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RESEARCH ARTICLE

After the Fire: Benefits of Reduced Ground Cover for Vervet Monkeys (*Cercopithecus aethiops*)

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Here we describe changes in ranging behavior and other activities of vervet monkeys (*Cercopithecus aethiops*) after a wildfire eliminated grass cover in a large area near the study group's home range. Soon after the fire, the vervets ranged farther away from tall trees that provide refuge from mammalian predators, and moved into the burned area where they had never been observed to go before the fire occurred. Visibility at vervet eye-level was 10 times farther in the burned area than in unburned areas. They traveled faster, and adult females spent more time feeding and less time scanning bipedally in the burned area than in the unburned area. The burned area's greater visibility may have lowered the animals' perceived risk of predation there, and may have provided them with an unusual opportunity to eat acacia ants. Am. J. Primatol. 71:252–260, 2009.

Key words: habitat use; El Niño; GIS; Kenya; predator avoidance

INTRODUCTION

Changes in ground cover can have direct effects on the behavior of animals that spend a large amount of their time on the ground. Prey animals often appear to prefer areas with less ground cover or shorter plants [Carey, 1985; Cowlishaw, 1997; Deutsch & Weeks, 1992; Hill & Weingrill, 2007; Rasmussen, 1983; Underwood, 1982] because a reduction in ground cover increases visibility for them, presumably enabling them to detect predators more easily [Deutsch & Weeks, 1992; Götmark et al., 1995; Korpimaki et al., 1996; Matson et al., 2005; Norment, 1994]. A reduction in ground cover may also facilitate movement [see Simons, 1991].

Reduced ground cover also affects predators, but more negatively. Decreased cover reduces the ability of terrestrial stealth predators to conceal themselves from their prey [FitzGibbon & Lazarus, 1995; Hill & Weingrill, 2007]. Felids, in particular, rely on ground cover to get as close as possible to their prey before attacking [Bailey, 2005; Sunquist & Sunquist, 1989], and presence of ground cover has been correlated with hunting success in leopards [*Panthera pardus*: Bothma et al., 1994; Cowlishaw, 1994], lions [*P. leo*: Cowlishaw, 1994; Schaller, 1972; van Orsdol, 1984], and cheetahs [*Acinonyx jubatus*: Caro, 1994; Eaton, 1974]. Extent of ground cover is related to the risk of attack on chacma baboons (*Papio hamadryas ursinus*) by leopards and baboons avoid areas where visibility is poorest [Cowlishaw, 1997; Hill & Weingrill, 2007]. Altmann and Altmann [1970] found that yellow baboons (*P. h. cynocephalus*) gave alarm calls more often and that attacks by predators occurred more frequently in areas of dense vegetation. Thus, for both prey and predators in terrestrial environments, changes in ground cover can have a profound effect on their survival.

Naturally occurring or human-induced fires severely reduce grasses [Heady & Child, 1994; Sinclair, 1977], the predominant form of ground cover in savannahs and savannah-woodlands. Fires occur relatively frequently in such ecosystems [Gill et al., 2000; Heady & Child, 1994] and animals must be able to adjust to these changes [Vieira & Marinho-Filho, 1998]. Although the ecological effects of fire have been studied, most investigate consequences in relation to responses of ecosystems, conservation and management practices, or effects on wildlife population dynamics [e.g. Andersen et al., 1998;

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Heady & Child, 1994; Heisler et al., 2004; Ramos-Neto and Pivello, 2000; Salvatori et al., 2001; Vieira, 1999], with fewer analyses of behavioral responses of animals [e.g. Rasmussen, 1983; Vieira & Marinho-Filho, 1998; Zimmer & Parmenter, 1998]. Rasmussen [1983], for example, found that yellow baboons altered their ranging patterns after wildfires, entering a portion of their home range only after fire had reduced the ground cover there, and proceeded to decrease their use of the area after the vegetation returned, presumably because of reduced ability to detect predators.

