

The Bug House at The Houston Zoo

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Introduction

In May 2014, the Houston Zoo officially opened The Bug House on Memorial Day weekend within the John P. McGovern Children's Zoo. This newly built gallery contains 25 exhibits of variable sizes, with 24 of these being interchangeable. The 25th was constructed for leaf cutting ant colonies. The service room is a 68 foot long space that houses access to 16 of the invertebrate exhibits and contains nurseries for immature invertebrates, as well as back up colonies for future exhibits.

As we reach our 1-year operational mark, this paper will cover several aspects of the evolution of The Bug House. First, this paper will highlight some of the features of the building, along with a brief description of the construction timeline. Second is the exploration of the evolution of our collection plan, based on keeper experience, species availability and practicality of rearing, or ability to rear or replace species. Third, this paper will discuss staffing and training, as invertebrates are new to many keepers within the Children's Zoo. One last aspect that will be highlighted is outreach—through keeper chats and zoo events and how The Bug House further advances the Houston Zoo mission statement to “provide a fun, unique and inspirational experience fostering appreciation, knowledge and care for the natural world.”

The Houston Zoo Bug House

The Bug House is a new facility, designed by Portico Group, and constructed by Bellows. Construction began in the fall of 2013, around the same time that the job posted for the invertebrate position. The exhibit began with a soft opening the Friday of Memorial Day Weekend and the official opening on Memorial Day 2014.

The Bug House contains 25 exhibits. Twenty four of these exhibits can be changed out, with different species being exchanged as needed. The twenty-fifth exhibit is specifically designed for a leaf cutter ant colony, having hydrostone nest chambers visible to the public. Nine exhibits can only be accessed from the exhibit gallery; these tanks are behind locked cabinets, and slide out from the cabinets on a track system. The remaining 16 exhibits are accessed only from the service room.

The sizes of the exhibits vary, as do the shapes. The most common dimension is 0.45 meters all three ways. These are all 'L' shaped boxes, with the box jutting out into the gallery, and the neck of the 'L' being where the access to the exhibit is (off public view, or behind the locked cabinet). Several of the exhibits also have dimensions of 0.61m X 0.6m X 0.9 m. The ant accessible exhibit space measures 0.91m X 0.61m X 1.06m, mostly consisting of twisting artificial vining, so people can watch the trail of

ants criss-cross the space. That does not include the more difficult to access hydrostone chambers below. Two other exhibits span 1.5 meters across. One exhibit has dimensions of 1.5m X 1.5m X 1.5m and the other one has a height of 1.8m (this is the first exhibit from the “front” entry door, showcasing native species).

The exhibits that are accessed from the service room have some unique features as well. Here, the lights are on adjustable, arching coils, so the light can be moved closer or farther away from the lid. This is actually necessary, as the tank lid will not stay open without the light fixture holding the lid upwards. All but two exhibits set on or in a built-in concrete shelf and may sit over 1.2 meters high. Two sets of exhibits sit on a stacked set. The two lower exhibits sit in a recessed cubby shelf. Five exhibits that open to the service room have doors that are located on the back wall. These are the only exhibits that do not require a step ladder to service. All the other tanks are ‘L’ shaped tanks whose openings are around 2 meters high.

One exhibit is an aquarium, holding approximately 38 Liters. This tank was not originally designed as an aquarium, but Variance, our tank designers, was able to alter the plans to accommodate an aquatic exhibit. The aquarium is accessed from the service room, and is the only space that could accommodate the weight of water and be plumbed for filtration. A canister filter is attached via tubing along the back. This tank is rectangular in shape, allowing for easier access for cleaning, and located as the bottom of a stacked exhibit, recessed in a concrete cubby.

