



Notophthalmus viridescens (Rafinesque, 1820) Eastern Newt



Notophthalmus viridescens dorsalis, photo © Jessica J. Miller, <http://www.livingunderworld.org>

INTRODUCTION

Eastern newts are rather small, sometimes brilliantly colored newts found in the eastern portion of the United States. There are four proposed subspecies, however, recent molecular studies do not support the subspecies model of *N. viridescens* (Gabor & Nice, 2004), and instead show a lack of significant molecular differentiation to warrant subspecies. For the purposes of this article, the four subspecies will be differentiated only for traditional purposes.

The bodies of the nominate form are a light brown to tan color with red colored spots on both sides of the slight dorsal ridge, running from the back of the head to the start of the tail. These bright spots indicate the toxicity of *N. viridescens* to potential predators. Some subspecies have a broken line or continuous line, instead of red dots, while others lack aposematic coloration on the dorsum altogether. The abdomen is yellow to orange, and covered in tiny black dots, as is the rest of the body in many individuals. Males and females of most populations are roughly the same size. Outside of the breeding season, males can be distinguished from females by their more robust hind limbs, and the presence of yellowish glandular spot on rear area of the vent. During breeding season semi-aquatic, adult males display black nuptial pads, cornified toe tips, swollen cloaca, and laterally compressed tails. The skin of semi-aquatic adults is rather smooth, compared to efts.

Eft coloration varies among the four subspecies, and ranges from vivid red-orange, to rusty brown, with some nearly identical in color as the adults. As red efts near sexual maturity, the bright juvenile color fades, and is replaced by the subtle hues of the adults. Efts may be up to 10 times more toxic than adults, as their bright coloration indicates. This anti-predator feature is utilized by some sympatric species, including *Pseudotriton ruber* and *Pseudotriton montanus*, two palatable species who are thought to be Batesian mimics of *Notophthalmus viridescens* efts (Petranka, 1998). Certain populations or subspecies may skip the terrestrial eft stage, and spend the

juvenile period in the water. Such individuals may go through complete metamorphosis into adults, however, some may develop into neotenes. Aquatic juveniles are similar in coloration as the adults, with smooth, olive colored skin, and laterally compressed tails. Aquatic juveniles are common in areas where the surrounding terrestrial habitat lacks adequate cover for the efts (Petranka, 1998). The terrestrial eft stage may last 2-7 years, depending on the subspecies and population. When an eft reaches sexual maturity it returns to the water, whereupon the new adult remains semi-aquatic for the remainder of its life. More accurately, they will remain semi-aquatic in the right conditions. During the change from terrestrial eft to aquatic adult, the newts' physiology changes drastically, almost as if it were going through a second, less severe metamorphosis. The skin becomes porous and thinner so as to absorb more oxygen under water, the hind legs become reduced, and the eyesight is modified for keener vision in murky waters.

Adults are typically semi-aquatic, or mostly aquatic, however, individuals and populations may return to a terrestrial mode of life under certain circumstances, such as diminishing water sources, polluted water sources, high temperatures, or to kill aquatic parasites. Adults can re-develop terrestrial adaptations, including thicker skin, stronger limbs to support the body, rounded tail, and modified eye sight; physical changes that are sometimes regarded as metamorphoses. Some populations may also leave the water to seek out a hiding spot for hibernation during the winter season. As long as they remain adequately moist, adult *N. viridescens* spp. can live on land very long periods of time, if not indefinitely. In a sense, *N. viridescens* spp. are capable of toggling their physiology between that suited for a terrestrial life and that of a semi-aquatic, as seen fit.

Neotenic adults are greenish-olive colored as well, and may or may not retain the dark stripe through eyes, characteristic of larvae. Males also develop swollen cloaca, nuptial pads, and cornified toe tips. Neoteny in *N. viridescens* is thought to be induced by environmental conditions, i.e. unsuitable terrestrial habitat in some cases. Experiments have shown that neoteny occurs more frequently in low-density larvae populations, where larvae can grow rapidly.

