



Overview of the salamandrid genus *Cynops* (Tschudi, 1839), with selected captive care information (Caudata: Salamandridae)



Cynops orientalis, photo © Jessica J. Miller, <http://www.livingunderworld.org>

INTRODUCTION

Newts of the genus *Cynops* are collectively referred to as the Fire Belly Newts, a name reflective of the bright colored bellies that characterize this genus. The orange, red, or yellow bellies are not unique to *Cynops*, however, as other Asian genera of the family Salamandridae also possess contrasting bright undersides, including *Paramesotriton* and *Pachytriton*. Morphologically, species of the genus *Cynops* are characterized by the presence of a single premaxilla, nasal processes connected with the frontals (sometimes), stout frontosquamosal arch, well developed occipital process of squamosal, short maxilla that does not contact quadrate, V-shaped vomerine teeth, a single pair of radii on basibranchial, thirteen trunk vertebrae, high and large neural spines, and no postsacral ribs on the caudosacral vertebrae (Zhao, 1988). Other characteristics include conspicuous labial folds, mildly to moderately tuberculate skin, mildly distinct vertebral ridge, long limbs and digits, and a small tongue that is free at both sides (Zhao, 1988; Frost, 2004). All species are semi-aquatic, and neoteny is occasionally observed.

The genus *Cynops* is categorized into three informal groups, the *wolterstorffi* group, the *orientalis* group, and the *pyrrhogaster* group, for which members of each group share similar physical characteristics and geological distribution (Zhao, 1988). The *wolterstorffi* group consists of *C. wolterstorffi*, and *C. cyanurus*. Based on post description analysis it is assumed that *C. chenggongensis* is also included in the *wolterstorffi* group. The *pyrrhogaster* group consists of the two Japanese species, *C. pyrrhogaster*, and *C. ensicauda*. The *orientalis* group consists of only *C.*

orientalis, and possibly *C. orphicus*, based on distribution information only.

Previously, *Cynops wolterstorffi* was classed in the separate genus *Hypselotriton*. As suggested by M.L.Y. Chang in 1936, the genus *Hypselotriton* is today considered a synonym of *Cynops*. In 1978, Freytag and Eberhardt described a new species, *Cynops shataukokensis*, from the Sha Tau Kok region of Hong Kong/Guangdong. As it turned out, the newts were actually a form of *Cynops pyrrhogaster*, possibly of the "Hiroshima Race", from Japan, that had been imported to Hong Kong through the pet trade, and sold as "Hong Kong Newts". In their original description, Freytag and Eberhardt neglected to mention this crucial fact, and so *C. shataukokensis* was considered a valid species until 1980, when Jean-Paul Risch published a paper on the taxonomic status of this species. Many do not recognize *C. chenggongensis* as a full species, and instead place this taxon as a subspecies of *C. cyanurus*.

Cynops are distributed in parts of China and Japan. Unfortunately, some species are considered extinct, or extremely rare, due to polluted habitats, the introduction of foreign species, habitat reduction, and collection for trade. *Cynops orientalis* has the largest range, covering almost the entire eastern portion of China. The present and historic ranges of the other Chinese species, *C. chenggongensis*, *C. cyanurus*, *C. orphicus*, and *C. wolterstorffi*, are very small in comparison. *C. pyrrhogaster* occupies the second largest range, which includes much of the main Islands of Japan. Finally, *C. ensicauda* are found only on the Ryukyu Islands of Japan.

This article pertains mainly to the three most common species: *C. ensicauda*, *C. orientalis*, and *C. pyrrhogaster*, as the remaining species are rare or understudied. *C. wolterstorffi* are thought to be extinct today, and *C. orphicus* are extremely rare and possibly extinct in the wild. Fortunately, *C. orphicus* exists in captivity and limited captive breeding projects are underway. *C. cyanurus* is moderately rare in captivity, although captive breeding occurrences seem to be on the rise among enthusiasts. *C. chenggongensis* is treated as a synonym or subspecies of *C. cyanurus* by many, and is also rarely kept in captivity. However, *C. chenggongensis* is known in captivity today, and successful captive breeding projects have recently occurred in Japan and other areas, although some still refute this information and maintain that all supposed *C. chenggongensis* in captivity are merely subspecies of *C. cyanurus*. Species descriptions and distribution information are provided for the rarer species, but they are excluded from the housing section. However, if the rarer species are kept in captivity, the housing section can be used as a guideline.

OVERVIEW OF SPECIES

Cynops ensicauda (Hallowell, 1860) Japanese Sword Tailed Newt & Okinawa Newt

Taxonomic Synonyms: Triton ensicauda (Hallowell, 1860), Molge pyrrogaster var. ensicauda (Boulenger, 1887), Molge pyrrogaster var. ensicaudus (Okada, 1891), Molge pyrrogaster ensicauda (Brown, 1902), Diemictylus ensicauda (Stejneger, 1907), Triturus ensicaudus (Dunn, 1918), Triton pyrrogaster ensicauda (Wolterstorff, 1925), Cynops ensicauda (Wolterstorff Herre, 1935), Triturus ensicauda (Sato, 1943) Triturus ensicaudus popei (Inger, 1947), Triturus pyrrogaster ensicaudus (Kawamura, 1950), Cynops pyrrogaster popei (Brame, 1967), Cynops ensicauda ensicauda (Thorn, 1968)

Vernacular Names Japanese Sword Tailed Newt, Sword Tailed Newt, Yellow-Bellied Newt, Gold Dust Newt (*spp. popei*), Okinawa Newt (*spp. popei*).

Cynops ensicauda is the largest species of the genus, reaching up to 5.5-6 inches as adults, with males slightly smaller than females. This species is usually chocolate brown or black dorsally, with bright orange or reddish bellies, mottled with black. The belly pattern and coloration is variable, and may consist of large portions of orange or reddish with little black coloration, or mostly black with little orange or reddish coloration. The bellies of some may consist of large, blurry, black blotches, or clear cut black spots contrasting the orange-red coloration. *Cynops ensicauda popei*, the Gold-Dust Newt or Okinawa Newt, possesses varying degrees of gold specks and blotches along the body and tail, a characteristics absent in *Cynops ensicauda ensicauda*. Some individuals of the Okinawa subspecies possess only light gold flecks, whereas other, extraordinary individuals may be more than 95% golden in coloration, with only small portions of brownish black visible. Gold coloration is present on many *C. e. ensicauda* individuals, in the form of tiny, merged flecks that do not contrast as vividly as those of *C. e. popei*. As the name suggests, the Sword-tail newts have a rather straight, long, pointed tail. Both *C. e. ensicauda* and *C. e. popei* may possess an orange or reddish dorsolateral stripe along both sides of the body, which may or may not be discontinuous in distribution. These lines are usually thicker in *C. e. ensicauda*, and are often times absent in *C. e. popei*. *C. e. ensicauda* may possess additional orange or red coloration about the dorsum in specs, dots, lines, or blotches, as well as along the sides of the tail.

Males of both subspecies can be distinguished from females by their shorter tails, and less robust physique; characteristics common in other *Cynops* species. The tails of females are slightly longer than the body, whereas the tails of males are shorter, or roughly the same length as the body. When a male and female are in close proximity, the difference in tail length is clear. During breeding times, males also possess more laterally compressed tails. Breeding males of *C. e. ensicauda* develop a bluish-purple, or whitish sheen along the lateral sides of the tail, a characteristic not observed in *C. e. popei*.

SUBSPECIES

C. e. ensicauda (Hallowell, 1830) Japanese Sword Tailed Newt *C. e. ensicauda* can be distinguished from *C. e. popei* by the absence of gold flecks about the body and tail. *C. e. ensicauda* males develop pale bluish-silver coloration along the tail during the breeding season, which

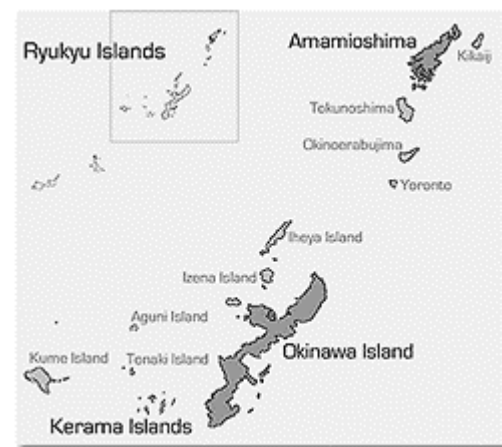
is not observed in *C. e. popei*. This subspecies is found within the Amami Island chain, Ryukyu Islands, Japan.

