The Horned Lizard Manual

Genus: Phrynosoma

By Mick Palermo
© PhrynosomaTexas ( "Fireside3" )
Phrynosoma_Texas@yahoo.com

( Last Updated 6/9/08 )

Permission is given to redistribute and reprint this publication only in its unaltered entirety.

Horned Lizard Quick Facts

- Diurnal - Active during the day
- Desert/Semi-Desert Dwelling - Prefers warmer, more arid climate
- Preferred Substrate - Sand
- Requires UVB lighting
- Diet - Insectivorous ( eats primarily Harvester ants )
- Social to other Horned Lizards, but usually solitary
- Does not prefer to be handled and does not like being watched too closely
- Requires water twice weekly
- Life span: Lives up to 8 years or perhaps more in the wild. Average is 4-6 in captivity with good care. One documented as living 18 years with an experienced herpetologist. Most Horned Lizards under substandard care die within months.

Preface

I have been studying & keeping these fascinating lizards for 5 years, with about 20 years of field “herping” and captive reptile experience in total. Horned Lizards are definitely not recommended for the beginner. They can be difficult and fragile in captivity, and this is especially true of wild caught Horned Lizards. Horned Lizards are among the most difficult reptiles to keep alive and healthy that I have yet dealt with. The novelty, casual, or novice reptile keeper would be well advised to seek an easier species. There is definitely a reason Horned Lizards have not
become easily propagated and widely kept as pets, despite their very Jurassic looking appeal.

“Horned lizards are among the most difficult lizards to keep in captivity because they have specialized dietary and thermal requirements, and they are susceptible to disease.” -Dr. Richard Montanucci, Herpetologist & author of “Maintenance and Propagation of Horned Lizards in Captivity”.

It is strongly advised that you do not buy wild caught animals of any kind, or capture wild Horned Lizards without a good deal of successful reptile keeping experience and an appropriate wildlife collection permit, where required. I consider a minimally experienced herp keeper to be one that has had 3-5 years of continuous experience with the same animal, although more than 10 years overall reptile keeping experience is preferable if you are going to attempt *Phrynosoma*. Most people selling these wild caught lizards do not have a clue about how to take care of them. I have seen them kept on ground walnut shell as substrates and offered prey that is not appropriate. At shows and from pet store dealers, they are usually wild caught, and will often come to you with diseases, parasites, and malnourished. Many die soon after you have paid your money. Wild caught reptiles often stress after capture and will not eat in their new surroundings, even starving to death in cases because they are not comfortable in captivity. A reptile that feels insecure in his surroundings often will not eat.

It is also strongly advised that anyone considering Horned Lizards read as much as possible and become proficient with the many care facts of this lizard before taking one on. I advocate this rule of thumb; if you can go onto a Horned Lizard web forum and can answer most of the basic general species information and captive care related questions asked by others, then you are more assured to be ready for one. This is a reptile which is not very tolerant of a “learn as you go” approach.

This “caresheet” (now “manual”) originated for the Montreal BioDome zoo in ’06, who were keeping *P. platyrhinos* for their Southwestern themed exhibit, and requested ants and a reference on *Phrynosoma* husbandry. Over the last year, it has expanded as I saw the need to fill the overwhelming gap in information on Horned Lizard husbandry. When I got started, there was not one caresheet anywhere, on any website, on the captive husbandry of the Horned Lizard. The “bibles” so to speak, were Sherbrooke’s “Introduction to the Horned Lizards of N. America” (which includes absolutely no care information), and Montanucci’s “Maintenance and Propagation of Horned Lizards in Captivity” (great resource, but dated I felt in some respects). To date, though there are several very good websites, which discuss their care and other issues, there remains nothing as comprehensive as this, which can be downloaded and read at leisure.

Over the course of developing this information, I have been told by many (to borrow some words from Melissa Kaplan) that there were too many words and not enough little white spaces. I cannot help the growing trend toward people (especially Americans) to be ADD about things, and who want it all summed up in a page or less. With Horned Lizards, as with most reptiles, it’s just not going to happen if you intend to care for them properly. If you are not up to the amount of reading required, then Horned Lizards are not for you. If you are not up for spending possibly $20 a week feeding them the ants they need, then Horned Lizards are not for you. Most Horned Lizards in inexperienced hands, especially those that have been wild captured, will die within a matter of months. Horned Lizards require skill to maintain, and preferably experience with reptiles. Consider that, and consider the plight of the Horned Lizards, which are declining in the wild, before you decide to make one a “pet”. Children need not apply. This is a sure death sentence for the Horned Lizard!

This manual is meant to supplement the knowledge of the responsible keeper, who will research the animal and its needs prior to obtaining one.
I. Introduction to the Genus

There are 14 different recognized species in North America. Most of these (8) are native to the southwestern US, though one or two species can be found in the central plains from Oklahoma to the Dakotas, and into the northwest and Canada. Though none of these species native to the US is federally protected as of yet, most of these species are state protected in many of the states in which they are native.

Limited health related information from Iguanidae Family applies also to *Phrynosoma* (they are closely related), i.e. stress factors and skin blackening syndrome, infections & wound care, etc. I Recommend Melissa Kaplan’s information on the Green Iguana in this regard (anapsid.org). This care sheet covers only *Phrynosoma* (Horned Lizards), but much of the general husbandry and technical information contained herein is applicable to other herps.

This care sheet is applicable to the majority of Horned Lizard species, and primarily *P. platyrhinos, P. solare, and P. cornutum*; though some species, such as *P. hernandesi* and *P. douglassi* are high elevation species and will have differing dietary, humidity, and temperature requirements.

*Species Identification & Distribution*

As covering in detail the identification of each individual species in this genus would be exhaustive and merely duplicate that which can be found in many other good resources, I will refer the reader to the following for identification:

http://www.ucpress.edu/books/pages/9297/identify.pdf
http://www.lifesci.utexas.edu/faculty/pianka/phryno.html

*Sexing & Dimorphisms*

Males have an easily identifiable row of yellowish-orange femoral pores, running lengthwise along the underside of each rear thigh, and hemipenal bulges at the base of the tail just rear of the vent (anal plate). The bulges will cause a slight concave line, bisecting the bulges hemispherically to either side of the tail. In most species, just rear of the vent there will be two larger "post anal" or “post ventral” scales, noticeably larger than surrounding scales. In juveniles, many or all of these sexual dimorphisms may not be apparent.

Male *P. hernandesi* (note clearly visible femoral pores and post ventral scales)
Females will have a less easily defined row of pores, and have thinner tails at the base (little or no bulging). However, some species have characteristically wider tails, and may be harder to differentiate without comparison. Females also are generally larger than males, although again, experience and comparison with previous examples will help, since age can be harder to determine.

II. General Husbandry

Housing

For several reasons Horned Lizards do much better in outdoor housing if the climate suitably approximates their home climate. For geographical locations that do not provide adequate climate and sunlight intensity (as in basking temperatures or UV exposure), a more enclosed environment or an indoor setup will be required, with artificial lighting and heating.

For outdoor enclosures, it is important to ensure the enclosure is secure, but open to airflow (No glass, plexi, etc.). It must be secure to keep out potential predators such as birds, canines, cats, rodents, and snakes. Chicken wire or something similar for the tops and high on the sides is recommended. The lower sides of the enclosure can be covered with a finer mesh screen (1/4") to prevent escapes, lizards getting their head or horns stuck, and snakes and other small undesirables getting in. This will still allow migration of appropriately sized insects into the enclosure for the lizards to forage on. Fine screen or glass will scatter and weaken much of the sun’s UV, hence it should not be used for the upper sides and top. Landscaping may be required to ensure that flooding does not occur in heavy rain. Up to 50% of the outdoor enclosure should include cave hides and shaded areas for the lizards.
to retreat from direct mid-day sunlight. Horned Lizards do not bask in the hottest part of the day. They seek cooler locations and wait for the late afternoon sun before setting out again to bask or look for food.

For indoor setups using an aquarium, the widely accepted minimum size is 40 gallons for one individual or a pair. Avoid housing more than two lizards in an aquarium smaller than 40 gallons. The larger size tank you can provide, the more comfortable the environment for the Horned Lizard. Horned Lizards need adequate space to roam and stimulate natural behaviors.

Aquarium décor often consists of Horned Lizard friendly cacti or other succulents, flat basking rocks, rocks to climb, cave hides for shade and security, and landscape background scenes.

It is a good idea to provide at least one semi-abrasive rock for the lizards to climb on, so as to wear their nails naturally, as they would in the wild. The average Horned Lizard would scurrying about a much greater distance every day, than is allowed in the average aquarium.

Use caution in arranging stacks of rocks or other décor that might pose an overhead hazard if unbalanced. Some species like to dig or burrow under or against rocks and other heavy items; that may topple over.

Consideration must be given to the layout with respect to insects being lost or left in the tank. Crickets will tend to climb and may find a way out. They will also hide under or behind any rocks or plants, and when left in the tank will often chew up your live plants, or on the animal themselves. Crickets left overnight can actually do a lot more damage to a reptile than most people realize. They can chew through the skin and scales sufficiently in some places to cause open wounds and abscesses, particularly around the soft parts of the mouth and eyes. Large numbers of harvester ants may damage plants as well…since they are “harvester ants”.

A locking aquarium screen lid is a good idea to keep things in, and keep cats, dogs, and other potential predators (including children) out.

**Substrate and Substrate Care**

Fine-grade sand, such as play-box sand is a popular suitable substrate for these lizards. A 50lb. bag is sufficient to fill a large aquarium or small outdoor terrarium. I prefer to use that which is sterilized and sifted for use in play-boxes. I have also considered recently the possible respiratory effects of factory produced play-box sand, which is pulverized quartz. Fine particulate quartz poses a long-term health risk in humans similar to asbestosis, and it is reasonable to assume the same in reptiles may be true. This sand poses little risk to consumers, and is generally only of concern to factory workers exposed to frequent dust from everyday production and movement. The long-term effect on a lizard, which is residing directly in the substrate is not known. For that reason, I have begun to advocate possibly pre-washing and drying play-box sand to remove the fine quartz dust. This may cause some increased clumping when damp, but may be a better trade off than leaving it un-rinsed. Substrate should be 2-3 inches deep, sufficient for the lizard to burrow for sleep and thermoregulation.

There are also calcium based “sand” substrates on the market (Calci-Sand), which claim to be digestible and safe. I have never recommended Calci-Sand, though I have used Vita-Sand. Calci-Sand is advertised as clumping when wet. This is cited as a selling point, but this is a bad selling point, because it clearly means it is an impaction hazard. Calcium of course will bind to other things in the presence of moisture, and harden. Calci-Sand also seems to be derived from crushed shellfish, and contains tiny sharp shards of shell. I wouldn’t want my reptiles even
accidentally ingesting that sort of thing on rare occasion. Vita-Sand has much smaller, finer grade particles and would seem to pose much less impaction risk. I recommend mixing this in a 50/50 ratio with play-box sand if you wish to use it. I would advise against using any of those with outrageous un-natural colors, or the ones that glow in the dark that have come out recently. Who knows what is in those, and how it will affect health of a Horned Lizard?

Clean substrate of scat (waste) daily. The best way to accomplish this is with a plastic spoon or small sifter. Sand should be sifted through frequently to remove debris, etc., and should be changed every 3 months or sooner. It should be obvious that any additional chemical additives should not be used in the substrate. New or re-used terrariums should be sterilized with 1:9 bleach water solution, Lysol or ammonium chloride based disinfectant, or at least 70% alcohol; rinsed completely and allowed to dry. Avoid using anything with additional additives such as fragrance, surfactants, or detergents. The only exception I would advise after disinfection, is cleaning with mild dish soap, or Natural Chemistry’s “Healthy Habitat”. This should also be done as routine maintenance when substrate is changed.

**The Importance of UV**

Horned Lizards are diurnal, which means they are active during the daytime and require UVA and UVB, as do most insectivorous and herbivorous reptiles: such as turtles, tortoises, iguanas, and dragons.

