

Notes on oil palm plantation use and seasonal spatial relationships of sun bears in Sabah, Malaysia

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The sun bear (*Helarctos malayanus*) is the least studied bear species in the world. As such, it is listed as “data deficient” in the 2002 International Union for the Conservation of Nature and Natural Resources (IUCN) *Red list of threatened species* (IUCN 2002). Sun bears are widely distributed throughout the tropical rain forests of southeast Asia, but many sun bear populations are declining because of hunting pressure and habitat fragmentation (Servheen 1990). In the Malaysian state of Sabah in the northernmost portion of the island of Borneo, the sun bear is listed as a protected species. Hunting, capture, or trade has been strictly prohibited by the Sabah Wildlife Department (Sabah Government 1997). The primary habitat of sun bears in Sabah is lowland dipterocarp forest (Davies and Payne 1982), which has been cleared and converted to settlement and plantations in many areas (Servheen 1990). Consequently, sun bears occasionally expand their ranges into human-occupied areas (Payne et al. 1985), attracted by plantation crops such as oil palm fruits (Servheen 1999). Therefore, sun bears are regarded as a plantation pest (Meijaard 1999a, Yasuma and Andau 2000). Nevertheless, details of their use of oil palm plantations are largely unknown.

Very little also is known about sun bear activity patterns and reproductive biology. Sun bears have

been observed to be active during both day and night (Payne et al. 1985, van Shaik and Griffiths 1996, Wong 2002), but data are limited. Some authors suggest that limited sexual dimorphism in body size indicates monogamous mating (Bunnell 1984, Ward and Kynaston 1995) and that female bears breed throughout the year (Ward and Kynaston 1995, Meijaard 1999b). Kurt (1990) stated that sun bears may live in groups of up to 4 members in addition to maternal families. More data from field studies are necessary to support these observations.

Study area

The Tabin Wildlife Reserve (TWR) is 1,205 km² and is located in the middle of the Dent peninsula in the eastern portion of Sabah (Fig. 1). Since it was designated as a wildlife reserve in 1984, all activities except scientific research have been prohibited in the reserve (Andau 1998). The monthly average temperature in TWR ranged from 20.6°C in February to 33.5°C in May; at Tomanggong Estate, 20 km north of TWR, the annual rainfall was 3,099 mm (Andau 1998). The climate of Sabah includes dry (Apr–Sep) and rainy seasons (Oct–Mar; Yasuma and Andau 1999).

Our study was conducted in the western portion of TWR. The forest in this area was a lowland mixed forest characterized by trees of the Dipterocarpaceae family dominated by *Shorea* and *Parashorea* species, with a patchy distribution of leguminous trees (e.g., *Koompassia excelsa*, *Intsia palembanica*, *Dialium* spp.), Borneo ironwood (*Eusideroxylon zwageri*), and figs. Pioneer species, such as *Macaranga* spp., *Anthocephalus chinensis*, and *Octomeles sumatrana*, which indicate recent heavy logging, also were dominant in the area (Yasuma and Andau 1999). The western portion of the study area was bordered by unpaved roads, a plantation of oil palm trees planted in 1986, and open areas cleared in recent years (Fig. 1).

Methods

Trap sites were selected along a forest road on the western boundary of the study area to enable us to check traps daily. We used barrel traps baited with honey to capture bears (Mano et al. 1990). Each captured bear was immobilized with a mixture of tiletamine hydro-

