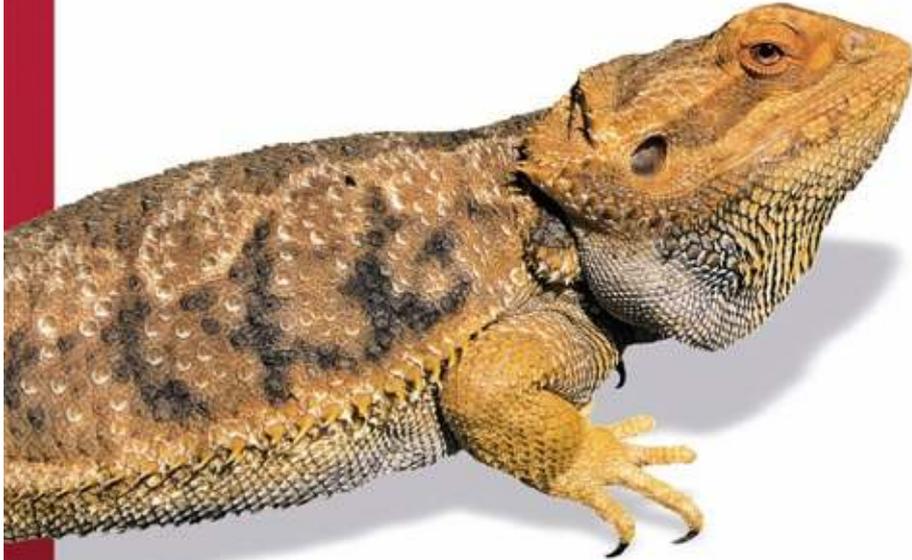


The Bearded Dragon Manual

FROM THE EXPERTS AT ADVANCED VIVARIUM SYSTEMS®



INCLUDES:

Choosing a Dragon • Diet & Housing • Breeding & Health • Filled Dragons
Care Tips for Beginners & Expert Herp Keepers

*Philippe de Vosjoli, Robert Mailloux, Susan Donoghue, V.M.D.,
Roger Klingenberg, D.V.M., and Jerry Cole*

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A gravid female bearded dragon is arm-waving in response to the black-throated male on her right.

INTRODUCTION

Attractive appearance, moderate size, a naturally tame demeanor, and a high level of personality (by reptilian standards) have made the inland bearded dragon one of the all-time favorite lizard pets. Compared to many other reptiles, bearded dragons are relatively hard and easy to keep. However, being ectotherms (cold-blooded), they have particular requirements significantly different from more typical pets such as dogs, cats, and birds. We warm-blooded humans don't always have a natural propensity for understanding the care of reptiles. Success at keeping bearded dragons depends on acquiring basic knowledge of their needs, as well as the supplies and technology to care for these beautiful lizards. Providing this essential information was our first objective when we (Philippe de Vosjoli and Robert Mailloux) joined to write this new, updated, and expanded version of *The General Care and Maintenance of Bearded Dragons*.

Interestingly, as we put our heads together, we realized that we had a great deal of useful information that hadn't yet appeared in print but that would improve our understanding of bearded dragons' life stages and in turn ascertain the best way to provide for their husbandry and breeding. Looking at the life stages of bearded dragons also made us aware that, like humans, they undergo changes in growth and behavior, which may require the dedicated owner to make adjustments in husbandry (and general care) to meet the needs of each life stage. As we worked on the project, it became clear that there were areas that needed more authoritative and extensive coverage.

As a result, we were fortunate in having several good friends and recognized experts in their field join us in this writing venture. Our friend Susan Donoghue, V.M.D., a published authority on reptile nutrition who has ongoing research on the effects of diet on bearded dragons, accepted the task of writing the section on diet and nutrition, as well as acting as general editor. Roger Klingenberg, D.V.M., another longtime friend who has collaborated with us on a variety of writing projects and who is the author of the best-selling *Understanding Reptiles Parasites*, agreed to write the section on diseases and disorders.

Because we all have an interest in another Australian lizard, the frilled dragon, and because this fantastic species has become more popular in recent years, we contacted our good friend and frilled dragon expert, Jerry Cole, from the UK. He graciously came through in record time with his formula for successfully keeping and breeding this species. Kevin Dunne, owner of Dragon's Den Herpetoculture, also contributed to this work by sharing information on his breeding colony of dragons and providing photographs of his unique morphs.

