



# Environmental Enrichment in Behavior-based Bear Husbandry, Part 1: Principles

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*Look for Parts 2, 3, and 4 of this article series in upcoming issues*

**E**nvironmental enrichment is a critical and inextricable component of behavior-based bear husbandry. To understand how the two work together to promote the mental and physical welfare of bears, one has to go back to the roots of

behavior-based bear husbandry. Historically, the term husbandry referred to the care and breeding of livestock, and was exclusively focused on the human agenda. Over time, collections of captive wildlife kept for the enjoyment of humans became popular first with the dynastic and the wealthy, and then with the public. The care of wildlife in

sight of a pacing polar bear at the local zoo was so common that the Dutch language contains the verb *ijsberen* (to polar bear) meaning to pace up and down (Poulsen, 1996).

There was a brief interlude of common sense that lasted until the late '80s where zoo designers built natural environments for wildlife befitting their species-specific needs. This focus on the animal agenda was fuelled by a resurgence of interest in Heini Hediger's (Hediger, 1950) writings. Hediger had been the director of the Tierpark Dählhölzli Zoo, the Basle Zoo, and the Zürich Zoo, and was an ethology professor at the University of Zurich. Today, he is considered to be the father of zoo biology. Bears and other wildlife took full advantage of their natural surroundings and predictably disappeared into the foliage. But all was not well. Zoogoers were dissatisfied with the fact that they could not see the animals that they had paid admission to view. In an attempt to remedy this, the focus changed again from the animal agenda to the human agenda and "naturalistic" habitats were born as part of immersion exhibitry that gave visitors the sense of being in the animals' habitats. Some of these enclosures were more successful than others, and wildlife again showed difficulty adapting to an increase in cement structures and a decrease in space. In this period of fluctuating focus from the human agenda to the animal agenda and back again, zoos have become dotted with varying enclosure designs in need of enhancement to better the living experience of the wildlife they house.

Behavior-based husbandry and environmental enrichment evolved as our understanding of the natural history of individual species grew, highlighting the need for increased complexity in captive environments. Initially behavior-based husbandry techniques and enrichment events were applied like Band-Aids to targeted animals exhibiting aberrant behaviors. Each effort created a pixel of insight into the big picture of that species' behavioral repertoire. We learned that mimicking a bear's natural habitat and the ingredients to express its daily and seasonal activity patterns



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zoos became expressions of societal mores.

Having little to no information on the natural history of most species, post-war Europeans and North Americans became entranced with single-issue husbandry styles. Great apes were housed in pairs in tiled showrooms for easy disinfection, since killing bacteria had become the new paradigm for human health. Large carnivores, including bears, were also kept in pairs and housed in thick cement grottos or pits, because they were dangerous and we were afraid of them. We were also afraid for them, so there was nothing in the enclosure to interact with lest they should hurt themselves. By the 1970s it became clear that these sensory-deprived animals were not thriving, since the majority exhibited some form of aberrant and/or repetitive behaviors. In fact, the



reduced the stressors inherent in captivity and promoted mental and physical well-being.

Behavior-based husbandry is the deliberate provision of species-specific, internal and external care to animals befitting their genetic and circumstantial expectations. It is focused on the animals'

nary care (Poulsen, 2011). Environmental enrichment can be understood in two complimentary, interdependent ways: the inherent complexity of natural or naturalistically provisioned enclosures and the addition of daily or seasonal complexity mimicking those biophysical features that appear ephemerally in the animals' wild habitat. The elements of a bear's natural environment fall into one of three categories: permanent structures such as boulders, trees, and rivers; ephemeral structures or events such as streams, photoperiod, seasonal appearance, or food resources; and those events that change constantly, such as some food resources and ease of catch (Poulsen, 1994). Successful behavior-based husbandry relies on an understanding of how a bear uses these structures and events in its daily and seasonal routines to ensure individual and species survival.

Bears are sentient animals born with a set of genetically encoded expectations to live a life specific to the habitat they were born to occupy. Thus they have expectations that their morphology and understanding of how to find food, mates, and lodging will work with the environmental opportunities around them. In other words, a bear does not have a genetic expectation to jump like a kangaroo, use his tail for locomotion, or nurture young in a portable sack. The further their environment veers away from their expectations, the more difficult it is to adapt, and the greater their stress level. In addition, bears have expectations based on their individual history and their current environment specific to their age, sex, and social condition.

