

Table 1. **Bird Ethogram Howdy & Mating Introduction Behavior Example.** ‘Akikiki courtship and breeding behavior ethogram developed in conjunction with San Diego Zoo Wildlife Alliance, PDXWildlife, Keauhou Bird Conservation Center and Maui Bird Conservation Center.

Behavior	Short Code	Event/ State	Measure (Lat/Freq/ Dur/Int)	Definition
General Individual Behaviors				
Singing		E	Freq	Male only behaviour. Continuous sequence of varying notes.
Locomote		S		Movement of more than 12 inches which could include, flight, jumping, hopping, creeping, etc.
Feeding/Drinking		S		Bird eating or drinking. Eating can occur on either food pan or wax worm log. If there is a 10-15 second pause and no feeding/drinking resumes the state will end. i.e. carrying food away from the food source, masticating/chewing while away, and then returning would still count a one bout of feeding. Reserve for when you can visually see the animal consuming food.
Foraging		S		Searching through browse or gleaning on logs with the intention of acquiring food. Score if you cannot adequately see food being consumed. Keep foraging “on” if locomotion between browse is <5 seconds.  Modifier:  <i>Social:</i> done in close proximity (less than 12 inches) and/or same piece of browse, log,

				<p>etc.</p> <p><i>Independent: solitary foraging</i></p>
Stereotypic Behaviour		S		<p>Stereotypical (pattern more than 3 times)</p> <p>Modifier:</p> <p><i>Pace Flying: repetitive flights induced by stress</i></p> <p><i>Head Rolling: Rotating head in a 360 degree circle with the rest of the body stationary.</i></p>
Preening		S		Self-grooming
Bathing		S		Bird in water, under mister, or rain actively self-grooming and/or splashing water on themselves.
Resting		S		Stationary, inactivity of bird, may include eye closing and sleep.
Not Visible		S		Cannot see the bird
Other		S		Anything not covered by the behaviours listed in this ethogram
Affiliative Behaviors				
Allopreening		S		One bird preens, nibbles or rubs another with head, beak or neck, or wing tags;

Barrier Contact		S		Bird grasps and holds onto the barrier between enclosures. Do not count if on browse or corner perch near barrier only when grasping onto wire mesh.
Proximity		S		<p>Bird is less than or equal to 12 inches of a conspecific. Often birds will actively forage in close proximity and move from browse to browse. If birds are greater than 12 inches apart for more than 15 seconds Proximity state will be ended.</p> <p>Modifier:</p> <p><i>Start:</i> Push as soon as proximity starts</p> <p><i>Stop:</i> Push as soon as proximity stops</p>
Beg		S		Bird pumps head up and down while holding wings out and pumping them up and down accompanied by begging call (short peeping).
Allofeeding		E		<p>One bird deposits or presents food item (e.g. live insect) into conspecifics mouth. For example if male holds live insect in mouth and female takes the worm the male would still be counted as allofeeding.</p> <p>Modifiers. <b>Two modifiers must always be selected:</b></p> <p>Must select one of the following:</p> <ol style="list-style-type: none"> <li>1. <i>Giver:</i> bird that is presenting the food item</li> <li>2. <i>Receiver:</i> bird that is taking the</li> </ol>

				<p>food item</p> <p>Also select one of the following:</p> <ol style="list-style-type: none"> <li>1. <i>Accept</i>: recipient of allofeeding eats or receives food item in beak</li> <li>2. <i>Reject</i>: recipient of allofeeding refused food (e.g. flies away, ignores, etc)</li> </ol>
Aggressive Behaviors				
Chasing		S		<p>A prolonged, continuous approach by one bird towards another while the other continuously moves away. Do not break chasing event unless there is a &gt;15 second pause.</p> <p>Modifier:</p> <p><i>Prior Conflict</i>: &gt;2 seconds prior to chasing an aggressive behaviour occurred (e.g. mouth gaping, displacement, contact aggression, etc.)</p> <p><i>No Prior Conflict</i>: &gt;2 seconds prior to chasing an affiliative or neutral behaviour occurred (e.g. allofeeding, allogrooming, begging, etc.)</p>
Contact aggression		E		<p>One bird aggresses another and actual physical contact is made; examples include: biting, pecking, striking, or landing on another bird, moving another bird's head away with the aggressor's own head/beak</p>

