

## COMMUNICATION

### Dry season activity, movement, habitat and den utilization of nine-banded armadillo (*Dasypus novemcinctus*) in neotropical dry forest, Costa Rica

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Received 26-XI-1998. Corrected 10-VI-1999. Accepted 16-VI-1999.

**Resumen:** Se estudió el armadillo (*Dasypus novemcinctus* Linnaeus) en Palo Verde, Costa Rica (10°30'N y 85°30'W) equipando siete animales con radiotransmisores. No hubo actividad en 0600-1500 h y ésta fue máxima en 1800-2100 h (95%). Los desplazamientos nocturnos fueron de 421.4 m (223-835 m). Seis individuos usaron 14 madrigueras en cuatro tipos de hábitat.

The nine-banded armadillo (*Dasypus novemcinctus* Linnaeus) has the greatest range and is the most studied of the 20 Dasypodidae species (Galbreath 1982, McBee & Baker 1982). It is an important food source for humans and wildlife in Central America, but no ecological information exists there for management purposes (Carrillo & Vaughan 1994). For these reasons, research on activity, movements, habitat and den use of nine-banded armadillos was carried out in Palo Verde National Park (PV), a tropical dry forest life zone located in northwestern Costa Rica (10°30'N and 85°30'W)(Vaughan *et al.* 1982). For detailed information on PV, see Vaughan *et al.* (1982). Seven nine-banded armadillos were captured by lifting them up by their tails as they foraged. Each armadillo was measured, weighed and individually marked with a painted number. A "radio telemetry package" was attached with Super Glue epoxy to the lower rear portion of the previously sand papered shell. This radio was constructed by the senior author. It consisted of a SM1 transmitter (AVM Telemetry Company, Dublin, California), two 1.74 volt

alkaline batteries (estimated 4-month life expectancy), all covered with a beeswax-paraffin mixture and encased in dental acrylic. An external antenna 15 cm long was soldered to the radio package at the antenna contact. Armadillos were freed at capture sites within two hours of capture. Radio-telemetry data was taken hourly for 24 h periods; data collection, vegetation mapping and data analysis followed McCoy *et al.* (1990) for *Tayassu tajacu*. Diurnal radio signals from inactive study armadillos led us to den locations. Home ranges were not calculated because of the limited data set.

Three adult males, 3 adult females and one juvenile female nine-banded armadillos were studied from February 25 to March 30, 1982. A total of 432 telemetry "fixes" (18 days of 24-hour time periods) were analyzed for activity, while 227 data points (16 days) between 1600-0600 h were analyzed for movement and habitat use (Table 1). *Activity Patterns:* Based on 432 data points, there was no activity between 0600-1500 h, activity was low between 1500-1800 h (sunset)(24%), maximized between 1800-2100 h (95%), 2100-2400 h (78%)

TABLE 1

Characteristics of nine-banded armadillo (*Dasypus novemcinctus*) weight, movement, habitat use and den use in Palo Verde National Park, Costa Rica. February-March 1982

	Sex	Wgt (kg.)	Points (# days)	Movement (m/night)	Habitat use EF/P/OP/GT/E	den use
101	F	4.75	73(5)	590,330,328,487,785	73/0/0/0/0	4-EF
102	F	2.85	14(1)	835	0/14/0/0/0	1-P
103	M	2.95	13(1)	223	0/0/13/0/0	2-OP
104	M	3.30	55(4)	233, 225,440,133	0/0/0/55/0	1-YT
105	F	3.75	17(1)	308	0/17/0/0/0/	
106	M	4.24	29(2)	388,200	10/-P	3-P,1-EF
108	F	3.37	26(2)	378,328		1-P,1-EF
Total			227(16)			

Key: EF-evergreen forest, P-pasture, OP-overgrown pasture, GT-young thicket, E- between EF/P

and 2400-300 h (76%) and fell between 0300-0600 h (45%). Bider (1962) also found *D. novemcinctus* active between 1700-0400 h, peaking between 2100-2200 h. McDonough and Loughry (1997) found *D. novemcinctus* active throughout 24 h cycles, maximum at sunset. Armadillos in this study normally entered their burrows about 0600h, spending daylight hours inactive; only on three occasions were unmarked individuals observed foraging diurnally. The harsh, dry season climate (no rainfall was recorded during the study period) probably influenced low diurnal activity. Clark (1951) observed armadillos in Texas foraging at 1430 h during extreme dry periods, attributing it to food scarcity, while Kalmbach (1943) calculated that rainy, cool, windy climates induced arthropod activity, triggering armadillo activity. **Movement:** Nightly movements averaged 421.4 m and ranged between 223-835 m (n = 16, S.D. = 167.1 m) with females moving significantly greater distances than males 485.4 m (n = 9) vs 263.1 (n = 7)(p< 0.005). These nightly movements were greater than the 387 m, 233 m and 383 m reported by Clark (1951), Fitch *et al.* (1952) and Layne and Glover (1977) respectively from studies in North America; however, environmental and methodological differences between studies (time of year, climate, radiotelemetry vs direct observation) make comparisons difficult. **Habitat uti-**

**lization:** Four habitat types were mapped in the study area: 1) evergreen forest (EF) categorized by ojoche (*Trophis racemosa*), yos (*Sapium theolcarpum*) and tempisque (*Mastichodendron capiri*); 2) overgrown pasture (OP) characterized by jaragua grass (*Hyparrhenia rufa*) grass with scattered guacimo trees (*Guazuma ulmnifolia*), cornizuelo (*Acacia cornigera*), and poroporo (*Cochlospermum vitifolium*); 3) mowed pastures (P)(grasses) surrounding the administration area (a swampy pasture formed in a lowland area), and 4) a 4-5 year old thicket of guacimo (GT)(*Guazuma ulmnifolia*) trees (Table 1). Each of five armadillos used one habitat type (all different) while #106 and #108 moved between EF and P, utilizing their edge on 21% of the observations. Use by *Dasypus* of more than one habitat type has also been documented by Fitch *et al.* (1952) and Taber (1945). **Den utilization:** Six individuals used a total of 14 dens (n = 2.3 dens each) in four different habitat types (Table 1). Jacobs (1976) calculated an average four dens per armadillo in Mississippi. Armadillo #105 used a black iguana lizard (*Ctenosaura similis*) den for an emergency escape. Clark (1951) found *D. novemcinctus* shared dens with cotton mice (*Sigmodon hispidus*), common opossum (*Didelphis marsupialis*) and spotted skunk (*Mephitis mephitis*). In this study, a male and female armadillo shared dens; Kalmbach (1943)

discovered the same during the breeding season in Texas. Carter and Encarnaga (1983) thought armadillo dens in Brazil fulfilled thermoregulatory and protective functions.

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