UVA is beneficial to the activity and psychology of the reptile, stimulating healthy activity, alertness, and breeding behavior.

UVB is needed for proper growth by promoting vitamin D3 synthesis important in absorbing and processing calcium and phosphorus. Just as in other animals that require sunshine, the UVB component of sunlight strikes the skin and the body produces vitamin D3 as a result. Vitamin D3 is a signaling hormone, and is used by the body in triggering metabolism of calcium and phosphorus into proper bone growth. Without proper UVB levels and calcium/phosphorus ratio (Ca:P) in the blood, the UV dependent reptile will eventually suffer severe bone deformities from Metabolic Bone Disease. The reptile's body will begin to rob the bones for calcium to maintain blood calcium levels. The best case scenario in that event, is that it will grow with deformities or have fragile bones, possibly leading to spine, jaw, and hip fractures. The worst case is that it will suffer a slow death due to complicated metabolic disfunction and organ damage.

The only reptiles which do not require frequent UVB, are nocturnal (such as nocturnal geckos or snakes) or rodent eating; such as snakes and monitor lizards, which derive their vitamin D3 needs mostly by digesting the livers of their prey.

Natural unfiltered sunlight is the best source of UV. If you can provide it in a proper outdoor setup, it is preferable. If not, a UVA/B light will be required. There are many UV lamps on the market today, but the best artificial sources of UVA/B come in the form of mercury vapor spot or flood lamps. Fluorescent tubes are better than nothing, but still inferior in the amount of UV they transmit. Many do not produce sufficient levels to meet the reptile's needs, even when fresh out of the box. This is why they are cheaper than mercury vapor lamps, and are required to be on much longer to provide an adequate amount of exposure.

Labeling of UV lamps is often misleading. **IF THE LAMP YOU BUY DOES NOT SPECIFICALLY STATE THAT IT PRODUCES "UVB", THEN IT DOES NOT PRODUCE "UVB".** The factor for determining the worth of a UVB lamp is not the % of
UVB (i.e. 10% or “10.0”) unless you know the measure of the total light transmitted over the spectrum. The factor you are looking for in a good lamp is microwatts of UVB per square centimeter (cm²), in the appropriate spectral range. An average summer day in the southwest U.S. can see UVB in the 200+ microwatt range. Most reptiles bask in the morning or afternoon hours where UVB levels may reach 100 mW/cm². It is generally accepted that 20 minutes sunlight exposure per day of such UVB is sufficient for the production of vitamin D3 in the reptile. Most fluorescent lights produce 3-13 microwatts brand new (probably that much UVB available on a full moon night). Heat and UVA/B requirements can be better met by using Mercury vapor lamps, most of which produce at least 50+ microwatts at 12” distance.

There are some who are concerned about the exposure to UV radiation from mercury vapor lamps, and to that I say: that as long as you are not camped out within a few feet of these lights for an extended period, and you are not foolishly looking right at them, then they present little danger. At several feet away, many of these lamps have UV outputs which are no more than what you would get in sunlit room with a lot of windows. In fact, you probably get more exposure walking to your mailbox on a summer day, than standing 3 feet away from these lamps. Their most effective radiation is within a narrow cone from the face of the lamp. Aluminum domes can also be mounted to the fixtures to further shield from UV scatter.

Mega-Ray SB series UVA/B mercury vapor lamp. These lamps should be oriented vertically to prolong element life.

Due to recent reports of faulty manufacture in compact coil UVB lamps, which have allowed near UVC transmission and severe eye damage to herps as a result, it is advised that people refrain from purchasing these type of UV lamps, and to discard any you currently own. Due to the nature of their compact coil design, they are also grossly inefficient compared to linear tubes.

DO NOT PLACE LIZARD IN AN AQUARIUM OR PLASTIC BOX OUTDOORS-The heat retained by the glass or plastic will quickly overheat and kill the lizard, turning an 80 degree day into 120 degrees inside an enclosure space on the hot sand.

If using an outdoor setup: Provide areas where the lizard may bask in direct sunlight, and plenty of areas of shade for the lizard to retreat to during the day, and where the enclosure does not overheat. Remember, this lizard does not stay out in the sun all day. It retreats during mid-day to shade. The lizard will also derive some UV indirectly from reflected UV (scatter).

**Lighting Setup and Operation**

For an indoor setup, a basking and UV light source will be necessary on one end, and cooler spot on the opposite end to retreat from the heat. During spring and summer months, the lights should be in operation from 10-12 hours a day. Winter light cycles are addressed in the hibernation section. Most UV and basking lights will need to be within 2 ft. of the substrate to provide adequate heat and UV. Adjustments will be necessary to achieve optimal
Temperatures and Humidity

As with other all reptiles, and diurnal reptiles in particular, proper temperatures are critical. Most people understand that reptiles are "cold blooded". What this really means is that reptiles are dependent on their environment to provide heat. They cannot generate it sufficiently by taking in and burning calories through metabolism, the way that mammals do. Therefore, to keep organs and the immune system in working order, the reptile requires heat from its environment. Without proper temperatures, the reptile will not be active, and may show no interest in eating. If it does eat, its digestive and immune system may not operate properly, causing health problems and making it more prone to illness.

Ambient & Day Temps:

Basking side: 100F-110F. I prefer to keep warm side temps around 105F. It may reach 115F or so directly below the basking source, which is fine if the setup allows enough of a gradient to be established throughout the habitat and the lizard has plenty of space to thermoregulate. Properly sized terrariums are necessary for such gradients, otherwise the lizard will overheat. Do not allow temps above 115F in the basking area. Most HL species reach critical heat exposure above 115F.

Temperature will be higher directly under the basking heat source; therefore, average ambient temperature should be gauged at the substrate surface away from the center of the heat cone.

Cool side: 82F-86F

These lizards burrow in sand to thermoregulate and sleep. Often if it is particularly hot, they may burrow in a shaded area or under a cave hide. The mouth being held agape is a sign that this lizard is too hot. Remove it or provide a cooler environment right away!

- Offer your lizard shaded hides or shaded/cooler areas in which to burrow.
- Electric powered heat rocks are potentially dangerous to the reptile and should not be used. The reason is that a cold or sick reptile may remain on the rock too long and burn itself.

Night Temps:

Night temperatures can fall to ambient temperatures without need for nighttime heat or lighting, so long as you do not live in a refrigerator. It should obviously not get near freezing. If you live in an extreme latitude or colder climate than where these lizards naturally inhabit, an under tank or night heat element might be necessary. Outdoor habitats may require deeper substrate, insulated shelter hides, ceramic heat emitters, or infrared lighting, particularly in colder months or in extreme latitudes. I recommend keeping it above 50F at the substrate surface. At prolonged low temperatures, the lizard may go into hibernation. Temperatures of as high as 38F may be sufficient to cause cold weather injuries to exposed tissues.

Humidity for most Horned Lizard species is less important, and does not require a gauge to monitor constantly. The twice weekly misting with water of the lizard and his surroundings will provide adequate humidity. Some species
or individuals may benefit from a humidity of 40-60%, especially during shedding. Excessively humid conditions on a regular basis however, may pose respiratory infection risks for species that are native to strictly desert environments.

To simulate summer monsoon conditions common in Az., some may prefer to dampen one end of the terrarium substrate. Some species may enter aestivation periods mid-summer and wish to find a slightly damp place to burrow. During the latter half of the summer, during the egg laying season, females may benefit from having a slightly dampened area available, so they may dig an appropriate nest to lay their eggs.

One method of dampening just the bottom most layer of substrate, without pouring water over the top of the lizard an possibly aspirating it, or caking it in, is to use a length of surgical tubing or nasal canula, pierced with holes at intervals, which is buried under the substrate. A marinating syringe with needle may also be used, but use caution when poking around the substrate with a Horned Lizard somewhere below.

**Watering**

Most Horned Lizards will not drink directly from a dish. I have mainly used dishes as a basking pool. Horned Lizards usually drink by "rain harvesting". As water droplets fall on its back, water is carried to its mouth by numerous channels along its body through capillary action. You may notice the lizard "smacking" its mouth. This is how it most often drinks.

Some Horned Lizards may drink after being placed in a shallow bath. I occasionally do this to offer additional hydration. Though mine do not often drink this way, they sometimes will. As they stand in the water, it will begin to move up their limbs and along their back to their mouth. They may begin to rain harvest and smack their mouths. You may stimulate them to drink by dropping a few drops of water on their backs and head, which "primes" their skin to move the water along. I have found the best way to offer water to my Horned Lizards, is by misting their backs and enclosure with a spray bottle, and the general area around the lizards. They may sometimes lap water off rocks and other items in the enclosure as well. This method may take some time however, and typically, my HLs can drink for up to 10 minutes this way.

Some Horned Lizards may also respond to a dropper, and an alternate method of offering water is to place a drop of water on its snout, right on the nares. The lizard will soon take the water in from its nostrils and drink. The lizard is able to close the opening to the trachea, at the bottom of its mouth. This is generally more effective with captive bred lizards, as wild caught Horned Lizards may tend to be spooked by close interaction and utensils.

![Young *P. solare* drinking from syringe](image)
Most Horned Lizards are native to desert or semi-arid climates; therefore, they do not require constant water, though access to a water source may be helpful so they may hydrate or soak ad libitum. Horned Lizards will generally accept water no more than once or twice a week. Individual characteristics will vary, but I have never seen a Horned Lizard which will drink every day. If the lizard does not wish to drink, it will probably scurry off.

Ensure the water is close to room temp. Water that is too cold could be a shock to the lizard’s body temp. Offer only bottled/filtered or distilled water. Tap water and most "mineral" waters contain "hard" minerals/salts, which may upset the Horned Lizards electrolyte balance.

**Diet**

**Insectivorous**: The main dietary component for most Horned Lizards is the "Western" or "Red" Harvester Ant (Pogonomymex genus), making up 60%-90% of the diet. The Regal Horned Lizard (P. solare) and Desert Horned Lizard (P. platyrhinos) are very dependent on Harvester Ants in their diet. Harvester Ants contain formic acid, which provides proper gastrointestinal pH. This acidity promotes proper gastrointestinal flora and protects the lizard from GI tract illnesses, bacterial infection, and is believed to help fight intestinal parasites by promoting a less hospitable environment in the digestive system (Dr. Richard Montanucci -Herpetologist). The Horned Lizard also receives hydration from the chemical breakdown of formic acid in its stomach, which produces a small amount of water, salt, and CO2 as by-products. Formic acid is also a carboxylic acid, a simple source of building blocks for necessary and more complex protein chains.

Harvester ants, being harvesters of seeds and other protein rich plant matter, are also an excellent source of lean essential fatty acids for the Horned Lizard. They provide the protein the Horned Lizard needs without loading him down with heavy common feeder items (such as crickets and mealworms), which are usually high in fat and chitin, and which are relatively more difficult to digest.

Whenever captive, *Phrynosoma* will rarely survive if not given a regular offering of live ants (Sherbrooke, 1995).

Horned Lizards can on occasion be offered small/pinhead crickets, freshly shed mini-mealworms, waxworms, Phoenix worms, Butterworms, Silkworms, Bruchid beetles, and they really seem to enjoy a moth, mayfly, or other winged insect every now and then. Although, these are secondary or supplement foods and should not be used as a dietary staple for reasons outlined below.

Crickets, mealworms, and many other common insect feeders contain a high amount of chitin in the exoskeleton, and some are high in fats and salts (usually the larvae feeder items). They should be used in moderation in the diet of the Horned Lizard. The Horned Lizard’s system is not suitably adapted for these as a frequent meal, and Horned Lizards are sensitive enough without introducing new complications in the diet.
If offering crickets, mealworms, etc. to be safe, ensure that they are the smallest of the available sizes. Horned Lizards do not possess great jaw strength and are accustomed to small prey they lift by the tongue, such as ants. Additionally, an insect too large for the lizard may create digestive problems, and pose a risk of fatal gastric impaction. High chitin content can irritate the intestines and lead to impactions. Do not try to be frugal with prey and buy the larger size, since it is only a few cents more. It will make a difference in your HL’s proper functioning gut. Typically, the rule of thumb for prey offering in reptiles is no larger than ½ the width of the head. In HLs, it is best to stay smaller than this on prey size.

