

Companion Animal Hospital Exotic Animal Care



The New Caledonian Crested Gecko, *Correlophus ciliatus* (formerly *Rhacodactylus ciliatus*), is a popular pet species native to the forests of New Caledonia and a few other surrounding islands in the Pacific Southwest. They are named for the paired crests running along the tops of their heads from the eyelids down the sides of the neck. This species of gecko was actually thought to be extinct until its rediscovery by naturalists in 1994, and despite having a “vulnerable” status by the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), animals were exported for the pet trade. Luckily, these geckos make excellent companion animals as they are well-tempered, gentle animals that are not easily stressed and breed readily in captivity. There are many diverse colour and pattern mutations available in the pet trade. Crested Geckos may live 15-20 years in captivity with good care.

Crested Geckos are easy to sex, starting around 5 to 9 months of age. These lizards are sexed by the presence or absence of copulatory (sex) organs, the hemipenes, which may be detected in males as a “bulge” at the base of the tail.

This is a relatively small lizard species, reaching about 20 cm (8 in) in length with their tail intact, or about 10-11.5 cm (4-4.5 in) not including the tail. The tail is semi-prehensile, gripping branches and twigs while the gecko is navigating its forest habitat.

1. The Unique Anatomy of Geckos

Geckos’ most unique features lie in their hands and feet¹: Their ability to “stick” to surfaces and climb up walls and across ceilings deftly is unmatched in the vertebrate world. The toes are covered in leaf-like folds called lamellae, which are made up of hundreds of hairs called setae, which in turn are covered in hundreds of projections called spatulae. These microscopically small structures actually create weak molecular bonds with a surface in great numbers, allowing the gecko to attach to most surfaces with extreme ease.

Crested Geckos, like most geckos, lack moveable eyelids. Instead, there is a transparent, immovable scale over the eye called the brille or spectacle. Because of this, these geckos do not blink! Geckos will use their tongue to wipe away debris from the spectacle’s surface.

¹ We refer to them as hands and feet in lizards as they have a plantigrade structure, where the palms and “flats” of their feet are the surface that they walk on. This is opposed to a digitigrade structure like in dogs and cats (where the digits are the walking surface), where we call the hands and feet “paws.”

2. Environment: Enclosure

Crested Geckos require an enclosure large enough to allow for ample climbing. Enclosures that are too small will not allow for thermoregulation or appropriate exercise. An adult Veiled needs an enclosure at least 1.2 m tall by 0.6 m wide by 0.6 m long (4 ft tall by 2 ft wide by 2 ft long). Younger chameleons may be housed in a smaller enclosure, and upgraded to larger housing as they grow.

Screen or mesh enclosures are generally best suited for chameleons, who need excellent ventilation. The mesh width must be large enough to not catch or lacerate the lizard's toes. Glass aquariums are not ideal, as they often do not offer good ventilation. Newer glass terrariums made especially for reptiles with ventilation grids and screen tops can work well for chameleons. Chameleons are naturally very territorial and often become stressed out by constantly seeing their reflection in glass terrarium walls, so if you are using a glass terrarium ensure that there are plenty of plants and branches to act as visual barriers; ensuring that the enclosure lighting is pointing directly downwards may also help reduce reflections. If you have more than one chameleon housed in the same room, use opaque barriers to prevent them from seeing each other as this is a serious source of stress.

3. Environment: Heating

Reptiles are ectothermic: They rely on external heat to maintain their bodies at a preferred temperature. All reptiles need an external heat source so that they may thermoregulate by shuttling within a heat gradient in their enclosure. Basically, when a reptile is too cool he will move to somewhere warm, and when he is too warm he will move somewhere cooler. Reptiles will move around in the gradient throughout the day to try to stay at a target body temperature.

To create a thermal gradient in the enclosure, a primary heating device should be placed on one end. In some homes, a secondary heating device may be necessary to maintain temperatures warm enough. The primary heating device can be a heat lamp left on during the day. Red coloured incandescent bulbs, sometimes called "infrared" bulbs, should not be used for nighttime heat as reptiles certainly see the red light, contrary to what they often advertise.

An overhead heating source, such as a heat lamp, is necessary to stimulate basking behaviours as this species is heliothermic (use sunlight to warm themselves in the wild). Mercury vapour bulbs that provide heat and UV light in one bulb are excellent for chameleons. While secondary heat sources like heating pads can help increase the ambient temperature in a cool enclosure, they are not suitable as a primary heating device for this species. A basking spot that reaches 40-41 °C (105 °F) with a temperature gradient of 27-30 °C (80-86 °F) is required. A nighttime temperature drop is very important for chameleons: Provide a drop in temperature at night to 21-24 °C (70-75 °F).

