Fire-bellied toads and barbourulas

(Bombinatoridae)

Class Amphibia
Order Anura
Family Bombinatoridae

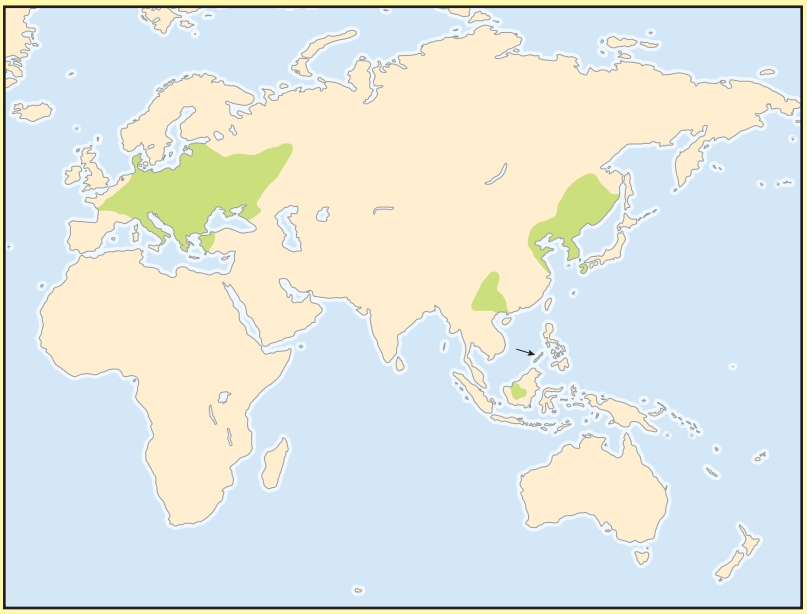
Thumbnail description
Often warty, aquatic toads with flattened bodies that may have a brightly colored venter

Size
1.6–3.9 in (40–100 mm)

Number of genera, species
2 genera; 10 species

Habitat
Usually found in marshes, ponds, stony mountain streams, shallow pools, or rock crevices

Conservation status
Vulnerable: 1 species; Lower Risk/Conservation Dependent: 1 species



Distribution
Much of Europe and eastern Asia

Evolution and systematics

The evolutionary relationships of the Bombinatoridae are debatable. Many authors believe that *Bombina* and *Barbourula* should be placed together with *Alytes* and *Discoglossus* in the family Discoglossidae. Others suggest that only *Alytes* and *Bombina* should be placed together and should be given the name Bombinatoridae (without consideration of *Barbourula*). At present, the most accepted hypothesis of relationships (and the one followed here) suggests that *Bombina* and *Barbourula* are each other's closest relative and should be grouped in the Bombinatoridae, whereas *Discoglossus* and *Alytes* are a separate, more distantly related group, the Discoglossidae.

Fossils of *Bombina* are known from the Pliocene to the Pleistocene. No subfamilies are recognized.

Physical characteristics

These medium-sized frogs have warty, almost "spiny" skin on the back. The color of the dorsum varies from brown-gray to greenish gray or bright green with dark spots. The belly, which is smooth, may be red, orange, or yellow with dark spots. There is no external eardrum (tympanic membrane), and the eyes have triangular pupils. Males have nuptial pads, enlarged bumps that help aquatic frogs hold on to females during breeding, on their first and second fingers.

Distribution

Bombinatorids occur in Europe east to Ukraine, western Russia, Turkey, eastern Russia and also in China, Korea, Vietnam, Borneo, and the Philippines.

Habitat

Frogs in the genus *Bombina* are aquatic and generally prefer slow-moving and open waters, such as swamps, ponds, and marshes. *Barbourula* typically are found in water in more mountainous regions, where they prefer streams and shallow pools, particularly those with stones and rocks. They often hide below rocks or in rocky crevices close to the edge of the water.

Behavior

Fire-bellied toads of the genus *Bombina* are diurnal and quite active in open areas during the day. These frogs have poisonous skin secretions that help protect them from predators. As is the case with many poisonous amphibians, their bright colors and distinct patterns help remind predators that they are toxic. If attacked or threatened by a would-be predator, fire-bellied toads will perform an arching "back bend" called the unken reflex; this maneuver exposes their brightly colored underbellies. Barbourulas, however, have more camouflaged color patterns and do not engage in the anti-predator behavior pat-

An oriental fire-bellied toad (*Bombina orientalis*) adopts a defensive display, showing the warning colors on its belly. (Photo by M.P.L. Fogden. Bruce Coleman Inc. Reproduced by permission.)

terns of the fire-bellied toads. They are highly secretive and spend most of their time hiding under rocks in streams. For this reason, little more is known about their behavior.