Baboons, patas monkeys (*Erythrocebus patas*), and vervets (*Cercopithecus aethiops*) live in savannah and savannah-woodland ecosystems. They might be expected, therefore, to have evolved the ability to adjust quickly to the fires that happen frequently in their environments. Of these species, vervets have the smallest home ranges and thus might be most affected by fires. Although baboons and patas monkeys have home ranges encompassing hundreds of hectares [Altmann & Altmann, 1970; Chism & Rowell, 1988; Isbell, in press; Isbell et al., 1999], vervets live in home ranges in the tens of hectares, typically along rivers, where they feed both in the trees and on the ground [Isbell & Jaffe, in press; Isbell et al., 1999; Struhsaker, 1967a]. When their habitat is altered by fire, how do they adjust? As prey animals for ambush predators, vervets might be attracted to newly opened areas for the safety those areas provide. On the other hand, as omnivores, vervets might avoid newly opened areas as those areas may have become devoid of many of their plant foods. Here we report changes in the ranging behavior and activities of vervet monkeys after a wildfire swept through a large area on the edge of their home range. The fire provided a unique opportunity to determine whether vervets perceive grass cover to be a hindrance or an advantage.

METHODS

Study Site and Animals

The data upon which this study is based were collected between March 1998 and July 1999 at Segera Ranch (36° 50′ E, 0° 15′ N; elevation 1800 m) on the Laikipia Plateau in central Kenya. Segera is a privately owned conservation area and cattle ranch of 17,000 ha with stable populations of at least 30 other species of large mammals (see Isbell et al., 1998a, b for more detailed descriptions of the fauna). Mean annual rainfall from September 1992 to October 2001 was 705 mm [Isbell et al., in press]. Rainfall varies considerably, but on average the wettest months are April and May and the driest February and September.

There are two habitat types in the study area. Riverine woodland is dominated by *Acacia xanthophloea* (fever trees), with an average height of 15.9 m [Enstam & Isbell, 2002], including a woody shrub layer of *Carissa edulis* and *Scutia myrtina* [Coe & Beentje, 1991]. In areas away from rivers, the habitat is dominated by *A. drepanolobium* (whistling thorn acacias) with an average height of 1.2 m [Enstam & Isbell, 2002] in the overstory and *Lintonia nutans, Brachiaria lachnantha, Themeda triandra* and *Pennisetum* spp. in the understory [Pruetz, 1999; Young et al., 1997].

The data presented here come from one study group of vervet monkeys. The group declined from 30 individuals at the beginning of the study to nine at the end, largely as a result of confirmed and suspected predation [Isbell et al., in press]. All vervets were individually identified by natural markings and physical characteristics. This study was noninvasive and complied with protocols approved by the UC Davis Institutional Animal Care and Use Committee and adhered to the legal requirements of Kenya.

Data Collection

Behavioral data

Data on ranging behavior were collected by K. E. J. every 30 min using a GPS (Global Positioning System) unit (Garmin) every observation day between 15 July 1998 and 15 July 1999 ($N = 71$ days; $\bar{x} = 3.4$ hr/day, range: 0.5–8.9 hr/day). This sampling regimen provided 250 GPS coordinates of the vervet study group's ranging behavior before the wildfire and 115 GPS coordinates after the wildfire. K. E. J. took GPS coordinates when she was in the center of the group, defined as the location at which she could locate at least half of the group's adult females in positions to the north, south, east, and west of herself.

Point samples of activity budgets [Martin & Bateson, 1993] of all adult and subadult males ($N = 3$) and adult females ($N = 5$) were collected between March 1998 and July 1999 (excluding September 1998 when no focal samples were collected) during 130 20 min focal samples. This analysis is limited, however, to data from the 56 focal samples ($\bar{x} = 7$ focal samples/individual; range, 1–6 focal samples per month) that were collected while the vervets were in *A. drepanolobium* habitat because habitat differences are known to affect vervet behavior [e.g. Enstam & Isbell, 2002]. K. E. J. randomly sampled all focal animals without replacement. Activities recorded during focal samples included ''feed'' (placing food in mouth, chewing, and swallowing), ''forage'' (searching for food, but not consuming), ''move'' (walking, running, climbing), ''groom'' (picking through the fur of an other individual), ''rest'' (inactivity, with eyes open or closed), ''bipedal scan'' (staring intently into the distance while moving one's head from side to side while on the ground and standing on the hind legs), ''arboreal scan'' (staring intently into the distance while moving one's head from side to side while in a tree), and ''other'' (any behavior not included in another category, e.g. scratching, drinking, etc.).

