

MARYLAND HERPETOFAUNA
TAXONOMY TIPS:
A Reference Guide



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Cover Photo: Eastern spadefoot; credit Rachel Gauza, AZA

Table of Contents

Table of Contents	i
List of Figures	ii
List of Tables	ii
Foreword	iii
Introduction.....	1
Salamanders.....	2
Larval salamanders	6
Frogs and Toads	7
Frog Call “Phonetics and Mnemonics”	9
Tadpoles	10
Lizards.....	12
Turtles	14
Snakes	16
Literature Cited.....	20
Recommended Reading	20
Websites & Online Materials	20
Field Guides.....	21
Other References	22
Local Public Participation in Scientific Research (PPSR) Programs for Herpetofauna	23

List of Figures

Figure 1. Costal groove illustration. (Stranko et al. 2010)	2
Figure 2. (a) large rear legs and (b) pale diagonal line on facial profile diagnostic of dusky salamanders (<i>Desmognathus</i> spp.) (Stranko et al. 2010).....	3
Figure 3. External gill structure of salamander larvae (a) without rachises (<i>Desmognathus</i> spp) and (b) with rachises (others). (Stranko et al. 2010).....	3
Figure 4. Larval salamander morphology. (Petranka 1998).....	6
Figure 5. Tadpole dichotomous tree for Maryland.....	11
Figure 6. Scale s used to differentiate between <i>P. fasciatus</i> and <i>P. laticeps</i> . (Stranko et al. 2010).....	12
Figure 7. Scutes of a turtle carapace. (Stranko et al. 2010).....	14
Figure 8. Key features of Maryland’s venomous vs. nonvenomous snakes.	16

List of Tables

Table 1. Ecology, life history, and taxonomy of Maryland salamanders.....	4
Table 2. Maryland salamander species by larval body type	6
Table 3. Identification key for stream salamander genera.....	6
Table 4. Maryland anuran characteristics by family.....	8
Table 5. Comparison of Maryland’s two toad (<i>Anaxyrus</i>) species.....	9
Table 6. Maryland <i>Lithobates</i> spp. separated by presence of dorsolateral ridges.....	9
Table 7. Phonetic and mnemonic descriptions of calls of Maryland’s anuran species.	10
Table 8. Scale and body type characteristics of Maryland’s lizards.....	12
Table 9. Comparison of <i>P. fasciatus</i> and <i>P. laticeps</i>	13
Table 10. Comparison of sometimes confused turtle species in Piedmont Maryland.	15
Table 12. Shared and distinguishing features between stinkpot (<i>Sternothernus odoratus</i>) and eastern mud turtles (<i>Kinosternon s. subrubrum</i>)	15
Table 13. “Black snakes”: Eastern ratsnake versus Northern Black Racer.....	17
Table 14. “Red-brown and blotchy snakes”: Eastern milksnake vs. Red cornsnake vs. Mole kingsnake vs. Northern watersnake	18
Table 15. “What’s small, black, & white/yellow, & red all over?”: Northern scarletsnake vs. Coastal Plain milksnake vs. Scarlet kingsnake vs. Rainbowsnake	18
Table 16. “Small and brown snakes”: Northern brownsnake vs. Northern red-bellied snake vs. Eastern wormsnake vs. Eastern smooth earthsnake vs. Mountain earthsnake	19
Table 17. “Striped snakes”: Eastern gartersnake vs. Common ribbonsnake vs. Queen snake..	19

Foreword

The Association of Zoos and Aquariums (AZA) is a non-profit organization dedicated to promoting excellence in the care and welfare, conservation, education, and research surrounding animals and their habitats. As the country's leading accrediting organization for zoos and aquariums, AZA is committed to building the largest wildlife conservation movement in the United States.

In 2008, AZA made a long-term commitment to global amphibian conservation by increasing the capacity of AZA-accredited zoos and aquariums to respond to threats facing amphibians, creating and sustaining assurance populations of threatened amphibians, and increasing public awareness of, and engagement in, amphibian conservation. The support and hard work from directors, curators, keepers, partners, and volunteers helps AZA maintain its commitment and has contributed to conservation progress and successes both locally and globally.

In 2009, AZA assumed management of FrogWatch USA™, a long-term frog and toad monitoring program that recruits volunteers to collect and report information about frog and toad populations in the United States. FrogWatch USA is at the forefront of AZA's commitment to increasing public awareness and engagement in amphibian conservation, as well as promoting general scientific literacy.

Citizen Science and other Public Participation in Scientific Research (PPSR) programs like FrogWatch USA promote scientific and educational goals. Participants gain an appreciation for the diversity of frog and toad species in the United States and develop an understanding of the importance of protecting wetland habitats. Moreover, FrogWatch USA provides volunteers with an opportunity to learn about and establish a closer relationship with the natural environment while contributing to a nationwide, scientifically-credible dataset that dates back to 1998.

The collaborative relationship between volunteers and the researchers and scientists they support expands the spatial and temporal data collection potential. In order for PPSR projects to maintain scientific integrity, it is essential that participants receive training on standardized techniques and learn the skills necessary to contribute to the dataset. This document provides guidance on the taxonomy of Maryland's herpetofauna, most notably those in the Piedmont region. Special attention is dedicated to species that are commonly confused. For more information about AZA or FrogWatch USA, visit www.aza.org.

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Introduction

Amphibians and reptiles are collectively known as “**herpetofauna**”, or “**herps**” for short. They are **ectothermic**, meaning that their body temperatures vary with their surrounding environment. More specifically, herpetofauna are **poikilothermic** vertebrates, and their body temperatures vary over a wide range of temperatures. As a result, herpetofauna primarily rely on behavioral means for thermoregulation, such as **basking** to increase body temperature and dry the skin, **aestivating** during times of high heat and arid conditions, or **hibernating** when food resources are limited and temperatures are low.

Although classically studied together because of similarities in behavior and collection and preservation methods, there are key differences between the two groups.

Generally speaking, **amphibians**, such as frogs, toads, and salamanders (in Maryland):

1. Lack scales and claws;
2. Have moist, glandular skin that is easily penetrated by water;
3. Lay soft-shelled, jelly-like eggs in water or damp places to keep them moist.

Most amphibians spend at least part of their lives in water habitats such as flowing streams, seasonal pools, or other wetland types and respire subcutaneously (through the skin) to some degree. Most hatch as aquatic larvae with gills or spiracles. As they grow into adults, many develop lungs which they use to breathe, and are capable of living both on land and in water. It is this type of development that coined the name amphibian - “amphi-” (double or both) and “bios” (life) in Greek. Some salamanders (in the Family Plethodontidae, lungless salamanders) never develop lungs and are reliant on the moisture in their environment in order to breathe through their skin. Plethodontid salamander species may or may not have an aquatic larval stage.

Unlike amphibians, **reptiles**, such as lizards, snakes, and turtles (in Maryland):

1. Have clawed toes (excluding snakes, which are limbless)
2. Have scales, shields, or plates covering their body
3. Lay shelled eggs (similar to birds)

Reptiles use lungs to breathe and generally lay eggs in terrestrial habitats. The thick, hard shell of eggs protects developing embryos from moisture loss. Some species of snakes are **viviparous**, giving birth to live young. As a result, reptiles are often found in drier environments than moist-skinned amphibians. Even primarily aquatic turtles and snakes utilize dry areas to bask.

Each of the following sections will discuss the major groups of herpetofauna in Maryland: salamanders, frogs and toads, lizards, turtles, and snakes. For each group, there will be references to the following anatomical views:

- **Dorsal** - top view, or back;
- **Lateral** - side view;
- **Ventral** - bottom view, belly, or underside.

Salamanders

Salamanders (including newts) are amphibians in the Order **Caudata**. Some are found in primarily aquatic habitats such as seasonal pools, small streams, and swamps, ponds, lakes, and rivers, while others are found in more upland settings. They are secretive, seeking refuge under logs and rocks, burrowing in leaf packs, and even retreating to caves. Maryland's salamander species can be grouped by their preferred habitats, which aids in locating and identifying individuals.

Maryland species have long slender bodies with a tail and two pairs of relatively equal-sized limbs. The head is typically separated from the body by a discernable neck, and costal grooves (Figure 1) are usually present. The shape and patterning of the body, musculature and markings on the head, and structure of the legs and tail are most useful for identification. In larval salamanders, gill structure is also used, and should be viewed and photographed in water.

