

Ethogram of the giant anteater (*Myrmecophaga tridactyla*) in captivity: an experience in the Temaikèn Foundation

TAMARA LETICIA SCHMIDT

Bióloga, Tec. en Genética, Universidad de Morón, Buenos Aires, Argentina – Voluntaria Departamento Curador de Mamíferos – Enriquecimiento Ambiental, Fundación Temaikèn, Ruta 25 Km 0.700, Escobar (1625), Buenos Aires, Argentina. E-mail: tam_schmidt@hotmail.com
Present/permanent address: Ehrlich 432, Ituzaingó, Buenos Aires (1714), Argentina.

Abstract The giant anteater (*Myrmecophaga tridactyla*) is one of the most distinctive animals of South America. In northern Argentina it is found in forests, savannahs, and grasslands. It is listed as Vulnerable in the IUCN Red List of Threatened Species. The present study was conceived as a husbandry tool for individuals of this species in zoos. The research was developed at CRET (Temaikèn Center of Species Reproduction) and consisted in elaborating the behavioral repertoire of a group of three adult females from April 2009 to April 2010. A total of 122 h of behavioral observations were made by the naked eye at a distance of 1–5 m through a metallic mesh, five times a week, with focal animal *ad libitum* sampling from 9:00 to 18:00 hr. A diagram of the exhibit was confected to ease the data collecting process. To facilitate the description of the behavioral acts, an identification of the different physical characteristics of each individual was conducted along with the segmentation of the body. During the 12 months of observations, 38 behavioral acts were defined, which were then grouped into eleven categories. Finalization of data collection was based on the saturation curve; the first asymptote was reached at 35 h, while the final one, which remained constant, was reached at 52 h and contained the 38 behavioral acts registered in the ethogram.

Keywords: behavior, captivity, ethogram, giant anteater, husbandry, *Myrmecophaga tridactyla*, Xenarthra

Etograma de oso hormiguero (*Myrmecophaga tridactyla*) en cautiverio: una experiencia en la Fundación Temaikèn

Resumen El oso hormiguero (*Myrmecophaga tridactyla*) es uno de los mamíferos más distintivos de América del Sur. Se encuentra en las selvas, sabanas y pastizales del Norte Argentino. Está listado como Vulnerable por la Lista Roja de Especies Amenazadas de la IUCN. El presente estudio fue concebido como una herramienta para el manejo de individuos de esta especie en zoológicos. El trabajo se desarrolló en el CRET (Centro de Reproducción de Especies Temaikèn) y consistió en elaborar el repertorio comportamental de un grupo de tres hembras adultas de oso hormiguero desde abril 2009 hasta abril 2010. Un total de 122 hs de observación se realizaron con registro animal focal *ad libitum*, cinco veces por semana, en los horarios de 9:00 a 18:00 hs, a una distancia de 1–5 m a través de una malla metálica. Se confeccionó un esquema del recinto para simplificar la recolección de datos. Para facilitar la descripción de los actos de conducta, se realizó una identificación de las características físicas de cada individuo junto con la segmentación de los cuerpos. Durante los 12 meses de observación, se definieron 38 actos de conducta, los cuales luego fueron agrupados en 11 categorías. La finalización de la recolección de datos se basó en la curva de saturación; la primera asíntota se alcanzó a las 35 hs, mientras que la última, que permaneció constante, se alcanzó a las 52 hs conteniendo los 38 actos de conducta registrados en el etograma.

Palabras clave: cautiverio, comportamiento, etograma, manejo, *Myrmecophaga tridactyla*, oso hormiguero gigante, Xenarthra

INTRODUCTION

Ethology is traditionally known as the study of natural animal behavior. Martin & Bateson (1986) specifically define the purpose of ethology as the study of the biological function of behavior, in the attempt to understand the purpose of behavior in its natural context. Lorenz (1993) discusses the significance of field and captive studies arguing that the comparison between the two is one of the basic tools of ethology, as stimuli are reduced and, therefore, some behaviors will be missing in captive conditions. Furthermore, an elevated threshold exists in captivity, meaning that more stimuli will be needed to trigger a specific behavior. Thus in captivity behaviors may be missing, but no behaviors will appear that do not already occur in nature.

Ethology can also provide key information for designing appropriate enclosures, since to study an animal, is actually to study a portion of nature that was separated from its environment. Lorenz (1993) recommends to never undertake a study without knowing the ethogram of the species and basic information on its ecology. Any project that involves the captive maintenance of animal groups should assign part of its resources to structuring an ethogram.

About the ethogram

Fagen (1978) defines a behavioral repertoire as a group of mutually exclusive and collectively exhaustive acts of an animal or species. Laffitte de Mosera & Caprio (1980) define ethogram as a precise description of animal activity, meaning a thorough description of the observable behaviors in the animal that constitutes the initial phase (observation) of the ethological method.

For Lehner (2003) an ethogram is a group of wide descriptions of the behavioral patterns characteristic of a species. This author clarifies that it is the result of many hours of observations, in some cases of sound recordings, and descriptions, and that it must be the starting point of any ethological research. According to Lehner (2003) the questions that an ethologist tries to answer about the behavior are: what happens (description), when does it happen (temporal component), how (motor patterns), and why (motivational and ecological adaptation of behavior). Martin & Bateson (1986) define it as a catalog of descriptions of discrete behavioral patterns, typical of the species-object, that form the basic behavioral repertoire of the species.

