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Short communication

Following the Afar: Using remote tracking systems to analyze pastoralists' trekking routes

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ABSTRACT

For nomadic pastoralists in arid environments, judicious migration of the herds is the principle strategy for short term survival and long term sustainability. Yet, this efficient mechanism is increasingly challenged by mounting population pressure, appropriation of land and restricted transboundary movements. Lack of information on trekking patterns and grazing areas makes it difficult for government authorities to protect the migration routes. Data are so scarce because the object of measurement is moving in directions no outsider can predict. Consequently, data collection is costly and laborious. The present study suggests the use of satellite telemetry to trace trekking routes in a near real-time mode that can operate without the presence of external observers on the ground. We report on a pilot that tests a remote tracking technique to locate the routing of a nomadic pastoralist during the dry spell, in the Afar region of Ethiopia. From a movement analysis we infer trekking routes and grazing areas as well as the spatial and temporal correlation between the vegetation cover index NDVI, and the visits by the herd. Our first results seem encouraging in that our data collection method can produce unique information relatively quickly and at low cost.

1. Introduction

Since ancient times migration at regular intervals between homesteads and grazing areas has been the pastoralists' main strategy to cope with fragile ecological conditions and recurrent droughts in arid environments. Migration also offers options to find the best forage places and watering points, hence promoting sustainability (Desta and Coppock, 2004). However, in arid lands population growth and appropriation of land for irrigation (Hundie, 2006) have caused pressure to mount, with overgrazing and violent conflicts among land users as most visible symptoms (Rass, 2006). Moreover, the development plans for massive expansion of biofuel plantations (Biopact, 2007) on 'marginal' drylands can be expected to restrict further land's accessibility to pastoralists.

Afar State in North East Ethiopia is a good case in point. This region (kililoch) hosts 1.5 million people, 78 per cent of which are pastoralists. Some of these pastoralists migrate along the seasons between a permanent base and distant grazing areas in semi-nomadic conditions, while the pure nomads among them move without a fixed homestead (CSA, 2003). These movements are based on cautious decisions that capitalize on all perennial and current information by choosing trekking routes that can make best use of the forage expected to be available on the way. However, accessibility to rangelands and watering points has increasingly been hampered by the expansion of sedentary agricultural settlements along the Awash River. The implementation of the state-owned Tenaha sugar plantation and increasing incidence of contested territorial claims by different ethnic groups from outside the region (Rettberg, 2008) are two prominent examples of new barriers to migration. Consequently, the Afar land held under shared property increasingly suffers from a 'tragedy of the commons', putting under considerable strain the traditionally efficient arrangements among clans to solve their conflicts. New regulatory and tax legislation that discourages traditional transboundary movements to Djibouti and Eritrea, has further heightened the tensions in the region (Ame, 2006). Furthermore, this already troublesome situation is likely to worsen if predicted future climate change materializes resulting in an overall reduction in soil moisture, while rainfall patterns become more erratic (Thornton et al., 2006). Finally, although current plans for expansion of biofuel plantations of sugarcane and Jatropha shrubs would open new economic prospects for the Afar region, they will also encroach further on the land available to pastoralists (Bekele, 2007).

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The intricate nature of collective decision making in nomadic societies makes it particularly important for government to safeguard the access of pastoralists to rangeland resources. This deserves priority as current partitioning of common property land threatens the coping strategies of its pastoralists. The distribution of property rights resulting from the partition also has indirect distributional effects as it creates new monopoly rents on resources such as wells and fertile land. For example, Getachew (2001) describes how land reforms among the Afar undermined clan solidarity as leaders appropriated the larger and better parcels. In addition, common infrastructure of water points and hay storages should be developed, while enforcing to the extent possible the longer term sustainability of ranging practices. This is a delicate task that should attribute due weight to prevailing ecological thresholds as well as to the inflammability of interactions between different land users and the fragility of the socio-economic conditions of each.

Consequently, interventions have to be particularly subtle, considerate and well planned. They will, therefore, benefit from reliable information on the spatial–temporal dimensions of migration patterns so as to identify the calendars of trekking along particular routes and the areas of concentrated grazing activity. These data can be related to more widely available information on changes in vegetation cover during the season, presence of watering points, territorial claims by various stakeholders, the road pattern and the location of market places.

