# NOTES ON THE EDIBLE FROGS OF THE UNITED STATES AND THEIR ARTIFICIAL PROPAGATION.

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# NOTES ON THE EDIBLE FROGS OF THE UNITED STATES AND THEIR ARTIFICIAL PROPAGATION.

The frogs are familiar representatives of the great class of cold-blooded vertebrates known as the Batrachia. The batrachians are intermediate anatomically and physiologically between the fishes and the reptiles (snakes, turtles, terrapins, alligators, etc.); they are chiefly characterized by the metamorphosis which the young undergo before assuming the functions and habits of the adults. The young are mostly aquatic and breathe by means of gills, which absorb oxygen from the water. Later the gills disappear and are replaced by lungs.

The frogs are included in the order *Salientia* (the leapers), distinguished by having a short, depressed body and four limbs, the hind pair being much enlarged and adapted to leaping and swimming; the tail, present in the young, disappears with age. In the related orders (*Urodela*, containing the salamanders and newts; *Proteida*, the mud-puppies or water-dogs, and *Trachystomata*, the sirens or mud-eels) the tail persists in adult life and the hind limbs are small, but the metamorphoses and habits otherwise more or less closely resemble the *Salientia*.

Associated with the frogs (*Ranidæ*), in the order *Salientia*, are the families (*Bufonidæ* and *Hylidæ*) to which the toads and tree frogs belong. The toads are very closely related to the frogs, but differ in having more terrestrial habits and, among other structural features, in the absence of teeth and the possession of an expansible thorax; their uncouth form and the pungent secretions which have brought them immunity from the attacks of other animals have added to the prejudice against their relatives, the frogs. The tree frogs are characterized by arboreal habits and corresponding changes in structure. More than 250 species of true frogs (*Ranidæ*) are known. They are most numerous in Africa and the East Indies.

The edible frogs of the United States belong to the genus *Rana* (Latin, a frog). Of these, Professor Cope in his Batrachia of North America (1889) lists 13 species and 6 subspecies or varieties, to which there have since been some additions.

## FOOD VALUE OF FROGS.

The value of frogs as food is now thoroughly recognized. The meat is white, delicate, and very wholesome and palatable. Although eaten at all times, it is in best condition in fall and winter; in spring it is of

relatively inferior quality. Only the hind legs are commonly utilized, the meat on the other parts of the body being edible, but in very small quantity. In some localities, however, the entire body, after the removal of the viscera, is fried with eggs and bread crumbs. The legs are prepared for the table by broiling, frying, or stewing.

A prejudice formerly existed against frogs as an article of food, perhaps based on their uncanny appearance and heightened through their appropriation by witches and empirics for spells in love affairs and the cure of various diseases. For a long time the French people alone availed themselves of this delicacy, though it was known to the Romans. From France the use of this food passed into Germany, England, and other parts of Europe, and later into the United States, where frogs are now more generally consumed than in any other country, and where, during the proper seasons, they may be found in the markets of any of the larger cities.*

## FROG-HUNTING.

The business of taking frogs for market has greatly increased in recent years. It is now carried on in all sections of the United States, and is of economic importance in about fifteen States, while in nearly all the remaining States and Territories frogs are taken for local or home consumption, of which it is impossible to get a statistical account. The States supplying the largest quantities for the markets are California, Missouri, New York, Arkansas, Maryland, Virginia, Ohio, and Indiana. More frogs are taken in New York than in any other State, but on account of their comparatively small size their value is less than in Missouri and California. The Canadian Province of Ontario also yields a comparatively large supply of market frogs. According to inquiries of the United States Fish Commission, the annual catch in the United States is but little less than 1,000,000, with a gross value to the hunters of about $50,000. The yearly cost of frogs and frog legs to the consumers is not less than $150,000.

The localities in which especially important frog hunting is done are the marshes of the western end of Lake Erie, and Lewis and Grand reservoirs, in Ohio; the marshes of the Sacramento and San Joaquin rivers, California; the valley of the Kankakee River, Indiana; Oneida Lake, Seneca River, and other waters of northern New York, and the St. Francis River and the sunken lands of the Mississippi River, in Arkansas and Missouri.

