

times I observed ample urination of clear fluid after the mother had cleaned the perineal area with her tongue, and on the fifth day I noticed a yellow-coloured stool denoting passage of milk through the intestinal tract.

The baby is obviously gaining weight and, barring unforeseen events, I am confident that Mumbi will continue to care adequately for her offspring, whom we have named Kumba.

Notes on the behaviour and breeding of pacaranas

Dinomys branickii

in captivity

L. R. COLLINS & J. F. EISENBERG
National Zoological Park, Washington, DC, USA

INTRODUCTION

The pacarana *Dinomys branickii* is a large caviomorph rodent inhabiting the valleys and lower slopes of the Andes in Colombia, Ecuador, Peru, Brazil, and Bolivia (Walker, 1964). Little is known of the behaviour of free-living specimens (Tate, 1931; Sanborn, 1931), but a few accounts have been published on their behaviour and maintenance in captivity (Mohr, 1937; Crandall, 1964). Gravid females have been taken in February and May. Females have four mammae, and two young apparently constitute the average litter. *Dinomys* are thought to be nocturnal and captive animals are primarily active after dark.

Although several zoos have maintained this species, its breeding in captivity has been recorded only recently. C. Schmidt (pers. comm.) reports two successful matings at Zurich Zoo. The first gravid female died before parturition, but the most recently-mated female was still alive on 10 January 1971. A female at San Antonio Zoo gave birth to two young on 8 January 1970 after arriving gravid from the wild. Pacaranas have been investigated since 12 February 1968 by personnel of the Research Division of the National Zoological Park.

BREEDING HISTORY AND MAINTENANCE OF COLLECTION

Five *Dinomys branickii* have been maintained in our collection. The first pair of specimens, acquired on 7 February 1968, consisted of a large female (♀ 1) and a smaller male (♂ 1). These animals were kept together for a short period in an observation arena measuring 6.5 × 5 m (21½ × 16½ ft); they were subsequently placed on exhibi-

tion. Although they were compatible and were maintained together in large quarters for four months, no sexual behaviour was observed between them. Female 1 died on 8 June 1968; male 1 lived until 23 August 1968.

An additional female (♀ 2) was acquired as an immature animal on 1 March 1968. She was housed with male 1 after the first female's death, but again no sexual activity was observed. Female 2 was then transferred to the Research Division and an intended mate (♂ 2), which had been acquired on 17 July 1968, was placed with her. These two animals were housed in a metal-lined enclosure measuring 3.6 × 1.0 × 1.2 m (12 × 3¼ × 4 ft). This was subdivided into four equal-sized compartments by the addition of metal panels with sliding access doors. Each animal had access to two compartments except during breeding encounters when both animals could get into all four compartments. Stout branches were provided for climbing, and wood shavings were laid on the floor.

Copulation was observed between female 2 and male 2 on 24 July 1968, but unfortunately the female died on 7 August 1968. An autopsy revealed myocarditis as the cause of death. It is interesting that, although the female was receptive to the male's mating attempts, the animals could not be housed together for extended periods without fighting. The same situation later prevailed between male 2 and female 3.

Since male 2 showed promise of being a potential breeder, a third female (acquired on 7 May 1968, and subsequently placed on exhibit) was transferred to the Research Division in an attempt to mate her with male 2. Copulation occurred

between this pair of animals and several intrusions were observed on 23 June 1969, but again the animals had to be separated at night to prevent fighting. Female 3 did not become pregnant as a result of the recorded mating, and, on 6 April 1970, both animals were placed in a rectangular cage where they are at present housed. This enclosure measures $4.9 \times 1.2 \times 1.2$ m ($16 \times 4 \times 4$ ft). Subdivision of the run is possible by closing a central partition; however, this was not at first necessary as the animals were compatible when placed in this larger arena. Fresh wood shavings are provided daily as cover for the concrete floor. Shelving 45 cm (18 in) wide was installed approximately 45 cm (18 in) above the floor at both ends of this enclosure, to which ramps provided access. Both animals seemed to prefer these elevated shelves as resting places.

