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Sloth bear *Melursus ursinus* maternity denning at the Wildlife SOS Bannerghatta Bear Rescue Centre, India

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Little is known about Sloth bear *Melursus ursinus* birthing behaviour and denning. The Wildlife SOS Bannerghatta Bear Rescue Centre, India, which houses rescued bears, is visited by wild male Sloth bears during the breeding season (April–July). Two female Sloth bears have been impregnated by these wild males, giving researchers the opportunity to observe maternal behaviour closely. One female bear made use of an excavated a den to give birth and raise her cubs. A second bear gave birth in an excavated shallow cavity. Neither mother left the cubs for food or water for weeks (22 and 28 days, respectively). In the first case, the cubs eventually joined their mother leaving the den for food and water 20 days after the mother had initially left the den alone, whereas in the second case, the cub still had not joined the mother on outings for provisions after 68 days, when both were moved from the den area.

Key-words: Bannerghatta Bear Rescue Centre; cubs; dens; India; maternal; sloth bear; Wildlife SOS.

INTRODUCTION

Sloth bears *Melursus ursinus* occur in the warmer climates of the Indian subcontinent and do not hibernate (Ward & Kynaston, 1995; Akhtar *et al.*, 2007). However, these bears make use of dens or shallow cavities for resting as well as for birthing and raising cubs in a defendable, secure environment. Dens can be either naturally occurring caves/hollows or excavated. This document uses two terms to distinguish between den types used for different purposes. The term 'resting den' refers to a shelter where Sloth bears spend time after foraging. Usually, resting dens are used during daylight hours, as Sloth bears are generally nocturnal. Likewise, the term 'maternity den' refers to a shelter used by a pregnant Sloth bear to give birth and rear cubs.

When Sloth bears make use of natural caves or hollows for maternity dens, they appear to choose them with extreme care. The bears appear to have a preference for caves with two or more cavities, especially in areas with predators such as Striped hyenas *Hyaena hyaena* and Leopards *Panthera pardus* that could potentially prey on cubs. The innermost den cavity is generally deep enough to make access difficult, even for the mother bear (Seshamani & Satyanarayan, 1997).

Little is known or has been published about Sloth bear maternity dens and how they might differ from resting dens. Although Sloth bear maternal denning behaviour has not been well documented or studied, some valuable work has been

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conducted. Joshi *et al.* (1999) used radio-telemetry to investigate the maternal denning of wild Sloth bears. Between 1991 and 1993 five pregnant females were observed entering maternity dens. The pregnant bears excavated all the dens in the banks of dry streams facing the stream beds, and all den sites were obscured with dense vegetation. Joshi *et al.* (1999) were unable to determine precisely when females gave birth. However, the telemetry data indicated that females did not leave the dens for *c.* 2 months, apparently going without food or water during that period. When the mothers first exited the dens, they only left for short periods to get food and water before returning to the den. The cubs made their first sojourn from the dens with their mothers roughly 2 weeks after their mother had first left the den. Jacobi (1975), who worked with Sloth bears at Amsterdam Zoo, the Netherlands, reported that two of three breeding females did not take food from day 3 to day 36 after parturition, and a third did not take food from day 7 to day 70.

This paper documents two cases of female Sloth bears at the Bannerghatta Bear Rescue Centre (BBRC) in Bangalore, India, being impregnated by encroaching wild males, giving birth and rearing cubs. The free-ranging area at BBRC is located on 26·3 ha of natural habitat within the range of the species. This unique situation of two female Sloth bears becoming pregnant provided an unprecedented opportunity to document cubbing behaviour. We will discuss what was discovered, what this information can tell us about the reproductive biology of the species in the wild and any implications for potential captive-breeding programmes.