In taking frogs for market, lines baited with red cloth, worms, or insects are extensively used; guns, small-bore rifles, and spears are also employed, and cross-bows are adopted for this purpose in Canada. They are often hunted at night, a lantern furnishing light for the

* While it is popularly supposed that the consumption of frogs in France is much larger than elsewhere, this is not the case, and, on the authority of the Revue des Sciences Naturelles Appliquées (1889), it may be stated that the annual consumption of frogs in the United States is ten times that in France.

hunter's aim, and at the same time blinding or dazing the frogs. After entering on their hibernation, many are dug out of the mud, large numbers often being found together at this time.

In the basin of the St. Francis River, in Missouri and Arkansas, where the business is important, frogs are captured by means of spears, with lines at the end of long rods, and with firearms. In the early part of the season, when the frogs retire to the mud during the cool nights, and only appear on warm, bright days, they are taken on hooks baited with red cloth and by guns and rifles. Later the bulk of the catch is made at night by means of spears with one to three barbed prongs. Two men usually hunt together in a boat, one rowing, the other standing in the bow with spear and a large reflector made especially for the purpose. The season in this region is principally from March to June. Only the hind legs are preserved; a pair of these weighs about half a pound.

The prices received for frogs varies greatly, and depends on the condition of the market, the size of the frogs, and the locality. Dressed legs yield the hunters from 12½ to 50 cents a pound, and live frogs from 5 cents to $4 a dozen. In the Kankakee Valley, Indiana, for example, the prices received by the hunters are 75 cents a dozen for large frogs, 10 cents a dozen for medium-sized frogs, and 5 cents a dozen for small frogs, while in San Francisco the market price is $3 to $4 a dozen.

The unrestricted hunting of frogs threatens their practical extinction in all places where their abundance and shipping facilities or proximity to market render the business profitable. Already a marked decrease in the supply is manifest in Lake Erie, in northern New York, and other places, and in order to meet the increasing demand hundreds of people are experimenting or preparing to engage in frog-culture.

The need of definite information as to the methods of procedure has been generally felt and frequent inquiries concerning frog-culture are received by the United States Fish Commission. While the practicability of artificial propagation has not been demonstrated, it is evident that the number of salable frogs from a given area may be largely increased by artificial means. To undertake intelligent work in this line a knowledge of the natural history of the frog is essential.

## HABITS AND DEVELOPMENT OF FROGS.

All frogs undergo a tadpole stage, though in some species this is so rapid as to lead the casual observer to think it omitted.

Upon the disappearance of frosts at the close of winter the hibernating frogs return to active life, and as the waters become warmer in the spring sun their notes are heard in suitable localities all over the country. In some species the song is distinctly a *chant d'amour;* in others it is continued long after the breeding season is over. During the breeding season the social instinct prevails, and species of usually solitary habits congregate in large numbers, thus becoming ready prey for the hunter.

The eggs are extruded by the female and are fertilized by the male as they pass out, very few failing to be impregnated. The process of oviposition or laying continues through several days, and during this period several hundred eggs may be deposited. The size of the ova varies with the species, but averages about 1.75 millimeters (.07 inch) in diameter. In passing down the oviduct the egg receives a thin coating of albuminous material; this rapidly swells when the egg enters the water and forms the well-known gelatinous mass in which the frog eggs are always found imbedded. The toad's eggs are laid in long strings and are readily distinguishable. The salamander's eggs are also placed in the water, but the gelatinous mass is somewhat firmer and the eggs are slightly larger than the frog's, and they are usually deposited somewhat earlier.

The eggs begin development, under favorable circumstances, as soon as fertilized, the rapidity depending mainly on the temperature of the water; incubation is much retarded by cold, and some seasons many eggs are killed by late frosts. At first the upper part of the eggs is black and the lower white, but the rapid growth of the black embryo makes the entire egg dark. The egg, which is at first spherical, soon becomes ovoid. In from 4 to 30 days the tadpole is able to wriggle out of its gelatinous envelope and shortly attaches itself to some plant or other support by means of a sort of adhesive organ in front of the mouth. At first the mouth and anus are closed, and food can only be obtained by absorption, the first food consisting of the gelatinous egg-envelope. In a short time the mouth and anus become functional, the alimentary canal lengthens, and macerated animal and vegetable matter becomes the food. The prevalent idea that the tadpole is exclusively vegetarian, based on its anatomical structure, horny jaws, and long intestine, is incorrect. Recent observations have shown that animal matter is preferred to vegetable; all food must be in a state of maceration, especial fondness for dead animals being shown.