Consider the photographs accompanying this article. This is a Kermode bear living in Canada's northern rain forest in British Columbia. The Kermode or spirit bear is the white phase American black bear (*Ursus americanus kermodei*) thought to be a genetic anomaly brought about by a double-recessive gene. Current research seems to indicate that having white fur may be a distinct advantage when catching salmon, as white is less visible to the fish against the colors of the sky when they

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TIME	WILD BEHAVIOR	ENCLOSURE/ENRICHMENT REQUIREMENTS
Sunrise	Bear wakes - stretches	<ul style="list-style-type: none"> <li>- Bears need constant indoor/outdoor access, except for enclosure maintenance and enrichment.</li> <li>- Bears often rise long before caregivers arrive for work.</li> </ul>
"	Bear checks status of companion animals i.e. cubs, mate, companions	<ul style="list-style-type: none"> <li>- Bears must live in appropriate social groups befitting their age, sex, and reproductive status; it is generally recognized that one male to two or more females results in the most peaceable group.</li> </ul>
"	Bear cleans in water or substrate	<ul style="list-style-type: none"> <li>- Bears must have access to pools, woodchips, soil, growing grasses, substrates in significant amounts to accommodate personal hygiene.</li> </ul>
"	Bear drinks	<ul style="list-style-type: none"> <li>- Bears must have access to clean potable water.</li> </ul>
Early A.M.	Bear begins morning search for food	<ul style="list-style-type: none"> <li>- This is a critical time for a bear, since his food search often begins before the caregiver arrives in the morning. A hungry bear in a food-deficient enclosure may express anticipatory or entrenched stereotypes; thus food must be available either in feeder devices, via an early caregiver shift available at sunrise, or via automated feeders.</li> <li>- Automated feeders can cause behavioral issues if used throughout the day as a substitute for a variety of enrichment events; however when used exclusively in the early morning to provide food to hungry bears, the method can prevent the onset of stereotypes.</li> </ul>
Early-Mid A.M.	Bear's search for food continues	<ul style="list-style-type: none"> <li>- Caregivers must have the ability to recall and shift the bear into another area using either personal relationship or operant conditioning to accommodate morning maintenance.</li> <li>- While the caregiver is cleaning and enriching exhibit areas, the bear must be kept stimulated for the entire duration that he is confined in the back areas with food enrichment until he can be released into the exhibit area.</li> <li>- This can be a good time to do operant conditioning, provided the bear has had a chance to eat to at least partially satiate itself.</li> <li>- It is imperative that the bear use a quantitative method to assess satiation, such as the bear leaving food, since a bear that eats all of his food does not indicate satiation and could indicate hunger.</li> <li>- The objective of the A.M. feed is to satiate the bear; thus enrichment offered should be interesting but not so challenging as to be frustrating. The challenge of food extraction in enrichment can be increased in the afternoon when the bear is interested in the activity and less concerned about satiation.</li> </ul>
Mid A.M. - Early Afternoon	Bears choose and prepare a daybed site, and take a nap	<ul style="list-style-type: none"> <li>- Bears will take an early afternoon nap, for which each bear requires a choice of private daybed sites, nesting material (straw, woodchips, excelsior [wood wool] etc.), ability to adjust body temperature (shade, sun), undisturbed down time (no training sessions or required public appearances).</li> </ul>
Mid Afternoon	Bears rise to continue food search	<ul style="list-style-type: none"> <li>- Caregivers lock bear into enriched back area to place enrichment into main outdoor enclosures.</li> <li>- Caregivers can do operant conditioning or relationship building sessions with bear</li> </ul>
Afternoon - early evening	Bears continue food search	<ul style="list-style-type: none"> <li>- At this time enrichment can offer greater mental challenge, novel items, foodless enrichment, and scent enrichment.</li> <li>- Enrichment that offers group activity such as wobble trees work well at this time, since satiated bears are 1) less likely to take personal ownership of event; 2) more likely to tolerate group efforts to solve problem; and 3) be disinclined to exhibit aggressive behavior.</li> <li>- Jungle gyms that allow hanging items or climbing opportunities provide bears with exercise if enrichment is used to entice bears into activity.</li> </ul>
Early evening	Bears continue food search but begin to search out site for bedding down for the night	<ul style="list-style-type: none"> <li>- Caregivers can either bring bears into enriched back area to accommodate the enrichment of the exhibit enclosure, or they can throw enrichment items over fencing or send it down through delivery pipes.</li> <li>- The enclosure must provide enough bedding and private areas for each bear to comfortably bed down for the evening.</li> </ul>
Night	Bears rest. On occasion bears become nocturnal usually to forage unhindered by either conspecifics or predatory species	<ul style="list-style-type: none"> <li>- Bears should be monitored to assess if any group members habitually become nocturnal feeders, as this can indicate that this bear is not competing well with more dominant members of the group.</li> </ul>