C. e. popei (Inger, 1947) Gold-Dust Newt, Okinawa Newt

This subspecies possesses golden flecks or solid gold coloration along the body and tail, and usually less orange coloration on the dorsum than *C. e. ensicauda*. This subspecies is found within the Okinawa Island chain, Ryukyu Islands, Japan.

DISTRIBUTION

C. ensicauda are found among the Ryukyu (Nansei) Archipelago, Japan. The Ryukyu's, stretching from the southern tip of mainland Japan to Taiwan, are divided into four main island groups; the Amami, Okinawa, Miyako, and Yaeyama Islands. *C. e. ensicauda* are known from Amami Oshima (Amami Islands), and *C. e. popei* are known from Okinawajima (Okinawa Islands), and Tokashikijima (Kerama Island group, Okinawa Islands). The Ryukyu Islands are considered subtropical, and climate is warm and humid.



A strait separates mainland Japan and the Ryukyu Islands, and has long prevented genetic exchange between newts found in the Islands and those on mainland Japan (now designated *Cynops pyrrogaster*). This strait was thought to have appeared some 8 million years ago, during the Miocene (Hayashi, 1988). Similarly, a strait also separates the Amami and Okinawa Islands, and thus also separates the two *C. ensicauda* subspecies. This strait is thought to have appeared 1-1.5 million years ago, during the middle Pleistocene (Hayashi, 1988).

CLASSIFICATION

Cynops ensicauda was at one time considered a subspecies of *Cynops pyrrogaster*, the only other species of the genus found in Japan. Hayashi and Matsui (1988) showed that *C. ensicauda* was genetically distant enough from *C. pyrrogaster* to warrant species level classification. Furthermore, *C. ensicauda* was subsequently divided into two subspecies based on geographical and morphological differentiation. Hayashi and Matsui (1988) later confirmed this classification by showing adequate genetic differentiation between the groups in question.

BREEDING BEHAVIOR

Breeding behavior and larval development are very similar for both subspecies. *C. e. popei* has been bred numerous times in captivity, whereas *C. e. ensicauda* seem to be

rarely bred in captivity. During the breeding season, male *C. e. ensicauda* develop a pale bluish-silver sheen along the tails, which is not observed in *C. e. popei*. The only physical characteristic observed in *C. e. popei* males during the breeding season is enlarged cloaca with visible villi, and sometimes more laterally compressed tail fins.

Courtship is similar to other *Cynops* species, consisting of tail fanning by the males, accompanied by increased aggressive and alert behavior. Breeding males will actively pursue and block the paths of females, while attempting to fan pheromones toward their snouts with the tail. Uninterested females will typically dart off in the other direction, while interested females will allow courting males to continue their display. Courting males will fan pheromones towards the female's snout while attempting to lead her off a ways. An interested female will follow a courting male, touching her snout to his cloaca periodically. Males deposit spermatophores onto the substrate, and attempt to lead females to pass over them so the sticky sperm cap can adhere to her cloacal lips.

After fertilization, females will deposit eggs sporadically over a period of several weeks, usually folding the eggs into small plant leaves.

C. ensicauda are probably the easiest species of this genus to breed in captivity due to their willingness to breed in mildly varied environments. Like the other *Cynops* species, *C. ensicauda* naturally enter breeding mode when temperatures begin to rise in the spring, following a cooler winter period. In captivity, a cooling period in the range of 58°F-65°F, followed by gradual warming to temperatures in the range of 68°F-73°F is usually substantial enough to stimulate breeding mode. *C. ensicauda* begin courtship and egg deposition when temperatures have reached about 65°F-72°F, and will usually cease when temperatures enter the upper 70's. Although they would experience higher temperatures during mid and late summer in the wild, consistent temperatures in the upper 70's and lower 80's are not necessary with *C. ensicauda*, and can be omitted to extend the breeding period. However, health problems can arise from over-breeding newts, and so it is recommended to simulate their natural cycles in the wild, which includes a cease in breeding when temperatures rise into the mid and late 70's.

Established colonies will enter breeding mode in the presence of mild temperature changes experienced in a temperature home, with no additional stimuli. A drop in temperature of only a few degrees, and flooding of the tank may prompt some to enter breeding mode.

Juveniles and larvae of *C. ensicauda* should be kept at temps around 70°F-75°F for the first few months after metamorphosis to ensure their survival. These temperatures correspond to mid and late summer temperatures, when larvae would develop, and young would begin metamorphosis in the wild. With new morphs, fatalities will occur if temperatures fall below 68°F for long periods. As they mature, *C. ensicauda* will tolerate lower temperatures in the winter.

Cynops pyrrhogaster (Boie, 1826) Japanese Fire Belly Newt

Taxonomic Synonyms: *Molge pyrrhogaster* (Boie, 1826), *Salamandra subcristata* (Temminck & Schlegel, 1838), *Cynops subcristatus* (Tschudi, 1838), *Cynops pyrrhogaster* (Gray, 1850), *Triton subcristatus* (Dumeril, Bribron, Dumeril, 1854) *Triton pyrrhogaster* (Strauch, 1870), *Salamandra pyrrhogastra* (Geerts, 1881), *Molge pyrrhogastra* (Boulenger, 1882), *Diemictylus pyrrhogaster* (Cope, 1889), *Triton subcristatus* var. *typica* (Krefft, 1898), *Triton subcristatus* var. *immaculiventris* (Krefft, 1898), *Triton pyrrhogaster typica* (Wolterstorff, 1906), *Diemictylus pyrrhogaster* (Stejneger, 1907), *Triturus pyrrhogaster* (Dunn, 1918), *Triton pyrrhogaster* (Wolterstorff & Herre, 1935), *Triturus pyrrhogaster sasayamae* (Mertens, 1969), *Cynops shataukokensis* (Freytag & Eberhardt, 1977)

Vernacular Names: Japanese Fire Belly Newt, JFBN, JFB.

Adult *Cynops pyrrhogaster* have dark brown to black, semi-rough bodies, with bright yellow, reddish, or orange bellies mottled with the same dark dorsal coloring. *C. pyrrhogaster* display a wide range of coloration; some variations may consist of a completely red belly, mostly red dorsum, completely or mostly black belly, grayish/whitish mottled dorsum, or albinism. Dr. Grumman has compiled an informative site that compares the ventral color and pattern of the different subspecies, [Morphological Characteristics of the Japanese Fire Belly Newt](#). Other variations are apparent in the belly color and pattern, which can be anything from yellow blotches, to tiny red dots, and just about anything in between. Variations in dorsal coloration also exist, ranging from chocolate brown to light brown, some with red or orange flecks and blotches. Gold flecks and blotches are also apparent in some populations. Sexual dimorphism is apparent in all subspecies. Breeding males develop laterally flattened tails that taper off into a thin thread, a bluish-purple sheen on the tail and body (dependent on race), swollen cloaca, and smoother skin.

New morphs are black with cream-yellow colored bellies mottled with black, some with a yellow or orange dorsal stripe. As new morphs mature, the bright colored dorsal stripe usually fades, and the newt may acquire additional orange or reddish coloration about the tail, feet, head, and dorsum.

DISTRIBUTION

C. pyrrhogaster are found on mainland Japan, throughout the islands of Honshu, Shikoku, and Kyushu. Adult *C. pyrrhogaster* are mostly aquatic, but may emerge onto land occasionally for various reasons. In the wild, some may spend long periods of time on land, particularly during the cold season, and return to the water to breed when temperatures begin warming. Adults of other populations may remain mostly aquatic year-round. Wild juveniles are thought to remain terrestrial for the first few years of life.



The map above shows some known localities of the various races, as adapted from Sawada (1963). It can be seen from these populations that the Hiroshima, Intermediate, and Sasayama races are in close proximity at some points, compared to the Tohoku and Kanto races, which are rather isolated from the others. It is worth noting that there may well be other, undocumented populations of Kanto and Tohoku races occurring in closer proximity with the other races. However, as outlined previously, genetic findings have shown that the Tohoku and Kanto races may be sexually isolated from other races, which supports the current "isolated" distribution pattern of these races.