Respiration is at first carried on by means of external gills. They are soon replaced by internal structures covered by opercula.

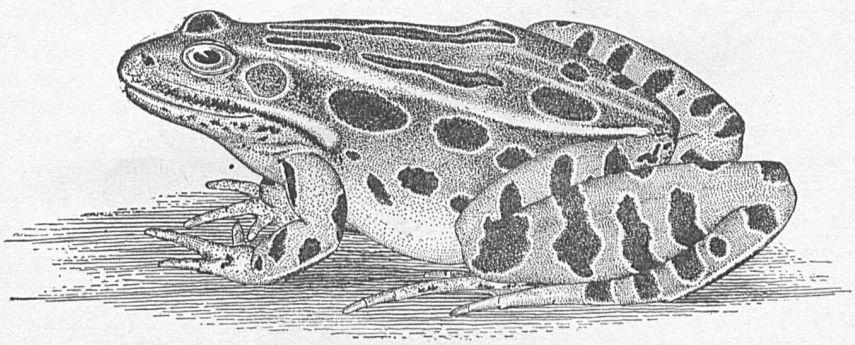
Rapidity of development depends upon the abundance of food and the temperature of water. The most favorable conditions are a shallow pool, readily warmed by the sun and well stocked with organic matter, that is, an old pond. In this stage the frogs may reach a length of several inches, the bullfrog tadpole being largest. The various species closely resemble each other, but can be distinguished after some experience by certain points of mouth structure, size, and coloration.

In a period varying from two months to two years the first indication of the adult form appears in the protrusion of the two hind legs. The forelegs or arms, owing to their being concealed by the gill membranes, are much later in coming out.

As the legs become functional the tail is absorbed and furnishes material for growth, so that little food is taken. In the case of the second-year tadpole the capture of insects is begun before the tail is

lost. As the gills are replaced by lungs during this period, it is essential that the tadpoles have access to land or resting-places, and it is a time of peculiar difficulty in the creature's existence. When the tail is almost fully resorbed, the purely aquatic life is forsaken for the amphibious and the food is changed from dead to living matter, which must demonstrate its living condition by motion. The peculiarly formed tongue—loose behind, so that it may be thrown out to quite a distance—is covered with a viscid secretion so that the frog readily captures any insects or small animals that approach it closely. Tadpoles are commonly satisfied to wait patiently for their food, and even the adults do not often search actively for food. Sexual maturity is reached in about three or four years, being latest for those varieties that pass the first winter in the tadpole stage. It is generally believed that frogs live for 12, 15, or even 20 years.

During the tadpole stage they furnish tempting morsels for fish, reptiles, some mammals, and other frogs, and especially for wading birds, like herons and cranes. Their defenseless condition and the shallowness of their natural habitats at this period make them ready prey,



Spring Frog or Leopard Frog (*Rana virescens*).

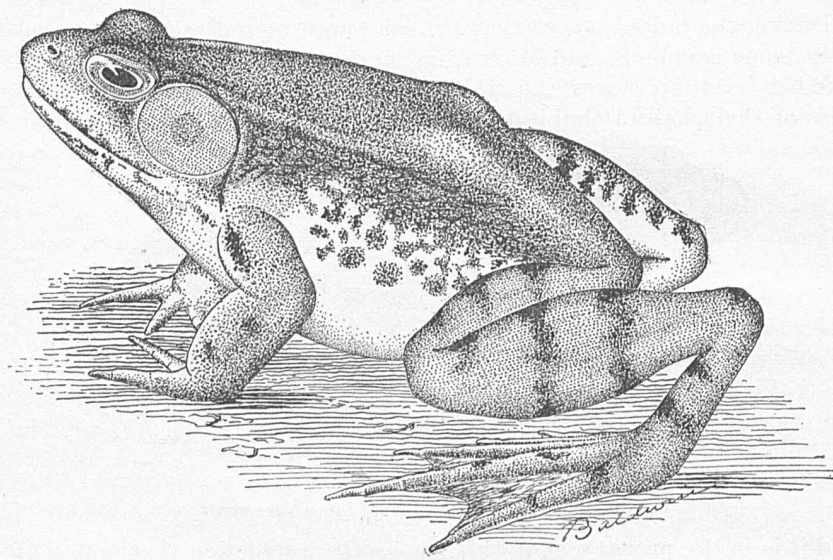
and it is in the prevention of this wholesale destruction that man may profitably intervene. In the adult frog stage the relentless pursuit by birds and reptiles is continued until of the hundreds of eggs deposited few become reproducing individuals. Only slight revenge for all this slaughter can be taken. They may occasionally capture disabled fish or small fish of sluggish habits found in the mud or on the bottom, and instances are recorded of their eating snakes, toads, and young birds, but insects and lower forms are their staple diet.