The entire project has been a rich learning experience for all of us about the value of cooperation among friends. The project also made us realize how much work still needs to be done with these lizards in a wide range of areas, including vivarium design, nutrition, herpetological medicine, and genetics. There are even aspects of basic biology that still need to be studied, such as the contribution of skin morphology and cell dynamics to the appearance of the various color morphs and the hyperxanthic response of certain lines of bearded dragons. There remain critical hurdles that have yet to be cleared, such as identifying the factors that have prevented the long-term captive keeping and breeding of Lawson's dragon and the eastern bearded dragon. These challenges and promises of an ever more exciting future continue to drive us into the peculiar passion called herpetoculture.

GENERAL INFORMATION

Kinds of Bearded Dragons

Bearded dragon is the common name applied to lizards of the genus *Pogona* in the family Agamidae, several of which display a beardlike extension of the throat when threatened. The bearded dragon most readily available in the pet trade is the inland bearded dragon (*P. vitticeps*).

Two bearded dragons are commercially bred in small numbers: Lawson's dragon (*P. henrylawsoni*) and the eastern bearded dragon (*P. barbata*). Lawson's dragon is a smaller and naturally tame species. Unfortunately, it is not as easy to reproduce consistently as the inland bearded dragon is and is not readily available. The large eastern bearded dragon is rarely offered for sale because it also has proven difficult to breed consistently and presents certain problems in long-term husbandry that still need to be resolved. Hybrids between inland bearded dragons and Lawson's dragons are also occasionally offered for sale under the name of Vittikin dragons. Because the inland bearded dragon is by far the most popular, the information presented in this book relates to this species unless mentioned otherwise.

Common Name	Species Name
Inland bearded dragon	<i>P. vitticeps</i>
Eastern bearded dragon*	<i>P. barbata</i>
Lawson's dragon*	<i>P. henrylawsoni</i>

* Hybrids of the eastern bearded dragon and Lawson's dragon are called Vittikin dragons

Inland bearded dragons now come in a variety of morphs including normal brown and tan dragons, German giants, vivid orange-red Sandfire lines, and pale hypomelanistic pastels and Snow/Ghost dragons. Other morphs can be expected to appear in the future as breeders constantly strive to introduce variety into the hobby. Prices of inland bearded dragons vary considerably depending on the age, type, color, and reproductive rate of the morph. You will have to evaluate which of the various kinds of bearded dragons is best suited for your purpose, whether as a pet, a living work of art, or as a source of revenue from breeding.



This is a very large female bearded dragon. Lizards this size require tanks at least three times their body length.

Is a Bearded Dragon the Right Pet for You?

Most experts correctly rank the bearded dragon as one of the very best reptile pets. These lizards are attractive, active, entertaining, moderately sized, easy to handle, naturally tame (with few exceptions) and relatively easy to keep. Compared to smaller reptiles, they are robust and hardy. Compared to larger reptiles, they are relatively safe for children, although basic hygiene habits such as hand washing must be practiced.

The only drawback to bearded dragons we've found is their enclosure requirements. As adults, these space-loving lizards require an enclosure of at least 48 inches long, although 72 inches is preferable. If space is a limitation, a bearded dragon may not be the best pet reptile for you. Because bearded dragons require substantial amounts of food, including live insects, they defecate frequently, so enclosures and substrates have to be cleaned daily. If daily cage cleaning is a drawback for you, consider some of the smaller insect-eating lizards such as leopard geckos. If live insects are a problem, consider some of the skinks (such as blue-tongue skinks) that fare well on foods obtainable at your supermarket, or certain geckos (such as crested geckos) that can be raised primarily on supplemented fruit purees or processed baby foods. However, if you have the space for bearded dragons, you will find that few lizards are more appealing, personable, and entertaining.

Although bearded dragons seem to present less risk of disease transmission than some other reptiles, simple hygiene must be practiced if your home is to be shared with a bearded dragon. Reptiles often carry the *Salmonella* bacterium, which can be shed in their feces and may pose a disease threat to humans, especially infants, toddlers, and those who are immune suppressed. Reptiles should never be allowed on food-handling surfaces such as kitchen counters and dining room tables. Hands should be washed immediately after handling a reptile. Food and water bowls should be washed separately from household dishes. Sound judgment and common sense will keep your dragon a low-risk, valued member of the household.

Habitat

All bearded dragons originated in Australia. Although dragons currently found in the pet trade are many generations removed from their Australian roots, details about their habitat in the wild provide clues to proper husbandry in captivity.

Most bearded dragons live in relatively hot, arid regions of Australia, and thus in captivity require a warm, dry enclosure. However, sources of water (offered in shallow bowls or as fresh greens) and gradients of temperature should always be made available to pet dragons.



Adult bearded dragons are easy to sex. In addition to larger heads, males have enlarged pre-anal and femoral pores, which are clearly visible in this photo-graph.

Wild bearded dragons in Australia enjoy climbing and basking on rock piles and on the rails and posts of fences. When designing a home for your dragon, include secure rocks and thick branches for its climbing enjoyment. Provide a spotlight so it can bask. In subsequent pages, we'll give you all the information needed for making your dragon feel right at home.