BREEDING BEHAVIOR

Breeding behavior is nearly identical in each subspecies, and has been well documented. During the breeding season, males develop laterally compressed tail fins, swollen cloaca, cornified toe tips, and nuptial pads on the insides of the back legs. The nuptial pads are adaptation to aid the male in holding the female during amplexus. Males also possess hedonic pits at the back of the head, which

are absent or reduced in females. Males and females are generally the same size.

N. viridescens breeds from fall through summer, depending on the subspecies and climate. Southern populations generally breed in late fall and early winter, through spring. Breeding in March and April has been documented in Louisiana populations (*N.v. louisianensis*). Intermediate latitude populations generally breed in the spring, and northern populations breed in fall and spring.

Males outnumber females at breeding sites, and actively compete for females (Petranka, 1998). Males typically compete more aggressively for larger females, as they are typically carrying more eggs. In the majority of cases, females are unresponsive to approaching males, prompting the male to quickly amplex her, which prevents her from darting away. Amplexus consists of the male grasping the female just in front of the fore limbs, with his hind limbs. The rough nuptial pads on the inner legs of breeding males prevent females from wriggling free. Occasionally, males may accidentally amplex other males, which are usually released after assuming a bowed head position. During amplexus, which could last for several hours, the male will rub the females snout with his forelimbs, chin, and the sides of his head, where genial glands are found, and fan cloacal secretions toward her snout with his tail. Responsive females often raise their tails at a 90° angle during amplexus. Several minutes before the female is released, the male increases courtship behavior with aggressive body contortions, and increased tail fanning. After releasing the female, the male will move in front of her, while undulating the body, and raising his tail. If interested, the female will follow the male, periodically pressing her head against his tail or cloacal region. This behavior prompts the male to release one or more spermatophores. After deposition, the male will turn perpendicular to the female to block her path. At this point, the female moves slightly forward to align her cloaca with the sperm cap for collection.

The fore-described behavior is the ideal case, however, many times the female simply darts away after she is released from the males grip. Another factor disrupting breeding is competition from other males. Once in amplexus, competing males attempt to dislodge male and female pairs, however they are usually unsuccessful. Competing males may assume the behavior of breeding females during the spermatophore deposition stage, allowing the rival male to move in between the courting pair and deposit his own spermatophores. In some instances where a male amplexes another male, the amplexed male may not assume the bowed head position described earlier. Instead, he may act as a female by nudging the amplexing males tail after being released, prompting him to release a spermatophore. In such instances, the spurious male may consume the spermatophore.

Occasionally, a simpler courtship routine is enacted. If a female is responsive to an approaching male, he may simply perform an undulating dance, followed by the deposition of a spermatophore. This behavior has been observed in captivity, and in few cases.

Eggs are attached singly to aquatic plants, and sometimes with the plant tip folded over the egg. Females may deposit

eggs a few at a time for several months. Incubation is typically complete within 20-35 days, depending on temperature.

New larvae are pond-type, with longer, bushy gills, and higher tail fins. Hatchlings are greenish-brown to yellowish, with two brown or black stripes running dorsolaterally down the sides of the back. Advanced larvae are light brown to yellowish, with black lines running from the snout, through the eyes. The red dorsal patterns may develop in the late larval stage in those subspecies that possess red dorsal markings as adults. Larvae are carnivorous, and cannibalistic. Larvae have been noted to separate into groups within a pond according to size, presumably a mechanism to avoid predation by larger larvae. The larval stage lasts anywhere from 2-5 months, depending on the subspecies and location.

