

## COMMENTARY

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# Possible Costs of Radio-Tracking a Young Adult Female Mantled Howler Monkey (*Alouatta palliata*) in Deciduous Habitat of Costa Rican Tropical Dry Forest

Anna L. Hilpert and Clara B. Jones

*Department of Psychology  
Fayetteville State University*

The use of biotelemetry in vertebrate field studies is “ubiquitous” (Moorhouse & MacDonald, 2005). *Radio tracking*, one type of biotelemetry, is defined as “the use of radio-transmitters and receivers to record location information” (Honest & MacDonald, 2003, p. 158). Radio tracking, an invasive procedure, may have harmful effects on mammals, including water voles (Moorhouse & MacDonald) and black rhinoceros (Jewell, Alibhai, & Law, 2001; Neubaum, Neubaum, Ellison, & O’Shea, 2005). Although the disadvantages of radio tracking rarely have been addressed in the primate literature, radio tracking has been used extensively in studies of primates, in particular, of nocturnal prosimians (Honest & MacDonald). We attempted a preliminary measurement of the effects of radio tracking on one young, adult, female, mantled howler monkey, TC (*Alouatta palliata*; see Figure 1). Compared with adult females of the same social group who did not wear a transmitter collar, our results provide preliminary support for the conclusion that TC’s behavior, fecundity, and survivorship may have been affected negatively by her telemetry device.



FIGURE 1 The young, adult female, TC, wearing a transmitter collar (see arrow). Note the appendages of TC's infant on her back. ©Clara B. Jones.

## METHOD

This study was conducted in the deciduous habitat of tropical dry forest environment during 18 months in 1976 and 1977 at Hacienda La Páccifica, Cañas, Guanacaste, Costa Rica. Details of the study site, nonhuman animals (Group 12), and procedures are available elsewhere (Jones, 1980). Adult females were observed for a total of 114 hr, 10 min; the focal animal was observed for 39 hr, 50 min, and *ad libitum* for 74 hr, 20 min (Altmann, 1974). On January 5, 1976, the young, adult female howler monkey, TC, was immobilized and fitted with a transmitter collar (AVM SM-1 sending at 296 Mhz with a Model LA 12 receiver; AVM Instrument Company, Champaign, IL) to facilitate location of her group that resided on a home range characterized by limestone outcroppings (see Figure 1).

An ethogram was used to record the frequency of behaviors exhibited by TC and all other females in her group ( $N = 7$  adult females in Group 12; see Table 1). One subadult female was eliminated from analysis. The chi-square ( $\chi^2$ ) test of proportions was used to compare rates of adult female behaviors (frequency of behaviors per female per category divided by total frequency of behaviors exhibited by each female; see Table 1). The criterion was set at  $p \leq .05$ .

## RESULTS

Compared with other adult females in Group 12, TC exhibited statistically significant differences in her rate of subgrouping alone,  $\chi^2 = 16.25$ ,  $df = 6$ ,  $p \leq .02$ , and in

TABLE 1  
Ethogram Utilized for Raw Data Collection

Female	n	Behavior								
		Sit/Rest	Move	Feed	SGA	SGO	ISS	IOS	Fight	Copulation
PS	336	55	154	61	1	35	14	9	2	5
GY	236	25	125	43	0	27	12	3	1	0
GS	549	81	259	86	8	54	38	17	2	4
TC	274	36	124	50	7	36	14	4	3	0
RPS	457	90	192	54	1	61	22	26	5	6
RS	378	52	164	65	8	50	30	8	1	0
YPS	371	66	171	72	8	34	4	13	1	2

*Note.* See the Method section for more details. Numbers are frequencies of behavioral events per female ( $N=7$ ). Females listed in order of dominance rank, from highest to lowest ranked (Jones, 1980). SGA= subgrouped alone; SGO = subgrouped with others; ISS= interact with same (adult) sex; IOS = interact with opposite (adult) sex; copulation = copulations and copulation attempts; PS = highest ranked; YPS = lowest ranked.