BANNERGHATTA BEAR RESCUE CENTRE

Wildlife SOS houses 77 Sloth bears in a 26·3 ha free-ranging enclosure at the BBRC. The free-ranging enclosure allows for observation and documentation of Sloth bear behaviour in a captive though somewhat natural setting. During the breeding season (April–July), Wildlife SOS researchers have observed wild male Sloth bears venturing from the surrounding Bannerghatta National Park to the BBRC perimeter, apparently drawn by the scent of female bears in oestrus. The males leave definitive signs around the perimeter, including scat and footprints, and often knock over equipment. Camera traps set specifically to monitor wild bears approaching the Centre have captured several images, one of which shows a male bear on the moat/trench wall at the BBRC perimeter on 29 June 2014. Several wild male bears have managed to breach the perimeter and enter the BBRC enclosure to mate with females before leaving the Centre and returning to the wild. It would appear that the wild bears are simply more capable of outmanoeuvring the electrical fences and moats than the captive bears. Two such visits resulted in the impregnation of two female Sloth bears (Bear 1-G and Bear 2-K; hereafter referred to as 1-G and 2-K). Although these pregnancies were unexpected and unanticipated, they provided the opportunity for close scientific observation of a little-known behaviour in Sloth bears.

All Sloth bears at the BBRC were rescued from the 'dancing-bear' trade, poaching or other human–bear conflict situations. The BBRC neuters all male Sloth bears that come into the facility. However, females at the BBRC are not spayed because of the invasive nature of that surgery and because all males are neutered. Bear 1-G and Bear 2-K both arrived at the BBRC after being removed from the dancing-bear trade. As such, they had been harvested illegally from the wild as cubs and had spent several years in captivity before being impregnated by the wild males at BBRC. Sloth bear cubs poached from the wild for the dancing-bear trade are generally taken from dens and their mothers at *c.* 1–2 months of age. Because of this, the cubs have usually not spent enough time with their mothers to learn all the behaviours necessary for adulthood, which may impact their denning behaviour in later life.

Study area

The BBRC is part of the safari zoo at the Bannerghatta Biological Park, and borders the relatively large Bannerghatta National Park (310 km^2) that is home to wild Sloth bears, Leopards and Asian elephants *Elephas maximus* (Fig. 1). The BBRC habitat is characterized by boulders, rocks, trees and hills, which is similar to the landscape and habitat outside the Centre. A deep dry trench lined with smooth granite walls and electric fencing encircles the entire BBRC facility, which encloses the 26·3 ha free-ranging area.

Enclosure, husbandry and behaviour

The enclosure for Sloth bears at BBRC is a 26·3 ha free-ranging area surrounded by electrical fencing and a dry moat (Fig. 2). Males ($n = 43$) and females ($n = 34$) occupy the free-ranging area together. Cubs that are less than 18 months old are kept in a separate, smaller area. Each individual bear has its own concrete den in which they are fed 7–9 kg of a millet porridge, along with two hard-boiled eggs, honey and vegetables twice a day. The bears are also fed fresh fruit once a day in the free-ranging area. The bears are usually only in their dens at feeding times. When the bears are not in their dens they are free to roam around the whole area at will. Other than an occasional squabble over food, the bears appear to get along well with each other. Each bear receives a full health examination once every 12 months (or more often in the case of a sick or injured animal). Forty different health parameters are checked.

MATERIALS AND METHODS

Two pregnant females (1-G and 2-K), housed in the free-ranging area at the BBRC, provided the opportunity for researchers to observe and document Sloth bear breeding behaviour in a captive environment that is somewhat natural in its setting and where the mothers could select their own denning locations. Wildlife SOS's highest priority in the case of the breeding females at the BBRC is the health and well-being of individual bears, which meant that it was not possible to observe the denning bears without a degree of human interference. The keepers continually offered food and water to the females and called to them in an effort to coax them out of their dens. This was done because the keepers were worried about the health of the bears and this was the first time cubs had been born in the BBRC.

Because of the Sloth bear's dense fur and the fact that they do not exhibit obvious behavioural changes during pregnancy, direct observation is the only means for determining pregnancy at the BBRC, unless a pregnant bear is randomly given a physical. Wildlife SOS keepers monitor the behaviour and diet of all the Sloth bears at the facility, and after parturition both mothers and cubs were monitored closely.

After 1-G gave birth, the den area was fenced off by BBRC workers so that the new family unit would not be negatively affected by the other 76 bears in the enclosure. This also allowed for food and water to be left at the den entrance and monitored each morning for consumption rates. Researchers also monitored sounds from within the den to ensure that the cubs were still alive. The den area 2-K selected could not be fenced off because of its location. However, the location and shallowness of the den meant that researchers could directly observe and monitor the female and cubs. After the mothers and cubs were removed from their respective den sites, researchers entered the sites to inspect them and gather information.