Characteristics of Bearded Dragons

Size

Baby inland bearded dragons are just under 4 inches in length when born. They weigh about 1/10 of a pound (2 1/2–3 grams). The length of adult dragons is typically 19–23 inches and they weigh at least 3/4 of a pound (250 grams). The German giant morph can reach 26 inches in length.

Longevity

Although there are a few reports of pet inland bearded dragons exceeding ten years of age, most live between five and eight years if initially healthy and raised under good conditions. We have an unauthenticated report of a twelve-year-old specimen.

Sexing

Although baby bearded dragons can be difficult to sex accurately, adults show secondary sexual characteristics that allow for relatively easy sexual identification.

Accurate determination of the sex of baby bearded dragons is difficult; at best it is an educated

guess. Some people make an educated guess on sexual identity by examining and comparing differences in tail taper. The tails of females taper more sharply from the base compared to those of males, which appear just slightly thicker. The differences in tail taper often become more pronounced as bearded dragons grow older. In our experience, this method is most successful when applied to the small percentage of individuals that show greater extremes of tail taper.

A recent technique has improved the probability of sexing small bearded dragons, but it must be performed with extreme care and is best done by an expert dragon handler. This method consists of holding a dragon with one hand and with the other *gently* bending the tail above the body plane. We can't emphasize enough that this is a process that must be performed gently. Careful bending of the tail above the body plane will cause the skin on the ventral (underneath) side of the tail base to be stretched back and show the outlines of hemipenal bulges in males. These bulges run directly caudal (toward the tail) from the vent (cloacal opening). A defined, central post-anal groove is a good indicator of a male. In females slight post-anal bulges may be visible, but they tend to run lateral from the vent midline like the arms of an inverted V. Absolute gentleness and good judgment are required with this procedure so as to prevent injury to the dragon. This method works best with experience and is usually complemented by other concurring observations, such as a wider cloacal openings and thicker tails in males.



One way to sex subadult and adult bearded dragons is to compare the width of cloacal openings. A female (*left*) has a smaller cloacal opening than a male (*right*) has. The photo on the right demonstrates the tail-bending method of sexing.

When sexing subadult and adult bearded dragons you can apply the method of bending the tail as described for sexing babies. As with babies, extreme gentleness is a must when employing this technique.

Subadult and adult animals can also be accurately sexed by pulling back the vent flap and exposing the cloacal opening. In males the cloacal opening is significantly wider and larger than in females. (In baby bearded dragons, this method is ineffective because males need to be older before the greater cloacal width becomes clearly noticeable.)

Many adults are also easy to sex from secondary sexual characteristics. These include thicker tails with less taper in males than in females, and enlarged pre-anal and femoral pores in males. Also, males develop larger and broader heads as well as a dark throat (beard), especially during the breeding season. In adult males, the hemipenes can also be everted by applying pressure with a thumb to the

side of the tail base, rolling up toward the vent so as to cause a hemipenis to protrude. This procedure requires experience to perform properly and is usually not necessary to determine the sex of adults. It is sometimes applied to determine the sex of small bearded dragons but is not recommended because of the risk of injury from crushing trauma if not performed with the proper level of experience and sensitivity.



This handler is manually everting the hemipenes of a male bearded dragon.

Life Stages

Bearded dragons undergo six life stages. Understanding these life stages is important to successful raising and maintaining bearded dragons for a long, happy life. The six life stages are delineated here with guides on age and size:

1) *Embryonic/Prebirth* (fifty-five to seventy-five days): In captivity this period of development which occurs within the confines of the egg, is usually spent in an incubator. However, genetics, diet, health of the mother, and incubation conditions can all play roles in health at this stage. These factors are of concern to breeders and deserve further study by scientists.

2) *Hatchling/Juvenile* (birth to about 8 inches in length): Stage 2 is characterized by ravenous appetite, frequent feeding, rapid growth, and a tendency to mutilate other young dragons, nipping on tail tips, toes, or other low extremities when food is insufficient. We've seen a hungry 6-inch bearded dragon try to eat its lifelong cage mate, which was only 4 inches long. It couldn't swallow the small dragon, but it did crush the victim's skull, killing it. Eating and growing are the primary concerns at this stage.



A pair of Lawson's dragons. A female is on the left and a male is on the right. Photo by Patrick Murphy.

In this stage, dragons frequently perform arm-waving behavior, a type of appeasement and intraspecies identity display. A social hierarchy based on feeding vigor/assertion and growth develops into two levels—the tough, big, and aggressive feeders and the shy, small, “feed after the others” individuals.