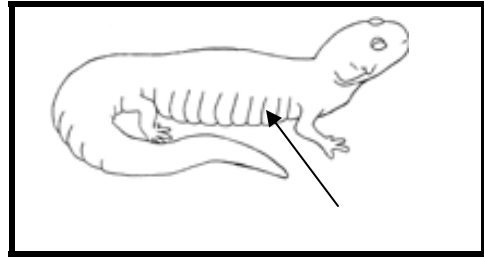


Figure 1. Costal groove illustration.
(Stranko et al. 2010)

There are five families and 21 species of salamanders known to Maryland. Seven species have been listed or identified as needing conservation: eastern tiger salamander (endangered), Jefferson salamander (watch list), eastern hellbender (endangered), common mudpuppy (endangered/extirpated), eastern mud salamander (in need of conservation/rare), green salamander (endangered), and Wehrle's salamander (in need of conservation). Of these, only the Jefferson salamander (*Ambystoma jeffersonianum*) can still be found in the Piedmont region.

There are 14 salamander species in the Piedmont representing three (3) families: Salamandridae (newts), Ambystomatidae (mole salamanders), and Plethodontidae (lungless salamanders, which comprises the most species). **Salamandridae** is only represented by one species, the red-spotted newt (*Notophthalmus viridescens viridescens*). This species is easily distinguished from other species by its rough, granular skin.

Mole salamanders (family Ambystomatidae, genus *Ambystoma*) are relatively large salamanders with stout bodies, rounded heads, and conspicuous costal grooves (which create an inflated appearance). *Ambystoma* spp. have an aquatic larval stage; in Maryland, they breed primarily in temporary wetlands known as seasonal pools.

Lungless salamanders (family Plethodontidae) lack lungs and have a nasolabial groove (a groove from the nostril down to the lip line used for chemoreception, which can be difficult to see). Seven genera are found in Maryland; four occur in the Piedmont region and can be distinguished from one another due to a number of distinct features.

Plethodon spp. (woodland salamanders) are the most terrestrial of the lungless salamanders in Maryland. The tail is typically rounded in cross-section along its entire length. Species vary in size and the dorsal ground color is usually dark with flecking, spotting, or a dorsal stripe.

Three genera are considered “streamside” salamanders. *Desmognathus* spp. (dusky salamanders) are robust, with rear legs that are conspicuously large (Figure 2a). Species possess a pronounced jaw and a diagnostic pale diagonal line that extends from the eye to the angle of the jaw (Figure 2b). Larval *Desmognathus* spp. are typically smaller than other stream salamander larvae and the hind limbs are larger than the front limbs. The head often appears rounded and gills (Figure 3a) lack rachises (comb-like structures).

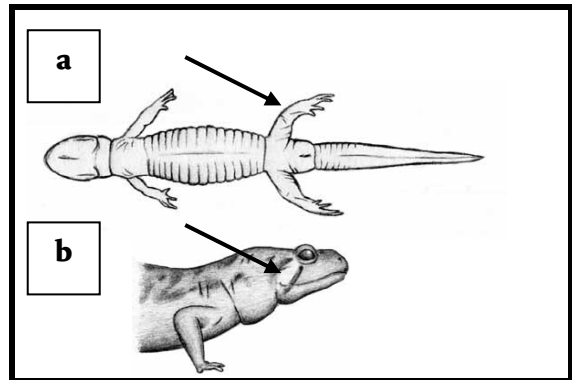


Figure 2. (a) large rear legs and (b) pale diagonal line on facial profile diagnostic of dusky salamanders (*Desmognathus* spp.) (Stranko et al. 2010)

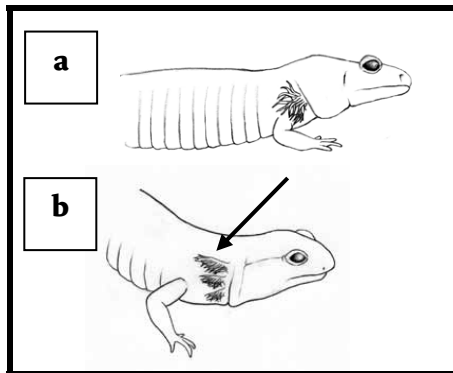


Figure 3. External gill structure of salamander larvae (a) without rachises (*Desmognathus* spp) and (b) with rachises (others). (Stranko et al. 2010)

Eurycea spp.

(brook salamanders) are slender bodied with a keeled tail that is triangular in cross-section, most noticeably on the posterior half. Larvae have gills with rachises (Figure 3b).

Pseudotriton spp. (red and mud salamanders) also have keeled tails, but are larger and full-bodied when compared to *Eurycea*. Adults and recently metamorphosed individuals are often vibrant shades of orange, red, salmon, or pink with varying degrees of dark dorsal spotting, flecking, and streaking. These patterns may become non-distinct and bleed together on older individuals, enhancing a brown or purple coloration. Larvae also have a reddish hue and profuse spotting, mottling, or streaking which

comes to resemble adult patterning as the larvae mature and approach metamorphosis. Larval period can last several years in these species, resulting in individuals that are larger than other stream salamander larvae in the Piedmont. The gills of *Pseudotriton* spp. larvae have rachises (Figure 3b) and are often bushy and deep red.

There is only one species in the genus *Hemidactylum*, the four-toed salamander (*Hemidactylum scutatum*). Diagnostic characteristics for each species of Maryland salamander are provided in Table 1. Table 1 groups salamanders by habitat, family, and genus and provides distinguishing key characteristics. Identification of larval salamanders is discussed further in the next section.

Table 1. Ecology, life history, and taxonomy of Maryland salamanders.

General Habitat	Family and Genus	Species	Notable Characteristics	
Large Stream or River	Cryptobranchidae; <i>Cryptobranchus</i> sp.	Eastern Hellbender (<i>C. a. alleganiensis</i>)	Very large & unique salamander w/depressed body, flattened head, and folded skin. State endangered – historic distribution in the Castleman, Youghiogheny, & Susquehanna Rivers.	
	Proteidae; <i>Necturus</i> sp.	Common Mudpuppy (<i>N. m. maculosus</i>)	Retains external gills through adulthood; 4 digits on each hind foot (as opposed to 5); believed to be extirpated from Maryland	
Lakes and Ponds (<i>Aquatic larvae – pond form</i>)†	Salamandridae; <i>Notophthalmus</i> sp.	Red-spotted Newt (<i>N. viridescens</i>)	Rough granular skin & prominent red, dark-bordered spots; Four (4) distinct life stages (egg, aquatic larva, terrestrial red eft (<i>sometimes skipped</i>), aquatic adult – gilled or lunged. Utilize seasonal pools and lentic waters; often prey on eggs of other amphibians.	
Seasonal Pools [in order of breeding period by calendar year]	Ambystomatidae; <i>Ambystoma</i> sp.	E. Tiger (<i>A. t. tigrinum</i>)	Endangered, eastern shore species. <u>Adults</u> – highly variable patterning but often have bands that extend down side; very distinctive, prominent eyes. <u>Larvae</u> – claw-like digits & very large gills; chin and throat immaculate.	
		Jefferson (<i>A. jeffersonianum</i>)	Species of Greatest Conservation Need; western portion of MD (Montgomery County and west). <u>Adults</u> – long toes & compressed, rudder-like tail; varying degrees of bluish speckling. <u>Larvae</u> – large dorsal blotches; head is conspicuously larger than body.	
		Spotted (<i>A. maculatum</i>)	Found throughout most of MD w/exception of lower E. Shore. <u>Adults</u> – conspicuous; striking yellow-to-orange paired spots; stocky & inflated appearance. Metamorphs will have yellow flecks before developing spots. <u>Larvae</u> – Drab and lack prominent markings.	
		Marbled (<i>A. opacum</i>)	Found throughout MD. Fall breeder. <u>Adults</u> – black with white (male) or silvery (female, juv.) crossbands. Venter completely black. <u>Larvae</u> – Dark (or black) with heavy pigment on chin & throat.	
Wetland (<i>Aquatic larvae - pond form</i>)	Plethodontidae (Lungless salamanders)	<i>Hemidactylium</i> sp.	Four-toed (<i>H. scutatum</i>)	Found throughout MD. 4 toes on each hind foot; squared snout; constricted tail; only MD salamander w/white belly w/prominent black spots.
Cliff and Talus (<i>No aquatic larvae</i>)		<i>Aneides</i> sp.	Green (<i>A. aeneus</i>)	State endangered & limited to far western MD. Green, lichen-like blotches; square-tipped digits. Habitat specialist - found primarily in rock crevices.
Woodland (<i>No aquatic larvae</i>)		<i>Plethodon</i> sp.	Eastern red-backed (<i>P. cinereus</i>)	Statewide and generally common. Multiple color morphs; salt and pepper mottled belly and tail rounded in cross-section. Overall sleek, worm-like build.
	Valley and Ridge (<i>P. hoffmani</i>)		Limited to valley and ridge & Allegheny plateau in MD. Long abdomen and tail; belly dark brown w/white mottling.	
	N. Slimy (<i>P. glutinosus</i>)		Locally common and found in Piedmont region & west. Black w/white or brassy flecks; dark venter. Skin secretions are sticky and “slug-like” when handled.	
	Wehrle’s (<i>P. wehrlei</i>)		Rare and found in far western MD. Brown w/fine and widely-scattered white or brassy spots; sides may have irregular blotches or bands. Throat is white or blotched and is lighter than belly.	

