

Behavioral repertoire of the poorly known Red-legged Seriema, *Cariama cristata* (Cariamiformes: Cariamidae)

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ABSTRACT: The Red-legged Seriema (*Cariama cristata*) is a typical bird of the Cerrado biome and widely distributed in Brazil. Despite the absence of population studies and information regarding its biology, the species is considered non-threatened. The present study describes behaviors of *C. cristata* observed in natural areas of the Brazilian Cerrado in the state of Goiás. Seventeen individuals, belonging to five family groups, were observed for a total of 110 h. Overall, 41 behaviors were described and grouped into the following categories: resting, locomotion, ingest/excretory, comfort/maintenance, social behavior, vocalization and reproduction. The description of behaviors performed by *C. cristata* provides a valuable foundation for further behavioral and management studies on the species.

KEY-WORDS: behavior, Brazil, Cerrado.

INTRODUCTION

The family Cariamidae belongs to the order Cariamiformes (CBRO 2014) and is represented by two species, *Cariama cristata* and *Chunga burmeisteri*. The Red-legged Seriema (*Cariama cristata*) is widely distributed in South America, occurring in Argentina, Uruguay, Paraguay, Bolivia, and in Brazil, from the northeast to the southeast (Redford & Peters 1986, Sick 1997). The species can measure up to 90 cm, weights up to 1.5 Kg (Sick 1997), and lacks sexual dimorphism, with males and females presenting gray plumage with the base of the beak and legs in red (Gwynne *et al.* 2010). Individuals of *C. cristata* can be found isolated or in family groups of up to four birds (Redford & Peters 1986), and despite its common occurrence throughout Brazil, the species remains poorly studied. Redford & Peters (1986) described aspects of the natural history and vocalizations of seriemas, based on occasional observations in the Emas National Park. Almeida (1994) described general aspects of nest building, mating, egg-laying and incubation behaviors of a Red-legged Seriema pair. More recently, Padget (2010), studying the structure and function of the vocalizations of captive *C. cristata*, described basic behaviors of the species.

Brooks (2014), while studying ecological aspects of *C. burmeisteri* in the Paraguayan Chaco, reported the positive correlation between wind speed and *C. cristata* activities.

The global population of *C. cristata* is considered stable and relatively abundant, although there are no empirical population studies that support the current conservation status of the species (BirdLife International 2015). *Cariama cristata* is among the most commonly sighted large bird in central Brazil and its call is frequently heard from long distances (Redford & Peters 1986), making this non-threatened species (Machado *et al.* 2008, IUCN 2014) to be considered a symbol of the Brazilian Cerrado.

Information concerning *C. cristata* remains scarce and is mostly based on observations of a few individuals in natural environments (Redford & Peters 1986, Almeida 1994) and zoos (Padget 2010). In this context, the present study describes behaviors of *C. cristata* performed in a natural area of the Brazilian Cerrado. Behavioral descriptions can be a valuable basis for systematic and quantitative studies (Lehner 1996) and contribute to the development of further management and conservation measures for the species (McDougall *et al.* 2006, Watters *et al.* 2009).

METHODS

Study area

The study was conducted in the municipality of Urutaí, located in the southeastern state of Goiás, Brazil, at the Federal Institute of Goiás (*Instituto Federal Goiano*) on the Urutaí Campus (17°29'S; 48°12'W, 736 m a.s.l.). The campus covers an area of 512 ha in a rural zone, with the land used predominantly for grazing and farming. Furthermore, the study area includes several Cerrado vegetation types, forming a mosaic of savanna, countryside and forest formations. This region is part of the Goiás Massif, with a predominance of plateaus and a topography ranging in elevation between 685 and 988 m a.s.l. The climate is tropical humid, with a mean temperature between 18 and 23°C (Costa 2005).

Study subject, preliminary study and observation sessions

A preliminary study was conducted to identify areas and groups to study, totaling 22 h of observations. Five resident groups were recognized and classified according to the sites where individuals occur throughout the study, either to sleep or nest. Additionally, the number of chicks, oviposition and hatching periods and the size of the individuals helped identify the groups (pairs without offspring; or with one or two offspring) as no individual marking or other type of identification was used.