In all cases, the following characteristics should be highlighted:

- temporality: an ethogram can never be considered finished
- thoroughness: the behaviors must be described accurately, to ensure that they are recognizable without a doubt

The elaboration sequence

An ethogram is a list of acts of behavior, it is what the observer considers implied in what he is observing (Lahitte *et al.*, 1993). Since an act of behavior comes from a specimen-environment relationship, the inventory of behavioral acts is consequently a list of the different ways that the observed specimens relate to one another and with their environment. The procedure is to observe and record, after the reading and analysis of those records, a description of the behavioral acts is elaborated, they are then grouped by affinities, differences, functionality, structure, etc. For each category of records, a group of acts can be defined that covers and summarizes them. When the observations that originated the records are presumed complete, meaning such an outlook that more observation time will not add records that do not fall into any of the already defined acts, then it is considered that the list of definitions is an ethogram, a complete list of behaviors of that species. Once this list of behaviors is completed, it remains incorporated into the conceptual framework and it starts being employed as a tool.

Having concluded this introduction, and with the ethological framework established, an ethogram is presented of the giant anteater (*Myrmecophaga tridactyla*) in captivity, conceived as a tool for the management of individuals of this species in zoos. The giant anteater is one of the most distinctive animals of South America. It has been recorded from Honduras in Central America, south through South America to the Gran Chaco region of Bolivia, Paraguay, and Argentina (Superina *et al.*, 2010). In Argentina its geographical range has been diminishing within the last century, being found presently in the forests of the province of Misiones, savannahs, grasslands, and forests of Formosa and Chaco, and in the woods of the drier Chacoan region including the east of Salta, Jujuy, and north of Santiago del Estero (Pérez Jimeno & Llarín Amaya, 2007; Pautasso *et al.*, 2009). In Argentina the species is categorized as In Danger (EN, in Spanish EP) (Díaz & Ojeda, 2000), and globally it is considered as Vulnerable (Miranda & Medri, 2010).

Myrmecophaga tridactyla is locally uncommon to rare. Habitat loss, roadkills, and wildfires are substantially affecting the wild populations and have led to a continuing decline in mature individuals (Superina *et al.*, 2010).

MATERIALS AND METHODS

The present study was conceived as a husbandry tool for individuals of this species in zoos. The research was developed at CRET (Temaikèn Center of Species Reproduction), and consisted in elaborating the behavioral repertoire of a group of three adult females from April 2009 to April 2010, including a

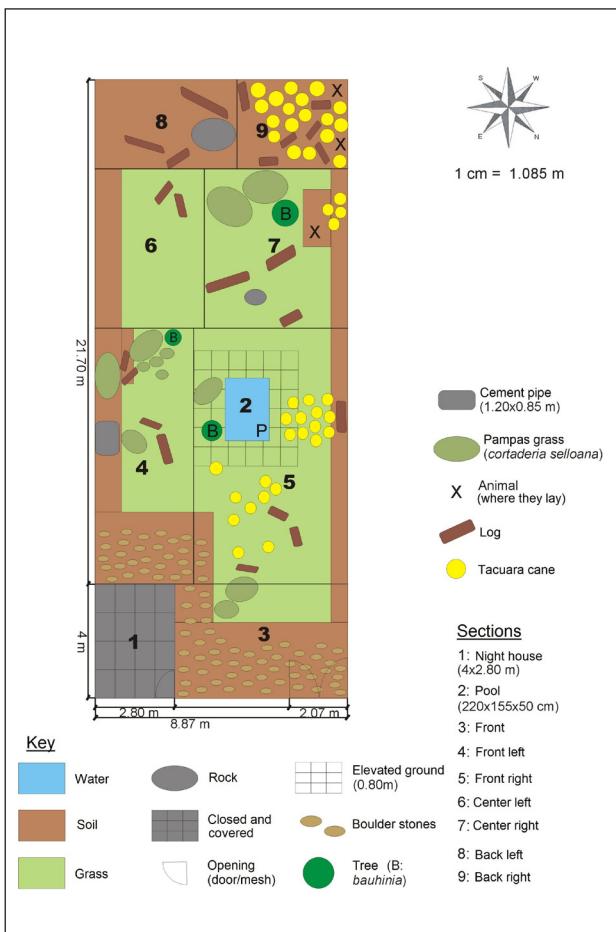


FIGURE 1. Diagram of the exhibit where the giant anteaters (*Myrmecophaga tridactyla*) were housed during the study. A reference scale, keys, dimensions, and sections are provided.

full year cycle of climatic seasons. A total of 122 h of behavioral observations were made by the naked eye at a distance of 1–5 m through a metallic mesh, five times a week (Monday–Friday), four times a day with focal animal *ad libitum* sampling (Altmann, 1974), during 12 months from 9:00 to 18:00 hs. A diagram of the exhibit (**FIG. 1**) was concocted and divided into sections to ease the data collecting process during the observations. To facilitate the description of the behavioral acts, a description of the different physical characteristics of each individual was conducted along with the segmentation of the body to identify them (**FIG. 2**). A climatic description was used as a reference applied in the observations.