agenda and holistically includes enclosure design and furniture, diet presentation and nutrition, care and maintenance routines, caregiver and animal relationship building, communication (e.g. operant conditioning), ambient parameters (e.g. photoperiod, temperature, sound), and veteri-





look up. Thus we may be witnessing evolution in progress (McCrory, 2013). The number of combinations and permutations of the biophysical structures and events in this habitat are astronomical, affecting the bears' every sense and ability: sight, sound, taste, touch, smell, thinking,

based bear husbandry program incorporating enrichment? By importing the information we have about the wild bear's daily routine into the captive environment. Tables I and II delineate how to set up a daily and seasonal husbandry routine befitting a Kermode bear [American black bear]. Bear species differ widely in their adaptations to varying niches. For example, the sun bear (*Helarctos malayanus*), frequently described as the "chimpanzee" of the bear world, is a small, tropical, often arboreal, highly insectivorous, omnivorous bear requiring an aseasonal warm temperature range, significant climbing structures, intricately varied diet, and a well-vegetated, complex captive environment. In comparison, the brown bear (*Ursus arctos*), a large, temperate, terrestrial, frequently vegetarian, omnivorous bear, closely related to the polar bear, requires a complex and geomorphically diverse captive environment, which includes seasonal diet and temperature changes that accommodate fall hyperphagia followed by winter hibernation needs.

Often there are inherent differences between the geophysical parameters of the bear's native habitat and the zoo's location. These can be overcome by assessing how a bear might be genetically adapted to deal with it in the wild. For example, few Andean bears (*Tremarctos ornatus*) experience freezing temperatures, with the exception of those bears that periodically move through the higher elevations of the Andes mountains. In the tradition of old school husbandry, it was common to attempt to *acclimate* Andean bears to winter temperatures inherent in zoos located in temperate zones by maintaining building temperatures at just above freezing. As a result, cold Andean bears nested as high up in the rafters of their buildings as possible and stayed there most of the winter in an attempt to stay warm. They rarely ventured outside or moved from the warmest spot in their building enclosures, thus they were frequently off exhibit. Using the principles of behavior-based husbandry, this problem was solved by increasing the building

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Table II Seasonal Husbandry Routine for Kermode Bears

SEASON	
FALL Hyperphagia	<b>WILD BEHAVIOR</b>
	The Kermode bear will be a voracious eater at this time of year, as his objective is to gain fat reserves to see him through the upcoming winter denning period and his walking metabolic depression in the ensuing early spring. Berries, fruits, nuts, and meat proteins (e.g. salmon) make up the majority of his fall diet. As winter nears, the bear alternates his time between feeding grounds and inspecting possible winter denning sites, eventually choosing one site to either build or renovate.
	<b>ENCLOSURE/ENRICHMENT REQUIREMENTS</b>
	The bear's diet must be increased according to his appetite not according to an artificial weight gain goal set for him by managers which could leave him calorie deficient and unable to manage properly through the upcoming winter. A bear that is not yet in metabolic depression and has had food resources decreased artificially can starve and die. Metabolic depression is complicated and not wholly understood, thus the bear knows best how many calories are required to survive an upcoming winter. Wild bears have been observed to walk off of feeding grounds when they are ready to den even when there are still berries and other food resources left, suggesting that food availability is not the only critical criteria signalling denning fitness. Bears will need a great deal of enrichment, which could include scatter feeds, puzzle feeders, lunch boxes and bags, rotting logs with bugs, and fresh browse such as willow. A choice of winter denning sites and bedding material should be available early on, so the bears can move from one to the other and assess suitability.
WINTER Denning	<b>WILD BEHAVIOR</b>
	American black bears hibernate for the winter months, even those bears that live in warmer climates such as Florida. The duration of the denning period depends on numerous criteria including biophysical parameters, age, and sex.
	<b>ENCLOSURE/ENRICHMENT REQUIREMENTS</b>
	A bear in metabolic depression experiences a 20-50% decrease in metabolism, reduction in heart rate from 40 b.p.m. to 8-10 b.p.m., a decrease in oxygen consumption up to 50%, and a slightly depressed body temperature to 86-95°F. A captive bear that is not given the opportunity to den becomes slow moving, often short tempered and unable to successfully take part in operant conditioning or other husbandry procedures. A bear requires a cool, dark, quiet, private place to den up with a large quantity of bedding material. It is imperative to set up a food and water depot near the bear's chosen denning site, since managers will not know if a particular bear was able to effectively compete with other bears for food resources and if he carries the necessary fat reserves for denning. Since bears will actually get up from denning for preferred foods and enrichment items, all treats and enrichment are to stop during denning to allow the bear undisturbed hibernation. The best food to leave at a food depot is pelleted omnivore chow. Generally, it is not a preferred food, and bears do not tend to rise to eat it unless they are nutritionally or fat deficient.
SPRING Walking Hibernation	<b>WILD BEHAVIOR</b>
	The bear gets up in the early spring when the weather warms up slightly and the ice and snow are melting. At this time, there is no new growth available to them, thus they root around to find overwintered berries, nuts, and the carcasses of animals that died during the winter. Foods are still scarce and their food intake is not high. Bear go through metabolic depression for the next several days to several weeks in a "walking hibernation." Thus the bear is still relying on fat reserves.
	<b>ENCLOSURE/ENRICHMENT REQUIREMENTS</b>
	The bear must not come out of his denning period bone thin. He must be carrying fat reserves to get him through his walking hibernation period. The bear's diet presentation must mimic the appearance of foods in the wild, and the caloric intake must be slowly increased up to the summer and then dramatically increased the following fall. The bear will need a great deal of enrichment throughout the day to occupy his time and will require bedding materials.
SUMMER	<b>WILD BEHAVIOR</b>
	The bear spends the late spring to early summer occupied with reproduction. When breeding season wanes, the bear begins to follow the appearance of food resources such as fish spawning, larval phases of insects, and berry production.
	<b>ENCLOSURE/ENRICHMENT REQUIREMENTS</b>
	The bear's diet presentation must mimic the appearance of foods in the wild and the caloric intake must be fully restored to summer capacity. The bear will need a great deal of enrichment throughout the day to occupy his time, and will require bedding materials.