The latest and only productive mating took place in this enclosure on 13 April 1970. It is not known whether fertilisation occurred on this date, but no further mating behaviour was observed until the animals were separated on 10 July 1970. The interoestrous interval for *Dinomys* is unknown but our experience with other large caviomorph rodents leads us to believe that it may be from four to six weeks. Hence, conception may have taken place one or two months later than 13 April. For this reason, gestation could not be determined exactly but it is certainly not more than 283 days nor less than 223.

Both animals receive a diet consisting of corn-on-the-cob, kale, white and sweet potatoes, carrots, apples, oranges, bananas, grapes, a variety of breads, a seed and grain mixture, monkey biscuits and pelleted alfalfa. Fresh or fresh-frozen corn-on-the-cob is an excellent dietary component when weight gain is desired. This item is usually the first to be eaten when the daily feed is placed in the enclosure. It also serves as an excellent medium for administering liquid multi-vitamin drops or medication, and the specimens receive one cob daily unless weight gain is desired.

BEHAVIOUR PATTERNS AND ASSOCIATION VOCALISATIONS

General maintenance behaviour: The animals move about by means of a crossed extension pattern with a forefront in synchrony with the

hind foot of the opposite side. At a slow walk the animal is plantigrade but as it increases speed, the heel of the hind foot is not brought into full contact with the floor; hence, the animal becomes semi-digitigrade during fast quadrupedal locomotion (Mohr, 1937). The animal can walk bipedally and very frequently does so during social encounters. This consists of moving the hind limbs alternately while maintaining an upright posture. The animals are unable to jump but they climb very well using the crossed extension pattern. Descending a tree trunk is accomplished by reversing this pattern and descending rear end first. They are able climbers and their long claws aid them in ascending trunks which are too large to be easily clasped. Their climbing ability is similar to that of the North American porcupine *Erethizon dorsatum*.

In the wild, the animals are said to den in a burrow; apparently they use natural crevices by enlarging them somewhat through digging (Tate, 1931). In captivity, the animals readily used nest boxes, although at times they prefer to sleep on a raised shelf. This suggests that they may sleep in trees if opportunity affords.

They may adopt a variety of postures when sleeping, including resting on the heels and the base of the tail while sitting in an upright position with the head drooping slightly on the chest; lying on one side at full length; or lying on the back with the ventrum fully exposed. Sleeping in the first position, that is, while sitting, is especially common when the animal rests in the crotch of a tree or utilises sleeping shelves. Nest-building behaviour by pregnant or parturient females was never observed.

Typically the animals feed while upright, holding the food with the forepaws. They are quite selective in their feeding habits as has been noted in the previous section. No caching behaviour could be detected on the part of our specimens.

The animals have rather complicated self-grooming patterns. A specimen will alternatively stroke the length of its face with the inner part of its wrists, first the right side, then the left. It may pause to wipe the wrists on the inside of the lips at the conclusion of the down stroke, repeating the arm or wrist stroke on the face. After several wipes on the face, the animal will begin to brush down and backward along its flanks with the wrists, pausing to scratch with its fore-claws

under an arm or between the legs. It appears that the washing pattern involves wiping the wrists on the side of either cheeks, brushing down over the face and flanks with the wrists, followed by delicate scratching movements. The claws of the forepaws may be used to scratch around the eyes and ears. The hind foot is also used to scratch the cheeks and face.

A pacarana will generally urinate and defaecate at a single locus in its cage, urine and faeces generally being deposited on the same spot. When two animals are housed together, they will use a common toileting spot within the cage. This behaviour suggests that urine and faeces may have a marking function; however, several other behaviour patterns may be important in marking. When moving about its home cage, males are frequently observed to rub their cheeks on branches or other artifacts. In addition to the cheek-rubbing, males secrete a whitish fluid from the glands surrounding the eye. Production of this secretion and its deposition in various parts of the cage will be discussed in the next section. Gnawing within the cage is generally performed at the same points over and over again. The animal, as it explores in the evening, will be observed to approach various protuberances in the cage, sniffing carefully and pausing to nibble only at the spots that have been gnawed previously. This suggests that some chemical trace is present – such as a saliva deposit or perhaps scrapings from the incisor teeth – which induces the gnawing response. Alternatively, the ‘cue to gnaw’ may be the uneven surface left by the previous gnawing attempts. Since the animals do not attempt to gnaw out of the cage, one suspects that gnawing at selected points within the home range could serve a marking function.

Behaviours observed in a social context.

