



COMMERCIAL POSSIBILITIES

AND LIMITATIONS IN

FROG RAISING

While there may be some profit from selling frogs, artificial propagation of frogs on a commercial basis has not been proved successful. The Fish and Wildlife Service has received thousands of inquiries about frog raising, but to the present time has heard of only two or three persons or institutions claiming any degree of success, so far as intensive frog culture is concerned. Much of the success claimed by a few "frog farms" appears to have been in the sale of breeding stock to would-be frog farmers. The Service has never engaged in frog culture and has never distributed or sold frogs, tadpoles, or frog eggs.

Frog farming.--Most of the so-called frog farms, and those that should be least expensive and require the least labor, are simply natural marshy areas or ponds with food and environment suited to the needs of frogs. In such areas the frogs, left to themselves, will thrive and multiply; results may be improved by increasing the shoreline as mentioned below.

A pond or swampy area may be stocked with adult frogs, or with eggs. In stocking with adults, better results may be obtained by introducing the frogs in late summer and fall in order that they may become accustomed to their new surroundings before the egg-laying season--April in the South and May or June farther north (in California some species begin breeding in January and February). Smaller species might be hatched to serve as food for the larger edible varieties, but the cannibalistic habit which this suggests dictates a segregation of the commercial species according to size to prevent their eating one another.

Frogs lay their eggs in ponds, and the tadpoles live in ponds, but young and adult frogs spend most of their time in summer on the shore, hiding among vegetation, watching for prey. Ample shoreline is important, but a large pond is not essential; the larger the pond, the less the shoreline in proportion to area. To increase the shoreline and to make it as irregular as possible, fingerlike bays may be dug and the earth so obtained may be used to make long peninsulas; round, irregular islands may be made, or horseshoe-shaped units, or long narrow ponds, according to the natural accommodation of the land. If no natural area is available, a series of hills and ditches may be constructed,

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running preferably north-and-south. This system gives more shoreline than any other shape, and the north-south trend of the ditches means that vegetation on the banks will provide shade that is vital to the frogs during the hot days of summer. In constructing a frog pond, select an area where the soil is capable of holding water, where a cheap supply of good water is obtainable, and where drainage is good.

Ricefields are suited to frog farming, and it has been suggested that raising muskrats and frogs might be combined to advantage. Willows and other shade trees should be planted along the banks. The water should not be deeper than is necessary to protect frogs and tadpoles from heat in summer and from freezing in winter; the depth would vary according to climate. Much shallow water 2 to 6 inches deep is essential; the small animals the frogs eat thrive best there and the frogs catch them more easily. If sufficient shade is provided, 12 to 18 inches of water is deep enough in the South; in the North, part of the pond may be deepened to make safe hibernation quarters, for in winter frogs seek deep water or bury themselves in mud.

In any area designed for frog raising, game fish such as black bass, pikes, and pickerel, and snakes, snapping turtles, cats, foxes, and other enemies should be excluded, while encouragement should be given to minnows, crayfish, waterbugs, and smaller species of frogs. Water birds are destructive of frogs, and about the only way to exclude them in small areas would be to stretch a wire net above the water occupied by the frogs. The larger frogs will devour small turtles of about 2 inches diameter and any fishes 3 to 4 inches in length.

If practicable a close-meshed fence about 3 feet high, topped with 1-inch mesh wire, about 18 inches wide, set on an outward incline of about 35 degrees, may be built around small ponds and pools to prevent undesirable frogs, toads, and other enemies from entering; by reversing the arrangement, the wire-topped fence may be used to prevent escape of the frogs.

Artificial feeding.--The problem of providing sufficient live food for frogs after they have reached the adult stage and when kept in small bodies of water, must be solved before intensive frog farming can be counted on. Tadpoles will thrive on any soft vegetable or animal matter, boiled potatoes, meat scraps, or decayed or fresh chicken dressings; but as soon as the legs are fully developed and the tail absorbed and the young frog is able to perch on a leaf or on a shady bank, he refuses such food and begins an intensive search for small insects. As he increases in size he snaps at increasingly larger forms of animal life, until in full adult size he will take anything from an insect to a 3-inch fish or a young turtle.

Because of their feeding habits, adult frogs cannot be fed with dead fish or raw meat, vegetable refuse, and the like, but must have living food, or food in motion. The Japanese, who experimented in frog culture for many years, devised a method of giving motion to silkworm grubs after they have been killed by boiling and the silk unwound from the cocoons. The dead grubs are placed in shallow wooden trays or flats containing about half an inch of water and anchored close to shore. The trays are kept in motion by means of

a small water motor, and the motion rolls the grubs back and forth; the frogs devour them greedily as long as this motion is maintained. Live food also is placed in these trays--minnows, crayfish, or other small animals easily obtainable, for the frogs are unable to catch the fish in the deeper water of the pond. Small cracks are left in the trays for the water to seep in, and each tray is braced between four logs so that it will float while holding about half an inch of water. The frogs like to perch on the logs, which at the same time prevent the minnows from escaping.

