If you are asked about anything that doesn't relate to lizards, if you are to be a lizard or lizard lover, you should just say that a lizard wouldn't know that. However, you should try your best to answer any questions that are asked. Almost all information needed for a lizard related question can be found in the document.

Below is a list of common lizards:

Calotes versicolor is an insectivore, and the male gets a bright red throat in the breeding season. It measures over 10 cm (3.9 in) in length snout-to-vent. Total length including the tail is up to 37 cm (14.5 in).[2] Two small groups of spines, perfectly separated from each other, above each tympanum. Dorsal crest moderately elevated on the neck and anterior part of the trunk, extending on to the root of the tail in large individuals, and gradually disappearing on the middle of the trunk in younger ones. No fold in front of the shoulder, but the scales behind the lower jaw are much smaller than the others; gular sac not developed. From thirty-nine to forty-three series of scales round the middle of the trunk. The hind foot (measured from the heel to the extremity of the fourth toe) is not much longer than the head in the adult, whilst it is considerably longer in the young. The coloration is very variable, sometimes uniform brownish or greyish-olive or yellowish. Generally broad brown bands across the back, interrupted by a yellowish lateral band. Black streaks radiate from the eye, and some of them are continued over the throat, running obliquely backwards, belly frequently with greyish longitudinal stripes, one along the median line being the most distinct; young and half-grown specimens have a dark, black-edged band across the inter-orbital region.

The ground-colour is generally a light brownish olive, but the lizard can change it to bright red, to black, and to a mixture of both. This change is sometimes confined to the head, at other times diffused over the whole body and tail. A common state in which it may be seen (as stated by T. C. Jerdon) is, seated on a hedge or bush, with the tail and limbs black, head and neck yellow picked out with red, and the rest of the body red. Jerdon and Blyth agree that these bright, changeable colours are peculiar to the male during the breeding-season, which falls in the months of May to early October.

Albert Guenther mentioned that Alexandre Henri Mouhot had collected in Siam one of those fine variations of colours, which, however, appear to be infinite. It has the usual cross streaks between the eyes and the radiating lines continent of India to China; it is very common in Sri Lanka, not extending into the temperate zone of the Himalayas. Sri Lankan specimens are generally somewhat larger; one of them measured 16 inches, the tail taking 11 inches. It is found in hedges and trees; it is known in Sri Lanka under the name of "Bloodsucker", a designation the origin of which cannot be satisfactorily traced; in the opinion of Kelaart, the name was given to it from the occasional reddish

hue of the throat and neck. "Roktochosha (রক্তচোষা)" is also a local name in the Bengali language, which also translates to "bloodsucker".

The female lays from five to sixteen soft oval eggs, about 5/8 of an inch long, in hollows of trees, or in holes in the soil which they have burrowed, afterward covering them up. The young appear in about eight or nine weeks. In a hot sunny day a solitary bloodsucker may be seen on a twig or on a wall, basking in the sun, with mouth wide open. After a shower of rain numbers of them are seen to come down on the ground and pick up the larva and small insects which fall from the trees during the showers.[3] Changeable lizards escape danger by darting to the nearest tree. If the predator comes even closer, they will scale to the side of the tree facing away from the predator and very swiftly dart up the tree. The predator looks behind the tree only to see that the lizard is up in the branches.

Yellow morph

During the breeding season, the male's head and shoulders turns bright orange to crimson and his throat black. Males also turn red-headed after a successful battle with rivals. Both males and females have a crest from the head to nearly the tail, hence their other common name, "crested tree lizard".

Unlike some other lizards, they do not drop their tails (autotomy), and their tails can be very long, stiff and pointy. Like other reptiles, they shed their skins. Like chameleons, changeable lizards can move each of their eyes in different directions.

Distribution

The native range of the species includes southeastern Iran, Afghanistan, Bangladesh, Bhutan, Cambodia, India (including the Andaman Islands), Indonesia (Sumatra), Malaysia (western), Maldives, Mauritius (Reunion, Rodrigues), Myanmar, Nepal, Pakistan, Philippines, Sri Lanka (Ceylon), Thailand, Vietnam (including Pulo Condore Island). It has been introduced to Brunei, Celebes, Oman, Seychelles, Singapore and

United States. The lizards were introduced to Singapore from Malaysia and Thailand in the 1980s. In Singapore, they are a threat to the native green-crested lizard.[4] The changeable lizard is relatively common and found in a wide range of habitats. They appear to adapt well to humans and are thus not endangered. They are commonly found among undergrowth, in open habitats as well as highly urban areas. However, in China people regularly kill them, as they are viewed as pests.

Diet

Changeable lizards eat mainly insects such as ants, beetles, dragonflies, and grasshoppers; as well as small vertebrates, including rodents and other lizards including agamids, geckos, and lizards.[5] They have teeth which are designed for gripping prey and not tearing, and thus they usually shake prey to stun it then swallow it whole. Sometimes, young, inexperienced changeable lizards may choke on prey that is too large.[*citation needed*] Changeable lizards also occasionally consume plant matter.[5]

Reproduction

Males become highly territorial during breeding season. They discourage intruding males by brightening their red heads and doing "push-ups". Each tries to attract a female by inflating his throat and drawing attention to his handsomely colored head. Oviparous; about 10—20 eggs are laid, buried in moist soil. The eggs are long, spindle-shaped and covered with a leathery skin. They hatch in about 6–7 weeks. They are able to breed at about 1 year old.

Eutropis multifasciata, commonly known as the **East Indian brown mabuya**, **many-lined sun skink**, **many-striped skink**, **common sun skink** or (ambiguously) as **golden skink**, is a species of skink that inhabits an extensive range from India and southern China to southern Indonesia.

Description

See Snake scales for terminology.

A many-striped skink in Bali, Indonesia

Eutropis multifasciata is a species of skink that often shows prominent coloured dorsal bands. They have a number of other distinctive features that allows this species to be distinguished from other species, particularly in the detail of the arrangement of their scales. Their snout is moderate to obtuse, and their lower eyelid is scaly. The nostril is positioned behind the vertical line of the suture between the rostral and first labial scale, and it has a postnasal scale. The anterior loreal scale is no deeper than the second, and is in contact with the first labial scale. The supranasal scales are largely in contact behind the rostral. The frontonasal scale is broader than it is long, and the prefrontal scales consistently form a median suture. The frontal scale is as long as or shorter than the frontoparietals and interparietal together, and makes contact with the second (and occasionally the first) supraocular. There are four supraoculars, the second of which is largest, and six supraciliaries, the first of which is largest. There are distinct fronto-parietal scales, larger than the interparietal, completely separating the parietals. There are a pair of nuchals and four labials anterior to the subocular, which is large and not narrower below. The ear-opening is roundish or oval and is as large as a lateral scale, or a little smaller. The dorsal scales are more or less distinctly tricarinate, with three or rarely five ridges. The nuchal and lateral scales are usually very feebly keeled or sometimes smooth. There are 30 to 34 scales around the middle of the body, and the dorsals are largest. The hind limb reaches the wrist or the elbow of the forelimb. The subdigital lamellae are smooth. The scales on the upper surface of the tibia are mostly tricarinate. The tail is 1.3 to 1.6 times the length of the head and body. They are brown or olive above; some specimens are uniformly coloured, while others have a large whitish/red patch on either side of their bodies. Their backs have small black spots, sometimes merging into longitudinal lines. The sides are usually dark brown, with whitish, black-edged ocelli. A well-defined light dorso-lateral band is very occasionally present, and the lower surfaces are yellowish or greenish white.[3]

Distribution

The species is widely present in southern Asia and occurs from India (Assam and the Nicobar islands) and southern China throughout continental Southeast Asia to southern Indonesia, with scattered records from New Guinea. It has been introduced to Australia and the USA.[1]

Invasive species

Taiwan

Eutropis multifasciata was first observed in Taiwan in 1992, in the southern Kaohsiung area.[4] It has since spread northward and established populations in the central-western and south-western lowlands.[5] The species has successfully adapted to Taiwan's agricultural areas, open forests, and human-disturbed areas.[5] It's high fecundity (reproductive ability) has enabled it to compete with other species for resources.[6] This is likely the cause of the decline in the populations of indigenous lizard species that occupy the same habitats as *Eutropis multifasciata*.[6] Since this species has a poor cold tolerance, its elevational distribution in Taiwan is restricted below 500 meters.[7] However, it is expected that in response to rising temperatures associated with climate change, this species will benefit from increased maximum activity time.[5] As a result, distribution of this species is expected to expand from lowland areas to higher elevations, especially if the landscape becomes more open.[5]

Lizard is the common name used for all squamate reptiles other than snakes (and to a lesser extent amphisbaenians), encompassing over 7,000 species,[1] ranging across all continents except Antarctica, as well as most oceanic island chains. The grouping is paraphyletic as some lizards are more closely related to snakes than they are to other lizards. Lizards range in size from chameleons and geckos a few centimeters long to the 3-meter-long Komodo dragon.

Most lizards are quadrupedal, running with a strong side-to-side motion. Some lineages (known as "legless lizards") have secondarily lost their legs, and have long snake-like bodies. Some lizards, such as the forest-dwelling *Draco*, are able to glide. They are often territorial, the males fighting off other males and signalling, often with bright colours, to attract mates and to intimidate rivals. Lizards are mainly carnivorous, often being sit-and-wait predators; many smaller species eat insects, while the Komodo eats mammals as big as water buffalo.

Lizards make use of a variety of antipredator adaptations, including venom, camouflage, reflex bleeding, and the ability to sacrifice and regrow their tails.

Anatomy

Largest and smallest

The adult length of species within the suborder ranges from a few centimeters for chameleons such as *Brookesia micra* and geckos such as *Sphaerodactylus ariasae*[2] to nearly 3 m (10 ft) in the case of the largest living varanid lizard, the Komodo dragon.[3] Most lizards are fairly small animals.

Distinguishing features

A young Mediterranean house gecko in the process of moulting.

Lizards typically have rounded torsos, elevated heads on short necks, four limbs and long tails, although some are legless.[4] Lizards and snakes share a movable quadrate bone, distinguishing them from the rhynchocephalians, which have more rigid diapsid skulls.[5] Some lizards such as chameleons have prehensile tails, assisting them in climbing among vegetation.[6]

As in other reptiles, the skin of lizards is covered in overlapping scales made of keratin. This provides protection from the environment and reduces water loss through evaporation. This adaptation enables lizards to thrive in some of the driest deserts on earth. The skin is tough and leathery, and is shed (sloughed) as the animal grows. Unlike snakes which shed the skin in a single piece, lizards slough their skin in several

pieces. The scales may be modified into spines for display or protection, and some species have bone osteoderms underneath the scales.[6][7]

Red tegu (*Tupinambis rufescens*) skull, showing teeth of differing types

The dentitions of lizards reflect their wide range of diets, including carnivorous, insectivorous, omnivorous, herbivorous, nectivorous, and molluscivorous. Species typically have uniform teeth suited to their diet, but several species have variable teeth, such as cutting teeth in the front of the jaws and crushing teeth in the rear. Most species are pleurodont, though agamids and chameleons are acrodont.[8][6]

The tongue can be extended outside the mouth, and is often long. In the beaded lizards, whiptails and monitor lizards, the tongue is forked and used mainly or exclusively to sense the environment, continually flicking out to sample the environment, and back to transfer molecules to the vomeronasal organ responsible for chemosensation, analogous to but different from smell or taste. In geckos, the tongue is used to lick the eyes clean: they have no eyelids. Chameleons have very long sticky tongues which can be extended rapidly to catch their insect prey.[6]

Three lineages, the geckos, anoles, and chameleons, have modified the scales under their toes to form adhesive pads, highly prominent in the first two groups. The pads are composed of millions of tiny setae (hair-like structures) which fit closely to the substrate to adhere using van der Waals forces; no liquid adhesive is needed.[9] In addition, the toes of chameleons are divided into two opposed groups on each foot (zygodactyly), enabling them to perch on branches as birds do.[a][6]

Physiology

Locomotion

Adhesive pads enable geckos to climb vertically.