Monitoring the thermal gradient is critical: Use a thermometer both at the animal's basking spot as well as at the cool end of the enclosure. It is not only important to ensure that your pet can get warm enough based on the species' preferred body temperature, but also that the cool end allows for proper cooling when needed. Hyperthermia, or an excessively high body temperature, can kill a reptile or amphibian within minutes, and ensuring that your thermal gradient is appropriate at both ends is critical. We recommend the usage of either a digital thermometer with a probe that may be placed at the appropriate spot, or a noncontact infrared temperature "gun" that can be pointed at any location in the enclosure. Note that some thermometers are not very accurate and may be misleading when monitoring temperatures. "Stick-on" LCD and dial thermometers are generally quite inaccurate and we do not recommend their use.

4. Environment: Lighting

These lizards need a broad spectrum light source that provides UV-B radiation to allow for normal calcium metabolism, and UV-A to help with prey identification. Please see our handout on lighting for reptiles for more information.

5. Environment: Substrate and cage furnishings

Substrate is the medium covering the floor of the enclosure. As chameleons spend little to no time on the floor of their enclosure, simple and easy-to-clean substrate like reptile carpeting can work well. Other substrate like soil, sphagnum moss, or coconut coir can help to increase the humidity in the enclosure, but prey insects may easily hide in this substrate. If you notice that your lizard is eating the substrate, or you notice that there is substrate in the stool, it is safest to switch to another substrate that cannot be eaten (such as reptile carpeting) before a gastrointestinal blockage occurs.

A number of sturdy branches should be provided to allow for climbing. Chameleons are shy lizards and need arboreal hiding spots to feel secure. False or live plants are useful to help create hiding spots throughout the enclosure so that the chameleons may thermoregulate while hidden if desired. Live plants can help maintain humidity and provide lots of cover, but they must be safe to eat as Veiled Chameleons will eat foliage for moisture. Weeping Fig (*Ficus benjamina*), Hibiscus (*Hibiscus rosa-sinensis*), pothos or devil's ivy (*Epipremnum aureum*), and Dwarf Umbrella Plant (*Schefflera aboricola*), and Heart-leafed Philodendron (*Philodendron scandens*) are all safe plants to use in chameleon enclosures.

4. Environment: Water and humidity

Chameleons will rarely drink standing water (although some do learn to drink from a dish), and instead will drink water droplets or condensation that has collected on leaves or other surfaces. A "drip bucket" positioned on top of the enclosure that allows for a slow dripping of water over

a plant in the enclosure lets the chameleon drink when needed. Additionally, misting the enclosure regularly (2-4 times daily) with a spray bottle or an automated mister will help to maintain ambient humidity cycling between 40-90%. Remember that excellent ventilation is needed for chameleons, as they are very sensitive to developing health problems related to stagnant air.

6. Nutrition

These lizards are primarily insectivorous but will also sometimes eat foliage. In the wild, eating leaves may be a strategy to take in more moisture during the dry season. Providing live plants that are safe to eat (see the section on cage furniture above) will allow the chameleon to eat them when desired. You may offer leafy greens such as romaine lettuce, collard greens, red leaf lettuce, etc. once or twice a week if your chameleon seems to enjoy eating them, but this should not replace the insect portion of their diet as vegetable nutrition alone is not enough to keep chameleons healthy. Arboreal food clips can be used to “hang” the leafy greens from the cage top or wall to imitate hanging foliage.

A number of feeder invertebrates are commercially available, and providing prey variety may provide better nutrition and also offers a source of enrichment:

- House Cricket, *Grylodes sigillatus* and *Acheta domestica*: Crickets are bred by the tens of thousands in commercial facilities, and are available in many pet shops in multiple size categories to feed to different species. Crickets are a good staple feeder and offer an opportunity for the gecko to exercise as they chase them. Crickets tend to be poorly fed in most pet shops and need gut-loading and supplementation to make them a more nutritionally complete meal.
- Mealworms, *Tenebrio molitor*: Mealworms are the larvae of a species of darkling beetle. They also need gut-loading and supplements to make them more nutritious.
- Superworms, *Zophobas morio*: Superworms are the larvae of a different species of darkling beetle. Although they are “meatier” and larger than mealworms, they still require gut-loading and supplements.
- Waxworms, *Achroia grisella* and *Galleria mellonella*: Two species of wax moths are commonly bred as feeders and bait. Their larvae, or caterpillars, are waxworms. These feeder insects are naturally calcium-rich, but also have a high fat content. They should be fed only occasionally to avoid obesity.
- Hornworms or Goliath Worms, *Manduca sexta*: These large, green caterpillars are becoming more commonly available as feeders. They are a great treat to offer lots of moisture and protein to your lizard, and their bright colour can stimulate even picky eaters to feed. Hornworms are commercially-raised on a special diet, so gut-loading with other foods is not possible. It is important to note that these caterpillars are the larvae of the Tobacco Moth, and wild-caught specimens are toxic because of their natural diet.