CLASSIFICATION

C. pyrrhogaster is informally divided into six races or subspecies, based on geographic distribution, and physical characteristics. Although all races are considered part of the same species, there is significant differentiation between them in terms of behavior and genetic properties, and the possibility of multiple species has been suggested several times. The Tohoku and Kanto races of Honshu, in particular, have been shown to share little gene flow, and are incapable of interbreeding. Experiments conducted by Sawada (1963) determined that females of the Kanto race are unable to collect spermatophores from Tohoku males, and Tohoku females are unresponsive to Kanto male courtship behavior, indicating the presence of sexual isolation between the two races. Electromorphic analysis conducted by Hayashi & Matsui (1990) showed that the Tohoku and Kanto races are genetically different from one another to a significant degree, and that little gene flow occurs between the two. Based on laboratory observations and allozymic data, it is presumed that the Kanto and Tohoku races do not breed in nature. In later experiments, Hayashi & Matsui (1988) showed that genetic interchange is minimal even among populations of the Tohoku race. Observations of the Tohoku race in nature support this finding, as there are notable differences in physical appearance between several populations.

The Kanto race displays varied genetic properties within two markedly different populations. One of these populations, found in Hachioji, is thought to be the result of hybridization among the Kanto race and individuals of an introduced race from southwestern Japan that were released into the wild after having been part of laboratory experiments (Hayashi & Matsui, 1990). The northern population, from Iwaki, is isolated from the Hachioji population by mountains, which has resulted in limited gene flow between the two. It is possible that the Iwaki population does not interbreed with other Kanto populations at all (Hayashi & Matsui, 1990).

Hayashi & Matsui (1988) conducted similar electromorphic tests on the western races, Hiroshima and Sasayama, which showed at least more gene exchange than between the Tohoku and Kanto races, especially near the range border. The Hiroshima race forms at least two distinct groups, while the Sasayama/Tamba race appears to form a single group (Hayashi & Matsui, 1988).

Kawamura and Sawada (1959) have shown distinct sexual isolation between *C. pyrrhogaster* and *Cynops ensicauda* in a "multiple choice" experiment, where males and females of each species and race were presented with males and females of the other species and races. The rejection by

females toward the advances of males was the main reason for sexual isolation in this experiment. Sasayama females refused all advances from foreign males, and *C. pyrrhogaster* (*Kagoshima*) females resorted to biting the necks of advancing males, and thus deterring them. *C. pyrrhogaster* (*Hiroshima*) females showed no interest in courting *C. ensicauda* males, and female *C. ensicauda* equally rejected *C. pyrrhogaster* (*Sasayama*) males. Other isolation factors included the inability of *C. ensicauda* males to recognize consenting *C. pyrrhogaster* (*Kagoshima*) females, incompatibility of behavior during the latter portion of courtship, and incompatible walking rates between males and females during the lead-and-follow phase of courtship (Kawamura & Sawada, 1959). Despite the common rejection by females of foreign males, Kawamura and Sawada (1959) indicate that *C. pyrrhogaster* (*Sasayama*) males show a preference for *C. ensicauda* females over females of their own species. *C. pyrrhogaster* (*Sasayama*)'s affinity for *C. ensicauda* females has been attributed to the fact that male newts typically prefer larger females, and *C. ensicauda* attain larger sizes than *C. pyrrhogaster*. Genetic differences that would prevent viable breeding between these two species were not found in Kawamura and Sawada's experiments, and although the breeding season and behavior is rather similar between *C. ensicauda* and some races of *C. pyrrhogaster*, the high percentage of rejection by females of foreign males, and seemingly minor discrepancies in courtship behavior prevent successful interbreeding between the two species.

Electromorphic studies conducted by Hayashi & Matsui (1988) showed that *C. ensicauda* and *C. pyrrhogaster* are indeed separate species, and that a higher level of genetic differentiation occurs between *C. ensicauda* and adjacent *C. pyrrhogaster* populations than between *C. ensicauda* and other races of *C. pyrrhogaster*. These later findings have secured *C. ensicauda*'s position at the species level, and put to rest Kawamura and Sawada's (1959) proposed classification of *C. ensicauda* as a subspecies of *C. pyrrhogaster*.

In essence, sexual isolation, whether genetic or behavioral, is present between some races of *C. pyrrhogaster*, and between *C. pyrrhogaster* and *C. ensicauda*. Furthermore, sexual isolation is not always more severe between *C. pyrrhogaster* and *C. ensicauda*, than between races of *C. pyrrhogaster*.

Subspecies & Races of *Cynops pyrrhogaster*

Sawada (1963) divided *Cynops pyrrhogaster* into six races based on geographic distribution and physical appearance. Some time later, Mertens described the Sasayama race at the subspecies level, *Cynops pyrrhogaster sasayamae*, with the remaining races forming one group under the subspecies *Cynops pyrrhogaster pyrrhogaster* (Hayashi & Matsui, 1988). Today, the validity of subspecies, as opposed to races, is debatable at best, however, it is generally accepted that the six races are indeed distinct groups within the *pyrrhogaster* species. For completeness, the two proposed subspecies, *C. p. pyrrhogaster* and *C. p. sasayamae*, will be differentiated, with the remaining races classed under *C. p. pyrrhogaster*.

Cynops pyrrhogaster pyrrhogaster

Atsumi Race

The Atsumi race are found along the Atsumi Peninsula, Aichi Prefecture, Chubu Region, Japan. Defining physical characteristics consist of a smaller body size, a red dorsal stripe, and two rows of dorsolateral spots or broken lines, in red, orange, or tan. Breeding males of this subspecies lack the purplish-blue coloration on the tail, but develop noticeable threads at the end of the tail.

Hiroshima Race

This race is found on the Regions of Kyushu, Shikoku, and western Chugoku, Japan. The Hiroshima race is highly variable in belly coloration, which may consist of solid reddish-orange coloration, or reddish-orange mottled with black speckling, equal sized black dots, irregular black spots, or some combination of large blotching with small dots. This race is also larger in average size, with the exception of Kagoshima populations, and males do not develop a filamentous tail end during the breeding season. Those collected by Kawamura and Sawada (1959) from Kagoshima are described as the smallest in average size of those collected, and with deep red undersides. Sawada's plates (1963) show individuals from the cities of Kagoshima (Kagoshima Prefecture), Tokushima (Tokushima Prefecture), Takamatsu (Kagawa Prefecture), Mibara, Ooita (Kagoshima Prefecture), and Hiroshima (Hiroshima Prefecture). The belly pattern shows a general trend of small black spots over the bright colored belly, particularly near the outer sides of the abdomen, and either lacking dark coloration, or possessing tiny spots down the center of the belly. Others from Sawada's plates (1963) have clear, un-mottled bands down the center of the belly, fully mottled bellies, or no mottling at all. Some individuals may also possess red or orange dorsolateral spots, while others may have solid brown-black dorsa.

Intermediate Race

Found in western Chubu and Kinki Regions, Japan. Individuals have solid brown or blackish dorsa, with reddish-orange bellies mottled with black coloring. Sawada's plates (1963) show individuals from Tsu (Kinki), Nagoya (Chubu), and Toyama (Chubu), with bright colored bellies, where black coloration appears to seep into the bright coloration from the sides, and one with a nearly solid, bright colored belly.

Kanto Race

This race is found in the Kanto plains, Kanto Region, Japan. Defining characteristics include a more blunt tail end, black rows with solid or broken red dorsolateral stripes, and a large red stripe down the center of the belly. Sawada's plates (1963) show individuals from Fujisawa, with bright colored bellies, such that the bright color lacks, or possesses minimal black mottling. The black coloration appears as though it seeps inward from the sides of the abdomen, through the bright coloration. At least one photo showed an individual with a solid, bright colored belly.

Tohoku Race

This race is found in the Tohoku Region, Japan. Sawada's plates (1963) show individuals from Mt. Chokai, Aomori, and Niigata, with similar belly color as the Kanto race, that is with bright colored bellies, where the black coloration appears as though it seeps inward from the sides of the abdomen, through the bright coloration, as opposed to typical mottling. Other photos of the Tohoku Race appear to have some black spots or dots in the orange coloration, as well.

***Cynops pyrrhogaster sasayamae* (= *Sasayama* / *Tamba* Race)**

Cynops pyrrhogaster sasayamae are found in northern Kinki and eastern Chugoku districts. Sasayama are the largest of the races/subspecies, and usually possesses two irregular black lines running down bright colored bellies. The bright ventral coloration usually consists of dense lots of tiny, bright dots on a black background. This characteristic is distinguishable from the typical black and orange/red mottling found on other subspecies, and other *Cynops* species. However, the belly pattern is highly variable and may consist of large, dark blotches, with or without black lines. Sawada's plates (1963) show individuals with dense, bright colored dots and a dark background, some with irregular, bright colored lines running parallel down the belly. This race/subspecies generally possess a noticeable bright colored area down the middle of the belly, which may or may not also contain black spots. During courtship, the males place one hind leg on the female's dorsum while fanning pheromones with the tail, a characteristic unique to this subspecies/race.