Communication mechanisms: The small eye of the pacarana suggests that vision is not one of the more important means of gaining information about its environment or the state of a conspecific. In fact, one of our specimens had cataracts in both eyes and seemed in no way inconvenienced by its inability to see clearly. Indeed, this specimen appeared to be able to orientate toward conspecifics and respond using olfactory, auditory and tactile cues alone; hence, many of the movement patterns are probably not

related to visual display functions but, rather, are movements accompanying the various positions taken up during combat. Olfactory signals are probably involved in marking behaviour, naso-genital investigation, and naso-nasal contact. General odours emanating from a conspecific are probably perceived during all close contact interactions and, indeed, it is difficult to separate tactile communication from olfactory communication during such interaction. Hence, rather than separate these two forms, they will be considered together when we discuss the various postures and movements in the next subsection.

Pacaranas produce seven clearly defined sound types. Two of these (tooth chattering and forefeet stamping) are mechanical disturbances produced by movements of the teeth or forepaws. The remaining five sound types are produced by expelling air through the glottis and pharynx.

Tooth-chatter: a rapid clicking of the incisor teeth, generally seen during a threat context.

Forefeet stamping: a slow rhythmic alternate patting of the forefeet, usually seen in a thwarting context.

Hiss: an unvoiced expiration often following staccato whimpering when interaction with a conspecific becomes intense or when the staccato whimpering is uttered as a warning that goes unheeded. This vocalisation may be accompanied by a rush at an adversary.

Grunt: a series of soft sounds uttered approximately one per second; heard in a defensive context.

Growl: a continuous emission approximating to a low rumble. This may be heard in a mild threat context and has been noted in males only so far.

Staccato whisper: a high-pitched vocalisation with several subtypes. It may be released by contact with a conspecific or may be produced when an individual is permitted to enter a conspecific's enclosure. It increases in intensity and duration as interaction with a conspecific becomes more frequent. It may be uttered as a submissive sound during initial encounters and at its highest intensity form may precede an actual threat or rush.

Two-syllable grunt: this sound has been produced only by juveniles, generally when following an adult. It is a soft note, grunt-like but definitely di-syllabic, repeated at intervals of about ten seconds. It appears to function as a contact note, permitting a juvenile to notify an adult of its presence.

The hiss, growl, and staccato whimper are the most common vocalisations heard in male-female encounters.

Defensive and offensive postures: Upon being disturbed the pacarana either attempts to move away or assumes an upright stance and begins vocalising. At the time of assuming the upright position, the fur is erected and the animal may tooth-chatter. Alternatively, it may hiss, and follow the hiss with a series of grunts repeated with about one-second intervals between individual grunts or, at high intensity, the grunts may fuse into a continuous growl or deep rumble.

Full threat display involves approaching while holding the mouth half open with the head tilted at a slight angle to the horizontal. The animal continues to approach and, when quite close to the offending object, rears up on its hind legs and continues to walk in a bipedal shuffle. The forepaws are held slightly in front of the body but relaxed at the wrists. The mouth is held half open with the yellow incisors exposed. The head is lifted higher and higher so that a horizontal line drawn from the muzzle to the base of the skull would be parallel to a line drawn through the long axis of the body. Upon approaching the object to be threatened, a male may exhibit an erect penis. This behaviour is accompanied by urination (en-urination) in a number of different caviomorph species, including *Dolichotis patagonum*, *Erethizon dorsatum*, *Cuniculus paca*, *Dasyprocta agouti* and *Myoprocta pratti* (Kleiman, 1969 and In press) but we have not seen enurination in male pacaranas during such an upright threat posture.

Contact-promoting behaviour: These behaviour patterns were observed in the initial phases of male-female encounters, some of which led to sexual behaviour and mating, which are discussed in the following section. Contact-promoting behaviour allows two individuals to become familiar with one another, and involves the exchange of chemical and tactile information coupled with various aspects of threat behaviour. **Marking:** during an encounter the male will often begin to mark with an exudate produced by glands associated with the mucous membranes of the eye sockets. The marking secretion (a milky fluid) is conspicuous, because it fills the rims of

the eyelids and drains copiously from the external nares. When the male pauses to sniff an object in the environment, bobbing the head up and down slightly, drops of the secretion are applied to the substrate. The male will attempt to place secretions high up on a vertical object, such as a tree trunk, by stretching to his greatest possible height in a bipedal stance with the forepaws placed against the surface to be marked. The deposited fluid dries quickly to a yellow-white residue which could possibly serve as an effective visual mark on a dark surface such as bark of certain tree trunks. Females have been noted to sniff the marked loci on numerous occasions. On one occasion a female in our group was observed to secrete copiously from her eyes at a time when she was not with the male, but she was never observed to mark with the fluid.