The fat and chitin content of many insect feeders requires the organs of the Horned Lizard to work too hard to break down and metabolize, in comparison to ants. It also requires extra water in the bowels to digest these components. This consumes the lizard’s water stores, which is not an ideal use of resources for a desert dwelling reptile. Insufficient hydration can lead to impaction, and for the Horned Lizard species that are desert dwelling, water stores are better put to use elsewhere in the body than being used to break down excessively fatty and chitinous meals.

Chitin is a long chain polysaccharide polymer, which is very strong, biodegrades slowly, and takes a lot of relative metabolic energy to break down. It is used for example in surgical sutures. This material slows down the digestion and normal bowel movements in the Horned Lizard. Though the harvester ant has a high amount of chitin in the exoskeleton, it is passed through and eliminated before it begins to breakdown. The essential nutrients from the harvester ant are contained in the gaster (stinger portion of the body), which does not have the same hard chitinous makeup as the rest of the exoskeleton. The essential nutrients are washed from the gaster with bowel secretions without the need for extensive digestion, as would be the case with crickets, mealworms, or other prey, where much of the food value of the insect resides underneath a hard chitinous exoskeleton, and must be digested to a greater degree.

The triglyceride fats, contained in overly fatty insect feeders, must have their molecular bonds broken down in digestion before the individual components can pass through the intestinal walls into the blood where they are then put to use, or recombined to be stored once again as fat in the animal. Triglyceride saturated fats are most common in animal sources, and often composed of a high number of carbon bonds (16 or 18 carbons). The more carbon bonds, the more heat required during metabolism to break them. Such metabolic work requires higher (or longer) metabolic activity (heat) to accomplish, and we already know that reptiles have a lower metabolic activity than mammals, fish, and birds. Think of the lethargy and energy conservation state of the crocodile or snake after a large meal. This is not required of the Horned Lizard when it is eating ants. The nutritional components are very simple and require little work before being put to use as energy for the lizard. The trade off is that the Horned Lizard must eat a high number of ants to maintain high activity levels. It just so happens that the Horned Lizard has a larger stomach in proportion to its overall size, for just such purposes!

To reduce the stress of captivity and moving the lizard to a new home, its natural staple prey is the best to offer to encourage eating. The Harvester ant is much leaner and nutrients more easily metabolized, thereby rendering needed energy to the lizard quickly and efficiently, with minimum strain on the organs and hydration state.

There have also been limited discussions amongst some Horned Lizard enthusiasts, about the possibility of Horned Lizards in the wild eating plant matter. Specifically, one case is cited from a popular book, “Krötenechsen” (Literal German-“Toad Lizard”) Bertrand Baur & Richard Montanucci (Herpeton Verlag); in which a P. platyrhinos in an outdoor habitat had dined on the fruit of a Deadly Nightshade plant (Atropa belladonna) that was meant for a Desert Iguana. This plant has some medicinal uses as a source of atropine, however, can be toxic to people and
domestic animals. Some non-domestic animals have been known to feed on the fruit of this plant without ill effect. It has been speculated that this might have been a form of self-medication by the lizard.

One Horned Lizard keeper known by this author, has stated that in the distant past he frequently offered chopped greens to his juvenile *P. coronatum*, and they apparently partook of them to some degree. He also stated that adults consumed red and green leaf lettuce, as well as flowers of *Alyssum maritimum*. I have not been able to duplicate this as of yet with any other species; however, it is of interest and something I continue to attempt from time to time. There is no harm in trying a few leafy greens, however, you should hold out no particular hope of making a leafy green plant eater out of your *Phrynosoma*.

**Handling and Offering of Harvester Ants**

Harvester Ants possess a potent sting, and some subspecies have been known to cause lethal dose in laboratory rats with as few as a dozen stings. People who are prone to anaphylaxis should use caution when handling these ants. Pogonomyrmex harvester ants are not quick to sting in general however. Having grown up in imported red fire ant country, I find harvester ants quite docile in comparison to the aggressiveness of fire ants. Harvester ants are also not difficult to handle by bare hand if need be. A loose harvester ant can be picked up by lightly pinching them mid-body. It is nearly impossible for them to sting in this position, as they bite with their mandibles first to gain leverage before being able to deploy their stinger barb. You can also easily roll them between the thumb and forefinger almost indefinitely without them getting a hold with which to sting.

When offering Harvester Ants place only a few at a time in with the lizard. Too many and they may turn aggressive and attack the lizard. The lizard may become stressed when confronted with more than a few ants in an enclosed space as well. The number of ants a Horned Lizard can handle at once will vary with the size of the habitat, and the species of the Horned Lizard. The *P. solare* tend to be very aggressive eaters, and will approach a relatively large number of ants to feed. In the wild, they will walk to within inches of the colony entrance and even eat ants that crawl about their head, or quickly shake them off and continue to eat. The *P. platyrhinus* is more of a trail ambusher, and prefers to pick off ants that are more spaced apart and consistent in their direction of travel. They tend to become much more stressed with a much lower number of ants, and will quickly retreat in the face of more than a couple of rowdy ants.

The Horned Lizard is believed to possess some immunity to the venom (or rather the venom is less effective against them, which can kill small rodents with as few as a dozen stings). Harvester ant venom it seems is more adapted to defend against small seed foraging mammals. The venom is roughly 1300 times less effective against the Texas Horned Lizard, as against a rat or mouse. However, it is apparent that Horned Lizards do feel some pain or discomfort from the sting. Harvester Ants, though slower to agitate and sting than say imported Red Fire Ants (*S. invicta*), nevertheless, possess a potent sting that is classed as one of the most painful in the insect world. This sting is similar to a bee or wasp sting and tends to be felt traveling up the lymphatic system in some cases. In the blood, the venom acts by causing the red cells to swell with excess water and burst (hemolytic venom). The person stung by Harvester Ants will often feel the sensation of wetness near the site of the sting.

Keep Harvester Ants hibernated/dormant in the refrigerator until ready for use. This will slow them down and make it easier for the lizard to eat. Place a few in a pile, preferably not directly under the heat source as this may kill them before they awaken, or make them too active too soon for the lizard to get to them. The lizard will approach the awakening ants to feed on them.

Offer your lizard a few ants at a time, many times a day if possible. Every time you have the chance to walk by the
lizard’s home, drop a few in. Any ants that have not been eaten in a timely fashion should be removed. If the lizard begins to panic and climb the walls when ants are introduced, reduce the number of ants. An adult Horned Lizard should be eating 50 or more ants a day, optimally. Some may even eat 100 or more. A juvenile or baby may eat 10-20 per day, depending on size. Offer the lizard as many ants as it feels like eating throughout the day, using common sense based on its individual size and the size of the specific species of Harvester Ants being used.

Placing cold harvester ants in an organized pile makes it easier for Horned Lizards to approach and eat. You may also use a high sided slick ceramic feeder dish, sunk into the substrate, which harvester ants may not be able to climb out of.

**Gathering Harvester Ants**

If you live in areas native to Red harvester ants, and you have the time to spare, you may want to gather your own ants. There are several means in which to do this ( pitfall method using a container, chimpanzee method using a stick or cloth and a plastic tub ), but the author believes that the easiest method is using a rechargeable handheld vacuum. After the ants are vacuumed into the container, dump them into jar by funnel, and refrigerate until they become dormant. Once activity has slowed or ceased, sift the ants from the sand and debris. The ants can then be refrigerated for storage, or put into a second container on its side, which is set above another bin or container, allowing them to wake and move about. Eventually, they will migrate toward the edge of the container they are in, and fall into the next, below it. In this way, the ants drop in, but leave most of the remaining debris behind.

One Horned Lizard can easily be supported with its daily ration of harvester ants by this method. But, you may have to gather everyday if you have only a few local colonies around, or you are keeping a P. solare. You must rotate the colonies you visit and take ants from, so as to not cause the colony too much loss, which they may not recover from. Be mindful of local wild Horned Lizards which may inhabit the area, and need that food resource as well.

A captive colony of harvester ants ( ant farm setup ) is not sufficient to support a Horned Lizard. The captive queen will not produce enough workers in such a small environment, and the colony will be quickly decimated by the demands of the Horned Lizard. If you have native harvester ants in your area, the best ant farm is nature.

**Additional notes about food items:**

*AVOID ALLOWING HORNED LIZARD TO EAT FIREFLIES/LIGHTNING BUGS. THEY ARE FATALLY TOXIC TO THESE AND MANY OTHER LIZARDS.*

In general, do not feed your Horned Lizard an insect you are not sure is safe for it. A good rule is not to give it anything that is not present in its native territory. For example: the ants you may be feeding it from outside in your
lawn might not exist where this lizard came from, and may be toxic to it. Not all ants are the same, and some actually contain alarm pheromones, which can be poisonous to the lizard. They also may not provide exactly what the Horned Lizard needs. Dr. Montanucci cites a case where he lost several of his young *P. ditmarsi* after feeding them “lawn ants” of the genus Iridomyrmex.

“Among a litter of 15 two-day-old *P. douglassii ornatum* to which I unknowingly fed these ants, five neonates thrashed violently, tried to disgorge the ants, and then died within 20 minutes. The remaining ten also went into convulsions, but eventually recovered.” R. Montanucci, *Maintenance & Propagation of Horned Lizards in Captivity*.

Some people have a tendency to buy these lizards and try to get out cheap by not buying the proper food. Don't try to get out of buying Harvester ants if you are going to get a Horned Lizard. It won't be very healthy without them, and you could potentially kill the lizard this way.

**Supplements**

To encourage proper bone development and prevent MBD, the reptile needs UVB. But, it also needs a proper Ca:P ratio to make use of that UVB. Without proper levels of any of these, the other factors are useless. Excessive phosphorus or other calcium binders will inhibit the proper use of calcium, however, phosphorous is needed for the process, hence the Ca:P ratio. There should be at least as much calcium as phosphorus present, and twice the amount would be better. Reptiles should optimally be given a diet with a Ca:P ratio of 1:1 or better (such as 2:1).

Insect feeders generally have a poor Ca:P ratio to begin with, and some are worse than others. Therefore, to make up for this, insects are feed a calcium high diet to “gut load” them, or they are dusted with calcium prior to being eaten. The precise calculation of Ca:P ratio for the lizard's entire diet is not usually practical, but doing a little research into the common Ca:P ratio for a given prey item and simply being aware of this factor is usually sufficient vigilance. The variety of insects the Horned Lizard eats in the wild cannot quite be duplicated in captivity with reliability; therefore, some adjustment in the captive dietary intake is necessary, though as little artificial means as possible is always best.

**Minerals**

For mineral needs, "Miner-all" from Sticky Tongue Farms is a recommended product. Mineral supplements containing 1:1, or better, calcium-to-phosphorus should be dusted onto crickets or other non-ant prey to improve their nutritional value. A straight calcium dust may also be used. Calcium is the only supplement that should be given with any frequency. There are substrates on the market, which are composed of calcium or contain calcium. Do not expect that all the lizard’s calcium needs can be met by using them. Some are actually dangerous, as described in the substrate section.

**Vitamins**

A reptile vitamin supplement once a week is more than sufficient. Twice monthly is better. A Horned Lizard on a proper diet will have little need for frequent vitamins. Do not follow label instructions, which advise vitamin supplements at every, or every other feeding. This is excessive. Excessive supplements can result in hypervitaminosis (poisoning), just as insufficient vitamins and minerals can create problems.