The three females were differentiated by fur color, size, and the difference in the anteaters' characteristic diagonal shoulder stripe in their fur, which is on both lateral sides of the torso. One of the females had lighter brown colored fur and the diagonal stripes were less defined. The second female had darker black fur and the diagonal stripes were more defined. The third female was larger in size, with brown fur, and presented defined diagonal stripes; also, her tail was longer than average.

Finalization of data collection was based on the saturation curve (Lehner, 2003) which consists of creating a graph showing the number of observed behaviors *versus* the number of observations until an asymptote is reached. When a constant asymptote is reached, more observations will not show new behavioral acts; this implies that even if the data collection is expanded, the observed behaviors will still be

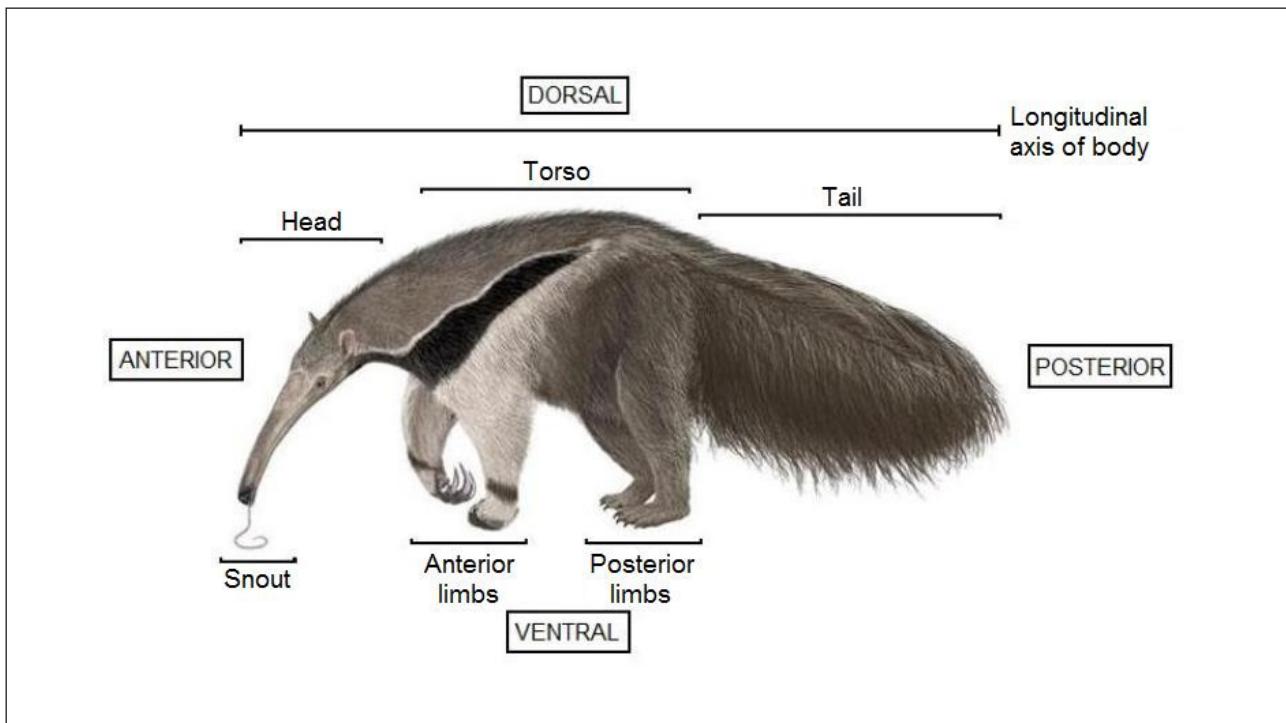


FIGURE 2. Segmentation of the giant anteaters' (*Myrmecophaga tridactyla*) body showing the anterior, posterior, dorsal, and ventral regions.

applicable to the same group of behavioral descriptions already found.

RESULTS

Displacement of the body segments

As shown in **TABLE 1**, the body segments were divided into head, torso, tail, and anterior and posterior limbs, and their displacement was described vertically and horizontally.

Behavior

During the 12 months of observations, 38 behavioral acts were defined, which were then grouped into 11 behavioral categories described in **TABLE 2**. A description of all specific behaviors recorded during the behavioral observation sessions are shown in the behavioral ethogram in **TABLE 3**. All behaviors were coded for frequency (total number of occurrences).

TABLE 1. Description of the displacement of the giant anteaters' (*Myrmecophaga tridactyla*) body. The body is segmented into head, torso, tail, and anterior and posterior limbs. The displacements are described both vertically and horizontally.

Body Segment	Vertical Displacement	Horizontal Displacement
Head	Below, above or in the same longitudinal axis of the body	To the right, left or in the same longitudinal axis of the body
Torso	Parallel to the ground standing on anterior and posterior limbs	Perpendicular to the ground standing on posterior limbs only
Tail	Below, above or in the same longitudinal axis of the body	To the right, left or in the same longitudinal axis of the body
Limbs	Extended	Semi flexed or flexed

TABLE 2. Description of the 11 behavioral categories that include the 38 specific behaviors observed in giant anteaters (*Myrmecophaga tridactyla*).