Aside from legless lizards, most lizards are quadrupedal and move using gaits with alternating movement of the right and left limbs with substantial body bending. This body bending prevents significant respiration during movement, limiting their endurance, in a mechanism called Carrier's constraint. Several species can run bipedally,[10] and a few can prop themselves up on their hindlimbs and tail while stationary. Several small species such as those in the genus *Draco* can glide: some can attain a distance of 60 metres (200 feet), losing 10 metres (33 feet) in height.[11] Some species, like geckos and chameleons, adhere to vertical surfaces including glass and ceilings.[9] Some species, like the common basilisk, can run across water.[12]

Senses

Lizards make use of their senses of sight, touch, olfaction and hearing like other vertebrates. The balance of these varies with the habitat of different species; for instance, skinks that live largely covered by loose soil rely heavily on olfaction and touch, while geckos depend largely on acute vision for their ability to hunt and to evaluate the distance to their prey before striking. Monitor lizards have acute vision, hearing, and olfactory senses. Some lizards make unusual use of their sense organs: chameleons can steer their eyes in different directions, sometimes providing non-overlapping fields of view, such as forwards and backwards at once. Lizards lack external ears, having instead a circular opening in which the tympanic membrane (eardrum) can be seen. Many species rely on hearing for early warning of predators, and flee at the slightest sound.[13]

Nile monitor using its tongue for smell

As in snakes and many mammals, all lizards have a specialised olfactory system, the vomeronasal organ, used to detect pheromones. Monitor lizards transfer scent from the tip of their tongue to the organ; the tongue is used only for this information-gathering purpose, and is not involved in manipulating food.[14][13]

Skeleton of bearded dragon (pogona sp.) on display at the Museum of Osteology.

Some lizards, particularly iguanas, have retained a photosensory organ on the top of their heads called the parietal eye, a basal ("primitive") feature also present in the tuatara. This "eye" has only a rudimentary retina and lens and cannot form images, but is sensitive to changes in light and dark and can detect movement. This helps them detect predators stalking it from above.[15]

Venom

Some lizards including the Gila monster are venomous.

Further information: Evolution of snake venom

Until 2006 it was thought that the Gila monster and the Mexican beaded lizard were the only venomous lizards. However, several species of monitor lizards, including the Komodo dragon, produce powerful venom in their oral glands. Lace monitor venom, for instance, causes swift loss of consciousness and extensive bleeding through its pharmacological effects, both lowering blood pressure and preventing blood clotting. Nine classes of toxin known from snakes are produced by lizards. The range of actions provides the potential for new medicinal drugs based on lizard venom proteins.[16][17]

Genes associated with venom toxins have been found in the salivary glands of a wide range of lizards, including species traditionally thought of as non-venomous, such as iguanas and bearded dragons. This suggests that these genes evolved in the common ancestor of lizards and snakes, some 200 million years ago (forming a single clade, the Toxicofera).[16] However, most of these putative venom genes were "housekeeping genes" found in all cells and tissues, including skin and cloacal scent glands. The genes in question may thus be evolutionary precursors of venom genes.[18]

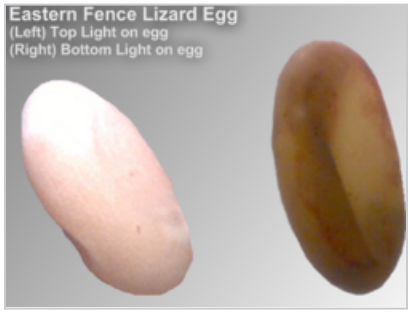
Respiration

Recent studies (2013 and 2014) on the lung anatomy of the savannah monitor and green iguana found them to have a unidirectional airflow system, which involves the air moving in a loop through the lungs when breathing. This was previously thought to only exist in the archosaurs (crocodilians and birds). This may be evidence that unidirectional airflow is an ancestral trait in diapsids.[19][20]

Reproduction and life cycle

Trachylepis maculilabris skinks mating

As with all amniotes, lizards rely on internal fertilisation and copulation involves the male inserting one of his hemipenes into the female's cloaca.[21] Female lizards also have hemiclitorises, a doubled clitoris. The majority of species are oviparous (egg laying). The female deposits the eggs in a protective structure like a nest or crevice or simply on the ground.[22] Depending on the species, clutch size can vary from 4–5 percent of the females body weight to 40–50 percent and clutches range from one or a few large eggs to dozens of small ones.[23]



Two pictures of an eastern fence lizard egg layered onto one image.

In most lizards, the eggs have leathery shells to allow for the exchange of water, although more arid-living species have calcified shells to retain water. Inside the eggs, the embryos use nutrients from the yolk. Parental care is uncommon and the female usually abandons the eggs after laying them. Brooding and protection of eggs do occur in some species. The female prairie skink uses respiratory water loss to maintain the humidity of the eggs which facilitates embryonic development. In lace monitors, the young hatch close to 300 days, and the female returns to help them escape the termite mound where the eggs were laid.[22]

Around 20 percent of lizard species reproduce via viviparity (live birth). This is particularly common in Anguimorphs. Viviparous species give birth to relatively developed young which look like miniature adults. Embryos are nourished via a

placenta-like structure.[24] A minority of lizards have parthenogenesis (reproduction from unfertilised eggs). These species consist of all females who reproduce asexually with no need for males. This is known to occur in various species of whiptail lizards.[25] Parthenogenesis was also recorded in species that normally reproduce sexually. A captive female Komodo dragon produced a clutch of eggs, despite being separated from males for over two years.[26]

Sex determination in lizards can be temperature-dependent. The temperature of the eggs' micro-environment can determine the sex of the hatched young: low temperature incubation produces more females while higher temperatures produce more males. However, some lizards have sex chromosomes and both male heterogamety (XY and XXY) and female heterogamety (ZW) occur.[25]

Aging

A significant component of aging in the painted dragon lizard *Ctenophorus pictus* is fading breeding colors.[27] By manipulating superoxide levels (using a superoxide dismutase mimetic) it was shown that this fading coloration is likely due to gradual loss with lizard age of an innate capacity for antioxidation due to increasing DNA damage.[27]

Behaviour

Diurnality and thermoregulation

The majority of lizard species are active during the day,[28] though some are active at night, notably geckos. As ectotherms, lizards have a limited ability to regulate their body temperature, and must seek out and bask in sunlight to gain enough heat to become fully active.[29] Thermoregulation behavior can be beneficial in the short term for lizards as it allows the ability to buffer environmental variation and endure climate warming.[30]

In high altitudes, the *Podarcis hispaniscus* responds to higher temperature with a darker dorsal coloration to prevent UV-radiation and background matching. Their thermoregulatory mechanisms also allow the lizard to maintain their ideal body temperature for optimal mobility.[31]

Territoriality

Fighting male sand lizards

Most social interactions among lizards are between breeding individuals.[28] Territoriality is common and is correlated with species that use sit-and-wait hunting strategies. Males establish and maintain territories that contain resources that attract females and which they defend from other males. Important resources include basking, feeding, and nesting sites as well as refuges from predators. The habitat of a species affects the structure of territories, for example, rock lizards have territories atop rocky outcrops.[32] Some species may aggregate in groups, enhancing vigilance and lessening the risk of predation for individuals, particularly for juveniles.[33] Agonistic behaviour typically occurs between sexually mature males over territory or mates and may involve displays, posturing, chasing, grappling and biting.[32]

Communication

Main article: Lizard communication

A green anole (*Anolis carolinensis*) signalling with its extended dewlap

Lizards signal both to attract mates and to intimidate rivals. Visual displays include body postures and inflation, push-ups, bright colours, mouth gapings and tail waggings. Male anoles and iguanas have dewlaps or skin flaps which come in various sizes, colours

and patterns and the expansion of the dewlap as well as head-bobs and body movements add to the visual signals.[34][6] Some species have deep blue dewlaps and communicate with ultraviolet signals.[28] Blue-tongued skinks will flash their tongues as a threat display.[35] Chameleons are known to change their complex colour patterns when communicating, particularly during agonistic encounters. They tend to show brighter colours when displaying aggression[36] and darker colours when they submit or "give up".[37]

Several gecko species are brightly coloured; some species tilt their bodies to display their coloration. In certain species, brightly coloured males turn dull when not in the presence of rivals or females. While it is usually males that display, in some species females also use such communication. In the bronze anole, head-bobs are a common form of communication among females, the speed and frequency varying with age and territorial status. Chemical cues or pheromones are also important in communication. Males typically direct signals at rivals, while females direct them at potential mates. Lizards may be able to recognise individuals of the same species by their scent.[34]

Tokay gecko mating call

Duration: 30 seconds.

0:30

Mating call of a male Tokay gecko

Problems playing this file? See media help.

Acoustic communication is less common in lizards. Hissing, a typical reptilian sound, is mostly produced by larger species as part of a threat display, accompanying gaping jaws. Some groups, particularly geckos, snake-lizards, and some iguanids, can produce more complex sounds and vocal apparatuses have independently evolved in different groups. These sounds are used for courtship, territorial defense and in distress, and include clicks, squeaks, barks and growls. The mating call of the male tokay gecko is heard as "tokay-tokay!".[35][34][38] Tactile communication involves individuals rubbing against each other, either in courtship or in aggression.[34] Some chameleon species communicate with one another by vibrating the substrate that they are standing on, such as a tree branch or leaf.[39]

Defence

Lizards are normally quick and agile to easily outrun attackers.[40]

Ecology

Lizard in tree. Many species are tree-dwelling

A lizard from Thar desert

Distribution and habitat

Lizards are found worldwide, excluding the far north and Antarctica, and some islands. They can be found in elevations from sea level to 5,000 m (16,000 ft). They prefer warmer, tropical climates but are adaptable and can live in all but the most extreme environments. Lizards also exploit a number of habitats; most primarily live on the ground, but others may live in rocks, on trees, underground and even in water.[40] The marine iguana is adapted for life in the sea.[6]

Diet

Western green lizard ambushes its grasshopper prey.