Vitamin D is a fat-soluble vitamin and a hormone produced as UVB radiation strikes the skin. The liver and kidney
help convert vitamin D to its active hormone form, D3. The major biological function of vitamin D3 is to signal the body to maintain normal blood levels of calcium and phosphorus, and regulate absorption of calcium. If the lizard is getting sufficient UVB however, there will be little or no need for D3 supplementation. **D3 IS NOT AN ALTERNATIVE TO GIVING THE LIZARD PROPER UVB EXPOSURE!**

The best way to keep a Horned Lizard healthy is to allow its systems to operate as naturally as possible. Using substitute methods and products, such as "UV drops" (D3) and D3 powder supplements, bypasses the natural operation of the lizard’s physiology and can create problems. In cases of inexperience and excessive use, these methods can be deadly to the animal. Vitamin D3 (Cholecalciferol) is also used as a rat and mouse poison, by causing hypercalcemia in the animal. Thus, as with anything, overuse can be a bad thing, and hormones should probably not be used as supplements by the average hobbyist/reptile keeper.

Avoid frequent use of reptile vitamin sprays. The reptile cannot absorb vitamins through its skin. It may keep the skin looking nice, but these sprays may also interfere with proper thermoregulation and D3 synthesis.

**Excrement of Bodily Waste**

A healthy and properly fed Horned Lizard will defecate every day, when fed a sufficient regular diet of ants. When fed a diet consisting of crickets, mealworms, or other items, the Horned Lizard will often take longer to digest and pass these items, perhaps up to 2 days.

Horned Lizard scat should be solid and contain very little moisture. A Horned Lizard eating sufficient ants in the diet will often pass scat that may be as long as the lizard’s own tail. It will appear surprisingly large given the size of the animal, but this is the nature of having to eat large numbers of ants. Horned Lizard scat will often be followed by crystalline urates, which will appear as a semi-solid yellowish-white substance. This is the way the Horned Lizard eliminates urinal waste through the renal system while still conserving water. Very little water is passed in the process, and the urates quickly dry into a solid mass.

Excessive salt is often additionally eliminated in the Horned Lizard through the nares (nostrils). The salt will accumulate around the nares. Periodically this salt accumulation will be removed by the lizard during normal activity, but it is a good practice to check and lightly brush, upward and away, any stubborn accumulations. Excessive and problematic salt accumulation probably points to excessive salt somewhere in the diet, or insufficient hydration.

**III. General Maintenance & Notes on Behavioral Characteristics**

**Shedding**

Your Horned Lizard will occasionally shed during the year, depending on its age and growth rate. A young lizard will typically shed several times a year until grown.

The beginning of the shedding process is usually first noticed around the snout. Once it has begun, the lizard may be less interested in eating until it has shed, though I have noticed that most Horned Lizards do not fast at all during the shedding process. It may take 2-3 days for most of the old skin to be removed. Once the skin has become fairly loose and much of it has begun to fall off, you may assist with the process by gently removing that which is loose in more problem areas for the lizard. These may include the toes and upper limbs, the horns, and
around the snout and eyes. Let the process go naturally for a few days, after which check the lizard over for any remaining skin. Use care in these delicate areas, but ensure that old skin has been removed to prevent infection, or other complications from developing in between the old and new layers. A soak in some warm water, rub with mineral oil, or a little skin conditioner spray at this time is sometimes helpful. Tweezers come in handy for this process as well. The nostrils will frequently be covered over by the old layer during shedding, and the horns will have a cap or "sheath" like cover, which usually has to be removed by the keeper. Take care removing any remaining old skin near the eyelids or nostrils. Horned Lizards will often flinch or squirm vigorously when these areas are touched and a stray utensil can do them harm. Pay particular care when working around the eyes, as some species do fight when these areas are touched.

Horn caps can be gently removed by lightly rubbing a toothpick at the base of the horn. Use the same technique to ensure that no skin is retained on the toes.

**Cleanliness and Prevention**

Keep different breeds, new animals separate, at least until they are deemed healthy, and parasite free. This will lessen the chance migration of certain diseases. It is recommended to disinfect your hands and utensils before coming into contact with animals in separate housing, especially those of different species. I prefer to use an antibacterial hand gel or soap.

In the case of any minor wounds, contact lens grade saline mixed 50/50 with betadine (povidone iodine) or Novalsan (chlorhexidine) may be used for irrigation and wound disinfection. An over the counter triple antibiotic cream every few days may also be required after wound rinsing. In the case of lingering or deep wounds, the lizard may require a systemic antibiotic, such as Baytril (enrofloxacin), from a reptile vet.

Horned Lizards frequently may get the substrate sand in their eyes. The Horned Lizard has a method to remove debris from its eyes by puffing up its eyelids, however, it is not always successful. Sand can be flushed from the Horned Lizard’s eyes, if needed, using an over the counter saline eye wash (sterile-no additives). In some instances, the eyes may be too irritated and the lizard will not keep its eyes open, or will close them when you are attempting. One method that has worked to open the eyes is to give the base of its tail a light and repeated squeeze. An assistant is helpful in these cases.

**Behavior**
Horned Lizards frequently like to attempt to climb the walls when they are stressed or new to an environment. While doing so they often stand on their tails, which can damage the vertebrae and break their tail. Their tails do not regenerate. To aid in reducing this behavior in indoor tanks, add landscape prints to at least 3 sides of the enclosure, and offer the lizard plenty of quiet and undisturbed time. As a temporary measure, a bed sheet may also be used to cover the tank. There is less chance the lizard will do this if it cannot see through the glass.

Horned Lizards do not like to be handled. They merely tolerate it, but it is stressful for them. You may notice them orienting their horns on their head in such a way as to protect themselves when touched. Many people think it is cute to rub their heads and watch them close their eyes and duck the head, like a dog enjoying a petting. However, this is actually not the case. This is a defensive posture against a perceived predator. Horned Lizards also frequently puff themselves up by inflating their lungs when they are scared. They do this to make themselves look bigger and more difficult to swallow. In addition, some species can, and do, squirt streams of blood from the vessels around their eyelids. This is another defense, though it is a display rarely directed toward humans. This defense is mainly reserved for canine and feline predators.

Horned Lizards also stress over frequent traffic, noises, or an audience too close to their enclosure, especially during feeding. Many will not eat if watched too closely.

Avoid housing more males in ratio to females. Excessive numbers of males will harass and highly stress the females, possibly contributing to their death. One male for every two or more females in a large enclosure would be most appropriate. If housing a male/female pair together, monitor the interaction closely. If the male is frequently chasing or otherwise harassing the female, or she seems inactive, stressed, or will not eat; remove her immediately to her own permanent separate quarters. It is best to introduce females into a habitat where a male has resided for some time, and is established in his home.

Notes about feeding and other habits of *P. platyrhinos*, *P. solare*, *P cornutum*, and *P. hernandesi*:

*P. platyrhinos* (Desert Horned Lizard)

Without a doubt, the most widely kept species of Horned Lizard is the Desert Horned Lizard (*P. platyrhinos*). This is chiefly because this species is still abundant in its natural range, and for that reason is offered the least protection; thus, many Desert Horned Lizards end up in the pet trade. The *platyrhinos* is a trail ambusher by nature, and does not react well when confronted with a large number of unorganized ants, which may be actively running about its enclosure and surrounding it. The *platyrhinos* is more of a sniper and prefers to sit just off the foraging trail used by harvester ants in shuttling food, picking off the ants one by one as they walk across its path. Feeding a *platyrhinos* may be a bit of a challenge to some, and requires patience. Often a keeper may have to sit in a feeding for some time with a *platyrhinos*, and offer only a few ants at a time. This species many times may cautiously approach its prey a few steps, catch its prey, and then withdraw several steps backward rapidly. If ants begin to crawl on the *platyrhinos*, it will often run away and attempt to shake off the piggybacking ant. Overall, they may be less sensitive to being watched during feeding than some other species of Horned Lizard once settled, but the keeper would be advised to keep a distance during observation and make as few movements as possible.

Another observation of *platyrhinos*, is that they not only burrow in the manner for sleep as most Horned Lizards do, but that they also like to dig burrows, or dens, particularly under dishes, rocks, and other tank decor. For this reason, one should use caution with heavy rocks or stacked rocks in the enclosure, to help prevent collapses onto
the lizard. They seem to enjoy partially buried cave hides, and I am currently experimenting with different sand substrates and a new clay type substrate to build dens for them.

*P. platyrhinos*, would have to be the first consideration as an entry level species to *Phrynosoma*.

**P. solare** (Regal Horned Lizard)

The *P. solare* (Regal Horned Lizard) is a much less common species, and while it is as docile in captivity as the *platyrhinos*, sometimes more so, it can still tend to be a bit sensitive to stresses and being watched too closely at first. A well-adjusted *solare* may settle enough after some time, not being bothered very much, even by the close presence of the keeper during feeding. Given some time, they might even take food items from the hand. It has been my experience that *solare* are one of the least timid species during feeding, even continuing to eat while my hand moved food items right to them. The *solare* is very dependent on harvester ants, and does very poorly, very quickly, if not offered a huge amount of ants regularly. The *solare* is a vicious anteater, and does not require ambushing techniques from a trail in order to eat its prey. The *solare* prefers a frontal assault, and will often directly approach a colony, which is swarming with hundreds of workers. They may sit just at the perimeter of the colony and pick off each soldier that comes to meet it, or walk right up to within inches of the colony entrance and eat 1-2 ants per second. *Solare* often continue to eat after being swarmed with ants, sometimes picking off the ants that crawl across their face and limbs, or dismounting an attacker with a rapid shake of the head, or a flick of the hind leg. Seldom do they run away from large numbers of ants, unless they are being stung. The nature of the *solare* is to remain very still, except the motion of its head while feeding, and this seems to assist in preventing stings. In captivity, an adult *solare* can usually be offered several dozen pre-refrigerated ants at one time. Once the ants begin to warm and stir out of their dormant state, the *solare* will approach and quickly pick them off. Individual personalities and enclosure size will also determine how many ants a particular Horned Lizard feels safe confronting.

**P. cornutum** (Texas Horned Lizard)

The *P. cornutum* (Texas Horned Lizard) is becoming more widespread in the pet trade again. Despite the fact that they are one of the most protected across their range, sources of captive bred or legally acquired (and probably illegally acquired) are bringing the Texas Horned Lizard into more and more pet stores across the country once again. It is a trend that this author is personally dead set against, for the reason that the *P. cornutum* is one of the most sensitive to stress and jumpiest in captivity of all Horned Lizards. Even captive bred *cornutum* seem to be highly sensitive, and it is a virtual death sentence for anyone to offer them for sale to the unprofessional, general public.

*P. cornutum* absolutely do not like to be handled, or to be watched at all while feeding. In the wild, they sometimes sit and wait in ambush near a harvester ant trail, or they may approach the perimeter of a less active ant colony. They are not as spooked normally by the numbers of ants that would startle a *platyrhinos*, but they are not always as brazen as the *solare*. They will stand their ground for a time and continue to feed, and shake off climbers if not more than a few in number. They love varied prey, even more so than others such as *platyrhinos*, and have great jaw strength in comparison to other *Phrynosoma*, indicating that they are also suited to catch and sufficiently masticate crickets, grasshoppers, beetles, and other larger prey with harder exoskeletons. I have found *cornutum* to consistently have greater jaw strength than even *P. hernandesii*, which runs contrary to previous schools of thought on the jaw strength of *P. hernandesii*, based on their higher elevation habitats; which were presumed to include fewer ants in the diet, and more large invertebrates. Having to perform any type of invasive
mouth inspection or medicating of a \textit{P. cornutum} is quite a chore and nearly impossible to do by force without harming them.