Naso-nasal contact: the animals come together and touch noses either while both animals are in a quadrupedal stance or while one is standing on its hind legs.

Naso-anal contact: one animal sniffs at the anal region of the second, again either while both animals are in a quadrupedal stance or while one is in a bipedal stance. Mutual naso-anal or nasogenital contact is termed circling.

Naso-genital contact: a variant of the former configuration, this occurs when both animals are on all-fours or when one is on its hind legs. Frequently, the female, when receptive, will arch her tail dorsally.

Upright confrontation and grappling: one animal assumes an upright bipedal stance and faces the other, and this may be a prelude to threat vocalisation. Balance is usually assisted by placing the forepaws on the conspecific's shoulders or upper fore limbs. Should the partner also assume an upright position, a mutual upright configuration occurs. If the animals do not threaten one another, they may nibble each other's necks; and if both are upright, they may entangle their forelimbs, and push and spar at one another with the forepaws. This latter pattern has been termed grappling.

Incisor coupling: this configuration may develop out of the grappling posture. Conspecifics maintain their balance by placing their forepaws on each other's shoulders or upper forelimbs. The head is then tilted to the right or left and the mouth is opened. The incisors are passed through the opening made by the partner's mouth and

coupled together with both animals' incisors being closed behind those of the partner. Touching has also been seen to occur but, in this case, the incisors are not coupled together but merely brought into contact on their frontal surfaces.

Head-over, head-under: the animals 'face each other in a quadrupedal stance. The male then places his chin over the female's snout, rubbing his chin on her rostrum.

Head toss and pivot: this is related to threat as described in the previous section and, indeed, is a variant of the upright threat. It involves a quadrupedal approach to the conspecific whereupon the animal will hesitate and check its forward motion by rising on its hind legs and tossing its head to one side while pivoting, either landing on all fours facing at an angle to the partner or remaining bipedal but facing slightly to one side. When performed mutually and bipedally, it has the appearance of a dance and has been termed the ritualistic dance.

Ritualistic dance: while both animals are in an upright posture, they will bounce and pivot on their hind limbs, pawing the air with their fore limbs while their heads are pointed vertically. The male shows an erect penis at this time but has never been observed to urinate on the female.

Grooming: during grappling, or during naso-anal or naso-genital investigation, the investigating animal may lick at the partner's genital area, flanks, shoulder or nape. If the interaction becomes agonistic in character, licking may grade into nibbling and then into nipping which may induce actual fighting.

SEXUAL BEHAVIOUR

The receptive female generally tolerates naso-genital contact from the male and proceeds to walk about the cage with her tail arched while the male continues to contact her naso-genitally. The following three behaviour patterns constitute the sexual response components for the pacarana's repertoire.

Driving: the male continues to follow the female at a walking pace, sniffing her ano-genital area. The female's tail is generally bowed with the tip pointing up and, as the male contacts the female's tail, she elevates it still further.

Lordosis: the female assumes a quadrupedal squat position with the posterior slightly elevated and the tail thrust to one side.

Mounting: the male approaches the female and bites her neck. He then straddles her from the rear, mounting her while clasping his forelimbs tightly about her abdomen just anterior to the hips. If the female is receptive, intromission and thrusting follow. A female may make several attempts to mount the male, usually by placing her forepaws on his back and, in one instance, actually climbing on his back. When the female attempts to mount, she frequently does so from the side of the male rather than from the rear.

Intromissions are of brief duration, lasting less than 20 seconds. Several intromissions may precede ejaculation. Three bouts of intromissions have been noted during one 10-minute period. The male appears to ejaculate once only and thus resembles other caviomorph rodents studied to date (Kleiman, In press).

