

## Substrate in Reptile Enclosures

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Almost every herp keeper has different cage design preferences. One of the most important aspects of enclosure design and functionality is the substrate or “bedding” that lines the bottom of the enclosure, if only because the majority of snakes and other reptiles stay low to the ground and many are even semi-fossorial at times. For this reason, the animals that you keep will be spending the majority of their lives in direct contact with the enclosure substrate.

There are many materials that can be used as substrates for herp enclosures, and many of these are commercially produced and available to herp keepers via pet stores or garden supply centers. Such commercial substrates include aspen bedding, cypress mulch, Eco Earth™, ReptiSand™, ReptiBark™, and many others. Generally, substrate types can be split into four basic categories; soils, sands, mulches, and gravels. There are several advantages and disadvantages to each substrate type.

### **Mulch” Substrates:“**

“Mulch” substrates include aspen bedding, ReptiBark™, and other shavings or chips made from organic materials, and are perhaps the most popular and widely available substrate types. Organic “mulch” substrates are made from a plethora of different wood types. The only word of caution when selecting the type of wood is to avoid pine and cedar wood, as both contain oils proven to be harmful to reptiles. Again, unless working with solely arboreal species, your animals will be spending a great deal of time directly on top of or under the substrate. Cypress mulch and aspen bedding are commonly used “reptile safe” woods for mulch substrates and there are also many others. Whatever wood is used, be sure to take preventative measures to eliminate potential parasites, more specifically, reptile mites. Mulch substrates can look very aesthetically pleasing, but can turn into a problem very quickly in the event of a mite infestation. Pay close attention to where the wood is coming from. Be sure to treat any wood taken from outside to be used as substrate with a commercial mite repellent such as MiteOff™ or Prevent-A-Mite™. I have also included instructions on how to make a cheaper alternative solution at the end of this article.

Several of the advantages of organic mulch substrates are good moisture absorption, for easy humidity retention within an enclosure; ease of cleaning (partly because of their absorbent qualities); and aesthetics (mulch substrates can look very natural and add to the design qualities of an enclosure). Several problems often associated with mulch substrates include “dust” from the substrate when trying to keep a more arid enclosure for desert-dwelling animals. This dust often creates problems during shedding (such as sticking of the skin during shedding). Dust from the substrate can also lead to respiratory infections, and is sometime accidentally ingested by the animal during feeding, as the drier and lighter dust particles will stick to a food item. Another problem often associated with the use of mulch substrates is humidity regulation. In desert enclosures, where humidity should be kept minimal, mulch substrates tend to hold on to moisture, often making low humidity levels difficult to attain. Also, while it is possible (although I do not recommend it), to gather your own wood from outside and chip it yourself, the commercially made mulch substrates are generally a bit safer to use, compared to wood from outside. These commercial mixes are generally a bit more expensive compared to other substrate types, and cannot be reused. Finally, for one of the same reasons mulch substrates are beneficial, their absorbent quality can also be counter productive, holding onto waste residue from the animal and requiring frequent replacement. For many more “sensitive” species, I simply refuse to use organic “mulch” substrates.