BREEDING BEHAVIOR

C. pyrrhogaster enters breeding mode in the spring, after a cooling or dormant period. In captivity, hibernation is not necessary for most individuals, if not all individuals and races, but a moderate cooling period of temperatures somewhere in the range of 50°F - 62°F usually suffices. Some individuals may only require a cooling period in the range of 60°F - 65°F, followed by warmer temperatures. Temperatures lower than 40°F may result in sluggish behavior, or hibernation. There is no harm in allowing the animals to enter hibernation, but as mentioned earlier, it is not necessary to stimulate breeding in captivity. During the cooling period, the newts may spend their time on land, depending on how low the temperatures fall. After the cooling period, temperatures can be quantitatively elevated to 68°F-73°F. Increased lighting durations during the warmer period may also help stimulate breeding in *C. pyrrhogaster*. In captivity, established colonies in temperate zones typically enter breeding mode consistently with no additional stimuli from their keepers. That is, the normal, yet buffered, temperature changes experienced indoors may suffice for established colonies.

Adult males are usually smaller than females, and during the breeding season will develop swollen cloaca, smoother skin, and laterally compressed tails, sometimes with a fine thread or filament at the end. Like other *Cynops* species, the tails of males are generally shorter than those of females. Some races will produce a purplish-blue or whitish sheen along the sides of the tail in a display similar to some *Paramesotriton* and *Pachytriton* species.

Courtship occurs in the water with the male butting the female with his head in an attempt to stimulate her. Males attempt to position themselves perpendicular in front of females, where they will fan pheromones with the tail toward the snouts of the females. Males of the Sasayama race may also place one hind foot on the dorsum of the female during tail fanning. *C. pyrrhogaster* will actively compete with other males for available females, so uncharacteristic aggressive and active behavior is common during the breeding season. Several aquatic plants, such as *Elodea* (*Anacharis*, or *Elodea densa*), *Crinum*, *Lilaeopsis*, *Vesicularia* (Java Moss), or other small-leaved varieties should be present, as plants are the most common place for egg deposition.

Females will produce approximately 100-200 eggs, usually attaching them to the bottoms of leaves, or folding leaf tips over the eggs, and may continue to deposit eggs at intervals for several weeks. Eggs begin hatching approximately 20-22 days after deposition (depending on temperature), and the larvae will metamorphose approximately 2-4 months after hatching (depending on water chemistry and temperature).

New morphs are dark brown or black in color, some with a yellow or orange stripe down the dorsal ridge, tail, and underside of tail. The belly is initially a whitish-cream color mottled with brown or black, and will develop into bright orangish-red with age. Bright coloration about the dorsum in the form of lines and spots also develops with age, while the yellow dorsal stripe usually diminishes. In the wild, juvenile *C. pyrrhogaster* are thought to remain terrestrial for the first few years of life, however, in captivity they may be raised in a semi-aquatic environment. It is worth noting that

some individuals may not adhere to a semi-aquatic environment, and may insist on a terrestrial habitat.

***Cynops orphicus* (Risch, 1983) Dayang Newt**

Taxonomic Synonyms: None

Vernacular Names: Dayang Newt

C. orphicus is a medium sized species, thought to be roughly the size of *C. pyrrhogaster*. This species is characterized by the presence of a flattened head with prominent canthus rostralis, finely granulated skin, dark colored dots along the laterally compressed tail (Zhao, 1988). *C. orphicus* also possess reddish-orange dots on the palms of each foot. *C. orphicus* is also noticeably lighter colored than any other *Cynops* species.

DISTRIBUTION

C. orphicus were once found in Dayang, Shantou Region, Guangdong province, China, but are very rare in the wild today. In fact, until recently they were thought to be extinct in the wild. There are many rumors about the actual number still in the wild today, and some claim several populations have been discovered from the year 2000 to the present. Much of their habitat has been replaced by agriculture, so a big comeback in wild populations is not foreseeable in the near future, unless unknown populations are discovered or serious conservation actions are taken. On the brighter side, there are a few known colonies and individuals kept in research facilities, including the Chengdu Institute of Biology, Chinese Academy of Sciences, and the University of California at Berkeley.

***Cynops orientalis* (David, 1873) Chinese Fire Belly Newt**

Taxonomic Synonyms: *Triton orientalis* (David, 1873), *Triton pyrrhogaster orientalis* (Wolterstorff, 1906), *Diemictylus orientalis* (Stejneger, 1907), *Triturus orientalis* (Stejneger, 1925), *Cynops orientalis* (Wolterstorff & Herre, 1935)

Vernacular Names: Chinese Fire Belly Newt, Dwarf Fire Belly Newt, Oriental Fire Belly Newt, CFBN, CFB.

Cynops orientalis are small, semi-aquatic newts commonly found in the pet trade. *C. orientalis* will reach approximately 4 inches from snout to tail tip as adults, with exceptional individuals reaching 4.5 inches. The dorsum is typically black to dark brown, with bright orange to burnt orange bellies mottled with black coloring. It is common for *C. orientalis* to turn gray, or considerably lighter colored for periods of time, or indefinitely, for unknown reasons. In addition to the "gray orientalis", some individuals may have orangish-red spots on the dorsum and/or feet, and may have an orange stripe or other reddish-orange markings on

the upper side of the tail. The skin is rather smooth in more aquatic individuals, and slightly granular for those that spend more time on land. *C. orientalis* lack dorsal crests, and have mildly noticeable dorsal ridges. In general, males have noticeably shorter tails than females, usually around 90%-95% the length of the body from snout to vent, whereas females' tails are typically the same length, or slightly longer than the body from snout to vent. Males are also smaller and less robust than females. During the breeding season, males will develop more laterally compressed tails, swollen cloaca, as well as more active and aggressive habits.

Larvae are uniform black, including the dorsum, tail, snout, and gills. The ventral surface may be a dark gray color. New morphs are black with cream-yellow colored bellies mottled with black. As morphs mature, the belly color turns to the bright orange or reddish color typical of adults.

DISTRIBUTION

Cynops orientalis are found throughout the Eastern Hemisphere of China, in the provinces of Kiangsu, Tchekiang, Kiangsi, Nganhoui Houpe (Sparreboom, 1997), and along the lower Yangtze River. Unfortunately, there is very little information published on the natural habitat of *C. orientalis*. It can be concluded from captive behavior that adults inhabit slow, or still lakes, ponds, brooks, and similar permanent water sources.



BREEDING BEHAVIOR

Breeding begins when temperatures start to rise in late winter and early spring. Males become aggressive and active in breeding mode, pursuing females relentlessly, and fanning pheromones with the tail. Males often block the paths of females, and attempt to coerce them into corners.

In captivity, well-established colonies or individuals may only require a short cooling period with or without higher water levels, followed by gradually warming temperatures. Established colonies housed correctly will typically breed consistently every year, even without any additional modifications from their keepers.

Females attach their eggs singly to small plant leaves, usually folding the leaf over the egg. In captivity, *C. orientalis* often utilize *Vesicularia*, *Lilaeopsis*, and *Elodea* (*Anacharis*) plant species for egg deposition.

Larvae are typical pond type, with long gills and tall tail fins. Shortly after egg yolks have been absorbed, larvae are only a few millimeters in length, lacking front and hind extremities. Larvae remain dark black or grayish colored throughout development, and typically do not possess any

unusual color characteristics, although anomalies do occur. Upon metamorphosis, larvae may be as long as 1.75 inches.

New morphs are solid black dorsally, with cream-colored bellies mottled with dark coloration. The characteristic orange-red ventral coloration begins development after several weeks. Upon metamorphosis, gill remnants are still visible in most, and the newts are typically inactive as they adjust. Initially, the skin is smooth and shiny, but becomes more tuberculate after a week or so. Juveniles of this species generally prefer to remain terrestrial, however, some keepers have successfully raised semi-aquatic juveniles to adulthood. *C. orientalis* are a temperate species, and juveniles should not be exposed to extremely high temperatures. A successful range is 68°F-73°F.