Behavior category	Description	Specific behavior
Alert	Brief state in which the animal is motionless, interrupting any activity it was engaging in, head points in the direction of a noise source if there was any; usually occurs in the presence of people.	Stand (SD)
Locomotor	Sequence of events in which the animal uses full body locomotion, moving from one point to another of the exhibit, horizontally or vertically.	Walk (WK), Run (RN), Turn (TU), Climb (CB)
Rest	Prolonged motionless state in which the animal is in a specific spot in the exhibit, distinguished by minimal or null head and limb movement, eyes commonly closed.	Sit (ST), Lay (LY), Sunbathe (SB)
Foraging	Sequence of events in which the animal explores the exhibit in search of food, distinguished by use of anterior limbs and snout and the presence of a substrate or object. It is observed more frequently during or after rainfall or after the grass in the exhibit is cut.	Investigate (IV), Smell (SM), Swipe (SW), Puncture (PT), Move (MV), Dig (DG)
Feeding	Any action that culminates with the ingestion of food or water, marked by the repetitive introduction and retraction of the tongue into the nutritional source, often accompanied with salivation, anterior limbs are not involved.	Drink (DR), Eat (EA)
Grooming	Any action that involves handling of its own body; the snout, anterior or posterior limbs contact any body part.	Self Smell (SS), Scratch (SR), Rub (RB), Snout Clean (SC), Bathe (BT)
Excretion	Event characterized by the elimination of feces or urine, executed in the back of the exhibit where there is dirt or in small superficial excavations on the ground.	Defecate (DE), Urinate (UR)
Social Interactions	Sequence of events that occur between specimens; the action of one individual evokes a behavioral response in the other.	Touch (TC), Sniff (SF), Follow (FL), Tongue Lick (TL)
Agonistic Interactions	Sequence of events that occur between specimens involving aggression.	Aggression 1 (A1), Aggression 2 (A2), Aggression 3 (A3), Defense (DF), Territorial (TR)
Stereotypic	Sequence of events, generally long, repeated always in the same manner, that does not show obvious functional achievements.	Pacing Figure 8 (P8), Pacing Figure 0 (P0)
Other	Other behaviors that do not fit the descriptions of the previous categories.	Tongue Out (TO), Play (PL), Vocalization (VO), Not Visible (NV)

TABLE 3. Description of each specific behavior recorded during the behavioral observation sessions in giant anteaters (*Myrmecophaga tridactyla*). Each behavioral act is listed within its behavioral category and has been coded.

Behavior category and specific behavior	Description
Alert	
Stand (SD)	In a specific area, the animal has all four limbs on the ground or only one anterior limb is raised and semi flexed inwards towards its ventral region, the head is horizontally above, below or commonly in the same longitudinal axis of the torso, the tail is also in the same longitudinal body axis, and the animal's eyes are open (FIG. 3).
Locomotor	
Walk (WK)	Standing with its head below or on the same longitudinal body axis, the tail does not touch the ground and remains also in the same longitudinal body axis, the animal stands on two opposite limbs at the same time. The sequence begins with the right anterior limb and the left posterior limb in contact with the ground, then the animal raises its left anterior limb and the right posterior one, moves both of them forward and places them on the ground. The animal then raises its right anterior limb and left posterior limb, moving both of them forward then placing them on the ground again and so on. The claws from both its anterior limbs are kept retracted towards its ventral region.
Run (RN)	Standing, the animal's head and tail are in the same longitudinal body axis, the tail does not touch the ground and may swing from side to side, the animal stands with two limbs in contact with the ground. The sequence starts with both anterior and posterior limbs against the ground, then both anterior limbs slightly raise and the posterior limbs stretch from the ground driving the animal forward rapidly while lifting both posterior limbs from the ground, the anterior limbs immediately touch the ground followed by the posterior ones that impulse the animal again and so on.
Turn (TU)	Walking, the animal then stops and rests its body weight on both its posterior limbs, it arches its column inwards towards the ventral region, puts its tail on the ground and turns its body horizontally towards the right or left, then the anterior limbs come in contact with the ground and the animal walks in the opposite direction it came from.
Climb (CB)	Standing, the animal raises, extends, and leans one or both of its anterior limbs against the mesh or the cement posts on the sides of the exhibit, the animal raises its head above the longitudinal axis of the body directing the snout towards any object, the tail and both posterior limbs are against the ground.
Rest	
Sit (ST)	The animal's anterior limbs are extended and in contact with the ground, its posterior limbs are fully flexed against the ground, its posterior body region and tail are also touching the ground, with or without horizontal or vertical head movement, the animal's eyes are open or closed (FIG. 4).
Lay (LY)	With either lateral side of its torso or part of the abdomen leaning against the ground, the head is also against the ground vertically tilted towards its ventral region or lifted from the ground, the animal's eyes are open or closed, its anterior and posterior limbs are flexed inwards or extended, the tail lays motionless on the ground or is bent towards the side covering its whole body including the head. According to Astwood Romero <i>et al.</i> (2010) this makes it difficult to differentiate the anterior and posterior regions of the animal (FIG. 5).
Sunbathe (SB)	Laying with its body on the ground while the animal's back or abdomen is exposed upwards towards the sun, its anterior limbs may shield the face. Or sitting with its chest facing the sun, the head is lifted above the longitudinal body axis with its snout extended vertically upwards.
Foraging	
Investigate (IV)	Standing, walking or sitting, the animal touches the substrate or object with its snout or one or both anterior limbs (FIG. 6).
Smell (SM)	Standing, sitting or walking (most common), the animal's head and snout are pointing to a substrate or object, the animal makes a nasal sound, without the use of its anterior limbs. If the object is elevated, such as vegetation or in the air, the animal raises its head vertically and stretches the snout towards it. If the object is on the ground, such as substrate or vegetation, the animal tilts its head below the longitudinal body axis and reaches it with its snout (FIG. 7).
Swipe (SW)	Standing, the animal extends one or both anterior limbs exposing its claws and repeatedly touches the substrate or object, the movement of its limbs is from front to back, the animal usually sniffs the substrate or object simultaneously.
Puncture (PT)	Standing, the animal extends one anterior limb against the substrate or object, it exposes its claws and with the largest one punctures the object once or various times creating a hole through which the animal then introduces its tongue.
Move (MV)	Standing, the animal raises and extends one anterior limb on an object, grabs the object from underneath with its claws and raises the limb toward its ventral region and outwards achieving the movement of the object. The animal may lean its head and sniff under the object simultaneously.
Dig (DG)	Standing, the animal extends one or both anterior limbs and touches the ground with its claws. It is a repetitive front to back limb movement that causes displacement of soil behind the animal leaving a hole through which it introduces its tongue (FIG. 8).

