The peatlands of Lesotho – an important ecological and socio-econmic resource

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Summary

The peatlands in the highlands of Lesotho are ecologically and economically significant. The peatlands are soligenous fens, formed in valley bottoms and side slopes, typically at elevations above 2,400 m. The peat depth is commonly 1-2.5 m. The peatlands are an integral part of the mountain landscape, and provide subsistence and other livelihood benefits to the rural communities. Overgrazing has caused severe gulley erosion in the peatlands, which threatens the integrity of the wetland systems. Effective conservation and management are needed to sustain the capacity of these wetlands to provide ecological functions and societal values.

Key index words: Lesotho, wetland, mountain peatlands, fen

Introduction

Peatlands such as those that occur in Lesotho are rare on the African continent. The wetlands have formed in high elevation valley bottoms and side slopes, reflecting the availability of water, productive vegetation and an adequate growing season to sustain mire development. These conditions have also yielded productive pasture land. These wetlands, along with the surrounding uplands, comprise range lands that are integral to rural livelihoods. Peatlands are generally recognized as a significant reservoir of carbon with implications to the global carbon cycle, and the Lesotho peatlands are no exception. Unfortunately, the majority of the wetlands have been seriously degraded, through compaction and gully erosion, primarily as a result of overgrazing. Our objective is to synthesize the limited information about these wetlands in an effort to: (a) document the importance of these wetlands as an ecological and economic resource that merits effective conservation and management, and (b) establish a basis for developing effective restoration and land management measures that will benefit the communities who depend on these lands to sustain their livelihoods.

Physical setting

The peatlands occur primarily in the Lesotho highlands, or Maluti mountains, which are comprised of three ranges, the Thaba-Putsoa, Central, and Qathlamba (Drakensberg). The Maluti mountains are developed in a highly dissected basaltic plateau. Two vegetative zones are recognized within the Maluti mountains, the sub-alpine or scrub forest / high veld transition zone (2,150-2,900 m a.s.l.) and the alpine or altimontane zone (2,900-3,482 m a.s.l.) (Backéus, 1988). The high veld transition zone is characterized by grasslands, and the altimontane by sclerophyllous heath communities (Backéus, 1988). Wetlands are common, and occur as seeps on the valley mid-slopes and as peatlands on the valley floor. The mean annual temperature in the highlands varies between 6 and 11°C, and the mean annual precipitation varies between 600 and 1,300 mm. The precipitation regime is not evenly distributed throughout the year; most of the precipitation occurs as rain during the spring and summer, with winter being characterized as cold and relatively dry with occasional snow cover. The Lesotho highlands are significant to the hydrology of Southern Africa because they form the headwaters of the Senqu (Orange) River, which flows through Lesotho, South Africa, Botswana and Namibia. Though Lesotho makes up only 3% of the total Senqu/Orange River catchment, it provides more than 40% of the river's annual flow.

Socio-economic setting

The use of the highlands is governed through a communal land tenure system. The principal chiefs are traditional leaders who have delegated authority to assign usage of the land. The communities consist of small rural villages, with the majority of the families in poverty. Each family typically has a small field to grow maize and/or sorghum.

Many families also keep a small herd of cattle, sheep and goats which are sustained primarily from forage derived from open rangelands. Grazing areas are assigned to a family, and a single herd-boy manages the livestock while on the range. The highlands are used, almost in their entirety, for livestock grazing; usage is heaviest in the summer, but the range does experience year-round use on the mid-elevation zones.

Approach

We have focused on wetlands in three areas of the Lesotho highlands (Butha-Buthe, Mokhotlong, Quthing) to address the linkages between environmental sustainability and rural community well being. These areas were selected because they are representative of the high elevation peatlands that have experienced serious gully erosion, and that have communities that are dependent on the range resources. Four to five peatlands in each area were surveyed for peat depth, morphology, disturbance condition, and assessment of the hydrogeomorphic setting. We were able to core to depth of 2.5 m; some peat exceeded that depth. To assess the socioeconomic values of the peatlands we reviewed the population and livestock census statistics for a 16 km radius at each of the sites. This radius was chosen because it was within the typical distance that herders and other users traverse for access.

Discussion

The peatlands

The peatlands in the Maluti mountains are soligenous fens. We recognized two geomorphic settings, valley-head peatlands and valley-side slope peatlands (Fig. 1). The valley-head peatlands are formed on top of lacustrine sediments, which were deposited either in a spring or small pond. The survey transects indicated that the peat initiated on the lacustrine sediments, and then spread down-slope and horizontally. The peat was highly humified (i.e. sapric), herbaceous organic matter; the depth averaged 1.9 m. When there was an abrupt transition from the headwall, the peat depth could be >1m at the interface. The water to support the valley-head peatlands is derived from underlying springs and runoff from the adjoining uplands (Fig. 1a). There was no evidence of woody material in any of the peat cores. Charcoal was abundant throughout the peat column indicating frequent fires.

