

APPENDIX G WATERSHED CONDITIONS

G.1 Introduction

The upper watershed consists of grasslands (the *paramo*) and rocky outcrops within the area from the watershed divide at an elevation exceeding 4,000 meters above sea level to the various upper water supply diversion points at about 3,600 meters above sea level. The grasslands of the upper watershed are generally not favorable and not used for crop cultivation; however, grazing of sheep and llama occurs in this area. Also situated within the upper watershed that yields water diverted by the Malingua Pamba-Tunguiche systems are two communities: Quilapamba (above the north tributary that feeds the Sorochupa system (I-1)) and Guantuloma (above the southern tributary that supplements water at the Pucara (I-3) irrigation system diversion point). It is noted that both of these communities also have developed water diversion systems and have land uses, for example, grazing, construction of roads and paths, that affect the watershed yield and water quality of the Malingua Pamba-Tunguiche systems. For this reason, and because all of these communities are in fact sharing the water yield of one watershed, it would be beneficial for EWB to expand their area of interest to the entire watershed after the immediate needs of the Malingua Pamba-Tunguiche systems are addressed. These communities have also approached EWB team members in the field and, informally, have asked for assistance.

The information contained in this appendix is based on field observation by EWB team member Debbie Hathaway and interview during a field tour with José Calvopina, an outreach conservationist working for the Pastoral Social¹ and Ruth Pérez, an agronomy professor at the Technical University in Latacunga. The field tour was conducted during the Fall 2007 EWB trip, and also included Mark Richards, Brad Davidson and Brett Sargent.

G.2 Recommended Watershed Conservation Practices

Based on information provided by José Calvopina, traditional land use practices include a mix of some that support conservation and some that are detrimental with respect to preserving the watershed's capacity to consistently yield water of good quality. The following recommendations were expressed:

- **Avoid burning the paramo.** There is a local sentiment that burning augments the growth of young, tender grasses and is helpful for supporting sheep grazing. However, this practice leads to increased erosion, problems with plant populations and overall, is not beneficial to the watershed.
- **Protect the high paramo from human land uses.** The primary function of the watershed should be water production. Almost every human activity in this environment causes degradation of the watershed. For example, sheep grazing causes soil compaction, loss of native vegetation, slumping, landslides, etc. This leads to decreased infiltration potential, greater wet season runoff, and decreased spring yield beyond the wet season.

¹ Pastoral Social is a outreach conservation organization associated with a church in Ecuador, funded by a group in Germany; José is one of two workers for a region including Samilpamba, Quilapamba, Chugchilan and part of the sub-tropical region, in addition to the Malingua Pamba-Tunguiche region.

- **Avoid road and trail building.** These activities produce cuts in the land surface and intercept the shallow water table that is present in the paramo. Intercepted shallow groundwater then becomes run-off, instead of continuing downgradient to support springflows. In other words, construction of road and trails, as well as platforms for homes, tend to be associated with an increase in wet season run-off and a reduction in dry-season spring flows.
- **If grazing is to occur, limit to llamas.** Cows devastate the soils of the paramo and rapidly reduce the water yielding value of the watershed, due to the intense degree of soil compaction that occurs, loss of infiltration capacity, and resulting erosion. Sheep are less damaging than cows, but also cause soil compaction and erosion. Llamas are preferable: they have a hoof structure that enhances soil texture rather than compacting it.
- **Do not plant pines or other non-native vegetation:** Pines have been found to degrade soil quality and use excessive amounts of water. Grasses and native shrubs are preferred to prevent or mitigate erosion. In the past, pines were planted by “Prodeco”, a government branch tasked with improving conditions in regions inhabited by indigenous people. However, after better understanding the detrimental impacts of the pines, this activity was later discontinued.

G.3 Watershed Rainfall and Flow Records

EWB-Denver initiated a program of rainfall and flow measurement in the spring of 2007. Under this program, weekly observations of flow at one flume and rainfall at three gages are made by groups of colegio students. The data are transmitted to EWB for processing. The attached figure summarizes the data collected in this program over a period of approximately 11 months. The student group is to be commended for their continuing support of this program. Continuing maintenance will be needed at the measurement stations to ensure data quality.