Fight		S		Both birds actively engage in aggressive physical struggle. For example colliding in the air, entangling feet, aggressive pecking, accompanied by aggressive and/or distressed vocalizations
Displacement		E		One bird approaches another stationary bird at perch or feeding station and the other bird moves away.
Stealing		E		One bird takes unoffered food item from possession of a conspecific.
Mouth Gaping		E		Short bout of open mouth presentation. Sometimes accompanied by aggressive vocalizations (staccato, abrupt version of their normal cheep).
Sexual Behavior				
Soliciting		E		Female behaviour only. Crouching with drooped wings with tail raise/tail flutter.
Copulation		E		Male mounting female with intent of mating/intromission  Modifier: <i>Correct</i> : Male positioned with tail aligned with female tail region <i>Incorrect</i> : Male positioned with tail grossly misaligned with female's cloaca

Gift Giving		E		Male or female present other sex with a non-food item (e.g. leaf, stick, etc)
Nesting Behavior				
Manipulating Nesting Material		S		Bird moves, manipulates, rearranges, or otherwise alters nesting material on rack.
Carrying Nesting Material		S		Bird removes nesting material from rack and carries it to different location in aviary
Nest Building		S		Bird arranges material into nest including cup formation and weaving behaviour.

Table 2. **Solitary Carnivore Ethogram Howdy & Mating Introduction Behavior Example.** Giant panda courtship and breeding behavior ethogram developed in conjunction with San Diego Zoo Wildlife Alliance & PDXWildlife.

Behavior	Short Code	Event/ State	Measure (Lat/Freq/ Dur/Int)	Definition
General Individual Behaviors				
Not Visible		S		Animal is temporarily out of view within the indoor enclosure. Record total time and frequency.
Other		S		Any behavior not covered in the ethogram
Feed		S		Grabbing/obtaining a food item, or chewing/manipulating food item, or ingestion of food item.
Locomote		S		Bout of directional travel between points where individual moves >4 steps, or sustained locomotion in a non-repetitive manner.
Sleep/Rest		S		Animal is not moving with eyes closed (sleep) or open (resting) and does not appear to be interested in their surroundings.
Stereotypy		S		Animal engages in unvarying and repetitive acts (3 or more repetitions) that have no obvious goal or function. With modifiers: see "Course Work>Behavioral Scoring Practice>Stereotypical>Stereo Ethogram 8-9.15.docx" for detailed descriptions of modifiers.
Affiliative Behaviors				
Proximity		S		The distance to the nearest panda is <1 adult panda body lengths.
Barrier run		S		Fast (run) along the barrier repeated during the breeding season. Usually done by males in response to an estrous female and

				<p>indicates high levels of motivation. Technically stereotypical but done in an elevated excitement state.</p> <p>Modifiers:  <i>Alone</i>: when conspecific is not present  <i>Joint</i>: when male and female are pacing the barrier together.</p>
Barrier pace		S		<p>Pacing the adjoining barrier of pen in a repetitive, technically stereotypical pace but done during the breeding season and when next to a opposite sex conspecific.</p> <p>Modifiers:  <i>Alone</i>: when conspecific is not present  <i>Joint</i>: when male and female are pacing the barrier together.</p>
Aggressive Behaviors				
Retreat		E		<p>Panda suddenly and rapidly increases the distance between itself and another panda &gt;2 body lengths (typically in response to aggressive behavior such as N1, N2, C1, C2, AM) by the opposing party. Usually in response to an aggressive interaction by another panda.</p>
Non- Contact Aggression, Level 1		S		<p>Agitated. Interaction which includes <u>mild</u> threats which are primarily defensive, connoting alarm, distress, apprehension, aversion. Vocalizations include <b>huff, snort, chomp, honk, moan</b>. Low intensity.</p>
Non- Contact Aggression, Level 2		S		<p>Threatening. Interaction which includes moderate threat vocalizations: <b>moan, bark, growl</b> and <b>roar</b>. Actions <b>may</b> include paw swats without contact and charge/lunge.</p>
Contact Aggression, Level 1		S		<p>A non-sustained (i.e., less than 5 seconds) aggressive interaction of moderate intensity, including actions such as <b>paw</b></p>