The majority of lizard species are predatory and the most common prey items are small, terrestrial invertebrates, particularly insects.[6][41] Many species are sit-and-wait predators though others may be more active foragers.[42] Chameleons prey on numerous insect species, such as beetles, grasshoppers and winged termites as well as spiders. They rely on persistence and ambush to capture these prey. An individual perches on a branch and stays perfectly still, with only its eyes moving. When an insect lands, the chameleon focuses its eyes on the target and slowly moves toward it before projecting its long sticky tongue which, when hauled back, brings the attached prey with it. Geckos feed on crickets, beetles, termites and moths.[6][41]

Termites are an important part of the diets of some species of Autarchoglossa, since, as social insects, they can be found in large numbers in one spot. Ants may form a prominent part of the diet of some lizards, particularly among the lacertas.[6][41] Horned lizards are also well known for specializing on ants. Due to their small size and indigestible chitin, ants must be consumed in large amounts, and ant-eating lizards have larger stomachs than even herbivorous ones.[43] Species of skink and alligator lizards eat snails and their power jaws and molar-like teeth are adapted for breaking the shells.[6][41]

Young Komodo dragon feeding on a water buffalo carcass

Marine iguana foraging under water at Galápagos Islands, Ecuador.

Larger species, such as monitor lizards, can feed on larger prey including fish, frogs, birds, mammals and other reptiles. Prey may be swallowed whole and torn into smaller pieces. Both bird and reptile eggs may also be consumed as well. Gila monsters and beaded lizards climb trees to reach both the eggs and young of birds. Despite being venomous, these species rely on their strong jaws to kill prey. Mammalian prey typically consists of rodents and leporids; the Komodo dragon can kill prey as large as water buffalo. Dragons are prolific scavengers, and a single decaying carcass can attract several from 2 km (1.2 mi) away. A 50 kg (110 lb) dragon is capable of consuming a 31 kg (68 lb) carcass in 17 minutes.[41]

Around 2 percent of lizard species, including many iguanids, are herbivores. Adults of these species eat plant parts like flowers, leaves, stems and fruit, while juveniles eat more insects. Plant parts can be hard to digest, and, as they get closer to adulthood, juvenile iguanas eat faeces from adults to acquire the microflora necessary for their transition to a plant-based diet. Perhaps the most herbivorous species is the marine iguana which dives 15 m (49 ft) to forage for algae, kelp and other marine plants. Some non-herbivorous species supplement their insect diet with fruit, which is easily digested.[6][41]

Antipredator adaptations

The frilled-neck lizard with fully extended frill. The frilled neck serves to make it look bigger than it actually is.

Main article: Antipredator adaptation

Lizards have a variety of antipredator adaptations, including running and climbing, venom, camouflage, tail autotomy, and reflex bleeding.

Camouflage

Lizards exploit a variety of different camouflage methods. Many lizards are disruptively patterned. In some species, such as Aegean wall lizards, individuals vary in colour, and select rocks which best match their own colour to minimise the risk of being detected by predators.[44] The Moorish gecko is able to change colour for camouflage: when a light-coloured gecko is placed on a dark surface, it darkens within an hour to match the environment.[45] The chameleons in general use their ability to change their coloration for signalling rather than camouflage, but some species such as Smith's dwarf chameleon do use active colour change for camouflage purposes.[46]

The flat-tail horned lizard's body is coloured like its desert background, and is flattened and fringed with white scales to minimise its shadow.[47]

Autotomy

A skink tail continuing to move after autotomy

Many lizards, including geckos and skinks, are capable of shedding their tails (autotomy). The detached tail, sometimes brilliantly coloured, continues to writhe after detaching, distracting the predator's attention from the fleeing prey. Lizards partially regenerate their tails over a period of weeks. Some 326 genes are involved in regenerating lizard tails.[48] The fish-scale gecko *Geckolepis megalepis* sheds patches of skin and scales if grabbed.[49]

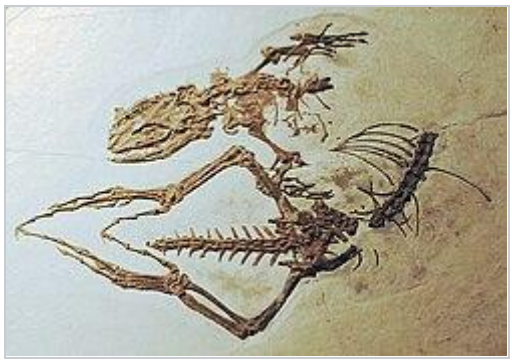
Escape, playing dead, reflex bleeding

Many lizards attempt to escape from danger by running to a place of safety;[50][b] for example, wall lizards can run up walls and hide in holes or cracks.[9] Horned lizards

adopt differing defences for specific predators. They may play dead to deceive a predator that has caught them; attempt to outrun the rattlesnake, which does not pursue prey; but stay still, relying on their cryptic coloration, for *Masticophis* whip snakes which can catch even swift prey. If caught, some species such as the greater short-horned lizard puff themselves up, making their bodies hard for a narrow-mouthed predator like a whip snake to swallow. Finally, horned lizards can squirt blood at cat and dog predators from a pouch beneath its eyes, to a distance of about two metres (6.6 feet); the blood tastes foul to these attackers.[52]

Evolution

Fossil history



Fossil lizard *Dalinghosaurus longidigitus*, Early Cretaceous, China

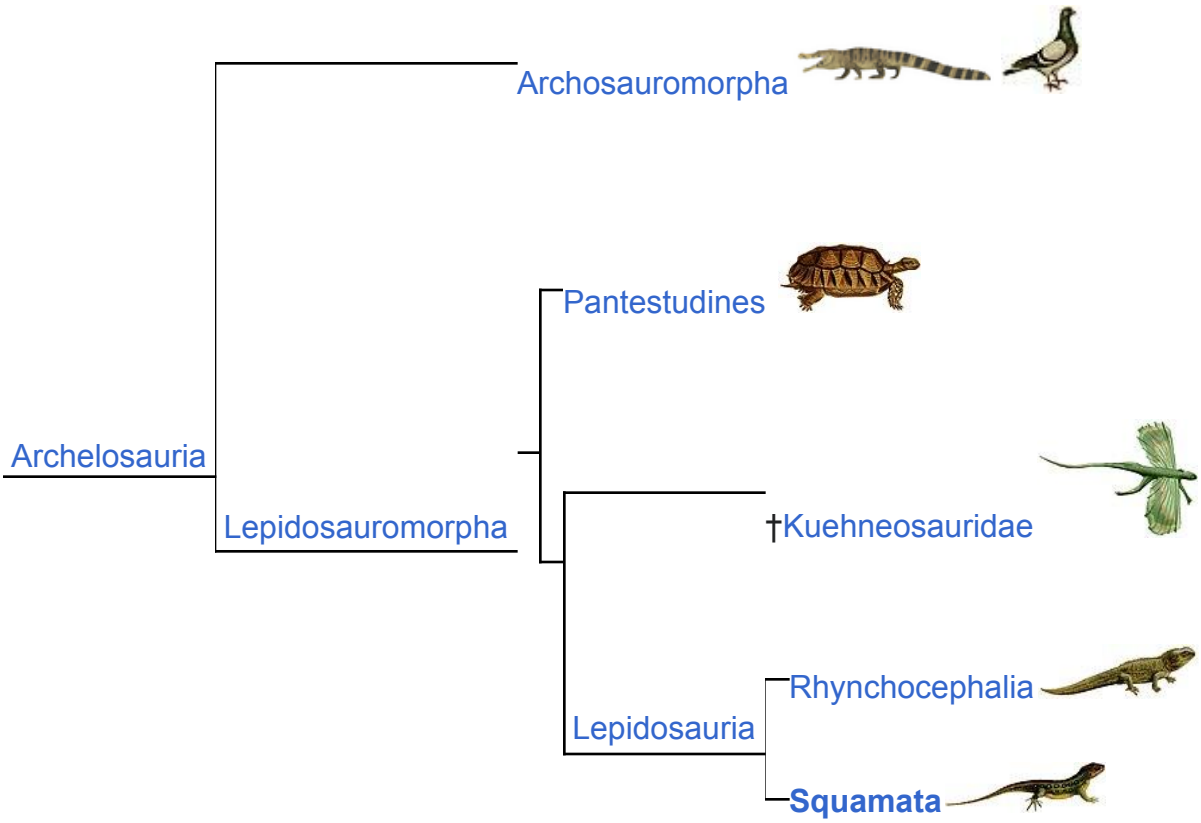
The closest living relatives of lizards are rhynchocephalians, a once diverse order of reptiles, of which is there is now only one living species, the tuatara of New Zealand. Some reptiles from the Early and Middle Triassic, like *Sophineta* and *Megachirella*, are suggested to be stem-group squamates, more closely related to modern lizards than rhynchocephalians, however, their position is disputed, with some studies recovering them as less closely related to squamates than rhynchocephalians are.[53] The oldest undisputed lizards date to the Middle Jurassic, from remains found In Europe, Asia and North Africa.[54] Lizard morphological and ecological diversity substantially increased over the course of the Cretaceous.[55] In the Palaeogene, lizard body sizes in North America peaked during the middle of the period.[56]

Mosasaurs likely evolved from an extinct group of aquatic lizards[57] known as aigialosaurs in the Early Cretaceous. Dolichosauridae is a family of Late Cretaceous aquatic varanoid lizards closely related to the mosasaurs.[58][59]

Phylogeny

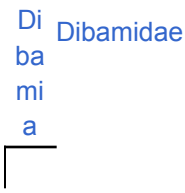
External

The position of the lizards and other Squamata among the reptiles was studied using fossil evidence by Rainer Schoch and Hans-Dieter Sues in 2015. Lizards form about 60% of the extant non-avian reptiles.[60]

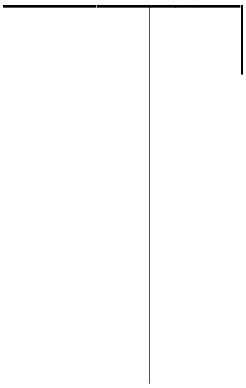


Internal

Both the snakes and the Amphisbaenia (worm lizards) are clades deep within the Squamata (the smallest clade that contains all the lizards), so "lizard" is paraphyletic.[61] The cladogram is based on genomic analysis by Wiens and colleagues in 2012 and 2016.[62][63] Excluded taxa are shown in upper case on the cladogram.


