Raising Bait Minnows in Small Tanks

Raising minnows or other small fish in tanks can be a rewarding hobby in itself and provide quantities of forage fish for a sportfish pond. Some care and attention is required is required for success however, the guidelines given below should help avert most of the common problems that may occur in small scale fish production.

Constructing a recirculating minnow production system

Commercially produced recirculating systems can be purchased from several aquaculture supply companies. However, systems also may be constructed from easily obtained materials. This section will provide information needed to construct a low cost, recirculating aquaculture system that will fit easily into a 10 x 10 foot space.

Tank

Suitable tanks can measure from 2-4 feet deep and 6-8 feet in diameter. Place the tank on a smooth, solid surface such as concrete, sand or tilled and leveled soil. Fiberglass tanks may require side supports for structural integrity when filled with water. Place the tank in a covered building or in shade if placed outside. A 110 volt electrical outlet and water supply should be nearby. Either well or tap water is suitable. **Place the tank in a location that is not accessible to small children to avoid the possibility of an accidental drowning.**

Water pump

Submersible water pumps can be purchased at hardware and garden centers or through aquaculture supply catalogs. Submersible, 110 volt pumps designed for water gardens and fountains are ideally suited for this application. The pump should supply water at a rate of 500-750 gal./hr; with a maximum head of 12 feet. A model with a long cord (20 ft.) is recommended. Pump outlet diameter should be 1/2 - 3/4 in. The pump inlet should be screened.

Biofilter

The biofilter removes toxic ammonia from the water. Place the biofilter in the center of the fish tank, on

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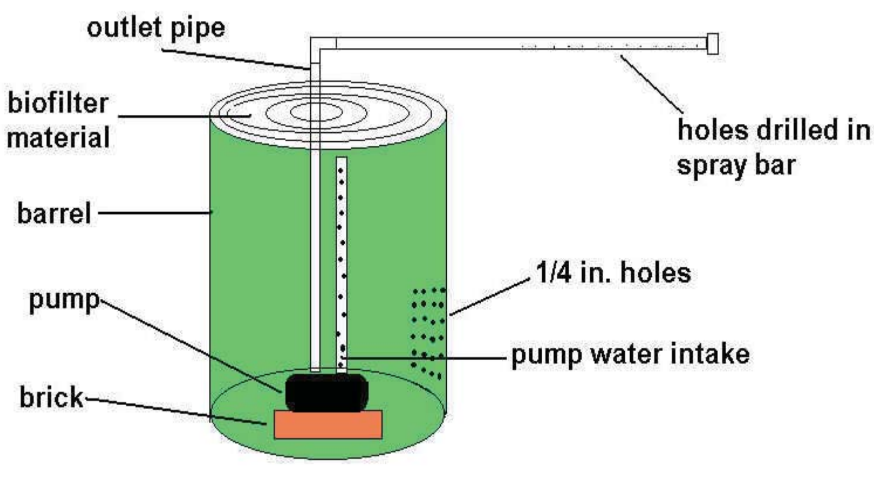
top of a brick platform about 2-3 in. high. The brick platform raises the pump a few inches above the bottom of the tank to prevent accidental removal of all water should the outlet pipe inadvertently direct water over the side of the tank.

The biofilter is constructed from a 30 gallon plastic barrel (fig. 2). Drill 1/4 in. holes, at about 1-2 in. intervals around the barrel, beginning 1 in. from the bottom, and continuing up the barrel to a height equal to the water level in the fish tank. This usually results in an 18 in. wide band of holes around the barrel. Wrap 1 layer of window screen mesh around the barrel covering the holes to prevent larval fish from entering the pump.

Attach the water pump to a brick with plastic coated wire, nylon string or electrical cable ties. This assembly should rest in the bottom of the barrel. The pump inlet should be about 2 in. from the bottom of the barrel. This allows sludge to build up without clogging the water pump. Attach PVC pipe to the outlet of the pump.

Run the pipe vertically about 2 ft., out the top of the barrel and then horizontally about 3 feet, to near the edge of the fish tank. **Before assembling water outlet pipe**, drill about 16, 1/8 in. holes, spaced 1 in. apart in a line along the length of the horizontal pipe. Cap the end of the pipe.



Biofilter Construction

Fill the barrel with biofilter material after the vertical water outlet pipe is installed. The recommended biofilter media is made from polyester fiber. It is a washable, coarse grade filter matting sold by the yard or by the roll, and 28 in. wide. A rolled piece about 9-11 feet long, slipped over the water outlet pipe, will usually fill the barrel and provide sufficient surface area for the biofilter. Other biofilter materials are available from suppliers and work equally well. An inexpensive substitute for manufactured biofilter products is lava rock, which is often used as a landscaping material.

