CRAWFISH CULTURE IN MARYLAND

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Aquaculture of crawfish has attracted considerable interest in Maryland, both as a gourmet food for personal consumption and as a means of potential profit. Though there are over 300 species of crawfish worldwide, crawfish aquaculture in this country usually limits itself to just two species, the red swamp crawfish, *Procambarus clarki,* and the white river crawfish, *P. acutus acutus.* Most farmers who raise crawfish — known also as crayfish, mudbugs or crawdads — generally rear the red swamp species in combination with only a few white river species. The biology and culture requirements of the two species are very similar, however, and will be discussed as if they were essentially the same. This fact sheet briefly examines some of the more important issues concerning crawfish aquaculture and includes a reference list for more detailed information.

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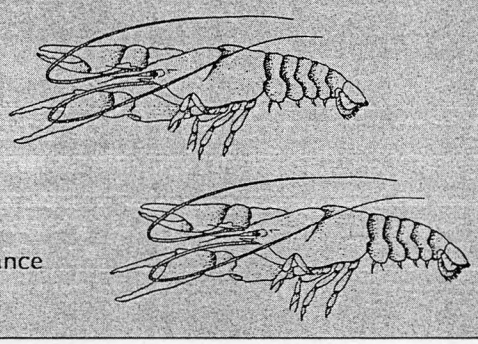


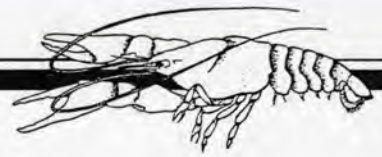
BIOLOGY AND LIFE HISTORY OF CRAWFISH

Natural crawfish breeding usually occurs when water temperature begins to warm up in the spring, with peak breeding occurring around 70°F to 80°F. In Maryland this is generally from mid- to late May through early June. The male, which has a modified abdominal appendage that serves as a sperm transfer canal, usually deposits a sperm pack into an external receptacle on the female.

Shortly after breeding, the female will burrow into the pond bottom, usually near the edge in shallow water. Some males will enter the burrows with the females, especially those females which have not yet bred, while other males and young crawfish will occupy root holes or burrow into the soft mud.

Burrows are generally two to three feet deep and are usually capped by the crawfish with a plug of dirt immediately after the burrow is completed. This plug seals the entrance hole and allows the female to live several months without being disturbed. The burrows generally have enough moisture to keep the gills moist while the pond is dry.

By September or early October eggs are laid in the burrows and fertilized. Red swamp crawfish produce about 400 eggs each, while white river crawfish produce slightly fewer. The eggs are held under-



Call them crayfish, crawdads or mudbugs — crawfish are good eating and fairly easy to raise. This pond looks right for crawfish culture, with a flat bottom, sloped sides and plenty of rice for the crawfish to feed on. Specially designed ponds are best, but crawfish will also grow in farm ditches and even in slightly salty water.

neath the female's tail in clusters and attached to the swimmerets by a sticky substance called glair.

Red swamp eggs hatch in 14 to 21 days, while the white river eggs can take up to 8 days longer, or 29 days. In general, the eggs and newly hatched crawfish cling to the female until she leaves the burrow. Peak hatching occurs in October, when the pond should be flooded. Plenty of water in the pond at this time is critical to the survival of the young as they are free swimmers at this stage and will be looking for food.

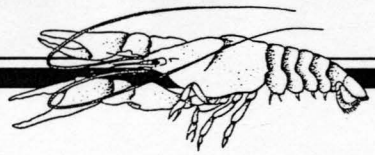
Crawfish are omnivorous; though they prefer fresh meat, they will eat dead or living plant and animal matter. Unequipped to hunt and capture more mobile organisms, crawfish are not active predators. Consequently, most of their diet may often consist of plant material and the bacterial organisms that aid in plant decay.

Growth rate depends on available food, water temperature and the density of crawfish in the pond. Crawfish usually go through 11 molts — shedding of the external shell (as with blue crabs) — before they are fully mature. Under differing conditions molts will occur every 6 to 11 days. Depending on nutrition, crawfish grow from 1/4 to 1/2 inch for each molt. This means a crawfish can reach a maximum size of 2-1/4 to 5 inches, with as many as 10 to 20 animals in a pound (10-20 count). Under ideal temperatures (70-80°F) and food conditions, the time from hatching to maturity will range from 50 to 90 days. Under less-than-optimal conditions (lower temperatures, 50-55°, and shortage of food) hatching to maturity may take as long as 150 days. There is some evidence that breeding and hatching can occur throughout most of the year.