Table 1. Ecology, life history, and taxonomy of Maryland salamanders. - Continued

General Habitat	Family and Genus		Genus features	Species	Notable Characteristics
Spring and Seep (Aquatic larvae - stream form) †	Plethodontidae (Lungless Salamanders) CONTINUED	<i>Desmognathus</i> sp.	Rear limbs conspicuously larger than forelimbs (i.e., meaty back legs) & a pale diagonal line that extends from the eye to the angle of the jaw ("Desmog. Line")	Northern Dusky (<i>D. fuscus</i>)	Found throughout MD. <u>Adults</u> - Variable coloration and patterning; numerous blotches and stripes. <u>Larvae</u> – 5-10 pairs of spots on body
				Appalachian Mountain Dusky (<i>D. ochrophaeus</i>)	Allegheny Plateau in MD. <u>Adults</u> - Tail more rounded than other <i>Desmognathus</i> spp. Middorsal chevron-shaped patterning. <u>Larvae</u> – 2-7 pairs of spots on body or lacking altogether; head often has a dark V- or Y- shaped pattern bordered by a pair of round light spots.
				Seal (<i>D. monticola</i>)	Allegheny Plateau in MD. <u>Adults</u> – Digit tips w/friction pads; dark "wormy" patterning. <u>Larvae</u> – 4-5 pairs of spots on body; underside of tail is diffusely blotched with pigment.
		<i>Eurycea</i> sp.	Keeled/triangular tail; brown or yellowish w/lighter venter	N. two-lined (<i>E. bislineata</i>)	Common throughout MD – most common stream-dwelling species. <u>Adults</u> – Two parallel lines from eyes to tail; bright yellow bellies. <u>Larvae</u> – Somewhat elongate head and branched gills; have two rows of parallel spots or paired stripes.
				Long-tailed (<i>E. l. longicauda</i>)	Not found on Coastal Plain. <u>Adults</u> – tail >50% total length; black spots on dorsum which are herringbone-shaped on tail. <u>Larvae</u> – streamlined body that tapers from head; short, well-formed gills; immaculate belly that drastically contrasts body; lacks paired spots down back.
		<i>Pseudotriton</i> sp.	Ranging from orange to red to purple in coloration; varying degrees of spotting and streaking	Northern Red (<i>P. r. ruber</i>)	Found throughout MD w/exception of lower E. Shore. <u>Adults</u> – yellow eyes; numerous black spots that run together (jelly bean-shaped); coloration on sides and belly intergrades; snout long. <u>Larvae</u> : Streaks and mottling resembling adults; dark eye bar in iris.
				Eastern Mud (<i>P. m. monticola</i>)	Muddy habitats in Coastal Plain and can be difficult to detect.. <u>Adults</u> – Brown eyes; distinct, scattered spots (polka-dotted); coloration on sides and belly sharply contrast; snout short; State Rare. <u>Larvae</u> - Streaked in some populations or marked with widely scattered, distinct dark spots (like adults)
		<i>Gyrinophilus</i> sp.	Reddish, salmon, or pinkish in color; <i>Canthus rostralis</i> present	Northern Spring (<i>G. p. poryphiticus</i>)	Mountainous regions/high elevation streams. <u>Adults</u> - <i>Canthus</i> <i>rostralis</i> and square-shaped nose; strongly-keeled tail. <u>Larvae</u> – stout-bodied; some faint reticulations; venter whitish; nose is "Corvette" shaped in appearance.

† - Refer to Figure 4 for larval morphology illustrations.

Larval salamanders

Larval salamanders generally fit into three body types, as illustrated by Petranka (1998) in Figure 4. Table 2 provides a break out of Maryland species by body type and table 3 provides tips on for stream salamander larval ID (body types “stream form - type 1” and “stream form - type 2”).

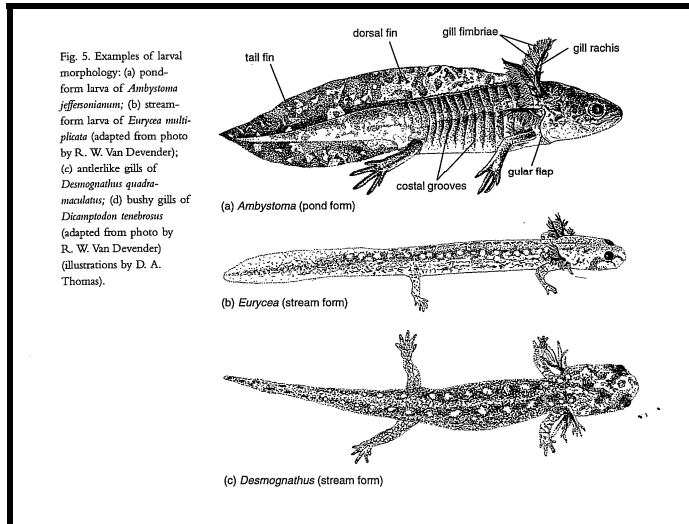


Figure 4. Larval salamander morphology. (Petranka 1998)

Table 2. Maryland salamander species by larval body type

Body Type	Species
Pond Form	- Spotted - Marbled - Jefferson - E. Tiger - Four-toed - Red-spotted newt
Stream form - Type 1	- N. two-lined - Long-tailed - N. red - E. mud - Northern spring
Stream form - Type 2	- N. dusky - Allegheny mountain dusky - Seal

Table 3. Identification key for stream salamander genera.

“Stream Salamander” – Larval ID:

1. Gill structure - rachises
 - a. Without → *Desmognathus* sp. (“duskies”)
 - b. W/rachises → PROCEED

2. Dorsal pigmentation/patterning
 - a. Paired spots or stripes → Northern two-lined
 - b. Light, mid-dorsal stripe/streak (no spots) → Long-tailed
 - c. Light brown to flesh-colored, no striping → Northern Spring
 - d. Spotting and/or streaking → *Pseudotriton* sp. (Red, Mud)

Frogs and Toads

Frogs and Toads are in the order **Anura** and can collectively be referred to as “anurans”. Anurans look very different, depending on life stage. Generally, adult anurans do not have a tail and have hind legs longer than the front legs that are adapted for hopping and jumping. The body is relatively short and there is no distinct separation of the head from the rest of the body, and the larval or tadpole stage is entirely aquatic. During this stage, anurans possess a tail, have a spiracle for breathing, and develop relatively short legs. Tadpoles with legs can be distinguished from salamander larvae by the lack of a discernable neck and external gills and the presence of distinctly longer back limbs than front limbs.






There are five (5) families and 20 species of anurans in Maryland. Four species are listed as endangered (eastern narrow-mouthed toad, barking treefrog), threatened (mountain chorus frog), or in need of conservation (carpenter frog). Like salamanders, there is an array of habitat preferences and morphological characteristics within each of these families. **True toads (family Bufonidae)** have thick, relatively dry, warty skin, and enlarged glands in the shoulder region called parotoid glands as adults (table 4). Unlike most frogs, toads tend to move in short hops, rather than large leaps. There are two species of true toads (*Anaxyrus* sp.; North American toads) in Maryland with overlapping ranges. The two species can also hybridize, producing offspring that have shared/blended features between the two distinct species. Table 5 presents a comparison of features between American toad (*A. americanus*) and Fowler’s Toad (*A. fowleri*).