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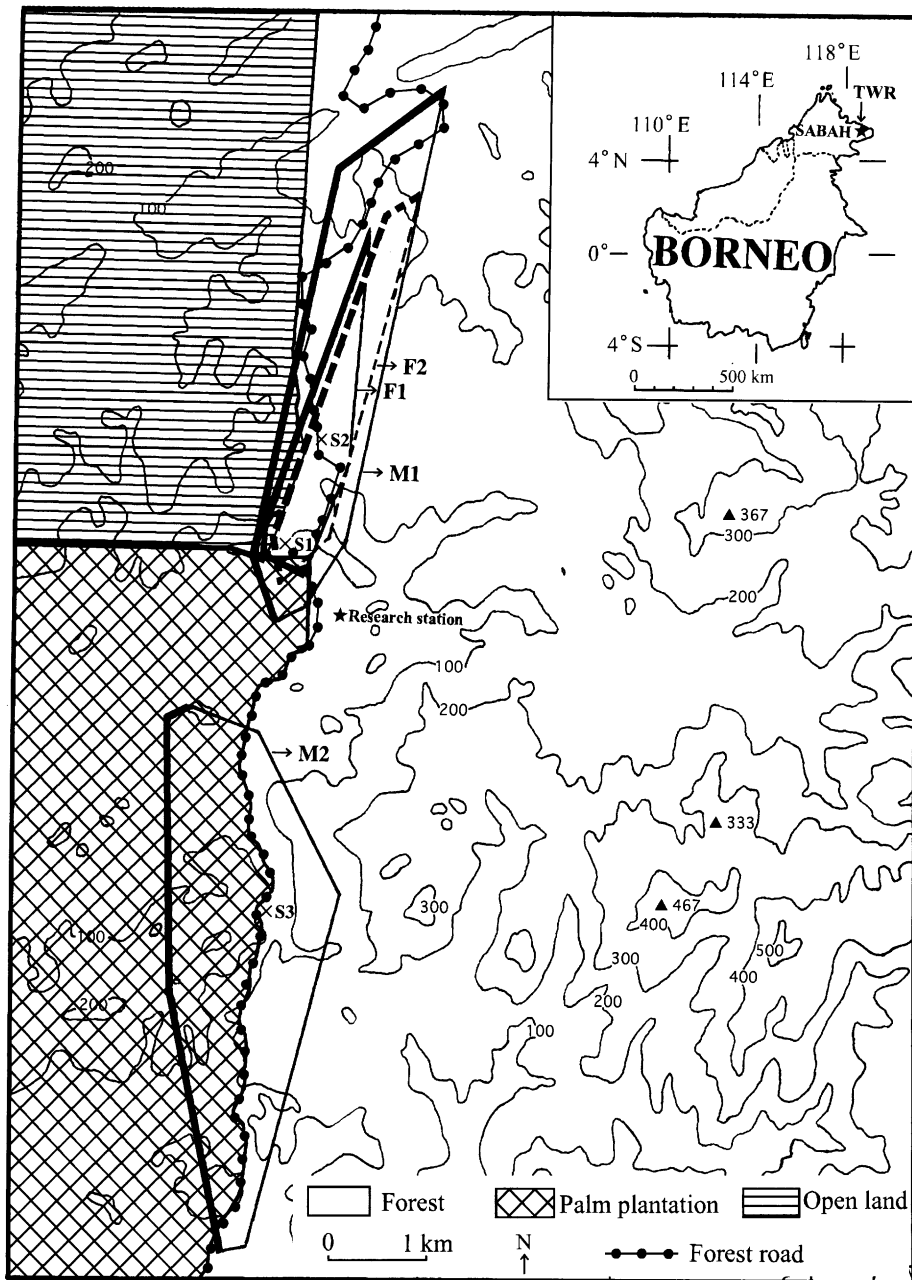


Fig. 1. Study area, Tabin Wildlife Reserve, Sabah, Malaysia, 1999–2001. Polygons show home ranges of bears in 2000. Radiotelemetry was conducted along the forest boundary road. Because radio signals often were not heard when they came from the forested side, the eastern margins (thin lines) of the home ranges are unreliable. S1–S3 represent trap sites.

chloride and zolazepam hydrochloride (Zoletil 100%, 10 mg/kg; Virbac, Carros, France), equipped with a 149 MHz radiocollar (Lotek, Inc., Ontario, Canada), and released at the trap site. Based on tooth wear, we judged that all 4 bears were adults.

We located the radiocollared bears by triangulation from forest boundary roads (Normua and Higashi 2000). We attempted to locate all radiocollared bears daily throughout the research period. In addition to daily locations, we examined radiocollared bears' presence on

Table 1. Information on radiocollared sun bears on the western boundary of Tabin Wildlife Reserve, Sabah, Malaysia, 1999–2001.

Sex individual code	Head–			Capture site (Fig. 1)	Tracking period
	Body mass (kg)	body length (cm)	Girth (cm)		
Male					
M1	59	124	80	S1	Mar 1999–Apr 2001
M2	47	123	72	S3	Nov 1999–Dec 2000
Female					
F1	39	104	76	S2	Jul 1999–Apr 2001
F2	35	108	72	S1	Jun–Jul 2000

the plantation by locating them twice (in the evening and before dawn) every night. We tracked all 4 bears only during 2000, and we generated home ranges based on 2000 data, using minimum convex polygons (MCP) (Mohr 1947). The distance between a radiocollared male and female was recorded daily whenever when we could locate both bears within 1 hour.

