WATERSHED PROCESSES FROM RIDGE TO REEF: CONSEQUENCES OF FERAL UNGULATES FOR CORAL REEF AND EFFECTS OF WATERSHED MANAGEMENT

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Molokai's south shore has some of Hawaii's most extensive and best-developed coral reefs. Historic terrigenous sedimentation appears to have impacted coral growth along several miles of fringing reef. The land upslope of the reef consists of small watersheds with streams that flow intermittently to the ocean. A USGS gage at the outlet of one of the most impacted watersheds (Kawela) recorded an average suspended sediment discharge of 1350 tons per square mile between 2006 and 2011. Approximately one-half of the total annual suspended sediment was delivered during one day per year. Once delivered to coastal waters, the sediment persists for many years and is re-suspended approximately 300 days per year. Geomorphic mapping, high resolution photography, and field surveys were used to map vegetation and erosive processes throughout the Kawela watershed. The surveys revealed denuded areas at mid-elevations in the watershed eroding at rates approaching 16 mm/year. This denudation and subsequent erosion is attributed to large recent populations of feral goats and previously by cattle. In 2006, a rapidly-eroding site was selected to monitor rainfall, runoff, erosion and vegetative cover. Intensive culling of goats by land managers began three years later (2009). From 2009 to 2014 a marked increase in vegetation was observed. Dry-season vegetation cover increased approximately from 3 percent to 15 percent and wet-season cover increased approximately from 28 percent to 68 percent. In addition, the nature of the vegetation changed from heavily grazed grasses and stunted shrubs to a much lusher foliage with an increase in native shrubs. During that same time period, the rate of erosion at the site decreased from about 16mm/year to less than 5 mm/year. The results indicate that ungulate removal allowed rapid vegetation recovery and subsequent reduction of erosion. Continued ungulate control may reduce sediment loads to coastal waters and lead to a gradual improvement in water quality and coral cover.

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