Dibamidae
Dibamia


Gekkota
Pygopodomorpha
Gekkomorpha
Gekkonoidea

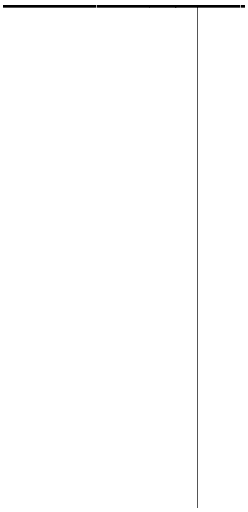


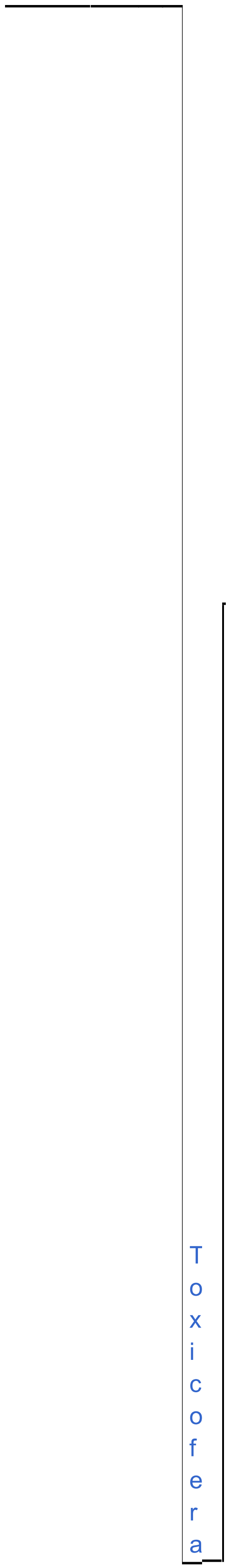
Scinciformata

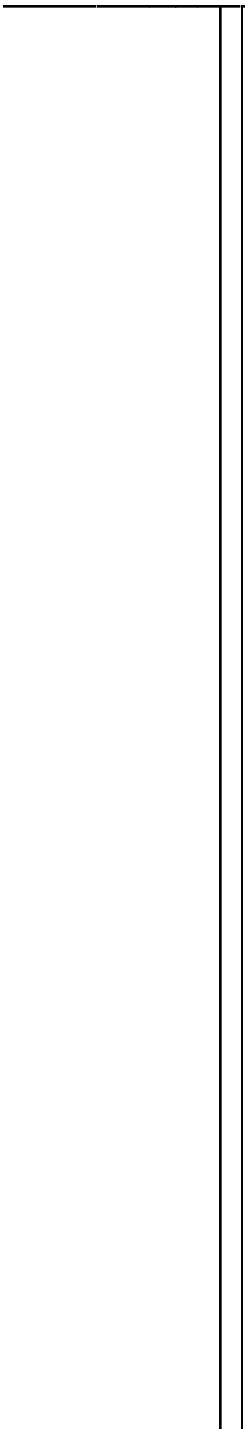
Scincomorpha

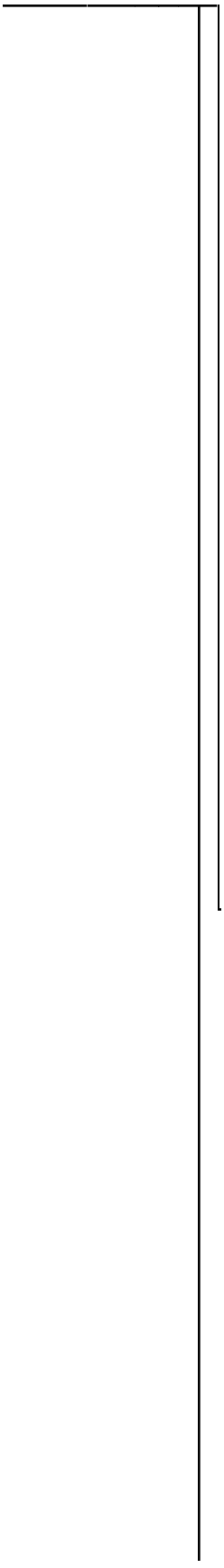
Cordylomorpha

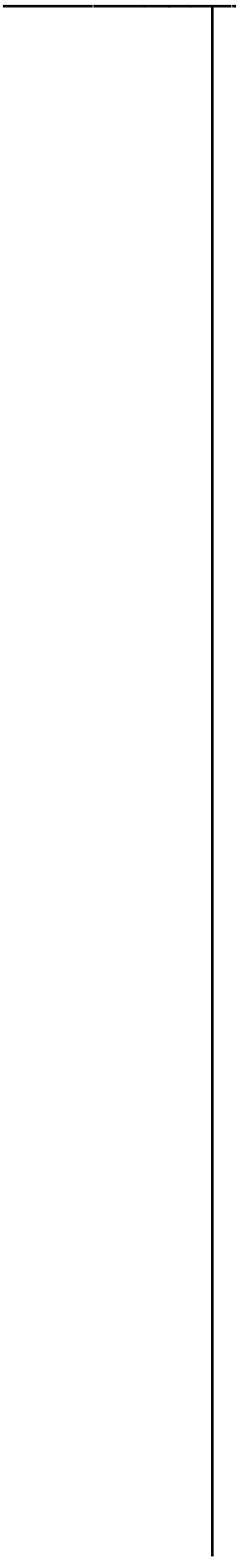

Lacertata
Teiformata
Lacertibaenia

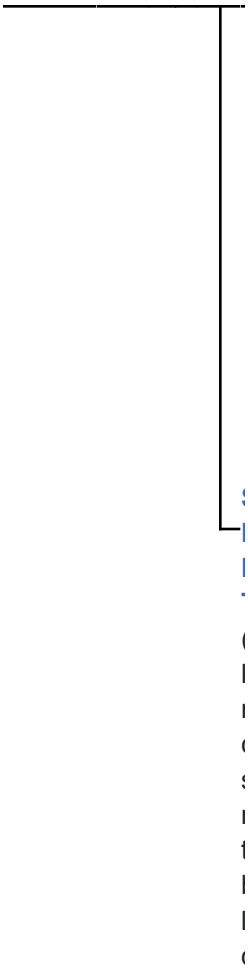



Toxicofera



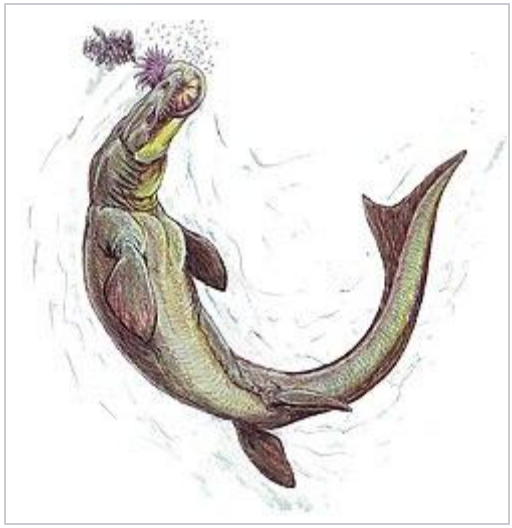






Taxonomy

Main article: List of Lacertilia families



Artistic restoration of a mosasaur, *Prognathodon*

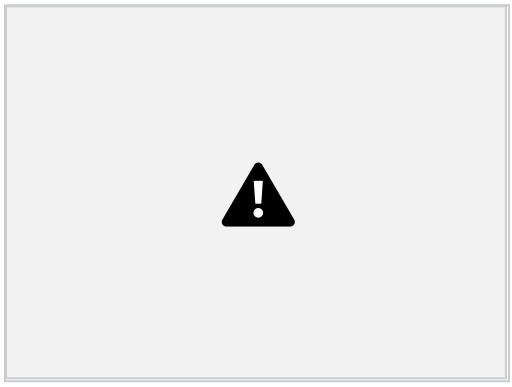
In the 13th century, lizards were recognized in Europe as part of a broad category of *reptiles* that consisted of a miscellany of egg-laying creatures, including "snakes, various fantastic monsters, […], assorted amphibians, and worms", as recorded by Vincent of Beauvais in his *Mirror of Nature*.[64] The seventeenth century saw changes in this loose description. The name Sauria was coined by James Macartney (1802);[65] it was the Latinisation of the French name *Sauriens*, coined by Alexandre Brongniart (1800) for an order of reptiles in the classification proposed by the author, containing lizards and crocodilians,[66] later discovered not to be each other's closest relatives. Later authors used the term "Sauria" in a more restricted sense, i.e. as a synonym of Lacertilia, a suborder of Squamata that includes all lizards but excludes snakes. This classification is rarely used today because Sauria so-defined is a paraphyletic group. It was defined as a clade by Jacques Gauthier, Arnold G. Kluge and Timothy Rowe (1988) as the group containing the most recent common ancestor of archosaurs and lepidosaurs (the groups containing crocodiles and lizards, as per Mcartney's original definition) and all its descendants.[67] A different definition was formulated by Michael deBraga and Olivier Rieppel (1997), who defined Sauria as the clade containing the most recent common ancestor of Choristodera, Archosauromorpha, Lepidosauromorpha and all their descendants.[68] However, these uses have not gained wide acceptance among specialists.

Suborder Lacertilia (Sauria) – (lizards)

- Family †Bavarisauridae
- Family †Eichstaettisauridae

- Infraorder Iguanomorpha
    - Family †Arretosauridae
    - Family †Euposauridae
    - Family Corytophanidae (casquehead lizards)
    - Family Iguanidae (iguanas and spinytail iguanas)
    - Family Phrynosomatidae (earless, spiny, tree, side-blotched and horned lizards)
    - Family Polychrotidae (anoles)
        - Family Leiosauridae (see Polychrotinae)
    - Family Tropiduridae (neotropical ground lizards)
        - Family Liolaemidae (see Tropidurinae)
        - Family Leiocephalidae (see Tropidurinae)
    - Family Crotaphytidae (collared and leopard lizards)
    - Family Opluridae (Madagascar iguanids)
    - Family Hoplocercidae (wood lizards, clubtails)
    - Family †Priscagamidae
    - Family †Isodontosauridae
    - Family Agamidae (agamas, frilled lizards)
    - Family Chamaeleonidae (chameleons)
- Infraorder Gekkota
    - Family Gekkonidae (geckos)
    - Family Pygopodidae (legless geckos)
    - Family Dibamidae (blind lizards)
- Infraorder Scincomorpha
    - Family †Paramacellodidae
    - Family †Slavoiidae
    - Family Scincidae (skinks)
    - Family Cordylidae (spinytail lizards)
    - Family Gerrhosauridae (plated lizards)
    - Family Xantusiidae (night lizards)
    - Family Lacertidae (wall lizards or true lizards)
    - Family †Mongolochamopidae
    - Family †Adamisauridae
    - Family Teiidae (tegus and whiptails)
    - Family Gymnophthalmidae (spectacled lizards)
- Infraorder Diploglossa
    - Family Anguidae (slowworms, glass lizards)
    - Family Anniellidae (American legless lizards)
    - Family Xenosauridae (knob-scaled lizards)
- Infraorder Platynota (Varanoidea)

- Family Varanidae (monitor lizards)
- Family Lanthanotidae (earless monitor lizards)
- Family Helodermatidae (Gila monsters and beaded lizards)
- Family †Mosasauridae (marine lizards)



The slowworms, *Anguis*, are among over twenty groups of lizards that have convergently evolved a legless body plan.[69]

Convergence

Lizards have frequently evolved convergently, with multiple groups independently developing similar morphology and ecological niches. *Anolis* ecomorphs have become a model system in evolutionary biology for studying convergence.[70] Limbs have been lost or reduced independently over two dozen times across lizard evolution, including in the Anniellidae, Anguidae, Cordylidae, Dibamidae, Gymnophthalmidae, Pygopodidae, and Scincidae; snakes are just the most famous and species-rich group of Squamata to have followed this path.[69]

Relationship with humans

Interactions and uses by humans

Most lizard species are harmless to humans. Only the largest lizard species, the Komodo dragon, which reaches 3.3 m (11 ft) in length and weighs up to 166 kg (366 lb), has been known to stalk, attack, and, on occasion, kill humans. An eight-year-old Indonesian boy died from blood loss after an attack in 2007.[71]

Green iguanas (*Iguana iguana*), are popular pets.