3) *Subadult* (8 inches to adult): The primary differences between stages 2 and 3 are size and behavior. Stage 3 begins when the young dragons reach a length of 7 to 8 inches. Mutilation tendencies toward animals in the same size range are reduced. The frequency of arm waving is diminished, especially in males. Growth rate is rapid and a greater percentage of plant matter is eaten. A pattern develops that the bigger a dragon grows, the more it eats, so the more it grows, and so on. Social behaviors are still limited and, if enough food is provided, mostly passive.

4) *Sexual Onset/Young Adult* (12 to 16 inches): Stage 4 lasts through the first three years of breeding. This socially interactive stage is characterized by a greater range of social behaviors triggered by sexual maturity. The onset of sexual social behaviors results in well-defined hierarchies with an alpha male becoming ruler of the roost. Males will perform courtship, territorial, aggressive, and breeding behaviors. Females perform push-ups to reveal identity. Females also display submissive arm-waving behaviors during breeding. Growth rates at this stage decline because of hormonal changes and the diversion of energy and nutrients away from growth and toward breeding. Adult size is achieved during this stage. After this stage's onset, bearded dragons will normally go through a winter shutdown period annually.

5) *Mature Adult* (fourth year of breeding until six or seven years old): A gradual decrease in reproductive rate and little if any significant growth is associated with this stage of a bearded dragon's life. It lasts two to three years.

6) *Old Age* (usually by six to seven years): This stage is characterized by little or no breeding, at least in females. There is no measurable growth. Eventually, old bearded dragons enter a terminal stage of decreased feeding and increased lethargy that, over weeks or months, lead to death. It is wise to cut back on calories (but not all nutrients) with old dragons and pay special attention to providing adequate levels of water as well as comfortable surroundings and stress-free days.

How Fast Do Bearded Dragons Grow?

In one experiment we raised a group of baby bearded dragons indoors using basking lights (basking

sites of 90–95°F) and twist Vita-Lite fluorescent full-spectrum bulbs within 6 inches of the dragon. We offered insects to the dragons three times a day and had a variety of plant matter available all day. Lights were on sixteen hours daily. Hatchlings averaged just under 4 inches in length when the experiment started. After fourteen weeks the largest specimen had reached a total length just over 12 inches. The smallest was 11 inches. As a general guide, under this kind of intensive rearing regime, growth will average 2 to 2 1/2 inches a month for the first six months, and sexual maturity can be reached as early as five to six months of age. Growth rate begins to taper after about six months.

Our studies show that baby bearded dragons kept under conservative husbandry conditions can increase in size a mind-boggling 4,000 percent within six months of hatching. Under more intensive conditions, a 5,000 percent increase in weight may occur. A baby inland bearded dragon will weigh about 0.08 ounces (2 1/2 grams) at birth. By six months of age and a length of 12 inches it will weigh about 4 ounces (between 100 and 115 grams—just imagine a human baby growing from 7 pounds to 280 pounds in six months).

What's the lesson to be learned from this? Bearded dragons grow fast, requiring more food than you may have realized and larger enclosures at an earlier age than you may have planned.

The Most Common Health Problems of Bearded Dragons

As with many fast-growing lizards, the most common problem encountered with immature bearded dragons is calcium deficiency associated with soft bones (metabolic bone disease) or twitches and seizures (low blood calcium or hypocalcemia). Calcium deficiency is due to several factors that may occur singly or together: improper vitamin/mineral supplementation, inadequate heat, and an inappropriate diet or feeding schedule, and insufficient exposure to an ultraviolet-B (UV-B) light source. Prevention is simple: follow the instructions in this book.

Two other diseases common in bearded dragons of all ages are caused by parasites. One is heavy pinworm infestation, which remains a significant cause of the failure of these lizards to gain or maintain weight. Another more problematical disease is coccidiosis, caused by a type of protozoan parasite. The latter requires diagnosis by a veterinarian and its treatment can be labor intensive and lengthy (see the chapter on diseases).

Older pet dragons may suffer from gout, liver disease, or kidney failure. At the current level of knowledge about these disorders, we suggest that these diseases are more likely to be prevented by assuring proper hydration, adequate thermal gradients, and an appropriate balanced diet.

SELECTING YOUR DRAGON

Probably nothing is more important for successful keeping of bearded dragons than the initial selection of your animal. You must pay attention and select, to the best of your abilities, an apparently healthy animal to start with. You should also evaluate what you expect from owning a bearded dragon, whether the lizard is meant to be a pet that should interact with you, or a display animal noted for its beauty, or a dragon that will be bred.

Gender and Number of Dragons

Both sexes of bearded dragons make good pets but males grow larger and are considered by some to exhibit more character, personality, and responsiveness. Of course, if you're going to own one bearded dragon, it doesn't take much more work (and can be much more entertaining) to keep a pair of these social creatures.