### **Soil Substrates:**

Soil substrates aren't very commonly used with reptiles, and maybe are not given enough of a chance. Perhaps one of the biggest concerns regarding soil substrates is their potential parasite load. If preventive measures are taken and the soil is treated with an anti-parasitic solution, soil substrates can work quite well. In large enclosures, natural soil substrates can be used in conjunction with live plants and combinations of other substrate types and cage décor, such as stone, and tree branches or driftwood. Soil substrates usually have good humidity retention, and humidity can be regulated easily by spraying the cage and monitoring temperature and humidity levels at regular intervals within the enclosure. Soil substrates also leave a lot of room for personal preference as far as aesthetics. Soil substrates are usually the safest in case of accidental ingestion of the substrate by the animals when feeding as well. In naturalistic enclosures, soil substrates lend the advantage of allowing live plants to be planted directly into the substrate. Soil substrates are usually fairly inexpensive and readily available in bulk supply. Some common disadvantages of soil substrates are that they aren't very easily "spot" cleaned, and unless the soil bed becomes "bioactive" it should be at least partially replaced regularly. Another big drawback is that parasites are not as easily eliminated in soil substrates compared to other substrate types. The potential parasite load often harbored in soil cannot be ignored completely, as with any substrate. The introduction of a large parasite population into the closed system of an enclosure can be disastrous. For this reason, it is highly advisable to avoid soils taken from the wild, without intense heating, drying, and the use of an anti-parasitic solution (as described above). Another reason to avoid "wild" soils is the possibility of contamination. Natural soils may contain any numbers of chemicals, ground pollution, fertilizers, and pesticides. In some cases, purchasing pre-bagged potting or top soil from your local garden supply center or plant nursery can be safer than naturally-collected soil (although to be sure to buy soil that has not been pre-fertilized, or treated with any pesticides or weed-eliminating chemicals). Still, I strongly recommend heating the soil intensely, spreading it into a thin layer, allowing it to dry completely, and then treating it with an anti-parasitic solution (as described above). ZooMed's Eco Earth™ is a soil substrate intended for use with reptiles and amphibians. Even still, as with any substrate, preventive measures should be taken (as described above), just to be safe. Another problem that some encounter with soil substrates is the same as that described above with the use of mulch substrates, in that some soil substrate beds may produce "dust" when keeping a soil substrate bed in a dry, arid enclosure. I will not go into detail regarding "bioactive" substrate, but it is at least noteworthy to give a brief description. In large naturalistic enclosures, bioactive substrates have their advantages. Basically, bioactive substrates are soil beds that are allowed to mature and develop bacterial colonies. In essence, these are "living" soil substrate beds, teeming with beneficial bacteria. These nitrifying bacteria convert raw ammonia from the animals waste into nitrate, and then to nitrite and other less toxic compounds. This basically creates a natural biological waste-management colony of bacteria. Bioactive soil substrate beds are usually created by stirring well-watered soil substrate beds and simply letting the naturally-occurring bacterial colonies develop. Many large zoo enclosures and even many healthy soil beds in small personal enclosures probably often develop bioactive substrate beds without the keeper even realizing it, as this is a natural process similar to "cycling" an aquarium.

### **Sand Substrates:**

Sands have limited practical uses as substrates in reptilian enclosures, but are commonly used in desert setups. I personally recommend avoiding "organic sands", such as those made from crushed coconut shell, as the same problems are associated with these artificial sands as with mulch substrates. These "organic" sands, also lack the absorbent benefit of mulch type

substrates. Granite-based sands work well, and there are many sand mixes commercially available at pet stores and garden supply centers in a wide array of colors and particle size. Sand substrates' biggest advantage perhaps, is that retile mites and other external parasites usually will not live as long hidden in sand substrate beds compared to other substrate types, mostly because sand substrate beds are usually drier. However, never underestimate the resilience of mite colonies. Basic preventative measures should be taken (as described above) to ensure adequate prevention of these infestations. Periodic treatment with an anti-parasitic solution should be performed when using sand substrates. Although sands can work very well for desert species, especially fossorial species, sand mixes usually do not work as well for tropical or temperate enclosures. Saturating sand substrates enough to maintain the appropriate humidity levels for tropical species usually creates an enclosure that is too wet, compromising the health of the animals. Even tropical species cannot be kept in extremely wet conditions for prolonged periods of time, or harmful skin conditions will develop. Although not practical for every enclosure setup, sand substrates do have their advantages. Sand substrates are usually easy to clean, and will not have to be replaced as often as soil or mulch substrates that hold onto moisture more. Sand substrates will not absorb moisture or fecal and urinary waste like some other substrate types. This is very handy when trying to maintain low humidity levels in desert enclosures. Some of the drawbacks of sand substrates for use in temperate and tropical enclosures include poor moisture retention. While it is favorable to keep humidity levels low in desert enclosures, tropical species require more humidity. It is sometimes difficult to maintain high humidity levels when using sand substrates. Another noteworthy caution when using sand substrates is something I have personally witnessed on a few occasions. While some sand accidentally ingested by reptiles during feeding usually does not turn out to be a serious issue, I have had several specimens die from accidentally ingesting sand substrates when feeding over the years. A good rule of thumb when using sand substrates is to always present the animals food with a pair of feeding tongs, hemostats, forceps, or long tweezers.