				<b>swat, bite, grab, and dominance mount.</b> “Moderate intensity” is defined as aggressive acts which have low potential for inflicting serious injury, e.g., drawing blood. Generally accompanied by vocalizations discussed in N2.
Contact Aggression, Level 2		S		Sustained aggression, including vigorous and potentially injurious physical contact (fighting, attacking), such as <b>bite, grab, paw swat, wrestle, chase</b> with contact. Intensity of aggression is high, as indicated by injury, duration, or vocalizations such as <b>roar</b> and <b>squeal</b> .
Yawn		E		Panda opens mouth to full length of mandibular extension exposing teeth and tongue. Seen in male-male competition.
Female Sexual Behavior				
Tail Up		E		Tail rose high enough to uncover vaginal opening. Often accompanied by bleating and chirping; used by females in estrus to indicate receptivity to mating (part of lordosis posture). If tail up is caused by caretakers testing the female by touching the tail, record "HO (tail up)."
Genital Manipulation (masturbation)		S		Any rubbing or grasping of genitalia with paws or with objects (e.g., bamboo).
Backwards walking		S		Animal walks backward for > 4 steps (i.e., one step is made with each foot). Often female backs toward male and presents anogenital area. Often accompanied by

				bleating and chirping.
Lordosis		E		As in TU, but hindquarters raised, and kneeling on forelegs; head often on the ground. Some variation in exact form occasionally observed, especially when female is rubbing genitalia on an object. Record TU 1-0 in addition to LOR.
Rear Present		S		Female will stand with hindquarters or sit with back presented to male. Often done leaning against bars and with snout elevated in the air toward male. Modifiers: "Tail up" if female is presenting to male with tail up, "Tail down" if female is presenting to male with tail down, "Back" if female is leaning back against bars.
Rolling		S		Animal lies on back and rolls and writhes (context is not dirt bathing).
Water Play		S		Splashing and rolling in water.
Mating Behaviors				
Genital Stimulation		S		Gentle licking and biting of the genital region.
Anogenital Inspection		S		Sniffing and investigation of the genital region without any physical contact (licking, nudging).
Mount		S		Mounts in which the genital areas are brought into contact or near contact. May grab the partner's scruff in the mouth and grasp the sides with the forepaws.

				<p>Modifiers:  <i>“Correct”</i> = as described above,  <i>“Incorrect”</i> = Mounts in which the genital area of the focal panda is brought into contact of nongenital area of other panda</p>
Vaginal Thrust		E		Thrusts pelvis (as in copulation) while mounted as defined above.
Intromission		S		Penis is successfully inserted into vagina. Record total time.
Position Female		E		Male physically contacts female to position her for mating or repositions her during the intromission
Hold for mounting		S		Female holds a lordosis tail-up position for >5 sec to allow mounting by the male. Modifiers: <i>“Correct”</i> =as described above, <i>“Incorrect”</i> = female will stand with rear presented to male and not running away but in <i>“wrong”</i> mating position, e.g. not in lordosis or with tail up, rear on ground, etc.
Rollback		S		During successful intromission males sit back on their hindquarters drawing the female onto their laps into a <i>“roll back”</i> position. Score as soon as male attains position within <i>“Intromission”</i>
Vocalizations				
Bleat		E		A twittering, goat-like call of variable length (1-3s). Contact call, appealing, non-aggressive, <i>“friendly.”</i>
Chirp		E		Short, tonal (free of distortion), high-pitched call rising and descending in pitch

				(i.e., frequency sonogram is chevron shaped, like an upside down U). Most common during peak estrus. Friendly, promotes social proximity. Males will rarely chirp, usually when in a state of heightened excitement when first interacting with an estrous female that has just been relocated to the pen next to them.
Bark		E		Short, (0.1-0.3s), fairly noisy, similar to dog bark. Threat, causes withdraw by receiving animal.
Moan		S		Low-pitched, low-to-medium amplitude, call of variable duration. Often has several short starting elements. Mild threat, often used by the female to discourage approach by the male. Perhaps best described as a “wookie call” as exemplified by Chewbacca of Star Wars fame.
Growl		E		Long, noisy, low-pitched growl similar to a dog’s. Very aggressive, often accompanies or precedes fighting. Mostly used by attacking animal.
Honk		E		Short (< 0.5s), tonal, low-pitched, nasal call, falling in pitch. Almost always produced repetitively in a series, generally lasting for several minutes. Often used when apparently stressed, frustrated, or otherwise uncomfortable (e.g., before passing a mucous stool).
Roar		E		Very loud, intense, harsh (highest level threat). Rare.

