

WATERSHED MANAGEMENT AND FORESTRY IN UPCOUNTRY MAUI, HAWAII

ROBIN S. VORA¹, U.S. Forest Service, Institute of Pacific Islands Forestry, Room 323, 1151 Punchbowl Street, Honolulu, HI 96813

1988 TRANSACTIONS OF THE WESTERN SECTION OF THE WILDLIFE SOCIETY 24:87-93

Abstract: Potential forest and watershed management practices in upcountry Maui were evaluated as part of a study to increase water availability. The primary method of obtaining more water for upcountry Maui is through increased storage of high flows in the East Maui watersheds. Additional diversion of water may further affect aquatic life downstream and location of storage facilities is a major environmental problem if located in fragile native forests. Better control and monitoring of use of herbicides is needed to ensure they are not applied directly into drinking water. A major recommendation is to control pigs in the East Maui watersheds to reduce damage to the fragile understory and to the peat and cryptogam layers of the rainforest floor. The result may be an improvement in water quality. Pig control will require expensive fence construction and less restrictive hunting regulations. Control of exotic plants is also needed to protect the native ecosystem. Planting of koa (*Acacia koa*) and other native plants, rather than exotics, is recommended at elevations between 1,830 and 1,980 m (6,000-6,500 ft). Future benefits of such tree planting include wood for speciality uses and fiber, expansion of habitat for endangered forest birds, watershed enhancement through possible benefits of fog drip and reduced sedimentation from disturbed areas, and aesthetic values associated with trees. Forestry incentives programs should be used to promote reforestation of private lands and help landowners defray its costs. Public education and participation in land-use planning will be needed.

Upcountry Maui area has serious water shortages during dry periods. The result has been rationing of water among ranchers and farmers and a moratorium on urban development since 1977.

The Soil Conservation Service has been evaluating alternatives to increase availability of water. As part of this evaluation, my objective was to review existing information and opinion about potential watershed management and forestry practices in the upcountry Maui study area and to make recommendations to public agencies and state and private landowners. I relied on professional opinion and judgement to develop many of the recommendations because much of the existing research and other information was incomplete.

EVALUATION AREA

Location, Ownership and General Land Use

The watersheds were below Haleakala National Park, but above the populated part of upcountry Maui (Kula), and included a portion of the forested watersheds to the northeast (East Maui watersheds). The major landowners are the state (forest reserves); the Haleakala, Kaonoulu, and Ulupalakua ranches from north to south on the western slopes of Mount Haleakala; East Maui Irrigation (EMI) below approximately 1,525 m (5,000 ft) elevation on the northern slope; and The Nature Conservancy above the EMI land to the park boundary (conservation lease from Haleakala Ranch). The Kula area along the western boundary of the project is characterized by a mix of rural and agricultural uses.

Rainfall

Warm, moist tradewinds flow almost constantly against the northeastern slopes of the mountains (Duffy 1965, Takasaki 1972, Tagomori 1979). These winds rise and become cooled, and condensation and cloud formation result. Clouds move through the forest canopy, generally between 600 and 2,100 m (2,000 to 7,000 ft), and fog drip may result even if there is no rain.

Rainfall ranges from 6,731 mm (265 in) per year in the East Maui watershed to as little as 472 mm (18.6 in) in the Kula area (Hawaii Division of Water and Land Development 1982). The rainfall isohyets run directly upslope along the northwestern rift. Average annual runoff is negligible in areas with average annual surface rainfall below 1,780 mm (70 in) (Kula area) (Nance 1985).

Groundwater storage is limited to small and shallow water bodies that provide the base of flow of springs and streams (Stearns and MacDonald 1942, Takasaki and Yamanaga 1970). There are several permanent springs, but most water comes from runoff according to Roger Skolmen (USFS, pers. comm.). Wesley Wong (DOFAW, pers. comm.) and others relate that within historic times many springs on the western and southern faces of Mount Haleakala dried up. The Ulupalakua Ranch once had sufficient water to grow sugar cane but no longer has that water because springs have gone dry, or because afternoon rainfall stopped in 1890 due to the destruction of the Kula Forest (Roger Skolmen, USFS, pers. comm.).

Water Transport

Water for Kula comes from the East Maui watersheds (U.S. Soil Conservation Service 1985). Flumes, ditches, and pipes are used to transport water. The herbicide Rodeo² (active ingredient: isopropylamine salt of glyphosate, same product as Roundup) is used to control vegetation.

¹ Present address: U.S. Forest Service, 11704th Avenue South, Park Falls, WI 54552

² Names of commercial products or enterprises are provided for information purposes only. No endorsement by the U.S. Government is implied.

