

The Animal Behavior Management Alliance.

WINTER





Greetings ABMA members- My name is Nicki Boyd and I am your new president until the end of the Tampa, Florida 2016 ABMA conference. This year we had our exciting (and first) European conference. Twenty four countries were represented in Denmark, and the conference host Copenhagen Zoo and Odense Zoo really helped make it a great event. Our board members Annette Pederson and Kirsten Anderson worked really hard to make the conference amazing.

From the opening ceremony with Hans Christian Anderson theatrical display to the inspiring key note from Ken Ramirez reminding us to raise the bar in animal care and/ or separate ourselves from those who are not willing to do so, the week was full of educational presentations, inspiring enrichment ideas and great site visits to several zoos and aquariums. Everyone was friendly and willing to share their thoughts and ideas, I personally came back presented what I learned to my facility and we have already started implementing ways to make our animals work for their food more, by drilling holes in the bone and hanging on chain with protected garage door springs like those presented in many of the Shape of Enrichment talks.

These conferences are the main reason I support ABMA and have volunteered my time as a board member for the last 7 years, the networking, learning and sharing make me a better animal trainer, plus give me material to inspire the animal care professionals at the San Diego Zoo where I work. ABMA appreciates all the support we get from our members, whether you attend a conference, submit articles on training and enrichment to the Wellspring or just promote us to your colleagues, we couldn't do it without you. Looking for more detail on our next conference for 2016 it is lining up to be another great one!

If you would like to get more involved with ABMA on a committee or the board of directors, feel free to reach out to me at nboyd@sandiegozoo.org or visit our website, theabma.org, and please keep the knowledge sharing alive, visit AP.com to go over the last conference presentations and check out the Collaboration site for more learning opportunities.

Sincerely,

Nicki Boyd

ABMA President 2015-2016

Tidbits and stories from the ABMA 2015 Conference in Denmark

By Ann Lablans

I feel very fortunate to have attended this year's ABMA conference in Denmark. I learned many things, some that had nothing to do with training.

On my first day I was reminded how incredibly helpful and generous ABMA members are. The Denmark trains were confusing to me but fortunately I met a fellow ABMA traveler, Andy Hallsworth. Andy helped me with my bags (I had that darn air cast on) thank goodness. You would not believe our luck, because we got on the wrong train and then proceeded to miss the next three trains. Each time we missed a train we had to go to a different platform. Up and down Andy hauled my bags, thank you Andy! He deserves a MVTP (most valuable team player) reward!

When I finally arrived at the Nyborg (pronounced Newborg) Strand Hotel, I found I had an amazing view out my window to the Great Belt. This is the largest and most important of the three straits of Denmark that connect theKattegatto theBaltic Sea. After settling in I decided that I should take a walk into Nyborg, it was only 2-3 km. I then discovered that it rained in Nyborg almost every day around 5:00 PM. So a little bit of rain for the walk back.

Sunday was spent in workshop with the dynamic duo Steve Martin and Susan Friedman Raising the bar: Contemporary Animal Training. This workshop was well worth the time. Again and again Steve and Susan reminded us not to say that an animal is preforming a bad behavior, but to ask what behavior do you want the animal to do? The take home message: turn it around and look for a solution. Do not label the animal and only see a problem. This theme continued throughout the week with so many wonderful presentations such as The Changing Face of Training in the Modern Zoo: The Welfare Connection by Ken Ramirez of Karen Pryor Clicker Training and the deeply moving presentation of Positive Reinforcement as a Replacement of the Antique Training Methods at Elephant Camps in Asia Gerardo Martinez of the Golden Triangle Asian Elephant Foundation and African Safari just to mention a couple.

I quickly learned that the Danes are much more pragmatic than North Americans. They actively invite donations of animals to be used for (carcass) feeding to the carnivorous animals in the zoo. The donated animal is quickly terminated then fed to monitors lizards, lions, bears, and other zoo meat eaters. Culled animals are used for education about the body organs and how it functions. I watched a lion necropsy. There must have been twenty-five children present, all about eight years old. The speaker had the visitors in the palm of her hand as she asked them how we breathe or how the heart works, truly amazing.

As I struggled to get around to the different outings, ABMA members continued to lend me an arm, or give me a seat, or linger behind at my slow pace to keep me company. We had outings to the Copenhagen Zoo, Blue Planet and Odense Zoo. Each of these site visits demonstrated the results of skillful training on animal welfare and showmanship.

During conversations at meals I learned that there are people working with animals for research rehabilitation. These people work with retired animals which need help to learn how to live and function outside of a research world. Since my focus has been on the research world, it is my hope is to use some of the things I learned at the ABMA conference to train animals in research in such a way that rehabilitation is not needed if and when we get the opportunity to retire an animal. I am still on that learning curve. I will continue to learn from the many skillful members that attended this conference. What an incredible experience and network of individuals. Well done ABMA and thank you Kirstin and Annette for the educational and fun experience at ABMA Denmark 2015.

SAVE THE DATE 2016!

UPCOMING EVENT



BREAKING DOWN BARRIERS: New Possibilities in Animal Welfare Tampa, Florida April 17-22nd, 2016

Join us in the Sunshine State of Florida to find new possibilities in animal welfare! The 2016 conference will be in sunny Tampa and will feature a key note address by Dr. Susie Ellis, executive director of the International Rhino Foundation. Workshops will feature a whole range of topics from veterinary care to advanced training concepts to further the knowledge and establish the best practices in animal welfare. In addition to exciting site visits to our Tampa Area co-hosts Busch Gardens Tampa and Tampa's Lowry Park Zoo, and a wonderful icebreaker hosted by the Florida Aquarium, we'll host our usual bevy of fascinating presentations, posters, networking opportunities and stimulating conversations. New this year, we've added some exciting new events and demonstrations to better serve our members, so you won't want to miss it! See you in 2016!

> Westin Harbour Island Tampa 725 S. Harbour Island Blvd. Tampa, FL 33602 813.229.5000 ABMA room rate \$135!



Have you ever wondered how you could reach more visitors in our day to day routines that would allow you to inspire and instill a passion for how we can conserve the animals that call our facilities home? What if I told you that this could be done without spending an extra cent of your facility's budget (they tend to like that part!)? Well wonder no longer, for hopefully through this article, you can begin to discover what could easily capture those special moments that all of us strive to create with our guests each day.

At Tampa's Lowry Park Zoo, we have started using our typical keeper routine times (i.e. cleaning, training, etc...) to help connect to our guests. What we realized is that the average guest coming into our zoo would read the signage, and perhaps learn a thing or two, but ultimately they would probably forget most of what they learned through those graphics by the end of the day. How could we, the animal care staff, help these people to remember what we feel is important-the animals? We decided that the best way people tend to remember things is through moments they can experience no place else. This led us to try out some very basic things that we have seen leave an impact on visitors from age 2-102.