Note that spadefoot toads are not true toads and are in the family **Pelobatidae (spadefoot toads)**; the eastern narrow-mouthed toad is also not a true toad, and is in the family **Microhyllidae (Microhyllid frogs)** and genus *Gastrophyrne* (North American narrow-mouthed toads). Table 4 further details differences between families of anurans.

Of the five anuran families, **Hylidae (New World treefrogs)** is the only one comprised of multiple genera. *Hyla* spp. (holarctic treefrogs) are the largest and most arboreal of the treefrogs. Their greatly enlarged toe pads facilitate climbing. *Pseudacris* spp. (chorus frogs) have a diminutive stature and are like a “mini *Hyla*”. They tend to have longitudinal stripes or an X-shaped dorsal patterning. Their toe pads are not as well-developed as *Hyla* sp., and they typically only climb understory or emergent vegetation. *Acris* sp. (cricket frogs) have toe pads that are virtually absent and are the least arboreal of the Hylids. They also possess rough-looking skin with fine warts. Other traits are used to distinguish tadpoles.

Ranidae (true frogs) is comprised of seven species (*Lithobates* spp., American water frogs) known to Maryland. There is debate over the occurrence of an eighth species, northern leopard frog (*L. pipiens*) in Maryland. In Maryland, adult Ranids can be distinguished by the presence or absence of dorsolateral ridges (Table 5) and the dorsal and ventral patterning. Size is not a reliable distinguishing trait, as the majority of species achieve a similar maximum size. The exception is American bullfrog (*L. catesbeianus*), Maryland’s largest anuran.

Table 4. Maryland anuran characteristics by family.


Family	Genera in Maryland	Characteristics	Illustrations*
Ranidae – True Frogs	<i>Lithobates (Rana) sp.</i>	<ul style="list-style-type: none"> - Powerful hind legs - Webbed feet - Stout waist - Large, broad mouth - Smooth skin without bumps or tubercles (generally) - Ground-dwelling & can move in long, powerful leaps 	 <p>Body type of True Frogs (Family: Ranidae)</p>
Hylidae – New World Treefrogs	<i>Hyla sp.</i> <i>Pseudacris sp.</i> <i>Acris sp.</i>	<ul style="list-style-type: none"> - Long, thin limbs - Toes terminate in distinctly enlarged disks or pads - Slim waist - Ability to climb 	 <p>Enlarged toe pads characteristic of True Tree Frogs (Family: Hylidae), specifically <i>Hyla sp.</i></p>
Microhylidae – Narrow-mouthed Toads	<i>Gastrophryne sp.</i>	<ul style="list-style-type: none"> - Narrow, pointed head - Distinct fold of skin across back of head - Small & stout with short legs - Ground-dwelling 	 <p>Body type of narrow-mouthed toad. (Photo by John White)**</p>
Bufoidea – True Toads	<i>Anaxyrus (Bufo) sp.</i>	<ul style="list-style-type: none"> - Thick, dry warty skin - Presence of parotoid glands (enlarged glands on the neck) - Move via short hops (often clumsy) - Ground-dwelling 	 <p>Parotoid gland and cranial crest</p>
Pelobatidae – Spadefoot toads	<i>Scaphiopus sp.</i>	<ul style="list-style-type: none"> - Sickle-shaped spade on inside of each hind foot - Vertical, elliptical pupils - Tubercles on skin - Stout w/broad mouth & short legs - Primarily fossorial (dig underground) 	 <p>Spade on each hind foot (Photo by Rachel Gauza)</p>

* - Illustrations from Stranko et al. (2010); ** -From "Discover Maryland's Herps" www.dnr.state.md.us/wildlife/Plants_Wildlife/herps/Anura/EasternNarrowMouthToad.asp

Table 5. Comparison of Maryland’s two toad (*Anaxyrus*) species.

Feature	American Toad (<i>A. americanus</i>)	Fowler’s Toad (<i>A. fowleri</i>)
1. Warts per dark spot	1 - 2	3+
2. Patterning on Chest & upper belly	Dark mottling	White belly with central dark breast spot (<i>usually</i>)
3. Tibial warts	Greatly enlarged	No greatly enlarged warts
4. Connection between parotoid gland & cranial crest	Separate or connected by a spur	Connected directly

Table 6. Maryland *Lithobates* spp. separated by presence of dorsolateral ridges.

Dorsolateral ridge illustration	Present	Absent
	Northern Green Frog (<i>L. clamitans melanota</i>) Wood Frog (<i>L. sylvaticus</i>) Pickerel Frog (<i>L. palustris</i>) Southern Leopard Frog (<i>L. sphenosephala utricularia</i>) Northern Leopard Frog (<i>L. pipiens</i>)	American Bullfrog (<i>L. catesbeianus</i>) Carpenter Frog (<i>L. virgatipes</i>)

Frog Call “Phonetics and Mnemonics”

Frogs and toads are the only herpetofauna in Maryland that produce vocalizations. The majority of vocalizations are associated with calling to attract a mate or advertise territory. The peak breeding activity in Maryland is generally February through August; however, optimum time to detect species varies. In the Piedmont region, typically wood frogs (*Lithobates sylvatica*), upland chorus frogs (*Pseudacris ferarrium*) and spring peepers (*P. crucifer*) are the first to call, followed by the two species of toads (*Anaxyrus* spp.) and the two species of gray treefrogs. The gray treefrog (*Hyla versicolor*) and Cope’s gray treefrog (*H. chrysoscelis*) look identical and can only be distinguished by their calls or genetic analysis. Pickerel frogs (*L. palustris*) join the chorus around the same time as the gray treefrog species. The American bullfrog (*L. catesbeianus*) and northern green frog (*L. clamitans melanota*) are often the last species to call and breed.

A careful ear is needed to detect agonistic encounter calls, which differ from breeding calls. The spring peeper produces an agonistic call that sounds very similar to the pattern of chorus frogs. Occasionally, individuals of different species can be heard after peak breeding, particularly after heavy rains. Weather further influences calling by affecting the speed and frequency of calls. Colder temperatures are associated with slower calls that are given less frequently. It is particularly important to note temperature for calling gray treefrog species, since the slower pulsing typical of the Cope’s gray treefrog is not mistaken for the call of a gray treefrog on a chilly night.

Table 7 presents some tips and tricks for learning the vocalizations of Maryland’s frogs and toads.

Table 7. Phonetic and mnemonic descriptions of calls of Maryland’s anuran species.

Family	Species	Descriptions
Ranidae	Wood frog (<i>Lithobates sylvaticus</i>)	Cackling, clucking, or quacking like a duck. Repetitious but muted clacking. Multiple syllables "Wa-ah-ah, wa-ah-ah, wa-ah ah"
	Southern leopard frog (<i>L. sphenocephalus</i>)	3-5 clucks or chuckles in rapid succession followed by a low growl. Guttural sounds; 2 balloons being rubbed together or deep scrape. "Wa-a-a-a-wa-a-a-a-wa-a-a-a-rrrrrup"
	Pickerel frog (<i>L. palustris</i>)	Snoring; slow and steady; 1-2 seconds. Low, muffled, and subtle; often raspy.
	Northern green frog (<i>L. clamitans melanota</i>)	Plucking a loose banjo string; hollow/dull sound; not musical; often isolated phrases. "Cl-tung"
	American bullfrog (<i>L. catesbeianus</i>)	Largest with deepest call; bass humming; mooing or mewing like a bull. Sometimes sounds like "jug-o'rum"
	Carpenter frog (<i>L. virgatipes</i>)	Hammering on a wooden board. Clacking or rapping.
Hylidae	Barking treefrog (<i>Hyla gratiosa</i>)	Likened to barking of a hound or muffled horn. Often abrupt and explosive. "Doomp"
	Green treefrog (<i>H. cinerea</i>)	Nasal quality and boisterous. Highly repeated up to 75 times. "Quank" or "Queenk". Nicknamed "bell frog".
	Gray treefrog (<i>H. versicolor</i>)	Musical/melodious; rippling/pulsing. Bird-like (has been likened to red-bellied woodpecker).
	Cope's gray treefrog (<i>H. chrysoscelis</i>)	Higher, more brash trill. Faster pulsing. Ratchet or squirrel-like.
	Spring peeper (<i>Pseudacris crucifer</i>)	Bird-like cheep or "peep"; high, piping whistle. Piercing. Often heard in loud choruses. Encounter call sounds like "preep".
	Upland chorus frog (<i>P. feriarum</i>)	The three species of chorus frog sound very similar. Overall, sound like someone dragging a fingernail along the teeth of a plastic pocket comb. Regular repeated and alternating feel. <i>P. brachyphona</i> has been described like an ungreased wagon wheel. Species ranges in Maryland are useful to consider.
	New Jersey chorus frog (<i>P. kalmi</i>)	
	Mountain chorus frog (<i>P. brachyphona</i>)	
Northern cricket frog (<i>Acris crepitans crepitans</i>)	Sharp, rapid clicking. Sounds like two marbles being tapped together or like a shaking a spray paint can. Rattle or clicker in rapid succession. Calls slower than that of southern subspecies.	
Microhylidae	Eastern narrow-mouthed toad (<i>Gastrophryne carolinensis</i>)	Bleating of a young sheep; baby crying; nasal and buzzy. "Baaaaaahhh"
Pelobatidae	Eastern spadefoot (<i>Scaphiopus holbrookii</i>)	Explosive/accented and tapers off at the end - "Berrrrr". Low-pitched grunt that is repeated at brief intervals.
Bufonidae	American toad (<i>Anaxyrus americanus</i>)	Long, musical trill lasting 5-30 seconds. Simultaneous whistle & hum "whirrrrrrrrr".
	Fowler's toad (<i>A. fowleri</i>)	Nasal cry that lasts 1-4 seconds - "waaaaahhh". Buzzy and shrill