Complexity of scale structure and color are two of the appealing features of bearded dragons. This is a “normal phase” bearded dragon.



Male eastern bearded dragons develop larger heads than females do.

How many bearded dragons should you get? To answer that question, you need to evaluate your objectives. If you want a single pet, an individual bearded dragon will fare well enough, although males in particular may display signs of social deprivation by displacing their social behaviors. They may, for example, head bob at you. Because bearded dragons are social creatures, a pair of a male and female, matched so they are close in size, is an ideal combination.

Breeders maintain larger groups, using a ratio of one male to two females. In large walk-in enclosures, you can keep up to two males and four females together. Although adult males will get into territorial and competitive engagements during the breeding season, they are usually not as aggressive as to cause serious harm to each other. Close observation is nonetheless always necessary to evaluate the compatibility of dragons kept in a group.

Baby bearded dragons raised in groups are very competitive and early on will form hierarchies in which the tougher and usually larger animals will intimidate smaller ones, eat most of the food, and grow faster, making them even more intimidating and dominating. If small specimens are not segregated from larger specimens, the small ones will often hide, fare poorly, or eventually become food for their bigger brothers and sisters. Close observation to evaluate the growth, health, and welfare of individual dragons is imperative.

Personality

Bearded dragons vary in personality. Some are more personable and responsive than others are. Some show more signs of intelligence. A very few are spunky from the time they are young, full of attitude, and readily displaying an open mouth in readiness to bite. A few of these spunky lizards can grow into nasty adult dragons, threatening to bite whenever you get near them. In their own way, these aggressive dragons can be an endearing contrast to the typical pet dragon that is tame and placid.

Size

As a general rule, young dragons that are relatively large have less risk of dying than tiny hatchlings. For a first-time owner, a 6–8 inch juvenile that appears in good shape is a better long-term survival prospect than a 4-inch baby and is well worth the extra cost. If good color is important to you, selecting larger individuals well on their way to developing bright colors is the surest way of knowing what you may end up with. Because breeders aim to keep groups consisting of one male to two or three females, excess larger males are commonly available and are ideal choices for those wanting a single pet. Occasionally breeders offer older females at reasonable prices. These dragons are past their reproductive prime but have several good years left as pets and family members.

What to Avoid

Do not pick a dragon that remains on the ground with its eyes closed. After brief periods of activity, sick and weak dragons often close their eyes and resume a sluggish posture. If most dragons in a tank appear unhealthy, do not buy a dragon from that enclosure for there is a good chance that the sick dragons will have infected the few that still appear healthy.

Do not pick a thin dragon with a skinny tail and visible outline of the hipbones. Avoid a dragon with depressions in the back of the head.

Do not select a dragon with fecal smearing around the vent and base of the tail. There is a good chance it has internal parasites.

Do not pick a runt or baby whose head appears bulbous in the back. It may eventually grow to normal, but you would be starting off with an undersized or premature pet.

Avoid a baby that shows repetitive opening and closing of the mouth, and makes light popping sounds. These are signs of a respiratory infection. Do not confuse this, however, with normal gaping performed when a dragon is starting to overheat under a basking light.

Finally, do not get the silly notion that you are going to save a poor dragon that is ill or runt. Most sick-looking baby bearded dragons die. If they don't, there is a good chance their owners end up spending quite a bit of money on veterinary bills to take care of their health problems. Nature doesn't select for the weakest and neither should you. If you already have healthy dragons, bringing a sick one home can put them all at risk of contracting a disease.

Signs of a Potentially Healthy Bearded Dragon

Healthy hatchlings may open their mouths and threaten to bite when a large hand approaches them. This is normal behavior for a healthy hatchling.

Look for an animal with rounded body contours and without skeletal outlines visible, particularly along the hipbones and spine. Examine digits and tail to make sure all parts are present.

Select an animal that is bright-eyed and either active or resting comfortably under a spotlight with head and upper body raised. Make sure it is bilaterally symmetrical: both eyes should be the same size, and it should be without a kink or bend in its back.

Once a salesperson removes the bearded dragon from its enclosure, ask to have its belly presented toward you so that you can examine the vent. The anal area should be flush with the body. There should be no brown fecal smears or caking around the vent.

Bearded Dragon Feces as Health Indicators

FAQ: *My bearded dragon has dark stools with a bright white edge. Is this normal?*

Yes. Bearded dragons, like most reptiles, excrete nitrogen in the form of semisolid urates (mostly uric acid), rather than as water-dissolved urea. This allows them to excrete nitrogenous waste while conserving water. Healthy bearded dragons produce dark, formed to semiformed feces with a white urate component.