One of the first examples was during one of my typical keeper routines. Depending on the animal, we, the keepers, are sometimes actually in the exhibit with the animals. What better time to capture a person's attention than when you are right next to an animal. This is typically why zoos tend to have amazing animal shows like free-flight shows and mixed species shows, but some places may not be able to afford that luxury. This example can be the solution. The other day, I was simply feeding our Marabou storks who are currently raising 2 hatchlings. I looked up and noticed that I had an audience. Granted, I came from a show background so the world is my stage, but seriously, these people were glued to what I was doing. Well, I had two choices. I could simply feed and continue on with my routine, or I could give myself human enrichment for the day. The answer was simple-I started engaging the guests. I asked how many of them liked birds. This opened up a familiar dialogue that people could relate to. I asked about the whole story of storks bringing people babies-they replied. I added in a little humor mentioning that these storks bring the ugly babies-I got a reaction. I let them know that I truly appreciated these animals and wanted them to understand why they were so important. I knew I had them listening to my every word and I could hammer into them my message I intended to say all along. These animals, like so many others, are facing huge problems in the wild.

I'm pretty sure you all can fill in the blanks on the rest of the conservation message, but needless to say, I empowered them with things they could do to help out animals both here and abroad and I know because it was during a feeding and not just a keeper talk, they will remember! One simple change to a routine, an added 5 minute talk, and now we are multiplying the numbers of people willing to help animals tenfold-a captured, defining moment.



Instance number two is at our elephant training demonstrations at the zoo's new training wall on the public side of their main habitat. The TLPZ's elephant team has trained some wonderful behaviors that are very impressive, showcasing the size and flexibility of the elephants. What truly captures our message is going from seeing to doing. During the talk, they describe how training takes place. To a non-trainer, that information might easily become to school-like. What if we allow them to feel as if they are training the animal with us? Towards the end of the talk, our trainers teach the cue to the audience and let them give the cue for the behavior (along with the elephant's trainer). As we had informed them that this training is important for both the mental and physical well-being of the animal, they now get to feel that they played a part not only in this session, but the overall care of an African elephant. Now they are remembering what training is and why it is so important to a zoo and the animals that inhabit them. This is one of those captured, defining moments.

My final example is another instance of incorporating a training session on habitat with one of our okapi for our guests. This isn't a scheduled keeper talk, so this adds to the excitement for those visitors that happen to come upon this session. They feel as though they are getting a special, up-close look at how we train and care for our animals. During the session, I have the opportunity to work on voluntary hoof trims and a behavior that showcases his tongue. I love doing these impromptu demos for the public because often the public doesn't understand all of the work we put into the husbandry aspect of behavior management. Now they get a chance to witness it and I can describe to them what voluntary behaviors truly are. Because of this, I can empower them to realize that voluntary training can happen with all animals. Now, we are able to relate with our guests by talking about voluntary behaviors with their own animals at home. As I mentioned in the earlier examples, you want to find a way to make them remember what you say, so have fun with behaviors. Since our okapi does a tongue present, I ask everyone to stick their tongues out as far as they can go, then I show them just how far an okapi can reach with their tongue. Something as simple as this demo can really cause you to capture that defining moment that we should all be seeking.



This is not to say that we are the only place that uses this idea of creating and capturing defining moments, and to those of you that have already been practicing this philosophy-that is wonderful news! If not, let this article empower you to try this out at your own facility. Imagine if we all are able to spread our messaging to where the public actively pursues exactly what we were originally hoping for how much better both our personal and animal lives would be!

This year's annual conference will be held in Tampa, Florida and our theme will be: "Breaking Down Barriers: New Possibilities in Animal Welfare". One of those barriers that inspired this theme is the labels people often use to describe themselves. I've heard people say, "I'm an Educator. I'm a Keeper. I'm a Trainer. I'm a Vet or Vet-Tech." The funny thing to me is, as an animal caregiver, you are all of these. If we truly wish to achieve animal welfare excellence, we must not let labels stand in our way. We look forward to sharing this idea in more detail with you next April, the 17-22, in Tampa! In the meantime, go to our ABMA facebook page and chime in with your specific examples as to how you or your facilities are capturing these defining moments for your guests!

Training terms of the Quarter

Premack's Principle - more probable behaviors will reinforce less probable behaviors.

Differential Reinforcement - the implementation of reinforcing only the appropriate response and not reinforcing (extinguishing) to all other responses.

Counterconditioning - the conditioning of an unwanted behavior or response to a stimulus into a wanted behavior or response by the association of positive actions with the stimulus.



Ruuxa and Raina

"Spirit" and "Guardian"

Dynamic Duo



Majani, born in November 2001, was the San Diego Zoo Safari Park's first ambassador cheetah along with his dog Clifford. In 2009, he was joined by three more cheetahs, Amara with her dog Hopper, and brother and sister Shiley and Johari with their dog Yeti. Then Kiburi joined the collection in 2010. All of our ambassador cheetahs have important roles helping connect our guests to wildlife as well as increasing awareness, compassion and support which they accomplish through presentations as well as our daily cheetah run event. And in turn, the dogs help their cats by making them feel more relaxed and comfortable.

In early 2014, radiographs of a pregnant female showed only one cub. Typically females will not put forth the effort to raise a singleton due to the high cub mortality rate in the wild. Instinctively, they "cut their losses." And hand raising a singleton presents challenges. They do not acquire the social skills learned by having siblings to grow up with.

In anticipation of hand raising this singleton, we decided to introduce it to a puppy right away. This was going to be harder than it sounds! We were asking our veterinary staff to allow a puppy to be put with the cub without going through quarantine first. Cheetahs are endangered and every individual is important to the captive population. We didn't want to risk bringing in an illness or disease to our collection, let alone an unvaccinated cheetah cub! We needed to find the right dog that would be medically "safe" as well as the right personality. Before the cub was even born, we started looking for a puppy that would be the right age and the right temperament and was from a "closed" facility that included a complete medical history which would greatly reduce the risk of bringing in anything that could endanger the cub.



Enter Raina, a Rhodesian Ridgeback! She was born on April 26, 2014.





A mere six days later, on May 3rd, Ruuxa was born.

As soon as Raina was weaned from her mother at five weeks, she was brought into the San Diego Zoo Safari Park's Animal Care Center and introduced to Ruuxa, who was only 4 weeks old and still being bottle fed. It was a match made in heaven!