### DESCRIPTIONS OF MARKETABLE FROGS OF THE UNITED STATES.

The species of frogs commonly eaten are the bullfrog (*Rana catesbiana*), the green frog (*Rana clamata*), the spring frog (*Rana virescens*), and the western bullfrogs (*Rana pretiosa* and *Rana aurora*).

The following references to their geographical distribution and brief descriptions of their color and form have mainly been extracted from Professor Cope's work on The Batrachia of North America (Bulletin No. 34, U. S. National Museum, 1889).

The most widely distributed species is the common frog, spring frog, shad frog, or leopard frog (*Rana virescens*). It is found from the Atlantic Coast to the Sierra Nevada Mountains, and from Lake Athabasca, in Canada, to Guatemala, Central America, but is most abundant in the Eastern States. It reaches a length of about 3½ inches, exclusive of legs. The toes are well webbed, but the web does not reach the tips of the fourth toe, as in the common bullfrog. The head is moderate in size, the snout being rather pointed; the tympanum (ear) is distinct and nearly as large as the eye. The hind limb being carried forward along the body, the tibio-tarsal articulation reaches nearly the tip of the snout. The color is usually bright green, marked by irregular black, dark-brown, or olive blotches edged with whitish or yellowish. These spots form two irregular rows on the back and one or two more or less



Green Frog or Spring Frog (*Rana clamata*).

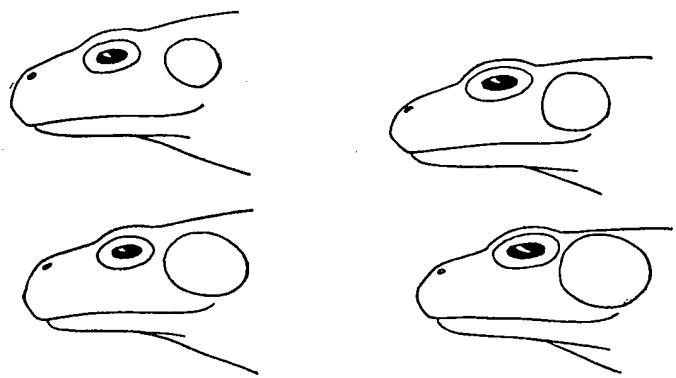
indefinite rows on the sides. The blotching is continued as spots or bars on the posterior extremities. These spots are frequently smaller and more numerous than shown in the specimen figured. The glandular fold which runs from the orbit to the posterior part of the body is yellow. The under surface is whitish or light yellow and unspotted. The leopard frog passes the tadpole stage the first season, and is more gregarious than the bullfrog or green frog. These considerations are of importance from a culturist's standpoint.

The green frog or spring frog (*Rana clamata*) is found throughout the Eastern and Central States and neighboring parts of Canada. The body and limbs are stout and massive, the legs are short, and the head is more rounded than in *R. virescens*. The tympanum is very large, though this differs in the sexes, as a rule being larger than the eye in

males and smaller in females. A fold of skin runs from the eye backward, with a short branch from the tympanum to the shoulder. The femur and tibia are equal in length, the web of toes not reaching end of fourth toe.