Feeding ecology and diet

Depending on the species, the diet may consist of different proportions of aquatic or terrestrial invertebrates, including worms, snails, beetles, and bugs. Tadpoles eat plants, fungus, and small invertebrates.

Reproductive biology

Fire-bellied toads from Europe breed from late spring to midsummer; males often call throughout the day and night. Most breeding occurs in the evening, and males grasp females around the waist. Females lay up to 200 eggs on immersed vegetation or directly on the bottom of the pond. Eggs hatch in about seven days, and tadpoles metamorphose within 45 days of hatching. Although little is known about the biology of barbourulas, it seems that females lay about 80 large eggs and place them under stones in streams.

Conservation status

The IUCN lists *Barbourula busuangensis* as Vulnerable, and *Bombina bombina* as Lower Risk/Conservation Dependent. Several species have disappeared from parts of their range, and one species is known only from a single locality. Others are critically threatened because of destruction of their habitats. A few species, however, seem to have been able to tolerate human modification of the environment and may even have increased in numbers in certain areas because of human influences.

Significance to humans

Fire-bellied toads are common laboratory animals, particularly for studies of embryology and physiology. They are also common in the pet trade, owing to their bright colors, interesting anti-predator behavior, and ease of care.

1. Oriental fire-bellied toad (*Bombina orientalis)*; 2. Yellow-bellied toad (*Bombina variegata)*; 3. Fire-bellied toad (*Bombina bombina).* (Illustration by Barbara Duperron)

Species accounts

Fire-bellied toad
Bombina bombina

TAXONOMY
Rana bombina Linnaeus, 1761, Europe and western Asia. No subspecies recognized.

OTHER COMMON NAMES
English: Firebelly toad; French: Sonneur á ventre feu; German: Rotbauchunke; Spanish: El sapillo de vientre de fuego.

PHYSICAL CHARACTERISTICS
The skin on the back of these frogs is covered with rounded warts and is dark gray to black, with large dark spots. Some individuals living in pools with a lot of vegetation are camouflaged by being bright green with sparse dark green spots. The belly is red or orange, with large bluish black spots and many white dots. There is no external eardrum (tympanic membrane), and the pupil of the eye is triangular.

DISTRIBUTION
These frogs are found in central and eastern Europe from Denmark and western Germany east to the Ural Mountains and south to the Caucasus Mountains. In the north they range to the Gulf of Finland. They also are found in Turkey. Some have been seen in Sweden, but these are most likely an introduced population.

HABITAT
Fire-bellied toads are aquatic in forests and wetlands. They live in dense vegetation as well as open areas, such as drainage ditches. They are also common to permanent freshwaters, such as river valleys, shallow stagnant lakes, ponds, swamps, bogs, ditches, flooded rice fields, and quarries. Sometimes they are found in slow-moving waters, such as springs, irrigation channels, rivers, and streams. In other areas, they seem to prefer stagnant water.

BEHAVIOR
These frogs are active mostly during the day when temperatures reach about 60°F (about 15°C). In the daytime they spend most of their time in the water or near the shore hunting for food. At night, when the humidity in the air is higher, they move onto land to continue foraging. During windy or cold weather, their activity levels decrease. From October to April they hibernate in mud at the bottom of ponds or on land. Although they are active primarily by day, males call mostly at dusk. As with other fire-bellied toads, this species displays the unken reflex when threatened. Despite this behavior and their toxic skin, they are still common prey for many animals.

FEEDING ECOLOGY AND DIET
Fire-bellied toads eat a variety of insects, but more than half of their diet is made up of aquatic prey. Of course, the more time they spend foraging on land, the more terrestrial insects they include in the diet. Terrestrial insects eaten most often include beetles, flies, and ants. The tadpoles may eat some aquatic insects as well, but they mainly eat algae and plants.