Chomp		E		Alternate rapid opening and closing mouth, with teeth coming hard together. Defensive, e.g., when the female avoids the male's approach. Mild threat. Often precedes or follows moans.
Huff		E		Audible exaggerated expulsion of air through open mouth (anxious, mild threat). Some huffs also include a vocal component. Most often observed in response to close proximity to humans.
Agonistic Squeal		E		Short, high-pitched, open-mouthed call. Often used by subordinate animal in a fight or in response to pain.
Ejaculation Bleat		S		Long string of continuous bleats which signals successful intromission by male. Female will join and make the same sound after male begins.
Chemical Communication Behaviors				
Anogenital mark		E		Rubs anogenital region (tail up) against object or substrate.
Squat mark		E		In squatting posture.
Leg cock		E		With one hind leg raised and paw placed against a vertical surface; posture is that of a dog cocking its leg, with the paw placed at least as high as the hip joint, often higher than any other portion of the body. Panda's body (head to tail) is relatively parallel to the marking surface, unlike reverse where the panda is perpendicular to the marking surface. Will often urinate.

				One leg MUST stay on ground if both legs are off it is Hand stand – see below.
Reverse mark		E		Backs into a vertical surface before marking by rubbing anogenital region in a circular motion. Body is generally perpendicular to the marking surface.
Hand stand		E		Elevates hind quarters vertically, hands support weight in an upside down posture fairly parallel to the vertical marking surface; both hind feet must leave the ground. Often bounces and urinates, and virtually never actually rubs the gland on the surface.
Urinate		E		Passing of urine.
Body rub		S		Rubs areas of body (head, neck, chest) against structures or substrate, <u>in a smooth, fluid motion</u> .
Scent Anoint		S		Picks up moveable object w/ paws and rubs object over body(e.g., “face-washing” similar to a cat).
Olfactory investigation		S		Places nose close to (< 3 inches) the substrate and sniffs and/or appears attentive for > 1 sec.
Flehmen		E		raises lips, exposing teeth and/or opens mouth noticeably while “Olfactory Investigating” scent, and inhales deeply.
Lick		E		licks area that it is sniffing during “Olfactory Investigation”
Defecate		E		Passing of fecal matter.

Foot scrape		S		Rapid scraping of hind feet back and forth on substrate while standing in place; apparently an aggressive act. Often precedes urination in males. Length of scrape varies markedly from a few inches (generally females) to several feet (generally males).
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Table 3. **Reptile Example Breeding Behavior Ethogram.** Caribbean iguana behavioral ethogram developed in conjunction with San Diego Zoo Wildlife Alliance & PDXWildlife.

Behavior	Short Code	Event/State	Measure (Lat/Freq/Dur/Int)	Definition
Social Interactions				
Investigating "Howdy Door" (HD)				Animals is at howdy door or in very close proximity to it (less than 30cm)
Scratching Howdy Door				Animal is actively scratching at the howdy door
Locomote				Short bout of directional travel between points, or sustained locomotion in a non-stereotyped manner.
Investigative Walking				Animal is slowly walking along shared barrier of enclosure, often tongue-flicking as if searching for something; no apparent path
Proximity				Animal is within at least one body length (~1m) of another animal.
Breeding Behaviors				
Copulation Attempt				Male climbs on female's back and the genital areas are brought into contact or near contact. May grab the female's nuchal crest in the mouth and grasp the sides.