RESULTS

Case study 1: Bear 1-G

There were no behavioural indications that 1-G was pregnant until the day she gave birth. Although 1-G had a slightly depressed appetite during pregnancy (based on a later comparison of her normal

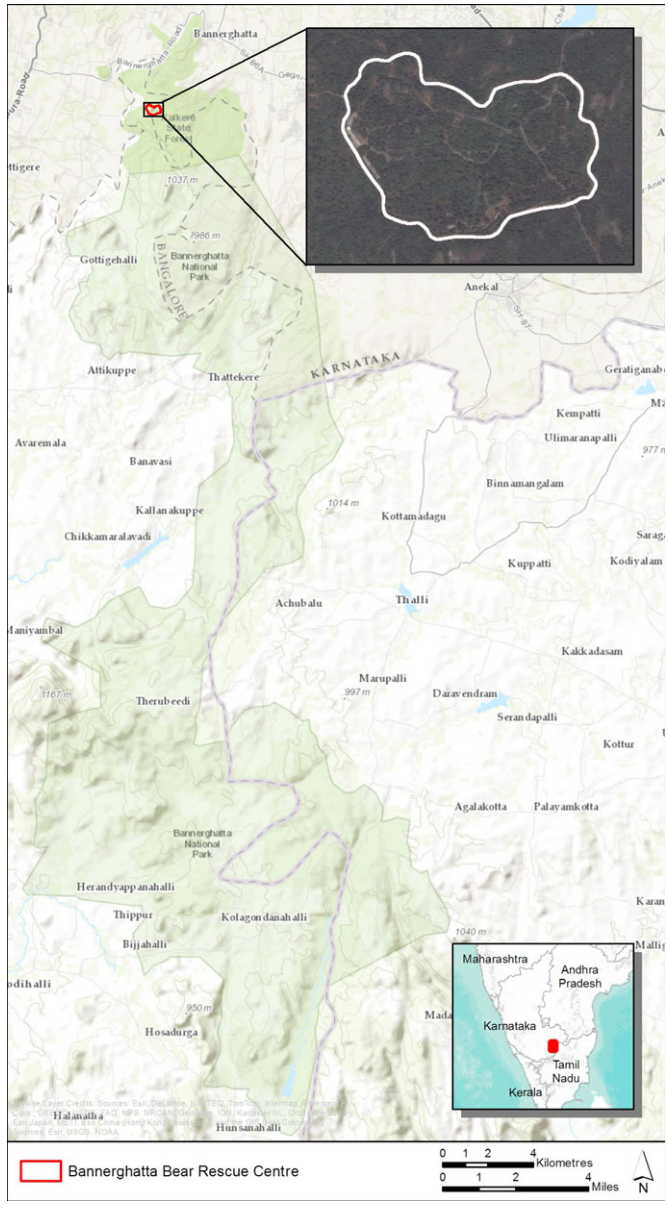

Fig. 1. Bannerghatta Bear Rescue Centre and Bannerghatta National Park, India.

consumption rate to that during the week before parturition), she continued to eat until 24 hours before giving birth. The only other physical characteristic indicative of pregnancy that she exhibited was the shine of her coat, which appeared sleek and shiny, unlike the dull appearance of the coats of non-pregnant bears.

Bear 1-G made use of a den for birthing that had originally been excavated by a different female that had never been pregnant. When 1-G did not appear for her morning

Fig. 2. Facility map of the free-ranging enclosure for Sloth bears *Melursus ursinus* at Bannerghatta Bear Rescue Centre, India.

meal on 22 November, keepers checked the den site, as she had been observed spending more time in and around it. From the den's entrance, the keepers could hear 1-G and her cubs.

After giving birth, 1-G stayed in the den without consuming food or water for 22 days, even though both were available at the entrance. After 22 days, she emerged alone, consumed some porridge (a nutritious gruel made from wheat/barley mixed with dates and eggs), drank roughly 2 litres of water and quickly returned to the cubs inside the den. She repeated this routine, leaving her cubs in the den, for an additional 20 days. Bear 1-G emerged from the den in the morning 42 days after giving birth, for the first time accompanied by two cubs. After all three consumed porridge and water, they returned to the den. This routine continued twice a day (morning and evening) until day 89, at which point the entire family group was moved to a concrete den area. Once the cubs had been weaned from the mother, she was returned to the general free-ranging area. The cubs were then placed in the separated cub area until they were 18 months of age and could be released into the general free-ranging area along with the adults.