Terrestrial bipedal-scanning was also monitored during 31 additional 5-min focal samples between January and June 1999 to estimate durations of bouts of bipedal scanning. Bouts were defined as being separated by other bouts by at least 15 sec of no scanning. These focal samples were terminated before 5 min if the focal animal climbed a tree. The total number of scanning bouts that took place and the identities of animals within 3 m of the focal animal were also recorded during the 5-min focal samples.

Alarm calls and predator sightings were recorded by all observers whenever they occurred.

Ecological data

Each month, K. E. J. collected ecological data after randomly selecting one observation day (1–31) and one observation hour (8am–4pm). If K. E. J. was not with the monkeys on the predetermined day, she collected ecological data on the next day she was with the animals. Grass height and ''degree of visibility'' measurements were recorded in 25×5 m transects ($n = 26$ transects, 10 in *A. xanthophloea* habitat, six in the unburned *A. drepanolobium* habitat, ten in the burned *A. drepanolobium* habitat). At the beginning of the hour, K. E. J. set up the transect after the group had left the immediate area, so as not to disturb them. Transects consisted of two stakes placed 25 m apart and connected with a line that was marked at 5 m intervals. Grass height was measured to the nearest centimeter using a meter stick placed along the line at 5 m intervals. ''Degree of visibility'' was measured using the meter stick fitted with a 25×25 cm square target at vervet eye-level that was painted with 25 5×5 cm black and white checkered squares. The stake at the beginning of the transect was notched at the eye level of a quadrupedal vervet monkey. ''Degree of visibility'' was recorded as the percent of squares that were visible through the notch, starting with the stake 25 m away, and moving it closer in 5 m increments until 80% (20 of 25) of the squares were visible through the notch [Rodman, 1991]. If moving the target 5 m closer to the notched stake resulted in more than 80% of the squares being visible through the notch, the target was moved out in 1 m increments until only 80% of the squares were visible. The farther away from the notched stake the target was when 80% of the squares were visible, the greater the ''degree of visibility,'' for humans and presumably, for vervets. As attack distances for leopards range from 5 to 10 m [Bertram, 1982; Kruuk & Turner, 1967], measuring the degree of visibility within 25 m provides a good indication of the vervets' ability to detect stalking predators at the most critical distances for attack [see also Hill & Weingrill, 2007].

Data Analysis

The GPS coordinates were imported into ArcView Geographic Information System version 3.0 to create a map of vervet ranging behavior and determine the rates of movement before and after the wildfire. Distance from the river is based on shortest straight-line distance from individual points to the river. Statistical analyses are based on average and maximum daily distances from the river.

All other data were imported from Excel (Microsoft, version 9.0, 1985–1999) into the VassarStats statistical computational web site (http://faculty.vassar.edu/lowry/VassarStats.html) for analysis. For determining activity budgets and substrate use, we calculated the proportion of time spent in each activity or on the ground per focal sample to minimize the dependence of sample points. Focal samples for the same individual were then combined for an average proportion of time spent in each activity or on the ground per individual (focal samples for the same individual were always separated by more than 24 hr). The unit of analysis is thus the individual, based on 1116 data points for activity budgets and 200 for substrate use. Statistical significance was set at $P = 0.05$.

RESULTS

Rainfall, Fire, and Grass Height

Between September and December 1997, an El Niño weather event occurred and mean monthly rainfall for these 4 months was 143.6 mm (range: 87.0–190.2 mm). The mean monthly rainfall for this same 4-month period during seven non-El Niño years was 48.9 mm (range: 0.0–136.0 mm) (L.A. Isbell, unpublished data). There was significantly more rain during the El Niño weather event than during the same months in the non-El Niño years (Mann–Whitney U-test, $U = 25$, $z = -2.51$, $P < 0.01$), resulting in exuberant growth of grasses (e.g. *Pennisetum stramineum* and *T. triandra*). Following the El Niño event, a drought occurred, and the grasses, while turning brown, remained tall until the wildfire (Fig. 1a). On 4 May 1999, a wildfire swept through the *A. drepanolobium* woodland (Fig. 1b) and burned along the eastern edge of the vervets' home range (Fig. 2). Grass height in the burned *A. drepanolobium* woodland was significantly shorter than in the unburned *A. drepanolobium* woodland (burned: $1.3\,\text{cm} \pm 0.3\,\text{cm}$, $N = 50$ [range: 0.0–5.0 cm]; unburned: $40.3\,\text{cm} \pm 3.3\,\text{cm}$, $N = 30$ [range: 20.0–93.0 cm]; $\chi^2_1 = 59.0$, $P < 0.0001$).