The color above is dark olive posteriorly, passing into brilliant green anteriorly. It is sometimes greenish-brown above and on sides, with small round brown spots. The buttocks are usually mottled with brown and yellowish white, but are almost uniformly black in some specimens. Below, this species, white or greenish white, sometimes more or less mottled and blotched. The throat is citron yellow.

This frog is especially aquatic in habits, not hunting on land; it frequents all kinds of fresh waters. It is more solitary in its habits than *R. virescens*, living singly, in pairs, or in small companies. It is active on land and in water, but not noisy. A nasal "chung" is occasionally uttered. When disturbed it often emits a shrill cry as it leaps into



*Rana catesbiana.* Upper figure female, lower figure male.

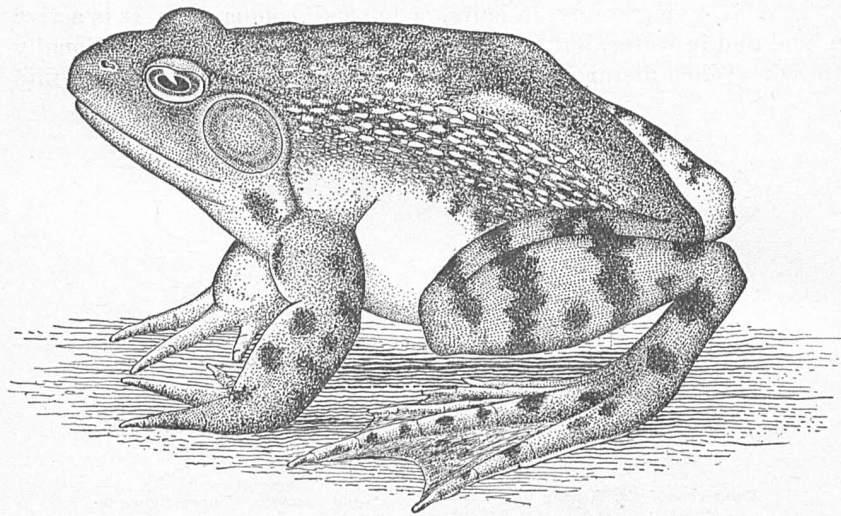
*Rana clamata.* Upper figure female, lower figure male.

Figures illustrating relative size of the tympanum in the two sexes.

the water. It is preeminently an inhabitant of swamps and marshes, especially those connected with rivers or large creeks. "It is the first species heard in spring, and although its voice is not loud, the noise produced by thousands of them is deafening when heard close at hand, and is transmitted through the atmosphere for many miles. It may be imitated by the syllables *chock, chock, chock.*"

The pickerel frog, marsh frog, or tiger frog (*Rana palustris*) closely resembles the leopard frog, but may be readily distinguished from it by the bright yellow on the thighs and legs. It is solitary in its habits and is often found in the grass, although preferring cold spring streams. In the Alleghany Mountains it is the most abundant frog. It is a very active species, taking longer leaps than any of the others here mentioned. The note is a prolonged, low, grating croak. Owing to its disagreeable odor it is but rarely eaten.

The bullfrog (*Rana catesbiana*) is the largest of North American frogs, reaching a body length of over 8 inches. It has much the same geographical range as the spring frog. The body is very bulky and clumsy, the legs are thick, and the head is broader than in *R. clamata*. A fold of skin extends from the eyes over the tympanum, around the insertion of forearm, and disappears on the breast. There are no folds on the sides of back, as in *R. clamata* and *R. virescens*. The skin is slightly rough above. The tympanum is larger than eye, with the same sexual differences as in *R. clamata*. The tibia is slightly shorter than the femur. The hind toes are fully webbed. The complete webbing of the fourth toe, with the absence of dorsal folds of skin, furnishes means of distinguishing this from the spring frog.