The exhibits are all hooked up to an automatic misting system, connected with an RO water unit holding 493 Liters. These systems can be turned on or off in groups or individually. There are three master valves, which can switch water flow on or off from a group of exhibits. Two of these valves control the flow in the service room, one controls water flow to the exhibits only accessible from the public gallery side. Plastic tubing is strung between tanks, and each tank has its own valve, so water can be isolated from individual tanks as well. The automatic misting pump is operated manually, so the pump must be turned on and off by keepers.

The Arrival of Bugs

After the start of 2014, the first non-native insects were slated to arrive. Native insects were already in the curator’s office. Since The Bug House was still undergoing construction, a different building that was permitted by the USDA had to temporarily house these acquisitions. A small animal holding room within the education center became the second space arthropods would be housed until The Bug House was ready. Some stick insects, millipedes and cockroaches were the first to arrive. However, it was recognized that the holding room would not be big enough to house the rest of the incoming orders, and a third building would need to be utilized. A small ward in the veterinary clinic was selected. Before acquiring the insects that would be housed here, the room needed to be prepped. A long drain had to be sealed off, as well as sealing off the lights and adding weather stripping to the doors. This room housed several species of beetles and mantids, from foreign vendors.

The first exhibit building walk-through occurred in March 2014. It required a hard hat, safety vest and safety goggles. The walk-through allowed us to view the public gallery space, the locations where

exhibits would be placed and their sizes, and to have a glance at the service room. The next time we would enter the building would be in April, making sure that all gaps, holes and vents were sealed off or had screens, and so we understood the layout of the building and where everything would be placed within the service room, just prior to the USDA inspection. The USDA inspection occurred in late April, while the building was still under construction. Also during this time, a meeting with Variance occurred. This meeting was a walk-through as they began putting in substrate and propping for the exhibits, to make sure the list they had of the species going into exhibits matched ours.

Occupancy was granted approximately a week before the exhibit would open to the public (and just days before a donor/member viewing). The day of move-in became a 12 hour ordeal as all tanks and tubs were moved from various buildings across zoo grounds, and arthropods began being placed in exhibits. Most of the exhibits were occupied by the end of the night, but some substitutions would be made over the next few days. That week also had all the media spots about the new exhibit—zoo blogs, newspapers and television stations had interviews, film footage and photography sessions occurred. Opening weekend, and throughout the summer, attendance in the building was high, with a lot of positive feedback. A daily keeper chat on bugs occurred throughout the summer months as well.

Every building and exhibit has its strengths and weaknesses as far as accessibility, for visitors as well as keepers, and design features. The first strength is the building was of new construction, and built specifically for invertebrates, as a USDA containment facility. This allows for more state-of-the-art features like exhibit spaces, lighting and misting amenities. This also ensures that the most recent USDA requirements are being met without a lot of retrofitting.

A second big positive is the appearance of the exhibits. The tanks are gallery quality, and were prepared with live plants, mosses and wood perching. On their own they looked like art; we joked that you wouldn't even have to put bugs in them, they were aesthetically pleasing on their own merit.

Having a large reverse osmosis water system at the ready is a positive as well. Because it refills automatically, unless there is maintenance work being done or the water has to be shut off at the source, there is always access to fresh RO water. A misting system that delivers water to all of the exhibits is always a plus. This has eliminated somewhere between 30 to 45 minutes of hand misting a day.

There are a few issues that as a team we wished were different. The first is that several of the exhibits are very high off the ground (floor level of the exhibit is almost 1.5 meters high, above the comfortable viewing height of many of our visitors. Adults often have to lift children to see what is in the exhibit. I myself have to stand on my tiptoes often. Some exhibits are so high and deep that even with a step ladder, one cannot reach the front of the exhibit for cleaning without a long pair of forceps.

A second issue with the exhibits is the permanent backdrop many of our exhibits have. There are several exhibits with rockwork that is neutral, and can be utilized as an exhibit for most habitats; there are a few however, that are not neutral and would not lend themselves to a different habitat type. Some of the other exhibits have a laminate forest scene background, and could not be utilized as any other habitat type. This limits our ability to diversify our exhibit collection, and forces us to very carefully plan out where non-forest invertebrates can go.