REPRODUCTIVE BIOLOGY
These toads breed from May to September, during which time males call either underwater or from a position floating on the water's surface. The male grabs the female around the waist, and she deposits up to 300 eggs. After about two months, eggs hatch, and tadpoles usually metamorphose before autumn. Toads become adults at about three years of age and live for about 12 years.

CONSERVATION STATUS
The IUCN lists this species as Lower Risk/Conservation Dependent. In western Europe this species is threatened or extinct in many areas. The destruction of wetland habitats seems to be the major cause of its decline. In other areas, it seems to be one of the most common toads.

SIGNIFICANCE TO HUMANS
As with other fire-bellied toads, this species is common in the pet trade and laboratory. ◆

Oriental fire-bellied toad
Bombina orientalis

TAXONOMY
Bombinator orientalis Boulenger, 1890, Chefoo (Yantai, Shandong, China). No subspecies recognized.

OTHER COMMON NAMES
English: Oriental firebelly toad, Oriental bell toad; German: Chinesische Rotbauchunke; Spanish: Sapo de vientre de fuego.

PHYSICAL CHARACTERISTICS
The skin on the back of these frogs is covered with pointed, even spiked warts. The dorsum is brownish gray, greenish gray,

or bright green with large dark spots. The belly is red or orange with large dark spots. The pupil of the eye is triangular.

DISTRIBUTION
These toads are found in the southern part of Primorsky Kraj (the Russian maritime territory), northeastern China (south to Jiangsu), Korea, and the Tsushima and Kyushu islands of Japan.

HABITAT
Oriental fire-bellied toads inhabit mixed coniferous or broad-leaved forests as well as spruce and pine forests, open meadows, river valleys, and swamps. They typically are found in slow-moving waters, such as lakes, ponds, swamps, streams, springs, ditches, and puddles. At the end of the summer, they are on land close to water.

BEHAVIOR
This toad is active in warmer temperatures. It hibernates from October to May, mostly on land in tree stumps, piles of stones, or leaves but also on stream bottoms. Up to six toads may hibernate together, presumably as a way to prevent water loss. As with other fire-bellied toads, this species displays the unken reflex when threatened.

FEEDING ECOLOGY AND DIET
Oriental fire-bellied toads eat a variety of insects, including beetles, flies, and ants. They also include worms and snails in their diet. The tadpoles mainly eat algae and plants but, as they age, increase the amount of aquatic and terrestrial insects.

REPRODUCTIVE BIOLOGY
These toads breed from May to August. Breeding and calling are similar to those of the fire-bellied toad, but a female may take many weeks to deposit all of her eggs. She deposits about 30 or so each week until finished and may deposit as many as 250 eggs. Eggs hatch in about two months, and tadpoles usually metamorphose before autumn. The maximum life span recorded for these toads is estimated to be about 20 years.

CONSERVATION STATUS
Not threatened.

SIGNIFICANCE TO HUMANS
As with other fire-bellied toads, this species is common in the pet trade and laboratory. ◆

Yellow-bellied toad
Bombina variegata

TAXONOMY
Rana variegata Linnaeus, 1758, Switzerland. No subspecies recognized.

OTHER COMMON NAMES
English: Yellowbelly toad; French: Sonneur á ventre jaune; German: Gelbbauchunke; Russian: Zheltobryukhaya zherlyanka; Spanish: El sapillo de vientre amarillo.

PHYSICAL CHARACTERISTICS
The skin on the back is covered with sharp warts. Unlike other fire-bellied toads, the skin on the belly also has warts, though fewer than on the back. These toads are also drabber than other fire-bellied toads, being dark olive with small dark spots. The belly usually is yellow with large dark spots, and the inner thighs and tips of the toes also are brightly colored. The pupil of the eye is triangular.

DISTRIBUTION
These toads occur in central and southern Europe (excluding the Iberian Peninsula, adjacent France, and Britain) southeast to the Carpathian Mountains in Ukraine.

HABITAT
Yellow-bellied toads inhabit all kinds of forests, meadows, grasslands, and glades, where they occur in lakes, ponds, swamps, rivers, streams (even those with fast currents), and springs. Apparently, the species has a fairly high tolerance for poor quality water, because it has been found in wetlands that are highly polluted with hydrogen sulfide and salts.