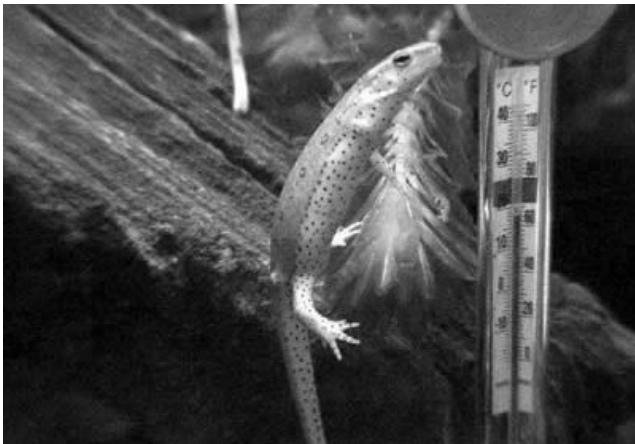
Upon metamorphosis, efts retreat to terrestrial hiding spots in droves. Eft coloration is apparent within 2.5 weeks of metamorphosis in terrestrial juveniles.

Semi-aquatic adults are found in slow moving, permanent water bodies, including ponds, lakes, swamps, ditches, and slow sections of streams. Aquatic habitats with abundant plant life also harbor abundant newt populations. Newts can be found in abundance around the shoreline, however, some may venture to deeper waters. Those populations that leave the water for winter hibernation or summer aestivation typically return to the same breeding ponds every year. Experiments have shown that *N. viridescens* possess homing capabilities when displaced from their ponds. *N. v. dorsalis* and *N. v. louisianensis* have been noted to remain hidden in muddy bottoms of evaporating ponds, rather than leave and seek out terrestrial hiding spots.

TRADITIONAL SUBSPECIES

Notophthalmus viridescens viridescens (Rafinesque, 1820) Red Spotted Newt, Eastern Newt

This is the largest subspecies, reaching lengths 4.41 inches (11.2 cm) total length. Adults of the nominate form are tannish-olive colored dorsally, with a lighter colored, yellowish belly. Three to eight orange-red spots outlined in black run dorsolaterally from the back of the head and/or top of head, to the start of the tail. These spots will vary in size and formation within a given group, but are a distinguishing characteristic of this subspecies. The entire body is usually covered in tiny black dots, including the tail, head, legs, belly, and dorsum. Efts of the nominate form are bright red or orange, and possess the typical reddish spots outlined in black that mark the adults. Efts of this subspecies are often called red efts, a reflection of their stunning red-orange coloration.



N. v. viridescens, photo © Jessica J. Miller, <http://www.livingunderworld.org>



N. v. dorsalis, photo © Jessica J. Miller, <http://www.livingunderworld.org>



N. v. viridescens eft, photo © Suzanne L. Collins, Center for North American Herpetology

N.v. viridescens have the widest distribution, which includes nearly the entire eastern coast of the United States, excluding Florida and southern Georgia, and upwards into southern Quebec and Ontario, Canada. *N.v. viridescens* can be found westward to central Alabama, Tennessee, Kentucky, Indiana, Quebec and Ontario, Canada.

Notophthalmus viridescens dorsalis (Harlan, 1828)
Broken Stripe Newt

Broken stripe newts are tannish-olive colored dorsally, with lighter, yellowish colored bellies. *N. v. dorsalis* possess a discontinuous, wobbly red line running dorsolaterally from the back or top of the head, to the start of the tail. The broken line appears as if the red spots of nominate form have been smeared together. Like the nominate form, the dorsal red coloration is outlined in black. The body is also spotted with fine black dots, and usually larger black dots and shapes. Neoteny has been documented in some populations of *N. v. dorsalis*. Efts of this subspecies are not as brightly colored as the nominate form, and are similar in coloration to the adults, or slightly lighter.

N. v. dorsalis have the smallest distribution, which includes northeastern South Carolina, and southeastern to mid-eastern North Carolina. In the Carolina's, *N. v. dorsalis* are noted for breeding and residing in clay-based bays and limesink depressions, surrounded by long leaf pine and wiregrass, pine plantations, and hardwood forests.