Strong lights (100- or 200-watt clear lamps) along the shore at night, particularly in the early part of the night, may be used to attract insects. Flowers should be planted to attract insects. Aquatic plants supply food and harborage for crayfish and tadpoles and act as oxygenators; water-plantains are good, and pondweeds are valuable in the deeper areas.

Edible species.--The common bullfrog (Rana catesbeiana) is the largest North American species, reaching a length of 8 inches from tip of nose to end of backbone. It is sometimes referred to as the "Giant bullfrog", and "Jumbo", or "Mammoth Jumbo." The tadpoles, when the hind legs appear, measure 6 to 7 inches from mouth to end of tail. This species ranges from the Gulf coast to southern Canada, and from the Atlantic to the Rocky Mountains. Its color varies in shades of green and brown; the under parts of both sexes are white with more or less distinct mottlings of brown; the male has a bright yellow throat, while that of the female is dirty white, mottled with brown. The bullfrog may be distinguished from other frogs by the broad flat head; the ear disk of the male is much larger than the eye, while the ear of the female is about the same size as the eye; a short fold of skin extends backward from the eye over the ear and down to the shoulder; the hind feet are fully webbed. In stocking ponds with breeders the sexes should be nearly equal in number, as a male usually pairs with but one female during a season.

The green frog (Rana clamitans), $3\frac{1}{2}$ to 4 inches long, is found in practically all of eastern North America. The southern bullfrog (Rana grylio), 5 or 6 inches long, is found in Florida and other southern States. The leopard frog (Rana pipiens), $3\frac{1}{2}$ to 4 inches, is widespread over North America east of the Sierra Nevada. The pickerel frog (Rana palustris), 3 to $3\frac{1}{2}$ inches, is found over North America east of the central plains. The yellow-legged frog (Rana boylei), $2\frac{1}{2}$ to $3\frac{1}{2}$ inches, is in California and Oregon; it is said to be less used for food because of its skin secretions. The western bullfrog or red-legged frog (Rana aurora), $2\frac{1}{2}$ to 4 or 5 inches, is found in the Pacific Coast States.

Spawning.--Bullfrogs begin laying eggs in March or April in the South and in May or June farther north. The eggs float in a sheet on the surface of the water among brush or vegetation, and a batch from one female covers about 5 square feet and comprises 10,000 to 25,000 eggs. The size of the egg mass identifies bullfrog eggs; the eggs of the green frog seldom cover more than a square foot. For stocking, the following eggs should be rejected: all that are laid single or in small clusters (tree frogs), or in strings (toads), and all in which the egg mass as a whole is velvety black (leopard frogs). The eggs should be carefully transferred, without breaking the masses,

to buckets of water, and deposited about the edges of the water to be stocked. A fine-meshed net may be used in handling them. The eggs hatch without care in from 4 days to 3 weeks, the time varying with the temperature.

Growth.--The rate of growth of the bullfrog tadpole varies with climate; in the Gulf States it never takes more than a year to transform into a frog, and part of the crop may transform in 5 or 6 months, while in the North 2 years may elapse before transformation takes place, as the growth and development of the tadpole and the young frog depend upon food supply and length of the growing season, which in the South is two to three times as long as in the North. In Louisiana, bullfrogs have been reared from the transformation state to mature size in 2 years, but in the North they take longer.

Diseases.--As a rule frogs in nature are not subject to serious diseases, but under crowded conditions in laboratories and small pools they may develop an infection known as "red leg". The only remedies that can be suggested are to remove the infected individuals immediately and, if possible, drain the ponds and let them remain dry for a few days.

The tadpoles breathe by means of gills and are dependent on the oxygen in the water; like fishes, they will develop diseases when weakened by depletion of the oxygen supply, whether from fouling of the water or other causes.

Protective regulations.--The several States make their own fishery regulations, and for information on laws governing the frog fishery and interstate shipment of frogs, licenses, or the creation of frog ponds, application should be made to State authorities. Copies of the State fish and game laws usually can be obtained from State fish and game departments (most of these are in the State capitals).

Methods of capture.--Several methods for capturing frogs are used by frog hunters. Some use a line baited with red cloth, worms, or grasshoppers. Some are adept at catching frogs alive by hand: a frog catcher will hold one hand over or in front of the frog to attract its attention and capture it by a quick movement of the other hand. A method of capture at night is to use a bull's-eye lantern or other bright light. The frogs are dazed and in most cases can be caught by hand or approached near enough for easy dispatch (though sometimes they turn out to be snakes).

Shipping frogs alive.--When frogs are shipped alive for stocking or other purposes, they should be packed in shallow crates or boxes, in which they should occupy not more than half the floor space. Free circulation of air is necessary. Damp leaves or moss in moderate quantity should be spread over the floor of the crate and kept moist throughout the journey. A piece of burlap or other soft material may be tacked in the crate, stretched tight about 2 inches below the wooden top, to prevent injuries to the frogs as they jump. In winter, live frogs should be protected from freezing. Since frogs take only living or moving food they cannot be fed when being held for shipment. They can survive a considerable time without food in cold weather, but in warm weather (their time of greatest activity) they cannot be kept for more than a few days.