In aquaculture of crawfish, breeding and spawning cycles can be controlled by flooding and drying ponds.

POND SITE AND PREPARATION

Because water level is very critical to the growth, survival and harvest of crawfish, the land you choose for the location of your pond should be relatively flat. The most efficient pond size is 3-1/2 to 5 acres, though it could be as large as 20 acres, and should retain water depths of 18 to 30 inches. Ponds are usually rectangular, with an earthen berm or levee in the middle, extending three quarters of the pond's length, to allow water recirculation (as will be described later). During winter, ponds must be at a capacity sufficient to leave



enough water below the ice: crawfish will die if they freeze. On the other hand, the pond should be shallow enough to prevent water quality problems such as oxygen depletion; no more than 25 percent of the pond should have water deeper than 30 inches.

If the contour of the land will not accommodate these water depths, then levees must be built. The outside levees should be 36 to 40 inches high and a minimum of 8 inches wide at the top. At least two sides of the levees in large ponds should be able to support vehicular traffic; they should have a 3:1 outside slope and be grassed to prevent erosion. Pond bottoms are best flat and level, having only enough slope to allow complete drainage, and should be free of all stumps and trees. Drains must be large enough to remove at least 3 inches of water in 48 hours. A great deal of information and help on proper pond construction is available from local Soil and Water Conservation offices.

Some commercial operations on the Eastern Shore of Maryland use drainage ditches for ponds and keep water in them all year long. While such operations can be quite successful, they require more labor since the crawfish have to be fed supplemental food and their breeding is not as easily controllable.

Soils

Minerals and chemicals normally found in soils are very important to the growth and welfare of crawfish; therefore, it is important to consider basic soil characteristics before starting an aquaculture operation.

Areas of high rainfall generally have low levels of the basic minerals necessary for crawfish survival. Such soils are usually too acidic and may need to be limed with dolomitic limestone. Liming not only increases the alkalinity of the soil and water (raises the pH) but also provides calcium, an essential element for growth. The crawfish shell is primarily calcium, and what the animal doesn't obtain from food sources it must get from the water.

Water

Crawfish prefer water in the neutral to slightly acidic range, pH of 5.8 to 8.2 with 6.7 to 7.0 optimal; if necessary, the pond should be limed as mentioned above. Research has shown that higher water hardness means better crawfish production; at a minimum, water hardness should be 50 ppm, though ideally hardness should exceed 100 ppm.

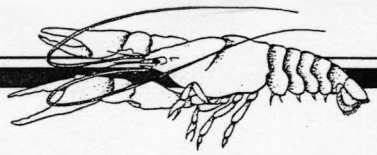
While well water is preferable, surface water will suffice if precautions are taken. Surface water can increase the chance of problems from contaminated run-off and the introduction of wild fish, which prey on crawfish. It is essential, therefore, to screen or filter surface water with a saran screen or box to prevent wild fish from entering the ponds. Well water is also a potential problem in Maryland because of high iron content. Concentrations higher than 4.0 ppm are detrimental, as iron precipitates on the gills and suffocates the crawfish. Iron can usually be removed by first pumping well water through a long ditch, which removes the mineral from solution before water enters the pond.

Crawfish will grow in saline waters. Adult survival and growth have been recorded in waters up to 10 to 12 parts per thousand. Juveniles, however, cannot tolerate as high a salinity and growth will be slower. Problems in juvenile growth may also arise when salinity increases due to pond evaporation. Tidal ponds, too, may be a problem because they are usually low and cannot be drained completely, leading to problems in planting a sufficient forage base for the crawfish to feed on during flooded periods.

Dissolved oxygen is the most important element in water: oxygen content should always exceed 3.0 ppm, though ideally it will be at saturation. If oxygen levels go below 3.0 ppm, emergency aeration must be started; this may require aeration pumps or simply the addition of fresh water.

STOCKING

Ponds should be stocked initially in the spring, in mid-April to early May. It is best to stock with freshly caught, pond-reared crawfish that have a 50 percent female count. Brood crawfish should be in the 12 to 18 animals-per pound range. In ponds with no crawfish, stocking recommendations range from 50 to 100 pounds of crawfish per acre, most experts suggesting the higher number. Crawfish are best placed in the middle of a pond where vegetation is generally heaviest; water level



should be at least 18 inches at this time. If proper management care is taken, future restocking should not be necessary.