Observations were performed by two previously trained researchers, between 5:00 and 19:00 h using *ad libitum* and focal animal sampling (Lehner 1996, Martin & Bateson 2007). Observations initiated randomly by *ad libitum* and focused on one individual when a new behavior started. Only behaviors observed at least twice and in two groups were reported.

Behavior description and categorization were established based upon the behavioral morphology of the species, as reported in previous studies and from field observations. Behavior terminology was adapted from a closely related species, the Kory Bustard *Ardeotis kori* (Lichtenberg & Hallager 2008). Throughout the observation period, a minimum distance of 10 m was maintained between the observer and the animals. Binoculars (10 × 50 m) aided the location and observation of the animals.

RESULTS

Seventeen individuals of Red-legged Seriema from five family groups (including pairs and pairs with offspring) were observed. From those, three groups were composed of a pair and one offspring and two groups were composed

of a pair and two offspring. Observations were made from August 2011 to June 2012, during 26 observation sessions, which a total of 110 h. Each group was observed for a minimum period of 20 h, in sessions of at least 4 h.

A total of 41 behavior types were observed and grouped into the following 7 categories: resting (n = 5), locomotion (n = 6), ingest/excretory (n = 4), comfort/maintenance (n = 14), social behavior (n = 4), vocalization (n = 3), and reproduction (n = 5) (Table 1). Categories and respective behaviors are described as follows:

TABLE 1. Behaviors grouped by categories of Red-legged seriemas (*Cariama cristata*) in the Cerrado biome of southeastern state of Goiás, Brazil.

Category	Behavior
Resting	Observing
	Resting
	Sleeping in the nest
	Sleeping on a branch
	Hiding
Locomotion	Walking
	Short flight
	Long flight
	Short run
	Long run
	Climbing on a branch
Ingest/excretory	Drinking
	Eating
	Eating crouched
	Defecating
Comfort/maintenance	Preening the chest feathers
	Preening the wings feathers
	Preening the thighs feathers
	Preening the tail
	Preening the cloaca
	Preening the dorsum
	Preening the abdomen
	Dust bathing
	Scratching the head
	Scratching the neck
	Scratching the beak
	Ruffling
	Repositioning the wings
Stretching	
Social behavior	Agonistic interspecific interaction
	Agonistic intraspecific interaction
	Air contact
	Juvenile chasing
Vocalization	Short vocalization
	Agonistic vocalization
	Full vocalization
Reproduction	Nest building
	Copulating
	Incubating
	Caring for nestlings
	Feeding nestlings

Category 1 - Resting

Observing: occurs when an animal approaches or invades the territory. With the legs stretched and the neck held erect at a 90° angle relative to the beak, the bird directs the head toward the visual field of the invader, remaining static (Figure 1a).

Resting: the bird bends its legs until touching the abdomen to the ground and remains at rest with the neck outstretched, as in the observation behavior (Figure 1b).

Sleeping in the nest: the bird bends the legs until they touch the abdomen and rests the tail on the nest, with wings partially open. The neck is bent backward,

without allowing it to touch the dorsum, and placed on the nest; then, the bird closes its eyes (Figure 1c).

Sleeping on a branch: in a tree, the bird bends its legs until they touch the abdomen, lowers the tail with the wings partially open, bends the neck backward until it touches the dorsum and closes its eyes. The abdomen of the bird does not contact the branch (Figure 1d).

Hiding: in threatening situations, the bird bends its legs until they touch the abdomen, lowers the tail, maintains the wings semi-open and bends the neck to touch its dorsum while hiding amid herbaceous vegetation. This behavior was observed in hatchlings and juveniles (Figure 1e).



FIGURE 1. Behaviors of *Cariama cristata* in the resting category: (A) Observing; (B) Resting; (C) Sleeping in the nest; (D) Sleeping on a branch; (E) Hiding.

Category 2 - Locomotion

Walking: the animal moves with semi-bent legs, keeping one foot in contact with the ground and the wings close to the body, while the neck is semi-bent and accompanies the body with each step. The tail remains lowered, forming a 30° angle with the body axis, and the beak is parallel to this same axis (Figure 2a).