### **Gravel Substrates:**

For whatever reason, gravels seem to be neglected as a very practical substrate for reptile enclosures. I use gravel substrates in the majority of my own enclosures, and there are several reasons why I feel that gravel substrates may be the ultimate substrate choice. I try to avoid the colorful painted gravels used in aquariums for more reasons than one. Actually, a big reason I do not use the painted gravels is solely for aesthetic reasons, as I have always been a stickler for "as natural as it can be". Also, although painted gravels can be used safely, as the paints are non-toxic for use in aquaria, in some cases paint chipping off of the gravel may cause problems if the substrate is accidentally ingested during feeding. I personally recommend the natural "river rock" gravels available in the aquarium section of most pet stores. Gravel substrates can be used in temperate, tropical, and desert enclosures quite easily. For tropical enclosures gravel substrates do a great job in keeping the humidity levels high, if a deep gravel bed lines the bottom of the enclosure. Deep tropical gravel substrate beds can be sprayed regularly with a spray bottle to keep humidity levels at their peak. All moisture drains under the gravel and collects in the bottom of the enclosure, increasing the amount of humidity in the air. The surface of the gravel however, will stay dry and sanitary for the animals in the enclosure, eliminating the risk of detrimental skin conditions cause from excessively wet conditions. In desert enclosures, where humidity is to be kept low, a shallower gravel substrate bed can be used, as the need to drain moisture away from the animal is not present in an arid environment. Another huge advantage to gravel substrates is that they do not absorb waste from the animals, and eventually will begin to decompose causing fungal growth as some organic mulch substrates do, instead, moisture from fecal and urinary matter drains into the bottom of the enclosure for ease of cleaning. Another advantage that is commonly overlooked is the fact that gravel substrate beds can be removed, disinfected, rinsed, and reused. For large collections, this fact will save the keeper a lot of money. For the naturalist, naturally-smoothed "river rock" gravel substrates can be very aesthetically pleasing.

The only disadvantage I can think of regarding gravel substrates is the cost. Some natural “river rock” gravels can be a bit more expensive compared to other substrate types. However, the fact that gravel substrate beds can be used again makes up for it every time the enclosure is cleaned.

### **The “Bare Bottom” / Newspaper Substrate Method:**

Although not the most visually attractive substrate choice, many reptile keepers use newspaper or other paper products to line the bottom of their enclosures. Newspaper does have its advantages, but really isn't the most practical choice for most enclosures. Newspaper is very readily available, and the cheapest of all of the substrate choices we've covered so far. It is also very easily cleaned and replaced. Although newspaper will absorb moisture, newspaper or other paper substrates should be kept dry when used as reptilian substrates, as damp or wet newspaper substrates will cause harmful skin conditions and begin to break down. This problem is sometimes solved by using a larger water bowl within the enclosure on the warm basking side of the enclosure to raise air humidity in the enclosure, making up for the dry paper cage lining. Newspaper is useful when quarantining new additions to the collection, as reptile mites, ticks, and other parasites are easier to spot on newspaper. Paper substrates are also very easy to remove and replace in the event of a mite infestation also. The drawbacks to newspaper used as a “substrate” within an enclosure are; poor humidity retention, the fact that the animal's waste remains on the surface resulting in the animal essentially living on top of its own waste, and obviously poor display quality. Despite all of the benefits of different substrate types, there are those who do not use any type of substrate at all. Running an enclosure “bare bottom” has only the advantage of easily spotting and eliminating parasites, as there is no substrate bed for mite and other parasites to lay their eggs and hide in, and in some cases, ease of cleaning. Personally I feel that the disadvantages of the “bare bottom” method outweigh these advantages. The biggest problems associated with running an enclosure without any substrate include the fact that waste materials will not be absorbed or drained away from the animal, in essence forcing the animal to live on top of its own waste. The bare bottom method may also stress the animals being kept in the enclosure because it is difficult for reptiles to gain traction on slick surfaces. Most snake species have a hard time moving about the enclosure without any substrate to get traction on and this may stress the animal. Also, fossorial species do not do well without substrate to burrow in and hide. Bare bottom enclosures usually retain very little humidity as well, which can cause health problems for tropical and temperate species. I personally advise the use of the bare bottom method only when quarantining new additions to the collection, or in the event of a parasite infestation.