Tadpoles

Field identification of tadpoles is notoriously difficult and often not exact. Furthermore, some identification cannot be reliably made past the genus-level in the field. The structure of the mouth parts are used in laboratory identification. The lack of an oral disk and head shape distinguishes the eastern narrow-mouthed toad from all other Maryland species. After that point, examining the location of the anal opening, structure of the tail, dorsal patterning and pigmentation, color of the venter, and eye placement are necessary to make an identification (Figure 5).

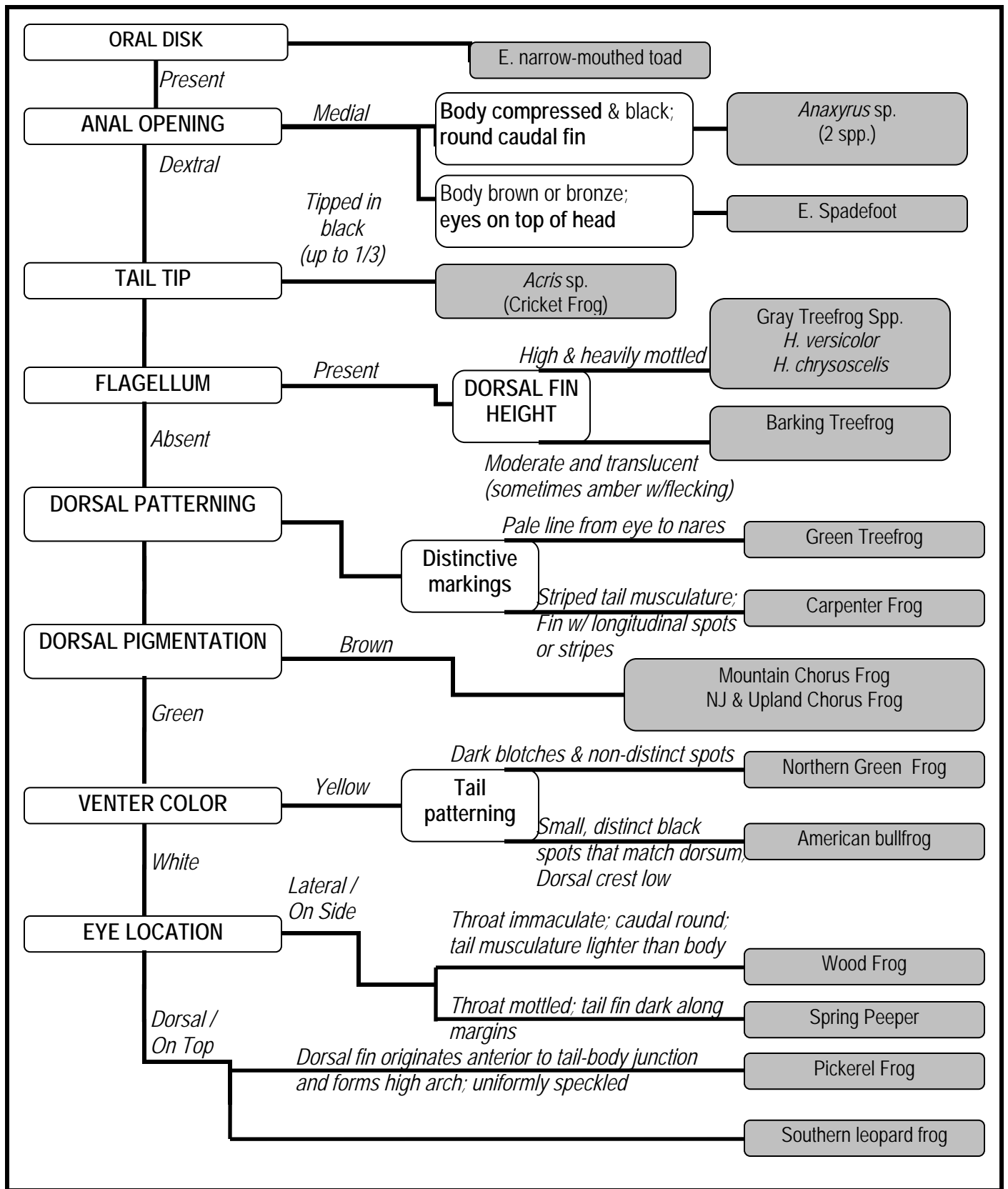


Figure 5. Tadpole dichotomous tree for Maryland.

Lizards

Lizards (order Squamata, suborder Lacertilia) have moveable eyelids, an external ear opening, two well-developed lungs, and a fused lower jaw. Although legless forms do exist, in Maryland, all species of lizard, in three families, have legs (Table 8). The four species of **skink (family Scincidae)** are characterized by smooth, small, and flat scales that produce a smooth and shiny appearance. The northern coal skink (*Plestiodon a. anthracinus*) is state endangered.

There is one species of **spiny lizard (family Phrynosomatidae)**, the eastern fence lizard, which is characterized by its rough, keeled overlapping scales that project backwards. Finally, there is one species of **whiptail (family Teiidae)**, the eastern six-lined racerunner, that is characterized by large rectangular scales and large keels on the tail that are rough to the touch.

Table 8. Scale and body type characteristics of Maryland’s lizards.

1.	Keeled (rough scales) with backwards-facing projections & “iguana-like” appearance → Eastern fence lizard
2.	Granular scales overall but enlarged ventral scales & 6 longitudinal → Eastern Six-lined Racerunner
3.	Smooth, flat scales and a shiny appearance → Skinks (family Scincidae)
a.	Primarily brown with dark striping on each side of body → Little Brown Skink or Northern Coal Skink
i.	Coastal Plain; diminutive stature → Little Brown Skink
ii.	Far western MD; Broad dark stripe w/four light stripes extending to tail; → Northern Coal Skink
b.	Larger skink with varying presence of 5 longitudinal dorsal stripes, red on head, or dark with blue tails (juveniles) → See Figure 6 and Table 9

Eastern fence lizard (*Sceloporus undulatus*), common five-lined skink (*Plestiodon fasciatus*), and broad-headed skink (*P. laticeps*) are the only species known to the Piedmont. Although the eastern fence lizard is quite distinctive, distinguishing the two species of skinks is problematic. Male broad-headed skinks (*P. laticeps*) can grow to be roughly one foot total length and develop broad, strong jaws upon reaching sexual maturity. Otherwise, *P. laticeps* and *P. fasciatus* are very difficult to distinguish without careful examination of facial scales (Fig. 6, Table 9).