- Silkworms, *Bombyx mori*: Silkworms are the caterpillar of the Silkmoth. They are bright-coloured and a great source of protein and moisture. Silkworms are raised on a mulberry foliage meal, and cannot be fed other gut-load diets.

As these lizards are diurnal, they should ideally be fed during the day when they are normally active. Chameleons may be fed daily as juveniles, and several times a week as adults, and any uneaten prey should be removed from the enclosure after a few hours to prevent escape and spoilage.

Please see our handout on insectivorous reptile nutrition for further information on gut-loading insects and using supplements.

7. Health

Good husbandry helps prevent most health problems in reptiles. As ectotherms, their immune system function is directly affected by both stress and their ability to thermoregulate, so proper environmental temperatures are critical. There are some other common health problems that you can avoid with the right precautions.

Parasites are unfortunately very common in captive reptiles due to overcrowded, stressful conditions and poor hygiene in pet stores and some breeding operations. Many parasites that affect chameleons have a direct life cycle, meaning that they require no other host species to help transmit them. Parasites like this tend to accumulate in captive reptiles and cause disease. Fecal testing is required to determine what kind of parasites your lizard may have so that the appropriate medication can be prescribed.

Chameleons belong to the family Chamaeleonidae, which are partly characterized by their jaw and tooth structure. These lizards have an acrodont dentition, meaning that the teeth sit on top of the jaw bone and not in a tooth socket. While it is not entirely understood why, this anatomy predisposes them to periodontal disease as they age. Regular monitoring of your lizard's oral health is part of keeping them healthy.

Vitamin and mineral deficiencies are unfortunately very common in pet chameleons. While it is not understood exactly why chameleons seem more “fragile” than other commonly kept lizards, ensuring that they have an appropriate environment (including broad spectrum lighting that is used correctly) and good nutrition certainly helps to prevent many health problems.

Female chameleons appear to be very prone to reproductive problems. They reach sexual maturity at about 6 months of age, and may produce infertile egg clutches several times a year. Mating a female to a male does not help to prevent reproductive problems. Both yolk and eggshell production demands a lot of calcium, and calcium deficiency is common. If you are concerned that your female may be starting to produce eggs, extra calcium supplementation and close observation is needed. Providing a laying box is needed so that the chameleon feels

she has a safe place to lay her eggs: A tub of damp sand large enough for the chameleon to dig into is an appropriate laying site, and should be provided as soon as the eggs can be seen as "lumps" through the body wall.

A weak hand and foot grip, inability to curl the tail, inability to "shoot" the tongue, and muscle trembling are all signs of early calcium deficiency and need to be addressed immediately. Additionally, if you find that your female chameleon is digging in her laying box but does not lay eggs or appears to be straining to lay eggs, this can be a sign of "egg-binding" (post-ovulatory stasis) and needs immediate emergency care. Calcium deficiency quickly becomes life-threatening, so please contact us ASAP if you notice any of these signs.

Chameleons cannot convert pro-vitamin A (beta-carotene) to the active form effectively, so they need pre-formed vitamin A in their insect gut-load as well as in their multivitamin supplement. Unfortunately it is easy to accidentally overdose on this vitamin, causing other health problems. Please consult with our staff about suitable supplement products for chameleons.

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Lighting for Reptiles and Amphibians

Some reptiles and amphibians require broad spectrum lighting that includes ultraviolet A and ultraviolet B radiation (wavelengths found in natural sunlight). Providing this special lighting in captivity is critical for the health of many common companion species.

1. What is ultraviolet light?

Ultraviolet light is invisible to the human eye, but important to many members of the animal kingdom. There are three classifications of ultraviolet light:

- **Ultraviolet A:** UVA is also called long wave or "black light" ultraviolet radiation. This class of UV is important in regulating natural cycles in some reptiles, such as brumation ("hibernation") and reproduction.