Short flight: these flights begin with a push of the legs, which are semi-bent initially and subsequently stretched concurrently with the flapping of the wings. This behavior is used to climb fences, termite nests, and branches, both in interspecific and intraspecific interactions (Figure 2b).

Long flight: such flights can begin on the ground or in a nest. When on the ground, the body is propelled, as in the short flights, but the animal soars for a longer period of time and flaps the wings until alighting. From a nest, the flight orients toward the less dense parts of the tree; the animal jumps, opens the wings completely with the feet facing forward and soars until reaching the ground (Figure 2c).

Short run: short runs occur when a bird finds food or during intra- and/or interspecific interactions. During food finding, there is an increase in the speed of the steps, the wings are pushed slightly away from the body, and the food is captured. During the interactions, the short runs can be followed by wing flapping or short flights (Figure 2d).

Long run: the stepping speed increases during a long run, the body is suspended between two steps, and the

wings are slightly open, with stops between runs followed by observation and further movement. This behavior usually occurs in threatening situations (Figure 2e).

Climbing on a branch: an individual approaches a tree, performs a short flight and climbs the tree using its claws. When necessary, new short flights are performed to reach the branch. The climb is preceded by the observation behavior and may be interspersed with long runs (Figure 2f).

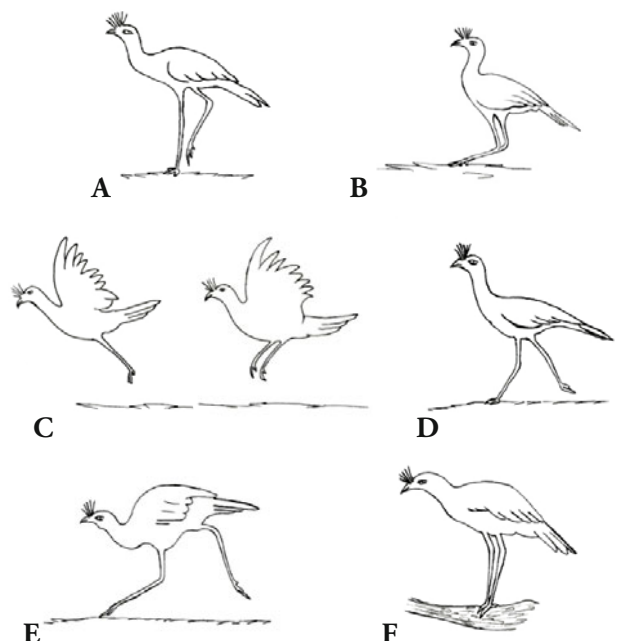


FIGURE 2. Behaviors of *Cariama cristata* in the locomotion category: (A) Walking; (B) Short flight; (C) Long flight; (D) Short run; (E) Long run; (F) Climbing on a branch.

Category 3 - Ingest/excretory

Drinking: the bird bends its legs, touching the tarsal-metatarsal areas to the ground, with the wings and the tail slightly lowered. Next, the bird moves its beak to the water source, takes in the water and points the beak upwards, opening and closing the beak while moving its neck vertically up and down until complete deglutition (Figure 3a). This behavior occurred at natural sources of water and at cattle water troughs.

Eating: upon finding a food item, the bird lowers its neck and tail, keeping the head aligned with the body, moves the wings away from the body and stretches the neck until capturing the food item. When the sighted food item is out of reach, the bird performs short runs.

For large food items, vertical movements are performed with the head until complete deglutition (Figure 3b). The following food items were observed: arthropods (insects, arachnids and myriapods), grains (corn, soybean and sorghum), seeds, fruits and vertebrates (amphibians, small rodents, eggs and nestlings of other bird species, and small reptiles, including *Amphisbaena* sp.).

Eating crouched: the bird bends the legs, touching the tarsal-metatarsal area to the ground and keeping the wings close to the body; captures the food on the ground with the beak; and swallows. This behavior occurs when the food items are grains, seeds or fruits (Figure 3c).

Defecating: the bird keeps the legs semi-bent, raises the tail, bristles the cloacal feathers and expels the feces (Figure 3d).