Intromission				Tails are wrapped hemipenis is successfully inserted into cloaca. Most activity ceases and animals remain relatively still.
Female Breeding Presentation				Female lowers body and lifts vent and tail. Often will try to get underneath the male.
Male Courtship Display				Male headbobs, many times in a wobbly side-to-side motion, often with mouth open slightly; usually while walking near or up to female or around her throughout cage.
Submissive Posturing				An animal (usually female) lies with body close to ground and head down when in close proximity to a conspecific (usually male).
Nesting Behaviors				
Burrowing/ Digging				Digging with front and hind limbs, often short in duration (under 5 minutes). This is typically in corners or at existing burrows
Nest Guarding				Female within close proximity (~2m) to the nest site. Stays close for up to two weeks and usually shows aggression towards keepers if they try to approach the nest.
Nesting				Digging large burrow in substrate. Often performed at night. This

				behavior is distinguished from normal burrow digging by the longer durations in the same burrow, staying in the burrow for an extended period, and females will often cover the burrow after digging.
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**Chemical Communication Behaviors**

Femoral Pore Drag				Scent marking with underside of rear thighs by dragging the thighs across a surface.
Face Rub				When an animal rubs their face/head on an object, ground, or other animal. Possibly a type of scent marking
Vent Drag				Scent marking with cloaca by dragging cloaca across a surface.
Defecate				Passing of fecal matter.

**Aggressive Behaviors**

Contact Aggression, Level 1				A non-sustained (i.e., less than 5 seconds) aggressive interaction of moderate intensity, including actions such as head-bobbing (low amplitude/fast), gaping, high-walking, laterally compressed body, turning sideways to the other animal, charging, lunging, face-to-face interactions with short
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				charges, nipping at tail and limbs. "Moderate intensity" is defined as aggressive acts which have low potential for inflicting serious injury, e.g., drawing blood. Generally accompanied by behaviors above and chasing, with bites to limbs and other parts of the body and/or short tail whips
Contact Aggression, Level 2				Sustained aggression, including vigorous and potentially injurious physical contact (fighting, attacking), such as those in N2 and C1, yet more intense head-bobbing, face-to-face interactions, jaw-wrestling, biting for longer periods, biting onto a limb and rolling, chasing with contact. Intensity of aggression is high, will often have injury
Tail Whipping				tail is used to hit another animal with high intensity/speed
Biting				One animal either nips or gives a full bite to another animal
Jaw wrestling				When two animals are in a bout of aggression and both animals have jaws wide open, pushing one another (usually jaw to jaw). Animals can be facing each other

				(nose to nose), side by side with bodies parallel to one another or with bodies facing each other with heads at one another's shoulder area
Face to Face Confrontation				Animals are facing each other, usually with heads on the ground (often while gaping hissing, or doing short lunges at one another)
Non- Contact Aggression, Level 1				Agitated. Interaction which includes head-bobbing (often low amplitude/fast) and gaping
Non- Contact Aggression, Level 2				Threatening. Interaction which includes high-walking, laterally compressed body, hissing, head-bobbing (low amplitude/fast), gaping, lunging
Headbob				Moves head up and down in a vertical plane. Modifiers: Low Amplitude = movement of head does not go beyond 1/2 head depth, High Amplitude=movement of head is greater than or equal to 1/2 head depth, Quick, Slow ; Gape (G)=Animal has mouth open, often during headbobbing - mouth can barely be open or be open very wide. Often during aggressive encounters

Gape				Animal has mouth open, often during headbobbing - mouth can barely be open or be open very wide. Often during aggressive encounters
Tail wagging				Usually during an aggressive encounter (sometimes during breeding attempts) - tail is low to the ground and proximal tail tip wags back and forth in a side to side movement
Tongue Flicking				Tongue is touched to any surface or animal
High-Walking				Male and female extend legs as far as possible while walking. Body laterally compressed.
Yawning				Animal is usually sitting still and mouth is opened slowly all the way to full extension
Hissing				A loud expression of air from the lungs
General Individual Behaviors				
Drinking				Drinking water
Eating				Feeding on provisioned food.
Sleep				Lying or sitting down asleep with eyes closed inside or outside a burrow.
In Burrow				Animal in burrow

Resting				Lying or sitting down with no to little movement, but awake with eyes open.
Basking				Basking under either ceramic heaters (no light given off), UV/heat bulbs (with visible light spectrum), or natural light
Keeper Interactions				Keeper staff are in enclosure. Animals may or may not interact with keeper, but animals may have behavioral changes when keepers are in enclosure and shortly thereafter
Not Visible				Animal is temporarily out of view within the indoor enclosure or is in outdoor enclosure with no camera view.
Other				Other behavior not described above