Numerous species of lizard are kept as pets, including bearded dragons,[72] iguanas, anoles,[73] and geckos (such as the popular leopard gecko).[72] Monitor lizards such as the savannah monitor and tegus such as the Argentine tegu and red tegu are also kept.

Green iguanas are eaten in Central America, where they are sometimes referred to as "chicken of the tree" after their habit of resting in trees and their supposedly chicken-like taste,[74] while spiny-tailed lizards are eaten in Africa. In North Africa, *Uromastyx* species are considered *dhaab* or 'fish of the desert' and eaten by nomadic tribes.[75]

Red tegu drinking water out of a dispenser.

Lizards such as the Gila monster produce toxins with medical applications. Gila toxin reduces plasma glucose; the substance is now synthesized for use in the anti-diabetes drug exenatide (Byetta).[17] Another toxin from Gila monster saliva has been studied for use as an anti-Alzheimer's drug.[76]

In culture

Lizards appear in myths and folktales around the world. In Australian Aboriginal mythology, Tarrotarro, the lizard god, split the human race into male and female, and gave people the ability to express themselves in art. A lizard king named Mo'o features in Hawaii and other cultures in Polynesia. In the Amazon, the lizard is the king of beasts, while among the Bantu of Africa, the god UNkulunkulu sent a chameleon to tell humans they would live forever, but the chameleon was held up, and another lizard brought a different message, that the time of humanity was limited.[77] A popular legend in Maharashtra tells the tale of how a common Indian monitor, with ropes attached, was used to scale the walls of the fort in the Battle of Sinhagad.[78]

Lizards in many cultures share the symbolism of snakes, especially as an emblem of resurrection. This may have derived from their regular molting. The motif of lizards on Christian candle holders probably alludes to the same symbolism. According to Jack Tresidder, in Egypt and the Classical world, they were beneficial emblems, linked with wisdom. In African, Aboriginal and Melanesian folklore they are linked to cultural heroes or ancestral figures.[79]

Notes

a. Chameleon forefeet have groups composed of 3 inner and 2 outer digits; the hindfeet have groups of 2 inner and 3 outer digits.[6]
b. The BBC's 2016 *Planet Earth II* showed a sequence of newly-hatched marine iguanas running to the sea past a waiting crowd of racer snakes. It was edited for dramatic effect but the sections were all genuine.[51]

"Water monitor" redirects here. For other uses, see Water monitor (disambiguation).

"Varanus salvator" redirects here; not to be confused with Varanus salvadorii.

Asian water monitor

V. s. salvator

Conservation status

Least Concern (IUCN 3.1)[1]

CITES Appendix II [1]

Scientific classification

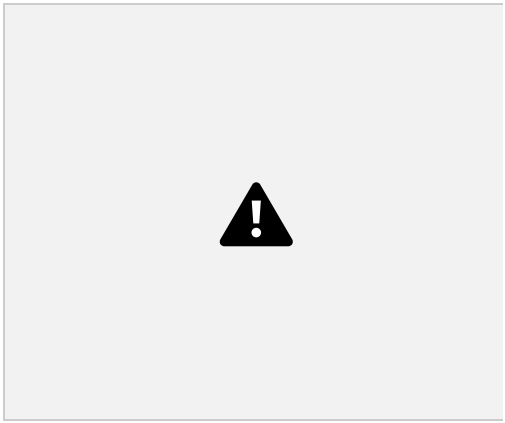
Kingdom: Animalia

Phylum:	Chordata
Class:	Reptilia
Order:	Squamata
Suborder:	Anguimorpha
Family:	Varanidae
Genus:	*Varanus*
Subgenus:	*Soterosaurus*
Species:	***V. salvator***

Binomial name

Varanus salvator

(Laurenti, 1768)



Range of the Asian water monitor

The **Asian water monitor** (***Varanus salvator***) is a large varanid lizard native to South and Southeast Asia. It is widely considered to be the second-largest lizard species, after the Komodo dragon. It is distributed from eastern and northeastern India and Bangladesh, the Andaman and Nicobar Islands, Sri Lanka, through southern China and Hainan Island in the east to Mainland Southeast Asia and the islands of Sumatra, Borneo, Java, Lombok, the Riau Archipelago, and Sulawesi. It is one of the most widespread monitor lizards.

The Asian water monitor has a natural affinity towards water, inhabiting the surroundings of lakes, rivers, ponds, swamps, and various riparian habitats, including sewers, city parks, and urban waterways. It is an excellent swimmer and hunts fish, frogs, invertebrates, water birds, and other aquatic and amphibious prey.

Due to its apparently large, stable population, it is currently listed as Least Concern on to the IUCN Red List.

Etymology

The generic name *Varanus* is derived from the Arabic *waral* (ورل), which translates as "monitor". The specific name is the Latin word for "saviour", denoting a possible religious connotation.[2]

Taxonomy

Stellio salvator was the scientific name used by Josephus Nicolaus Laurenti in 1768 when he described a water monitor specimen.[3] It was subordinated to the genus *Varanus* by Theodore Cantor in 1847.[4] There is a significant amount of taxonomic uncertainty within this species complex. Morphological analyses have begun to unravel this taxonomic uncertainty but molecular studies are needed to test and confirm the validity of certain groupings within this genus. Research initiatives such as these are very important to assess changes in conservation assessments.[1]

The Asian water monitor is a member of the subgenus *Soterosaurus*, as well as the eponymous *Varanus salvator* species complex, which comprises all *Soterosaurus* species other than the black rough-necked monitor.[5]

Subspecies

Subspecies	Common name	Distribution	Image
V. s. salvator	Sri Lanka	Restricted to Sri Lanka	

	nwatermonitor		
V. s. andamanensis	Andaman Islands water monitor	Andaman Islands and the southern Nicobar Islands;[6] the type locality is Port Blair.[4]	

V. s. bivittatus (Mertens 1959)	Two-striped water monitor	Indonesian islands of Java, Bali, Lombok, Sumbawa, Flores, Alor, Wetar and some neighbouring islands within the Sunda archipelago. The type locality is Java.[4]	
V. s. macromaculatus	South east Asian water	Bihar, West Bengal to Assam, Arunachal Pradesh, Manipur and Meghalaya through Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam to Malaysia, Singapore, Sumatra, Borneo, Bali, Bangka, Batam, Belitung, Bintan, Enggano, Matak, Nikoi. The type specimen was captured in Thailand.[7]	

	rmonitor		
V. s. ziegleri	Ziegler's water monitor	Obi Islands, North Maluku, Indonesia.	
V. s. celebensis	Sulawesi water	North Sulawesi Province of the island of Sulawesi, Indonesia.[*citation needed*]	

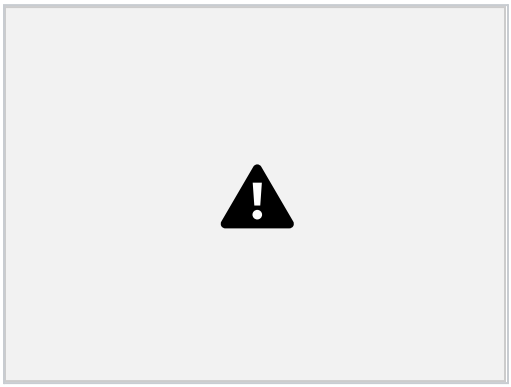
	monitor		

Nota bene: *Varanus cumingi*, *Varanus marmoratus*, and *Varanus nuchalis* were classified as subspecies until 2007, when they were elevated to full species.[7]

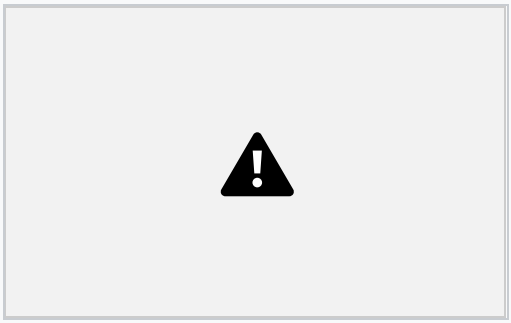
Melanistic Southeast Asian water monitor

The black water monitor from Thailand's Satun Province and Thai-Malaysian border area was formerly the subspecies *V. s. komaini*, but now is regarded as a junior synonym and melanistic population of *V. s. macromaculatus*.[7]

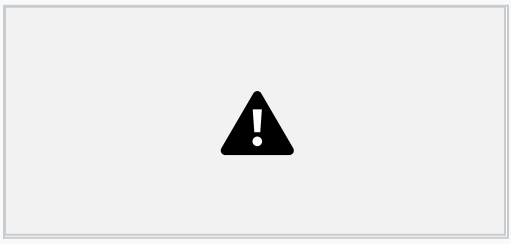
Description



Young water monitor



V. s. macromaculatus



Closeup showing split tongue

The Asian water monitor is dark brown or blackish with yellow spots on the underside that fade gradually with age. It has blackish bands with yellow edges extending back from each eye. Its body is muscular, with long, powerful, laterally compressed tail. Its scales are keeled; the ones on top of the head are larger than those on the back. Its neck is long and its snout is elongated. It has powerful jaws, serrated teeth and sharp claws.[8]

Adults rarely exceed 1.5–2 m (4 ft 11 in – 6 ft 7 in) in length, but the largest specimen on record from Sri Lanka measured 3.21 m (10.5 ft). A common mature weight is 19.5 kg (43 lb).[8] However, 80 males killed for the leather trade in Sumatra averaged only 3.42 kg (7.5 lb) and 56.6 cm (22.3 in) snout-to-vent and 142 cm (56 in) in total length; 42 females averaged 3.52 kg (7.8 lb) and 59 cm (23 in) snout–vent length and 149.6 cm (58.9 in) in total length.[8] Males are larger than females and attain breeding maturity at a length of 40 cm (16 in) and a weight of 1 kg (2.2 lb); and females at a length of 50 cm (20 in).[8]

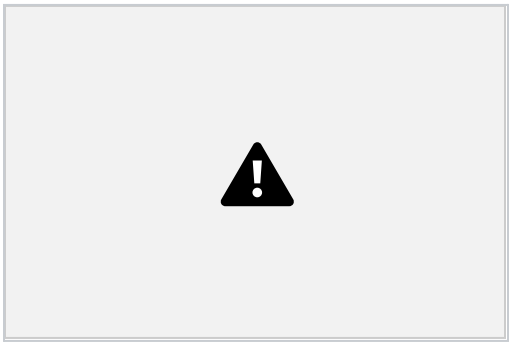
A series of adults weighed 7.6 kg (17 lb).[9] Mature individuals in northern Sumatra were estimated to have a mean estimated body mass of 20 kg (44 lb).[10] A sample of 55

Asian water monitors weighed 2–32 kg (4.4–70.5 lb).[11] The maximum weight of captive individuals is over 50 kg (110 lb).[12]