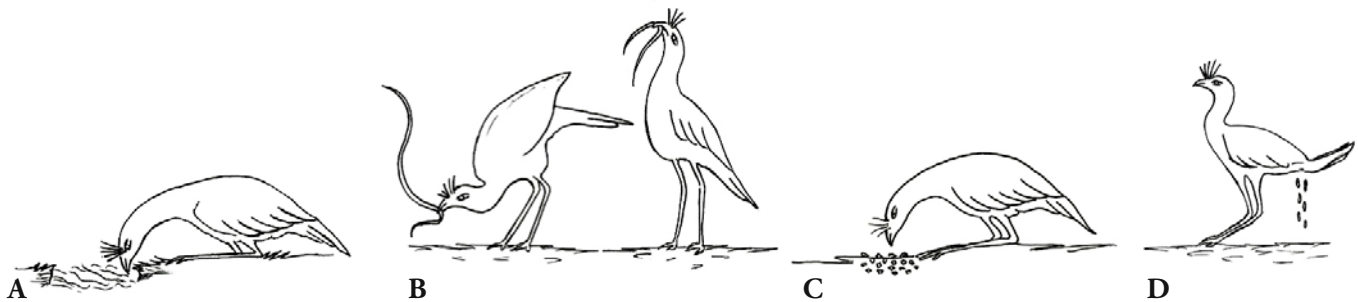


FIGURE 3. Behaviors of *Cariama cristata* in the ingest/excretory category: (A) Drinking; (B) Eating; (C) Eating crouched; (D) Defecating.

Category 4 - Comfort/maintenance

Preening the chest feathers: the bird bends the head down and uses the beak to preen the chest feathers while keeping the legs straight and the tail completely downward, following the trunk axis, which stays in the vertical position. This grooming begins by moving the beak from the base to the tip of the feather, repeating the movement along other feathers in the same region. In all grooming behaviors, the direction of beak movement is always from the base to the tip of the feather (Figure 4a).

Preening the wings feathers: this activity can occur on the inner or outer side of the wings. During the external cleaning, the bird curves its neck sideways toward one of the wings, which is slightly stretched; the legs are stretched; the tail is lowered, forming an approximately 45° angle with the legs; and the beak is used to preen the wing feathers from the base toward the tip. During the internal preening, the bird stretches the wing to be cleaned and bends the neck toward the inner part of the wing, allowing the use of the beak to preen the feathers (Figure 4b).

Preening the thighs feathers: the bird tilts the head toward the thigh, keeping the legs straight and the tail lowered to form an angle with the legs of approximately 45°, and uses the beak to preen the feathers (Figure 4c).

Preening the tail: the bird stretches the tail feathers like a fan, keeping them in alignment with the body; the neck turns backward over one of the wings; and the beak is used to preen feathers (Figure 4d).

Preening the cloaca: the bird raises its tail, bristles the cloacal feathers and moves the head in the direction of the cloaca, preening feathers with its beak (Figure 4e).

Preening the dorsum: the bird turns its head toward the dorsum and uses its beak to preen feathers in this region, while keeping its tail at an angle of approximately 45° relative to the legs (Figure 4f).

Preening the abdomen: the bird tilts its neck, turning the lashes downward, with the tail lowered at an angle of approximately 45° with the legs; the wings follow the tail line; and the beak is used to preen feathers (Figure 4g).

Dust bathing: the bird scratches the ground and flexes its legs, touching the legs to the ground; moves the legs from side to side; lowers one of its wings; and lies on it. Using its neck, the bird moves sand to its dorsum. Next, the bird opens its wings slightly, places the dorsum in contact with the ground while moving side to side, and then rises promptly; these movements are repeated several times (Figure 4h).

Scratching the head: the bird closes an eye, raises a leg, lowers its head and scratches its head by moving its claws from the neck toward the beak (Figure 4i).

Scratching the neck: the bird flexes one leg and moves it toward the neck with the head lowered, bristles the neck feathers and moves the claws in the direction opposite to the arrangement of the feathers, keeping the tail lowered (Figure 4j).

Scratching the beak: the bird flexes one leg and moves it toward the beak, lowers both the head and the tail and uses the claws to scratch from the lashes toward the tip of the beak (Figure 4k).