In the wild, \textit{cornutum} appear to have very good eye sight, and frequently will dart away quickly to cover when you are still many yards away, if they feel exposed or like they can make it in time. This is the opposite of what most \textit{solare} will do. They are large Horned Lizards, but very fast on their feet. In comparison, \textit{solare} prove easy to pick up when you can spot them, though their camouflage is excellent and they are hard to spot. However, \textit{cornutum} may reveal themselves by running; usually when they do, you are going to have trouble keeping up, as they are fast and rapidly stop several yards away to blend in, or under cover. Your eyes will continue to track the target that stopped a little while ago. They are very spry and nervous; and I think of them as the squirrels of the Horned Lizard world.

I should also take a minute to caution anyone who is holding a \textit{cornutum} in his or her hands. \textit{P. cornutum} must be handled with both hands and gently restrained from jumping by the upper body, to prevent them from being injured. \textit{P. cornutum} can, and do, leap from your hands without any warning after sitting for some time very docile in your palm. This advice applies to all Horned Lizards, but especially \textit{cornutum}.

\textbf{P. hernandesi (Mountain Short-Horned Lizard)}

The \textit{P. hernandesi} (Mountain Short-Horned Lizard) remains somewhat rare in the pet trade and is protected in much of its range, though is a popular species among researchers and serious Horned Lizard enthusiasts. The hernandesi is a cold climate, high elevation species, which gives birth to live young. For these reasons, it is obviously a subject of interest. Because it is normally found in high elevations and among rugged terrain, it tends to enjoy some protection from collection by novices through casual encounters.

In my experience with \textit{hernandesi} thus far, they appear to be intelligent, aware, and very docile; which is to say that they are less apt to show displays of stress, or timidness, than many other species. They seem to settle quite quickly. In just a few days, they were easily conditioned to take food readily from the hand, and approached with interest anytime a hand appeared. With some of the more powerful jaws among the Horned Lizards, they are able to easy take many invertebrates that another Horned Lizard might pass on.

\textit{P. hernandesi} historically have not fared as well in captivity even as some of the other species however. They are not recommended for those new to \textit{Phrynosoma}.

**Visual Display Behaviors**

**Head Bobbing** - You may notice, particularly with a Horned Lizard fresh from the wild or with more than one Horned Lizard, a quick up and down motion of the head. This head bobbing is a form of communication. It is observed sometimes during basking or other relaxed activity, but most often it is seen during feeding, foraging, or exploring a habitat. It is most often seen when Horned Lizards approach each other, or particularly when a male sees a female, or a male sees another male. The Horned Lizard is either looking for a reply to his bob, to see if others are there, or it is communicating something directly to the other, perhaps to ascertain species or other information. Each species has its own particular variation of the head bob. What this communication is about, exactly, is unclear. The communication may be used as a territorial signal for other Horned Lizards to go somewhere else, especially during feeding. Although some observances of aggression toward different species have been recorded, Horned Lizards are not generally known to be aggressive to one another.
**Tail Wagging** - This is sometimes observed when feeding on ants, but in my experience is most often observed when eating crickets, moths, mealworms or other less frequent prey. Though it is by no means conclusive, it is considered to be a sign that the lizard is excited by the prey, and a healthy sign of how the lizard feels in its environment. Tail wagging is seen just before the Horned Lizard strikes for its prey, and may or may not be accompanied afterward by a bob of the head. I have seen tail wagging in some *platyrhinos* when offered harvester ants, or misted with water.

**Slow Tail Wag** - This is believed by this author to be a sign of submission (or aggravation) and is usually only seen at times when a female Horned Lizard is picked up for physical examination. It is a very specific rolling or “wave” type of wag, much like what may be seen in an agitated cat. It is also observed in female Horned Lizards, which seem to be receptive to mating.

**Upturned Tail** - This may be a sign of an agitated Horned Lizard that wishes to be left alone, or a sign of submission. It is also often seen when a female Horned Lizard is receptive to a male and wishes to mate. If so, the female will often dart in front on the male and raise her tail. It is also seen when a female is startled and is possibly displaying that she is female, so to avoid aggression directed toward her. I have also observed a male *P. platyrhinos* use an upturned tail when confronted with several other male *platyrhinos* from a different geographical location. This display took on a more curved appearance, being bent more toward mid-tail, than at the base of the vent as is seen in females. A downward turned tail has been observed in a juvenile male *P. cornutum*, which was engaging in defensive behaviors, with elevation on all fours limbs and threatened biting behavior.

**Body Tilting** - Often seen when a Horned Lizard is approached, and usually when it is touched. Many people rub the lizard’s abdominal fringe scales and falsely believe the lizard is enjoying being rubbed. It is actually a defense to prevent a predator from getting a lower jaw underneath the lizard and picking it up by mouth. The Horned Lizard drives that portion of its body downward into the ground to shield itself. A Horned Lizard also uses this body tilting in the early morning or late afternoon to bask, by flattening its body and pointing its back toward the sun.

![Female *P. hernandesi* warms in the morning sun by body tilting](image)

**Horn/Head Tilt** - Many people like to rub Horned Lizards about the head, and the lizard will often close its eyes and tilt the head downward. Again, this does not mean the lizard is enjoying its petting. It is another defense against predators, and it does this to orient its horns upward as a defense against being eaten. It thinks you are a threat, and it is stressed.

**Body Inflation** - Another famous defense used by Horned Lizards. The lizard inflates its lungs to make itself appear too large to eat, and to display its array of spiked body armor. It may also, on rare occasions, jump at an attacker, hiss, or threaten to bite.
**Blood Squirt** - This is the most famous of all Horned Lizard behaviors, though it is really quite rarely seen toward humans. This defense is most often directed at canine and feline predators, and the threatened Horned Lizard will attempt to squirt a stream of blood right into the mouth or eyes of the predator. For unknown reasons, the taste of this blood is foul to certain predators (except birds), and it will usually back away from the lizard and rub its snout in the grass, or with its paws to remove the taste. Meanwhile, the lizard is scurrying away to safety. Against humans, this behavior is seldom displayed unless the lizard is very startled and abruptly handled. The *P. cornutum* and *P. solare* are most noted for this behavior, though a few other species have been observed to do so as well.

**Tongue Flicking or Licking** - Like snakes, lizards have a vomeronasal or “Jacobson’s” organ at the roof of their mouth, which is used to smell with by sampling with the tongue. In many lizards, such as the Horned Lizard, this organ has a reduced functionality. Species of lizard, which have forked tongues similar to snakes, have more sensitivity to scent molecules in the air and make more use of this organ, yet the Horned Lizard can still smell by direct sampling. It makes use of this by frequently licking the rocks, sand, and even other animals around it to sample for scent molecules. The forked tongue reptile has many advantages by detecting scents from long range on the air. This may come into use in detecting females for mating, the scent of another male’s territory, finding water, detecting predators, or tracking prey. The Horned Lizard may still be able to utilize some of this information by sampling through direct contact. Horned lizards are sometimes observed licking each other on or near the head, perhaps ascertaining identity or some other scent-related information, and it is seen in females who appear to be receptive to mating, often accompanied by rapid head bobbing and wagging of the tail against the ground.

**Burrowing** - The Horned Lizard burrows to hide from predators during sleep and to stay warm at night. They lose heat much slower on cold nights when buried rather than exposed to the air. The Horned Lizard also burrows during the heat of the day to cool off or hide.
Color Change - The Horned Lizard, like many other lizards, uses color-adjusting pigment cells in its skin to lighten or darken its coloration. This is commonly seen when the lizard is initially basking in the morning when it is cold, and attempting to maximize heat absorption. As it heats up, it will lighten its coloration to thermoregulate. Skin darkening ( or “blackening” ) is also seen when the lizard is sick, or in fight or flight mode, and is stressed. In a lizard that is ill, the skin darkening serves the same purpose as the fever in the mammal. Since the reptile cannot generate its own heat from muscle “shiver” the way that mammals can, it relies on taking in extra heat from the environment to boost its temperature. In the “fight or flight” mode, when the lizard is stressed, it will darken its skin. This purpose is to boost its temperature, and thereby the blood pressure and circulation, in order to maximize its response; be it running, blood squirting, or other defensive measures.

“Peek-a-boo” - This refers to the act the Horned Lizard usually takes in the morning as it first awakes and is preparing to get up. What it is doing with its head poking out of the sand, is allowing the blood flowing through its head to heat and warm up the brain as it surveys the area for threats, etc. In this manner, it can see what is around it while minimizing its exposure. The Horned Lizard has the ability to regulate the blood flowing in and out of its head to the body, and in so doing, can warm its blood and brain more rapidly. Once this happens, it can begin to shunt some of this blood to the body to warm its limbs for movement.
**Dominance or possessive displays with the feet** - Many lizards use the placement of a foot onto another lizard to indicate dominance or possessiveness over a mate. Though this is usually seen in larger Iguanids or Pogona, this has been observed in Horned Lizards as well by the author.

**Aggressive displays** - Though more rare in Phrynosoma, occasionally a Horned Lizard may display aggression toward another. A case of a Horned Lizard biting a rival on the tail and limbs, and proceeding to drag it some distance has been documented previously. I have observed similar behavior on two separate occasions from an individual Horned Lizard (a juvenile female *P. cornutum*). In one case, the lizard became agitated than an elder female had repeatedly taken her mealworms from directly under her snout, and she abruptly approached the older lizard, dropped her head as a bull, and delivered the larger lizard a swift head butt. On another occasion, the larger female accidentally repeatedly stepped upon the juvenile who was partially burrowed in sand. The juvenile abruptly emerged from the sand to again strike the elder Horned Lizard in the same fashion. It should be noted that this particular *P. cornutum* had a disposition that made this behavior less of a surprise than perhaps it should have been otherwise. She also remains the only example to actually deliver a squirt of blood at me upon being picked up. Though being fully capable of this, and I have seen many blood squirting “threats” (with swelling of the eyelids), Horned Lizards do not typically display this behavior toward people unless extremely agitated or surprised.

**Climbing** - Though not known for being arboreal, some Horned Lizards, such as the *P. cornutum*, may sometimes climb into small trees and bushes in the wild to sleep, and, get off the ground and away from predators. Most frequently in captivity, this behavior is observed when a Horned Lizard is stressed, and it will try to climb the walls of the enclosure.
IV. Advanced Husbandry

NOTE: Many of the medical procedures outlined in this section are potentially fatal to the animal if not performed properly. These medical procedures are intended for the use of herpetologists and reptile keepers of an advanced level, who have some knowledge of veterinary medicine. If you lack this level of expertise, do not attempt these procedures. Take your animal to a reptile veterinarian.

Horned Lizards, like most reptiles, can die seemingly quickly without apparent notice of symptoms, or soon after symptoms are discovered. The reason is that reptiles attempt to hide symptoms of their illnesses as long as possible in the wild, so as not to be singled out by a predator for being weak and easy prey. Many times when the less experienced reptile keeper notices a problem, it can already be too late. Thus, prevention and proper husbandry with reptiles is key, as well as not wasting time when illness is suspected. A visit to a competent reptile vet as soon as possible is the best course. Many times a year I answer questions on various forums related to a sick reptile, where someone is seeking "urgent help!", "lizard dying!", etc. What people need to understand is that while many of us on forums can offer good advice and probably diagnose the possible problem(s) with enough information; those seeking such help are not often versed enough in reptiles to give accurate and complete details, and such correspondence is unnecessarily time consuming. This wastes vital time for the dying animal that should be on the way to the vet instead. The forum can be used to seek second opinions and avenues to look into after the animal is in vet care. Additionally one must be on top of their husbandry game with these lizards, as some reptile vets shy from even seeing them; either because they are unsure of their legal status as a pet, or because they are not familiar enough with this genus to be comfortable treating them.

Signs of Illness

A Horned Lizard that is stressed, cold, or sick, may take on a darker coloration. A lizard that is merely stressed may be dark, but otherwise alert and active. Remove or reduce factors that could be contributing to stress.

A lizard that is too cold, or is sick may, in addition to having a dark skin color, also sleep frequently above the substrate, show lethargy, disinterest in eating, and may not open its eyes. Check temps., and warm if needed. The lizard changes the pigmentation structure in its skin in these cases to allow it to absorb more heat, thus generating a type of artificial fever, since it cannot generate a fever through muscle shiver the way that mammals do.