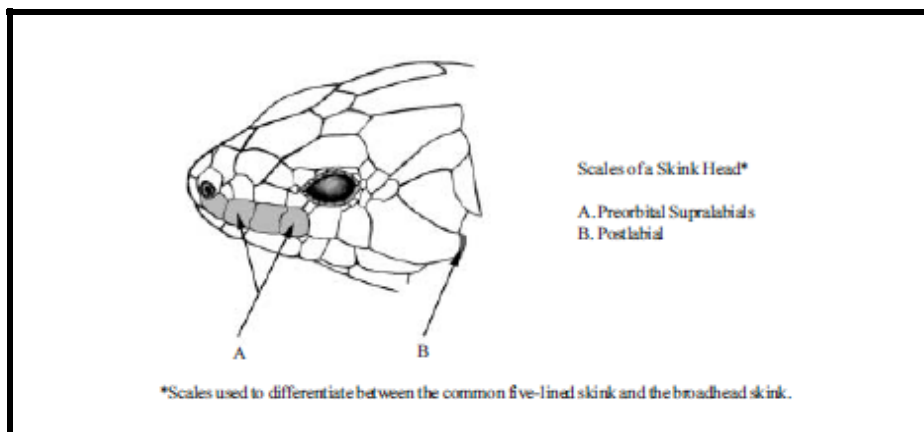
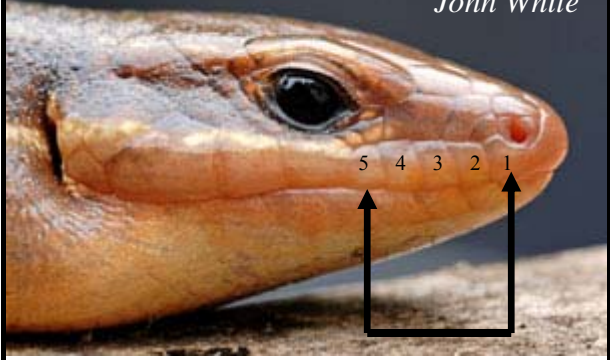



Figure 6. Scales used to differentiate between *P. fasciatus* and *P. laticeps*. (Stranko et al. 2010)

Table 9. Comparison of *P. fasciatus* and *P. laticeps*.

Scale Counts	Common five-lined (<i>P. fasciatus</i>)	Broad-headed (<i>P. laticeps</i>)	Illustration
Preorbital Supralabials	4	5*	 <p style="text-align: right;"><i>John White</i></p> <p>Preorbital supralabial count of Broad-headed skink (<i>P. laticeps</i>). Photo by John White**</p>
Post labial	2	0 enlarged	 <p style="text-align: right;"><i>George Jett</i></p> <p><i>P. fasciatus</i> postlabial scale count. Photo by Georae Jett.</p>

* Need to count on both sides of the head.

** From "Discover Maryland's Herps" /www.dnr.state.md.us/wildlife/Plants_Wildlife/herps/Squamata/Broad-headedSkink.asp

The possibility also exists for southeastern five-lined skink (*Plestiodon inexpectatus*) to occur in Maryland, although, it has only been historically reported from Cove Point, Maryland (Stranko et al. 2010), which would be the northernmost extent of its known range. The mid ventral row of scales on the tail of *P. inexpectatus* are about the same size as the other scales on the tail. The dorsal patterning is also subtly different from *P. fasciatus* – a dorsolateral light stripe is found on scale rows four and five (counting from the dorsal midline).

Turtles

Turtles (order Testudines) are reptiles with a shell that covers at least part of the dorsum and venter. There are five families and 19 species of turtles native to Maryland, including sea turtles. The northern map turtle (*Graptemys geographica*) is listed as state endangered, and the bog turtle (*Glyptemys mühlenbergii*) is a federally threatened species. One species, red-eared slider (*Trachemys scripta elegans*), is an introduced species that is now well-established.

Species can be identified by the shape, patterning, and scute characteristics of the shell (Fig.7). The **carapace** is the dorsal portion of the shell and the **plastron** is the relatively-flat ventral portion.

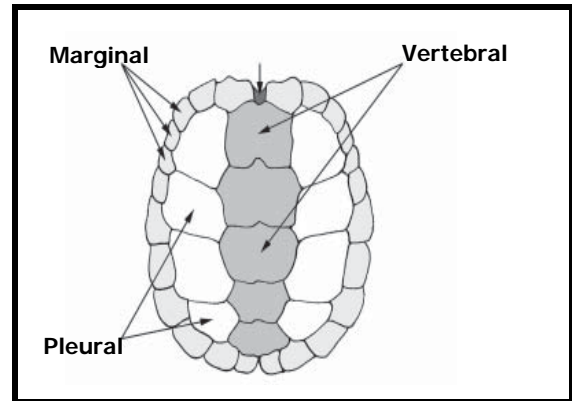


Figure 7. Scutes of a turtle carapace.
(Stranko et al. 2010)

Turtles fill a variety of ecological niches. Some, like the eastern box turtle, are primarily terrestrial, while others, like sea turtles, spend nearly their entire lives in water with the exception of coming ashore to lay eggs. Likewise, sea turtles are found in saltwater, while the majority of other species are found in freshwater habitats. The diamond-backed terrapin and eastern snapping turtle can be found in brackish water. While some turtles can occupy nearly any body of water or wetland, some, like the bog turtle have very specific habitat requirements.

There is primarily freshwater in the Piedmont, therefore only freshwater-dwelling species will be discussed. Three families of turtles are found in the Piedmont: 1) snapping turtles (Chelydidae), 2) box and water turtles (Emydidae), and 3) musk and mud turtles (Kinosternidae). It is unlikely that the eastern snapping turtle (*Chelydra serpentina serpentina*) would be confused with any other species. It has a long, muscular, saw-toothed tail, and a well armored carapace. It has a large head with powerful jaws and is able to cause serious injury. While the hatchlings are the size of a small cookie, the adults can grow to almost the size of a round, 30-gallon garbage can lid. Unfortunately, their sometimes nasty disposition and desirability as food has caused a decline in this species.

Multiple species of turtles can often be viewed basking communally on the same surface. Table 10 compares the species four Piedmont species that are most frequently found together. One of these species, the painted turtle (*Chrysemys picta*), has two subspecies that can occur in the Piedmont (Table 11).

The two species of musk and mud turtles (family Kinosternidae) look superficially similar. They share an undivided gular scute, but can be distinguished by examining a number of features (Table 12).

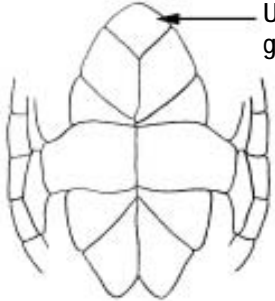
Table 10. Comparison of sometimes confused turtle species in Piedmont Maryland.

Painted Turtle (<i>Chrysemys picta</i> ; 2 subspecies)	Red-eared Slider (<i>Trachemys scripta elegans</i>)
<ul style="list-style-type: none"> - Yellow, elongated blotches behind eyes - Scutes bordered by yellow (sometimes reddish) - Red markings on marginal scutes - Plastron typically yellow - Shell has flattened appearance 	<ul style="list-style-type: none"> - Prominent red or yellow patch on side of head (ear area) - Head stripes form arrowhead - Plastron yellow w/central dark blotch (or several) - Carapace striped and serrated on posterior margin
Spotted Turtle (<i>Clemmys guttata</i>)	Northern Red-bellied Turtle (<i>Pseudemys rubriventris</i>)
<ul style="list-style-type: none"> - Small-bodied (<5 in.) - Small yellow-to-orange spots cover carapace (or may be absent) - The plastron (lower shell) is yellow, cream, or orangish with large black blotches - Limbs and head will have some degree of orange, red, or yellow spotting and blotching 	<ul style="list-style-type: none"> - Upper jaw has distinct cusp - Prominent stripe on top of head that joins thin lines above the eyes at the snout - Red, orange, or coral plastron - Dark pattern along seams of the plastron that fades with age. - Head and plastron markings fade and old adults may appear primarily black

Table 11. Distinguishing features between two subspecies of painted turtle (*Chrysemys picta*).