Ruffling: this behavior begins with the bristling of the neck feathers, followed by the ventral and dorsal feathers, and gradually moves toward the tail feathers; the

bird opens the wings slightly and shakes the body to the right and left, starting at the head and moving toward the tail (Figure 4l).

Repositioning the wings: one wing is moved away from the body, raised, circumferentially displaced backward and then repositioned (Figure 4m).

Stretching: stretching begins with the body erect and the tail lowered at a 45° angle, with the legs and the beak facing forward. The bird raises one leg, flexes the leg against the abdomen and extends it backward with the toes bent; this movement can occur concurrently with the full opening of the wing on the same side (Figure 4n).

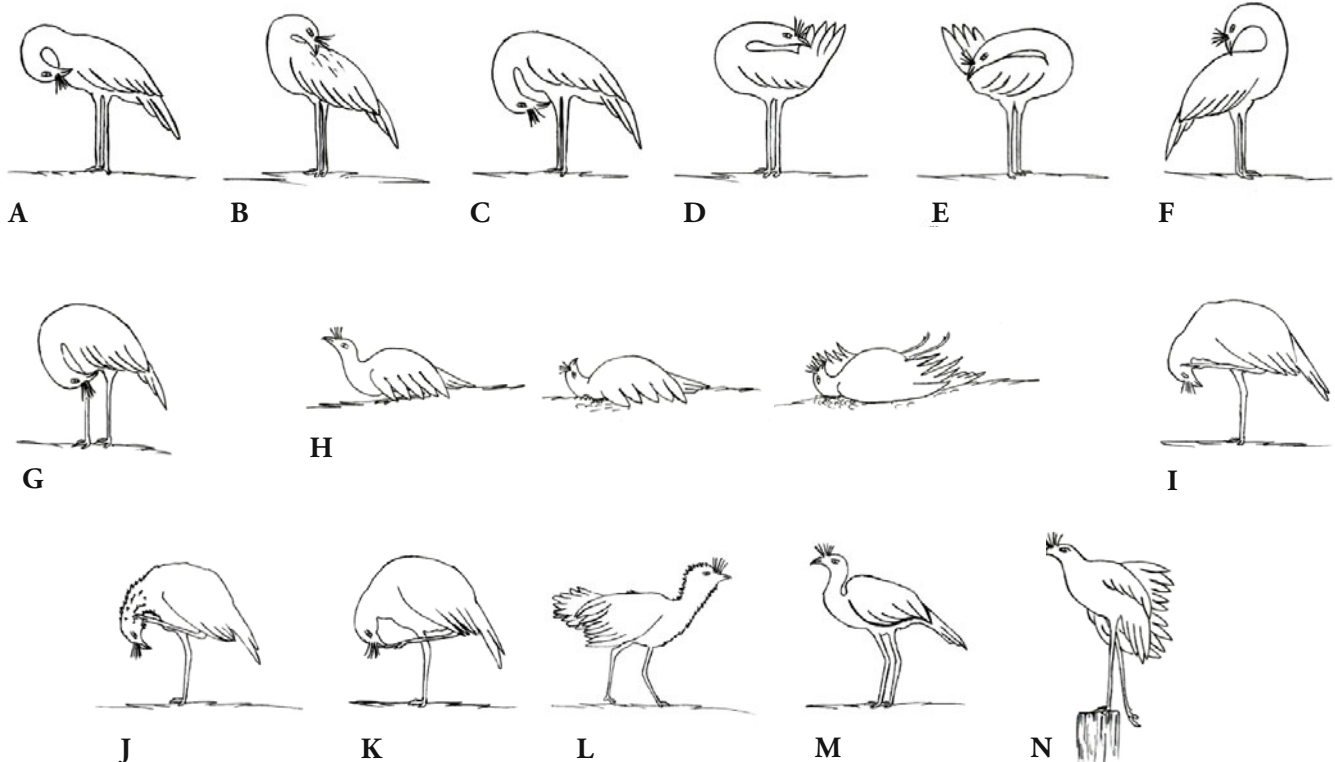


FIGURE 4. Behaviors of *Cariama cristata* in the comfort/maintenance category: (A) Preening the chest feather; (B) Preening the wings feather; (C) Preening the thigh feathers; (D) Preening the tail; (E) Preening the cloaca; (F) Preening the dorsum; (G) Preening the abdomen; (H) Dust bathing; (I) Scratching the head; (J) Scratching the neck; (K) Scratching the beak; (L) Ruffling; (M) Repositioning the wings; (N) Stretching.