An automatic camera triggered by a passive infrared sensor (HOGA, Inc., Kyoto, Japan) was set near trap site S1 (Fig. 1), because footprints of sun bears were frequently found there. We attempted to take photographs of sun bears from 1999 to 2001 to document social units.

Results

Four bears were captured during 470 trap nights (117.5 trap nights/capture) from 1999–2000 (Table 1). The tracking periods of individual bears ranged from 2–26 months (Table 1). The radiosignal of the bear labeled F2 could not be heard approximately 2 months after deployment of the transmitter; the radiocollar likely was dropped in the interior portion of the refuge.

Twenty-four hour tracking sessions were conducted 5 times in 1999, 4 times in 2000, and twice in 2001 for M1 and F1 by locating them every 2 hours from sunrise (0600) to the following sunrise. The number of locations used to estimate home range sizes in 2000 was 48 for M1, 41 for M2, 23 for F1, and 11 for F2. MCP home-range sizes were 4.0 km² for M1, 5.1 km² for M2, 1.2 km² for F1, and 1.3 km² for F2. Radio signals from forested areas often were affected by complex topography and dense vegetation; open land and plantations had flat terrain, where signals could be detected up to 2 km.

We frequently located radiocollared bears in oil palm plantations at night, but never during the daytime (Table

Table 2. Locations of radiocollared sun bears on the western boundary of Tabin Wildlife Reserve, Sabah, Malaysia, 1999–2001.

Individual	Year	Day (0600–1800)			Night (1800–0600)		
		F ^a	U ^b	P ^c	F	U	P
M1	1999	55	80	0	10	81	71
	2000	41	63	0	10	70	62
	2001	12	30	0	0	40	19
	Total	108	173	0	20	191	152
M2	1999	12	15	0	3	8	10
	2000	9	26	0	7	27	34
	Total	21	41	0	10	35	44
F1	1999	23	45	0	18	57	12
	2000	33	65	0	14	91	32
	2001	29	26	0	13	34	24
	Total	85	136	0	45	182	68
F2	2000	9	9	0	0	17	9
	Total	9	9	0	0	17	9

^aF = Bears were successfully located in the forest.

^bU = Unknown.

^cP = Bears were successfully located in the plantation.

2). Bears moved into plantation areas up to 1.6 km west from the road located between the plantation and the forest.

We compared the duration of stay on the oil palm plantations for bears M1 and F1 based on 24-hour tracking periods. Bear M1 often moved onto the plantation soon after sunset and tended to stay after midnight. Bear F1 tended to move onto the plantation later and returned to the forest earlier than M1. Consequently, M1 spent more time and moved further onto the plantation than F1 (Fig. 1).

M1 and F1 remained very close to each other for a few days at the end of October in both 1999 and 2000, but they remained separate during other seasons (Fig. 2). F1 did not visit the plantation during February and March in 2000, although her radiosignal occasionally was heard near the forest margin. However, F1 frequently visited the plantation during the same months in 2001.

We took 48 pictures of bears, including 4 pictures of radiocollared bears. Forty-six of the photographs were of solitary animals. The remaining 2 were of a pair of adults and an unmarked female with a cub.

Discussion

The use of agricultural lands varies among ursid species. Grizzly bears (*Ursus arctos*) in North America (Servheen 1983) and Asiatic black bears (*U. thibetanus*)