Cynops chenggongensis (Kou & Xing, 1983) Chenggong Fire Belly Newt

Taxonomic Synonyms: *Cynops cyanurus chenggongensis*
Vernacular Names: Chenggong Fire Belly Newt

Kou and Xing first described *Cynops chenggongensis* in 1983. Females and males were collected from Shuitang, Chenggong County, Yunnan province, China. *C. chenggongensis* are similar to *C. cyanurus* in appearance, but differs in being longer, with rather smooth skin. *C. chenggongensis* have arched backs, and reduced dorsal ridges compared to *C. cyanurus*. Some individuals may have rows of orange-yellow spots along the sides of the tail, sometimes extending up to the shoulder. These spots are more distinct in females (Zhao, 1988). *C. chenggongensis* possess an orangish-red, or yellow spot behind the eye, a characteristic also found in *C. cyanurus* and *Cynops wolterstorffi*.

CLASSIFICATION

C. chenggongensis has previously been treated as a subspecies of *Cynops cyanurus*. Zhao, 1988, include only *Cynops cyanurus* and *Cynops wolterstorffi* in the informal "wolterstorffi group", however, it can be presumed that *C. chenggongensis* is also included in this group based on similar appearance, former classification, and geographical distribution. The wolterstorffi group includes all three species historically, and presently found in Kunming, Yunnan province, China.

DISTRIBUTION

Cynops chenggongensis are found near the Xi River (Xijiang, Pearl) in Kunming, Yunnan province. The Xi River channels from the South China Sea, through Hong Kong, and up to the Yunnan province, where it bends just under Kunming. Chenggong is a small county within the Kunming prefecture, Yunnan province. Unfortunately, there is very limited information about this rare species.



Cynops wolterstorffi (Boulenger, 1905) Wolterstorff's Newt

Taxonomic Synonyms: *Molge wolterstorffi* (Boulenger, 1905), *Triturus wolterstorffi* (Dunn, 1918), *Triton wolterstorffi* (Wolterstorff, 1925), *Hypselotriton wolterstorffi* (Wolterstorff, 1934), *Triturus wolterstorffi* (Liu, 1950), *Hypselotriton wolterstorffi* (Freytag, 1962), *Cynops wolterstorffi* (Scholz, 1995)

Vernacular Names: Wolterstorff's Newt, Yunnan Lake Newt.

Adult *C. wolterstorffi* were similar in appearance to *C. cyanurus* and *C. chenggongensis*, with black, semi-rough bodies, and bright orangish-red bellies with black mottling. *C. wolterstorffi* often had orange or red dorsal stripes down the spine and tail, and like *C. cyanurus* and *C. chenggongensis*, possessed an orange-red spot behind the eye. The belly was variable, sometimes with reddish stripes, blotches, and dots. The dorsum was often mottled with the red or orange coloration. Males developed blue sheens on the tail, and laterally compressed tails during the breeding season. Females were longer and more robust than males. The fore descriptions were compiled from Zhao, 1988, Fei, 1999, and the AmphibiaWeb database.

DISTRIBUTION

Cynops wolterstorffi is considered extinct today, with no living specimens in captivity, and no recent populations discovered in the wild. Their known distribution included only areas around Kunming Lake, Kunming City, Yunnan province. *C. wolterstorffi* were found in shallow waters along the shores of Kunming Lake, and branching ponds. This species was documented as hibernating in deeper waters, and breeding during April and May. *C. wolterstorffi* were abundant in the wild as recent as the 1950's, with thousands of individuals being seen during their active season. Populations began dwindling shortly after, and in 1979, no newts could be found in the Kunming Lake area, or surrounding areas. A fisherman reported catching a single newt in 1984, but *C. wolterstorffi* never made a comeback, and is presumed extinct in the wild. Pollution of Kunming Lake, habitat reduction, and the introduction of foreign predators are thought to be the main causes of the declining populations from the 1950's to the 1970's. Hopefully, there are undocumented and undiscovered populations still in existence, as has been the case with a few other amphibians species presumed extinct. However, with no definite sightings for at least 25 years, it is likely that *C. wolterstorffi* is in fact extinct.

**CLASSIFICATION**

C. wolterstorffi was originally classed as *Molge wolterstorffi* (Boulenger, 1905), and at a later point placed in the genus *Triturus* based on the appearance of populations from Kunming, Yunnan province. Later, in 1934, Wolterstorff re-described this species as *Hypselotriton wolterstorffi*. It was suggested by M.L.Y. Chang in 1936 that *Hypselotriton* should be included in the genus *Cynops*, and based on

morphological data, *Hypselotriton* is today considered a synonym of *Cynops* (Zhao, 1988). *C. wolterstorffi*, together with *C. chenggongensis* and *C. cyanurus*, comprise the wolterstorffi group, an informal classification based on physical similarities and geological distribution.

Cynops cyanurus (Liu, Hu, & Yang, 1962) Blue Tailed Fire Belly Newt

Taxonomic Synonyms: None

Vernacular Names: Blue Tailed Fire Belly Newt, Blue Tailed Newt

Adult *C. cyanurus* typically possess a dark dorsum, and brightly colored belly mottled with dark coloration. The tail is mottled with blackish coloration, and may have faded orange coloration along the upper edge. Some adults may have faded orange dorsal stripes. Adult males develop an obvious blue sheen along the tail and flanks during the breeding season, hence the vernacular name "blue tailed fire belly newt". Juveniles appear to display an array of coloration, including solid orange, mottled orange, tannish, dark brown, and black. Orange and orange- mottled larvae and adults have also been observed. *C. cyanurus* possess an orangish-red or yellow spot behind the eye that develops early in youngsters. This spot is also found in *C. chenggongensis* and *C. wolterstorffi*, however, because of the rarity of *C. chenggongensis*, and the extinct status of *C. wolterstorffi*, the orange "eye spot" is often used to identify *C. cyanurus* among hobbists and captive breeders.

C. cyanurus is thought to be most similar to *C. wolterstorffi*, an extinct species formerly found in the Kunming area. *C. cyanurus* is also very similar in appearance to *C. chenggongensis*. *C. chenggongensis*, an extant but rare species, are also found in the Kunming area, and together with *C. cyanurus* and *C. wolterstorffi* comprise the "wolterstorffi group". This informal grouping is based on similar appearance and geological distribution, and includes the three recognized Kunming species.



C. cyanurus have been successfully bred in captivity by providing a cooling period of temperatures around 50°F - 60°F, followed by temperatures in the range of 70°F - 75°F. Rearing techniques are assumed to be similar to the common *Cynops* species, however captive breeding successes have been limited.

SUBSPECIES***Cynops cyanurus cyanurus*** (Liu, Hu, and Yang, 1962)

The nominate form is found in mountain ranges of the Guizhou province, China, at elevations up to 1800 meters above sea level, near the Yunnan province border, and possibly across that border into Yunnan. *C. cyanurus cyanurus* can be distinguished from the other subspecies

by the orange colored cloaca and underside of tail. Males are smaller than females, reaching up to 3.6 inches, and females up to 4.2 inches.

Cynops cyanurus yunnanensis (Yang, 1983)

This subspecies was described from mountainous regions in the Chuxiong and Kunming regions, Yunnan province, at elevations around 2400 - 2700 meters. *C. c. yunnanensis* can be distinguished from *C. c. cyanurus* by the presence of a dark colored cloaca and, and usually a dark colored underside of tail. However, these characteristics are also present in *C. c. chuxiongensis*. This subspecies is larger than the nominate form, with females reaching lengths of 4.6 inches, and males up to 4.0 inches.

Cynops cyanurus chuxiongensis

This subspecies is found in mountainous regions in the Jingdong and Kunming regions, Yunnan province, eastward to Guizhou, at elevations around 2400 - 2700 meters. Some consider *C. c. chuxiongensis* and *C. c. yunnanensis* to be the same, although there is some differentiation in the size and shape of the cloaca. *C. c. chuxiongensis* can be distinguished from *C. c. cyanurus* by the presence of a dark colored cloaca, and usually a dark colored underside of tail, characteristics also present in *C. c. yunnanensis*.