Category 5 - Social behavior

Agonistic interspecific interaction: with the approach of animals from a different species, especially toward the nests or chicks, there is a bristling of the neck feathers, opening of wings, agonistic vocalization, short runs toward the animal and attacks with the talons and beak; interspersed short and long flights may also be performed toward the intruder (Figure 5a). We observed agonistic interactions towards a Scaled Dove (*Scardafella squamata*) and a Six-banded Armadillo (*Euphractus sexcintus*).

Agonistic intraspecific interaction: there is

bristling of the neck feathers followed by a series of short runs toward the opponent. This interaction may occur between individuals of the same group, ending upon the withdrawal of the opponent (Figure 5b).

Air contact: occurs between a juvenile and a parent; both perform a short flight toward one another, projecting the talons forward so that the talons of the juvenile crash frontally in the air with those of the adult, and then return to the ground (Figure 5c).

Juvenile chasing: an adult performs successive ascents and descents from trees and is always chased by a chick, which repeats the movements of the parent (Figure 5d).

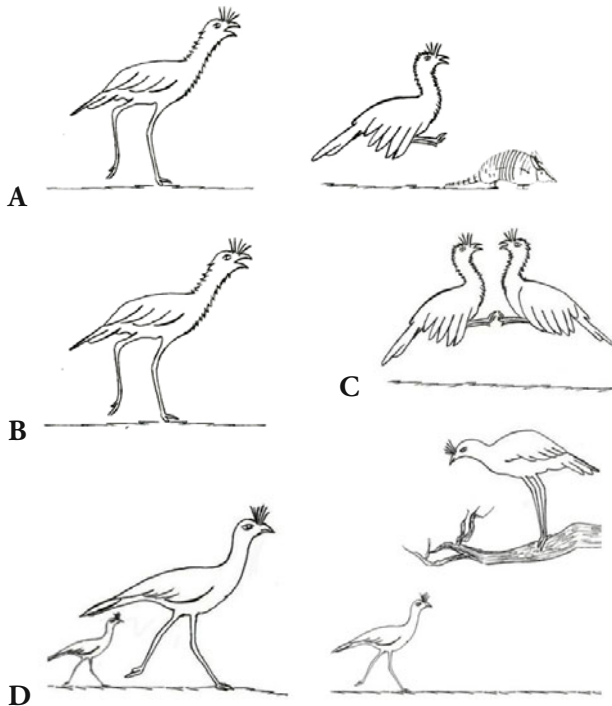


FIGURE 5. Behaviors of *Cariama cristata* in the social behavior category: (A) Agonistic interspecific interaction; (B) Agonistic intraspecific interaction; (C) Air contact; (D) Juvenile chasing.

Category 6 - Vocalization

Short vocalization: this sound occurs in the form of a single strophe (glô), which is repeated several times during other behaviors, such as vigilance and agonistic and non-agonistic intraspecific interactions, and also represents the beginning of full vocalization. This behavior is typically observed when a group member (or members) is lost from sight (Figure 6a).

Agonistic vocalization: this activity occurs in the form of a single strophe (grrééh), with the neck feathers ruffled, the beak opened (approximately 80°) and the neck and beak facing the territorial intruder. The vocalization is repeated and can be directed toward intra- or interspecific intruders (Figure 6b). This behavior took place in situations of agonistic intraspecific interaction.

Full vocalization: the bird emits a series of strophes (glô, glô, glô, gli, gli, gli, i, i, i, i, i, i) that are accompanied by vertical up and down movements of the neck, an open beak facing upward, straight legs, wings close to the body

and the tail lowered. The vocalization can be performed during intraspecific interactions between individuals of the same group or different groups and is usually performed as a duet but can also occur as a solo (Figure 6c).