Traditionally, we have introduced cheetahs to their dogs once the dogs have cleared quarantine and the cheetah has been vaccinated. This means they are usually four months old. These introductions are done slowly and carefully on leashes, allowing the cheetah to get used to the much more rambunctious puppy. It can take anywhere from one to three months for the pair to be able to comfortably live together 24/7. Because Ruuxa was so young, within several days, the two became inseparable. They also became media darlings, on the news, in print and of course on FaceBook!

They even have their own toys and t-shirts in the Zoo gift shop.



However, within several months, it was clear that Ruuxa had medical issues with his front legs.

The difference can be seen in these comparison photos of Ruuxa and a female, Bahati, both at four months of age.



Fortunately for Ruuxa, he received the best of medical care. He had surgery to try to repair the growth in his front legs.



And his big sister was by his side every step of the way.





After several procedures and many radiographs, Ruuxa's condition has been diagnosed as chondrodysplasia, or a genetic "dwarfism" that affects his front limbs. He is not experiencing any pain and most definitely is not having any mobility issues from his condition. He runs, wrestles and plays with Raina. He continues his training for voluntary exams and radiographs with Raina by his side. We are optimistic about his future as an ambassador and having a normal lifespan while enjoying a pain-free and active life.



Who trains what and whom?

Allison B. Kaufman¹, Deirdre Yeater², Kathleen M. Dudzinski³, & Dawn K. Melzer²

¹University of Connecticut, Storrs, CT 06269; ²Sacred Heart University, 5151 Park Avenue, Fairfield, CT 06825; ³Dolphin Communication Project, P.O. Box 711, Old Mystic, CT 06371

Email: allison.kaufman@uconn.edu

Natural Behavior



Photo credit: M. Pagel, Adventure Aquarium

Husbandry Behavior



Photo credit: T. Hoffland, IMMS



Photo credit: T. Hoffland, IMMS

The primary purpose of this study was an attempt to determine a possible repertoire of behaviors familiar to dolphins and pinnipeds housed in human care for use in future studies. However, in the course of this, it was discovered that the information obtained might also create a useful database of frequently trained behaviors, which could in turn be made available for the improvement of training and enrichment programs.

A large scale survey of animal trainers was conducted at facilities which house dolphins and pinnipeds in both the U.S. and abroad via an AZA listserv and Facebook group for marine mammal trainers. The response was excellent – out of 224 facilities accredited by the Association of Zoos and Aquariums (AZA), 53 were represented by at least one respondent. Forty-four of these answered the survey with regard to pinnipeds, seven in response to cetaceans, and two in response to both (although species were combined for purposes of analysis). The behaviors addressed in the study fell into one of three categories - voluntary veterinary or husbandry procedures (Ramirez, 2013); behaviors taught specifically to entertain the public; and basic, natural, or species-specific behaviors (i.e. vocalizations) which can be captured or otherwise brought under stimulus control. Behaviors were placed into these categories by four people with marine mammal training experience. Inter-rater agreement between them was very high.

Preliminary results suggest an excellent potential for the creation of a large database of behaviors as a foundation for generating new ideas for training, to allow for better communication between teams when troubleshooting behaviors, and to inform research questions. The database would also facilitate analysis of behaviors most often trained (i.e. husbandry, natural, or basic), which has significant impacts on both animal welfare and attitudes of the public towards captivity. Lastly, it would allow for an empirically based evaluation and comparison of training programs for captive marine mammals. However, a second survey will need to be conducted to collect the data necessary.

A factor analysis was used to compute composite scores for factors of behavior by facility. There were two main "factors", or related groups, the behaviors fell into. Factor 1 appears to be composed of all basic behaviors, in addition to a majority of both basic husbandry behaviors (i.e., tooth brushing, voluntary weights) and the less "flashy or high energy" show behaviors (i.e., open mouth, high five). Factor 2 appears to contain most of the more "flashy or high energy" show behaviors and invasive husbandry behaviors (i.e., voluntary fecal, gastric sampling).

- Table 1 -			
Factor analysis of behaviors trained to dolphins and pinnipeds			
Factor 1	Factor 2		
innovate	Tail stand		
Mouth present/open (no touch)	Wave		
Spin (on land)	Blow bubbles		
High jump	Slide thru trainer's legs		
Touch nose to back	Public tactile		
Shape recognition	Jump or hop		
Shame (and double shame)	Bow		
Salute	Whisper		
Slap side	Hoop jump		
Roll (on land)	Front flip (including multiples)		
High five	Back flip (including multiples		
Seal crawl	Speed swim		
Stand up (against trainer or wall)	Hug		
Balance ball on nose	Surf		
Flipper stand	Mimic or follow (walk or other action)		
Dance	Foot push		
Flare/show whiskers	Kiss		
Go into crate, cage or squeeze cage	Shark		
Present/ allow touch for medical	Yes/ no (include nodding or shaking)		
Voluntary injection or blood draw	Water squirt/ spit		
Mouth present/ open (with touch)	Tow		
Toothbrushing	Blow kiss		
Oral rinse	Play frisbee/ catch/ soccer		
Flipper present	Fish control		
Voluntary weight	High jump		
Ear present/ drops	Splash		
Eve present/ drops	Flipper walk		
Go to rock	Voluntary fecal or urine culture/ swab		
Retrieval	Blow hole swab		
Station/ Seat	Inhale or Exhale (including voluntary		
Target	Gastric sample or hydration		
Recall	Lobtail		
A to B's (including "come", "go", "here")	Vocal (any type)		
Hold/ stay			
Gate or shift	Legend		
Back up	show behaviors		
Go into water	husbandry behaviors		
Porpoise	basic behaviors		
Scratch head/ groom	natural behaviors		
contacti netta, groom			

The success of factor analysis as a methodology suggests that facilities may have a fair amount of internal consistency in training programs, and may choose (intentionally or not) to focus on either basic and subtle behaviors, or crowd pleasing and invasive behaviors. Without some consistency within the facilities the factor analysis would not have shown significant results.

A follow up survey has been created to allow further investigation. The survey can be accessed at <u>https://goo.gl/ecjIxd</u>. This second study will be twofold. First, it will request participants provide their names, facilities, and contact information for purposes of creating a networking database. The original survey was not specific enough to gather accurate information and permissions. Second there will be an *anonymous* portion of the survey which will request opinions on the importance of behaviors. Participants will be asked about both their opinion on the importance of training specific behaviors, and the value they perceive is placed on the training of those behaviors by their facility. The goal here is to further investigate the idea that different facilities have different training focuses, in addition to providing some empirical data on the transition from entertainment based training toeducation based training, which may be vital for training programs in the future.