To stimulate the onset of burrowing, water draw-down should begin by the 10th of June at a rate of 1-1/2 to 3 inches per day. Avoid rapid drainage to prevent the crawfish from "panicking" and migrating out of the pond. A slow draw-down will also give the smaller crawfish time to burrow into the soft mud to survive the summer. Drying the ponds allows new growth of vegetation, forces females to "dig" deeper and reduces predation from birds and animals.

FORAGE PRODUCTION AND SUMMER MAINTENANCE

The summer months are devoted to producing forage for the crawfish to eat during the fall and winter after the ponds have been reflooded. Larger ponds could be allowed to dry completely so that a tractor can be brought in for planting without bogging down; smaller ponds can be seeded by hand while the bottom is still moist. Generally, however, it is best to plant forage crops, such as rice, millet or sorghum once the pond is dry, in late June or July. Although rice is the preferred food, it is possible to plant other grains or grasses. If waterfowl management is to be integrated with crawfish culture the primary crop may be sorghum and/or rice. Remember that ducks will pass nutrients into the water, which could stimulate heavy algal blooms; these algae in turn could lead to oxygen loss and thus be detrimental to the crawfish. Therefore, if grain crops are going to be used for ducks and crawfish, be sure that the waterfowl are being harvested.

Sorghum should be planted at the recommended rate for a normal agricultural crop. Millet is planted at 45 pounds per acre and rice at 100 pounds per acre. The rice should be planted by the middle of July, the soil fertilized with 200 pounds of 15-15-15 per acre or 200 pounds of 21-0-0 at tillering. It is important to cultivate the crop just as you would ordinarily because it will provide the crawfish with their primary food in fall and winter.

FALL FLOODING AND MAINTENANCE

Ponds are usually flooded in late September or early October, though the exact time depends on the crawfish hatch. It is important to begin flooding as soon as the young crawfish are evident in the burrows; if there are delays the young crawfish may starve. To check for their presence, it may be necessary to dip out a number of crawfish burrows, perhaps by siphoning water from them.

Water entering the pond will soften the "burrow plug." The female and young will then emerge and begin feeding. Young crawfish can usually be found in the shallow areas of the pond in dense vegetation. Adult and intermediate sized crawfish are found towards the center of the pond, in deeper water.

If rice is the forage crop, some recommend not flooding the pond until water temperatures drop below 70°F. In Maryland, this should usually occur by late September. Also when using rice, limit initial flooding to 8 inches, to decrease plant decomposition and prevent water quality problems such as low dissolved oxygen.

Plant decomposition is one of the biggest consumers of dissolved oxygen in ponds. According to researchers in Louisiana, decomposition of rice occurs very slowly under 40°F, but the rate doubles with every 15° increase in temperature.

There is a pond management "trade- off" decision that individual growers must make. On one hand, it is best to slowly fill the ponds to prevent water quality problems from rapid decomposition of the vegetation; on the other hand this practice may prevent a fall harvest in Maryland.

As long as conditions are adequate for crawfish growth (water temperature above 60°F, adequate dissolved oxygen and food) crawfish continue to grow in the pond and the remaining adults can be harvested. However, once water temperatures go below 50°F, activity and growth slow down and it becomes difficult to capture crawfish. Under ideal conditions it takes 60-90 days for the young to reach market size, but due to the fall and winter temperatures in Maryland it will be springtime before the young reach an adequate size for harvesting.

One way to prevent the loss of a fall

harvest is to adequately aerate the pond once the desired depth has been reached. This can be done in several ways: by using mechanical aerators, by flushing fresh water through the pond, or by using relift pumps that draw water from the bottom on one side of the divided pond (referred to earlier in Pond Site and Preparation) and discharge it into the other side. This water flow will create a circular current and may help maintain oxygen levels if water exchange is adequate. A pump must circulate the entire volume of water within five days and optimally within two days.

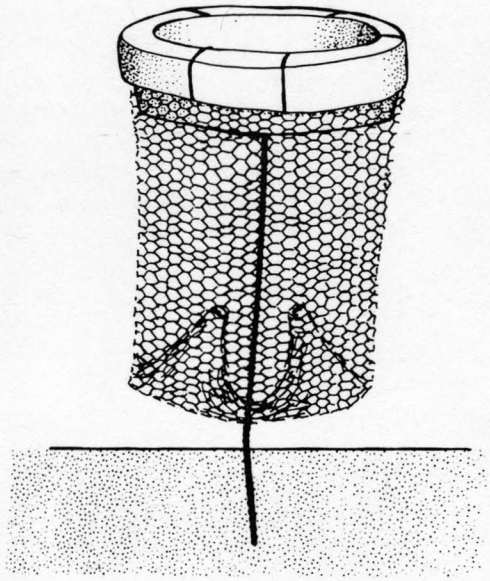
It may be necessary to supplementally feed the crawfish if the pond is fully flooded early in the fall and food supply is diminished by plant forage decomposition and active feeding. Good sources of supplemental food include straw, hay, soybean meal and, if obtainable, rice bran. Protect against oxygen depletion by spreading the material in thin layers in several areas of the pond.