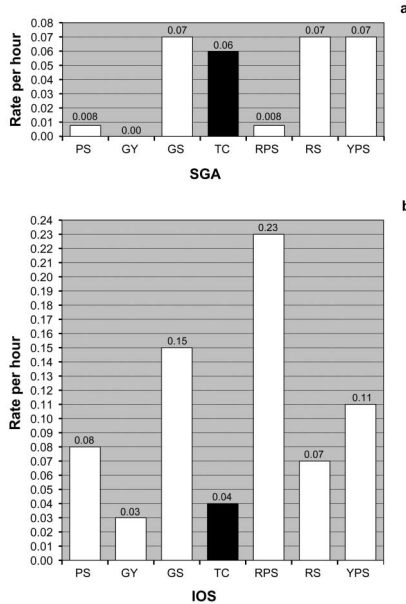


FIGURE 2 Rate of expression of two behavioral events: (a) subgroup alone (SGA) and (b) interact with opposite sex (IOS). Rates for TC are displayed in black bars. White bars represent rates for all other females. Females are presented in order of dominance rank from highest (PS) to lowest (YPS; Jones, 1980). See RESULTS section for further explanation.

her rates of interaction with adult males,  $\chi^2=27.89$ ,  $df=6$ ,  $p \leq .001$  (see Figure 2). No other comparisons were statistically significant. That three other females showed a statistical increase in frequency of subgrouping alone (see Figure 2) and that the second-ranked female was less likely to interact with adult males than TC indicate that multiple factors affect the behavioral repertoires of female *A. palliata* (presence or absence of an infant, dominance rank).

Our analyses revealed, in addition, that TC and her juvenile (born January 1976) disappeared from their group by March 1977 (Jones, 1980). Because other females often expel howler females from their groups (Crockett, 1984; Jones, 1980, 2004), it is possible that TC's disappearance was a result of agonistic interactions among females that may have related—directly or indirectly—to her transmitter collar. Although young female *A. palliata* may enter groups for brief periods before leaving (M. R. Clarke, personal communication, January 20, 2005; C. Jones, Group 12), this phenomenon is not associated with reproduction and thus cannot explain TC's disappearance with her infant.

Consistent with the conclusion that TC may have experienced agonistic relations with other group females, TC exhibited a high—although insignificant—rate of fighting (see Table 1) compared with most other adult females in Group 12. Furthermore, TC, a young female, failed to rise to dominant rank (Jones, 1980), indicating that she was unsuccessful socially. Mantled howler females in tropical, dry forest environment exhibit an age-reversed dominance system whereby young females occupy the highest positions in the female dominance hierarchy (Jones, 1978, 1980). The presence of a transmitter collar may have exacerbated TC's social subordination and increased the likelihood of ejection from her group.

## DISCUSSION

Future studies on the effects of biotelemetry on primates require a larger sample size, including between-group observations and a within-subject design whereby an individual's behavior is compared before placement of a device, while wearing a device and after a device has been removed. The method used in this research relied on opportunistic measures. Nonetheless, our findings are consistent with the interpretation that a transmitter collar may have deleterious effects on a female howler's behavior, fecundity, and/or survivorship—similar to conclusions that have been made in regard to other mammals (Jewell et al., 2001; Moorhouse & MacDonald, 2005). These investigations potentially are important to researchers because biotelemetry requires the additional risks of animal immobilization (Cooke et al., 2004). TC was more likely than were other adult females in her group to be subgrouped alone and less likely to interact with adult males, suggesting that her social behaviors were affected more than nonsocial and/or maintenance activities (see Table 1). Supporting this view is the observa-

tion that TC disappeared from her group with her offspring, probably leading to her death because secondary dispersal is rare in this species (Glander, 1992).

## SUMMARY

Field experiments are required to determine the causes of the patterns identified in this report and their potential threats to the internal validity of field studies on mantled howlers. The literature on biotelemetry suggests that radio collars are likely to have deleterious effects on animals when a radio collar exceeds 5% of body weight—"the 5% rule"—(Cooke et al., 2004; Neubaum et al., 2005). Because all adult females in Group 12 wore identification collars and tags (Jones, 1980), however, a partial control was incorporated in this research (Gauthier-Clerc et al., 2004). Ultimately, the benefits of using transmitter collars must be weighed against the costs (Cooke et al., 2004), including the important issues of scientific significance, research ethics, and animal welfare.

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