The valley-side peatlands occur on the longitudinal side slopes (Fig. 1b). The valley side slopes are typically steep, 5-10 %, with a layer of colluvium over bedrock. The peatland originated where the surface and shallow sub-surface runoff discharged at the base of slope, as the peat is typically thickest at the base. The peat then appears to have aggraded up-slope, as a result of surface water discharging further upslope due to the reduced hydraulic conductivity of the peat at the toe slope. These peatlands are typically asymmetrical with respect to the valley; the apex is abutted to one side with a steep side slope (e.g. >15%) and peat forming over colluvium on the opposing slope (Fig. 1b). The peat effectively in-fills the base of the valley and the thickness diminishes from the valley bottom towards upslope. These peat cores commonly had gravel lenses in the lower (> 50 cm) portion of the solum, demonstrating episodic erosion or landslide events. There were few gravel layers in the upper peat, indicating a period of slope stability; there are contemporary alluvial fans on the peat surface from current erosion. These peat cores also showed evidence of frequent fires. These peatlands are maintained hydraulically from upslope runoff, and may be functionally connected to the valley-head peatlands.

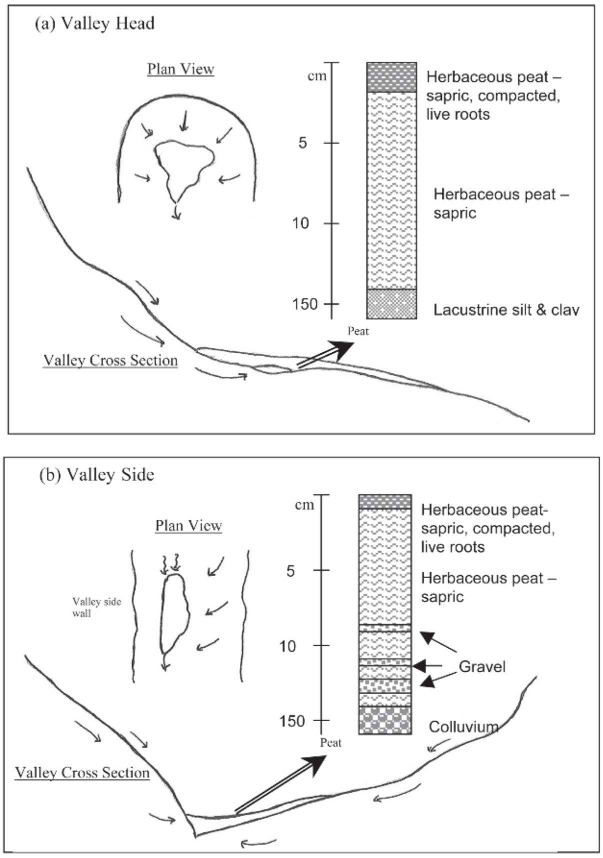

Figure 1. Schematic of the landscape setting of the (a) valley-head peatland and (b) valley-side slope peatland in the Maluti mountains. The cross-section depicts the peatland relative to the valley; the inset above depicts the plan view with the peatland relative to the valley watershed divide. Arrows indicate direction of surface and shallow sub-surface flow. The morphology of the peat is depicted by the stratigraphy inset.

Both of these peatland settings are maintained by surface and shallow sub-surface runoff from upslope, which occur as sheet flow. Accordingly, they have developed as a result of dispersed hydrologic inputs. Although there were few examples, transmission through intact peatlands occurs as sheet flow. Observations from other high-elevation peatlands in Lesotho have termed the peatlands as bogs (van Zinderen Bakker, 1955; Jacot Guillarmod, 1962); however, the narrative from those works suggests fen systems, and our work found no evidence of bog peatlands. Studying several mires at lower elevations, Backéus (1988) clearly showed that those systems were oligotrophic fens.