Many species of reptile (Fleishman et al. 1993), insects (Salcedo et al. 2003) and birds (Cuthill et al. 2000) can see UVA light. It is important in helping to see members of the same species or even prey. It has been demonstrated that reptiles provided with UVA light generally do better in captivity, with increased levels of natural activities, greater reproductive success, and better appetites (Klaphake et al. 2004).

UVA is produced by the sun, by broad spectrum fluorescent bulbs and black lights (Gehrmann 2006).

UVA is definitely beneficial to diurnal species (species active during daylight hours). It may be most important in visually-oriented species, like members of the iguana (Iguanidae), agama or dragon (Agamidae) and true chameleon (Chamaeleonidae) families of lizards, as well as in turtle and tortoise species.

- **Ultraviolet B:** UVB is also called medium wave ultraviolet radiation, and is essential in vitamin D₃ production (the “sunshine vitamin”). Vitamin D₃ allows the body to use calcium from the diet. Some species can use vitamin D₃ from dietary sources (animal matter), but many species either cannot absorb dietary D₃ or do not encounter vitamin D₃ in their natural diet.

It is uncertain whether reptiles can see or detect UVB. It is produced by the sun, and by some broad spectrum artificial lighting (Gehrmann 2006).

UVB is important to provide for most diurnal lizards, chelonians and some amphibians. Herbivorous (plant-eating) animals absolutely need UVB lighting as they cannot use dietary vitamin D₃. Without UVB lighting, calcium deficiency occurs and manifests as many health problems, including the metabolic bone diseases (a group of pathologies related to calcium metabolism).

There is a growing amount of research suggesting that species that we have not traditionally recommended UV-B lighting for can benefit from exposure. For example, some studies (Acierno et al 2008, Hedley and Eatwell 2013) have demonstrated that snakes can certainly use UV-B lighting. More investigation is needed to determine the health benefits of providing broad spectrum lighting to these species, however in the meantime it may be safest to allow for lighting that is as natural as possible for these captive snakes.

- **Ultraviolet C:** UVC, or short wave ultraviolet radiation, is produced by the sun but filtered by our atmosphere. Some lights will produce UVC radiation very close to the bulb surface. It is germicidal and used in air and water disinfection systems. Exposure to UVC radiation is harmful to the skin and eyes, and does not need to be provided to reptiles or amphibians in captivity.

2. Types of broad-spectrum lights

There are several types of commercial bulb available to provide your companion animal with broad spectrum lighting. Select a bulb according to the animal you have, and the type of enclosure you are using.

- Linear fluorescents are suitable for enclosures with a lot of floor space, as well as for long animals that have a large body area that needs UV exposure. Examples of brands include: **Exo Terra Repti Glo** by Hagen, **Iguana Light** and **Reptisun** by Zoo Med, **Desert Series 50** and **Tropical Series 25** by Zilla.



- Compact fluorescents are limited in their "spread" (place them horizontally towards the basking area, to increase surface area exposed) but have a greater relative irradiance closer to the bulb, so they are more suitable for small enclosures.

Examples of brands include:

Exo Terra Repti Glo by Hagen, **Reptisun** by Zoo Med, **Desert Series 50** and **Tropical Series 25** by Zilla.



- Mercury vapour lamps are only suitable for very large enclosures. They produce a large amount of heat as well as visible light, UVA and UVB (Baines et al. 2006). Users must be very careful to avoid thermal burns, always test the environmental temperatures before introducing your pet to the enclosure when using a mercury vapour lamp.

Examples of brands include:

PowerSun UV by Zoo Med, **Exo Terra Solar Glo** by Hagen.



3. Using broad-spectrum lighting

Keep the following points in consideration when lighting reptile or amphibian enclosure:

- Always research recent current care information about what kind of lighting your species needs. Reptile and amphibian care and medicine is a field that is constantly evolving.
- Never allow a glass or plastic barrier to occlude your broad spectrum light. Glass and plastic filter 99-100% of UVB radiation, even if visible light may pass through (Baines et al. 2006).
- The amount of UV produced decreases with distance from the bulb. Most bulbs are effective at a distance of less than 30 cm (12") from the basking spot (but read the manufacturer's recommendations). However, because bulbs may also produce small amounts of harmful UVC radiation near the bulb's surface, keep a minimum distance of 10 cm (4") (Baines et al. 2006).
- Screen or mesh covers or enclosures will physically block some UV from reaching the animal (Baines et al. 2006). If you have mesh or screen between your broad spectrum bulb and the animal, ensure that your pet can get relatively close to the bulb, or add a reflector to increase how much UV is projected to the basking spot.
- Reptiles and amphibians are never in direct sunlight for the entire day. Always ensure that your pet can choose a location as a shelter from UV light exposure.
- Replace the light every 6-12 months, or according to the manufacturer's recommendations. The UV output of a bulb decreases over time, even if the light is still producing visible light (Klaphake et al. 2003).
- Consider using "high output" bulbs (with an 8.0 or 10.0 rating) with species that would be exposed to a lot of UV light (like desert animals) or in large enclosures, and mid-range output bulbs (5.0) with other species or in smaller enclosures. Low output bulbs (2.0) are probably useless in terms of UVB output.