The last major issue seems to be with our signage. These are frames that clasp a plastic sign between 2 sheets of plexi, and are backlit with LED lights. They are not a universal size—there are 3 different options. We have to contend with both horizontal and vertical orientations, and two completely different height/length dimensions. One has to plan where a bug may go before it is ordered, so a sign can potentially be ready by the time the bug arrives via shipping. If a specimen on exhibit dies, a new arrival may not be able to slip into this vacancy due to the fact the pre-ordered sign is not a match. At times, multiple exhibits have been changed in one day to accommodate being able to place specimens in the best exhibit possible for them, and utilizing the right sign. There has even been a few times when there were no bugs in the current collection that would match a sign in the correct configuration at all. Those times an insect went in without a sign.

Collections obviously evolve over time, even during the planning stages. The Bug House was no exception. A rough draft opening exhibition list was provided by Kevin Hodge, though the previous curator was the individual that had created it. There were also some sketches in the planning book of how some of the exhibits would look based upon some of these choices. Many of these were open to change, based on availability, personal experience and opinion.

To help plan what species would be utilized on exhibit, a word table was provided with the exhibit number (1-24, as # 25 was a constant), a long blank square for the species, and then a square with the dimensions of the tank, as these varied widely from space to space. It seemed to make for endless possibilities, and every time the table was brought up on a computer, its contents seemed to change dramatically.

The initial draft of exhibits created by the previous curator was beetle heavy (over 50%), and after doing some research, there was serious doubt about availability from vendors, and that all of these species could be reared without large amounts of resources and time (not to mention space!). Other changes made to this draft were because of what personal contacts were able to assist with—Woodland Park graciously offered several species to fill exhibits.

One of the changes/additions to the plan was for white-eyed assassins (*Platyeris biguttata*). This was so there were representatives from Hemiptera, and also because it was a good, low-maintenance choice. They would also represent a different habitat, as many of our species are rain forest specimens. An aquatic tank was also an addition. Water bugs and diving beetles are easily obtained, and make for a dynamic exhibit. On a personal level, it seemed important for there to be a representative of an invertebrate that lived in fresh water.

An additional add-on was an exhibit that contained green lynx spiders (*Peucetia viridans*) and vinegaroons (*Mastigoproctus giganteus*). Although this exhibit has changed, it was an interesting idea, and a personal favorite, although co-workers were not as crazy about it. The *Peucetia* were our only true spider in the collection, and would spread along the top portion of a tall exhibit. The *Mastigoproctus* would scurry around on the substrate, occasionally climbing up the branch in the center of the exhibit. The difficulty was having such small specimens in a large tank, even though there were many animals in the beginning. Some predation naturally occurred, but many times individuals would just be in hiding (with in the grasses, behind or under rocks, or in burrows underground). It was however, the scenario you would find in your backyard—many small creatures you had to stop and look for. It was understood,

though, the argument for high visibility, especially as it was a tall exhibit. It has housed several species over time, and is now exhibiting *Eurycantha calcarata* (New Guinea stick insect).

Peruvian fire sticks (*Oreophoetes peruana*) and Peruvian jumping sticks (*Stiphra spp.*) were additions that happened at different times. A personal contact was able to supply *Oreophoetes* at the beginning; they would be a contrast to the *Extatosoma tiaratum* (Australian prickly stick) and *Heteropteryx dilatata* (giant thorny phasmid), both in appearance and in food source. The idea was to have another low maintenance species. The colony of *Oreophoetes* had a drop in numbers heading into fall, and the reason is still not clear, but temperature is thought to contribute. Numbers are beginning to rise again with new hatchlings. The *Stiphra* were acquired later from another institution. Exhibiting an Orthopteran that behaves like a Phasmid is just an interesting premise.

