

EDIBLE FROGS

A. Neveu

Research Director, Aquatic Ecology Unit, Institut National de la Recherche Agronomique, France

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Summary

Edible frogs represent only a very small proportion of all Amphibia and Ranidae, since many species are too small or, more importantly, too toxic for human consumption. In some parts of the world, there is a very long history of using frogs either as a food or medicine. Although European countries are currently among the greatest consumers of frogs' legs, accounting for 8000–9000 tons/year, the appreciation of this delicacy is

more recent, dating back only to the sixteenth century. Historically speaking, the frog occupies an important place in folk culture as a symbol and also in certain belief systems. The biological and ecological importance of the frog arises from its two-phase cycle of development—aquatic for tadpoles, and terrestrial for adults. Owing to particular physiological and behavioral adaptations, the different species of frog have the capacity to colonize highly diverse types of environment. But, under the direct or indirect influence of human activities, many changes in habitats relating to the physical and chemical environment are now having an unfortunate impact on frog populations. The edible frog reacts to the adverse effects of aquatic and terrestrial pollution, so this species may be considered as a good indicator of the overall state of the natural environment. A strong decline in certain frog populations has been caused by their steady harvesting as a food resource, faced with a growing consumer demand and accelerated by the development of the deep-frozen food sector. It is hoped that the development of frog farming in some countries will be able—in the long term—to meet consumer demand and help in saving the overexploited wild populations, which have also been weakened by pollution.

1. Introduction

*“Une grenouille vit un bœuf
 Qui lui sembla de belle taille
 Elle, qui n'était pas grosse en tout comme un œuf,
 Envieuse, s'étend, et s'enfle et se travaille
 Pour égaler l'animal en grosseur,

 La chétive pécore
 S'enfle si bien qu'elle creva”.*

Extrait de “La grenouille qui se veut faire aussi grosse que le Bœuf”.
J. De La Fontaine (1621–1695).

*“A frog saw an ox: in his eyes
 A huge and handsome figure.
 He, who was no bigger
 Than an egg from top to toe,
 In envy stretched and strained in an effort to blow
 Himself up to the same size,

 At which the poor frog, overloaded
 With wind and vanity, exploded”.*

*Extract of “The frog who wanted to be as big as the ox” by the French fable writer,
 J. De La Fontaine (1621–1695).*

The little green frog evoked by de La Fontaine, probably the common Green Frog (*Rana esculenta*), was very ambitious for his time and might have been content merely to imitate the American bullfrog (*R. catesbeiana*). Whether small or large, both species are among the most appreciated of the edible frogs. Maybe one day genetic

modifications will enable frogs to become as large as an ox. Although this would probably be a great advantage from the culinary point of view, the well known voracious appetite of this animal would make it dangerous for human consumers.

In fact, what does the term edible frog mean? A relatively small animal (50–200 g. in weight), whose legs provide pleasant delicate-tasting meat that certain consumers (the French, among others) are very keen on eating. Although it is a luxury food belonging to haute cuisine, it is often also served as a regional dish at festivities. But the edible frog is also a cold-blooded animal with a rugged and slimy skin that has toxic properties, to be found basking in the mire around pools of stagnant water. It has a ferocious appearance, a calculating look in its eye and emits a noisy croak unpleasant to human ears, giving rise to almost as much revulsion as that produced by its cousin the snake.

From the scientific point of view, all frogs for human consumption (edible frogs *sensu lato*) belong to the class of Amphibia (=Batrachia) (4000 known species), and are placed in the order Anura (3500 species) and for the most part within the family Ranidae (700 species), among the genus *Rana* (250 species). These animals have an important place in evolutionary history, being situated at the transition between aquatic and terrestrial species. In fact, it was about 300 million years (M.Y.) ago that the first amphibians left the aquatic environment, along with the first Tetrapods (four-footed animals). The most notable of these amphibians were the Labyrinthodonts, a group that is found up until Triassic times. For about 130 million years, they occupied a niche in the environment as predators and then became competitors with the reptiles from the middle of Carboniferous times onwards.

Later on, in the early Triassic (220 M.Y. ago), the modern Amphibia made their appearance with the genus *Protobatrachus*, the most likely ancestor of the frogs. While the first true frogs date back to the beginning of the Jurassic (190 M.Y.), many members of the Order Anura are already present at the end of the Jurassic (140 M.Y.). Forms that are very similar to present-day species developed from Eocene times onwards (54 M.Y.), particularly during the Oligocene (36 M.Y.) with the first appearance of the Ranidae. In the late Jurassic the fragmentation of the Gondwanaland resulted in three continents, the Africa part rifted from the South America between 90–100 M.Y. ago and becomes the center of the radiation of ranids. A western part of Africa with India fragmented in the mid Cretaceous (100 M.Y.) and moved toward Asia. This drifting land resulted in the isolation and radiation of various anurans. When India was fused to Asia (35 M.Y.) the genus *Rana* was first recorded in an area apparently situated to the south of India. Probably at least two stocks dispersed to Europe during the late Oligocene and to America via Beringia during Oligocene and Miocene. The colonization of Europe took place at a late stage, followed by a return towards North Africa across the last-remaining land bridge between the two continents (Straits of Gibraltar) at around 7 million years ago.

From this time onward, the frogs have come to occupy most types of aquatic environment, but more generally they favor stagnant waters. Their local abundance meant that the predator *Homo sapiens* quickly noticed them. Therefore, it is of interest here to follow the evolution of relations between frogs and humans through the course

of history. These relations are often complex; with frogs being used as some kind of symbol, a source of food or even as an experimental animal.