If its condition does not improve, take it to a competent reptile vet, preferably one who knows Iguanid lizards.

A reptile exhibiting these common signs of illness should have possible issues addressed immediately:

- Continually darkened skin color even under basking temps and UV
- Loss of appetite
- Lethargy
- Lack of coordination (ataxia)
- Paralysis or partial paralysis (particularly of the hind limbs)
- "Stargazing" (staring into space for extended periods without apparent reason or reaction to visual stimuli)
- Seizure of any kind
- Sitting in one location for most of the day, with eyes closed and without much reaction to being disturbed
- Refusal to open eyes even when disturbed
- Refusal to burrow (for burrowing species)
• Lack of self righting reflex when inverted (Some Hls may remain more still than others while inverted)
• Regurgitation
• Mouth agape or labored breathing
• Eyes having sunken-in appearance
• Watery, off colored, or foul smelling feces

**Common Illnesses & Medical Treatments**

**Gastroenteritis and Gastroenteritic Infections**

A common illness among captive Horned Lizards is gastroenteritis (intestinal inflammation or lesions) due to irritation or infection, as noted by Dr. Richard Montanucci (Montanucci- *Maintenance & Propagation of Horned Lizards in Captivity* - 1989). Among captive Horned Lizards he studied with illness, Montanucci attributed roughly 56% of those illnesses to gastroenteritis and related bacterial infections. Gastroenteritis and gastroenteritic related infection can commonly be caused, or contributed to, by prey that is too large, too continuous, prey that is filthy or diseased (often crickets), by parasites such as nematodes attached to the intestinal walls, or by ingestion of foreign matter that irritates the bowels, leading to infection. This author also additionally feels that captive stresses on Horned Lizards which may reduce normal immune response, is a significant concern in allowing such infections. Gastroenteritis of a bacterial nature was effectively treated by Montanucci with oral Tetracycline 20mg/Kg. For resistant strains, an Aminoglycoside antibiotic was recommended (Montanucci-ibid).

Additional hydration support therapy should be performed during administration of such antibiotics to prevent damage to kidneys and liver, and ideally any antibiotics given by injection should be administered intramuscularly in the front third portion of the reptile so as not to be routed directly to the renal portal system. Prolonged use of Aminoglycosides or Tetracyclines may have toxic effects to the kidneys. Outdated Tetracycline is highly toxic to kidneys and should not be used.

Given the time since Montanucci's article was published, other products such as Baytril (enrofloxacin) may need to be evaluated in the Horned Lizard. Baytril and other antibiotics of that class have their own set of concerns for adverse side effects, and their overuse in Europe is blamed on resistant enteritis causing bacteria strains; however, Baytril's possible damage to joint and muscle tissue seems to be less cause for concern than kidney damage from Tetracycline or Aminoglycosides. Baytril should be avoided if possible in juveniles, as the adverse effects are most pronounced on the young. It is a very good broad spectrum antibiotic against numerous types of infection, though I have used oral Clindamycin and cephalosporin class antibiotics to great effect in Horned Lizards. The adverse effects of these classes of drugs are much lower when dosed properly. Clindamycin is not absorbed by the intestine, and therefore only effective orally on digestive/gastrointestinal infection, or as a topical treatment.

Gastroenteritis caused by adenovirus infection seems to be increasingly common in reptiles, and has high mortality rates. Symptoms of gastroenteritis commonly include those previously listed, as well as:

• Elevated upper body posture (pushed up on its forelimbs)
• Visible labored breathing (normal breathing is less frequent and more subtle)
• Mouth agape breathing
• Watery, off colored, or foul smelling feces
• Distended abdomen
**Impaction**

A lizard with an impaction may exhibit most of the above symptoms ( except passing scat ). This is a serious situation, which could result in death if not treated quickly. Impaction is usually caused by ingestion of foreign matter such as rocks or other substrate, overfeeding prey other than ants, feeding prey that is too large, or dehydration. Suspected impactions are often treated initially with warm water soaks. While this may help, it most often does not. Immediate supplemental hydration through drinking water and/or saline should also be offered, and the lower abdomen may be lightly massaged to aid the process. If this does not render results quickly and if the lizard has not passed scat in several days, and has stopped eating, it may require further laxative. The Horned Lizard does not typically go as long between meals as can other reptiles. Further treatment for impaction should ideally be performed by a vet, or under direction of a vet, as if done improperly it can give the lizard diarrhea and dehydrate it very quickly, possibly leading to further complications and death. I have had success treating impactions with careful cloacal irrigation of light mineral oil or saline, or very small ( a few pinhead size ) drops of Milk of Magnesia given orally.

Another type of impaction, which is likely with males, is hemipene impaction with seminal deposits. A male lizard may accumulate these seminal plugs in the hemipenal area of the vent. These plugs are usually passed with the scat during the normal course of defecation, or the lizard may evert his hemipenes from the vent in order to clear them. In some cases, the plugs may remain and cause a buildup, which can lead to blockage, prolapse, swelling, pain, and loss of circulation to the hemipenes, infection, tissue necrosis, and need for amputation. On occasional inspection, you may find these deposits accumulating. If so, they can sometimes be removed gently with the use of soft covered tweezers, or by gently evertting the hemipenes and cleaning with a moistened q-tip with a rolling motion.

* As with many of the medical maintenance tips given in this manual; do not attempt this if you are inexperienced in such techniques, are unsteady of hand, or have poor eyesight.

**Prolapse**

A prolapse occurs when an internal organ or tissue is pushed out of the cloaca ( vent ). The prolapse can be of a sexual organ ( male-hemipenes ) or of the intestines. Prolapses of sexual organs ( hemipenes ) in males are somewhat normal and usually not indicative of a problem so long as there no apparent injury or bowel related difficulty that caused it. The lizard usually remedies this situation in his own time.

A prolapse of the intestinal tissue is a serious matter that requires immediate attention to prevent death. If the prolapsed intestine is not corrected soon, the organ will dry out, may be punctured, inflamed, or develop infection. If the intestine is damaged or prolapsed for too long without treatment, the lizard may not survive even if it is put back into place.

A prolapse can most commonly occur as a result of impaction, from dehydration, or from overfeeding. In this situation, the organ should be rinsed with sterile saline or room temperature clean water. The lizard should be taken to a reptile vet immediately. If this is not possible right away, the lizard should be placed in a room temperature sugar water bath for about half an hour to see if the intestine will retract, at least partially. An alternative method is to apply a heavy sugar/water paste to the organ very gently with a cotton swab, which may help reduce swelling and ease correcting the matter on its own. Do not allow the sugar water mixture to dry out on the tissue. If this does not help, then keep the tissue clean and moist until you get to a vet. Keep the organ
covered, protected, and moist at all times through continual soaks or close contact with damp paper towels, and/or with mineral oil coat of the exposed tissue. Even should the organ be retracted back into the body cavity, the lizard should still see a vet soon for follow up. To prevent tissue damage, inexperienced keepers should not attempt to push the organ back in. Retraction of the organ is a delicate procedure and even the smallest perforation can be fatal.

**Emaciation/Dehydration**

Occasionally a Horned Lizard may lose interest in eating because of stress or improper food items, or due to illness. In the case where the lizard loses weight to the point that it is dangerously emaciated, force-feeding may be required to hydrate and give nutrients while the lizard recovers. There are rescue powder formulations on the market which when mixed with a fluid, provide enough nutrients to the lizard for these purposes. If a reptile is ill enough that it requires force feeding, then it should ideally be taken to a reptile veterinarian for stomach tubing. Novices should not attempt to force feed a reptile, particularly the Horned Lizard, which has small jaw parts and teeth which may be damaged if done improperly. Any wounds caused by improper forcing of the mouth may lead to additional problems in the form of stomatitis (mouth rot infection).

Force-feeding of whole insect prey is not advised in the weakened state of the reptile, as it is difficult and may lead to extra stress and trauma. It will also needlessly burden the biology of the reptile by requiring its digestive system to work more than it should in such a state. The digestion of whole prey in the seriously ill reptile may not take place in its weakened state, which will not render to it the necessary nutrients. This may also cause needless consumption of water from other organs such as the liver, kidneys, heart, and lungs; diverting it to the bowels when it is really needed in those other vital systems to fight the illness.

If force-feeding is required, I recommend using liquid formulations such as Critical Care for carnivores or Fluker’s Repta-Aid. The formula can be mixed according to the included chart, with a liquid solution of 50/50 Pedialyte and sterile saline or distilled water. The formula should be room temperature or slightly warm to prevent hypothermia to the animal. Other necessary items for the administration of tube feeding formulas are: a syringe 1cc or smaller (without needle), and a feeding tube (5Fr-gauge or smaller) lubricated with a light coat of mineral oil. Ensure that insertion of the feeding catheter is not forced; that it does not go farther than necessary down the esophagus, and that the tube does not accidentally run into the trachea, which is the opening at the bottom of the mouth (on top of the tongue). The catheter should glide easily. Pre-measuring the catheter to about 1/3 the length of the lizard, from the mouth, is usually a safe distance for administration of liquid diets. The tube must be far enough in to prevent the lizard aspirating on the liquid, but not so far as to do damage to the stomach or blowing right past into the bowels. For these reasons, it is recommended this not be attempted by the inexperienced reptile keeper, if at all possible.

When in doubt, it must always be assumed that the lizard is possibly dehydrated as well, and fluids should always be part of a force-feeding protocol. Even a reptile which is sick, but does not yet require force feeding, should be offered constant hydration to ensure optimal biological function. The reptile should be sufficiently hydrated before being fed anything while sick. Typical practices for hydration therapy in most reptiles suggest 2% of body weight q.24hrs, or 20ml/Kg q.24-48hrs.

Caution must be taken to avoid over hydration, which can set up a roller coaster of diarrhea and continued dehydration.
A dehydrated Horned Lizard will show sunken eyes, and the rim of the eye sockets will be visible. The skin of a dehydrated Horned Lizard may also “tent” when pinched, rather than return to its original position. This most often shows up on the soft belly skin. Dehydration often goes hand in hand with illness. Either the dehydration will result in illness, or a poorly managed illness will result in dehydration. For a Horned Lizard, which is not taking water by dropper or misting, daily soaks in a luke-warm bath of purified (non-tap) water are recommended to assist rehydration. If unsuccessful, fluid administration by cloaca tube, stomach tube, or subcutaneous injection may be required. Hydration fluid injections to Horned Lizards should be given with the smallest needle possible and should be given in several locations about the limbs or tail to ease discomfort and prevent tissue damage. I use 3/10 cc insulin syringes with a 30-31 gauge needle, injected SQ in-between the soft scalation on the underside of the limbs, and ventrolateral the vertebrae in the tail, injecting one or two units at a time.

**Drowning/Aspiration**

In the case of drowning, or aspiration of fluid during force hydration, the reptile has the ability to survive for some time without oxygen due to its low metabolic activity. Emergency resuscitation can be performed.

Invert the reptile with its head facing downward to allow any fluid to drain. Pump its limbs inward and outward from its body. In the case of Horned Lizards, which have their ribs oriented horizontally and parallel to the spine, you may further assist in expelling the fluid and taking in air by gently squeezing the flexible rib cage inward on either side and pushing slightly to the rear along the abdominal fringe, then reversing the motion. Oxygen is helpful if available, though the reptile won’t be stimulated to breathe on its own until O2 levels in its blood drop. Partial mixture with room air may further help. If the reptile regains consciousness and begins to breathe on its own, a nebulizer treatment later may be helpful to assist expulsion of remaining fluid. Antibiotic treatment may be necessary to prevent or treat possible ensuing pneumonia.