BEHAVIOR
As with fire-bellied toads, this toad is active in warmer temperatures. Hibernation begins in October and ends sometime between March and May, depending on the elevation. These toads hibernate on land in burrows or holes under stones and logs. In thermal springs with warm waters, they may stay active throughout the winter.

FEEDING ECOLOGY AND DIET
Yellow-bellied toads mainly forage for food on land and eat a variety of terrestrial arthropods, including beetles, spiders, flies, and ants.

REPRODUCTIVE BIOLOGY
In the spring these toads leave hibernation and migrate to waters. Mating is similar to that of other toads in the group; it begins within 10 days of entering the water and continues throughout the summer. Heavy rains often increase the intensity of spawning in populations. Sometimes heavy rains in summer are followed by intensive spawning in small wetlands. The mating call is similar to that of the fire-bellied toad, but quieter and higher. The clutch consists of 45–100 eggs deposited in portions, similarly to the oriental fire-bellied toad.

CONSERVATION STATUS
Although not listed by the IUCN, at least 13 local populations of this toad are now extinct, and others are in grave danger.

Despite their tolerance for poor water conditions, destruction of natural habitats and urbanization is the main threat to their survival.

SIGNIFICANCE TO HUMANS

Generally, the species is of no major significance to humans, but it may be found sporadically in the pet trade. ◆

Philippine barbourula

Barbourula busuangensis

TAXONOMY

Barbourula busuangensis Taylor and Noble, 1924, Philippines. No subspecies recognized.

OTHER COMMON NAMES

English: Busuanga jungle toad.

PHYSICAL CHARACTERISTICS

Barbourulas have cryptic color patterns that help them blend in with their surroundings. Usually these are drab colors, such as olive and brown, with some darker markings. Their hands and feet are fully webbed, which is an adaptation for a highly aquatic lifestyle.

DISTRIBUTION

The species occurs in the Busuanga and Palawan islands of the Philippines.

HABITAT

These frogs generally are found in water in mountains, where they prefer streams and shallow pools, particularly those with stones and rocks. They often are found below rocks or in rocky crevices close to the edge of the water.

BEHAVIOR

They are highly secretive and spend most of their time hiding under rocks in streams. For this reason, little more is known about their behavior.

FEEDING ECOLOGY AND DIET

Presumably, they actively forage for a variety of aquatic invertebrates, including insects. They also may include terrestrial invertebrates in their diet.

REPRODUCTIVE BIOLOGY

Although little is known about the biology of barbourulas, it seems that females lay about 80 large eggs and place them under stones in streams.

CONSERVATION STATUS

The IUCN lists this species as Vulnerable. Because these frogs are sensitive to water quality, pollution of streams on Busuanga severely limits the amount of available habitat. Therefore, they are threatened and likely subject to extinction.

SIGNIFICANCE TO HUMANS

None known. ◆

Resources

Books

Duellman, William E., and Linda Trueb. *Biology of Amphibians.* Baltimore: Johns Hopkins University Press, 1994.

Garcia Paris, Mario. *Los Anfibios de España.* Madrid: Ministerio de Agricultura, Pesca y Alimentación, 1985.

Gasc, Jean-Pierre, A. Cabela, J. Crnobrnja-Isailovic, et al., eds. *Atlas of Amphibians and Reptiles in Europe.* Paris: Societas Europaea Herpetologica and Muséum National d'Histoire Naturelle, 1997.

Herrmann, Hans-Joachim. *Terrarien Atlas.* Vol. 1, *Kulturgeschichte*, *Biologie*, *und Terrarienhaltung von Amphibien*, *Schleichenlurche*, *Schwanzlurche*, *Froschlurche.* Melle, Germany: Mergus Verlag, 2001.

Zug, George R., Laurie J. Vitt, and Janalee P. Caldwell. *Herpetology: An Introductory Biology of Amphibians and Reptiles.* 2nd edition. San Diego: Academic Press, 2001.

Other

Canatella, David. "Bombinatoridae." Tree of Life. (15 June 2002) <http://tolweb.org/tree>

Frost, Darrel R. Amphibian Species of the World: An Online Reference. V2.20. 1 Sept. 2000. (15 June 2002) <http://research.amnh.org/herpetology/amphibia>

AmphibiaWeb. (15 June 2002) <http://elib.cs.berkeley.edu/aw/index.html>

Anne M. Maglia, PhD