If anyone has questions regarding this survey or the results, please contact Allison Kaufman at <u>allison.kaufman@uconn.edu</u>.

References:

Ramirez, K. (2012). Marine mammal training: the history of training animals for medical behaviors and keys to their success. *Veterinary Clinics of North America: Exotic Animal Practice*, 15, 413-423.

Yeater, D., Kaufman, A.B., Dudzinski, K.M., and D.K. Melzer. (2014, August). Who trains what and whom? Poster presented at the *Animal Behavior Society*, Princeton, NJ

Acknowledgements:

We would like to thank all of the marine mammal trainers who responded to the survey and J. Kaufman for assistance with data analysis. We also recognize K. Faust, M. Pagel, and J. Richards for help classifying the behaviors.

Reducing aggressive behavior in a Laughing Kookaburra through station training



By Chris Gaus	
Senior Aviculturist	
The National Aviary	
_	

We all know you can reduce or eliminate aggressive behavior in an animal by training an incompatible behavior. What can be astonishing about this is how quickly you can reduce aggressive behavior even in an animal who has been practicing the behavior for years.

The National Aviary has had our Laughing Kookaburra, Giggles, since 2004 when he was about one month old. Giggles has been used as both an exhibit and education bird, so has a base level of training in behaviors such as crating, stepping up, and stationing. Attempts to weight manage Giggles seemed to only cause him confusion; as a result, Giggles has been food managed ever since.

I have cared for Giggles periodically since I started at The National Aviary in early 2006. In 2013, Giggles was housed in a large parrot cage in our Atrium area, and was cared for by myself and other staff who sometimes covered my routine. Giggles has always been comfortable with me, taking food from the hand, stepping up, and very rarely becoming aggressive.

Shortly after moving into this cage in the Atrium, however, Giggles began displaying aggressive behavior towards another staff member, Diane. When Diane would service his enclosure, Giggles would fly to the bottom of the cage and try to bite her hand as she changed his papers. Diane would walk past the cage and Giggles would fly at the side of the enclosure, or down to the bottom where he would start thrashing the papers. Diane tried to build a relationship with Giggles by offering him food; this didn't appear to help. It was decided that Diane should not service Giggles anymore. However, it soon became apparent that the behavior had become so ingrained that Giggles had begun to transfer it to interns and other staff who resembled Diane.

In June 2015, Giggles was moved into an enclosure within our Canary's Call exhibit space. This area is covered by Diane as the Senior Aviculturist. Soon after moving into the enclosure, Giggles began flying at the mesh at the front of the enclosure whenever Diane came to service his enclosure. When she would open the door, Giggles would fly at her through the doorway, often biting and latching on to her. Once again, this practiced aggression began transferring to other staff covering that routine.

The suggestion was made that Giggles might be frustrated by the location of his food bowls within the exhibit, and unable to easily get to his diet. To address this, his food bowls were moved to the ground for easier access. The new food bowl location didn't make any significant change in his aggressive behavior, however.



In early July 2015, after some brainstorming, I was asked to begin taking care of Giggles again. We wanted to see if he would exhibit aggression toward someone he had never shown aggression toward in the past.

From the very first day I took over his care, Giggles did not show any signs of aggression. I started stationing him to a log on the ground in the middle of his exhibit. Giggles would either fly right to the log as soon as I opened the door, or he would fly down on a point cue. Once he was on the log, I would give Giggles a food item from his diet (a piece of mouse, superworm, or rat pinkie). Once Giggles had been reinforced on the log, I was able to service the exhibit, place his food and water dishes on the ground, and close the exhibit door without him attempting to fly at the doorway.

After a week of this training plan, I introduced a second person to serve as coverage on my days off. I brought another aviculturist, Anna, to watch a couple of sessions so she could see exactly where Giggles needed to be in the exhibit and how to reinforce him. The instructions were that if Giggles in anyway became aggressive or flew at the doorway, Anna was not to feed him -- close the door and end the session. I observed a few sessions where Giggles initially became aggressive when Anna tried to care for his exhibit. After a number of timeouts, however, he seemed to understand that he had to sit on the log or he would not get fed.

Soon after this, Anna was able to service Giggles with little to no issues. There were a couple instances where Giggles bit her on the hand while she was moving bowls around in the exhibit, but we suspect that may have been because he thought she was handing him food. Anna did the right thing each time -- closing the door and leaving so that Giggles could not practice the aggression. However, in case the movement of his food bowls was becoming an issue, the training plan changed to feeding Giggles his entire diet (or as much as he would eat) on the log. This had the obvious benefit of increased reinforcement on the station, as well as the chance to do more than the usual two sessions (morning and afternoon) per day. After this change was made, Giggles showed no further aggression towards Anna.

With what we felt was a solid training plan in place, Diane and I decided to gradual work Giggles back into her routine. I started this the same way I had with Anna, by Diane come with me while I serviced Giggles' enclosure. Diane stood behind me while I reinforced Giggles on his station. Initially, Giggles showed no signs of wanting to fly at the door, focusing instead on his job of sitting on the log. We decided to push our luck: Diane would try to reinforce Giggles.

This was not the best decision we made in the course of this project. Immediately after I stepped aside to give Diane access, Giggles appeared to notice her for the first time and flew from the log directly at her. I was able to put my hand up in time to block Giggles; he then displaced his aggression onto me by latching onto my hand. We were able to get him back into the exhibit, close the door, and end the session.

From that point, Diane and I decided to make smaller approximations of our final behavior. Diane stood behind me and verbally bridged Giggles when I fed him ("Good!"). After a few sessions, Giggles he stopped looking for Diane when he heard her voice. After that we were able to have Diane stand within view Giggles' behind me and bridge Giggles from there. Giggles offered a couple of glances towards her, but never flew at her.

By now we were started to run up against a deadline -- I would be going on vacation at the end of July. Diane felt comfortable enough with the training plan – including ending sessions at the first sign of aggression -- that she was willing to attempt servicing without me. Initially there were some instances of aggression, but as before, once Giggles realized he would not be fed unless he was sitting on the log, he chose to calmly sit on the log and wait for his reinforcement.

When I returned from vacation mid-August, I was excited to hear that Diane had resumed servicing Giggles' enclosure as part of her routine without a recurrence of his aggression. Diane has even been able to work with other aviculturists that Giggles had used as targets for his displaced aggression, allowing them to service Giggles when they had to cover that routine.

In the span of about a month, we were able to modify aggressive behavior Giggles had been practicing for years and allow his primary caretaker to do her job efficiently and without headaches (both figuratively and literally).