TABLE 3, CONTINUED ON NEXT PAGE

TABLE 3, CONTINUED

Behavior category and specific behavior	Description
Feeding	
Drink (DR)	Standing, the animal draws its head in direction to a water source, tilting its head vertically below the body axis, then sticks its tongue out until it reaches the water and retracts it, or submerges the snout and sticks its tongue in and out while blowing out the nose.
Eat (EA)	Standing, the animal's head is tilted vertically above or below the body axis, the snout is in direction or in contact with a nutritional source found in different substrates (ground, log, rock, vegetation). The animal sticks its tongue out of the oral cavity repeatedly, often accompanied with salivation, it may emit nasal sounds, and while swallowing the food external movements of the throat are seen. When eating from substrates or vegetation, the animal introduces its snout in the ground or at the base of a plant, it usually uses one anterior limb to separate the leaves in order to stick its head further in between the leaves and eat (FIG. 9, FIG. 10).
Grooming	
Self Smell (SS)	Standing, laying or sitting, the animal extends the snout towards a body part of its own and sniffs it, the snout can be in contact or kept at a close distance to that body part.
Scratch (SR)	Standing, laying or sitting, the animal raises and extends one anterior or posterior limb towards its own body part, once they come into contact the animal exposes its claws and performs short and repetitive movements against it (FIG. 11)
Rub (RB)	Standing or laying, the animal makes contact with its whole body or back against the cement posts of the exhibit, against the edge of the pool by laying down or against slanted tree logs by walking under them. It is usually a repetitive movement from side to side or front to back maintaining the contact of the body with different substrates.
Snout Clean (SC)	Standing or laying, the animal's claws from one anterior limb come into contact with the base of its own snout, wrapping around it and the animal moves the limb sliding its claws to the snout's tip, it may be repetitive and usually occurs after eating to remove dirt or ants.
Bathe (BT)	The animal enters a pool with both the head and tail raised above the water, then sits and scratches its back or abdomen with one anterior limb, the animal usually turns its head in the direction it is scratching, it does not submerge its head into the water. When coming out of the pool, the animal continues scratching with its anterior or posterior limbs, then usually sits and rearranges its tail fur with anterior limbs, the animal may also rub its back against the edge of the pool.
Excretion	
Defecate (DE)	Standing on all four limbs, the animal raises its tail slightly above the longitudinal body axis, excretes feces and then moves away.
Urinate (UR)	Standing on all four limbs, the animal separates horizontally one posterior limb from the other and excretes urine, it may slightly crouch its posterior region, then moves away.
Social interactions	
Touch (TC)	Standing or laying, one animal touches with its anterior limb the back, snout or head of another animal that responds by either ignoring it, touching it back or eluding it by moving aside.
Sniff (SF)	Standing, sitting, laying or walking, the snout of one animal approaches any body part of another and smells it, the other animal responds by either ignoring it, sniffing it back or eluding it by moving aside.
Follow (FL)	Walking, one animal follows another behind it or next to it, both directing themselves in the same direction for a short distance, the other animal continues walking, there is no physical contact between them.
Tongue Lick (TL)	Standing, one animal is facing or next to another, one of them tilts its head vertically downwards below its body axis and turns it upwards to the right or left touching with its snout the snout of the other that also tilts its snout downwards. If both animals stick their tongue out they come into contact and lick each other, if only one of them does it then it licks the other's snout. This usually occurs after feeding.
Agonistic interactions	
Aggression 1 (A1)	Standing or walking, one animal leans its snout against another's back or snout pushing it downwards, the animal that receives the aggression responds by either standing still or eluding it by moving aside. This usually occurs when both animals try to access or walk in the same place at the same time.
Aggression 2 (A2)	Standing or walking, one animal raises, extends and leans one or both of its anterior limbs against the head, snout or back of another animal, when it occurs against the other's back, the animal pushes it downwards forcing the other animal to sit, if it uses both anterior limbs it holds the other's posterior region and prevents it from walking. The animal that receives the aggression responds by either standing still or trying to walk to get away, if he achieves it the aggressor may follow him a short distance (FIG. 12).
Aggression 3 (A3)	Standing, one animal raises one or both of its anterior limbs, exposes its claws and swipes the other animal's back, head or snout. The animal that receives the aggression takes a defense posture.