PROTOCOL OF MATING BEHAVIOUR

A total of 15 observed encounters were carried out involving male 2 and female 3, and three observed encounters between male 2 and female 2. Copulation was observed twice between male 2 and female 3 and once between male 2 and female 2. A 38-minute encounter between male 2 and female 3 on 24 July 1968 proceeded as follows:

0907: Naso-nasal contact followed immediately by upright confrontation posture of both animals with grappling and pushing
 ♀ retreats (BREAK) naso-nasal contact
 ♂ applies neck bite while attempting mount
 ♀ assumes upright posture
 ♂ retreats (BREAK) naso-anal contact (♀ to ♂)
 ♀ retreats (BREAK). Both animals actively exploring each other's enclosure compartments
 ♂ approaches and mounts ♀
 ♀ dislodges ♂ and assumes upright posture
 ♂ applies neckbite and mounts
 ♀ exhibits lordosis posture
 ♂ extends penis
 intromission
 thrusting
 withdrawal (BREAK). Naso-genital (♂ to ♀)
 ♂ tests ♀ with snout
 ♂ mounts ♀
 ♀ assumes upright posture
 incisor coupling (BREAK). Both animals assume upright and spar with forepaws
 Both animals display ritualistic dance
 ♀ assumes quadrupedal stance

♂ attempts mount
 naso-genital contact (♂ to ♀)
 ♂ attempts neckbite (broken by ♀)
 ♂ driving ♀
 ♂ attempts to mount
 ♂ driving ♀
 head-over-head-under contact (♂ rubbing chin on top of ♀'s snout)
 naso-genital contact (♂ to ♀)
 ♂ driving ♀ (BREAK). ♂ sniffs log in ♀'s enclosure
 naso-anal contact (♀ to ♂) (BREAK). Both animals sniffing each other's enclosure thoroughly
 ♂ marking ♀'s enclosure
 ♀ mounts ♂
 ♂ retreats (BREAK). Both animals face each other and assume upright confrontation postures
 grappling
 ♀ attempts to mount ♂
 ♂ nuzzling ♀'s neck and side
 ♀ attempts to mount ♂ (BREAK)
 ♂ marking ♀'s enclosure
 naso-anal contact (♂ to ♀ (BREAK)
 0945: Both animals feeding and seem disinterested in each other. Termination 1010.

This encounter thus involved three brief bouts of contact including naso-nasal, naso-anal, and bipedal upright postures. These three introductory contact bouts were followed by a period of investigation by each animal of the other's enclosure compartments. The male then successfully mounted and copulated with the female. Copulation was followed by two contact bouts that included a variety of social behavioural patterns (i.e. incisor coupling, ritualistic dancing, head-over head-under contact with chin rubbing, driving with attempted mounting by the male, naso-genital contact and attempted neck biting). Another period of enclosure investigation ensued during which the male marked the female's enclosure. A final period of social interaction involved several attempts by the female to mount the male followed by another marking of the female's enclosure by the male.

THE PREGNANT FEMALE

On 6 April 1970, male 2 and female 3 were allowed access to each other. Attempted copulation occurred the same day and mounting with intromission was observed on 13 April. The animals were left together until 10 July 1970, when it was

noticed that the female was becoming increasingly hostile towards the male as well as towards the staff, attacking anyone in close proximity. The female was observed to be increasing in girth as the weeks passed. Nipple elongation and pigmentation (dark pink) gradually occurred.

On 21 January 1971, a milk discharge was noticed on the female's left anterior nipple. The animal was extremely large by this time and the male showed great interest in her. On the morning of 1 February 1971, blood and mucus was discharging from the vaginal orifice. She was restless and did not remain in any one position for very long. Periodic blood and mucus discharges continued throughout the morning and she was observed to eat most of the discharged matter. She appeared to be in labour, as contractions and straining were observed. At noon the decision was made to attempt Caesarean section, and she was immobilised by an intramuscular injection of 16 mg Sernylan and 20 mg Sparine at 1350 hours. The animal's weight at this time was 16 kg (35 lb).

Weight (with placenta and umbilical cord attached)	1,076.5 g	825 g (29 oz)
Head and body length	285 mm	265 mm
Tail length	90 mm	67 mm
Hind foot length	75 mm	70 mm
Ear pinnae length	14 mm	13 mm
Longest mystacial vibrissae length	65 mm	62 mm

Table 1. Measurements of full-term young pacaranas *Dinomys branickii* delivered by Caesarean section.