Measured behaviors in the captive Eastern indigo snake (Drymarchon couperi)

as a result of direct human interaction

Brian Ogle¹

Fred Antonio²

¹Corresponding author Beacon College, Leesburg, Florida. Email: bogle@beaconcollege.edu

²Central Florida Zoo's Orianne Center for Indigo Conservation

Abstract

Students enrolled into an introductory animal behavior course were asked to design and conduct a study focusing on applied topics. This small-scale study set out to examine the behavioral responses to human activity in a captive population of Eastern indigo snakes (*Drymarchon couperi*). Each snake experienced the same intervention, which consisted of observation in regular housing environments, temporary holding in a separate container, and handling by a human. Data suggests that the interaction with humans increases the state of arousal in captive snakes.

Key words: snake behavior, human interaction, Eastern indigo snake, Drymarchon couperi

In the summer of 2015, the students enrolled in an animal behavior course at Beacon College were asked to conduct an experiment to quantify animal behavior. This was done in partnership with Central Florida Zoo's Orianne Center for Indigo Conservation. The study focused on behaviors of the Eastern indigo snake *(Drymarchon couperi)*. Students believed that the presence of and interaction with humans causes anti-predatory behaviors (hiding, fleeing, etc.) in captive snakes. The exhibition of these behaviors may signal an increase in stress in the captive-housed animals.

This topic is of relative concern as the application of findings can assist in the management of the Eastern indigo snake for conservation programs. It is believed that the reduction of stress experienced by the animals held in captivity will increase their longevity and reproductive health (Morgan & Tromberg, 2007). These sources of stress are separate from the intentional stressors experienced to educate the animals during the head-starting period for higher survivorship in animals selected for reintroduction into historical ranges.

The study of ethology, or animal behavior, has been closely associated with the study of animal welfare. Animal behavior researchers and animal care staff recognize animals do respond to, interact with, and attempt to control their immediate environment. This attempt to control the immediate environment presents specific challenges in developing behavioral husbandry programs for captive animals. Welfare is often measured by the animal's frequency of displaying certain behaviors, many of which are signals of stress (Gonyou, 1994). Captivity is often associated with positive outcomes, including healthier, longer-lived lives compared to their wild counterparts. However, each species possess unique susceptibilities that cause an increase in stress during captivity (Mason, 2010). Understanding the source of stress and the behavioral signals of stress in any given species will ultimately increase the ability to provide the best welfare for captive animals (Mench, 1998). Because of this, it is vital that researchers explore species-specific stress responses and signals.

It is understood that animals face many forms of stress in the environment, which all can have impacts on overall health and reproductive success. Some forms of stress are exhibited in changes in the animal's physiology, such as an increase in stress hormones, the mobilization of energy stores, and growth suppression. In addition, animals may exhibit behavioral changes. These behavioral changes may include the lack of interest in reproduction, unwillingness to defend territory, and a higher likelihood to flee or hide (Moore & Jessop, 2003). Whenever possible, animals will attempt to remove themselves by fleeing to escape a sense of fear or distress (Mench, 1998). Captive animals are also prone to exhibit these behaviors. The impacts of stress induced by human interaction may have negative impacts on longevity, reproductive success, and survivorship.

Generally, the variation of an animal's behavior is correlated with an alteration to the environment. The goal for any captive animal management program is to reduce sources of stress and promote natural behaviors (Mench, 1998). However, this can be very difficult to achieve, especially since a primary source for stress in some animals may be direct interactions with humans. Morgan and Tromberg (2007) note that forced proximity to humans may lead to noticeable signals of stress in captive mammals and birds found in zoological collections. In comparison to the amount of literature focusing on mammals, there have been limited studies on the impacts of direct human interaction on the stress levels presented by reptiles in general. One such study examined the impacts of capture –related stress on the Red-sided garter snake *(Thamnophis sirtalis parietalis)*. Results from this study suggest that capture behaviors do produce stress responses in the animals. This is supported by a significant increase in cortisol; however, when introduced to a female after capture, the breeding behavior did not alter (Moore and Mason, 2001). Other studies conducted in the field have examined the anti-predatory behaviors in wild snakes to explore the factors that influence the extent of behavior display (Durso and Mullin, 2014). Several recent studies have explored the welfare implications of captive snakes (Pascall, Murray, and Colt, 2014; Adwick, 2011). These articles challenge current reptile welfare. These researchers note a need to increase welfare in reptiles, and researchers need to devote energy to exploring the "physical, emotional and mental state together" to do so.

Methods

Methods were modeled after a similar study that examined response stimuli to prey by Eastern indigo snakes (Saviola, Lamoreaux, Opferman, & Chiszar., 2011). Data was collected over a period of two consecutive days. An ethogram was developed using validated terms and measurement methods from existing protocols (Greene & Mason, 2000; Barker, Murphy, & Smith, 1979; Carpenter, Gillingham, & Murphy, 1976). The defined behaviors listed on the observation tool represented a variety of common anti-predatory behaviors. Behaviors were recorded in 20 second intervals for a total of 6 intervals. Please see Table 1 for a detailed description of behaviors recorded. In addition to the defined behaviors, the tongue flick rate per twenty seconds was also recorded.

There were two age-related groups of Drymatchon couperi selected for observation. Group I was composed of a mix-gendered, mature (5+ years of age) group of animals; Group II was composed of a mix-gendered, juvenile (approx.. 9months of age) group of animals.

Each group of animals was observed to establish a baseline. The observation was completed in the individual snake's regular holding enclosure with no human interference. The control trial consisted of observing the snakes for the initial observation period as well as the post-intervention observation period with no human interference. In the experimental conditions, the snake was observed for the initial observation period, engaged in a human centered intervention, and then returned to the original enclosure to be observed again for the post-intervention observation period.

Each snake in Group I completed three trials. These trials consisted of 1) establishment of a baseline, 2) handling by a human for one minute, and 3) placement into a separate holding can with a lid for one and a half minutes. Each snake in Group II completed two trials, which consisted of 1) establishing a baseline and 2) being handled for one minute. Data was not collected during the intervention, only before and directly upon return to the enclosure. Each snake was allowed a minimum of ten minutes in its enclosure before participating in a different experimental condition.

Analysis of the data focused primarily on the change in tongue flick rate as well as trends in the ethogram data. Each experimental condition was compared to the baseline within each study group. Data for similar experimental condition was then compared across study groups.