In captivity, Asian water monitors' life expectancy has been determined to be anywhere between 11 and 25 years depending on conditions, in the wild it is considerably shorter.[13][14]

The teeth are compressed, serrated (though irregularly) and recurved. Up to two replacement teeth lie behind each tooth position at a given time, and teeth are replaced every 59 days.[15]

Distribution and habitat



V. s. macromaculatus in a tree, in Sundarbans East Wildlife Sanctuary

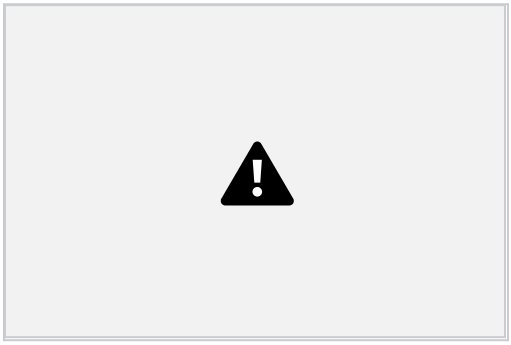
The Asian water monitor is widely distributed from India, Bangladesh, Sri Lanka, Myanmar and Thailand excluding the north and northeastern parts.,[16] Cambodia, Laos, Vietnam, the Chinese Guangxi and Hainan provinces, Malaysia, Singapore to the Sunda islands Sumatra, Java, Bali, Borneo and Sulawesi. It inhabits primarily lowland freshwater and brackish wetlands. It has been recorded up to an elevation of 1,800 m (5,900 ft).[1]

The Asian water monitor is semiaquatic and opportunistic; it inhabits a variety of natural habitats though predominantly resides in primary forests and mangrove swamps. It has been noted that it is not deterred from living in areas near human civilization. In fact, it has been known to adapt and thrive in agricultural areas as well as cities with canal systems, such as in Sri Lanka, where they are not hunted or persecuted. Habitats that

are considered to be most important are mangrove vegetation, swamps, wetlands, and elevations below 1,000 m (3,300 ft). It does not thrive in habitats with extensive loss of natural vegetation and aquatic resources.[1] It prefers cool areas in a habitat compared to other large lizards.[17]

A population of these monitors have become established as an invasive population in the southeastern parts of the USA.[18]

Behaviour and ecology



Water monitors robbing eggs from a nest. Illustration by Pierre Jacques Smit, from Richard Lydekker's *The Royal Natural History*, 1893–1896

Water monitors defend themselves using their tails, claws, and jaws. They are excellent swimmers, using the raised fin on their tails to steer through water. When encountering smaller prey items, the water monitor will subdue it in its jaws and proceed to violently thrash its neck, destroying the prey's organs and spine which leaves it dead or incapacitated. The lizard will then swallow it whole.

Asian water monitor hatchling

Juvenile Asian water monitor

Adult Asian water monitor

In dominantly aquatic habitats, their semiaquatic behavior is considered to provide a measure of safety from predators. This along with their versatile diet is said to contribute to their plasticity, or ecological adaptability.[1] When hunted by predators such as the king cobra (*Ophiophagus hannah*) they will climb trees using their powerful legs and claws. If this evasion is not enough to escape danger, they have also been known to jump from trees into streams for safety, a tactic similar to that of the green iguana (*Iguana iguana*).[13]

On the island of Flores, it is sympatric with the Komodo dragon.[19] Like the Komodo dragon, the water monitor often eats carrion,[2][20] or rotten flesh. By eating this decaying flesh, the Asian water monitor provides benefits to the ecosystem by removing infectious elements, cleaning the environment.[21]

While adults are terrestrial, juveniles are primarily arboreal.[22]

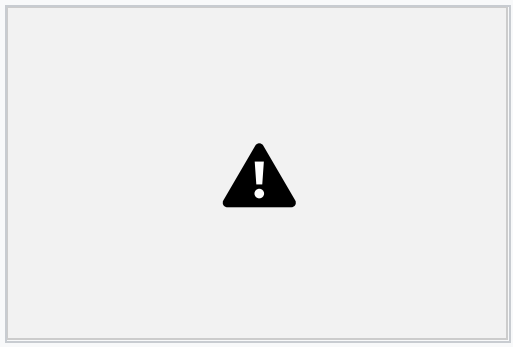
The first description of the water monitor and its behaviour in English literature was made in 1681 by Robert Knox, who observed it during his long confinement in the Kingdom of Kandy: "There is a Creature here called Kobberaguion, resembling an Alligator. The biggest may be five or six feet long, speckled black and white. He lives most upon the Land, but will take the water and dive under it: hath a long blue forked tongue like a sting, which he puts forth and hisseth and gapeth, but doth not bite nor sting, tho the appearance of him would scare those that knew not what he was. He is not afraid of people, but will lie gaping and hissing at them in the way, and will scarce stir out of it. He will come and eat Carrion with the Dogs and Jackals, and will not be scared away by them, but if they come near to bark or snap at him, with his tail, which is long like a whip, he will so slash them, that they will run away and howl."[23]

Reproduction

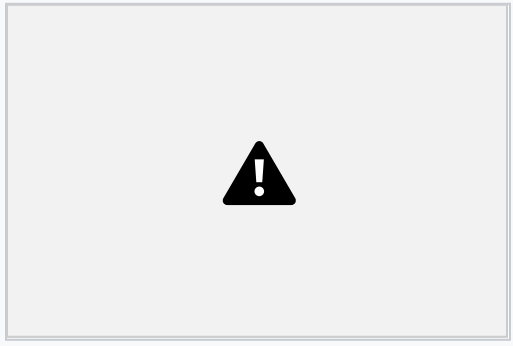
The Asian water monitor breeds between April and October. The females lay eggs about a month after mating in rotting logs or stumps. A clutch varies from 10 to 40 eggs with an incubation period of 6 to 7 months. When hatched, hatchlings are fully developed and independent. Once males and females reach a length of about 150 cm (59 in), respectively, they will become reproductively mature and able to breed.[*citation needed*]

Diet

Asian water monitor feeding on a beached stingray carcass



Asian water monitor eating a fish head



Asian water monitor at Kandy Lake (Bogambara lake), Sri Lanka. Possibly obese or pregnant, or both.

The Asian water monitor is carnivorous and consumes a wide range of prey. It eats fish, frogs, rodents, birds, crabs and snakes.[2] It also eats turtles, young crocodiles and crocodile eggs.[24]

Water monitors have been observed eating catfish in a fashion similar to a mammalian carnivore, tearing off chunks of meat with their sharp teeth while holding it with their front legs and then separating different parts of the fish for sequential consumption.[25] They feed on suckermouth catfish in Thailand, which helps manage their booming population since they are not eaten by the human population there.[26] In Java, they have also been recorded entering caves at night to hunt bats that have fallen from cave's ceiling.[27]

The diet of the Asian water monitor in an urban area in central Thailand includes fish, crabs, Malayan snail-eating turtles (*Malayemys macrocephala*), Chinese edible frogs (*Hoplobatrachus rugulosus*), birds, small rodents, domestic cats (*Felis catus*) and dogs

(*Canis familiaris*), chickens (*Gallus gallus domesticus*), food scraps and carcasses.[28] They have been known to feed on dead human bodies. On one hand, their presence can be helpful in locating a missing person in forensic investigations, on the other hand, they can inflict further injuries to the corpse, complicating ascertainment of the cause of death.[29] The stomachs of 20 adult Asian water monitors caught on Redang Island contained mostly human food waste, followed by turtle eggs and hatchlings, crabs and lizard eggs.[30] The monitor does not thrive in these areas, but manages to live in them. Studies are being conducted in order to understand how these creatures are able to do so in and around human civilization.[31]

In Sri Lanka, human corpses are often scavenged on by *V. s. salvator*, which can make it hard to identify the deceased, or to run autopsies. For instance, the feeding marks made by a monitor's sharp claws resemble wounds made by bladed weapons.[32] In one case, however, the presence of eight dead water monitors near the corpse of a partially scavenged 51-year-old man prompted investigation that revealed the possibility that the man died from poisoning after ingesting a bottle of Carbosulfan pesticide, which then poisoned the water monitors that scavenged on the body.[33]

Venom

V. salvator skull

Asian water monitor in Sri Lanka (top), Asian water monitor in Malaysia (bottom)

The possibility of venom in the genus *Varanus* is widely debated. Previously, venom was thought to be unique to Serpentes (snakes) and *Heloderma* (venomous lizards). The aftereffects of a *Varanus* bite were thought to be due to oral bacteria alone, but recent studies have shown venom glands are likely to be present in the mouths of several, if not all, of the species. The venom may be used as a defensive mechanism to fend off predators, to help digest food, to sustain oral hygiene, and possibly to help in capturing and killing prey.[34][35]

Predation

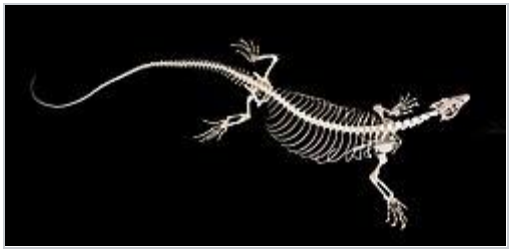
Adult water monitors have very few predators; with the exception of human hunters, only saltwater crocodiles (*Crocodylus porosus*) are known to target them.[36]

Interaction with humans

In 1999, a seven-year-old boy in Pahang, Malaysia, was bitten in the leg while bathing, requiring 18 stitches.[37]

The monitor was traditionally viewed negatively in Thailand with the lizard's name functioning as a swearword; public perception has become more positive in the 2020s.[38]

Threats



Skeleton

Monitor lizards are traded globally and are the most common type of lizard to be exported from Southeast Asia, with 8.1 million exported between 1998 and 2007 for the international leather market.[39] Today the majority of the harvesting of feral water monitors occurs in Southeast Asia, in Indonesia, and in peninsular Malaysia.[40] Efforts to breed or farm Water monitors in captivity on a commercial scale have not been widely successful. The Asian water monitor is one of the most exploited varanids; its skin is used for fashion accessories such as shoes, belts and handbags which are shipped globally, with as many as 1.5 million skins traded annually[1] and between 50,000 and 120,000 skins harvested from the wild in peninsular Malaysia.[40] Other uses include a perceived remedy for skin ailments and eczema,[41] novelty food in Indonesia,[42] and a perceived aphrodisiac,[43] and as pets.[44] In India, several tribal communities hunt these monitor lizards for their meat, fat and skin and the eggs are also harvested. They are often considered as pests and their populations are also threatened by habitat loss and habitat fragmentation.[45]

Conservation

Roadway crossing sign, Thailand

Young *V. s. macromaculatus*. Video clip

In Nepal, it is a protected species under the Wild Animals Protection Act of 2002. In Hong Kong, it is a protected species under Wild Animals Protection Ordinance Cap 170. In Malaysia, this species is one of the most common wild animals, with numbers comparable to the population of macaques there. Although many fall victim to humans via roadkill and animal cruelty, they still thrive in most states of Malaysia, especially in the shrubs of the east coast states such as Pahang and Terengganu as the regulations in Malaysian states differ based on wildlife management authorities.[46] In Thailand, all monitor lizards are protected species.[44] It is still common in large urban areas in Thailand and is frequently seen in Bangkok's canals and parks. Because of this, it is currently listed as Least Concern in the IUCN Red List. These classifications have been made on the basis that this species maintains a geographically wide distribution, can be found in a variety of habitats, adapts to habitats disturbed by humans, and is abundant in portions of its range despite large levels of harvesting.[1]

Loss of habitat and hunting has exterminated water monitors from most of mainland India. In other areas they survive despite being hunted, due in part to the fact that larger

ones, including large females that breed large numbers of eggs, have tough skins that are not desirable.[47]

In Sri Lanka, it is protected by local people who value its predation of "crabs that would otherwise undermine the banks of rice fields".[47] It is also protected as it eats venomous snakes.[48]

The species is listed in Appendix II of the Convention on International Trade in Endangered Species (CITES) meaning international trade (import/export) in specimens (including parts and derivatives) is regulated.[1]

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General conservation of reptiles

The table below lists the conservation statuses of the species in this taxon assessed under the Singapore Red List as published in the 2nd and 3rd editions of the Singapore Red Data Book (RDB2 and RDB3 respectively).