HARVESTING

Under ideal environmental conditions, and with optimal growth and reproduction, it is possible to harvest between 500 to 2000 pounds of crawfish per acre per year. Harvesting is labor intensive as crawfish are collected by traps or pots. Recommended are 18-inch cone-shaped stand-up traps with two 1 to 1-1/2 inch openings in the bottom (one in each corner) for shallow ponds, and pillow traps for deep ponds. Traps can be constructed of either 3/4-inch vexar, which is the preferred material, or coated chicken wire. They should be fastened with stainless steel rings; in addition, a retainer ring, a six-inch wide collar of metal or plastic, is placed inside the trap at the top. This retainer ring prevents captured crawfish from crawling out.

A prop stick or rod is fastened to one side of the trap. The rod extends far enough below the trap to pierce the pond bottom, allowing the trap to stand upright. Twenty to thirty traps per acre, evenly spaced over the pond, should be sufficient; they should be fished at least once every twelve hours.

Traps can be baited with beef scraps, fish heads, canned dog food, chicken parts or commercially available baits. At present some of the commercially available baits and cutfish (particularly gizzard shad or carp) have been most effective. In cold water about 1/6 pound of bait per trap per day is adequate; in warm water baits should be increased to 1/4 pound per trap per day. Old bait should be removed from traps daily.



Like a crabpot on a stick, this chicken wire trap catches crawfish. The trap stands on its rod above the bottom of the pond and attracts crawfish with various kinds of bait. The crawfish enter through wire cones at the bottom and, like crabs, find it impossible to exit because of their stiff shells.

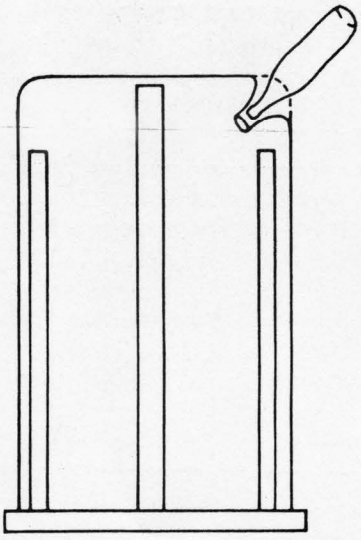
All of the crawfish should not be taken during harvesting, or restocking the pond may be necessary.

MARKETING

The two major outlets for crawfish are the consumer market and the fish bait market. For the consumer market, a quality item is paramount.

There are two ways to assure quality. The first way is to purge the crawfish of all food items from the gut, thus providing a cleaner and aesthetically more attractive animal. Purge crawfish by placing them in a separate water-aerated tank or in a large trap set in the pond for 12 to 24 hours after capture. The second way is to market only those crawfish with completely filled tails. Crawfish greater than 3-1/2 inches and 10-20 count are preferred as consumer products. These two techniques, purging and harvesting only full-tail crawfish, help assure a high-quality product. Remember that berried females (females with eggs) and small young crawfish should not be harvested at any time.

Marketing crawfish requires the same planning and sales effort as any other fish or seafood product. Make contact with



One way to mass produce crawfish traps is to build a wooden jig. Use the jig to form the chicken wire, then make good use of a soft drink bottle to mold two coneshaped entry points for the crawfish.

distributors, brokers, local outlets or direct markets such as restaurants before undertaking a crawfish farm. Be sure to check the seasonality of the market and price variations. The more markets available, the greater the flexibility and profit. Likewise, the more questions you ask and the longer you plan, the more contacts you will make that can help build your market.

FURTHER READING AND REFERENCES

Much of the information in this report has been adapted for Maryland from the following papers. They can be obtained from each author directly or, in many cases, from the Aquaculture Section of The National Agricultural Library in Beltsville, Maryland.

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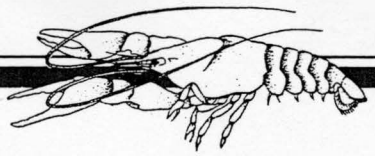

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