Results

Rate of Tongue Flicks. - During the baseline observation, the average frequency in Group I decreased during the first three intervals and ultimately remained consistent at an average of 5 tongue flicks per twenty seconds. The same was observed each time a baseline was measured before implementing a study condition,. However, there was an observed increase in the average frequency of tongue flicks at the start of each new study condition. In Figure 1, this is represented by Intervals 1, 2, and 3. An increase in frequency of tongue flicks was observed upon the immediate return of the animals to the enclosures after participating in the study condition. This increase in tongue flicks was statistically significant. In Figure 1, this is represented by Intervals 4, 5, and 6. At the start of each activity, the rate of initial tongue flicks was higher than the previous intervention activity. This increase from the first trial to the final trial was 63%. Animals in Group II had a lower rate of tongue flicks during the first interval of the initial observation. However, all of the animals in this age group would flee and hide after the first observation interval. Due to this behavior a true comparison is difficult to complete.

Observed Behaviors. - Handling of the animals in the primary study group provided the most dramatic behavioral responses. The animals frequently demonstrated relaxed body postures during the observation period before handling the animals, they. These behaviors included: extending their bodies, being fully visible, and low rates of locomotion. However, upon returning to the container the animals were more likely to hide, move towards the back of the container, and avoid the stimulus (handler). These behaviors continued for at least two minutes upon returning to the holding container. The reduction in visibility after handling was measured at 66% across all trials. The difference between behaviors observed each day was not significant, t(2)=0.1982. In addition, differences between genders was not significant.

When comparing the two study groups, the juvenile animals were more likely to flee and hide before and after human interaction. The change in visibility when compared to the adult animals was not significantly different, t(2)=0.500.

Discussion

The activities performed during data collection do fall outside of the regular routine experienced by the animals. The snakes in the study, especially the juvenile animals, demonstrated an increase display of head-hiding and locomotion after each trial. These behaviors are often associated with stress (Warwick, Arena, Lindley, Jessop & Steedman, 2013). However, behavioral signals associated with fear or excessive aggression, such as striking or vocalizing, were absent. This suggests that the stress experienced by the animals was minimal.

Ford (1995) suggests that findings in most snake behavior studies are often compromised by external factors, including: temperature, feeding condition, shedding cycle, and general health. These factors may have influenced the changes in the (individual?) animal's behavior. Since the primary reason for human interaction with these specific animals is for husbandry associated tasks, the animals may have anticipated a food offering during the data collection period. Bassett & Buchanan-Smith (2007) suggest that captive animals

often show signs of stress as a direct result of a disturbance in their normal routine. Morgan and Tromborg (2007) offer a further explanation noting the increase stress in captive animals stems from their desire to exert control over their immediate environment. Because animals often have a higher sense of predictability in captivity compared to the wild, changes in a predictable routine will elicit a stress response. Since the activities of this study were not a normal level of human activity and did not match the regular husbandry routine schedule, the responses that were recorded could be attributed to this theory. It is recommended that future studies be conducted to examine the behaviors exhibited by animals during regular routines to avoid the creation of a stressful environment.

A limitation to this studywas the lack of hormone measurement. In order to create a validated correlation of stress resulting from the behaviors observed and the human interactions, future studies should strive to include blood chemistry analysis to monitor immediate changes in hormones (Moore & Jessop, 2003).

Because this was a training exercise for students, there were errors in data collection. These errors were accounted for in the presented data. Compromised data sets were not used in the final analysis.

Conclusion

The preliminary data supports the proposed hypothesis and suggests the interaction with humans increases the state of arousal in captive snakes. This may potentially lead to an increase in stress experienced by the individual animals. Additionally, the presence of human observers may directly influence the results of behavioral observations. It is recommended that further investigation be completed to explore the influence of human activity on behavioral repertoire.

Acknowledgements

We would like to thank the staff of the Central Florida Zoo's Orianne Center for Indigo Conservation and to administrators of Beacon College for their support. In addition, we would like to thank the student researchers for their contributions (Czachur, M., Haddad, D., Logus, D., Marley, S., Packard, M., Rhodes, C., & Williams, J.).

References

Adwick, S. (2011). Protecting the welfare of reptiles. Veterinary Record: Journal of the British Veterinary Association, 168(23), 607-608.

Barker, D. G., Murphy, J. B., & Smith, K. W. (1979). Social behavior in a captive group of Indian pythons, Python molurus (Serpentes, Boidae) with formation of a linear social hierarchy. *Copeia*, 466-471.

Bassett, L., & Buchanan-Smith, H. M. (2007). Effects of predictability on the welfare of captive animals. Applied Animal Behaviour Science, 102(3), 223-245.

Carpenter, C. C., Gillingham, J. C., & Murphy, J. B. (1976). The combat ritual of the rock rattlesnake (Crotalus lepidus). Copeia, 764-780.

Durso, A. M., & Mullin, S. J. (2014). Intrinsic and extrinsic factors influence expression of defensive behavior in Plains Hog-Nosed snakes (Heterodon nasicus). Ethology, 120(2), 140-148.

Ford, N. B. (1995). Experimental design in studies of snake behavior. Herpetological Monographs, 130-139.

Gonyou, H. W. (1994). Why the study of animal behavior is associated with the animal welfare issue. Journal of animal science, 72(8), 2171-2177.

Greene, M. J., & Mason, R. T. (2000). Courtship, mating, and male combat of the brown tree snake, Boiga irregularis. Herpetologica, 166-175.

Mason, G. J. (2010). Species differences in responses to captivity: stress, welfare and the comparative method. Trends in Ecology & Evolution, 25(12), 713-721.

Mench, J. (1998). Why it is important to understand animal behavior. ILAR Journal, 39(1), 20-26.

Moore, I. T., & Jessop, T. S. (2003). Stress, reproduction, and adrenocortical modulation in amphibians and reptiles. Hormones and Behavior, 43(1), 39-47.

Moore, I. T., & Mason, R. T. (2001). Behavioral and hormonal responses to corticosterone in the male red-sided garter snake, Thamnophis sirtalis parietalis. Physiology & behavior, 72(5), 669-674.

Morgan, K. N., & Tromborg, C. T. (2007). Sources of stress in captivity. Applied Animal Behaviour Science, 102(3), 262-302.

Pascall, M., Murray, A., & Colt, T. (2014). Reptile Welfare: A Sensory Approach. Animal Keepers' Forum, 41(11), 316.

Saviola, A. J., Lamoreaux, W. E., Opferman, R., & Chiszar, D. (2011). Chemosensory response of the threatened eastern indigo snake (drymarchon couperi) to chemical and visual stimuli. *Herpetological Conservation and Biology*, 6(3), 449-454.

Warwick, C., Arena, P., Lindley, S., Jessop, M., & Steedman, C. (2013). Assessing reptile welfare using behavioural criteria. In Practice, 35(3), 123-131.