But to obtain a better understanding of the frog's place on Earth, it is necessary to outline the main biological and ecological characteristics of these animals, particularly in relation to their developmental cycle, which takes place between the aquatic and terrestrial environments, but also in view of their high fertility, which allows a rapid turnover of stocks. Despite this, the pressure of environmental change under the influence of human activities and the over harvesting of populations has led to a decline in frog species. But this problem should be placed in its real context, that is, by asking whether or not a true global decline is actually occurring. If so, does this decline represent a bioindicator of the quality of the biosphere? At present, most of the frogs consumed by humans are still animals taken in the wild. With improvements in farming technology, however, it may be envisaged that consumer demand will be satisfied in the long term. The emergence of intensive raniculture, as discussed in section 6 below, may become an indirect means of protecting wild species of edible frog.

2. Historical Relations with Humans

2.1 Gastronomy

In Europe, frogs were long considered as poisonous and it was only around the sixteenth century that they appeared in the best culinary circles of the Old Continent. During the nineteenth century, their use as a food started to develop as well as varied ways of preparing them for the table. While the French at this time only ate the hind legs, Germans were used to eating the entire body. Wetland areas were rapidly subjected to intense catching and frog populations began to decline.

Some countries are traditional consumers of frogs; in Africa, for example, *Xenopus* is dried in the sun and eaten whole. Certain other species are captured, especially the Goliath frog which can weigh up to 5–6 kg. In certain cooking traditions of the Far East, frogs are eaten whole along with the skin and innards. The eating of frogs in China can be traced back into antiquity, and the most commonly consumed species are *R. tigrina*, *R. nigromaculata* and *R. spinosa*. In North America, the most sought-after species are *R. catesbeiana* (the largest can attain a weight of 800–1200 g.), *R. pipiens*, *R. clamitans* and, more rarely, *R. sylvatica*. The local species consumed in South America belong chiefly to the genus *Leptodactylus*. In Europe, the principle species concerned include the entirely aquatic green frogs belonging to the *R. esculenta* “complex,” (the Edible Frog *R. esculenta*, the Marsh Frog *R. lessonae*, and the Lake Frog *R. ridibunda*), as well as the Common Frog (*R. temporaria*), which has a terrestrial adult phase.

2.2 Laboratory Animal

Historically, frogs have been used as laboratory animals because of their abundance, size, and apparent lack of suffering. Science as a whole, and particularly animal physiology, owes a great debt to the frog. In this context, we can briefly mention the work of Galvani (1737–1798) and Volta (1745–1827) on the nervous system, Spallanzani (1729–1799) on fertilization, and the role of spermatozoids, as well as

Bernard (1813–1878) on the effects of anesthetics. More recently, Rostand (1894–1977) studied parthenogenesis and teratogenesis in the frog.

The frog is currently still used as a basic aid for teaching animal morphology and physiology in secondary and high schools. In research, the frog serves as an experimental animal in many cytophysiological studies, being especially useful because of the biochemical secretions from its skin.

2.3 The Frog as a Symbol in Relation to Beliefs

2.3.1 Symbol of Fertility

The idea of the frog as a beneficent animal rapidly arose from observing its developmental cycle, often explosive in nature, as well as its habit of gathering together for reproduction and its metamorphosis. The frog is considered as a symbol of fertility and rebirth in many parts of the world. Thus, farmers in Africa take it as a sign of the return of rains, corresponding to a symbol of fertility but also of power. Various beliefs have grown up around this same idea, including the myth of raining frogs. This belief is based on the multitude of frogs that come out of their shelter after the first seasonal rains in arid zones, and which climb about everywhere. In fact, this myth persisted from antiquity up until the eighteenth century.

2.3.2 Symbol of Evil Influence

In Judeo-Christian societies, the frog and the toad, long considered as the female and male of the same species, are associated with Evil. A reference to this characteristic is found in the Bible, where the frog is presented as the second scourge of Egypt. In Medieval paintings and sculptures, it is often used in representations of Hell. In addition, the frog occupies a major place alongside the toad in works on sorcery.

2.3.3 Meteorological Symbol

According to traditions in different countries, the frog is either a symbol of the sun or the rain. It was long considered that placing a frog in a jar with a ladder could provide some indication of the weather. If it climbed up the ladder, the weather would be fine, but if it stayed at the bottom, the weather would be rainy. In principle, this would appear paradoxical since many batrachians show hyperactive behavior during rainy weather (calls, migrating).

2.3.4 Symbol of Wonder

We find this animal mentioned in a great number of tales from many European countries. Moreover, these tales produce just as much attraction as repulsion, which is perhaps due to the popular confusion existing between the frog and the toad. Certain authors to show up the manners of their society have also used the frog.

The writing of Jean De La Fontaine is a good example of this, owing to his talent—among others—for observing nature as well as the behavior of animals and humans.

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Biographical Sketch

André Neveu graduated from National Agronomical High School *Institut National Agronomique Paris-Grignon* (INAPG) and from Paris VI University with a Ph. D. in animal Biology in 1970. From beginning to now he is employed in the French *Institut National de la Recherche Agronomique* (INRA). Today he is working in the Ecobiology and Quality of Continental Hydro systems Unit set up in Rennes (Brittany, France) as senior scientist (research director) and Unit director. His first research works dealt with the ecology of macro invertebrate fauna and trophic relations in salmonid streams. Now, he is working on green frog (*R. esculenta*) population dynamics, brown frog (*R. temporaria*) restoration and inter-specific

relations between alien species of crayfishes, and allochthonous ones. He published many scientific papers dealing with benthos production, fishes feeding rhythms, frogs, and crayfish's ecology.

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