Runny, pasty, and unusually pale and smelly feces are signs of possible illness, as are unusually large amounts of soft urates. Unpleasant as it may sound, monitoring the state of feces is one way of assessing the health status of your bearded dragon.

Quarantine

Quarantine is unnecessary if you have only the one newly purchased bearded dragon. However, anyone purchasing one or more dragons and wanting to add them to an enclosure with other bearded dragons or to a breeding colony should first quarantine the new lizard(s) individually in a separate enclosure with newspaper substrate for a period of at least sixty days. During that time, carefully monitor the lizard(s), and have a veterinarian perform fecal exam for parasites. Keep a weekly record of a lizard's weight during this period to assess its growth and health. Diseases of special concern are coccidiosis and pinworm infection, both of which can quickly spread in an established collection. You will save yourself a lot of trouble by establishing quarantine procedures before mixing animals.



An outstanding red/gold bearded dragon. Photo by David Travis

MAKING A HOME FOR YOUR DRAGON

We strongly urge you to keep your bearded dragon within a suitable enclosure. Allowing a dragon to free-roam a room or house may appear at first to be a good thing, but what may be perceived as freedom for the lizard can become a death trap. Dragons that are loose in households fail to keep themselves adequately warm and hydrated. They can become immunosuppressed, falling ill from infections. Moreover, loose dragons may be stepped on by humans and preyed upon by household dogs and cats. They may receive serious or fatal electrical shocks from power wires or equally serious trauma from toppling books, lamps, and the like. Loose dragons risk setting households on fire by bringing combustibles such as curtains into contact with hot items such as lightbulbs. Responsible bearded dragon owners who are dedicated to providing the best for their pets should keep their dragons in appropriate enclosures and let them out only when they can be supervised closely.

Enclosures

Bearded dragons are moderate-sized lizards that, as they grow, require large enclosures. When deciding on enclosures, it is important to consider the bearded dragon as a two-stage lizard even if you want to invest right away in the larger enclosure it will need when fully grown. You can start a baby dragon for the first four to six months in a 30-inch-long enclosure. Keeping a baby dragon in a large enclosure can be problematic, because the dragon may fail to find its food, water, basking sites, and shelters. As the baby grows, however, you will need to provide a larger enclosure.



Large, molded plastic snake cages with sliding glass fronts can be modified to accommodate bearded dragons. This cage, produced by Bush Herpetological, was made to house desert iguanas, a species with requirements similar to those of bearded dragons. With plastic enclosures, take care in placing the spotlights to avoid melting the plastic. Photo by Val Brinkerhoff, courtesy of Dan McCarron



This 30-inch vivarium with front sliding-glass doors is set up for temporary display of baby bearded dragons. Snake plants and a pony-tailed palm decorate the display.

The smallest enclosure for one or two adult bearded dragons is either a 4-foot x 2-foot vivarium or a 6-foot x 18-inch vivarium. At the very limits, a standard 55-gallon (48-inch x 13-inch) vivarium houses a single adult specimen. Anything smaller will restrict activity in a way that is not optimal for the animal's welfare. Enclosure size requirements need to be considered before you decide to purchase one of these lizards.

The most widely sold enclosures in the reptile trade are all-glass tanks with sliding screen tops. These are fine for bearded dragons except for two problems: many stores do not carry the larger sizes, and transportation and weight of these enclosures may become an issue. There are large, lightweight plastic molded enclosures with sliding glass fronts sold in the reptile trade (e.g., Bush Herpetological and Vision Herpetological) that can be designed for housing bearded dragons. These enclosures can be mail-ordered if your local reptile store does not stock them.



In this outdoor breeding setup, wooden pallets are joined to create sites for perching and basking as well as shade.

Outdoor Enclosures

In a few warm areas of the United States, such as southern California, bearded dragons can be kept outdoors in screened or covered pens year-round as long as they are provided with shelters from rain and have areas of soil or piles of hay to burrow into. Breeders have built effective pens inside greenhouses. Greenhouses should have controls for monitoring and maintaining desired temperatures including whitewash, opening panels, fans, and heaters.

In most other areas of the U.S., bearded dragons can be kept outdoors in simple pens during warm

months. Make sure you build secure enclosures with screen or mesh tops to prevent escape and to keep out potential predators such as foxes, raccoons, cats, and birds of prey. Inexpensive alternatives are large plastic screen enclosures now sold in the reptile trade. They are ideal for allowing lizards to bask outdoors in sunlight (see the chapter on heating and lighting). It is important not to place these all-screen enclosures on concrete or asphalt. Because both of these surfaces absorb heat when exposed to sun, dragons may overheat and die if housed in a screen cage without shade, water, and climbing areas.