Vegetation

Dense forest once covered much of the land above cultivated areas and up to about 1,830 m (6,000 ft) (Nelson 1967). The extensive cutting of sandalwood species that began in 1791, along with heavy cutting of fuelwood and introduction of livestock, initiated the demise of native forests in accessible areas.

Today, native forests of koa (*Acacia koa*) and ohia (*Metrosideros collina*) remain in the East Maui watersheds. Ohia dominates on the western slopes with native shrubs, matted fern, and some trees in the understory. Much of the drier face of Mount Haleakala has been converted to pasture land. Several areas, including state forest reserves, have been planted with exotic trees (Wong et al. 1969). A eucalyptus (*Eucalyptus* spp.) plantation at Ulupalakua, dating from 1861, may be one of the oldest hardwood plantations in the United States. Redwood (*Sequoia sempervirens*), Monterey cypress (*Cupressus macrocarpa*), sugi (*Cryptomeria japonica*), and other conifers were planted in the Kula Forest in the 1930's.

Portions of the Kula Forest burned in 1952. Reforestation was accelerated in the 1960's with plantings of eucalyptus, pines (*Pinus* spp.), and other exotics. Portions of the Haleakala and Ulupalakua ranches have been planted recently with Monterey pine (*Pinus radiata*) and koa. The forest reserves are now a mixture of exotic plantations and native trees with an exotic grass understory. Native koa regenerated naturally in dense stands after approximately 40 ha (100 ac) of Makawao Forest was cleared in 1960.

Above about 1,830 m (6,000 ft) the pasture land grades into high elevation sub-alpine scrub with species such as pukiawe (*Styphelia tameiameia*), ohelo (*Vaccinium reticulatum*), and mamane (*Sophora chrysophylla*). Most of the remainder of the western slope may be described as dry, exotic grassland. This is the Kula ranch country.

Forest Management

Timber harvest is of low priority and has been done only on a small portion of the Haleakala Ranch, except for the historical cutting of native forests mentioned previously. The DOFAW administer the state forest preserves. They are concerned primarily with watershed management. LeBarron (1970:2) stated that management is based on the theory that heavy forest cover serves best to regulate the supply and quality of water. Exotic species have been used in afforestation because "they had better growth, quality of products, and ability to take and hold the land" than native species.

Exotic Plants

Exotic plants from all regions of the world are found in Maui. Several of these exotics, such as black

wattle (*Acacia decurrens*), gorse (*Ulex europaeus*), broomsedge (*Andropogon virginicus*), blackberry (*Rubus* spp.), and banana poka (*Passiflora mollissima*) can become serious pests. Banana poka, for example, smothers all tree seedlings. It has been a serious pest on the Big Island and is becoming a problem on Maui.

Exotic Animals and Sport Hunting

Sport hunting occurs on exotic mammals and birds. Meyer Ueoka (DOFAW, pers. comm.) estimates there are about 500 pig hunters, mostly members of affluent sportmen's clubs. Access to private East Maui Irrigation lands for pig hunting is restricted to the Maui Hunters and Sportmen's Club. Pigs are hunted from February to June and only on weekends. The bag limit is 2 pigs per hunter. There are about 500-600 game-bird hunters. They hunt ring-necked pheasant (*Phasianus colchicus*), California quail (*Callipepla californica*), and chukar (*Alectoris chukar*).

Native Forest Birds and Habitat

A loss of native species has resulted from habitat destruction through conversion to pasture land and displacement or replacement of native components by introduced species of plants and animals (Jacobi and Scott 1985). Honeycreepers are the primary group of endangered forest birds. They include the Maui parrotbill (*Pseudonestor xanthophrys*), crested honeycreeper or 'akohekohe (*Palmeria dolei*), Maui akepa (*Loxops coccineus ochraceus*), po'o-uli (*Melamprosops phaeosoma*), and nukupu'u (*Hemignathus lucidus*). The decline in abundance of some native forest plants may be contributing to the decline in native bird populations (Ralph 1977). Introduced mammals, especially feral pigs (*Sus scrofa*), feral goats (*Capra hirtus*), axis deer (*Cervus axis*), and domestic cattle have degraded forests. The harvesting of seed-producing koa and nectar-producing sandalwood could have also caused a decline in potential foods. Avian malaria, transmitted by night-biting mosquitoes (*Culex cinquiaries*), has decimated native bird populations below an elevation of 1,520 m (5,000 ft). DOFAW has a captive breeding program for endangered birds that they plan to expand to include these honeycreepers.

MANAGEMENT RECOMMENDATIONS

Suggested Goals

It is desirable to retain the native vegetation now present and replace it where it has been lost to provide better habitat for native forest birds. It is also desirable to maintain high water quality for consumption by humans, and to increase infiltration in the Kula area and runoff in the East Maui watersheds.

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