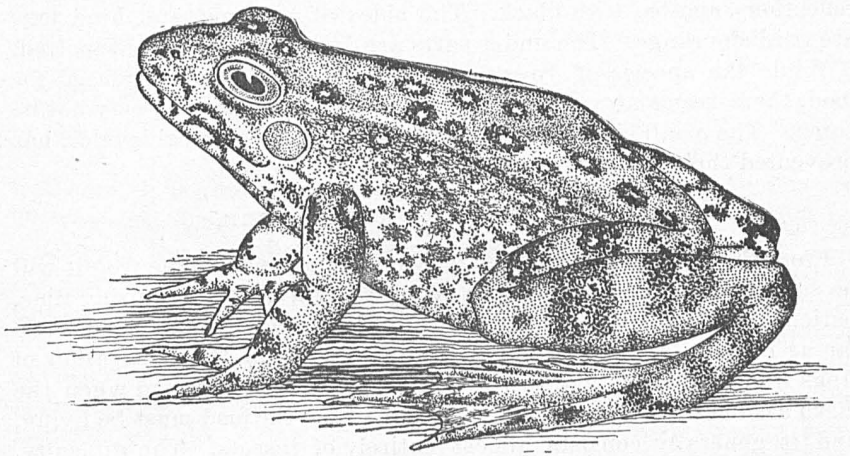


Common Bullfrog (*Rana catesbiana*). Male.

The color above is olivaceous, brown, or ferruginous, with darker blotches half the diameter of the eye, more or less uniformly distributed. The color is sometimes yellowish green without blotches or other markings. The hind legs are barred above and the buttocks blotched with nearly black markings. The lower parts are white, with obscure mottlings of brown, the throat sometimes being bright yellow. In the young the blotches above are reduced to distinct black dots, and the under parts are yellowish anteriorly. The habits are much the same as those of *R. clamata*. Both species pass the first winter in the tadpole stage and are said under unfavorable circumstances to pass even the second winter so. This fact, with the solitary habits of the adult, is of importance to the culturist.

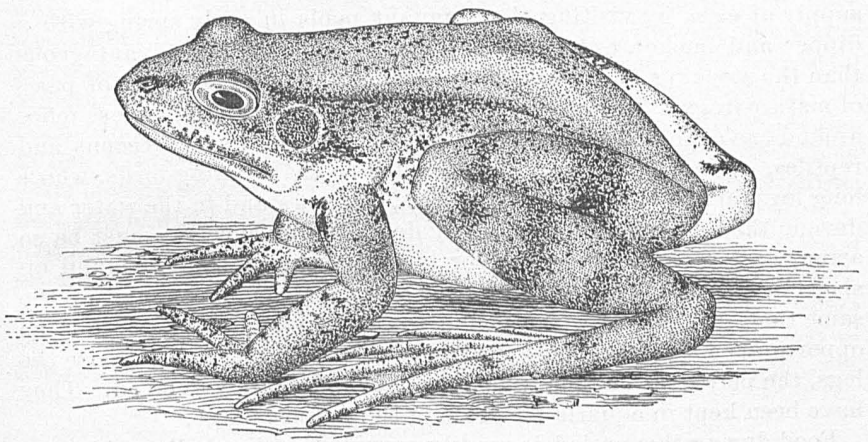
The Western frogs are not well known. The range of *Rana pretiosa* is from Montana west to Puget Sound, thence south to southern California. It is the common frog of the Northwestern States. The body is stout and depressed like *R. catesbiana*. The head is obtuse, rounded, subtruncate, and broader than long. The eyes are small and the

tympanum, which is sometimes indistinct in some small specimens, is smaller than the eye. Skin thick. The femur is shorter than the tibia and not quite half length of body. The toes are fully webbed. A depressed ridge extends from eye to flank. The color is dull yellowish-



Western Frog (*Rana pretiosa*).

brown (dead leaf) above, darker on sides, with circular brown blotches between the ridges. The outer surface of the limbs is blotched transversely. The body spots are often less numerous and smaller than in the specimen figured. The under parts are yellowish white, with obscure brown marbling, posteriorly salmon color.



Western Bullfrog (*Rana aurora*).

*Rana aurora* is found in the western coast region of the United States. The body is depressed and elongated; limbs slender, well developed; head broad, acute, rounded anteriorly; eye moderate; tympanum smaller than eye, but not so small as in preceding species. A fold of

skin runs from eye to hind leg. The femur is shorter than the tibia, which is rather more than half the length of body. The toes are not quite fully webbed, the last joints of all the toes and last two of the fourth toe being free. The color above is greenish-yellow, with golden reflections, spotted with black. The sides of abdomen and hind legs are reddish-orange. The under parts are dull yellowish-green, spotted.