Substrates

Because of the potential risks of sand impaction, many people choose to initially raise baby bearded dragons on newspaper. For animals over 8 inches, we use silica-based, dust-free play sand (used in children's sandboxes) as a substrate and have never had problems with impaction. Our evaluations of various substrates are as follows:

- ❑ **No Substrate**: Many breeders raise their babies on bare floors within plastic tubs or glass tanks. Advantages of bare floors include easy monitoring of stools, lack of hiding places for crickets, minimal risk of impaction, and less-intensive maintenance. Bare floor enclosures are easy to empty of landscape structures and can be moved outside for washing with a garden hose. A disadvantage is that the floors require regular wiping. As the dragon grows larger and messier, bare tanks become unattractive and tedious to clean. With larger animals, the hard, smooth floor surface can also lead to overgrown nails and bent toes.
- ❑ **Newspaper**: This is the substrate most recommended for quarantine and treatment of sick animals. Newspaper is cheap, readily available, easy to replace, and well suited for examining feces. Many specialists recommend newspaper for initially raising babies because it allows monitoring of stools and eliminates any risks of impaction. Downsides are that newspaper is visually unattractive, and regular or daily replacement can be labor intensive. If used with adult dragons on a long-term basis, there is a risk of overgrown nails and bent toes.
- ❑ **Sand**: Sand is our favorite substrate. We have never had problems using a variety of sands with bearded dragons of all ages (yes, we use sand with babies), but there are reports of sand impaction in babies. For this reason, we recommend paper towels, newspaper, or brown butcher paper for hatchlings up to a length of 8 inches. After that size, sand is the most natural-looking and easy-to-maintain substrate for bearded dragons. We use play sand because it is relatively dust-free. There are other types of sand, including limestone sand, sold in the reptile trade that are attractive and may work with bearded dragons. However, we're concerned about reports of baby dragons becoming seriously ill from intestinal impactions following the ingestion of sands containing calcium. Until more information becomes available, they are probably best used only with large bearded dragons. Avoid unscreened/unwashed sands, particularly unprocessed silica sands because of health risks from inhaling dust lifted by the dragons' digging. To clean fecal material, remove fouled sections of sand daily using a scoop. Change sand every four weeks or as needed.
- ❑ **Sandy Soil**: Mixes of sand and soil work well with bearded dragons. A problem with soil is that it can make dragon colors appear more brown and less colorful over time. Dust is also a problem. As with substrates of just sand, spot cleaning is easy. Sandy soil must be replaced on a regular basis. In outdoor setups, natural soils make up the floor of most screenhouses and greenhouses and generally

work well with bearded dragons.

- ❑ Alfalfa Pellets and Rabbit Pellets: Alfalfa pellets are absorbent but have drawbacks. Some people develop serious allergies to alfalfa. Moreover, the pellets exude a strong odor when wet and can crumble, turning into a pervasive dust that escapes enclosures. There is also a risk of flour beetle infestation. These beetles are harmless but can spread and infest any grain-based food in your kitchen. (In time, you could have hundreds of tiny beetles scattered throughout your house). Alfalfa is too soft a substrate for adequate nail wear. Some veterinarians believe that there is a high incidence of respiratory disease in lizards housed on alfalfa pellets and rabbit pellets. These pellets are quick to mold when they become wet, so lizards may inhale mold spores, predisposing them to respiratory disease. Clearly, these pellets are not our favorite substrate.



This 36-inch vivarium has been designed for housing baby bearded dragons. It includes perching areas, live plants, a basking light, a UV-B fluorescent bulb, and a hot rock as a secondary heat source.

Landscaping

Many new owners make the understandable error of landscaping their bearded dragon vivaria without any climbing areas. Not only does this limit the space available for your dragon's activity but also makes for a dull display. Remember, inland bearded dragons are semi-arboreal and like to climb on rocks and dried wood. In Australia, they are often seen on the top of fence posts and rails. These perching sites can be reproduced in captivity by adding large sections of dried grape wood, fig wood, cork bark rounds, or rocks. Ledges along the back and sides of a tank can also be created. These raised areas make ideal basking sites and most hobbyists design them so that they are located under spotlights. At least one raised site should be provided per enclosure. In addition to a raised area, you should also have plenty of open ground, maintaining at least two-thirds of the floor surface as open space. Bearded dragons also enjoy shelters for sleeping at night or for brumation (shutting down during the winter rest or period). Our favorite shelters for bearded dragons are big slabs of rounded cork bark. They're attractive, light, and easy to clean.



In this custom indoor display, stacked rocks serve as basking site and shelter. The plant is a *Dracaena marginata*, a species readily available in stores that sell houseplants. Photo by Val Brinkerhoff.