Fig. 1. The unburned (a) and burned (b) *Acacia drepanolobium* habitat. (photos: K. C. Jaffe)

Ranging Behavior and Rate of Movement

Before the fire, there was no significant difference in the average distance the vervet group ranged east ($\bar{x} = 19\,\mathrm{m} \pm 3.1\,\mathrm{m}$; $N = 38$ days) or west ($\bar{x} = 21.4\,\mathrm{m} \pm 3.3\,\mathrm{m}$; $N = 36$ days) away from the river per observation day (Mann–Whitney U-test, $U = 698.5$, $z = 0.03$, $P = 0.48$; Fig. 3). After the fire, however, the average distance the vervet group ranged east (in the direction of the burned area; $\bar{x} = 111.5\,\mathrm{m} \pm 24.3\,\mathrm{m}$; $N = 16$ days) was significantly greater than the average distance they ranged west each day ($\bar{x} = 9\,\mathrm{m} \pm 2.7\,\mathrm{m}$; $N = 13$ days; Mann–Whitney U-test, $U = 14$, $z = 3.92$, $P = 0.0001$; Fig. 3).

The maximum daily distance the group moved away from the river after the fire ($\bar{x} = 188.5\,\mathrm{m} \pm 39.7\,\mathrm{m}$ [range: 40.6–559.7 m]; $N = 17$ days) was also significantly greater than before the fire ($\bar{x} = 54.3\,\mathrm{m} \pm 5.6\,\mathrm{m}$ [range: 6.5–125.1 m]; $N = 38$ days; Mann–Whitney U-test, $U = 534$, $z = -3.83$, $P = 0.0001$). The increased distance from the river was not randomly distributed throughout the vervets' home range, but was concentrated in the newly burned area (Fig. 2). When the vervets ranged east of the river after the fire, they ranged significantly farther from the river when in the burned area ($\bar{x} = 188.5\,\mathrm{m} \pm 39.7\,\mathrm{m}$ [range: 83.7–330.4 m]; $N = 11$ days) than when in the unburned area ($\bar{x} = 54.3\,\mathrm{m} \pm 5.6$ [range: 5.2–277.4 m]; $N = 12$ days; Mann–Whitney U-test, $U = 8$, $z = 3.54$, $P = 0.0004$).

The vervet group's use of the burned area occurred soon after the fire. On 10 May, six days

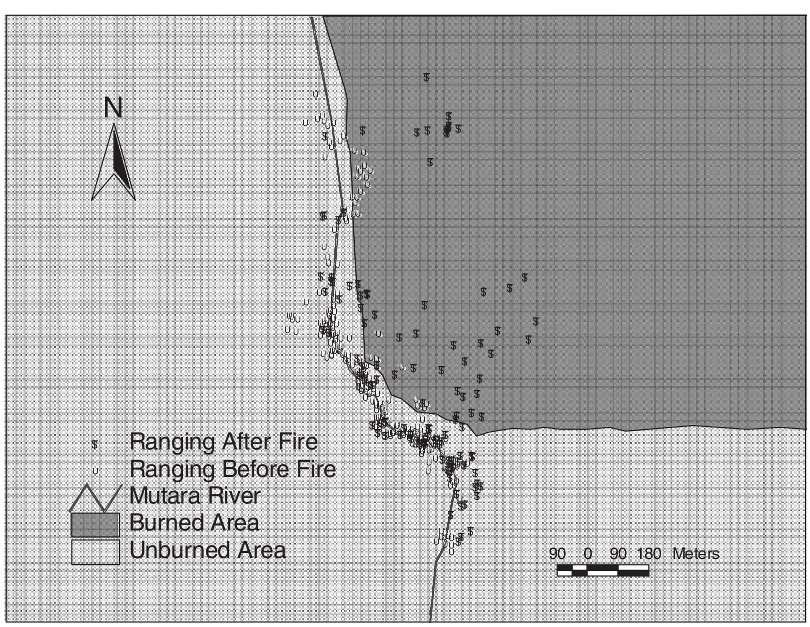

Fig. 2. Global Information System (GIS) map of the vervet home range, showing the ranging behavior of the group before (15 July 1998–2 May 1999) and after (10 May–1 September 1999) the brush fire. Points indicate GPS reading of group position at 30 min intervals.