Thank you for your trust in taking care of your reptile companion. If you have any questions or concerns about his or her care at home, please call the hospital to speak with our staff.

4. Sources and further reading

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- Klaphake, E, E Adkins, T Driggers, G Ferguson, W Gehrman, Z Gyimesi, E May, M Ogle and T Owens. 2003. Roundtable: Ultraviolet Light and Reptiles, Amphibians. *Journal of Herpetological Medicine and Surgery*, 13:27-37.
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Insect-eating Reptile and Amphibian Nutrition

Insectivores are animals that eat insects and other arthropods. Captive insectivores require special attention to their nutrition, as commercially-available insects do not match the nutrition that a wild animal obtains from eating hundreds if not thousands of different prey species.

1. Gut-loading prey

Most commercially-raised insects are nutrient-poor until they have been fed a nutritious meal. This is partially for cost-effective insect breeding (they do not need optimal nutrition to breed in vast numbers), and partially because feeding nutrient-rich foods can affect their lifespan.

There are a number of gut-loading diets available commercially. Please consult with our staff for product recommendations. Most diets are recommended to be fed to insects for 24-48 hours before those insects are then fed to your reptile or amphibian.

Feeding cat and dog food as a gut-load is not recommended. While they are an excellent source of some nutrients, they are a significant source of cholesterol. Insects cannot synthesize their own sterol molecules (including cholesterol), and are not a common natural source of cholesterol unless they eat other cholesterol-containing animals. Dogs and cats need dietary cholesterol, but it can lead to serious health issues in insectivores that have not adapted to needing it in their diet.

Prey insects should always be kept in clean, well-ventilated containers to prevent mold growth. Feeding prey raised in moldy, unsanitary conditions will contribute to disease in your pet.

2. Supplements

Even with an excellent gut-load product, supplements are strongly recommended to ensure that your reptile or amphibian is getting balanced nutrition. Powdered supplements are dusted onto insect prey before they are offered to your pet. Because the powder can fall off in the enclosure, it is important to offer dusted insects when your reptile or amphibian is most active.

Arguably the most important supplement is calcium. Most insect species commonly fed as prey (including crickets, mealworms, superworms, and others) have very poor calcium content, and an inverted calcium-to-phosphorus ratio (Ca:P). This is the proportion of calcium and phosphorus in any food, an important value to consider as these two mineral nutrients have a close relationship. The target dietary Ca:P for insectivores is 1.5-2.0:1 (one and a half to twice as much calcium compared to phosphorus). Few commercial insects naturally have this calcium content, so supplements are necessary.

It is recommended that every insect meal with naturally poor calcium content be dusted with a calcium supplement, unless you are feeding a very high-calcium gut-load meal to your insects. Calcium carbonate is the most common supplement form, and there should be no added phosphorus or vitamin D₃.

For insectivores that do not have any broad spectrum (UV-B) lighting, a calcium supplement with vitamin D₃ should be used regularly as this vitamin is necessary for calcium metabolism. Most reptiles and amphibians can manufacture their own vitamin D₃ from this special artificial light that replaces sunlight, and this is the safest way to provide vitamin D₃. Oral vitamin D₃ supplements can be used cautiously; over-supplementation causes vitamin toxicity which will lead to organ failure and death. There is very little data available on minimum vitamin D₃ requirements and how much is required to cause toxicity in the thousands of reptile and amphibian species. Using a calcium plus D₃ supplement is generally recommended every 5-10 meals; however this is only a general guideline. When UV-B lighting is available, there may be no need for oral supplementation. Note that no toxicity can occur from using UV-B lighting, and is much safer than “guessing” at oral D₃ supplementation.

A general multivitamin and mineral supplement can help ensure that your pet is not missing any micronutrients (nutrients that are needed in small quantities, and may not be found in every meal). Like with vitamin D₃-containing supplements, over-supplementation can cause toxicities.

Unfortunately, there are many products available in the pet industry that do not offer a guaranteed analysis of the nutrient content. Please consult with our hospital staff for product recommendations.