Nail Wear

In captivity, if lizards are kept on solid surfaces or on soft substrates they can end up with overgrown nails and digits that bend to the side. To prevent this, consider scattering rough pebbles on the substrate surface or adding flat sections of rough rock such as limestone to the landscape design. Lizards wear down nails by running or climbing on rock surfaces.

Plants for Bearded Dragon Setups

We have received many letters requesting lists of plants that are well suited for bearded dragon setups. We know that popular vivarium plants such as pothos or Chinese ever-green are quickly crushed, nipped, trashed, and dried up in a bearded dragon setup. Only a few species of plants are tough enough to hold up to bearded dragon abuse indoors. Our top choices include ponytail palms (*Beaucarnea recurvata*) and snake plants (*Sansevieria* spp.), particularly the tougher ones with thick or cylindrical leaves that are more adapted to arid conditions. With smaller dragons, jade plants (*Crassula argentea*) fare reasonably well but do not usually grow thick and strong enough indoors to withstand the weight of larger dragons. The only cactus we recommend is the spineless tree opuntia (*Consolea falcata*). In taller enclosures with strong light, some of the dracaenas fare well. Outdoors, we have successfully used large jade plants, elephant bush (*Portulacaria afra*), tree yuccas, and dracaenas. Interestingly, we have found that in outdoor setups jade plants are particularly favored by these lizards for resting areas.



These bearded dragons in an outdoor enclosure particularly like to perch on large jade plants.

If you want to add foliage to your bearded dragon vivarium, remember that plants take up space. A large enclosure that is at least 6 feet long is required for combining adult bearded dragons and plants. When placing plants in indoor setups, it is better to introduce them in pots buried in the substrate rather than planting them directly into the substrate. This makes watering possible without wetting the entire setup and helps reduce water loss to the surrounding substrate. It also allows easy removal and replacement of plants as needed.

In terms of design, larger plants are best placed toward the back of the vivarium and smaller ones at midlevel to provide a sense of balance. Generally, placing plants at the base of landscape structures such as rocks or wood will have an attractive, natural effect. Once plants are introduced, the dragons should be monitored closely. Damaging activities such as climbing (it can break branches and topple plants) and attempting to eat plants (which injures or destroys them), tend to occur early on as the dragons explore the new items in their space. Observation should provide you with guidelines for adjustments in plant placement and selection.



Bearded dragon enclosures should be provided with adequate shelter. Photo by David Travis.

Vivarium Maintenance

It is important to monitor your bearded dragon daily to evaluate its attitude, condition, and health and to make sure the vivarium is functioning properly. Bearded dragons are active lizards that eat large amounts of food and consequently defecate correspondingly large amounts. In short, they tend to be messy. For this reason, regular maintenance of a vivarium is a must. With adult dragons, this means regularly using a cat litter scoop to clear fecal material from the substrate. In addition, if water is kept in the enclosure, it should be replaced at least every other day and whenever the container is fouled, especially since dragons may soil the water. The water container should be washed, disinfected (using a 10 percent bleach solution) and thoroughly rinsed on a regular basis to remove accumulating bacterial slime and fecal traces. Assuming the dragons are not kept in crowded conditions, the substrate should be replaced completely about once a month. If paper is used as a substrate, it should be replaced every two to three days, or even daily if necessary. Dirty landscape materials should be removed and disinfected by soaking for a couple of hours in a container with a 10 percent bleach

solution, then rinsed and allowed to soak in water to clear traces of bleach.

THE IMPORTANCE OF HEATING AND LIGHTING

Providing proper heating and lighting is essential to keeping caged bearded dragons healthy. Their activity and metabolic processes depend on proper light and heat gradients. Without them, your dragons cannot survive.

Heating

Providing adequate heat is critical to the welfare of bearded dragons. The primary source of heat should be a white (not red) incandescent bulb or spotlight in a reflector-type fixture capable of handling the wattage and heat output. A fixture with a ceramic base and no electrical switch in the base typically last longer for this kind of use. Look for a fixture with a switch on the cord, or plug the fixture into a surge suppressor unit and use that switch to turn it on and off. The fixture should be placed on or above the screen top over basking sites such as flat rock or wood. The temperature measured at the site should be 90–100°F, and the bulb wattage should be adjusted to provide the proper temperature. An alternative is to use a higher wattage bulb and wire or plug the fixture into a light dimmer. This allows you to adjust the heat output.



When raising baby bearded dragons, many hobbyists choose to include a hot rock type of heater as a secondary heat source.



During the warmest time of the day when temperatures can reach 100°F, these bearded dragons choose to rest in the shaded portion of their green-house enclosure.

Several bearded dragon specialists recommend combining a hot rock with an overhead spotlight

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