Cover the barrel with a lid. Cut a hole for the vertical water outlet pipe. The lid prevents fish from entering the barrel. It also helps prevent excessive algal growth and clogging on the biofilter material by excluding light.

Adjust the spray bar to direct a spray of water perpendicular to the side of the tank, and down at an angle of 45-80 degrees . Properly directing the spray bar produces a circular current that concentrates solid waste, uneaten feed etc to the center where it easily can be siphoned out of the tank.

Temperature regulation

Place a thermometer in the tank and check temperature daily. Aquarium water heaters, available at pet stores are used to maintain a reasonably constant water temperature. More than one heater may be needed to sufficiently warm the tank. Determine heater size in watts by multiplying the number of gallons of water in the tank by 4. For example, a 250 gallon tank requires 1000 watts of heater capacity or two, 500 watt heaters. Adjust heaters to maintain a temperature of 65-80 degrees F. Place the heater in the center well of the filter to avoid breakage.

Water temperature must be below 85 degrees to encourage

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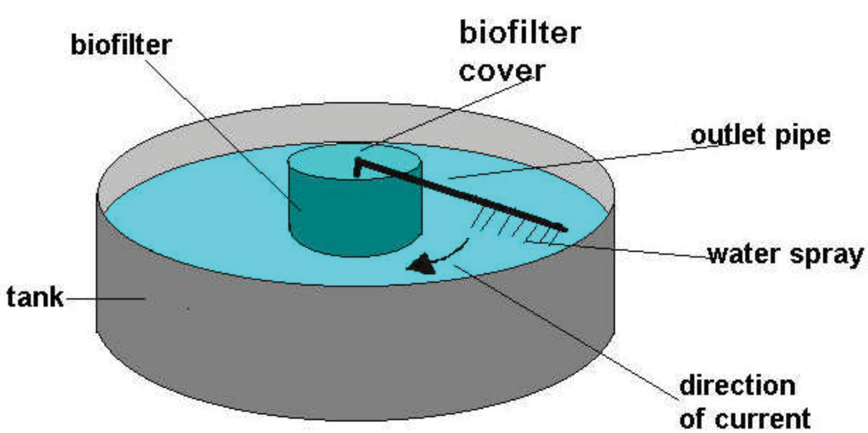
continuous spawning of fathead minnows. Summer temperatures can quickly warm a tank of water above this desired temperature. Place the system in a shady area to help keep water cool. Add cool tap water or well water if necessary to maintain cooler temperatures.

Tank

The tank is often the most noticeable part of the system but the least likely to cause problems. Tank volume is usually 200-1000 gallons. Circular tanks work best because water circulation is more complete, with fewer “dead spots” and solid waste collection is made easier because water currents concentrate waste materials near the center of the tank. Tank depth is usually about 2-4 feet ; diameter is 6-10 feet. Similar sized rectangular tanks can also be used effectively.

Use a smooth walled tank. Rough walls or protuberances in the tank can damage fish skin or scales, allowing bacterial or fungal infections to develop.

Cover the tank. Use bird netting, a weighted cast net or screen to cover the tank. Many species will jump out, given the opportunity.



Bait production tank

Biofilter operation

Biofilters break down toxic, ammonia- based waste products from fish and fish feed. A biofilter can be constructed of anything that has a large surface area that can support bacterial growth and allow for continuous water circulation over the filter surface. Filter materials are manufactured in a variety of configurations. Woven mat materials and plastic balls or beads with a large surface area are commonly available from supply catalogs. Lava rock works well for low intensity applications such as the minnow system described here. Sand filters, usually used for swimming pool filtration are not suitable for fish culture. They tend to clog too rapidly to work effectively in most systems. Filters must not be constructed of anything toxic to fish or bacteria, and must be well oxygenated, (5-8 mg/l is optimal in most systems). Many filter materials used in heating and air cooling applications contain fungicides, and other compounds toxic to fish and bacteria. Do not use them in the biofilter.

Bacteria, appearing as a grey or brown film, growing on the biofilter, break down fish waste products. In a newly established system, ammonia level will increase rapidly the first 2-3 weeks if fish are present. As initial bacteria species begin to colonize the biofilter they convert ammonia released by the fish into nitrite. It takes about 4 weeks for these bacteria to become well established. During this time nitrite and ammonia can reach toxic levels unless about 50% of the water is replaced every 3-4 days. Other species of bacteria also will begin to colonize the biofilter. They will consume nitrite and convert it into nitrate which is relatively harmless to fish. The filter should have sufficient bacterial colonies to be fully operational within 4-6 weeks. At this time bacterial populations stabilize at levels that consume and convert most toxic waste products into harmless forms;

and frequent water exchanges are no longer necessary.