Notophthalmus viridescens louisianensis (Wolterstorff, 1914) Central Newt

This subspecies possesses larger black spots about the body, legs, and tail, in addition to fine dots. Some individuals may possess faint red spots along the back, discontinuously outlined in black. Efts of this subspecies are not as brightly colored as the nominate form, sometimes appearing dark brownish-red in coloration. The eft stage is sometimes completely skipped in this subspecies, especially in areas with minimal cover in the surrounding terrestrial environment. Adults may stay active year round in some populations, with mating occurring in the fall, winter, and spring, while others may seek hibernation on land during the colder months. Metamorphosed individuals may remain semi-aquatic, bypassing the eft stage, while others will develop into terrestrial efts.



N. v. louisianensis, photo © Douglas Creer, Department of Biological Sciences, Florida International University.

N. v. louisianensis cover a relatively large area, which spans the intersection of northern Florida, Georgia, and Mississippi, westward to eastern Texas, and north into lower Ontario, Canada, passing through eastern Oklahoma, central and eastern Missouri, eastern Iowa, Wisconsin, and eastern Minnesota. The easternmost distribution borders the range of *N. v. viridescens* in most areas. Large gaps in distribution occur in central Illinois, Indiana, western-central Wisconsin, and southwestern Louisiana. Aquatic habitat includes shallow ponds, slow moving permanent water bodies, and calm streams.

Notophthalmus viridescens piaropicola (Rafinesque, 1820) Peninsula Newt

This subspecies possesses fine speckling of black dots all over the body, tail, and legs. The background coloration is usually dark tan, sometimes black, and the belly is lighter colored. *N. v. piaropicola* lack red spotting altogether. Transformed efts lack the bright coloration of the nominate form, and are often similar in coloration as the adults, sometimes darker. The eft stage is sometimes completely skipped in this subspecies, especially in areas with minimal cover in the surrounding terrestrial environment.



N. v. piaropicola, photo © Takeshi Ebinuma

N. v. piaropicola have a comparatively small distribution, which includes only the peninsula of Florida. Aquatic habitat includes slow moving water bodies, often those with significant colonies of hyacinth. Aquatic newts can be found residing among the maze of hyacinth roots, and efts commonly reside in semi-tropical surrounding forests. This subspecies has been documented in several nature reserves and parks in Florida, including the Florida Everglades National Park, the Archbold Biological Station, the Corkscrew Swamp Sanctuary, and Big Cypress National Preserve Park.

ETYMOLOGY / NOMENCLATURE

Etymology: *Notophthalmus* (Latin): Noto translates to markings, and ophthalmus translates to eye; refers to the round markings on red-spotted newts.

viridescens (Greek): Greenish tint.

dorsalis (Latin): pertaining to the back, or dorsum - refers to the dorsolateral broken stripes on *N. v. dorsalis*.

louisianensis (New Latin): Belonging to the state of Louisiana.

piaropicola (New Latin, Latin): piaropus means water hyacinth (New Latin). -icola means inhabitant of.