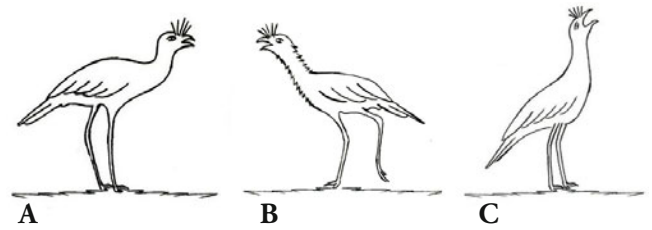


FIGURE 6. Behaviors of *Cariama cristata* in the vocalization category: (A) Short vocalization; (B) Agonistic vocalization; (C) Full vocalization.

Category 7 - Reproduction

Nest building: the bird pair collects materials on the ground (e.g., twigs, dry grass and cattle manure) with the beak and transports them to the nest, performing short flights. The beak and toes are used to allocate the materials within the nest (Figure 7a).

Copulating: the female opens her wings, bends her legs, places her abdomen on the ground and raises her tail; the male jumps on the dorsum of the female, opens his wings, lowers his tail and rubs his cloaca on that of the female. Copulation lasts approximately 7 s (Figure 7b).

Incubating: the parents take turns incubating the eggs, spending most of the day performing this behavior. While one parent remains at the nest incubating eggs, the other approaches and performs the behaviors of observing and climbing on a branch. The parents exchange their tasks 3 times per day, on average (Figure 7c).

Caring for nestlings: both parents care for the nest, exchanging functions periodically. While one parent searches for food, the other stays on top of nestlings, performing frequent body suspensions. Chicks can walk around the nest and are pulled under the adult with the beak (Figure 7d).

Feeding nestlings: the adult brings food to the nest in the beak and places the food on the nest or directly in the beak of the chick, often breaking the food into small pieces with the help of its talons and beak; the chick lifts its head and opens its beak to receive the food and can vocalize (Figure 7e).



FIGURE 7. Behaviors of *Cariama cristata* in the reproduction category: (A) Nest building; (B) Copulating; (C) Incubating; (D) Caring for nestlings; (E) Feeding nestlings.

DISCUSSION

The present study is the first to describe in detail the behavioral repertoire of *C. cristata* in the wild, providing information for further studies on the behavior of the species. Although observations were conducted for approximately one year, it is possible that other behaviors occur, especially in contexts or periods not observed in the present study or during other developmental stages.

Some behaviors described in the present study were not observed by Padget (2010) in captivity, such as “climbing on a branch”, “juvenile chasing” and “air contact”, which suggests a need to adjust the artificial habitats provided for *C. cristata* to allow the species to freely express its behaviors and to improve the well-being of birds (Dawkins 2004). However, certain behaviors described by Padget (2010) for the captive birds were not observed in the present study, such as “pacing”, “object pass”, “sun bathing lying” and “sun bathing standing”. According to Mason *et al.* (2007), animals in captivity may show stereotyped behaviors, such as pacing, and other abnormal repetitive behaviors. It is possible that the object pass and the sun bathing behaviors are also abnormal behaviors, performed only by captive birds and related to a lack of environmental enrichment.

A variant of the intraspecific agonistic interaction behavior was observed in only one group of birds. On several occasions, a bird directed this agonistic behavior toward its own image reflected in a metal water trough and directed toward the reflective portions of automobiles. This behavior was performed vigorously and without interruption even when humans approached seriemas, reinforcing the territorial feature of the species, as reported by Redford & Peters (1986).

During the incubation period, there was parental exchange in the nest, which contradicts the observation by Almeida (1994). However, the absence of sexual dimorphism prevents further description of parental roles.

The daily occurrence of at least one group of *C. cristata* in urban areas highlights the opportunism of the species in relation to anthropogenic activities. These individuals were observed ingesting leftover human foods, arthropods during grass trimming, grain crops and eggs from animal production. However, the proximity of seriemas to humans and urban areas exposes the animals to several risks, including hunting, road kill (Carvalho *et al.* 2014), poisoning and the spread of diseases transmitted by domestic birds. The process of urbanization is expected to threaten biodiversity; therefore it is necessary to understand the mechanisms of behavioral plasticity of an animal exposed to environmental alterations (Sol *et al.* 2013).

The description of behaviors performed by *C. cristata* presented may be useful for proposing management strategies for this species.

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