Because it takes some time for the biofilter to become fully operational, it is best to start the recirculating system about 1 month before brood fish are stocked into it. Ammonia to feed bacteria can be added to the system at start up. Two sources of ammonia are fish and fertilizer. Stock 1-2 dozen fathead minnows per 100 gallons of water to start the system. Feed fish lightly every 2-3 days. These fish may die during start up if ammonia or nitrite levels exceed their tolerance for these conditions. Household plant fertilizer also can be used at the rate of about 1 tablespoon per 100 gallons of water.

To quick charge a filter with bacteria, add about 4 cups of rich garden soil to the filter media.

At start up add **1/2 cup un-iodized salt/100 gal. water.** Addition of common, un-iodized table salt will prevent uptake of nitrite into fish gills reducing the risk of nitrite poisoning and lessen osmotic stress on newly stocked fish.

Temperature is important

Biofilters operate best at temperatures between 65 and 85 degrees F. Temperatures outside this range reduce bacterial metabolism and the efficiency of the biofilter

If fish must be placed into a system without an established biofilter, use the following precautions:

Feed fish lightly. Every 4-5 days is often enough until the filter is activated.

Change water. Many water problems are most easily solved by replacing some or all of the tank water. Change out about ½ of the tank water every 4 days for the first 2-3 weeks. Changing water will help maintain ammonia at safe levels for the minnows. Fish exposed to high concentrations of ammonia may have burned gills that reduce their ability to take in oxygen from the water Ammonia can be smelled when it reaches very high levels in the tank. Fish behavior is also a clue. Fish sometimes will try to jump out of the tank when ammonia is excessive. Dead fish with bright red or bloody gills may also indicate high ammonia levels. Around the third week ammonia level will decline, however, nitrite level increases

pH

pH values may drop during the biofilter activation period and throughout the culture period. This happens because bacteria use carbon compounds, primarily carbonates, in their growth that tend to stabilize pH values in a neutral range. Alkalinity is mostly a measure of carbonate and bicarbonate ions. (see section on water quality) This value declines as the carbonate is used by the bacteria in the biofilter and pH drops. pH levels below 5 can harm fish.
In the minnow production system described here, weight of fish and biofilter capacity should not greatly effect alkalinity or pH unless the water used in the system is very soft. If water is soft or low in alkalinity, any potential problem can be prevented by placing about 25 lb. of agricultural limestone into the tank. The ag lime can be placed in a plastic tub or feed sack for handling convenience. Periodic additions of Sodium Bicarbonate (baking soda) can be used in place of ag lime. Add only enough to maintain pH at 6.5 – 7.5 and alkalinity at 20-50 mg/l. However, caution is advised. Do not raise the pH more than 0.5 pH points per day or fish may become stressed or die.

Biofilter maintenance

Some filters may need sludge removed occasionally. Bacteria may become thick enough to prevent adequate water flow or mechanical functioning of the filter. If this occurs, remove excess bacteria with **de-chlorinated** water. **Do not thoroughly clean the filter**
Using chlorinated water or completely cleaning the filter will remove or kill most of the bacteria. The filter will then need to go through another activation period before it is optimally functioning. As biofilters are concerned, benign neglect is better than over zealous cleaning.

Solids collection

Recirculating systems require some method of collecting solid waste particles occasionally. Purchased systems usually have a settling tray or some other device to remove solids. Solids also can be siphoned out of the tank with a hose as needed. This is convenient to do in round tanks where circular currents concentrate the waste in the center of the tank. Solid waste removal is important because it reduces the work of the biofilter. Solid waste particles also can clog the biofilter, reducing its efficiency.

Water pump

Most recirculating systems are driven by the water pump. It circulates water from the tank, through the biofilter and the solids collector back to the tank where it is often sprayed into the tank to provide aeration and directed water circulation.

Prevent clogging of water pump inlet

The water pump inlet can be clogged easily with waste solids, fish food or biofilter material. Screen the inlet. Check the pump often to insure that it is running and not clogged with debris or screen material.

Heater

The in-tank water heater stabilizes water temperature. This eases metabolic stress on fish and just as importantly, stabilizes the bacterial environment in the biofilter. Prevent water temperature from exceeding 90 degrees F. Drain and replace excessively warm water with fresh water from the tap. **Remember to de-chlorinate water before use with fish.**

De-chlorinate the water in the tank with a commercial water de-chlorinating agent or use sodium thiosulfate at a rate of about 2 teaspoons sodium thiosulfate per 100 gallons of water.