Surprisingly, information on the spatial dynamics of livestock migration tends to be reported on through narratives that describe herd movements in general terms but do not pinpoint actual movements. This is understandable since on the ground data collection on nomadic routes by traditional methods requires continuous presence of at least one observer per herd for extended periods of time, to cover the trekking strategies that anticipate the inter- and intra-annual climatic variability. To account for the variability of agro-ecological factors (e.g. soil, landscape, vegetation), of rangeland management systems and of the various herd compositions these observations should be collected among a sufficiently large number of herders. This is not only costly but could also bias the experiment due to the physical presence of an external observer, whose personal safety needs to be guaranteed.

The present study proposes a telemetric technique that circumvents many of these difficulties by replacing an external observer with a physical device. Specifically, we report on a pilot that uses a Platform Transmitter Terminal (PTT), carried by a single herder that gives a real-time signal on his time and location to a satellite system. These satellite based location and data collection services are commonly applied in scientific disciplines of wildlife management and ecology (e.g. Coelho et al., 2007) to analyze movements of free ranging animals (Cushman et al., 2005; Nussberger and Ingold, 2006) and migratory species in avian (Diebold et al., 2008) and marine (Aarts et al., 2008) studies.

The positional location of the herder in our experiment will also be related to widely available data on the Normalized Difference Vegetation Index (NDVI), derived from 10-day aggregated images (1×1 km) of the VGT2 instrument carried by the SPOT-5 satellite. The NDVI data provide information on grazing sites and occurrence of water resources (Geerken et al., 2005), which are clearly essential drivers of herd migration. Hence, the objective of this study is twofold. First, we test the use of the telemetric technique and its suitability to track and characterize nomadic routes in terms of distance, direction, speed and areas of grazing intensity, using statistical measures and graphically. Second, we analyze the interaction between herd positions and changes in NDVI where we check, in particular, whether the herds visit more suitable sites, and also the extent to which their grazing affects these sites.

The herder selected lives in the sub-province Zone 1, district (Woreda) Ayssaita, in the neighborhood association (Kebele) Mamulei/Kufrelie, and manages a herd of 75 heads (5 camels, 35 cattle, 25 goats, 10 sheep). The monitoring lasted from 30 October to 10 December 2007, during the dry season. The bimodal rainfall pattern in the Afar has in general small (dadaa and sugum) rains in March and April, whereas the main (karma) rains last from July to August.

This pilot is an early step of a comprehensive research program that aims to assist policy makers in the formulation of development options for pastoralists in the Afar region under different scenarios of non-pastoralist development and climate change. It specifically considers ways to minimize the tensions between sedentary agricultural initiatives and pastoralist communities, such as safe passages through large scale plantations so as to guarantee unrestricted access to rangelands that might become unapproachable otherwise.

The paper proceeds as follows. Section 2 explains the functioning of the telemetric system and provides some details on the beacon. Section 3 reports on the result from the single herder pilot. Section 4 describes how the pilot is to be expanded to a full survey, with due consideration of pastoralist interests.

2. The Argos system: how it works

The PTT receives its geographic coordinates from GPS satellites and transmits this information to a polar orbiting Argos satellite that picks up the signals and stores them on-board. The Argos satellite relays the information, in a near real-time mode, to a radar system that forwards the data to the CLS (Collecte Localisation Satellites, Montpellier) processing center where the data are made available on line. The accuracy of positional data from the GPS satellites is within a radius of 15 m.

The PTT is an MAR-YX transmitter with a diameter of 150 mm, 480 mm height (with antenna) and a weight of 1.6 kg. It can operate under extreme temperature conditions from −20 to + 50 °C and is water resistant. It uses non rechargeable lithium batteries that last for 50–150 days depending on data transmission intensity. To reduce energy requirements and to optimize the chance of successful reception by satellite the PTT is programmed to transmit every 2 h, as this offers the best compromise between monitoring of activities and frequency of satellite overpasses. Positional data are made available on line and can be downloaded as tables or google-earth compatible.kml files.

3. Results

The experiment took place in the months October until December 2007, and falls within the large dry season in the Afar that lasts from September until March. At the start of the reporting period incidental rains were observed in the sub-province where the herder resides (FAS, 2008).

During the reporting period, the positional data were transmitted at irregular intervals, most likely because the antennae was covered and not well exposed to transmit its signals. On average, 8 signals per day were transmitted with a standard deviation of 2.9.

In this dry season, herd movements were characterized by daily returns to the homestead. Limited availability of watering points that prevents migration over larger distances was mentioned by the herder as the main reason for the daily returns. The maximum daily distance to the stable was less than 1 km, in 40 per cent of the reported days, varied between 1 and 5 km in another 40 per cent and was more than 5 km in the remaining 20 per cent. The average daily maximum distance covered was 9.3 km while a minimum of 0.18 km and a maximum distance of 38.9 km were reported. In