Peatland disturbance

Erosion is the environmental disturbance regime that characterizes Lesotho (Showers, 2005), and the peatlands are no exception. The majority of the peatlands are impacted, primarily by overgrazing. The most consequential effects are gullies through the peatland; once formed the gully functions to drain the peatland (Fig. 2). The ultimate consequence, as evidenced by several sites visited during our recent work, is the near complete oxidation and erosion of the peat, and loss of the wetland system. The effect of the wetland degradation is loss of carbon storage, water storage and a host of other ecological functions; these consequences have relevance at international, national, and local scales. Concern about the loss of the Lesotho peatlands and corresponding wetland functions was first published in the mid-1950's (van Zinderen Bakker, 1955), and has been reinforced by each of the few observers since (Jacot Guillarmod, 1962; Backéus, 1988; Grab and Morris; 1997). The date of gully formation in the peatlands is not known. The gullies in the lowlands originated in the early 1900s and grazing in the mountains followed the rangeland use in the lowlands (Showers, 2005). There is evidence of overgrazing from changes in the plant communities in the mountains as early as1938 (Staples and Hudson, 1938; as cited in Backéus, 1988). Accordingly, it is probable that the peatland gullies originated in the mid-1900s.

The primary mechanism causing the gully formation in the peatlands is concentrated surface runoff onto the peatland; as a result of soil compaction from livestock grazing, infiltration of the upland soils is reduced, with subsequent rills and concentrated surface runoff into the peatlands. The resultant hydrologic regime contrasts with the sheetflow, which should be characteristic of an undisturbed system. The peatland is also grazed and as a result its surface is highly compacted. Consequentially, flow is concentrated and down-cutting proceeds. In the valley-head peatland the gullies typically form on the axis of the valley slope. In the valley-side wall peatlands the gully forms at the base, typically exposing cobbles and colluvium.

Another consequence of the intensive grazing is the reduction of vegetative cover in both the upland and wetland which makes the land vulnerable to wind erosion. The winters are characterized by a dry, cold, and frequently windy climate; Grab and Deschamps (2004) measured significant rates of ablation on both the peat and upland surfaces.

The social and economic significance

The Maluti mountain peatlands are an important natural resource that are relevant to both local economies as well as the Lesotho national economy. During the development of the Lesotho Highlands Water Project, which provides for managing water resources and exporting water to the Republic of South Africa, it was recognized that peatlands are important to sustaining the water quality and flow regimes of upstream water resources; unfortunately, direct measures were not made. The occurrence of the peatlands in the headwater valleys is relevant to two specific hydrologic functions: base flow and water quality. The use of the peatland for grazing has the potential to deteriorate water quality, and the gully erosion will alter the hydrologic regime and contribute to the delivery of sediment, organic matter, and nitrogen.

In addition to providing valuable grazing land, the peatlands provide an important source of building materials, food, medicines and fuel. Accordingly, the

Figure 2. A valley-head peatland, with a gully. The gully serves to drain the peatland. The peatland boundary is depicted for reference. The gully is approximately 1.5 m deep.

integrity of the wetland system has direct ramifications to the wellbeing of rural populations. For two of the areas that we investigated, there are approximately 18,000 persons within a 16 km radius of the peatlands in the Butha-Buthe area, and 13,000 persons around the Sani site in the Mokhotlong district. The livestock population density within the same area is over 50,000 animals for each site. While the use of the resource is dispersed among the population, these statistics demonstrate the relevance of the health of the watersheds to rural subsistence communities.

The wetlands are fundamental to the ecological diversity of the Maluti mountains, and inherent in that diversity is the foundation for new and/or expanded economic opportunities, which in turn could create incentives for adopting more effective land use and resource management strategies. Most notably, preservation of the wetlands and implementation of sustainable land use practices are vital to maintaining, and ideally improving, the capacity of the highlands to support continued livestock grazing. Additionally, the wetlands could provide added economic opportunities through community-based resource management and/or the creation of new businesses associated with ecotourism (e.g., adventure tourism, bird watching, hunting, fishing, trekking, kayaking). However, as evidenced in developed countries, unconstrained ecotourism that embraces adventure touring (all terrain vehicles, 4x4 trails, etc.) may cause serious long-term damage to the environment; since these altimontane zones are particularly sensitive, careful planning and regulation are warranted.

Challenges for wetland restoration

There are tremendous sociological and technical challenges for restoring the peatlands in Lesotho. The communal land tenure system, complex jurisdictional issues over range resources, and diverse societal needs create a challenging setting for decision making and effective management. The lack of infrastructure to the rural landscape is also a significant obstacle to accessing sites for remediation. Despite these challenges, the significance of the wetlands to the wellbeing and livelihoods of rural communities, warrants consideration and investment. There value as a unique natural resource on the African continent, with significance from biodiversity to carbon sequestration, also merits the consideration. The problems have been highlighted since the mid-1900's, but if remediation measures aren't developed soon, the wetlands will erode and greatly diminish Lesotho's landscape.

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