CURRENT MULTIRESOURCE INVENTORY DATA: IMPLICATIONS FOR MANAGEMENT

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Abstract: The multiresource inventory (MRI) combines information from photo interpretation and permanent field plots to assist managers and administrators in making informed decisions regarding the utilization and protection of Hawaii's forest lands. The MRI for the islands of Molokai, Oahu, and Kauai have been completed, and key results and management implications are included in this paper. The value of the MRI data will increase in subsequent inventories when permananent plots are remeasured.

There are increasing demands and expectations on Hawaii's forest lands. The range of interests include clean and plentiful water, forest products, hunting, hiking, and the protection of native ecosystems. The State of Hawaii is charged with meeting these demands on its forest lands. An essential tool in this process is accurate resource information.

Traditionally, forest inventory work in Hawaii emphasized the collection of timber volume data. To assist managers and administrators in addressing the demands on Hawaii's forest lands, the Resource Evaluation section of the Division of Forestry and Wildlife, Department of Land and Natural Resources, collaborated with the U.S. Forest Service to design an inventory based on their needs. The result was the Division's first multiresource inventory (MRI).

A major objective of the MRI was to establish a statewide network of permanent ground plots to provide information on forest trends including tree growth and mortality. In addition to providing traditional timber volume statistics, the MRI addresses other concerns such as watershed condition, impacts of noxious weeds and feral animals, and the status of native Hawaiian forest communities. This paper summarizes the MRI results for the islands of Molokai, Oahu and Kauai. Results from the Molokai inventory are published (Buck et al. 1986), and the results for Kauai and Oahu are in press (Buck et al. 1988).

METHODS

The MRI combines information obtained from aerial photographs and maps with field plots in a two-phase sampling procedure. In the first phase, photo points are systematically located on aerial photographs at a sampling intensity of approximately 200 acres per photo point. A 1-acre area around each point on the aerial photographs is interpreted for land class, vegetation type, and erosion. Additional information recorded for each point includes rainfall, elevation, land use zoning, and ownership.

In the second phase, field plots (approximately eight percent of the photo interpretation sample) are randomly selected from the photo points in proportion to the area in each land class. These field plots provide a ground check for the photo interpretation sample which is then statistically adjusted for land use/vegetation changes or error in photo interpretation.

Each field plot is carefully located and permanently referenced for remeasurement in subsequent inventories. A field plot consists of a cluster of seven sample points encompassing 3.5 acres in area. Sample trees are measured to provide estimates of forest stand volume, condition, and growth. A classification scheme based on the dominant plant species in defined vegetative layers is used to name the representative vegetation community for each field plot (Buck and Paysen 1984). Additional data collected at these points includes animal impacts, distribution of noxious plants, recreational use and potential, erosion type and severity, stand origin, recent disturbances, and presence of wildlife species. Data-gathering procedures are detailed in the Hawaii Multiresource Inventory Field Manual (Costales and Buck 1983). Terminology used is given in Table 1.

The MRI data is computerized for easy retrival of information in different formats and combinations. MRI data interactions and perspectives add value to resource data. For example, locating a threatened bird is one thing, but knowing that it is on privately-owned land zoned for agricultural use is more helpful to a manager.

MRI permanent plots constitute an initial baseline sample that can be intensified for future studies targeted for specific product. For example, it is possible to go into the first stage photo sample and choose additional field plots of a specific vegetation type to obtain more accurate volume estimates.

RESULTS
Vegetation Types

Forest occupies 134,300 acres (36 percent) of the island of Oahu and 188,500 acres (55 percent) of the island of Kauai (Fig. 1). The native tree, 'ohi'a (*Metrosideros polymorpha*), is the predominant forest vegetation type on both islands (Table 2). Kiawe (*Prosopis pallida*), an introduced tree species, and 'ohi'a comprise

Table 1. Terminology Used in Multiresource Inventory in Hawaii.

Feral—Having escaped from domestication and reverted to a wild state.

Forest land—Land at least ten percent stocked with trees and not now developed for nonforest use. Also includes land 50 percent or more covered by shrubs. This land includes both timberland and other forest land.

Grassland—Nonforest land with ten percent or more herbaceous cover. May be grazed or ungrazed, and includes intensively pastured areas.

Hawaiian Homes—Organization administering land set aside for use by those of Hawaiian ancestry.

Introduced—Birds, plants, or animals brought to the Hawaiian Islands by humans.

Land class—A classification of land by major use.

Naturalized forest—Forests of introduced tree species established through natural processes.