Taxonomy follows AviList v2025 and the information is accurate as of November 2025.

Note

You can find more information about these species in Flora & Fauna Web

Singapore Red List category classification (RDB2 and RDB3)

Family	Taxon Name	Common Name	RDB2	RDB3
Geomydidae	*Cuora couro*	Malayan Box Turtle	Not Listed	NT
Trionychidae	*Amyda cartilaginea*	Asian Softshell	EN	VU

Geoemydidae	*Cyclemys dentata*	Asian Leaf Turtle	CR	CR
Trionychidae	*Dogania suplana*	Malayan Softshell Turtle	CR	CR
Geoemydidae	*Heosemys spinosa*	Spiny Hill Turtle	VU	EN
Geoemydidae	*Notochelys platynota*	Malayan Flatshell Turtle	EN	CR
Cheloniidae	*Eretmochelys imbricata*	Hawksbill Turtle	CR	CR
Cheloniidae	*Chelonia mydas*	Green Sea Turtle	CR	CR
Crocodylidae	*Crocodylus porosus*	Estuarine Crocodile	CR	CR
Agamidae	*Aphaniotis fusca*	Earless Agamid	EN	EN
Agamidae	*Bronchocela cristatella*	Green Crested Lizard	Not Listed	LC
Agamidae	*Draco melanopogon*	Black-bearded Gliding Lizard	VU	VU
Agamidae	*Draco quinquefasciatus*	Five-banded Gliding Lizard	EN	EN
Agamidae	*Draco sumatranus*	Common Gliding Lizard	Not Listed	LC
Gekkonidae	*Aeluroscalabotes felinus*	Fox-faced Gecko	CR	CR
Gekkonidae	*Cnemaspis peninsularis*	Peninsular Rock Gecko	VU	VU
Gekkonidae	*Cyrtodactylus consobrinus*	Peter's Bent-toed Gecko	CR	CR

Gekkonidae	*Cyrtodactylus majulah*	Singapore Bent-toed Gecko	Not Listed	VU
Gekkonidae	*Cyrtodactylus pantiensis*	Panti Bent-toed Gecko	Not Listed	CR
Gekkonidae	*Cyrtodactylus semenanjungensis*	Peninsular Bent-toed Gecko	Not Listed	CR
Gekkonidae	*Cyrtodactylus quadrivirgatus*	Striped Bent-toed Gecko	VU	CR
Gekkonidae	*Gekko hulk*	Green-eyed Forest Gecko	CR	CR
Gekkonidae	*Hemidactylus frenatus*	Common House Gecko	Not Listed	LC
Gekkonidae	*Cosymbotus craspedotus*	Frilly Gecko	CR	CR
Gekkonidae	*Hemidactylus platyurus*	Flat-tailed Gecko	Not Listed	LC
Gekkonidae	*Gehyra multilata*	Four-clawed Gecko	Not Listed	LC
Gekkonidae	*Lepidodactylus lugubris*	Maritime Gecko	Not Listed	LC
Gekkonidae	*Gekko monarchus*	Spotted House Gecko	Not Listed	LC
Gekkonidae	*Hemiphyllodactylus typus*	Lowland Dwarf Gecko	VU	NT
Gekkonidae	*Gekko browni*	Flap-legged Gecko	CR	CR
Gekkonidae	*Gekko kuhli*	Kuhl's Gliding Gecko	CR	CR
Scincidae	*Dasia grisea*	Brown Tree Skink	EN	VU

Scincidae	*Dasia olivacea*	Olive Tree Skink	EN	CR
Scincidae	*Emoia atrocostata*	Mangrove Skink	EN	CR
Scincidae	*Eutropis multifasciatus*	Common Sun Skink	Not Listed	LC
Scincidae	*Eutrophis longicaudata*	Long-tailed Sun Skink	Not Listed	DD
Scincidae	*Eutropis rugifera*	Rough-scaled Sun Skink	EN	VU
Scincidae	*Lygosoma bowringii*	Supple Skink	Not Listed	LC
Scincidae	*Lygosoma siamense*	Thai Supple Skink	Not Listed	DD
Scincidae	*Lipinia vittigera*	Striped Tree Skink	EN	EN
Scincidae	*Tytthoscincus temasekensis*	Swamp Skink	CR	EN
Varanidae	*Varanus dumerili*	Dumeril's Monitor	Not Listed	CR
Varanidae	*Varanus nebulosus*	Clouded Monitor	Not Listed	LC
Varanidae	*Varanus salvator*	Malayan Water Monitor	Not Listed	LC
Acrochordidae	*Acrochordus granulatus*	Banded File Snake	Not Listed	NT
Typhlopidae	*Indotyphlops braminus*	Brahminy Blind Snake	Not Listed	LC
Typhlopidae	*Ramphotyphlops lineatus*	Lineated Blind Snake	Not Listed	CR

Typhlopidae	*Argyrophis muelleri*	White-bellied Blind Snake	CR	CR
Cylindrophidae	*Cylindrophis cf. ruffus*	Red-tailed Pipe Snake	CR	VU
Xenopeltidae	*Xenopeltis unicolor*	Sunbeam Snake	Not Listed	LC
Pythonidae	*Malayopython reticulatus*	Reticulated Python	Not Listed	LC
Colubridae	*Ahaetulla fasciolata*	Speckle-headed Whip Snake	CR	CR
Colubridae	*Ahaetulla mycterizans*	Big-eyed Whip Snake	CR	VU
Colubridae	*Ahaetulla prasina*	Oriental Whip Snake	Not Listed	LC
Colubridae	*Boiga cynodon*	Dog-toothed Cat Snake	EN	VU
Colubridae	*Boiga dendrophila*	Gold-ringed Cat Snake	VU	NT
Colubridae	*Boiga drapiezii*	White-spotted Cat Snake	Not Listed	CR
Colubridae	*Boiga jaspidea*	Jasper's Cat Snake	CR	CR
Colubridae	*Calamara schlegeli*	Pink-headed Reed Snake	VU	NT
Colubridae	*Calamaria lumbricoidea*	Variable Reed Snake	EN	EN
Colubridae	*Calamaria lovi gimletti*	Gimlet’s Reed Snake	Not Listed	EN
Colubridae	*Chrysopelea paradisi*	Paradise Tree Snake	Not Listed	LC

Colubridae	*Chrysopelea pelias*	Twin-barred Tree Snake	Not Listed	NT
Colubridae	*Coelognathus flavolineatus*	Malayan Racer	EN	LC
Colubridae	*Dendrelaphis caudolineatus*	Striped Bronzeback	Not Listed	LC
Colubridae	*Dendrelaphis haasi*	Haas' Bronzeback	Not Listed	CR
Colubridae	*Dendrelaphis formosus*	Elegant Bronzeback	EN	VU
Colubridae	*Dendrelaphis cyanochloris*	Blue Bronzeback	Not Listed	EN
Colubridae	*Dendrelaphis kopsteini*	Kopstein's Bronzeback	VU	NT
Colubridae	*Dendrelaphis pictus*	Painted Bronzeback	LC	LC
Colubridae	*Lycodon subannulatus*	Malayan Bridle Snake	EN	EN
Colubridae	*Dryophiops rubescens*	Keel-bellied Whip Snake	CR	EN
Colubridae	*Gonglyosoma baliodeirum*	Orange-bellied Ringneck	EN	EN
Colubridae	*Gonyosoma oxycephalum*	Red-tailed Racer	EN	VU
Colubridae	*Lycodon subcinctus*	Banded Wolf Snake	CR	CR
Colubridae	*Lycodon capucinus*	Common House Snake	Not Listed	LC
Colubridae	*Oligodon octolineatus*	Striped Kukri Snake	Not Listed	LC

Colubridae	*Oligodon purpurascens*	Brown Kukri Snake	CR	CR
Colubridae	*Oligodon signatus*	Barred Kukri Snake	CR	EN
Colubridae	*Pseudorabdion longiceps*	Dwarf Reed Snake	EN	NT
Colubridae	*Ptyas carinata*	Keeled Rat Snake	Not Listed	VU
Colubridae	*Ptyas fusca*	White-bellied Rat Snake	EN	VU
Colubridae	*Ptyas korros*	Indochinese Rat Snake	Not Listed	LC
Colubridae	*Sibynophis melanocephalus*	Black-headed Collared Snake	EN	VU
Colubridae	*Xenelaphis hexagonatus*	Malayan Brown Snake	EN	CR
Paretidae	*Asthenodipsas laevis*	Smooth Slug Snake	Not Listed	CR
Homalopsidae	*Cantoria violacea*	Cantor's Water Snake	CR	EN
Homalopsidae	*Cerberus scheneiderii*	Dog-faced Water Snake	Not Listed	LC
Homalopsidae	*Fordonia leucobalia*	Crab-eating Water Snake	EN	EN
Homalopsidae	*Gerarda prevostiana*	Gerard's Water Snake	EN	EN
Homalopsidae	*Homalopsis buccata*	Puff-faced Water Snake	VU	VU
Homalopsidae	*Phytolopsis punctata*	Blackwater Mud Snake	Not Listed	CR

Homalopsidae	*Raclitia indica*	Selangor Mud Snake	Not Listed	CR
Natricidae	*Rhabdophis rhodomelas*	Blue-necked Keelback	EN	VU
Natricidae	*Psammodynastes pictus*	Painted Mock Viper	CR	CR
Natricidae	*Xenochrophis maculatus*	Spotted Keelback	VU	VU
Natricidae	*Xenochrophis trianguligerus*	Triangle Keelback	CR	CR
Elapidae	*Bungarus fasciatus*	Banded Krait	EN	VU
Elapidae	*Calliophis bivirgatus*	Malayan Blue Coral Snake	VU	VU
Elapidae	*Calliophis intestinalis*	Malayan Banded Coral Snake	VU	NT
Elapidae	*Naja sumatrana*	Equatorial Spitting Cobra	LC	LC
Elapidae	*Ophiophagus hannah*	King Cobra	EN	VU
Elapidae	*Laticauda colubrina*	Yellow-lipped Sea Krait	EN	VU
Viperidae	*Trimeresurus purpureomaculatus*	Shore Pit Viper	EN	VU
Viperidae	*Tropidolaemus wagleri*	Wagler's Pit Viper	EN	NT
Elapidae	*Aipysurus eydouxii*	Marbled Sea Snake	Not Listed	EN
Elapidae	*Hydrophis hardwickii*	Hardwicke's Sea Snake	Not Listed	EN

Elapidae	*Hydrophis platurus*	Yellow-bellied Sea Snake	Not Listed	EN

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Common lizards and information

In the urban ecosystems of Singapore, small gecko species represent a conspicuous and ecologically significant group of reptiles. Among these, the **Common House Gecko (*Hemidactylus frenatus*)**, **Flat-tailed Gecko (*Hemidactylus platyurus*)**, **Spotted House Gecko (*Gekko monarchus*)**, and **Lowland Dwarf Gecko (*Hemiphyllodactylus typus*)** are the primary taxa commonly encountered in and around human structures or nearby vegetated spaces. These species exemplify adaptations to nocturnal insectivory, utility of artificial lighting in prey acquisition, and a suite of behavioural and morphological traits that enable their persistence in densely populated tropical landscapes.

