf life of feeds is less than 3 months from the date of manufacture. Therefore, foods must be stored properly and fed quickly.

Water quality problems

Localized water quality problems, particularly low dissolved oxygen, are common in cage culture. The high fish densities, along with the high feeding rates, often reduce dissolved oxygen and increase ammonia concentration in and around the cage, especially if there is no water movement through the cage. Low dissolved oxygen within cages may not affect other organisms in the lake, pond or stream.

Diseases

Diseases are a common problem in cage culture and they can cause catastrophic losses. Wild fish around the cage can transmit diseases to the caged fish. The crowding in cages promotes stress and allows disease organisms to spread rapidly.

Vandalism and poaching

Caged fish are an easy target for poachers and vandals. Cages must be placed where access can be controlled and poaching risks reduced.

Predation

Predation can be a problem if cages are not constructed or managed properly. Turtles, snakes, otters, raccoons and fish-eating birds will take fish or damage cages unless precautions are taken.

Limited production

Fewer pounds of fish per acre are produced in cages than in open pond culture systems. This is mostly because of the stress associated with fish density, the poorer localized water quality, and the increased incidence of disease.

Overwintering problems

It is difficult to overwinter warm-water fish in cages. There is usually a high mortality rate because of bacterial and fungal diseases.

The disadvantages of cage culture should be considered carefully before

production begins. Many of these problems can be dealt with through proper construction, location and management.

Species selection

Research in the southern U.S. has centered primarily on the cage culture of channel catfish and rainbow trout, with some studies conducted on carp, hybrid striped bass, tilapia and sunfish. For a species to be practical for cage culture, we must know its culture requirements and be able to satisfy them. That means supplying the water quality it needs and having access to commercial feeds that meet its nutritional requirements. Some species, like blue catfish, do not do well in cages because they cannot tolerate the crowding that is necessary for efficient cage production.

Before attempting to raise fish in cages, the producer should carefully analyze potential markets, the production site, water quality, construction and production costs, and legal requirements. Of these, the market is most often overlooked by novice fish producers. Research the markets in your area before deciding whether or not to culture fish. Finally, check with your local Extension office or state department of natural resources about the permits needed for aquaculture and the processing and transportation of fish.

Other publications in this series on cage culture are:

SRAC #161, *Cage Culture: Site Selection and Water Quality*

SRAC #162, *Cage Culture: Cage Construction and Placement*

SRAC #163, *Cage Culture: Species Suitable for Cage Culture*

SRAC #164, *Cage Culture: Handling and Feeding Caged Fish*

SRAC #165, *Cage Culture: Cage Culture Problems*

SRAC #166, *Cage Culture: Harvesting and Economics*

SRAC fact sheets are reviewed annually by the Publications, Videos and Computer Software Steering Committee. Fact sheets are revised as new knowledge becomes available. Fact sheets that have not been revised are considered to reflect the current state of knowledge.



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