Term	Definition	Options
Visibility	the 1st half of the animal (including head) is clearly visible	(1) Visibility
Elevated Head	animal's head is raised to the point so it is no longer touching level (ground/base) surface	(1) Elevated Head
Shape of the neck the full a c	the shape of the neck is either in a relaxed posture, fully extended with no bend; shape of the neck is in a defensive posture, S-shaped bend	(1) S-shape
		(2) Extended
Body shape	the shape of the body is either in a coiled position or fully extended	(1) Coiled
		(2) Extended
Locomotion	animal is actively moving in a forward or backward motion	(1) Forwards
		(2) Backwards
Direction of attention	the animal places head towards or away from exter- nal stimuli	(1) Towards
		(2) Away

Table 1. Listed descriptors with corresponding operational definitions from ethogram used to gather observational data on observed behaviors.

Figure 1. Average rate of measured tongue flick per 20 second intervals during trial conditions in adult snakes.





BIRTH ANNOUNCEMENTS

Baby male Okapi born 9/24/15 at Lowry Park Zoo. His name is "Bakari".



Two lion cubs born on 9/10/15 at Denver Zoo. They are a boy and girl named Kalu and Kamara



Female Hamadryas baboon born 11/15/15 at Oakland Zoo to parents Martijn and Maya. Her name is Akila which means "intelligent" in Swahili.

Environmental enrichment for New World primates:

How a drilled wooden disc could become enriching



Barbara Regaiolli, Caterina Spiezio

Parco Natura Viva - Garda Zoological Park, Bussolengo (VR), Italy.

Animal welfare is one of the main goals of modern zoological gardens. Nowadays, the use of ethological parameters, which are a sensitive and non-invasive measure of animal welfare, is widespread among zoos and other facilities that host animals with different purposes. In particular, assessing the presence of species-specific behaviors and comparing the behavioral patterns of animals in captivity with those of wild conspecifics is considered a way to assess the animal's psychological and physiological well-being (Hosey *et al.*, 2009). Environmental enrichment has recently became a common practice among zoos, since it is a valuable technique to increase behavioral choices of animals in captivity, allowing them to display a wide range of species-specific and self-remunerative behaviors. For example, food related enrichments are commonly used to stimulate foraging activity, in particular in non-human primates, providing the opportunity to display natural behaviors as well as the conspecifics in the wild, therefore increasing their welfare (Hosey *et al.*, 2009). Many New World primate species (e.g.: marmosets and tamarins) in the wild feed on exudates, such as sap and gum, and these food resources may make up a large part of their diet. For example, marmosets are mainly gummivore species: they display morphological and behavioral adaptations for gum-feeding, such as enlarged, chisel-shaped incisors, allowing them to gouge tree bark and suck out the gum or sap, and specialized large intestine (Rowe, 1996; Sussman, 2000). Although tamarin diet relies mainly on fruits and insects, these species also could occasionally consume exudates, as these substances are rich in carbohydrates and proteins.

To fulfill the nutritional needs of *Callitrichidae* in captivity, gum arabic could be provided as an alternative to exudates normally found in the wild (Goodrum *et al.*, 2000). However, providing gum arabic in bowls or within the routine fruit ratio does not allow *Callitrichidae*, in particular marmosets, to display the species-specific behavior of tree gouging and gum-seeking, possibly leading to boredom and loss of natural ability to obtain certain types of food. In order to supply marmosets and tamarins with the opportunity to display a gum-feeding behavior as natural as possible, the environmental enrichment program of the *Callitrichidae* species housed at Parco Natura Viva has been improved by providing a gum-feeder (Figure 2). In particular, Geoffroy's (*Callithrix geoffroyi*) and pygmy marmosets (*Cebuella pigmea*) (Fig. 1 and 3), cotton-top tamarins (*Saguinus oedipus*) (Fig. 4) and Midas tamarins (*S. midas*) (Fig. 5) have been provided with wooden drilled discs with 10 to 15 holes each. The daily amount of gum arabic was put in the holes of the wooden discs to make the monkeys work for food. To verify the effects of this new feeder on these-Parco Natura Viva *Callitrichidae* groups, some studies have been carried out to collect data about the behaviors of the individuals before and during the introduction of the feeder.



The marmosets and the gum-feeder

A total of 7 Geoffroy's marmosets and 2 pygmy marmosets were involved in different studies about the introduction of the gum-feeder. First of all, resting, out of sight and abnormal behaviors have not been reported for any of the subjects and the observed behavioral patterns, in particular exploration, affiliative behaviors and locomotion, seem therefore to be consistent with those showed by wild marmosets. Since due to their small size and high metabolic rate (Kinzey, 1997; Committee on Well-Being of Nonhuman Primates, 1998) marmosets are active primates with a cooperative breeding system, these findings seem to highlight an overall well-being of the colonies, both before and during the provision of the gum-feeders. Regarding the effect of the gum-feeder on the marmoset behavioral patterns, with the exception of a slight increase in some affiliative behaviors following the introduction of the new device, no significant differences were found.

After the animals got used to the presence and employment/use/utilization of the gum-feeder, a further study of the Geoffroy's marmosets was conducted, aiming at investigating whether the provision of gum once or twice a day could affect the behavior of this gummivore species. The results of the study underlined that the introduction of gum arabic twice a day had no effects on the Geoffroy's marmoset behavior, suggesting that despite its importance for the species' diet this food might be provided once a day as a substitute for tree gum. Although empirical data could not support this statement at all, the use of the gum-feeder could play an important role in the determination of this result: the way marmosets have to work for the gum by interacting with the feeder could be more important than the quantity of gum arabic that is normally given. This could be particularly true for captive environments in which fruits, insects and other food supplements are always available.

The tamarins and the gum-feeder

The study of the effects of the gum-feeder on the tamarin behavior was carried out with 8 subjects belonging to the genus *Saguinus*: 4 cotton-top tamarins and 4 Midas tamarins. As in the marmoset colonies, species-specific behaviors such as exploration, affiliative behaviors and social play were displayed by all the tamarins, and time budgets for each activity were consistent with those reported in the wild. Indeed, as well as marmosets, tamarins are small sized, active and very social primates (Committee on Well-Being of Nonhuman Primates, 1998), therefore these results suggest an overall good welfare of these species. However, although not excessively, the Midas tamarins displayed coprofaghy, which could be considered an abnormal behavior, presumably related to behavioral abnormalities. Although the introduction of the gum-feeder had no overall effect on the behavior of the cotton-top tamarins, it led to a significant decrease of the abnormal behavior in the Midas tamarins.