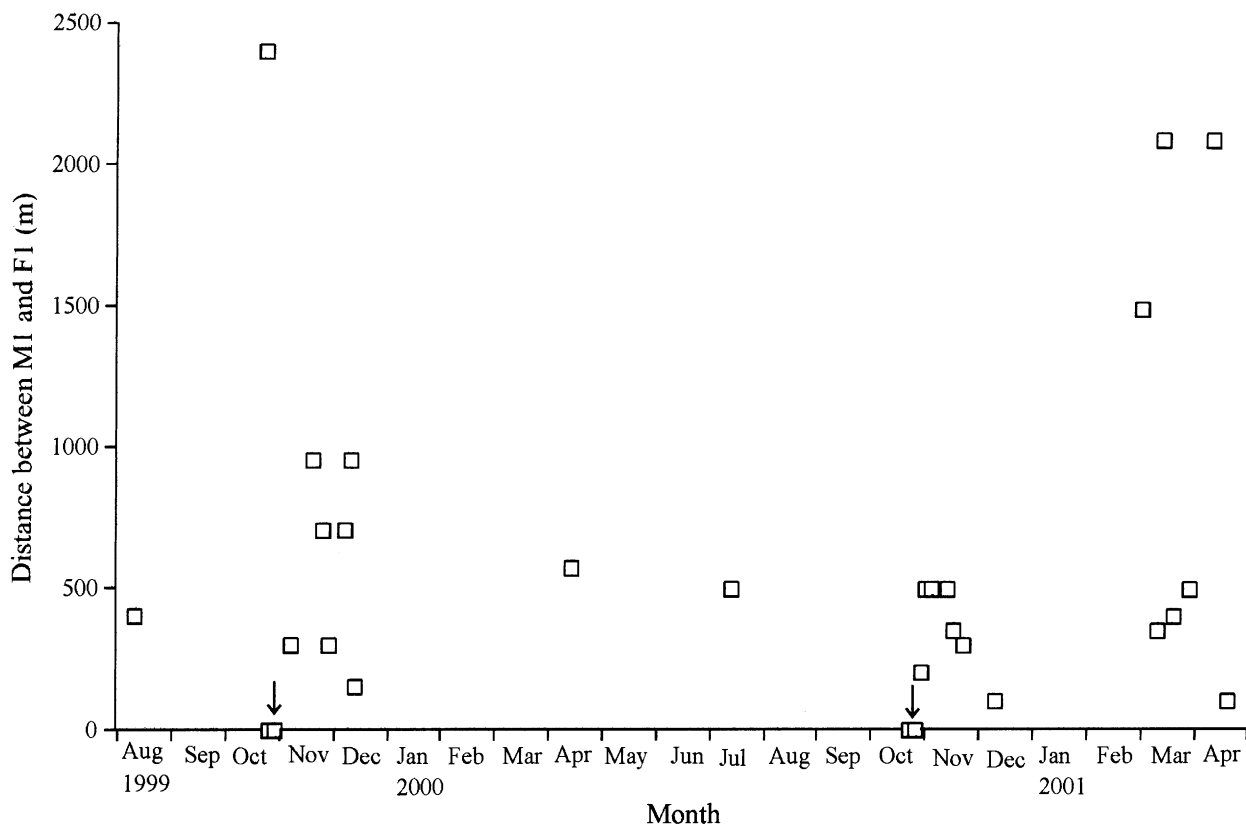


Fig. 2. Seasonal patterns of distance between a male (M1) and a female (F1) sun bear radiocollared at the western boundary of Tabin Wildlife Reserve, Sabah, Malaysia, 1999–2001. Symbols represent mean distances of sequential 3-day periods. The 2 bears accompanied each other during late October of 1999 and 2000 (arrows).

in China (Reid et al. 1991) frequently visit agricultural areas at night during fall, when agricultural crops become available. Sloth bears in Nepal (Laurie and Seidensticker 1977) and American black bears (*U. americanus*; McCutchen 1990) also use cultivated areas primarily at night, whereas Andean bears (*Tremarctos ornatus*) in Peru raided cornfields during mid-day if laborers were absent (Peyton 1980). Sun bears in our study used oil palm plantations only at night. We observed no use during daylight hours, even if laborers were absent. Sun bears may stay in the forests during daytime to reduce exposure to high temperatures (35°C).

For captive female sun bears, the concentration of progesterone may peak from early November to January (Onuma et al. 2001). We documented F1 accompanied by M1 at the end of October, and we speculate that F1 mated in 1999 and gave birth in 2000. Dathe (1970) observed that captive female sun bears give birth about 3 months after mating. Because female sun bears den while giving birth and for the first few weeks of rearing

their young (Ward and Kynaston 1995), the February–March 2000 absence of F1 could have represented a denning period. The segregation of M1 and F1 except during the assumed mating season suggests that M1 did not accompany the maternal family of F1. A maternal family photographed with the automatic camera also was not accompanied by a male bear. Finally, we did not find evidence of group formation as suggested by Kurt (1990).

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