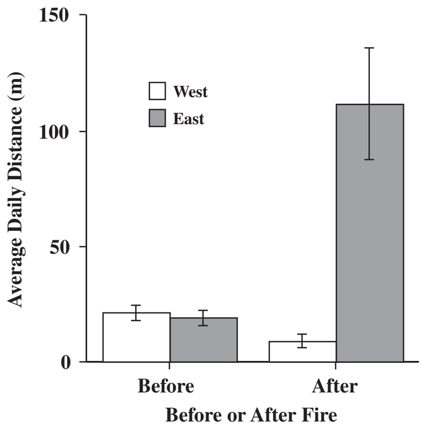

Fig. 3. The average daily distance (in meters) the vervets traveled from the river before and after the fire. Before the fire, there was no difference in the average distance traveled east (range: 0.0–70.4 m) and west (range: 0.0–120.9 m). After the fire, the vervets traveled farther east (in the direction of the burned area; range: 0.0–321.6 m) than they did west (no fire; range: 0.0–29.1 m). Lines indicate standard errors.

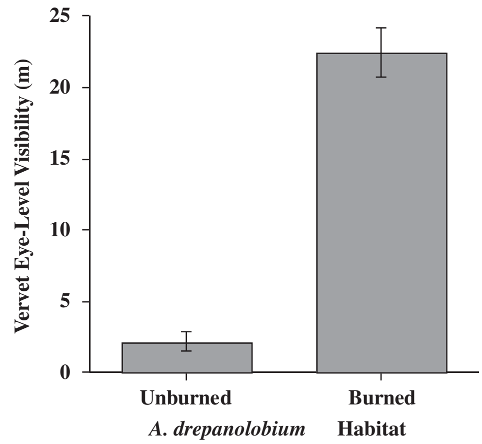

Fig. 4. Visibility at vervet eye-level (distance at which 80% of a target was seen by observers) in the unburned (range: 0.0–4.0 m) and unburned (range: 10.0–25.0 m) *A. drepanolobium* habitat. Lines indicate standard errors.

after the fire (we could not locate the group 5–9 May), the group ranged almost four times farther east than they did on 2 May, two days before the fire (2 May: $\bar{x}$=46.1 m$\pm$22.9 m; 10 May: $\bar{x}$ = 167.6 m$\pm$31.7 m; $N = 5$ GPS readings at 30 min intervals before and after the fire). The increase in distance from the river continued until 19 June, reaching its peak on 13 June. Between 10 May and 19 June, the vervets' average daily distance from the river continued to be significantly farther than their average daily distance before the fire (Mann–Whitney U-test, $U = 458$, $z = -3.9$, $n_1 = 32$, $n_2 = 17$, $P = 0.0002$). Between 22 June and 15 July, the vervets' average daily distance from the river returned to levels similar to those before the fire (Mann–Whitney U-test, $U = 166$, $z = -1.96$, $n_1 = 32$, $n_2 = 7$, $P = 0.05$).

The vervet group also traveled significantly farther per 30 min period in the burned area ($\bar{x} = 75.7$ m$\pm$10.1 m; $N = 11$ focal samples) than in the unburned area ($\bar{x} = 46.6 \pm 4.5$ m; $N = 23$ focal samples; Mann–Whitney U-test, $U = 11$, $z = 4.23$, $P < 0.0001$), and thus traveled more quickly in the burned area.

Visibility, Substrate Use, and Scanning Behavior

In the burned area, 80% vervet eye-level visibility occurred at a significantly greater distance from the notched stake than in the unburned area (unburned: $\bar{x} = 2.2 \pm 0.7$ m, $N = 6$; burned: $\bar{x} = 22.5 \pm 1.7$ m, $N = 10$; $\chi^2_1 = 12.1$, $P < 0.0005$; Fig. 4). Vervets spent 40% of their time on the ground in burned portions of *A. drepanolobium* habitat verses 23% of their time on the ground in unburned portions, but this difference was not statistically significant ($\chi^2_1 = 3.11$, $P = 0.07$, $N = 6$ individuals).