Some of the exhibits had changes in species, but not in idea. The first exhibit has a permanent desert background and propping, and will always be utilized as an exhibit showcasing Texas native invertebrates. It was originally planned as mixed species, and continues to be so. The original plan was to exhibit cactus longhorn beetles (*Moneilema gigas*), rainbow scarabs (*Phanaeus vindex*) and a migratory butterfly. Ideas for that included different longwings (*Dryas julia*, *Heliconius charitonia*, *H. melpomene*) or a monarch (*Danaus plexipus*). A pull-down screen was even installed in this exhibit to help contain the butterflies within the exhibit space while servicing. No butterflies actually went into this exhibit, but there was a trial run of *H. melpomene* in the large exhibit that opened to the service room. Later on, butterflies were scrapped all together, with the exception of *Danaus* incidentals that came on the milkweed plants. The *Phanaeus* were also scrapped, due to the fact they were under the surface of manure most of the time. In the end, the exhibit housed lubber grasshoppers (*Romalea* and *Taenipoda*), darkling beetles (*Eleodes spp.*), fiery searchers (*Calosoma scrutator*) as well as *Monoleima*. Grant's rhinoceros beetle (*Dynastes granti*) is a desired species for the future.

An exhibit that has not changed on the native exhibit wall is the death feigning beetle/velvet ant (*Absolus verrucosus/ Dasymutilla spp.*) exhibit. These two species tend to be active at all times of the day, have a long life span, and are hardy specimens. It is a great low maintenance exhibit. Another exhibit that has been fairly low maintenance, and has stayed in its original configuration is the milkweed beetle (*Labidomera clivicollis*) exhibit. Incidental *D. plexipus* larva are also raised in this exhibit, and can be released outside after pupation.

The aquatic tank has also remained unchanged. Two giant water bugs (*Abedus herberti*) and a dozen sunburst diving beetles (*Thermonectus marmoratus*) share this space well. The idea of exhibiting crayfish has been contemplated, but the small size of the tank would allow for only a couple individuals, and would probably increase the work needed to maintain water quality. Although, the crayfish would be interactive, running forward to either greet visitors or threaten them. Fortunately, the *Thermonectus* are highly active, and people appear to enjoy watching them swim about.

Flamboyant flower beetles (*Eudicella smithi* and *gralli*) were species added to the exhibit list, and has been exhibited most of the time (it made a short hiatus while larva were pupating, but the colony is larger now). Originally, there was concern that there would need to be a separate breeder and exhibit colony. This is due to a concern of keeping beetles visible, so soil depth was supposed to be kept shallow—too shallow for any breeding. A compromise was made, and with a larger beetle population, deeper substrate

was allowed to be put in place. Breeding now occurs on exhibit and guests can still see beetles on the soil surface. Larva are routinely removed from exhibit for pupation in a larger off exhibit space.

Another visitor favorite has been the second large exhibit, housing giant Malaysian katydids (*Macrolyristes corporalis*), *Heteropteryx* and the giant wingless phasmid (*Phobaeticus serripes*). Once visitors realize the bamboo shoot is an insect, they begin to see more animals than plants. The exhibit started with 3 males and 1 female *Phobaeticus*, a handful of *Heteropteryx* and one pair of *Macrolyristes*. All three species have readily bred, and to our delight hatchlings appear on a near daily basis. The *Phobaeticus* have been by far the most successful, with one female delivering over 100 successful hatchlings.

A third staple exhibit has been a large beetle exhibit, although this “exhibit” rotates both location and species wise. Atlas (*Chalcosoma atlas*), Goliath (*Goliathus goliatus*), Elephant rhinoceros beetles (*Megasoma elephas*) and Western Hercules (*Dynastes hercules*) beetles rotate through the collection at various times. All but *Goliathus* have resulted in mating and successful breeding (he was a bachelor). At this stage we have third instars of *Chalcosoma* and *Megasoma*, and first instar *Dynastes*. The downside to these options are the long larval and pupation stages; more beetles have to be ordered in while waiting for just one generation of larva to get just to pupation.