This essay provides a comprehensive review of the morphology, behaviour, dietary ecology, reproductive strategies, and urban ecological roles of these geckos. The document examines patterns of nocturnality, territoriality, predator-prey dynamics, and life history traits, providing an integrated view of their biology relevant to students, researchers, and naturalists.

Common House Gecko (*Hemidactylus frenatus*)

Morphological Characteristics and Adaptations

The Common House Gecko, *Hemidactylus frenatus*, is among the most abundant lizard species associated with human habitations in Singapore. It typically measures between 7 and 15 cm in total length, with coloration ranging from translucent pale grey to tan or speckled patterns that facilitate camouflage against walls and ceilings. This species possesses expanded toe pads equipped with specialized adhesive structures that permit climbing on smooth, vertical, and inverted surfaces. The lack of movable eyelids is compensated by a transparent spectacle over the eye, which protects and maintains ocular moisture while enhancing nocturnal vision. The tail exhibits small tubercles in non-regenerated forms, and individuals frequently autotomise (shed) the tail when threatened, allowing escape from predation.

Behavioural Ecology

Hemidactylus frenatus exhibits classic nocturnal activity patterns, emerging from daytime refugia in crevices, tile gaps, or shaded vegetation shortly after dusk. Nocturnality confers advantages in thermoregulation, predator avoidance, and exploitation of nocturnal insect prey. Individuals are primarily solitary and territorial, aggressively defending micro-territories — often limited to

portions of a wall or colonial lighted facade — against conspecifics. Territorial behaviour includes acoustic signalling; males produce repeated chirping vocalisations that function in territorial advertisement, mate attraction, and agonistic interactions. The species' ability to perceive and respond acoustically to rivals and potential mates underscores the complexity of its communication repertoire.

Diet and Foraging Strategies

The dietary ecology of the Common House Gecko is characterised by broad insectivory and opportunism. These geckos feed on a diverse array of small arthropods — including but not limited to mosquitoes, moths, flies, ants, beetles, cockroaches, and spiders — making them effective natural pest controllers in urban settings. They often forage near artificial light sources, which attract high densities of nocturnal insects, thereby increasing feeding efficiency. Both ambush (sit-and-wait) and active foraging strategies are observed; geckos may remain stationed near light-rich locations until prey approaches within striking distance, after which rapid tongue flicks and lunges facilitate capture.

Temperature and seasonal conditions influence feeding behaviour: in cooler microhabitats below critical thermal thresholds, digestive efficiency declines and feeding activity is suppressed. However, within the stable thermal range typical of Singapore's tropical climate, these geckos maintain high nocturnal feeding activity and can survive extended periods without food due to physiological adaptations influencing energy reserves.

Reproduction and Life History

Reproductive behaviour in *Hemidactylus frenatus* includes polygynandry, wherein both sexes may engage with multiple mates during a single breeding season. Females lay small clutches — typically two eggs — in concealed, humid crevices on walls or under rocks, which are adhered to substrate surfaces using a sticky secretion. Incubation spans several weeks, and hatchlings are independent at emergence, attaining sexual maturity within approximately one year. Reproduction in tropical urban environments may occur year-round, facilitated by relatively stable temperatures and abundant insect prey.

Interactions with Humans and Other Species

The adaptability of the Common House Gecko to artificial structures and lighting has enabled its successful global proliferation beyond its native range. In Singapore it coexists with humans in homes, commercial buildings, and outdoor spaces with high insect activity. While generally harmless to humans, these geckos occasionally come into conflict when entering living spaces or leaving faecal deposits near light fixtures. Their role as insect predators is widely regarded as beneficial in controlling pest populations.

Flat-tailed Gecko (*Hemidactylus platyurus*)

Physical Traits and Habitat Use

The Flat-tailed Gecko, *Hemidactylus platyurus*, is a similarly small gecko species that frequents human structures and urban edges. With a flattened body and a distinctive fringed tail, this species reaches up to approximately 14 cm in total length. The flattened tail may assist in stability and movement across surfaces and crevices. Like other geckos, *H. platyurus* exhibits adhesive toe pads that enable locomotion across vertical substrates.

While present in Singapore, this species is generally less conspicuous than the Common House Gecko but is nonetheless part of the urban lizard fauna, occupying niches on walls, windowsills, and garden vegetation.

Behavioural Patterns

Distinct from some strictly nocturnal relatives, *Hemidactylus platyurus* exhibits flexibility in activity patterns, foraging both day and night depending on environmental conditions. This species makes use of muted clicking vocalisations as a form of intra-specific communication. Its behaviour in urban environments involves opportunistic movement across rooftops, building facades, and unlit walls to exploit prey resources.

Diet and Ecological Role

The Flat-tailed Gecko is an insectivorous opportunist, consuming small insects drawn to artificial lighting at night, as well as diurnal insects active during twilight or in shaded areas. The broad diet reflects adaptability to varied microhabitats and underscores its ecological role as a predator of small arthropods in urban matrices.

Spotted House Gecko (*Gekko monarchus*)

Morphology and Distinguishing Features

The Spotted House Gecko, *Gekko monarchus*, is a larger urban-associated gecko species native to the Malay Peninsula, Sumatra, Borneo, and nearby islands, including Singapore. Adults may reach approximately 20 cm in total length, with robust bodies covered in small bumps or tubercles, and a well-defined “W” pattern on the nape characteristic of the species. Adhesive toe pads and large, lidless eyes are typical of gekkonid morphology. Tail regeneration following autotomy is common, although regenerated tails differ in texture and colour from original tails.

Behavioural Ecology

Gekko monarchus is strictly nocturnal and demonstrates arboreal and vertical substrate utilisation, often inhabiting concrete structures, tree trunks, and building facades at night. When

disturbed or alarmed, individuals engage in tail waving and may produce rapid, audible breath sounds. Both males and females are capable of producing soft clicking and chirping vocalisations used during courtship, territorial interactions, and social communication.

Diet and Foraging Behaviour

Strictly insectivorous in its feeding habits, the Spotted House Gecko consumes a variety of insects and arthropods including cockroaches, crickets, flies, spiders, and even wasps. Foraging occurs predominantly at night, with geckos actively moving through complex microhabitats in search of prey. Their role as predators of diverse invertebrates integrates them into urban food webs where insect biomass is high.

Lowland Dwarf Gecko (*Hemiphyllodactylus typus*)

Physical Traits and Habitat

The Lowland Dwarf Gecko, *Hemiphyllodactylus typus*, is one of the smallest gecko species present in Singapore's reptile fauna. Adults may reach around 10 cm in total length, with slender bodies and relatively short limbs adapted for arboreal navigation among low vegetation in forest edges and mangrove habitats. Though occasional presence near urban green spaces is recorded, this species is seldom observed in the cores of heavily urbanised areas, likely due to its cryptic behaviour and preference for vegetated microhabitats.

Behaviour and Feeding Ecology

This gecko is exclusively nocturnal, exhibiting high activity after dusk when temperatures and humidity are optimal for insect hunting. Arboreal by nature, *H. typus* spends much of its time on shrubs, tree ferns, and low branches, where it captures very small insects and spiders. Its slender build and nocturnal habits allow it to forage effectively in low-light conditions, often in cluttered foliage where larger geckos are less effective.

Patterns of Behaviour Across Urban Geckos

Nocturnality and Activity Rhythms

All four species — *H. frenatus*, *H. platyurus*, *G. monarchus*, and *H. typus* — share a predominantly nocturnal lifestyle, aligning their activity with cooler temperatures, reduced exposure to diurnal predators, and peak availability of nocturnal insect prey. This pattern allows them to exploit nocturnal insect biomass effectively and reduces competition with diurnal lizards.

Territoriality and Communication

Territorial behaviours are most pronounced in the Common House Gecko, where males employ vocalisations and physical displays to defend feeding and mating territories. These vocalisations — repeated chirps or clicks — function to establish dominance and reduce physical conflict. Other species such as the Spotted House Gecko also produce soft calls during courtship and social interactions, indicating that acoustic communication plays an important role in social ecology among geckos.

Anti-predator Adaptations

Tail autotomy is a widespread defensive mechanism among urban geckos. When grasped by a predator, the gecko can detach its tail, leaving the detached segment to wriggle and distract the predator while the lizard escapes. Regenerated tails often differ in morphology but continue to serve certain functions.

Foraging and Diet

All focal species are insectivores, feeding primarily on a diversity of arthropods. Urban environments — particularly areas illuminated by artificial lights — create hotspots of insect activity that these geckos exploit. Use of artificial lighting enhances their foraging success and helps explain high densities of geckos on walls near lamps, windows, and outdoor fixtures.

Reproductive Strategies and Life History

Egg Laying and Development

House geckos and related gecko species are oviparous, with females laying small clutches of eggs in sheltered, humid crevices. For *H. frenatus*, clutches of two eggs are typical, with incubation periods reflecting ambient thermal conditions. Hatchlings are miniature replicas of adults, independent from birth, and reach maturity within a year — a life history pattern that supports rapid population turnovers in urban environments.

Ecological Roles in Urban Environments

These urban geckos play significant ecological roles as mesopredators in urban landscapes. They help regulate populations of pest insects such as mosquitoes, flies, and cockroaches, providing ecosystem services that benefit humans. By occupying vertical and arboreal niches, they help integrate energy flow between invertebrate prey and higher trophic levels, including birds and larger reptiles that may occasionally prey upon them.

Conclusion

The house and little geckos of Singapore — *Hemidactylus frenatus*, *Hemidactylus platyurus*, *Gekko monarchus*, and *Hemiphyllodactylus typus* — exemplify the adaptability of small reptiles to urban ecosystems. Their nocturnal insectivory, morphological adaptations for climbing, territorial behaviours, and use of acoustic communication reflect evolutionary responses to urban pressures and opportunities. Serving both as controllers of insect populations and as integral components of urban biodiversity, these geckos warrant continued study and appreciation for their ecological contributions.