While the species of frogs described are those commonly used for food, there seems no valid reason why any of the *Ranidæ* may not be eaten. The small size of some, with possibly a disagreeable odor, has prevented their use up to this time.

## SUGGESTIONS FOR FROG-CULTURE.

From the foregoing discussion of the development of the frog it will be seen that its culture must be of necessity a matter requiring time, patience, and an appreciation of the animal's habits and needs. So far as can be learned, attempts thus far made in the cultivation of frogs from the egg stage have been arrested at the period when the larva assumes the adult form. From this time the food must be living, and it generally consists almost entirely of insects. The difficulty, approaching impossibility, of furnishing these in sufficient quantity has been the great drawback. The placing about the pond of meat and decaying matter to attract flies has been suggested, but the contamination of the water by the poisonous matters of decomposition has counteracted all benefits produced. The frogs, failing in the supply of more natural food, have been compelled to devour one another.

To rear the tadpole is comparatively easy. Anyone may obtain a supply of eggs by visiting the stagnant pools in early spring with a dipper and bucket, but this method is said to be less advantageous than the stocking of suitable waters with a sufficient number of pairs of mature frogs. The young can be protected by building a close fence around the edge of the pond to exclude such enemies as raccoons and reptiles, while a screen must be provided so that wading birds, whose long legs furnish them special facilities, can not stand in the water and devour the helpless tadpoles. Any device to be effective must be so arranged that there is no room for birds or other animals to stand on shore or in shallow water, either on or under the screen, and at the same time it must allow the young to come to land, for if there is no opportunity for the tadpoles to breathe the air at rest and exercise the legs, the period of metamorphosis will be indefinitely delayed. They have been kept in aquaria for years in the tadpole stage.

Food during this period is readily provided. If a shallow old pond is chosen, already well stocked with organic matter, it will supply, unaided, food for a large number of frogs. This may be readily increased by supplying animal refuse, liver and such material, care being taken, of course, not to leave a surplus to putrefy and infect the water. The more abundant the food and the warmer the water the more rapid is the

growth, hence the desirability of selecting a shallow pond. The young should be separated from the adult frogs during this time, as they are eagerly eaten; and it is needless to say that the pond must be free from fish, turtles, snakes, and crayfish.

The critical period occurs at the time of metamorphosis. The creature is now abandoning its aquatic habits and has not yet a perfect apparatus for terrestrial life. Any slight disarrangement of the natural environment is liable to destroy the equilibrium. The rapid resorption of the tail furnishes matter for growth, so that food is not so much a necessity, but as soon as the terrestrial habit is fully assumed live food is absolutely requisite, and should be furnished in liberal quantities. There seems to be no reason why this might not be accomplished by transfer of the tadpoles to waters where natural food abounds. It is useless to attempt to supply this food artificially by any method at present known, neither has any device to increase the natural abundance of insects been practicable as yet. The pond should have a growth of rushes and other plants; wild rice (*Zizania aquatica*) has been recommended, but it might attract birds that would prefer young frogs and tadpoles to their vegetable fare. Shade is necessary. Such a pond will furnish natural food for a large stock of frogs, and give opportunity for successful breeding.

One of the most successful "frog farms" is in Ontario, in the Trent River basin. It has been in operation about twenty years and annually yields a comparatively large product of frogs. The waters were stocked by means of mature mated frogs. No attempt is made to confine the frogs until near the time for shipment to market. They are then taken alive at night, with the aid of a torchlight, and confined in small pens that can be drained when the frogs are desired for market. No food is given, as this is naturally present in sufficient amount for successful growth. The species is the eastern bullfrog (*Rana catesbiana*); it begins to breed at the age of three years and reaches a marketable size in four years. During the years 1895 and 1896 this "farm" yielded 5,000 pounds of dressed frog legs and 7,000 living frogs for scientific purposes and for stocking other waters.

While at present it would perhaps be advisable to limit practical attempts at frog-culture to stocking natural waters with paired breeders, experiments in artificial methods should not be abandoned. There seems no reason why methods similar to those at present pursued in fish-culture may not eventually be successful in the case of frogs.