Vervets spent a mean of 12.9 ± 2.1 min per hour scanning bipedally in the burned area verses a mean of 16.3 ± 1.4 min per hour scanning bipedally in the unburned *A. drepanolobium* habitat, a difference that was not statistically significant (Mann–Whitney U-test, $U = 21$, $z = 1.1$, $n_1 = 8$, $n_2 = 8$, $P < 0.13$). The nonsignificance was largely owing to different trends between the sexes and greater variance in male behavior. Although the data for subadult and adult males and adult females were insufficient for independent analyses, males generally spent more time bipedally scanning in the burned *A. drepanolobium* area than in the unburned area (18.5 ± 3.0 min/hr, vs. 13.6 ± 2.6 min/hr; $N = 3$ individuals), and two males increased, whereas one male decreased, the rate of bipedal scanning in the burned area. All adult females, however, *decreased* their rates of bipedal scanning in the burned area (9.5 ± 1.5 min/hr vs. 18.0 ± 1.3 min/hr in the unburned area; $N = 5$ individuals).

Feeding, Foraging, and Moving

Data on activity budgets are only described for females because the sample size per male in the burned (range: 0–3 focal samples) and unburned (range: 1–6 focal samples) areas was insufficient for analyses. Females (range: 4–8 focal samples in the burned area and 3–7 focal samples in the unburned areas) significantly increased their time spent feeding when they were on the ground in the burned area compared with the unburned area (51% vs. 24%; $\chi^2_1 = 7.47$, $P = 0.006$; $N = 5$ individuals). They did not significantly alter their time foraging in the burned area compared with the unburned area (11% vs. 19%; $\chi^2_1 = 0.45$, $P = 0.50$). Adult females did not significantly modify their time spent moving in the burned area compared with the unburned area (30% vs. 40%; $\chi^2_1 = 3.62$, $P < 0.06$). In the burned area, adult females spent a greater proportion of time feeding compared with foraging (51 vs. 11%; $\chi^2_1 = 4.16$, $P = 0.04$), but not moving (51 vs. 30%; $\chi^2_1 = 0.76$, $P = 0.38$).

Alarm Calls and Predator Sightings

No alarm calls were heard and no mammalian predators or snakes were seen by observers during 30 hr of observation in the burned area. During 422 hr of observation in the unburned area, vervets gave one ''leopard'' alarm call per 23 hr ($N = 19$) and one ''snake'' alarm call per 71 hr ($N = 6$). Observers saw mammalian predators once per 36 hr ($N = 12$) and snakes once per 53 hr ($N = 8$) in the unburned area [see Seyfarth et al., 1980 for further discussion of vervet alarm call categories].

DISCUSSION

The wildfire that swept through the eastern edge of the vervets' home range significantly reduced ground cover, increasing the visibility at vervet eye-level on the ground. The wildfire was associated with movement into the burned area, where the vervets had never been observed to go before. What benefits did they derive from the fire? Although definitive conclusions cannot be drawn from the relatively limited dataset, some preliminary statements can be made about the effects of reduced ground cover on vervet behavior.

First, vervets may be able to walk more efficiently in areas with little or no ground cover. Indeed, the vervets traveled at a faster rate in the burned area compared with the unburned area. This could have been achieved because lack of ground cover allows more direct travel and easier detection and avoidance of obstacles such as puff adders (*Bitis arietans*), which are deadly to primates [Chism et al., 1984]. They are terrestrial, sit-and-wait predators that are normally difficult to see because of their cryptic coloration [Branch, 1998; Marais, 1992; Spawls & Branch, 1995]. At our study site, they were most often found in clumps of grass at the bases of trees. Burning eliminated this habitat for puff adders, and those that survived the fire or that might have moved in after it would have been easier to see.

Reduced ground cover may have also lowered the vervets' risk of exposure to mammalian ambush predators. Heightened visibility increases the ability of prey to detect predators and to detect them at greater distances [FitzGibbon & Lazarus, 1995; Koivula & Rönkä, 1998; Lauro & Nol, 1995; Martella et al., 1995; Matson et al., 2005; Schooley et al., 1996]. Our findings for adult female vervets are consistent with other studies that have documented a decrease in vigilance with decreasing degree of obstructive cover [e.g. Lagory, 1986; Martella et al., 1995; Metcalfe, 1984; Underwood, 1982]. In unburned areas, visibility at vervet eye-level was 2.2 m. This distance is within ambush range of leopards [Bertram 1982; Kruuk & Turner, 1967], one of the main predators of vervets [Isbell, 1990; Isbell et al., in press]. In the burned area, visibility at vervet eye-level increased 10-fold, potentially increasing the vervets' ability to detect leopards earlier and perhaps also discouraging leopards from using the area. Earlier detection may be an effective anti-predator strategy as leopards often give up the hunt once they have been detected [Zuberbühler et al., 1999] and ground cover is necessary for their successful hunting [Bertram 1982; Bothma et al., 1994; Cowlishaw, 1994; Kruuk & Turner, 1967].