SELECTED HOUSING & CAPTIVE CARE

This section is aimed mainly at the common species, *C. orientalis*, *C. ensicauda*, *C. pyrrhogaster*, and *C. cyanurus*, but can be used as a guide in the improbable event the rare species are acquired in captivity. In the wild, some adult *Cynops* species and subspecies will spend the winter months on land, either in hibernation or brumation. In captivity, however, most can be kept semi-aquatic year-round, with only a small land portion for short-period refuge. Fortunately, for breeding purposes, *Cynops* species generally require only a cooling period, followed by warmer temperatures. This makes the common species among the easiest to breed in captivity. New morphs and juveniles, however, may insist on remaining fully terrestrial for the first year or more of their lives. See the section below for more information on rearing young *Cynops*.

Cynops are passive, non-aggressive newts, and can be housed in same-species, multi-member tanks. For successful breeding, *Cynops* should be housed in spacious tanks. Two to three adults of the smaller species, *C. orientalis*, *C. cyanurus*, and *C. pyrrhogaster*, should be housed in no smaller than a 15 gallon aquarium with an ample supply of water and some land areas, but may need more room if breeding is attempted. *C. ensicauda* are considerably larger than other *Cynops* species, and so require larger tanks. Two to three adults can be housed comfortably in a 20-gallon aquarium, but again, may need more room for successful breeding. As with all species, the bigger the tank the better. Larger tanks require less maintenance, and chances of successful breeding are higher in spacious tanks. Larger tanks are also more natural for the newts, as most newts do not live in close proximities in the wild, but congregate during the breeding season. Very large tanks often become colonies within a year or so, as larvae and juveniles may develop naturally, but usually with the addition of supplemental food items.

Cynops should be housed in large, semi-aquatic tanks, with plenty of vegetation. In temperate zones, most adults will remain largely aquatic year round, only leaving the water for short periods of time. However, some adult individuals have been known to remain terrestrial for long periods of time, and may require a larger land area with hiding places. Like all aquatic animals, *Cynops* are sensitive to water chemistry, and a sudden change from semi-aquatic to terrestrial may indicate a problem with the water quality, however, if temperatures are very low, individuals may seek out a hiding place for hibernation or brumation. To be safe, it is recommended to keep a freshwater test kit on hand, and regularly check the pH, ammonia, nitrite, and nitrate levels (for more information about water chemistry see article 0006 - *Water Quality and Amphibians* and article 0009 - *Introduction to the Nitrogen Cycle*). Adults are not too picky about pH, but extremes in either direction may result in terrestrial behavior. In the case of larvae and juveniles, highly acidic or alkaline pH can result in fatalities. A successful pH range would fall somewhere between 6.8 and 7.4. Adult *Cynops* seem to prefer fish-less, slow moving or still waters, which should reflect the way their home is constructed. The temperature requirements of *Cynops* are variable, as outlined further down this section. The water area can support a filter with a carbon and sponge insert, or a canister type biological filter for larger tanks. The filter should not create a strong current or disturbance; otherwise the newts may not enter the water at all. Most filters can be positioned so that the output is facing the side of the tank, or rocks or thick vegetation can block and slow the output if it cannot be re-positioned. If a filter is not included, a partial water change (10%-20%) should be done weekly or biweekly, assuming an adequate colony of nitrifying bacteria have developed within the tank (for more information about the Nitrogen Cycle, see article 0009 - *Introduction to the Nitrogen Cycle*). Gravel is the standard form of aquatic substrate, but a bare bottom tank with adequate biological filtration is acceptable as well. With bare bottom tanks, decaying organic matter (i.e. feces, shed skin, uneaten food, etc.) should be siphoned out weekly or biweekly. Bare bottom tanks do not provide a large area for beneficial bacteria to reside, so it is recommended to use a biological filtration system, or provide a portion of gravel, or other substance that can support a sufficient colony of bacteria. A common practice is to include a mesh bag filled with some substance that can house a sufficient colony of bacteria, such as fine gravel, sand, or a biological filter media such as Bio-Max by Hagen. This will help regulate the water chemistry and cut down the risk of ammonia or nitrite spikes in the absence of adequate biological filtration. Bare bottom tanks may make moving about in the tank floor difficult for some species; however, this is uncommon with *Cynops* due to their relatively small size and still water preference. Many keepers and breeders have successfully used sand substrate, however, it is worth noting some possible risks with this type of substrate. First, sand may become impacted in the stomachs of some amphibian species, especially those that lunge and inhale food items. Amphibians can pass an extraordinary amount of materials, but sand can eventually accumulate in the stomach and become impacted. One of the arguments in favor of sand is that in the wild, amphibians live in waters with very fine mud bottoms, and gravel-bottoms are not a form found in natural pond environments. So, it is assumed that amphibians are exposed to sand-like particles in the wild

without problems. This may be true in some cases, but there is a difference in the actual composition and mass of mud and sand. Sand is heavy, and more similar to tiny rocks, which poses more of a risk of impaction than fine-grade mud. With *Cynops* species, sand is not a large risk factor due to their rather mild feeding behavior, so this is a decision that is really at the discretion of the keeper. Whatever substrate is used, live aquatic plants should be included in the water area, as *Cynops* seem to appreciate densely planted aquariums. *Elodea*, *Crinum*, *Lilaeopsis*, and *Vesicularia* are commonly used, and are acceptable for egg deposition if breeding is attempted. Another benefit of their small size is that *Cynops* species typically do not uproot or damage vegetation, and so can be housed in elaborate, aquatic garden tanks. Other, larger plant varieties, such as *Anubias* spp., *Nomaphila* spp., *Nuphar* spp., and *Crinum* thalianum, can be added as well, and will provide relief from aquarium lighting, as well as hiding spots. If lighting is included, only fluorescent bulbs should be used, as they do not radiate heat in the manner an incandescent bulb does.

Adult *Cynops* are typically housed in large aquariums with 8-20 inches of water, or deeper, and a land area composed of large, mossy rocks or driftwood breaking the surface of the water. Java Moss, *Vesicularia dubyana*, can be attached to aquatic objects, as well as wet objects that break the surface of the water. This is a very diverse moss, and is often used to line projecting land items, such as rocks or driftwood, where it will grow into an attractive, green mat. Alternatively, potted plants can be submerged to the rim in the water to serve as land "islands". With the "potted plant island" method, the soil may need replacing every so often, as water eventually leeches through most containers.

Cynops orientalis, and *Cynops pyrrhogaster* can be kept around 68°F-73°F during the warmer months, and around 50°F-65°F during the winter months. *C. pyrrhogaster* can tolerate warmer temperatures of around 75°F for periods of time during the summer, but warmer temperatures are not required with any subspecies, and have not shown any beneficial effects. *C. cyanurus* inhabit mountainous regions, but has been bred in captivity by maintaining a winter period of around 50°F-57°F, and increasing summer temperatures as high as 75°F. The significance of temperature for breeding purposes is little known for *C. cyanurus*, but is assumed to be similar to other *Cynops* species; i.e. a cooling period followed by a warming period. *C. ensicauda* are exposed to temperatures exceeding 75°F in the wild. *C. ensicauda* adults can be kept at 73°F-78°F during the summer, but not exceeding 85°F for long periods of time, and around 58°F-65°F during the colder months. *C. ensicauda* will enter breeding mode around 67°F-73°F, after a cooler period, and will usually cease when temperatures consistently exceed 74°F. Larvae and morphs of *Cynops ensicauda* should be kept in the low to mid-70's to simulate the mid and late summer season, when they would development in the wild. Lower temperatures usually result in fatalities of larvae and new morphs of this species. The fore described temperatures are recommended if breeding is to be attempted, as they simulate seasonal changes to a degree, however, established individuals will typically enter breeding mode even if a significant cooling period is not provided, that is, in the normal temperature fluctuations within their

surrounding, indoor environment. A drop in temperature of only a few degrees, and/or flooding their tank may stimulate some or rise.

As with all amphibians, to avoid the spread of foreign pathogens, *Cynops* species should not be housed with other amphibian species (see article 0007 - *Species Mixing: New World Syndrome*). Never use distilled, or reverse osmosis water alone with amphibians, as these can disrupt the chemical composition of amphibian cells. Also, amphibian aquariums should be allowed to establish an adequate colony of nitrifying bacteria (nitrogen cycle) prior to introduction of inhabitants. Failure to cycle a tank prior to the introduction of amphibians can result in fatalities (for more information on water quality and the nitrogen cycle, see article 0006 - *Water Quality and Amphibians and article 0009 - Introduction to the Nitrogen Cycle*).