Recommended activities include:

- Ensuring that the flume is not leaking substantially and remains level.
- Removing accumulated silt from the flume prior to each measurement.
- Ensuring that the rain gages are located properly, away from structures
- Checking the gages to straighten if they become tilted, and cleaning sediment from the rain gages.
- Striving to maintain periodic weekly readings of rain gages (and flume).
- Reading rain gages more frequently, if necessary, during periods of high rainfall.

G.4 Native Plants of the Paramo

This section identifies numerous native plants of the high paramo. The presence of these shrubs and grasses are critical to maintaining the water-yielding function of the watershed. Among the native plants are laurel, romerillo, yagual, quishar, chilca, paja, mortiños (blueberries), shanshi (looks like blueberries, but is highly poisonous), chicoria, trebol de páramo, alvejilla, nachac, chuquirahua.



Laurel



Romerillo



Yagual



Quishar



Paja



Chilca



Nachac (flowers used for liver problems)



Shanshi (poisonous)



Mortiños (blueberry)

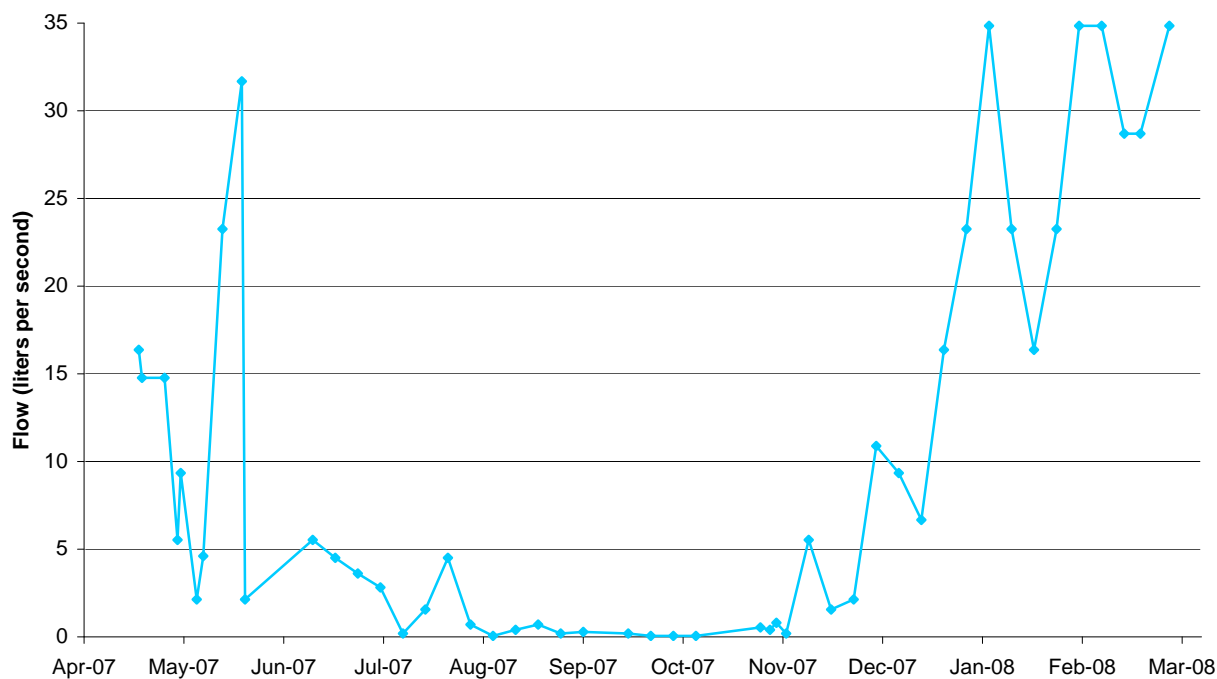


Mortiños, edible on left
Shanshi, poisonous on right



Typical paramo vista

**Instantaneous Flow Observations at Malingua Yacu
EWB H-Flume**



Average Precipitation