TABLE 3, CONTINUED ON NEXT PAGE

TABLE 3, CONTINUED

Behavior category and specific behavior	Description
Defense (DF)	An animal after receiving aggression 3 stands, raises one or both of its anterior limbs and exposes its claws until the aggression ceases, there is no physical contact with the aggressor since this one usually retracts.
Territorial (TR)	Standing or sitting, one animal raises, extends and touches with one anterior limb the other's snout pushing it away, this usually occurs when both animals eat from the same nutritional source. The animals do not always touch, sometimes the animal only raises an anterior limb towards the other's snout exposing its claws (FIG. 13).
Stereotypic	
Pacing Figure 8 (P8)	An animal walks from one edge of the exhibit border to another through a lateral wall making an 8 figure, turning in each corner to the left to continue walking in the opposite direction, the animal may momentarily stop to smell the ground, vegetation or air. This is usually executed in the back of the exhibit (sections 8 and 9), in the front along the night house door (section 3), or on the left lateral border (section 6). It is highly repetitive, and it can be carried out by all animals in the same section at the same time.
Pacing Figure 0 (P0)	An animal walks along all the borders of the exhibit making a 0 shape, this generally begins from the back towards the front through one of the lateral sides, the animal walks through the front side and returns to the back by the opposite lateral side, then walks through the back side back to the starting point. When walking in the left border, the animal usually passes through a cement pipe that is located there, and when passing by the night house it smells the door. It is slightly repetitive.
Other	
Tongue Out (TO)	Standing, sitting, laying or walking, the animal's head is in the same longitudinal axis of the body or above it, the animal draws out its whole tongue from the mouth and immediately retracts it without it touching anything, this is usually seen after the animal smells something or when it wakes up.
Play (PL)	Standing or sitting, with its snout, anterior or posterior limbs in contact with objects or logs, the animal manipulates the object by first swiping at it with one or both anterior limbs, then abruptly lays on the ground against its back without letting go of the object, picks it up and situates it against its chest or abdomen holding it in place with one or both posterior limbs and continues swiping at it with its anterior limbs, the animal may pounce over the object with its abdomen against it (FIG. 14).
Vocalization (VO)	The animal makes a short low-frequency whistle, it is highly unusual and cannot be widely described nor could it be audio recorded.
Not Visible (NV)	The animal is partially or fully outside the observer's viewing range, it is most likely in the back right corner of the exhibit covered by the vegetation (section 9) or inside the night house.



FIGURE 3. Giant anteater (*Myrmecophaga tridactyla*) standing with all four limbs on the ground, with both head and tail in the same longitudinal axis as the torso.



FIGURE 4. Giant anteater (*Myrmecophaga tridactyla*) sitting and interacting with enrichment object, with both anterior limbs extended and posterior limbs flexed.



FIGURE 5. Giant anteater (*Myrmecophaga tridactyla*) laying, the tail covers the body, the head is lifted from the ground, and the eyes are open.



FIGURE 8. Giant anteater (*Myrmecophaga tridactyla*) digging the ground with its claws. One anterior limb digs while the animal introduces its tongue in the hole it created.



FIGURE 6. Giant anteater (*Myrmecophaga tridactyla*) investigating in the vegetation, the snout is touching the substrate.



FIGURE 9. Giant anteater (*Myrmecophaga tridactyla*) eating from an enrichment nutrient source, the snout is in contact with the nutritional source and the tongue is seen.



FIGURE 7. Giant anteater (*Myrmecophaga tridactyla*) sniffing tree logs, the head is tilted below the longitudinal body axis and reaches the logs with its snout.



FIGURE 10. Giant anteater (*Myrmecophaga tridactyla*) eating from an enrichment termite mound. The head is above the longitudinal body axis and the snout is in contact with the nutritional source.



FIGURE 11. Giant anteater (*Myrmecophaga tridactyla*) scratching its back. The animal is in a sitting position using one anterior limb to scratch itself and the other anterior limb to support its body weight.



FIGURE 12. Giant anteater (*Myrmecophaga tridactyla*) displaying aggression against the back of another anteater. The aggressor is leaning one anterior limb against the other animal forcing it to sit.



FIGURE 13. Giant anteater (*Myrmecophaga tridactyla*) displaying territoriality against another anteater. Both animals are eating from the same nutritional source and one animal is pushing the others' snout away with one of its anterior limbs.

Data collected

FIGURE 15 shows the number of new and accumulated behaviors versus the number of observation sessions. The first asymptote was reached at 35 h, there was a second one at 46 h, and the final asymptote, which remained constant, was reached at 52 h and contained the 38 behavioral acts registered in the ethogram.

There were many changes in the behavior of the females throughout the seasonal changes. The investigative and feeding behavior increased during the rainy season and on average, the anteaters were most active during the afternoons *versus* in the mornings. The heat of the summer with 30–35 °C was when the anteaters were most active. The captive facility where this research was conducted is outside the giant anteater's natural distribution, which possibly affected the behaviors the animals displayed.