She was standing quadrupedally but manageable by 1412 hours, and at 1437 hours she was given another intramuscular injection of 4 mg Sernylan and 10 mg Sparine. This injection was followed at 1500 hours by a third injection involving 10 mg Sernylan and 10 mg Sparine. By 1510 hours she was immobile. Investigation of the mammae showed them to be dry. The nipples were pale and had regressed. An X-ray followed by a digital examination revealed the presence of one uterine young and it was decided to commence the Caesarean section immediately. Two dead young were removed from the uterus. The female made a rapid post-operative recovery.

DESCRIPTION OF FULL-TERM UTERINE YOUNG

The young were precocial, and at the time of their removal from the uterus were fully furred with open eyes and ears. Each had well-developed upper and lower incisors. Measurements of both are given in Table 1.

DISCUSSION AND SUMMARY

Dinomys branickii will breed in captivity provided that the animals are housed in spacious enclosures. Even though individuals may show great tolerance for one another, separation of an adult male and female with subsequent simultaneous introduction at intervals of approximately five to ten days helps to establish a compatible relationship and perhaps induces mating activity. These rodents exhibit an extremely long gestation period which, though we have not established its length with certainty, is between 223 and 283 days. This would make it the longest recorded for a rodent. Its length suggests that females produce only one litter per year; hence, their recruitment rate in the wild is very low. The young are extremely precocial at birth, as indicated by the condition of the foetuses removed from our female and by observations at San Antonio Zoo, but this is in accordance with observations recorded for other caviomorph rodents (Kleiman, 1969; Smythe, 1970).

The behaviour patterns of *Dinomys* show broad similarities with those recorded for other caviomorph rodents (Kleiman, 1969; Maliniak & Eisenberg, 1971; Smythe, 1970). *Dinomys* shows, in some respects, certain similarities in behaviour to *Proechimys* – which might be considered to be a relatively unspecialised caviomorph rodent. Thus, a staccato whimper indicative of submission may be emitted by either sex during the initial phases of an encounter which is not agonistic in its nature. An upright posture is assumed by both males and females indicating threat, but, on the other hand, enurination has not been recorded for *Dinomys* or *Proechimys*. However, unlike *Proechimys*, *Dinomys* has a relatively brief mount duration (Maliniak & Eisenberg, 1971), and in

this respect its behaviour resembles that described for other caviomorphs.

The large size, increased weight, shorter tail, and slow movements conform to patterns and trends seen in some of the larger cursorial caviomorphs, such as the capybara *Hydrochoerus*, agouti *Dasyprocta*, and paca *Cuniculus*. However, *Dinomys* is not cursorial but is rather slow and ambling in its movements, and in this respect, resembles the North American porcupine *Erethizon*. It is also similar to *Erethizon* in that it is an able climber, a previously unreported ability. The marking behaviour of *Dinomys*, involving secretions from the glands associated with the orbit, which drain into the nasal cavity, appears to be unique.

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REFERENCES

- CRANDALL, L. S. (1964). *Management of wild mammals in captivity*. Chicago and London: The University of Chicago Press.
- KLEIMAN, D. G. (1969). *The reproductive behaviour of the green acouchi, Myoprocta pratti*. Ph.D. dissertation, University of London.
- KLEIMAN, D. G. (in press). The courtship and copulatory behaviour of the green acouchi, *Myoprocta pratti*. *Z. Tierpsychol.*
- MALINIAK, E. & EISENBERG, J. F. (1971). The breeding of *Proechimys semispinosus* in captivity. *Int. Zoo Yb.* 11: 93–98.
- MOHR, E. (1937). Vom Pacarana (*Dinomys branickii* Peters). *Zool. Gart., Lpz.* 9: 204–209.
- SANBORN, C. C. (1931). Notes on *Dinomys*. *Publ. Field Mus. Nat. Hist.* 18: 148–163.
- SMYTHE, N. (1970). *The behaviour and ecology of the agouti (Dasyprocta punctata) and related species on Barro Colorado Island, Panama*. Ph.D. dissertation, University of Maryland.
- TATE, G. H. H. (1931). Random observations on South American mammals. *J. Mammal.* 10: 176–178.
- WALKER, E. P. (1964). *Mammals of the world*. Baltimore: Johns Hopkins Press.