TAXONOMIC SYNONYMY

Salamandra stellio (Say, 1819), *Triturus viridescens* (Rafinesque, 1820), *Triturus miniatus* (Rafinesque, 1820), *Salamandra symmetrica* (Harlan, 1825), *Salamandra punctatissima* (Wood, 1825), *Salamandra dorsalis* (Harlan, 1829), *Salamandra greeni* (Gray, 1831), *Salamandra symmetrica* (Harlan, 1835), *Salamandra millepunctata* (Storer, 1840), *Salamandra coccinea* (DeKay, 1842), *Triton dorsalis* (Holbrook, 1842), *Triton symmetricus* (Holbrook, 1842), *Notophthalmus viridescens* (Baird, 1850), *Tristella symmetrica* (Gray, 1850), *Molge ocellata* (Gray, 1850), *Notophthalmus miniatus* (Gray, 1850), *Notophthalmus viridescens* (Gray, 1850), *Triton punctatissimus* (Dumeril, Bibron, and Dumeril, 1854), *Triton symmetricus* (Dumeril, Bibron, and Dumeril, 1854), *Diemyctylus viridescens* (Hallowell, 1856), *Notophthalma viridescens* (Gray, 1858), *Triton viridescens* (Strauch, 1870), *Salamandra ventralis* (Provancher, 1875), *Triturus viridescens* (Boulenger, 1878), *Molge viridescens* (Boulenger, 1882), *Diemyctylus miniatus* (Yarrow, 1882), *Diemyctylus miniatus viridescens* (Yarrow, 1882), *Diemyctylus viridescens viridescens* (Cope, 1889), *Diemyctylus minutus* (Gage & Norris, 1890), *Diemyctylus viridescens* var. *vittatus* (Garman, 1896), *Notophthalmus viridescens* (Gill, 1907), *Diemyctylus viridescens* (Gill, 1907), *Diemyctylus viridescens louisianensis* (Wolterstorff, 1914), *Notophthalmus viridescens viridescens* (Stejneger & Barbour, 1917), *Notophthalmus viridescens vittatus* (Stejneger & Barbour, 1917), *Triturus dorsalis* (Dunn, 1918), *Triturus viridescens* (Dunn, 1918), *Triturus viridescens symmetrica* (Schmidt, 1924), *Diemyctylus viridescens louisianensis* (Wolterstorff, 1925), *Diemyctylus viridescens dorsalis* (Wolterstorff, 1925), *Triturus viridescens louisianae* (Strecker, 1928), *Triturus viridescens louisianensis* (Schmidt & Necker, 1935), *Notophthalmus viridescens louisianensis* (Herre, 1936), *Diemyctylus viridescens forma columbia* (Scharlinski, 1939), *Triturus louisianensis* (Carr, 1940), *Triturus viridescens viridescens* (Bishop, 1943), *Triturus viridescens piaropicola* (Schwartz & Duellman, 1952), *Diemyctylus viridescens evergladensis* (Peterson, 1952), *Notophthalmus viridescens* (Smith, 1953), *Diemyctylus viridescens* (Schmidt, 1953), *Notophthalmus viridescens dorsalis* (Smith, 1953), *Diemyctylus viridescens dorsalis* (Schmidt, 1953), *Notophthalmus viridescens louisianensis* (Smith, 1953), *Diemyctylus viridescens louisianensis* (Schmidt, 1953), *Notophthalmus viridescens piaropicola* (Smith, 1953), *Notophthalmus viridescens* (Mecham, 1967), *Notophthalmus viridescens louisianensis* (Mecham, 1967).

IN CAPTIVITY

N. viridescens are passive, non-aggressive newts, and can be housed in multi-member tanks. Two to three adults can be housed in no smaller than a ten-gallon aquarium with an ample supply of water, but larger tanks are always better. This is a temperate climate species, and can be kept around 62°F-68°F during spring and summer, and 45°F-60°F during winter months. Temps as high as 50°F may induce hibernation in some individuals, depending on the exact origin and subspecies of the individual.

Adult *N. viridescens* should be housed in a semi-aquatic tank with more water than land. Most adult individuals will remain largely aquatic year round in ideal habitats, only leaving the water for short periods of time. However, some adult individuals have been noted to remain terrestrial for long periods of time, and may require a larger land area with hiding places. Although short and moderately long bouts of terrestrial behavior are normal for this species, a sudden change from semi-aquatic to terrestrial may indicate a problem with the water quality. 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). Adult *N. viridescens* prefer cooler, fish-less, slow moving or still water bodies, which should reflect the way their home is constructed. The water area can support a filter with a carbon and sponge insert, or a canister type biological filters 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 small 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. Gravel is the standard form of submerged substrate, but bare bottom tanks are 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, and adequate biological filtration should be provided. Live aquatic plants should be included as *N. viridescens* prefer densely planted water bodies. *Elodea*, *Crinum*, *Lilaeopsis*, and *Vesicularia* are commonly used, and are acceptable for breeding purposes. *N. v. piaropicola* are often found in beds of hyacinth, which would make a natural addition to the captive home of this subspecies. If lighting is included, only fluorescent bulbs should be used, as they do not the feet of the tiny efts, making movement difficult, and causing undue stress. Chemical-free soil substrate can be purchased from many pet stores (Jungle Mix is a suitable brand), or collected from clean, chemical-free outdoor sources. However, collected soil can introduce harmful pathogens or chemicals, so using this type of substrate may pose health risks in some situations. A basic setup would consist of 3-6 inches of damp soil, live plants, and a few dark hiding places (rock caves, small terra cotta planters, etc.).