Finally, these studies about the behaviors of marmosets and tamarins in captivity seem to underline that the introduction of a gum-feeder might be mainly ineffective for these species. A possible explanation for this lack of significant results could be that all *Callitrichidae* colonies hosted at Parco Natura Viva are part of an intensive daily environmental enrichment program and are housed in naturalistic enclosures, allowing the performance of species-specific behaviors and a good welfare status. However, the slight increase in affiliative behaviors in the marmosets-- a cooperative breeder and very social species-- and the significant decrease in abnormal behaviors in the Midas tamarins seem to underline positive implications of the gum-feeder introduction on New World primates' behavioral patterns.



Why having (have?) (or not having (have?)) gum for dinner?

According to some researches on *Saguinus mystax* and *Saguinus fuscicollis* in the wild (Heymann & Smith, 1999), gum feeding in tamarins should be more frequent in the afternoon, between 2:00 and 4:00 pm. Indeed, gum digestion is time consuming in these species, since exudates tend to remain in the intestinal tract for a long time. On the other hand, marmosets eat exudates regularly and have a gastrointestinal system with specific adaptations for the digestion and absorption of these substances (Rowe, 1996; Sussman, 2000): in these species, gum-feeding is frequent in both the morning and evening hours. To improve the husbandry of captive *Callitrichidae* species hosted at Parco Natura Viva, data about duration of gum-feeding at different times of the day in marmosets and tamarins were also collected. The results of this study showed that, according to their dietary habits, marmosets spent more time than tamarins gum-feeding. Furthermore, no differences in either group was reported for the duration of gum-feeding between the morning and evening sessions. According to the literature, this result is quite striking in the tamarins that should eat more gum in the evening to facilitate its digestion. By providing protection from predators and the availability of all food types at almost every moment of the day, captive environments might provide the animals with the choice to consume different kinds of foodstuffs whenever they need and want to. Again, the presence of the gum-feeder could partially explain the fact that tamarins ate gum in the morning as well in the evening: in captivity, the opportunity to display species-specific behaviors such as gum-feeding from trunks might be more important than the physiological need to eat exudates in the evening.

References

- Goodrum, L. J.; Patel, A.; Leykam, J. F.; Kieliszewksi, M. J. (2000). Gum arabic glycoprotein contains glycomodules of both extensin and arabinogalactan-glycoproteins. *Phytochemistry*, 54: 99-106.
- Heymann, E. W. & Smith, A. C. (1999). When to feed on gums: temporal patterns of gummivory in wild tamarins, Saguinus mystax and Saguinus fuscicollis (Callitrichinae). Zoo Biology, 18: 459–471.
- Hosey, G. R.; Melfi, V.; Pankhurst, S. (2009). Zoo Animals: Behaviour, Management and Welfare. Oxford University Press, Oxford.
- Kinzey, W. G. (1997). Synopsis of New World primates (16 genera). In: Kinzey, W. G. (ed.). New World primates: ecology, evolution, and behavior. New York: Aldine de Gruyter. p 169-324.
- National Research Council (US) Committee on Well-Being of Nonhuman Primates. The Psychological Well-Being of Nonhuman Primates. Washington (DC): National Academies Press (US); 1998. 6, New World Monkeys: Callitrichids.
- Rowe, N. (1996). The pictorial guide to the living primates. East Hampton (NY): Pogonias Pr. 263 p.
- Sussman, R. W. (2000). Primate ecology and social structure. Volume 2, New world monkeys. Needham Heights (MA): Pearson Custom. 207 p.

FIGURE CAPTIONS

Figure 1: a Geoffroy's marmoset searching for insects in the enclosure of Parco Natura Viva.

Figure 2: the gum-feeder provided to the Parco Natura Viva tamarins and marmosets.

Figure 3: a pygmy marmoset housed at Parco Natura Viva.

- Figure 4: a cotton-top tamarin on a tree in the enclosure at Parco Natura Viva.
- Figure 5: a Midas tamarin housed at Parco Natura Viva.





The traditional zookeeper-made hammock is woven from perpendicular lengths of hose with their ends fastened by nuts, bolts, and washers. The two layers of industrial hose and lots of metal hardware create heavy furniture that never gets taken down for cleaning or repair. Here's another way to make what we need that's just as strong but easier.

The only tools necessary are a sturdy little knife and a marker. The measurements can be all done by eye.

Select your length and width. I cut off a chunk about 3 feet long and used it as a ruler to cut two more pieces. The flat diameter of the yellow hose is 8 inches; therefore this hammock at three strips will be 2 feet wide. These will be our "runners" that will be the visible part of our finished hammock.

For the "tab" pieces I'm using a narrower red hose. You could use the same size as the runners because the same principles apply, though I like using the narrower widths if I can to save weight.



Here is my example's layout of runners and tabs. In addition to the smaller tabs you'll see longer tabs that span the width of the hammock. This is a way to reinforce the hammock for heavier animals so the weight is distributed through all runners at once rather than just side to side. However, this same hammock could be made with only smaller tabs at the same locations.



Cut small pieces of the tab hose so that they will overlap at least 1 inch on either side of two runners. Then mark where the overlap is on the red hose so we know where to cut our notches. We'll be cutting into them about ³/₄ inches at most. The uncut space between the notches has to be wider than half the total tab width for ease of assembly.

The notches only need to be as wide as a flat piece of fire hose, about a $\frac{1}{4}$ inch or so. But for your first hammock I recommend making them a $\frac{1}{2}$ inch wide to give yourself some wiggle room.

Place the tabbed piece back over the runners and mark on the runners where the innermost part of the notches is. Put aside the tabbed piece and now the space in between is what we will remove. These will be shallow cuts to create a slot where the red tab pieces can slip in.

You're only trying to expose the inside of the hose and not cutting a deep notch like before. I have tried cutting directly into the side, but it's difficult to cut straight and there's too much material left over which causes the final hammock to bunch up.









Now the fun part! Fold those tabs in half and tuck them into the slots of the runners.

For the continuous tabs this step can get tough. Start from the center runners of the hammock then work your way to each side.

In the end you have nice flat, parallel slats that scrub with ease, don't trap debris and feces, and allow for ropes to be strung through any of the holes or (the?) length of the runners. Or you may drill holes for fastening points like quick links or carabineers, or directly attach them to a frame with screws. Or (you may?) leave it as is and make a neat doormat.



If you're concerned about the exposed edges of the hose those could always be sewed shut with zip ties, or even better I've been working on using the tab and slot method to create a wraparound frame. Details are available at http://enrichminute.blogspot.com where I will be sharing these and more enrichment ideas in the future.