### **Preventative Measures Against Parasites:**

Because the majority of reptiles spend the majority of their lives in direct contact with the substrate of their environment, the cleanliness of enclosure substrate must be adequate. There are a plethora of internal and external parasites that can be very harmful to reptiles. Most of these, such as reptile mites, fungi and mold, ticks, and other reptile parasites. Also, an uncleanly substrate bed, rich in bacteria, can harbor conditions suitable for viral infections which can be fatal. There are a few commercially available anti-parasitic reptile enclosure sprays on the market. The majority of these sprays are considerably expensive, and are Permethrin based. My personal favorite cheap alternative to commercial Prevent-A-Mite solutions is also a Permethrin based solution, made from [Sawyer Permethrin Pump Spray](#), and [ECOLAB's ProForce Disinfectant Cleaner](#). I simply empty the 12 oz. bottle of Sawyer Permethrin Pump spray into one gallon of purified water. Then, approximately ½ cup of the ProForce Disinfectant spray is added to the purified water / Permethrin solution. The solution is mixed well.

For use: combine ½ cup of the final solution and one gallon of purified water. Dispense into spray bottles and lightly spray the bottom and sides of the empty, clean, and dry enclosure in a fine mist. Allow the solution to dry, and wipe to inside of the enclosure with a clean dry cloth.

This solution can also be applied to fine soils, gravels, moss, leaf litter, rocks, and wood that are collected from the wild. For wild-collected substrate application: spread the gathered soil, gravel, leaf litter, moss, etc. in a thin one-inch layer in a cool, dry place. Allow the gathered material to dry thoroughly. Apply a sufficient application of our anti-parasitic solution (diluted in our 1 gallon Purified Water X ½ Cup concentrated solution) in a fine mist with a spray bottle. Spray the material until coated, but not dampened. Allow two or three days for the material to dry thoroughly. Spray the material lightly with pure water after drying. Allow the material to dry completely for a few days. Store this substrate material in an airtight container.

This solution actually works better than most of the commercially available preventative parasite sprays. Many of the commercially available sprays are heavy only in Permethrin, and completely lack an anti-bacterial agent. This solution is also reliably safe if used the manner described as well. When mixed up in large quantities, this solution can be stocked much cheaper than when using the commercially manufactured products.

### **Conclusion:**

I hope we have covered most of the general pro's & con's of the common substrate types in regard to their application in environment-specific reptile enclosures. Substrate and cage parameters (humidity and temperature) should be matched to the substrate most suited to the animal's needs, and most closely resembling the substrate that the particular species would likely encounter in the wild. Remember, before obtaining a new species, research the habitat that this particular species inhabits in the wild. Research the climate of the habitat your new species lives in, noting the yearly rainfall and humidity, average temperatures, seasonal and nighttime/daytime temperature fluctuations. Adjust your cage and equipment so that these same conditions are closely matched. Furnish the cage with the appropriate substrate and cage furnishings. Utilize our anti-parasitic solution or mix up some of the solution described above to disinfect cage substrate and furnishings.

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