Stir vigorously and let the water pump mix the chemical in the tank for a few minutes before adding fish.

Monitor water temperature

Use a thermometer to measure water temperature and adjust the thermostat on the water heater to about 75-80 degrees F.

Aeration

Aeration adds oxygen to the water and can help circulate it. Most species of fish are stressed at oxygen levels below 3-5 mg/L. Stressed fish are prone to disease and death. Maintenance of oxygen levels at or above 3 mg/l improves chances of successful production. Fathead minnows are hardy and tolerant of low oxygen and generally poor water quality conditions. These attributes make the fish a good candidate for recirculating system culture.

Bacteria in the biofilter also begin to suffer and metabolize waste less efficiently as the oxygen level drops. Many systems use an aerator pump and diffusor stones to pump a stream of air bubbles into water. **Replace or clean air stones every 6 months.** Water can be aerated by spraying it into the tank or dropping it from a height back into the tank. Aeration is best achieved by use of a fine spray of water or the smallest possible air bubbles.

Maintain oxygen levels at or above 5 mg/L Use an oxygen test kit if available.

Water

De-chlorinate tap water

Chlorinated water kills fish. To de-chlorinate, use commercial de-chlorinating chemicals, sodium thiosulfate or allow a tank of tap water to “age” at least 1 week prior to stocking fish. However, small water losses from evaporation or periodic draining of up to 20 percent of the tank volume can be made up with regular chlorinated tap water without harming fish. However:

Never leave an unattended water hose running in the tank

This is the single greatest cause of failure in small recirculating aquaculture systems. **Also, do not put soap, chemicals or foreign objects into the tank.** Many of these things may be toxic to fish even in small quantities.

Changes in water chemistry often cause problems in recirculating aquaculture systems. One of the most common and misunderstood problems is a drop in pH. Values below pH 5 can cause severe stress and death in most fish as well as the bacteria in the biofilter. pH drops because carbonates (measured by the alkalinity test) are used up by bacterial metabolism in the biofilter.

A 25 lb. bag of agricultural limestone suspended in the fish tank will prevent most pH related problems. Although at production levels suggested for this system, pH problems probably should not occur unless water hardness is very low, less than 20 mg/l.

Toxic waste product concentrations also may increase in the tank. The most likely cause is excess feeding.

Drain and replace 10-20% of water volume each week to reduce ammonia levels, and maintain proper pH and alkalinity levels.

Stress kills fish

Do not temperature shock fish. When fish are moved or taken from one body of water and put into another, always allow the water temperature to slowly equilibrate for 30 minutes.

When fish begin to die in the tank it is most often because they are stressed from poor water quality**.** If fish begin to die, do the following things:
examine dying fish - look for sores on the body or bleeding from gills. Sores and "cottony" patches indicate bacterial or fungal diseases. Treat fish health problems by improving their environment. Watch fish behavior. Are they sluggish or excited? Fish may act excited when ammonia levels are high.
Test water quality - Dissolved oxygen, ammonia and pH are most important. Take necessary steps to correct water chemistry imbalances.
Replace 50% or more of tank water with fresh water. Remember to de-chlorinate the water. This step will solve most water quality emergencies. Avoid sudden temperature changes when replacing large quantities of water. Fish and the biofilter can be harmed.
Contact the nearest University Fisheries Extension Specialist for further consultation. They can help detect problems that may have been overlooked.

Stocking density

It is tempting to overstock a recirculating system. Claims are made about raising fish at densities as high as 1 lb or more per gallon of water. High stocking densities leave no room for error. Fish can literally die within minutes from a power or equipment failure. A thorough knowledge of water chemistry and much practical experience is needed for managing high density systems.

Stocking at low densities

Low density stocking brings a much greater chance of success. Most systems can perform with few problems if fish total pounds of fish remain under 5 lb fish per 100 gallons of water. Densities can be increased with experience and success.