focus, moisture, balance, emotion, hunger, movement, success, problem solving, and the list goes on. The American black bear and all other species of bear are genetically programmed for such profound environmental complexity. This should put the single enrichment event offered per day in an otherwise stagnant enclosure into its proper perspective. It's not enough for such incredibly perceptive creatures.

So how does one begin to develop a behavior-



enclosure temperature so that the bears were comfortable, and installing door flaps to keep the warm air inside. As a result, Andean bears became active in the winter, often running outside to play in the snow for short jaunts, knowing that they could go back inside at will to warm up and dry

out. In this case, daily enrichment programming is needed year-round, as the bears remain active throughout the year.

Polar bears (*Ursus maritimus*) are another bear species highly adapted to an extreme environment, occupying niches in the Arctic Circle.

Fortunately, several

subpopulations living in the southern Hudson's Bay area experience seasonality. It is the behavior of these bears that give zoo managers information about how polar bears can be successfully housed in temperate climates. These bears go through an annual cycle opposite to that of the brown bear. These polar bears gain weight in the winter months and lose weight in the summer months, experiencing a walking hibernation while waiting for the bay to freeze in the fall, allowing them to again migrate to their traditional hunting grounds on the pack ice. Some bears become omnivorous feeders in the summer while others fast. Gravid females begin a weight loss in the summer that

lasts through the following spring when she brings her newborn cubs to the pack ice in the north. She begins by digging an earthen cave into the side of a river bank on the tundra, later adding a snow room in the winter after the snow has accumulated on the hillside. By mimicking diet changes and presentation through enrichment programming, thereby allowing proper weight loss and gains at the appropriate times, these bears can thrive year round.

To further the discussion on utilizing enrichment programming in behavior-based bear husbandry, three additional parts to this article will follow in upcoming issues of *Shape*, including the following topics: enrichment in behavior-based bear diets and nutrition; enrichment and behavior-based bear denning; and the importance of enrichment in behavior-based bear integrations. ✧

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## 12<sup>th</sup> International Conference on Environmental Enrichment, 2015, Beijing, China

The 12<sup>th</sup> ICEE will be jointly held by Beijing Normal University and Beijing Zoo from May 24 to 28 in 2015. The conference website, [iceebj.bjzoo.com](http://iceebj.bjzoo.com), has been set up and is ready for your reference and registration. The deadline for early bird registration is January 31, 2015; regular registration is from February 1, 2015 to March 10, 2015. If you would like to present a paper, abstracts are due March 10, 2015. Information concerning the conference venue and important dates can currently be found on this website; information about pricing, accommodations, the program, and other updates will be posted as they become available, so please continue to check back. We welcome you to Beijing in 2015.

—Dingzhen Liu, Executive Chairman of 12<sup>th</sup> ICEE