The maternity den used by 1-G has a single, elliptically shaped, south-east-facing entrance (Fig. 3). The two-chambered den opens into a main corridor, which has a low ceiling that widens progressively deeper into the den. The primary chamber is situated at the rear, and appears to be where the cubs were delivered and nurtured. The secondary chamber, which is near the den's entrance, appears to have been used solely for waste, as urine and scat were found there (Table 1; Fig. 3). Based on what appeared to be recently moved dirt when the den was first inspected, 1-G likely modified the den after entering it.

Case study 2: Bear 2-K

As with 1-G, 2-K's pregnancy went undetected until the day she gave birth. The situation was identical: she behaved normally while pregnant other than a slightly depressed appetite, although she did eat within 24 hours of giving birth. Like 1-G, her coat exhibited a noticeable sheen.

Bear 2-K gave birth in a shallow cavity that she had dug on the side of the moat

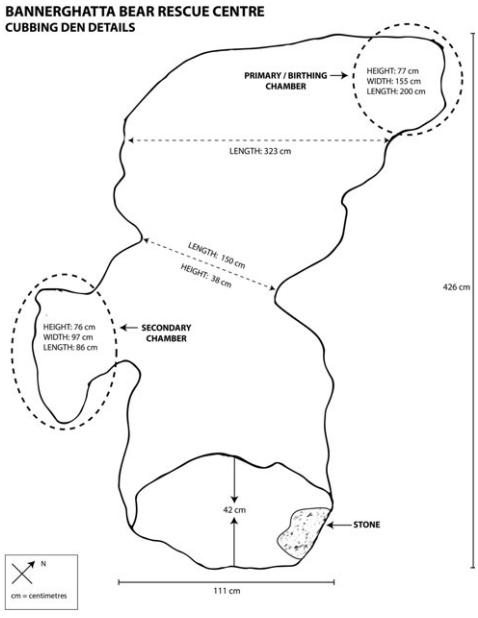

Fig. 3. Layout of maternity den for Sloth bear *Melursus ursinus* (Bear 1-G) at Bannerghatta Bear Rescue Centre, India.

that surrounds the BBRC's free-ranging enclosure. Bear 2-K was not present for the 6 December morning feeding but was soon observed in the shallow cavity. The cavity's location and structure allowed for close visual observation of 2-K and her cubs but the area could not be fenced off from the free-ranging enclosure.

Bear 2-K remained with the cubs in the cavity for 27 consecutive days after giving birth without leaving, and was observed grooming and positioning the cubs close to her (Plate 1). One cub died during a storm on day 16, when rains caused the banks of the cavity to cave in. From day 28 until day 68 (when the mother and surviving cub were moved from the den area by keepers to protect them from other bears in the free-ranging enclosure), 2-K left the den to eat and drink twice a day every day, always leaving her cub in the den cavity.

The shallow den excavated and used by 2-K was 91 cm wide, 76 cm high at the entrance and 137 cm deep. The cavity was excavated 1·5 m below the main level of the enclosure on a slope facing the dry trench.

DISCUSSION

Breeding and birthing season

Sloth bears typically breed May through July in Nepal (Laurie & Seidensticker, 1977; Joshi, 1996) and India (Gopal, 1991), and in the state of Karnataka (Iswariah, unpubl.), where the BBRC is located. Laurie & Seidensticker (1977) suggested that breeding occurs at other times of the year. It has also been suggested that there is not a specific breeding period further south Sri Lanka (Phillips, 1984). However, Norris (1969) reported that cubs are born in the summer in Sri Lanka, suggesting that mating occurs in the winter. At the BBRC, which is in southern India, wild male bears begin to arrive at the forest edge overlooking the 26·3 ha free-ranging enclosure as early as April, indicating that females may already be in oestrus. Wild bears frequent the area through July, possibly meaning that the breeding season in the Bannerghatta National Park may run from April through July, slightly longer than previously reported.