Do not over-feed

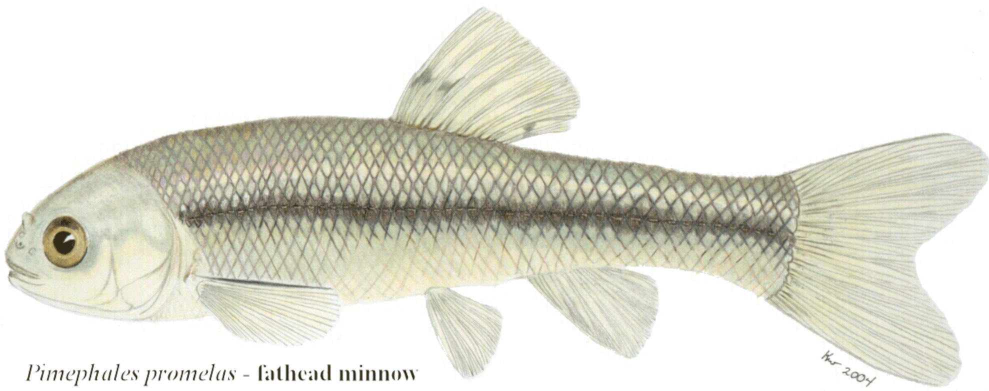
Watch feed carefully. Feed only what can be consumed in a 10 minute period daily. Feed smaller amounts when fish are fed several times per day. If ammonia levels rise excessively or if algal blooms become heavy, cut feeding down to 2-3 days per week.
Algae, "moss" or "scum" may develop in the tank. Young fathead minnows will feed on these plants and associated aquatic invertebrates. Excess quantities of these plants can clog pumps and biofilters and alter water chemistry. Algal blooms are caused by abundant light and excess nutrients in the tank either from over feeding or failure to remove solids from the tank on a regular basis. Algal blooms are heaviest where sunlight is abundant. Greenhouse conditions can produce intense algal blooms in nutrient laden water.

Prevent heavy algal blooms, do not over- feed
Most water problems can be prevented or reduced by draining 10-20 percent of the tank volume each week and replacing it with fresh water.

These tips should help insure a successful recirculating minnow culture system.

Fathead minnow production

Initially stock the recirculating system with 3 -4 dozen fathead minnows. These fish can be purchased from the local bait shop. Place an old pallet, or float a few pieces of untreated lumber or plywood in the tank to provide spawning sites.



Pimephales promelas - **fathead minnow**

Brood stock should be about 2 ½ inches long. Breeding males are dark colored and have blunt shaped heads with tubercles (small protruberances) on the head. Females are silvery to olive colored and somewhat smaller than the males. Spawning begins in spring when water temperature reaches 60 - 65 degrees F. Spawning stops if water temperature rises Above 85 F. but will resume when temperature cools. Fathead minnows spawn repeatedly throughout the spring and summer. Life span of the fathead minnows is 2-3 years. Initial broods stock can be used for 2 years.

Each female lays about 1000 eggs. Usually 200-500 per spawn. The female may spawn 1-12 times per year. Eggs incubate in 5-7 days depending on temperature. Males picks up fertilized eggs in their mouths and move them to nesting sites. Fathead minnows will deposit eggs on the underneath side of the lumber placed in the tank. In the wild, eggs are usually attached to the underside of submerged rocks, logs, plants and undercut stream banks.
Growth rate depends on feeding. Young hatched in early spring can reach sexual maturity and spawn by late summer.

Feeding

Do not clean the sides of the culture tank.
Young fathead minnows can feed on the algae, phytoplankton and zooplankton found growing on the sides. This food source is particularly important for newly hatched fry. Regular feeding with fish food is often all that is required to obtain algal growth. However, algal growth and phytoplankton blooms can be encouraged by adding a small amount of liquid fertilizer to the tank. Use a formulation that is high in phosphorous. About 1-2 tablespoons of household plant fertilizer per 100 gallons of water is sufficient. Do not over fertilize.

Feed minnows a small amount of fish food daily, all they will consume in about 45 minutes. Minnow feeds can be purchased in bulk from feed stores in some areas or ordered from feed mills. Channel catfish food is more commonly available and will do as well. Use a high protein 36% or more floating ration. Buy the smallest size available. Pellets can be crushed if small crumbles or meals are not in stock. Remove uneaten food from the tank bottom every 2-3 days.

Harvest

Harvest minnows as they reach a size of about 1-1.5 inches long. Time from hatching to harvest depends on water temperature and feeding rate. Harvest minnows with a fine mesh dip net. Handle fish gently to avoid damage to scales and skin.

When stocking ponds, place minnows in a large cooler filled with water taken from the production tank. Slowly replace water in the cooler with water from the pond over a 30 minute period of time.

This is a very important procedure that gradually acclimates the minnows to pond temperature and chemical characteristics. Failure to acclimate minnows to the new pond can result in high or complete mortality.

Provide spawning substrate such as old boards or pallets in the pond to be stocked with fathead minnows. Anchor spawning material in 1-3 feet of water near the edge of the pond. Provide cover around spawning sites in the form of cedar trees or other material. Addition of cover provides protection to young minnows long enough for some of them to reach sexual maturity, breed and further supply forage fish for the pond.