**Parasites**

**Internal Parasites:**
Prey insects may contain microorganisms or other parasites. The Harvester Ant is known to be a common intermediate host of nematodes, which are a common reptile gastric parasite. Horned Lizards deal with this in the wild; but captive stresses on a Horned Lizard, which can reduce immune system function, can cause an increase of parasitic proliferation, and cause complications or illness. Crickets can be particularly filthy if not kept in clean conditions, and this can contribute to disease and parasites. Ammonia levels from crickets kept confined in closed spaces can cause illness when eaten by Horned Lizards.

There has been much discussion amongst experienced Horned Lizard keepers about the necessity of treating Horned Lizards for parasites. Some advocate less interference with the lizard’s physiology and possible pH/electrolyte imbalance. This author views this as a valid concern, however, feels the benefits of such infrequent intrusion (twice yearly) outweighs the potential consequences of untreated parasitic infestation. Untreated heavy parasite load can lead to fatal anemia as the parasites steal nutrients from the lizard.

The Horned Lizard should be treated for internal parasites with liquid Panacur (fenbendazole 50-100mg/Kg), as needed when nematodes are discovered, and optionally before and after hibernation. See “parasites” under the hibernation section for more. If gastric parasites are suspected, most vets will perform a fecal floatation or slide smear inspection to detect presence of parasites at relatively low cost. More than one test may be required before giving clear bill of health however, as evidence of parasites is not always present in every sample.
Mites:
Mites do not normally infest Horned Lizards, due to the dry and hot conditions of the substrate Horned Lizards are normally kept on. If you are using a substrate other than sand, or are keeping the substrate too humid for a species other than hernandesi or douglassi, then there is always the chance for mites. There are many commercial reptile or bird mite sprays and treatment products on the market; however, I do not advise using 90+% of them. Many of these sprays contain, basically, a dilute nerve agent pesticides such as pyrethrins or permethrin. I prefer instead in these situations to coat the animal down with mineral oil and let sit for up to half an hour. These oils have good penetration between scales, and will smother the mites. They will either leave the reptile or suffocate.

Alternatively, Panacur ( which is covered in the hibernation section ), also makes a great topical application to kill mites when diluted 50% with saline or distilled water. This method takes a little longer to work, but is very safe. One commercial off the shelf product, which seems to be safe for reptiles, is “Reptile Relief” by Natural Chemistry. This product also may take some time to work, but is safer than others. Mites that have formed abscesses below the skin will likely need the skin incised and the mites removed by a vet. These products must come into direct contact with the parasite to be effective.

Stomatitis ( Mouth Rot )

Stomatitis is a common illness normally caused by opportunistic infection after a gum or mouth injury. If left untreated, it can progress and spread to other parts of the body, such as the lungs, where it will result in respiratory infection that could be fatal. Even if it does not spread, the mouth infection itself usually results in pain and weight loss for the reptile, as it is usually in too much pain to eat. For a Horned Lizard, this condition can prove fatal in little more than a week. Injuries that lead to stomatitis typically result from stressed lizards running into the glass repeatedly, or from incorrect mouth prey by the keeper, which tears the gums or other mouth tissue allowing later infection. These injuries can be difficult to spot early with the normal eye. I recommend you always keep a 10x jewelers type magnifying lens (Loupe ) on hand and inspect your lizard frequently for such injuries, debris in the eye, small parasites, retained shed on the toes, and many other conditions. It is an invaluable piece of husbandry equipment for such purposes.

A jeweler’s Loupe is invaluable for examining Horned Lizards for injuries and other medical issues.

Stomatitis can be treated initially with a saline debris wash. For external injuries of the mouth: treat the wound by dabbing with q-tip soaked with chlorhexidine ( Dermachlor or Novalsan ), dilute povidone iodine ( Betadine ), benzalkonium chloride ( Bactine ), or 3% hydrogen peroxide. Ensure it is not swallowed by the lizard. For initial treatment, or until you can get to a vet, a topical application of triple antibiotic gel may help ( the keeper must insure that the gel does not attract more debris to the wound, and the lizard may have to be moved onto paper towels instead of sand until the condition clears ). These infections may spread subcutaneously to the inner gums, other tissues, or jawbone, and can be fatal if systemic antibiotics are not prescribed. In these cases, the lizard may require oral antibiotics such as Baytril or Clindamycin. I have used Clindamycin topicaly on stomatitis mouth
abscesses in Horned Lizards with successful recovery.

Among Horned Lizards, *P. solare* are particularly prone to stomatitis and mouth injury it seems. In this author’s experience, a higher incidence of *P. solare* have been treated for mouth abscesses and injuries that other species of Horned Lizard. There seems to be a corresponding connection between this higher incidence of mouth abscesses in *P. solare*, and the build and strength of their jaw. *P. solare* have one of the weakest jaw strengths of the of the Horned Lizards, and the weakest amongst species kept by this author. This correlates to the extremely high numbers of ants they eat in the wild, which do not require them to have the jaw strength that others, such as *cornutum*, has. They also seem to have more delicate scololation across the mouth than other species. I speculate that the delicate build of the *solare’s* jaw and thin scolasion, leads to a higher incidence of mouth injuries and abscesses, from their common habit of rubbing their jaws against glass of the terrarium in an attempt to get out, as well as, normal abrasive burrowing activity in the coarse substrate.

**Respiratory Infection**

In cases where a Horned Lizard from an arid environment has been kept in excessively damp and cool conditions, or a species from a more humid environment kept in excessively dry and warm conditions; a respiratory infection can result. The symptoms for RI can be very similar to those for enteritis or impaction, and additionally, if you listen closely you may hear wheezing or a crackling sound as the lizard breathes. In these cases systemic antibiotics and a boost in ambient temperatures is in order.

Baytril ( enrofloxacin ), being the veterinary equivalent of Cipro, is often prescribed for RI in reptiles. A new trend in RI treatment in reptiles is nebulization treatment, and I was experimenting with this treatment before realizing that some vets were beginning to advocate its use as well. Albuterol or other nebulizer respiratory dilators can be diluted with saline and administered for a number of minutes to the reptile patient to breathe more freely. I use a large ziplock bag, which the patient is then placed in. The nebulizer mouthpiece is then taped into an opening in the bag, and the rest of the bag sealed, and filled with the nebulized drug. Administration of these drugs should be done cautiously however, as they can result in critical hypokalemia in small patients, tachycardia, or make an infection worse.

Antibiotics such as Baytril may also be diluted with saline and nebulized, and in this manner the drug is administered directly into the lungs.

**Reptile safe medications**

Medications for systemic infection or analgesia should ideally be administered only by reptile veterinarian or sufficiently experienced keeper, or under the direct consultation with a vet. Dosage calculations and administration protocol for reptiles, especially small reptiles, require some math and reptile physiology knowledge.

http://www.anapsid.org/resources/rxdose.html
http://www.anapsid.org/signs2.html
http://www.anapsid.org/herppain2.html
Probiotics (Bene-bac)

Reptiles receiving forced feeding, fluid support, or antibiotic therapy should also receive probiotic supplementation to encourage appetite and replace beneficial gut flora that is destroyed by many antibiotic treatments.

While undergoing antibiotic treatment, the reptile patient may benefit from reduced or cessation of UV exposure. There is some indication that UV exposure while under antibiotic treatment may lead to oversensitivity, burns, or reduced immune functionality. The reptile patient must also have more than average hydration to help prevent liver and kidney damage during antibiotic treatment. Many antibiotics are processed by the liver or kidneys, and there is the potential for organ damage if hydration status is not maintained during antibiotic therapy.

Humane Euthanasia

There may come a time during a Horned Lizard keeper’s experience where the lizard or another reptile is severely injured or ill, and cannot be saved. In order to spare it from needless suffering, the most compassionate course may be to humanely euthanize. It is a hard decision to make sometimes, and a reptile vet should be consulted, if at all possible, to make the process as painless as possible for the animal.

For many years unenlightened herpetologists, vets, and reptile enthusiasts, advocated freezing, stunning, pithing, decapitation, or other traumatic injury to euthanize reptiles. If not done properly the animal will no doubt suffer more than it has to, and repeated attempts are often necessary. This is not only needlessly traumatic, but also generally considered barbaric practice nowadays. It has been reported that the reptile brain remains active for up to an hour after decapitation (Cooper et al, 1984). Any person with compassion then, can see why decapitation of a reptile would be quite immoral and possibly terrifying to the animal. Freezing leads to formation of ice crystals in soft tissue usually long before the animal loses full consciousness, and this is terribly painful as the ice crystals lyse (or tear apart) cellular structure. Freezing should only be performed secondarily to full anesthesia and analgesia.

Overdose by sedative-hypnotic/anesthesia and analgesia is a more humane method, however, as many of these drugs have limited or questionable effectiveness in the low metabolic activity of the reptile, they may not be entirely reliable. The drugs listed below are commonly used in exotic medicine. In the author’s opinion, the most humane way to end a reptile’s suffering is to use high doses of sedative-hypnotics and general anesthesia/analgesia to render the brain both unconscious and unaware of pain. When conducted properly the reptile will slip into a hibernation-like state that is not painful, and, simply not wake up.

Such drugs are: Pentobarbital (anesthesia) or combination formula “Euthasol”, Butorphanol (analgesic-sedative that should be used in combination with an anesthetic), Propofol or Fospropofol (anesthesia), Tricaine methane-sulfonate (anesthesia), Ketamine (analgesic-anesthesia), Isoflurane (analgesic-anesthesia), or Succinylcholine (anesthesia).

Sedative-hypnotics/general anesthetics can be used alone to effect, but if the anesthesia is to be followed by freezing, then a strong analgesic should also be used. Once this takes effect, the body temperature may be lowered by refrigeration, then freezing until all biological function has ceased.

Some turtle species are resistant to very cold temperatures, even subfreezing temperatures, and in those cases post-freezing examination is advised to ensure the animal has indeed expired and will not regain consciousness in
An alternative means of humane euthanasia available to the average herp keeper is CO or CO2 (carbon monoxide or carbon dioxide). Though these methods are less effective in reptiles, since their metabolic activity is lower than for mammals, and they can hold their breath for quite a long time. They require very little oxygen compared to mammals. The safest and most painless guarantee for humanely euthanizing a reptile or any other animal, is to take it to a professional; however, there may be cases where one is not available at that hour, within reasonable distance, or the severity of the injury precludes a trip. In these cases, CO or CO2 may be used. The reptile will have to be secured in an airtight container, with a high concentration of the gas introduced for some time in order to be effective. The reptile should be left undisturbed for at least 30 minutes to an hour, to ensure that it has expired. Removal of the animal too soon may result in it regaining consciousness, in extreme pain or disabled due to the gas.

Hibernation (Preparation, During, and Post Procedures)

Horned Lizards hibernate in the late fall until late spring/early summer in the wild. As with any hibernating reptile, proper fat reserves and hydration to live through hibernation is necessary. As a general rule, if you have not had experience hibernating reptiles before, or it is late in the year and you have recently acquired your lizard; you should not hibernate them the first year. Wait until your second season with them, especially if their weight or other health issues are in question. Sometimes reptiles die in hibernation. In fact, after keeping all sorts of reptiles for many years now, I usually skip hibernation the first year with most of my new reptiles.

Hibernation is not necessarily a mandatory event with a captive Horned Lizard, however, by offering this natural cycle, your lizard will feel more normal, and consequentially may live a longer and healthier life. When you think "hibernation", many people have images of a bear, sleeping away the winter in a cozy cave den. However, hibernation is not a time of cozy sleep. During hibernation, many of the animal’s less vital systems are shut down. It is surviving on minimal life support to get it through the wintertime, where it could not survive due to weather conditions and lack of food. It awakens when survivable conditions return. In particular to Horned Lizards; harvester ants hibernate as well (or more accurately-retreat to underground to live on stored food). So, during the winter months, there are no ants or other insects for the lizard to eat.