Feature	Eastern (<i>C. p. picta</i>)	Midland (<i>C. p. marginata</i>)
Vertebral & pleural scute arrangement	Straight row	Alternate
Plastron	Immaculate (w/o dark blotches)	Dark blotch (variable in size, shape, intensity)

Table 12. Shared and distinguishing features between stinkpot (*Sternotherus odoratus*) and eastern mud turtles (*Kinosternon s. subrubrum*)

Shared feature	Distinguishing Features	Stinkpot (<i>Sternotherus odoratus</i>)	Eastern Mud Turtle (<i>Kinosternon s. subrubrum</i>)
 <p>Undivided gular scute</p> <p>From Stranko et al. 2010</p>	Plastron hinge	Single	Double
	Plastron size	Small relative to size of turtle and does not cover appendages	Large & hinged, covering most of body
	Vertebral Scutes	Squarish/Rectangular	Triangular
	Head Pattern	2 distinct light stripes on side of head from eye to tip of snout	Spotted, mottled or streaked with yellow; yellow does not go from eye to tip of snout
	Barbels	Present on chin & throat	Absent

Snakes

Snakes (order Squamata, suborder Serpentes) are limbless reptiles with scaled and elongated bodies. All snakes lack external ear openings and eyelids, and have long-forked tongues. There are 29 different varieties of snakes in two families found in Maryland. Two, the rainbow snake (*Farancia e. erythrogramma*) and the mountain earthsnake (*Virginia valeriae pulchra*) are state endangered. There are three state watchlist species: red-bellied watersnake (*Nerodia e. erythrogaster*), northern scarletsnake (*Cemophora coccinea copei*) and timber rattlesnake (*Crotalus horridus*).

The timber rattlesnake is one of two venomous snake species in Maryland; the other is the copperhead (*Agkistrodon contortrix*). They are in the viper family (Viperidae) and there are several morphological characteristics that can be used to easily identify these two species from other nonvenomous species (Figure 8). The remaining species are in the family Colubridae, which is the largest snake family in the world. There are venomous and nonvenomous species of Colubrids, but only nonvenomous species are found in Maryland.

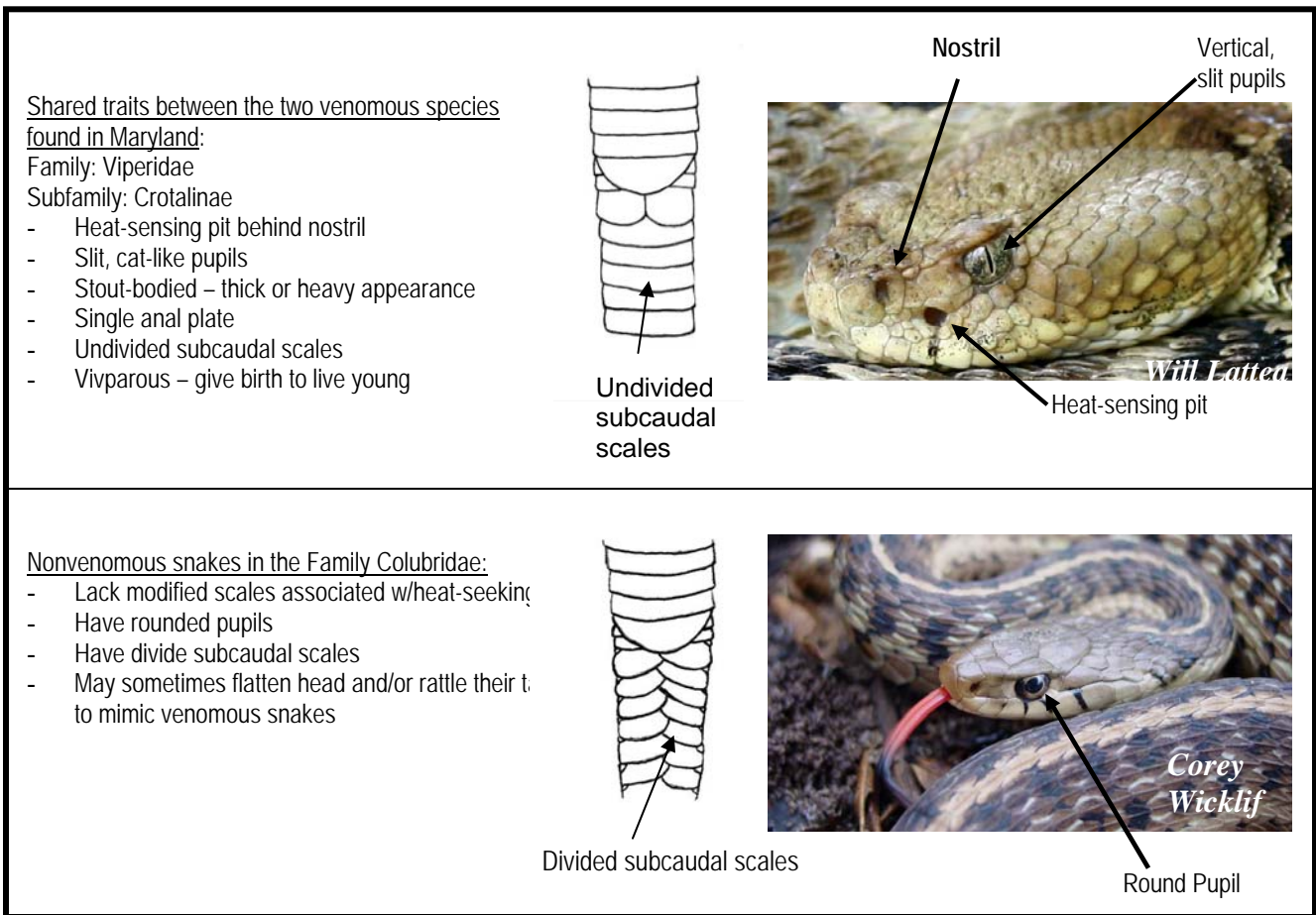


Figure 8. Key features of Maryland’s venomous vs. nonvenomous snakes.

Generally, snakes are adapted for hunting their prey and are well-camouflaged. Copperheads and rattlesnakes are exemplary examples of ambush predators. The northern rough greensnake has a vine-like appearance and keeled scales that assist in climbing and foraging for spiders. Eastern ratsnakes have a bread loaf-shaped body and weakly keeled scales that assist with climbing in pursuit of bird nests and rodents. Still other snakes are drab in color and small in stature, allowing for preying upon soft-bodied insects. Some species of snakes, such as the northern black racer, eastern gartersnake, and common ribbonsnake, frequently stalk amphibians in wetlands, while others are nearly fully aquatic. Northern watersnakes hunt a variety of aquatic prey while others, such as the queen snake and rainbow snake are specialized hunters (preying upon soft-shelled crayfish and American eels, respectively).

A few of Maryland’s snake species are conspicuously colored. These species have evolved a form of mimicry in which they resemble the venomous coral snake. The eastern coral snake is found primarily in the southeastern United States; there is also a Texas subspecies. Body shape and stature, markings on the head, and dorsal and ventral patterning are the most important considerations for distinguishing Maryland Colubrids.

Snakes are among the most misunderstood of all herpetofauna. Many harmless species of snakes are often mistaken for venomous species and killed, impart to their appearance as well as behavior. Many species of snakes coil up, flatten their heads and strike (or feign striking) when threatened. Some, such as the eastern ratsnake, will even rattle their tails to mimic rattlesnakes. Juvenile ratsnakes, juvenile racers, northern watersnakes, red cornsnakes, eastern milksnakes, and eastern hog-nosed snakes are the most frequent victims. It is illegal in Maryland to intentionally kill a snake without a special license.

Since many species can be easily-confused, this document breaks them out into general groupings. Table 13 presents “black snakes”, Table 14 presents “red-brown and blotchy snakes”, Table 15 presents coral snake mimics, Table 16 compares “small, brown, and drab snakes”, and Table 17 presents “striped snakes”.

Table 13. “Black snakes”: Eastern ratsnake versus Northern Black Racer

Feature	Eastern Ratsnake <i>(Pantherophis alleghaniensis)</i>	Northern Black Racer <i>(Constrictor coluber)</i>
Dorsum coloration	Black, faint trace of spotting pattern	Dorsum plain black (no pattern in adult)
Venter coloration	Varying amounts of white and a hint of a checkerboard pattern	Venter dark gray, sometimes black or steely blue. Underside of head & neck white.
Eye characteristic	Smaller, lighter-colored eye	Large, dark eye
Scales	Weakly keeled	Smooth
Body form	Shaped like a bread loaf in cross-section	Body round in cross-section
Body function	Good climbers!	Very visual predators that move quickly!
Juveniles	Postocular stripe that stops at mouth & is entirely dark (resembles a mask or bandana); patterning continues onto posterior half of tail	Large eyes; no dorsal patterning on the posterior half of tail
Others to watch out for...		
- The eastern kingsnake (<i>Lampropeltis g. gutela</i>) is black, but has white or cream-colored crossbands that create a chain-like pattern.		
- There are also melanistic phases of timber rattlesnake and eastern hog-nosed snake.		