DISCUSSION

Little background information was available on the specimens used in this research. They were born in the wild and then donated to the Temaikèn Foundation. This lack of background information brings forth a discussion regarding the variations between behaviors in the wild and in captivity. For example, in this study the only laying behavior observed was with the tail folded over the body when sleeping, which helps the anteater conserve the body heat generated by its metabolism and also serves to camouflage the sleeping animal (Shaw & Carter, 1980).

However, observations in natural habitats indicate variations of this behavior depending on



FIGURE 14. Giant anteater (*Myrmecophaga tridactyla*) playing with an enrichment object. The animal is laying on the ground while manipulating the object with its anterior limbs and holding it in place with its posterior limb.

ambient temperature (Medri & Mourão, 2005). In a large number of sightings ($n=107$), giant anteaters were found sleeping with their bushy tails covering their bodies even on days when the temperature exceeded 30 °C, while on a cool sunny morning, when ambient temperature was about 17 °C, the giant anteater was sleeping stretched out flat on the ground exposing the full length of its body to sunlight, a behavior that suggests it was using solar radiation as a source of heat to raise its body temperature (Medri & Mourão, 2005).

Another finding that shows the variations of giant anteater behavior is the bathing habit. In this research, the animals used the pool to bathe and also enjoyed being hosed down by their keepers as a part of their enrichment. In the wild, bathing in water is rare in mammals that are not semi-aquatic and giant anteaters do not share the physical characteristics of other bathing mammals. However, Emmons *et al.* (2004) acquired over 70 photos with a camera trap of giant anteaters coming to a watering hole in Parque Nacional Noel Kempff Mercado in Santa Cruz, Bolivia. The photos showed many anteaters arriving dry, then leaving the hole soaking wet (Emmons *et al.*, 2004).

There has been much dispute regarding the climbing behavior of giant anteaters. In this study

this specific behavior was only recorded when the animal was motivated to climb with the use of food type enrichment. This behavior was described by the observations of Young *et al.* (2003), where the ability of both captive and wild giant anteaters to climb termite mounds, trees, and man-made objects was fully described. In both studies, the conclusion reached is that a sufficiently hungry or motivated giant anteater will display the climbing abilities needed to obtain certain goals, such as food.

Agonistic behaviors recorded in this research and others in captivity seem to be less violent and do not end with serious injuries, as opposed to the fighting behavior that occurs in the wild and which has been described in the scientific literature (Shaw *et al.* 1987; Rocha & Mourão, 2006; Kreutz *et al.*, 2009). However, some of the aggressive behaviors seen in this study could be associated with reproductive periods when comparing these behaviors with those found in the work of Astwood Romero *et al.* (2010). Although the study performed by Astwood Romero *et al.* (2010) is about courtship and mating behaviors of giant anteaters in *ex situ* conditions, it also includes a basic ethogram with some of the same behaviors recorded in this study, such as climbing, sleeping, smelling, rubbing, running, following, turning, eating, and grooming. The agonistic behaviors displayed by these three females seem to fit some of the courting descriptions of Astwood Romero *et al.* (2010), and may in fact be a part of a misdirected courtship attempt.

CONCLUSIONS

The results described here are useful for the husbandry of giant anteaters in captivity in order to achieve their welfare. The zookeepers of these animals now have a better understanding of them, accomplishing the goal of this study.

Accomplishing a good management of animal behavior is of utmost importance because it results in sanitary treatments, veterinarian interventions, and handling with higher probabilities of success. This study has helped improve the training techniques used by the keepers of these giant anteaters.

Good management also helps in the conditioning of exhibits and in the possible reintroduction of the animals into their environment, as it allows recognizing when an animal is ready to be released. Based on the results of this study, the three females will be separated from each other and placed in better conditioned exhibits.

Environmental enrichment allows the animals to express species-appropriate behaviors and thus increases the chance of successful reproduction of endangered species, such as the giant anteater. Following the completion of this ethogram a more suitable environmental enrichment program will be

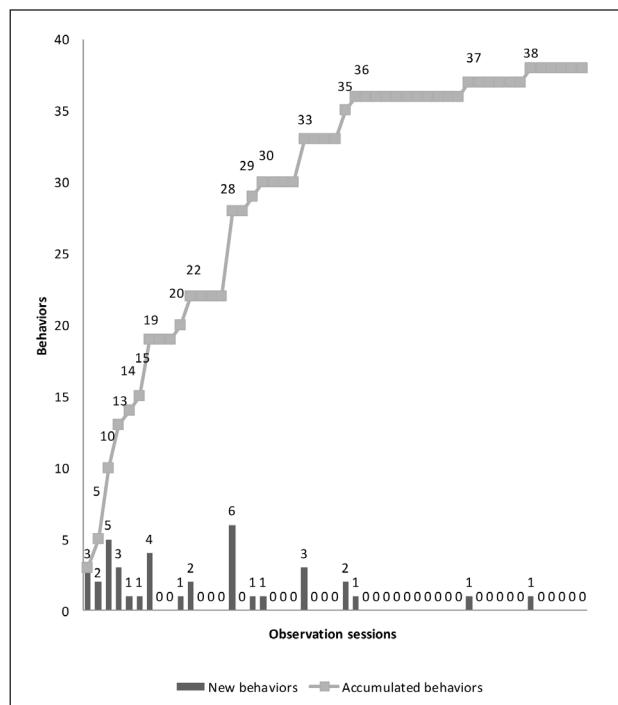


FIGURE 15. Chart showing the number of new behaviors / accumulated behaviors observed in giant anteaters (*Myrmecophaga tridactyla*) versus the number of observation sessions. The first asymptote was reached at 35 h, there was a second one at 46 h, and the final asymptote, which remained constant, was reached at 52 h and contained the 38 behavioral acts registered in the ethogram.

put into practice at Temaikèn Zoo to diminish the high frequency of aggression and stereotypies recorded in this study.