One last staple exhibit worth mentioning are the arachnids. At this time, three tarantulas are out on exhibit. A bird-eater (*Theraphosa*), a Mexican red-leg (*Brachypelma emilia*) and a Gooty sapphire (*Poecilotheria metallica*) are spread throughout the gallery. A *Theraphosa* and the *P. metallica* have been exhibited from opening, but the young *Brachypelma* was added later on.

A challenge in the process of creating a workable exhibit was staffing and training. Staff experience with invertebrates varied. One part time keeper had significant experience, but did not have a large role in the exhibit preparations at the time (she is now full time, and is co-primary for the unit). A second full time keeper had a fair amount of arachnid experience. For several of the staff, the experience was limited, but they wanted to learn. Add in to the equation that the department staffing at the time was low, and there were few opportunities to train in the beginning. Part of the pre-training for the curator and two of the staff members was a weekend trip to Audubon. Supervisors were also learning and training, especially when it came to breeding and rearing juveniles.

Time to train staff even as the collection began to expand to other buildings was minimal. Most of the time, training consisted of shadowing over the course of one day. At this stage, because even the protocols were fairly temporary, one day was acceptable. There were only certain keepers taking care of the specimens in the vet clinic and education buildings, as there were not enough days to train all keepers, and more specialized care was being needed.

When the exhibit was first designed, supervisors hoped the workload would equal out between four to six hours a day. It was advised on hire, however, that this exhibit would take longer than that time frame to finish. There was some general surprise when it was advised it would probably take close to all day; it did not take long after opening for it to be realized by all that it would indeed take all day to finish all day-to-day care. In fact, with everything spread in multiple buildings, it was already taking most of an 8 hour day to complete the necessary tasks. Each time a shipment came in, it could take over an hour to unpack and house them in pre-labeled bins (taking into account also mixing substrate components).

Another aspect of the original staffing plan is that all full time staff would be trained (training lasts 5 days) to work bugs as part of the regular rotation through Children's Zoo sections, although that would not start until later in the summer. After seeing how quickly populations change, and the entirely different needs the different species can have, it was decided that training all staff fully in bugs would not be possible in just five days. The current staffing consists of two primary keepers that spend more of their work week in this section than elsewhere, and three other full time keepers that may spend a day a week or every other week in the section.

When bugs were first moved into The Bug House, one full time staff member was on light duty. This allowed for this particular keeper to shadow for a week, and be more fully trained than other keepers had up until this point. This also allowed for the creation of charts and cheat sheets to help the other keepers working in bugs. At a later point, one of the keepers that had been working in bugs had received a job at another facility. Another full time keeper was trained to work in bugs over five days.

The Bug House still operates with a core team within the Children's Zoo taking day-to-day care of the collection. There was a need, however, to cross train all staff for one day to expose them to what goes on, what tanks are safe to open, how to right flipped beetles, when to leave a specimen alone, etc. This was something started this last spring. One thing that staff are trained on is more in-depth explanation of USDA regulations. All full time staff have to read and sign the SOP for the unit, but most had not seen through demonstration how we follow those regulations. Their day of training includes learning how trash is disposed of, what is okay to put in a regular trash can and what is bagged for the deep freezer. They are also shown the different aspects of containment. They learn about what to do if an insect is found outside of its enclosure—our native versus non-native species, what species is safe to contain on their own, and which ones they need help with. They also learn how to properly right flipped insects, and which tanks are safe for them to reach into (there are a few tanks that only fully trained bug keepers may access). It also exposes them to what the invertebrate keepers do on a daily basis—they hear about what goes on, but they don't generally understand the projects, or even the names of the species, let alone what they are, as they never see them.

