

Rainy Season Herding Patterns of Agro-Pastoral Livestock Smallholders in Southwestern Mali: A Preliminary GPS-Based Assessment

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Introduction

Smallholder livestock production in Mali's rain-fed agro-pastoral systems is strongly limited by deficient levels of ruminant feeding (Cibils et al. 2015). Crop cycles frequently dictate access to common grazing resources giving way to the *smallholder's paradox*. During the rainy season when quality and quantity of forages are highest, access to common grazing lands is extremely restricted because smallholders seek to minimize the risk of crop damage liability. Conversely, during the dry season, when forages are dormant and scarce, mobility and grazing access is unrestricted. Herders (often children) can further constrain ruminant foraging choices when deciding *where* and *for how long* animals graze. The objective of this pilot study was to characterize movement and activity patterns of herded GPS-collared ruminants during the season with highest movement/access constraints.

Materials and Methods

Six animals were fitted with a Garmin ETrex Legend GPS receiver connected to a double D cell battery pack, placed in a watertight box mounted on a polyethylene strap. Three small adult ruminants (a doe, a ewe, and a ram) and three large adult ruminants (two oxen and a cow) belonging to farmers in a village located close to Koutiala, region of Sikasso, Mali, were tracked for a week in September 2015. GPS receivers were configured to log animal locations at 1 min intervals. All GPS receivers were WAAS enabled insuring fix location precision of ≤ 3 m. At end of the week, collars were retrieved, and data were downloaded for mapping and analysis.

Location data were projected in UTM 19 N zone coordinate system and were explored in Google Earth™ and MS Excel. We calculated time at which tracked animals left and returned to the village in the mornings and evenings; total time of each daily herding circuit (h); and distance traveled in a day (km). GPS points were classified into presumed activity classes based on known movement velocities of common animal activities (resting, grazing, and traveling). Small ruminants were presumed resting, grazing, or traveling if their velocity was < 0.5 m/min, between 0.5 and 5 m/min, or > 5 m/min, respectively. For large ruminants, velocities of < 1 m/min, between 1 and 20 m/min, or > 20 m/min were presumed to indicate resting, grazing, or traveling, respectively. Means and standard errors for all parameters were calculated in MS Excel. Pearson Correlation Coefficients were calculated using PROC CORR in SAS 9.3 (SAS Institute, NC) to determine the relationship between estimated time spent grazing while being herded and both distance of the herding route and daily herding time. Correlations were declared statistically detectable at $P \leq 0.05$.

Results

Two collars malfunctioned, so we analyzed data retrieved from four of the six GPS collars (two large and two small ruminants) which yielded 29,010 GPS locations. Large ruminants left the village approximately 3 h earlier and returned almost 1 h later than their small ruminant counterparts. Large ruminants spent 4

additional h in the field and traveled about 4 additional km each day compared to small ruminant counterparts. Large ruminants grazed for over 7 of the 12.6 h they remained in the field each day whereas small ruminants grazed for less than 3 of the 8.8 h of their daily herding route (Table 1).

Table 1. Characterization of smallholder herding patterns during the rainy season in an agro-pastoral village close to Koutiala, Mali. (Means ± SEM)

		Large Ruminants	Small Ruminants
Individuals tracked		2	2
Tracking period (days)		5.5 ± 0.5	4.5 ± 0.5
Total GPS fixes		16,106	12,904
Daily Herding	Began	6:22 AM	9:21 AM
	Ended	7:01 PM	6:10 PM
Daily Herding Time (h)		12.66 ± 0.10	8.81 ± 0.23
Daily Distance Traveled (km)		11.76 ± 0.60	7.95 ± 0.14
Activity During Daily Herding	Grazing (h)	7.36 ± 0.59	2.75 ± 0.16
	Resting (h)	1.56 ± 0.08	1.41 ± 0.33
	Traveling (h)	3.76 ± 0.42	4.76 ± 0.25

Increased distance of daily herding routes was associated with detectably less time spent grazing by large (P=0.02) but not small (P=0.17) ruminants (Fig. 1). Longer daily herding time was associated with significantly more time spent grazing for small but not large ruminants (Fig. 1).

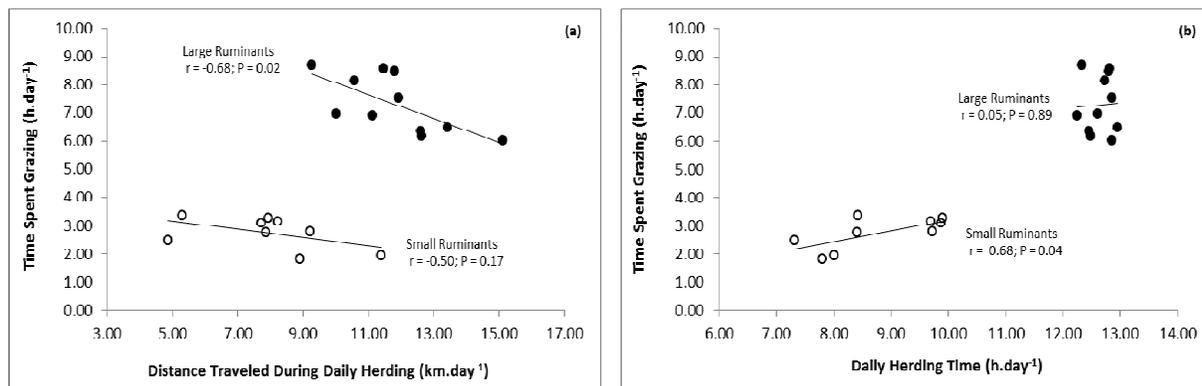


Figure 1. Hours per d spent grazing by large and small ruminants in relation to distance traveled during daily herding (a) and duration of daily herding (b) during the rainy season in village close to Koutiala, Mali (number of points corresponds days*animals).

Discussion and Implications

Estimates of time spent grazing by large ruminants in this study are comparable to what Arnold and Dudzinsky (1978) described for free ranging cattle (7–12 h d⁻¹) but considerably less than what these authors observed in free ranging sheep and goats (6–10 h d⁻¹). Our estimates suggest that during the rainy season, large and small ruminants from the herds we monitored were possibly able to harvest about 90% and < 50% of their daily dry matter requirements, respectively, while being herded on common rangelands adjacent to the village.

References

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