ACKNOWLEDGEMENTS

The author is pleased to acknowledge those who made the research possible. Special thanks go out to the supervisor of the work, Florencia Presa, whose guidance and support were key to develop an understanding of the topic. Infinite appreciation to the Temaikèn Foundation for the use of the facilities, and to all the members of the Nutritional Department and the zookeeper staff for their assistance and cooperation throughout the study.

REFERENCES

- Altmann, J. 1974. Observational study of behavior: sampling methods. *Behaviour* 49: 227–267.
- Astwood Romero, J. A., P. C. Casas Martinez, S. A. Ojeda Holguin & R. Murillo Pacheco. 2010. Notas sobre el comportamiento de cortejo y apareamiento de *Myrmecophaga tridactyla* bajo condiciones ex situ. *Edentata* 11: 34–43.
- Emmons, L. H., R. Peña-Flores, S. A. Alpirre & M. J. Swarner. 2004. Bathing behavior of giant anteaters (*Myrmecophaga tridactyla*). *Edentata* 6: 41–43.
- Fagen, R. M. 1978. Repertoire analysis. Pp. 25–42 in: Quantative ethology (P. C. Colgan, ed.). John Wiley and Sons, New York.
- Kreutz, K., F. Fischer & K. E. Linsenmair. 2009. Observations of intraspecific aggression in giant anteater (*Myrmecophaga tridactyla*). *Edentata* 8–10: 6–7.
- Laffitte de Mosera, S. & R. Caprio. 1980. Glossary of ethology. 2nd edition. University of the Republic, Faculty of Humanities and Sciences, Institute of Biosciences, Department of Biology and Ethology, Uruguay. 154 pp.
- Lahitte, H. B., J. Hurrell & A. Malpartida. 1993. Ecología de la conducta. De la información a la acción. Ediciones Nuevo Siglo, La Plata. 188 pp.
- Lehner, P. 2003. Handbook of ethological methods. 2nd edition. Cambridge University Press, Cambridge.
- Lorenz, K. 1993. La ciencia natural del hombre, Metatemas volumen 32. El manuscrito de Rusia. Tusquets Editores, Barcelona. 400 pp.
- Martin, P. & P. Bateson. 1986. Measuring behavior: an introductory guide. 1st edition. Cambridge University Press, Cambridge.
- Medri, I. M. & G. Mourão. 2005. A brief note on the sleeping habits of the giant anteater – *Myrmecophaga tridactyla* Linnaeus (Xenarthra, Myrmecophagidae). *Revista Brasileira de Zoologia* 22: 1213–1215.
- Miranda, F. & I. M. Medri. 2010. *Myrmecophaga tridactyla*. In: IUCN 2011. The IUCN Red List of Threatened Species 2011.2. International Union for Conservation of Nature and Natural Resources. <<http://www.iucnredlist.org>>. Downloaded on 18 June 2012.
- Patterson, B. & R. R. Pascual. 1972. The fossil mammal fauna of South America. Pp. 247–309 in: Evolution, mammals, and southern continents (A. Keast, F. C. Erk & B. Glass, eds.). State University of New York Press, New York.
- Pautasso, A. A., G. Pérez Jimeno, V. B. Raimondi & C. Medrano. 2009. Revisión de la situación del oso hormiguero gigante (*Myrmecophaga tridactyla*) en la provincial de Santa Fe, Argentina: estado de conocimiento actual y medidas de conservación adoptadas y propuestas. *Biológica* 10: 17–27.
- Pérez Jimeno, G. & L. Llarín Amaya. 2007. Contribución al conocimiento de la distribución del oso hormiguero gigante (*Myrmecophaga tridactyla*) en Argentina. *Edentata* 8–10: 8–12.
- Rocha, F. & G. Mourão. 2006. An agonistic encounter between two giant anteaters (*Myrmecophaga tridactyla*). *Edentata* 7: 50–51.
- Shaw, J. H. & T. S. Carter. 1980. Giant anteaters. *Natural History* 89: 62–67.
- Shaw, J. H., J. Machado-Neto & T. S. Carter. 1987. Behavior of free-living giant anteaters (*Myrmecophaga tridactyla*). *Biotropica* 19: 255–259.
- Superina M., F. R. Miranda & A. M. Abba. 2010. The 2010 anteater Red List assessment. *Edentata* 11: 96–114.
- Young, R. J., C. M. Coelho & D. R. A. Wieloch. 2003. A note on the climbing abilities of giant anteaters, *Myrmecophaga tridactyla* (Xenarthra, Myrmecophagidae). *Boletim do Museu de Biología Mello Leitão (Nova Série)* 15: 41–46.

Received: 14 February 2012; Accepted: 17 September 2012