RAISING *C. ENSICAUDA*, *C. ORIENTALIS*, AND *C. PYRRHOGASTER* YOUNG

All *Cynops* morphs and juveniles look similar, with tiny black bodies and cream-colored bellies, some with colorful dorsal stripes. Although adults of the common species are some of the hardiest, and least-demanding newts in captivity, *Cynops* morphs and juveniles can prove surprisingly difficult rear. Often, they will not take certain food items, and may require much individual attention to ensure they are eating. At this stage, the main diet usually consists of bloodworms, black worms, and finely chopped earthworm. Some individuals may also take fruit flies and larvae, white worms, pinheads, flour beetle larvae, and grindal worms. See article 0014 - *Introduction to the Lifecycle of Newts* for more information on embryonic and young newts.

Most newly morphed individuals can be kept terrestrially on chemical-free paper towels, or semi-aquatic in a few centimeters to a few inches of water, with a generous supply of shallow vegetation, and a few land areas. The semi-aquatic method requires less maintenance than the terrestrial method, and those kept semi-aquatic tend to grow faster, and reach sexual maturity quicker. The semi-aquatic method entails relocating newly metamorphosed newts into a tank with approximately 2-15cm of de-chlorinated water, dense aquatic vegetation, and a solid land area. The aquatic plants should be arranged in such a way that they serve as makeshift land areas, so that the newts are able to prop themselves up on the plants with their heads out of the water. *Elodea* (*Anacharis* spp., or *Elodea* spp.) and java moss (*Vesicularia dubyana*) work well for this purpose. Most individuals do fine in water of depths of several inches, where they can fully submerge, as long as they have available land areas. Such individuals typically share their time between the water and land, and may take food in the water and on land. Others may refuse to enter the water at all. The solid land area can consist of a flat rock or other such material. The purpose of the land area is so that the morphs can emerge onto dry land if desired. Often, a good number of morphs in a batch will choose to remain on the land area the majority of the time.

Gravel bottoms are fine for use with morphs, as well as adults. Bare-bottom tanks can also be used in the semi-aquatic method, and may make feeding easier for those

individuals that spend more time in the water. Bare bottom tanks of only a few inches of water can reach toxic levels of ammonia rather quickly. Filters should not create a strong disturbance, as new morphs could become stressed if caught in the current of the filter. In the event that biological filtration cannot be used, a section should be added to house a substantial colony of nitrifying bacteria. This can be accomplished by adding a section of gravel to the tank floor, or a mesh bag filled with Bio-Max (Hagen), or other substance made to house nitrifying bacteria. The nitrogen cycle must be completed before introducing new morphs, as they are delicate and susceptible to incorrect water chemistry. It is also recommended to keep a freshwater test kit on hand, and check the pH, ammonia, nitrite, and nitrate levels often.

Some newts of the genus *Cynops* may not adhere to a semi-aquatic tank, and may require a terrestrial setup. A terrestrial type setup for new morphs can consist of damp, bleach-free paper towels as substrate, with a few dark hiding places (wood caves, overturned terra cotta planters, etc.). Bleach-free paper towels are sometimes hard to find, but can be purchased online. A suitable brand is Seventh Generation Natural Paper Towels. These are recycled, with no added color or dye. Damp soil typically clumps up on the morphs legs and bodies, which can inhibit locomotion. When the morphs are a bit larger, some may want to house them on fine-grade, chemical-free soil substrate, which is okay as long as a significant moisture level is maintained. However, for tiny morphs, bleach-free paper towels may be the superior choice for terrestrial substrate. Bleach-free paper towel substrate must be replaced often (every few days or so) to ensure the health of the inhabitants. Food items quickly rot and become toxic on paper toweling because it is a sterile environment, lacking the microbes found in natural soil to help break down organic matter. Because paper towels provide such a sterile environment, they also allow any pathogens found on the newts to multiply at an exponential rate, like in a petri dish, which is another reason the substrate *must* be replaced often. Live foods, especially aquatic worms, cause the toweling to go bad very quickly. After feedings, it is recommended to replace the toweling within 2 days in average sized tanks. Smaller tanks may require more frequent changes. It is also necessary to ensure the paper towels are always adequately moist, as paper towels are capable of absorbing moisture from the inhabitants as they begin to dry out, which could lead to the desiccation of the newts. Experience has shown that shallow tanks with screen lids, usually the type made for reptiles, work well for raising new morphs. To ensure varying levels of moisture, the tank can be slightly slanted so that the majority of the water falls to one side. This way, the newts can choose the moisture level they prefer. Drier sections, such as rock caves, wood caves, or terra cotta pots can be added as well. A portion of the tank can be covered to ensure adequate humidity, which may be a necessity in arid climates. Young *Cynops* can also be raised terrestrially on pillow moss substrate. This is a live moss that grows above soil, or in a few centimeters of water. Moist Java Moss (*Vesicularia dubyana*) can also be used for ground cover or other purposes, and small newts tend to hide in and under moss clumps.

If kept terrestrially, it is recommended to keep two tanks so that the newts can simply be transferred to another tank

when it is time to change the substrate, rather than transporting them to a temporary home and then back into their permanent home. This minimizes stress, and the possibility of injury to the newts while transporting, and may be more convenient with large colonies. Some keepers may prefer to house only one, or a few individuals in smaller tanks or large tupperware containers. Neither method, terrestrial or semi-aquatic, is superior in terms of the health of the newts if proper maintenance is upheld, however, the semi-aquatic method seems to be preferable among breeders because it requires less maintenance, the newts grow faster, and feeding is usually easier. See article 0020 - Captive Habitats: Ideas, Instructions, and Examples and the Captive & Wild Habitats section of the Photo Gallery.

With the semi-aquatic method, the water to land ratio can be slowly increased, as the inhabitants grow older, and hardier. *C. pyrrhogaster*, *C. orientalis*, and *C. ensicauda* can typically be housed the same as adults, which are mostly aquatic, within the first year. Because they grow slower with the terrestrial method, individuals may not adhere to a semi-aquatic lifestyle until after the first year. When they are ready to re-enter the water, the newts can be introduced slowly to a semi-aquatic environment by gradually raising the water level. If they completely reject the semi-aquatic environment, then they are probably not ready to return to the water.

The Steinhart Aquarium in San Francisco, California, has successfully reared several young *C. e. popei* from eggs simply by letting nature take its course. The eggs and larvae were apparently left in the tank with the parents, with only a tiny area of land composed of a piece of driftwood protruding out of the water. From first observation of eggs and larvae in the tank, to a few months after metamorphosis, there were approximately 25 visible youngsters remaining in the water with the adults. Most were crowded on the small island, however, a few were free swimming in close proximity to the adults, while others were propped up on small plants with just their heads above water. Considering their age, these individuals were large and robust, as would be expected from raising them in a semi-aquatic environment.

As with all amphibians, tap water should be treated with a water conditioner prior to the introduction of amphibians. Never use plain tap water, de-ionized, distilled, or reverse osmosis water alone with amphibians. See article 0006 - Water Quality and Amphibians and article 0009 - Introduction to the Nitrogen Cycle for more information about water quality and the importance of the nitrogen cycle.

NUTRITION

Cynops can quickly become accustomed to taking food from forceps, and can be quite eager and voracious feeders. Like other newt species, *Cynops* possess a lateral line system that enables them to detect the slightest disturbance on the surface of the water. The lateral line system can be seen running dorso-laterally down the back and along the tail of both larvae and post-morphs, resembling a light-colored perforated line. In a typical captive tank of several inches of water, healthy, established individuals will come out of hiding places and scurry to the

surface when food items are just barely submerged. Most individuals will consume frozen bloodworms and other foods from the bottom of the tank, as well. In addition to detection of water disturbances, *Cynops* can detect food items by sight and smell. Adults will usually accept frozen bloodworms, black worms, tubifex worms, small wax worms, maggots, chopped earthworm, and sometimes fruit flies. Juveniles require smaller foods, such as fruit flies and larvae, rice/flour beetles and larvae, white worms, grindal worms, but may also take tubifex worms, black worms, chopped earthworm, pinhead crickets, and frozen bloodworms. When feeding live worms to aquatic individuals, a worm feeder may be beneficial in some cases. Worm feeders are small, inverse cone-shaped cups that are suctioned onto the side of the tank, and that possess small holes for the worms to dangle out of. These cups can reduce the number of worms that burrow into the substrate, thus allowing the newts to consume more, and also preventing large colonies of worms in the tank. Unfortunately, these little cups do not work well with every individual, as the newts must learn how to use them. Often times, the newts will climb inside the cups, or simply wait at the bottom for the worms to drop out.