Most cubs in Nepal and India are born November through January (Jacobi, 1975;

AREA OF DEN	HEIGHT (cm)	LENGTH (cm)	WIDTH (cm)	NOTES
Entrance	43	N/A	112	elliptical shape, opening to the south east
Main chamber	38	427	152–320	
Secondary chamber	76	86	97	evidence of urine and faeces
Primary 'birthing' chamber	76	198	158	no nesting material

Table 1. Birthing den for Sloth bear *Melursus ursinus* (Bear 1-G) at Bannerghatta Bear Rescue Centre, India: dimensions given in centimeters (cm); N/A, not available.

Plate 1. Sloth bear *Melursus ursinus* (Bear 2-K) with cub in shallow cavity den at Bannerghatta Bear Rescue Centre, India. *Wildlife SOS.*

Laurie & Seidensticker, 1977; Joshi, 1996; Iswariah, unpubl.) after a period of delayed implantation (Puschmann *et al.*, 1977). Cubs born in the BBRC were also born during that time period.

Although 1-G and 2-K ate less than normal during their pregnancy, they were still eating enough to make a pregnancy determination difficult. The shiny coat that pregnant Sloth bears exhibit, coupled with the depressed diet, could be indicators that help researchers identify pregnant females in the future.

Birthing behaviour and timing

Previous research suggests that female Sloth bears remain in their dens for 1–2 months before coming out to drink or eat (Jacobi, 1975; Joshi *et al.*, 1999), consistent with observations at the BBRC. Bear 2-K gave birth in a shallow cavity and left the den to eat and drink 28 days post partum. Bear 1-G gave birth in a larger den and did not eat or drink for 22 days post partum (Fig. 4). There are two possible reasons that these two individuals at BBRC left their dens for food and water after slightly less than a month. First, these bears were in a protected environment where detection by conspecifics was not a threat. Second, keepers began calling 1-G by her name ('Gayathri') a few days after parturition to see if she could be drawn from the den and continued to do so until she finally emerged. This was done out of concern for the mother's health, as the keepers were not experienced in Sloth bear cubbing behaviour and wanted to ensure the well-being of the mother and cubs.

Bear 1-G's cubs did not emerge from the den until 42 days after birth and 20 days after their mother first emerged. Bear 2-K's cub, which was healthy and survived to adulthood, still had not joined her outings for food or drink after 68 days, when the pair were moved from the shallow cavity to a different denning area to protect them from other bears in the enclosure. The number of days that 2-K's cub did not leave the den was longer than usual based on observation of 1-G's cubs as well as the scant information available from other studies. The cubs that Joshi *et al.* (1999) observed were not thought to have left the den for the first time until 1–2 weeks after the mother initially emerged.

Data collected at the Wildlife SOS Sloth bear rescue and rehabilitation facilities show that Sloth bear cubs, like those of other bear species, are born altricial. The cubs are deaf, or at least cannot hear very well, for 14–

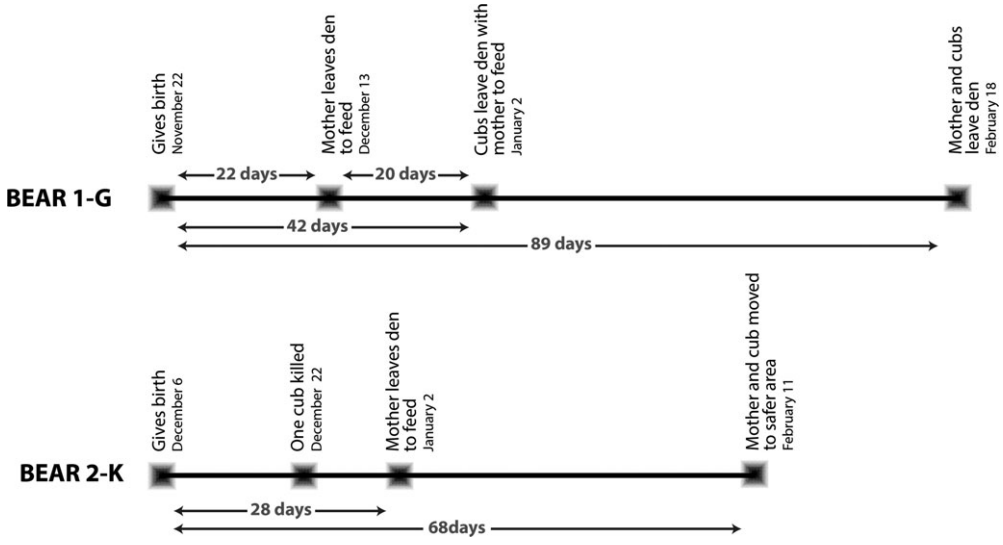

Fig. 4. Maternity timeline for two Sloth bears *Melursus ursinus* **(Bear 1-G and B 2-K) at Bannerghatta Bear Rescue Centre, India. One cub died after heavy rains caused the maternity den to cave in.**