Part time keepers are not trained in the section, and generally do not even enter unless accompanied by a full time staff person. They do have the option of doing bug keeper chats. Zoo interns shadow the section for a day, but are not in the section unsupervised. They are taught about the USDA regulations, and they must ask before disposing of anything to ensure it ends up in the right place. They do not perform any tasks in the service room or any exhibits without supervision in this section. They have a project within the Children's Zoo that they work on, but it tends to be more observational or guest-related. Teen volunteers also shadow for a day, and are not left unsupervised in any section.

Outreach and Guest Experience

Even before The Bug House opened, outreach to the public about the upcoming exhibit, as well as about the importance of insects began, and continues today. Outreach comes through guest experiences like keeper chats, to donors and members through special events, and to the public through media—television, internet and newspapers. The goal of the outreach is to provide experiences that drive appreciation for the natural world. It should represent the mission statement to “provide a fun, unique and inspirational

experience fostering appreciation, knowledge and care for the natural world.” These experiences are provided on a regular basis, and positive feedback has been given.

Before The Bug House opened, there were staff photography sessions to make graphics for the exhibit, and to put in zoo publications. There were television spots and newspaper pictures and articles. Most of the coverage gave insects a positive light; there was one station, however, that wanted to film the “scary” insect exhibits, having their guests make faces of disgust. They did not ask for any staff explanation of the exhibits, or defense of the bugs.

Both as part of a new exhibit, and as one of the indoor exhibits touted as a “chill zone,” The Bug House featured a daily bug chat from opening day. This approximately 15 minute, informal chat differs from each keeper that gives it. It began as keepers (generally me, at least in the first half of the summer) giving talks in front of the exhibit that struck fancy that day. Over time, it also incorporated bringing a live bug out into the exhibit hall. Sometimes the bug would be in a critter keeper, sometimes the keeper would hold it in their hands; depending on the species, guests would be able to touch it. The chats could take place in front of an exhibit, in the corner by the bench, or even right outside the entrance doors to the exhibit.

The main challenge to the chat is the shape and construction of the room. Unfortunately it is a giant box that rebounds all noise. The echoes, along with the busy attendance within the gallery, made chats turn into yelling (the personal nickname given to these daily occurrences became the “bug scream”). A “Chatter Vox” was made available, but it also only resonates in the cubic space. The other challenge to the chats is that the general pattern of attendance is one where people pass by exhibits, but don’t necessarily spend a great deal of time. There is opportunity to state the name of the species, a few tidbits about its geographical origin, and a little on its life habits before people are ready to move on. Part of this is perhaps due to the noise volume in the building, and maybe also by the darker lighting conditions. Weekdays have been a better experience, with lighter crowds and a more patient audience. Chats are still offered on the weekends as part of this summer’s “chill zone” chats, but earlier in the day.

Bugs have even gone to or been a part of, special events. Invertebrate handling has happened for a member/donor evening event shortly after the grand opening. Spiders and tarantulas took part in the “Spider: Spotlight on the Species” event in the Children’s zoo. A tarantula was handled at one of the larger fund raisers of the year. A *Macrolyristes* made an appearance for an event near the grand opening of the new gorilla exhibit. Tours of The Bug House are available for purchase by the general public. No one has taken that offer to date. One make-a-wish type tour was given during the early summer. One last special outreach event that has occurred: Joel Sartore took photographs for his project “Photo Ark,” that is a documentation of the biodiversity on Earth.

The Bug House at The Houston Zoo has just completed its first year in operation, after seven months plus of dedicated preparation. Housing 24 interchangeable exhibit spaces and a leaf cutter ant colony, the custom built, propped exhibit spaces reflect the aura of an art gallery for the invertebrate world. Houston Zoo keepers faced challenges including procuring specimens, construction delays, staff training, and providing invertebrates as part of the outreach and guest experiences programs. The Bug House continues to build and maintain existing colonies, as well as begin with new species, as well as training and exposing a staff with limited invertebrate knowledge to become a successful, well-loved, sustainable exhibit within the Children’s Zoo for years to come.