Table 14. “Red-brown and blotchy snakes”: Eastern milksnake vs. Red cornsnake vs. Mole kingsnake vs. Northern watersnake

Eastern Milksnake (<i>Lampropeltis triangulum triangulum</i>)	Red Cornsnake (<i>Pantherophis guttatus</i>)
<ul style="list-style-type: none"> - A, Y, U, or V-shaped light patch on nape - 3 or 5 rows of reddish-brown, black-bordered blotches down the body - Overall strongly blotched with 32+ blotches on body - Venter has a black and white checkerboard pattern - Smooth scales 	<ul style="list-style-type: none"> - Arrowhead pattern on head (dorsal view) - Postocular stripe extends below the mouth (<i>P. alleghaniensis</i> (juvenile) has stripe that ends at mouth) - Dorsal background color is gray, brown, orangish brown (wild populations) - Rectangular red to reddish brown blotches that are typically bordered w/black. There are smaller more irregular blotches on the sides. - Venter black and white checkered pattern - Body shaped like mailbox or breadloaf in cross section - Weakly keeled scales
Mole Kingsnake (<i>Lampropeltis calligaster rhombomaculata</i>)	Northern Watersnake (<i>Nerodia sipeidon sipeidon</i>)
<ul style="list-style-type: none"> - Small head that is not distinct from neck - Dorsal background light to dark brown which may have yellow or greenish hues on sides - Up to 71 well-separated reddish-brown, dark-edged spots down back (or may be lacking altogether) - Smooth scales 	<ul style="list-style-type: none"> - Extremely variable coloration and patterning - Dorsum of the body and tail have a variable number of complete, closely-spaced, dark crossbands and blotches; blotches occasionally touch - Venter w/2 irregular rows of half moons - Strongly keeled scales - Typically aggressive when threatened

Table 15. “What’s small, black, & white/yellow, & red all over?”: Northern scarletsnake vs. Coastal Plain milksnake vs. Scarlet kingsnake vs. Rainbowsnake

Northern Scarletsnake (<i>Cemophora coccinea copei</i>)	Coastal Plain Milksnake (<i>Lampropeltis triangulum temporalis</i>)
<ul style="list-style-type: none"> - Upper jaw protrudes noticeably beyond the lower jaw - Bold red, black-bordered blotches on a yellow, cream, or gray background - Distinct black band lies across the head, behind the eyes - Venter white or yellowish and unpatterned 	<ul style="list-style-type: none"> - 31 or fewer blotches that appear as bands when viewed from above - Full or partial neck collar - Lack patterning at nape when compared to <i>L.t. triangulum</i>
Rainbowsnake (<i>Farncia e. erytrogramma</i>)	Scarlet kingsnake (<i>Lampropeltis t. elapsoides</i>)
<ul style="list-style-type: none"> - Longitudinal stripes on dorsum - Paired rows of small black spots on venter - Glossy and iridescent (like a Brazilian rainbow boa) - State endangered 	<ul style="list-style-type: none"> - Bands of yellow, black, and red - Black bands separate the other two colors - Red snout (coral snake has black snout/face) - * not confirmed in Maryland

Table 16. “Small and brown snakes”: Northern brownsnake vs. Northern red-bellied snake vs. Eastern wormsnake vs. Eastern smooth earthsnake vs. Mountain earthsnake

Northern brownsnake (<i>Storeria dekayi dekayi</i>)	Northern red-bellied snake (<i>Storeria occipitomaculata occipitomaculata</i>)
<ul style="list-style-type: none"> - Two parallel rows of blackish spots down the back - Dark downward streaks on the side of the head, behind the eye - Belly virtually unmarked - Juveniles have incomplete light ring around neck - Keeled scales - Throughout MD 	<ul style="list-style-type: none"> - Three pale/light-colored spots on the nape of the neck (do not match venter) - Belly is most often red, but can be orange, pale yellow, or even blue-black - Keeled scales - Throughout MD (spotty; rare on coastal plain)
Eastern Wormsnake (<i>Carphophis amoenus amoenus</i>)	Eastern Smooth Earthsnake (<i>Virginia valeria valeria</i>)
<ul style="list-style-type: none"> - Small, pointed head - Smooth & iridescent - Tail ends in short spine - Venter typically pink - Statewide w/exception of far Western Md 	<ul style="list-style-type: none"> - Tiny dark spots; not in parallel rows - Underside of head, body, and tail are plain white, grayish, or yellowish - No spine on tail - Scales smooth (except for faint keels on back above cloaca) - Piedmont and coastal plain (western shore) of MD
Mountain Earthsnake (<i>Virginia valeria pulchra</i>)	Other superficially similar species...
<ul style="list-style-type: none"> - Resembles <i>V.v. valeria</i> - Weakly keeled scales - Different scale row count (17 midbody & posteriorly : 15 anteriorly) - Far Western MD; Endangered 	<ul style="list-style-type: none"> - Northern ring-necked snakes are most often black with a complete ring that matches the yellow or orange belly. - Southern ring-necked snakes differ from the northern subspecies by having an incomplete/broken ring, black half-moons down the center of the venter, and small black spots on the chin and lips

Table 17. “Striped snakes”: Eastern gartersnake vs. Common ribbonsnake vs. Queen snake

Eastern Gartersnake (<i>Thamnophis sirtalis sirtalis</i>)	Common Ribbonsnake (<i>Thamnophis sauritus sauritus</i>)	Queen Snake (<i>Regina septemvittata</i>)
<ul style="list-style-type: none"> - Bold mid-dorsal/ longitudinal stripe - Pale lateral stripes - Two rows of dark spots alternating between stripes - Variable patterning - Stockier build than <i>T. s. sauritus</i> - Statewide and Common 	<ul style="list-style-type: none"> - Three bold cream, yellow, or greenish longitudinal stripes - Yellowish spot in front of each eye - Long tail (>1/3 Total Length) - Very slightly built - Statewide (but uncommon in Western MD) 	<ul style="list-style-type: none"> - Yellow stripe along lower side of body (at lower jaw level) - Striped belly (yellow w/brown (4)) - Stripes down the back (may be difficult to see) - Keeled scales - Most common in Piedmont and Western MD (some Northern Coastal Plain)

Literature Cited

Species names in accordance with:

Crother, B.I. (ed.). 2008. Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, pp. 1-84. SSAR Herpetological Circular 37.

Figures from:

1. Petranksa JW. 1998. Salamanders of the United States and Canada. Washington and London: Smithsonian Institution Press. 587 pp.
2. Stranko S, S Smith, L Erb, and D Limpert. 2010. A key to the reptiles and amphibians of Maryland. Produced by Maryland Department of Natural Resources, Chesapeake Bay and Watershed Programs, Monitoring and Non-tidal Assessment Division.
3. Photos as credited.

Recommended Reading

Gratitude to Scott A. Smith for his compilation; categorized and updated by Rachel Gauza.

Websites & Online Materials

- [AZA] Association of Zoos and Aquariums. Species list by state and territory. Available online: www.aza.org/states-and-territories
- Altig R, RW McDiarmid, KA Nichols, PC Ustach. Tadpoles of the United States and Canada: A Tutorial and Key. Available online: www.pwrc.usgs.gov/tadpole/
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- Towson University Department of Herpetology. Herpetofauna of Maryland Series. Available online: wwwnew.towson.edu/herpetology/index.htm
- [USGS] United States Geological Survey. National Amphibian Atlas (NAA). Available online: www.pwrc.usgs.gov:8080/mapserver/naa
- [VHS] Virginia Herpetological Society. Herpetofauna of Virginia Series. Available online: www.virginiaherpetologicalsociety.com

Frog & Toad Calls

In addition to some of the online guides above (i.e., Davidson College, eNature, MDDNR, VHS), recordings and/or practice quizzes are also available from the following:

- Cornell Lab of Ornithology. Voices of the night: The calls of the frogs and toads of eastern North America. Audio guide.
- Elliot L, C Gerhardt, and C Davidson. 2009. The frogs and toads of North America, a comprehensive guide to their identification, behavior and calls. Houghton Mifflin Harcourt, New York, NY. 343 pp + CD.
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Field Guides

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Local Public Participation in Scientific Research (PPSR) Programs for Herpetofauna

- FrogWatch USA™ - www.frogwatch.org or www.aza.org/frogwatch
- North American Amphibian Monitoring Program (NAAMP) - www.pwrc.usgs.gov/naamp/
- Maryland Amphibian and Reptile Atlas (MARA) - www.marylandnature.org/mara

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