Fat Reserves

There are many conditions that must be right in order for the animal to survive this dormant state and come out of it next year. Most important is fat reserves. During hibernation, the lizard survives by lowering its metabolism and burning its stored fat for food (fuel). The lizard must be of healthy weight and have sufficient fat reserves to last through this period. The experienced keeper will be able to tell at a glance whether the lizard has enough fat. The primary indicators of sufficient fat reserves are in the tail and the legs. To prepare the lizard to have enough fat reserves, you may have to increase frequency of feeding a couple of months before you plan to hibernate it.
Clearing the Digestive System

Care should be taken when feeding your lizard crickets, mealworms, or other non-ant invertebrates. This can set up a fatal problem just before hibernation if you are not attentive. The same danger from feeding too numerous or excessively large crickets and mealworms is present during other periods, but during hibernation even more so. The dangers are from slower digestion of these insects vs. ants, impaction, and sepsis.

Large prey or excessive prey that is slower to digest, such as crickets and mealworms, can create an intestinal blockage as the digestive system shuts down. This may cause a septic condition that can kill the lizard with toxemia. You must ensure that the lizard’s digestive tract is clear before hibernation, as any remaining undigested food items in the lizard’s system when it shuts down will decompose and result in a septic condition, possibly killing it or making it very ill.

At least a week before you plan for the Horned Lizard to burrow and hibernate, you must discontinue feeding and allow the lizard to digest it’s last meal and dispose of it (up to 2 weeks fasting is recommended if you have used prey other than ants in the recent past ). You should be keeping track of its bowel movements more closely in the weeks leading into hibernation time, so that you can gauge when its system is clear. If the lizard is outdoors or in a room where it experiences conditions closely approximate to outside temperatures, you may notice it showing a reduced interest in eating as it gets closer to winter. In these cases, the lizard usually takes care of this fasting and elimination itself. It is still good to keep tabs however, as your lizard is not in the wild experiencing and doing all things it might be doing if it were in the wild. You have to look at keeping a Horned Lizard in this respect; you are interfering with its natural state, conditions and habits in almost everything you do, no matter how inconsequential it may seem.

If you have not yet verified that the lizard’s digestive system is clear before it goes under to hibernate, then wake it up again until it leaves scat. For this reason, you should always remove scat daily so that you can keep track. Besides increasing cleanliness in its habitat, this also helps to pinpoint health issues. If you leave its habitat dirty with waste, then you will not be able to determine when it has not defecated for several days and may be impacted. It may possibly be in immediate danger of dying, but, you won’t know about it if you can’t tell when it defecated last.

Hydration

The next important factor after fat reserves and clearing the digestive system, is hydration. Increase the amount of times you water your Horned Lizard to 3 or more times a week in the weeks leading up to hibernation. Warm water soaks, two or more times a week are helpful. Extra water in the lizard’s system will also assist it in clearing the bowels. A dehydrated lizard may wake from hibernation searching for water.
Parasites

The Horned Lizard should be treated for parasites with liquid Panacur (fenbendazole 50-100mg/Kg) preferably two months before expected hibernation. The first dose should be followed 2 weeks later by a second, with the last 2 weeks used to give the lizard time to pass any parasites. If you do not know exactly how to do this, see a reptile veterinarian.

Pre-Hibernation Steps Summary:

- Stock up on fat reserves (several months away)
- Treat for parasites (at least 2 months away)
- Stock up on water (1-2 weeks away)
- Clear the system (1-2 weeks away)

Lighting Cycle

If you are hibernating your Horned Lizard indoors, you can somewhat regulate the time frame when it goes into hibernation. This is done through temperature and lighting. As it nears the late fall, begin to reduce the amount of lighting and heat the lizard gets during the day. If you normally leave the lights on for 10 hours a day, then start the next week with 9, and 8 the next. You should also move the lights back in increments so that the temperatures are progressively lower during the day as well. I also like to rotate the lamps beam across the aquarium, like the sun traversing the sky. I usually plan to put them into hibernation just before Thanksgiving, but sometimes the lizard knows best, and will go under to hibernate when it feels the time is right. As the Horned Lizard’s internal clock gets synchronized with the reducing light and temperatures, it will sense winter coming. Its metabolism will begin to lower and it may have reduced appetite. If it does not, then you may need to adjust lighting/temps, and offer less food to help reduce its metabolism further. You will need temperatures to get down consistently to the low 60s to mid 50s for hibernation to begin. I attempt to stay within the mid 40s to low 50s during hibernation. Avoid direct exposure to temperatures below 40F.

Premature Waking During Hibernation

Once hibernated, the lizard may stay down consistently until spring, or it may awaken a few times. In my experience, when hibernated indoors, they sometimes awaken a couple of times over the winter. Usually it’s due to a warm spell, but there are other reasons why they may wake. Among the most common are:

1. Rising temperatures may cause their metabolism to raise and wake them up, especially if their sand is not deep enough to insulate them from warm spells. Ensure that wherever you hibernate your Horned Lizard, that it will be fairly insulated from warm spells, with an average temperature as consistent as you can get it. Also, ensure that it will not become cold enough to freeze. If the lizard is not protected by enough substrate above, below, and to either side, it may freeze to death or suffer frostbite.

2. They may be dehydrated and searching for water. Offer water and see if it drinks and goes back to sleep soon. Water is ok to give at any time during hibernation, and the lizard can go right back to sleep. If it has additional waste to eliminate, it may emerge again at some point after rehydrating, to pass scat or urates.
3. They may be sick or have insufficient fat reserves. It is hard to tell sometimes if a groggy Horned Lizard, coming out of hibernation with a low metabolism, is actually sick or not. If there is any question about it being ill, then warm it back up slowly and check its reactions and activity. If it seems well, alert, and responsive after warming for part of the day, then allow it to cool again and return to hibernation. If there is any question that it might not have enough fat reserves, or it still appears to have something wrong with it; then discontinue hibernation and slowly return it’s habitat to warmer temperatures. Seek assistance of a competent reptile vet if normal recovery and activity is not resumed within 2-3 days. Reintroduce to food slowly and only after a few days of warming and rehydration.

Do not give the lizard food while it is temporarily awake if you plan to return it to hibernation. If you do, then you must wait several days again, until you are sure its system is clear. However, keep in mind that the longer it remains awake, the faster it is burning calories and fat. Either put it back into hibernation within a few days, or abort hibernation.

If the lizard is waking excessively during the winter, then abort hibernation.

I tend to prefer my reptiles to awaken at least once, so I can check on them. But, you may also have a Horned Lizard which is sleeping soundly...so much so that you worry that it is still alive. It is not uncommon to have a Horned Lizard go most or all of the winter without seeing it. This is usually a good sign, if it was healthy, had sufficient fat stores, and was well hydrated. But, sometimes I get the urge to check on them anyway. The best way to do this is to scrape back a little sand from around the lizard and rub the top of its head, its fringe scales on the side, or lightly squeeze the base of its tail. Usually, it will respond with a slight movement while staying "asleep".
Do not dig the lizard up completely nor disturb the sand under its belly, nor around the limbs. Only move the minimum amount of substrate is necessary for the examination. Do not re-bury the lizard. The Horned Lizard has a specific way that it burrows which allows it to sleep under the substrate and still have room for the body cavity to expand for respiration. This involves specific placement of its forelimbs to its sides as it moves forward during burrowing. Let the lizard re-burrow itself if its body position is disturbed.

Horned Lizards have a specific way they like to sleep, even if they don’t always make it under the substrate. (P. hernandesi)

**Awakening from Hibernation (Spring)**

As spring comes and temperatures begin to get warmer during the day, the Horned Lizard will probably awaken on its own. You may find him/her sitting on their favorite basking spot one morning waiting for sunshine. If by late April or early May your lizard has not awakened yet, or the lizard is "up" and "down" as we say, then begin to cycle your lights and temperatures back up, in reverse order from how you did in the fall, to simulate approaching summer.
You do not have to take a month getting the lights back to 10-12 hours a day and the temps into the 90-100s, but you don’t want the lizard to go from hibernation to summer basking temps by the next day. Anything you can do to reduce shock/stress and make things more natural for the lizard will likely help it live a longer, healthier life.

Proper temperatures are also important to get the metabolism back in order and encourage appetite, and for proper digestion. Most reptiles need warm temperatures for all its organs to operate properly and digest its food. Once your Horned Lizard awakens from hibernation and is warmed a little, it is likely to be thirsty. Give it plenty of water. This will help get its organs back to running normally, by flushing any waste and preparing the digestive system for food. It's probably not going to want to eat a big meal with a dry whistle and bowels. This could also cause an impaction or prolapse. After it gets some water for a day or two, then offer it some harvester ants. This is small prey, and the breakdown of the venom will help further hydrate it. The plant based essential fatty acids from the ants, will also provide easily metabolized lean energy.

On occasion, a reptile will not seem to be hungry after being awake a week or more. If this happens, ensure that temperatures are correct, and that it has sufficient UVA/B exposure, and water. A lack of these can cause loss of appetite. If the problem persists, try another food item to get its interest, or try a different time, or reduce other possible stress factors, such as location or traffic. If this is unsuccessful, consult a reptile vet or competent keeper quickly. Horned Lizards do not go as long without food as many reptiles are capable of doing. After the lizard has been awake for a few weeks and is back to normal, eating good and basking plenty, it should be treated again for parasites in two doses / 2 weeks apart. Post-hibernation treatment is optional, but recommended.

Attempt to refrain from giving larvae, beetles, anything larger than small crickets, etc. in the 2 weeks following emergence from hibernation, or if the lizard is still not displaying completely normal and full activity. If used too soon, this may result in serious health problems.

**Post-Hibernation Steps Summary:**

- Warm up
- Re-hydrate
- Offer small prey
- Treat for parasites

By following these instructions you should have a good chance of success with hibernating your Horned Lizard or other reptiles.

**Recommended Products:**

- Natural Chemistry - Healthy Habitat and other products
- Fluker's Repta-Aid
- Mega-Ray UVB lighting (reptileuv.com)
- TXI brand sterilized playbox sand
- "Miner-all" - Sticky Tongue Farms
- Bene-Bac bird and reptile pro-biotic
General & Minor Care Equipment List:

- Reptile terrarium water conditioner
- Distilled water
- Betadine-povidone iodine
- Novalsan (chlorhexidine)
- 91% rubbing alcohol
- Triple antibiotic ointment
- Pedialyte
- Calcium gluconate
- 10x jewelers loupe
- Mineral oil
- Calcium carbonate powder
- Panacur (fenbendazole)
- Styptic powder
- Cotton swabs
- Bene-Bac probiotic powder
- Penlight
- Liquid bandage (antiseptic and wound sealant)
- Sterile saline (for wound rinsing and eye flush)
- 1cc syringes - no needle (for administering minor medications and hydration fluids)
Horned Lizard References:

Maintenance and Propagation of Horned Lizards (*PHRYNOSOMA*) in Captivity
Bulletin of the Chicago Herpetological Society
Volume 24, Number 12, December, 1989
Richard R. Montanucci
Department of Biological Sciences
Clemson University

Introduction to the Horned Lizards of North America
Wade C. Sherbrooke
California Natural History Guide
ISBN 0-520-22827-8

*Krotenechsen*
Lebensweise, Pflege, Zucht
Bertrand Baur and Richard R. Montanucci
Herpeton Verlag
ISBN 3-9802892-8-1
Horned Lizards - The Book of Horny Toads
Jane Manaster
Texas Tech University Press
ISBN: 978089672495

For additional information and discussion about Horned Lizards:

http://www.pets.groups.yahoo.com/group/hornedlizards - author’s webgroup offering scientific papers, husbandry tips, & ordering of Harvester Ant feeders.


Horned Lizard Species and Distribution Information:
http://www.ucpress.edu/books/pages/9297/identify.pdf
http://www.zo.utexas.edu/faculty/pianka/phryno.html

For the very best overall reptile related website; containing valuable resources on general reptile husbandry and wellness: www.anapsid.org

For information about UV lighting: http://www.reptileuv.com (recommended UV products)

Just Say “NO” to Petco!