16 days because the ear canal is blocked. Additionally, Sloth bear cubs do not open their eyes until 20–25 days after birth, rendering them blind for the first 3 weeks of life.

Maternity dens provide females and their cubs with protection from both the elements and predators (Oli *et al.*, 1997; Linnell *et al.*, 2000). Potential predators, such as Leopards and Tigers *Panthera tigris*, are not a concern for denning Sloth bears in the free-ranging enclosure at the BBRC; however, protection from the elements is still important. The fact that 2-K gave birth in a small cavity, rather than a more protected den complex, probably is the reason she lost 50% of her litter (one cub) to the elements. Bear 1-G, by using a pre-existing den complex, opportunistically took advantage of what was already available. The use of previously dug dens is not unusual for several bear species (Judd *et al.*, 1986).

Den structure

Sloth bear dens are smaller than, yet comparable to those excavated by Polar bears *Ursus maritimus* and Brown bears *Ursus arctos* (Judd *et al.*, 1986; Durner *et al.*, 2003). However, how typical 1-G's den is when compared to other Sloth bear maternity dens is unknown. It is also not known how much alteration 1-G made after the initial excavation by another bear. Bear 2-K's den was simple, and we surmise that it would probably have been inadequate for giving birth to and rearing cubs in the wild. Sloth bear maternity dens have not been reported as being this shallow, so it is possible that this den choice was influenced by the female's inexperience having been in captivity for a large part of her life.

RECOMMENDATIONS

Our recommendations for breeding captive Sloth bears derived from our observations of these two breeding females are listed below.

1. When possible, facilities should be located in or near the species' natural habitat, or an attempt to approximate that habitat should be made.
2. The mothers and cubs should be kept isolated from other bears until cubs are at least 18 months old.

3. Additional macronutrients and vitamin supplements should be provided for lactating mothers.
4. If there is no natural cave structure, bedding should be provided for the mother before and after birth.
5. Only familiar staff should conduct observations and monitoring so as not to disturb the Sloth bears.
6. A closed-circuit television (CCTV) camera should be installed in potential dens to make it possible to observe the family unit without disturbing the denning females.

CONCLUSIONS

Sloth bears are listed as Vulnerable on the International Union for Conservation of Nature's Red List (Dharaiya *et al.*, 2016), and the species is facing increasing pressures from human-population growth and other factors. Therefore, it is increasingly important to understand the needs of both wild and captive female Sloth bears to enable them to breed successfully. With this in mind, it is important to note that pregnant Sloth bears at the BBRC continued to eat and drink until the day before or day of giving, although they exhibited a slightly depressed diet during their pregnancy. Additionally, the coats of both pregnant Sloth bears appeared shiny and clean. Previous studies of wild Sloth bears have suggested that females remain in their dens for up to 2 months after parturition. The BBRC data support the claim that Sloth bear mothers do not eat or drink for a substantial amount of time after parturition, although the findings showed the mothers only stayed in the dens for about a month before exiting for food and water. The disparity might be attributed to the differences between a captive and a wild setting, or it may simply be the product of being able to observe the bears more closely and gather more accurate data.

The initial emergence of the cubs in one of the case studies, 20 days after the mother first emerged, generally supports the findings of field telemetry studies, which suggest that the cubs made their first sojourn from the den roughly 2 weeks after the mother first emerges for food and water. However, the total time, as with the amount of time the mother remained in the dens without eating or drinking, was roughly a month less at BBRC than in the wild study. This *c.* 2 week time span – when the mother leaves the den for food and water while leaving the cubs behind – is a very vulnerable time for the cubs, when human poachers and other predators may target the cubs.

This rare opportunity to observe the denning behaviour of two female Sloth bears in natural surroundings in a large free-ranging area at BBRC has provided valuable information for those working to conserve this threatened species.

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