Adults, juveniles, and larvae should be provided with a variety of foods to ensure proper nutrients. During developmental stages, newts are at higher risk of falling victim to nutritional disorders, such as Metabolic Bone Disease, if their diets are lacking necessary substances.

Metabolic Bone Disease, or MBD, is usually associated with an imbalance of calcium, phosphorous, and vitamin D₃, as well as over-ingestion of fat-soluble vitamins, certain minerals, and oxalates. Amphibians use lipoproteins to transport vitamin D metabolite 25-hydroxy-cholecalciferol, which means that over-consumption of fatty acids and fats could have adverse effects, even if calcium, phosphorous, and D₃ dietary levels are acceptable (Wright & Whitaker, 2001).

Amphibians afflicted with MBD appear weak, and may be suffering from pathological fractures about the spine and other bones, loss of bone density, splayed limbs, scoliosis, tetany (different than in cows), bloating (gastrointestinal gas), hydrops, subcutaneous edema, gastric or cloacal proplase, or a combination of these conditions (Wright & Whitaker, 2001). Mandibular deformities, abnormal posture, reluctance to move, splayed limbs, and scoliosis are some external symptoms that could be attributed to MBD (Wright & Whitaker, 2001).

Treatment of MBD can be arduous because it's nearly impossible to tell from appearance just what element is missing from the diet, or if something undesirable is present in the diet. Proper diagnosis is obtained from radiographic studies that show symptoms such as abnormally shaped mandibles, thin cortices of long bones, expansion of marrow cavity, loss of bone density, limb deformities, and pathologic fractures (Wright & Whitaker, 2001). Initial treatment generally consists of calcium and vitamin D₃ supplements, with regular radiographic tests to check results.

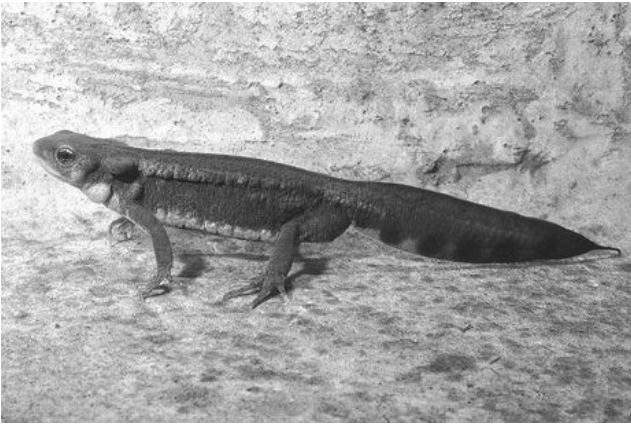
Most arthropods fed to captive amphibians, namely crickets, possess an inverse calcium-to-phosphorous ratio,

making them a calcium-deficient food source for amphibians. Those that are fed a diet of only crickets are at high risk of developing MBD. The calcium-deficiency of crickets can be counteracted by "gut-loading" the crickets 48 hours prior to feeding to amphibians. Gut loading means feeding crickets meals high in nutrients, namely calcium, prior to feeding the crickets to other organisms. When an amphibian eats a cricket it will absorb any nutrients within the cricket, so healthy crickets lead to healthier amphibians, and vice versa. Cricket diets can be purchased at most pet stores that sell crickets, or online from any reptile/amphibian supply company, and should be around 5%-8% calcium to maintain a positive calcium-to-phosphorous balance (Wright & Whitaker, 2001). A major disadvantage to gut-loading with high calcium foods is that the crickets usually cannot survive more than 48 hours on such a diet, and smaller insects, such as fruit flies and flour beetles cannot survive more than a few hours. Also, it has been shown that amphibians fed a diet of properly gut-loaded crickets still develop calcium imbalances, implying that there are other major factors affecting calcium absorption and utilization acceptable (Wright & Whitaker, 2001).

Another method of increasing the nutritional value of crickets is to dust them with mineral-vitamin powder immediately before offering the insects to amphibians. Dusting is supposed to increase the calcium and D₃ levels upon ingestion, but has been proven sufficiently ineffective. The main problem with the dusting method is that the powder comes off easily as the insects move about the amphibian's home, which reduces or eliminates its transfer to the amphibian.

For more information about MBD and other nutritional disorders, see article 0001 - Common Amphibian Ailments.

Although it may be tough to get some juveniles, and even adults, to accept more than one type of food, it is important to work with them until they're eating properly. Metabolic Bone Disease is a deformity of the skeletal structure that occurs due to insufficient amounts of calcium from the diet during development, and is particularly common in juveniles that are fed only tubifex worms, or only pinhead crickets. Both of these food items do not provide balanced nutrition alone, but can be used in addition to other foods, such as frozen blood worms, live black worms, chopped earthworm, and fruit flies. Frozen and live bloodworms in particular are considered an excellent source of food for fish and amphibians, because they are high in calcium and iron. Maggots are also a good choice, as they are high in protein, however, some amphibians may have problems digesting the tough outer "skin" layer, and may excrete them whole or partially digested. *For more information about MBD and other nutritional disorders, see article 0001 - Common Amphibian Ailments. For more information on food items, see article 0002 – Amphibian Foods and Feeding Tips. For live food resources in the US, see the Links section.*



Cynops pyrrhogaster male in breeding dress. Photo © Paolo Mazzei, Amphibians & Reptiles of Europe, <http://www.herp.it>



Cynops ensicauda popei male. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops pyrrhogaster. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops ensicauda popei female. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops pyrrhogaster morphs. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops ensicauda popei larva. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orientalis. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orientalis egg. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orientalis female. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orientalis larva. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orientalis male. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orientalis new morph. Photo © Jessica J. Miller, <http://www.livigunderworld.org>



Cynops orphicus. Photo © David Wake 2001, Museum of Vertebrate Zoology, UC Berkeley



Cynops cyanurus. Photo © Henk Wallays, Henk.Wallays@pandora.be



Cynops orphicus. Photo © David Wake 2001, Museum of Vertebrate Zoology, UC Berkeley



Cynops cyanurus (yunnanensis?). Orange female. Photo © Guillaume Seguin



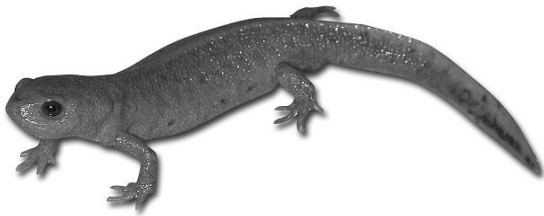
Cynops cyanurus (yunnanensis?). Normal male, with mild bluish sheen. Photo © Guillaume Seguin



Cynops cyanurus (yunnanensis?). Juvenile showing unusual orange-black mottling. Photo © Guillaume Seguin

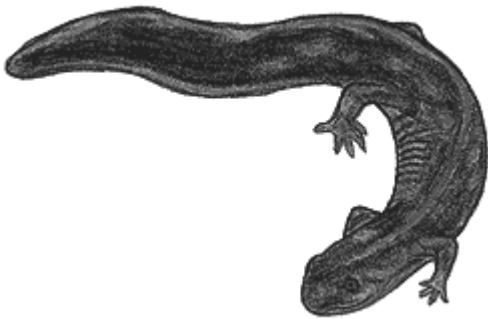


Cynops cyanurus/chenggongensis. Photo © Henk Wallays, Henk.Wallays@pandora.be



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Cynops chenggongensis . Photo © Angus Lee, Hong Kong



Cynops wolterstorffi (adult female) Illustration adapted from Fei, Liang, Atlas of Amphibians of China. Technology Press, Zhengzhou, China, 1999

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Other Site of Interest

Morphological Characteristics of the Japanese Fire Belly Newt (Dr. Grumman),

<http://www.geocities.co.jp/HeartLand/3108/herpetarium/captivity/ve ntpattern-C-pyrrhogaster.html>

Cynops species, <http://home.debitel.net/user/bachhausen/Salamanderseiten/Nachz uchten.htm>

Maintenance and Breeding of Newts of the Genus *Cynops*, <http://www.callisto.ru/amphibia/max/mspage.htm>

Cynops wolterstorffi on AmphibiaWeb, http://amphibiaweb.org/cgi-bin/amphib_query?where-genus=Cynops&where-species=wolterstorffi

Molche-Register (Paul Bachhausen), http://de.geocities.com/paul_bachhausen/Molch-Register/Archiv/pyrrhogaster/cynops_pyrrhogaster.htm