If fine soil cannot be obtained, small efts can be kept on bleach-free paper toweling until they are large enough to handle the soil 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 harmful 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. It is also necessary to ensure the paper towels are always adequately moist, but not soaking wet, 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.

radiate heat in the manner an incandescent bulb does. As with all amphibians, to avoid the spread of foreign pathogens, *N. viridescens* should not be housed with any other amphibian species.

Adult *N. viridescens* are typically housed in a large aquarium with 8-30 inches of water, and a land area composed of large, mossy rocks or driftwood breaking the surface of the water. Larger tanks can be sectioned off at the 1/3 mark with plexi-glass, making two separate areas in the tank. The larger side is for the water area, and the smaller side is for soil and live plants. This type of setup may be beneficial to those individuals that spend a considerable amount of time on land, terrestrial adults, juveniles who have yet to make the transition to semi-aquatic adult, and for individuals that will hibernate during the winter. Alternatively, potted plants can be submerged in the water to serve as land islands.

Typically, *Notophthalmus viridescens* spp. juveniles are true efts, spending the first few years of life completely terrestrial. *N. v. viridescens* efts are perhaps the most recognized eft-stage species because of their striking coloration during this phase. Other subspecies, such as *N. v. dorsalis* may not possess this striking coloration during the eft stage, and instead may resemble the adult color scheme. *Notophthalmus* efts are physiologically suited for a terrestrial life upon metamorphosis, with thicker skin, modified eyesight, stronger legs to support the body, and a high concentration of Tetrodotoxin (see article 0011 - Toxicity and Defense Methods of Amphibians for information on toxicity).

Metamorphosed efts should be kept terrestrially for the first few years of life, prior to reaching sexual maturity and assuming a semi-aquatic lifestyle. New efts measure around 25-35mm, and can usually be kept on chemical-free, moist soil. Course soil may result in clumping around

A more natural setup would consist of a large soil and live plant area with an ample supply of densely-planted water designed in such a way that the terrestrial adolescents can make the transition to sexually mature adult in the same environment, and reside in that same environment indefinitely. However, this is not practical in most situations, and newly mature adults are usually relocated into a more aquatic type setup when sexual maturity is reached. More elaborate setups can include several different species of plant life, mosses, caves, burrows, sloping hill sides, rocks, driftwood, small logs, natural-looking water bodies, waterfalls, etc. See article 0020 - Captive Habitats: Ideas, Instructions, and Examples and the Captive & Wild Habitats section of the Photo Gallery.

As with all amphibians, tap water should be treated with a water conditioner or primer prior to the introduction of amphibians. Never use plain tap water, de-ionized, distilled, or reverse osmosis water with amphibians. Also, the tank should be cycled (nitrogen cycle) prior to the introduction of 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.

References

AmphibiaWeb. (2003). <http://amphibiaweb.org/>. (Accessed: 2001-2003).

Behler, John L., and F. Wayne King. *National Audubon Society Field Guide to North American Reptiles and Amphibians*. New York: Knopf, 1979, 1996.

Beltz, Ellin. (2003). North American Reptile and Amphibian Names. *Ellin Beltz*. <http://ebeltz.net/herps/etyhome.html> (Accessed: 2001).

Center for North American Herpetology. (2003). <http://www.cnah.org/> (Accessed: 2000).

Gabor, R., and C. Nice. 2004. Genetic variation among populations of Eastern Newts, *Notophthalmus viridescens*: A preliminary analysis based on allozymes. *Herpetologica* 50(3): 373-386.

Nature Serve Explorer (Database). *Nature Serve*. <http://www.natureserve.org/explorer/index.htm> (Accessed: 2000-2003).

Petranka, James W. *Salamanders of the United States and Canada*. Smithsonian Institution Press, 1998.