The behavior of vervets also suggests that they perceived a lower risk of predation in the burned area. Vervets preferentially seek out and climb taller trees when they detect terrestrial predators such as leopards [Cheney & Seyfarth, 1990; Enstam & Isbell, 2002; Seyfarth et al., 1980; Struhsaker, 1967b]. After the fire occurred, however, the vervets moved away from tall trees and into areas they had never been observed to visit since the long-term study's inception in 1992. This behavior is similar to that reported for yellow baboons in Mikumi National Park, Tanzania, which began using an area only after a fire swept through it and removed the dense vegetation [Rasmussen, 1983].

Although unfamiliar areas can be more dangerous for vervets [Isbell et al., 1990, 1993], the rate of bipedal scanning by adult female vervets decreased in the burned area, suggesting that female vervets did not perceive an increase in predation risk despite never having used the area previously. It is interesting that the two individuals whose rates of bipedal scanning actually increased in the burned area were males, who may have used the increased visibility afforded by reduced ground cover to scan for extra-group males and other vervet groups. Our findings are consistent with other studies which have shown that, when there is variation in vigilance behavior of males and females, females tend to scan for survival reasons (i.e. to detect predators) whereas males tend to scan for reproductive reasons (i.e. to detect other males) [e.g. Baldellou & Henzi, 1992; Boinski, 1987; Boinski & Mitchell, 1994; Cowlishaw, 1998].

Finally, it is possible that burned areas can provide vervets with unusual feeding opportunities. Although we did not collect systematic data on feeding behavior before or after the fire, we have some general observations that can shed light on this issue. Many primate species alter their ranging patterns in order to take advantage of seasonal increases in plant food availability [e.g. Baoguo et al., 2000; Olupot et al., 1997; Zhou et al., 2007]. The same explanation cannot be applied to the shift in ranging behavior of vervets into the burned area, however, because plant food availability decreased in the fire zone; all herbaceous vegetation and vegetation on woody plants were burned up. Although fire damage to *A. drepanolobium* stimulates growth at the bases of the trees, this takes time [Okello et al., 2001] and vervets began using the burned area before such growth could occur. Indeed, the vervets began using the burned area just days *after* the fire burned the vegetation in that area, which suggests they were not going there to eat plant foods. In addition, the vervets did not continue to go into the burned area but returned to their preburn ranging pattern within about 6 weeks after the fire, at about the time when new vegetation might be sprouting and growing.

Vervets were, however, attracted to some kind of food resource in the burned area because they spent significantly more time feeding in the burned area. We observed the vervets to concentrate their feeding in the burned area at the bases of *A. drepanolobium* trees. These trees house several species of ants, including *Crematogaster* spp, year round [Isbell & Young, 2007]. Interestingly, within about an hour of smoke inundation, *just before* a fire passes through, *C. mimosae* and *C. nigriceps* evacuate their domatia (the swollen thorns) in their host trees and take their brood to safety into crevices at the bases of the trees until the fire has passed and substrates become cooler [T.M. Palmer, personal communication]. Vervet monkeys eat arthropods in addition to plant foods [Isbell et al., 1998a, b; Isbell & Jaffe, in press] and such a concentration of acacia ants, temporarily unprotected by the hard casing of the swollen thorns, could be highly attractive to vervet monkeys. Our difficulty in clearly seeing the foods eaten by the vervets also suggests that they may have been eating ants (and perhaps other small arthropods), which are likely to be underestimated as food items in the study area because of their small size [Isbell, 1998; Isbell et al., 1998a, b].

Fires occur regularly in the kinds of habitats occupied by vervets [Gill et al., 2000; Heady & Child, 1994], and our results suggest that they are drawn to such areas. Vervets may perceive the lack of ground cover as a benefit, perhaps to better avoid predators and take advantage of unusual feeding opportunities.

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