Noxious plants—Any plant species considered harmful to forest resources and that has the propensity to spread unless control measures are taken.

Other forest land—Forest land incapable of yielding successive crops of trees for usable wood products because of adverse site conditions (poor drainage, sterile soils, steepness, rockiness, and dry climate—generally less than 30 inches of rainfall per year). Includes forest lands having low productivity for timber but that may be productive for range, watershed, recreation, or wildlife habitat.

Pali land—Very steep, mountainous land with slopes of more than 80 percent. Includes land that is more than 50 percent rock outcropping and recent barren volcanic ash, cinder, and lava flows.

Timberland—Forest land capable of producing 20 ft³ or more per acre per year of industrial wood (commercial roundwood other than firewood) because of suitable site conditions (good drainage, deep and fertile soils, adequate rainfall) and not withdrawn from timber use. This land class is characterized by its potential for restocking with trees.

Vegetation types—Dominant overstory species as determined by stereoscopic inspection of 1-acre plot photos.

41 and 40 percent respectively of Molokai's 80,748 acres of forest.

Ownership

Only one-quarter of the forests on Oahu and Molokai and 43 percent of Kauai's forest is state-owned (Fig. 2). Private corporations own the majority of the forest lands emphasizing the importance of integrating forest management plans with the private sector.

Land classes

There are six major land classes: timberland, other forest land, urban, cultivated, grassland, and pali land. The difference between timberland and other forest land is its ability to produce sustainable timber crops. Factors to determine this include soil type, steepness, precipitation, and elevation.

One-quarter of Oahu is in the urban land class compared to only four percent of Kauai and three percent of Molokai (Table 3). Oahu has the greatest number of people (80 percent of Hawaii's population), the smallest area of forests, and the largest demand for water supply and recreation on its forest lands. Cultivated land occupies 15 and 19 percent of Oahu and Kauai. The water needed to irrigate these lands places a high priority on the islands forest watersheds.

DISCUSSION

The MRI provides a benchmark for additional studies focusing on trends and potential problems in Hawaii's forests. For example, noxious plants, particularly guava (*Psidium* spp.) and clidemia (*Clidemia hirta*), are a major component in the native forests. Slight sheet erosion was observed in areas with monotypic stands of these vegetation types. Subsequent inventories will provide data on the rate and extent of spread of these introduced plants.

Hurricane Iwa created forest gaps in the Kokee area of Kauai in 1982. In these disturbed areas, koa and guava seedlings are both naturally regenerating. Guava is an aggressive non-native tree which is shade tolerant and can effectively limit the natural regeneration of other native species. Succession trends in this important native forest area need to be monitored.

MRI data identified over 280,000 acres of naturalized forests on the three islands surveyed. Little is known about these naturalized forest communities in Hawaii and research is needed to manage these forests to their full potential.

The value of the MRI will increase as the permanent plots are remeasured and forest community trends become apparent. Long term monitoring will also provide valuable growth and mortality information. The MRI is a tool to help understand and better manage Hawaii's forests.

Table 2. Area by vegetation type in 1986.

Vegetation Type	Island		
	Oahu	Kauai	Molokai
Tree-dominant types		acres	
'Ohi'a (*Metrosideros polymorpha*)[1]	37,563	109,040	32,833
Koa (*Acacia koa*)[1]	28,548	13,438	—
Kukui (*Aleurites moluccana*)	2,775	7,633	4,773
Java Plum (*Eugenia cumini*)	10,978	11,403	1,909
Guava (*Psidium* spp.)	10,287	12,143	5,918
Kiawe (*Prosopis pallida*)	17,354	10,359	33,215
Silk-oak (*Grevillea robusta*)	—	17,625	—
Ironwood (*Casuarina* spp.)	6,167	—	—
Eucalypts (*Eucalptus* spp.)	—	3,156	1,527
Other tree-dominant types	20,686	3,736	573
Subtotal (tree-dominant types)	134,358	188,533	80,748
Shrub-dominant types			
Haole koa (*Leucaena leucocephala*)	12,808	13,824	9,354
Christmas berry (*Schinus terebinthifolius*)	20,549	3,499	3,818
Hau (*Hibiscus tiliaceus*)	—	2,190	—
Lantana (*Lantana camara*)	—	8,735	—
Melastoma (*Melastoma malabathricum*)	—	4,074	—
'A'ali'i (*Dodonaea* spp.)[1]	—	—	2,481
Other shrub-dominant types	617	3,736	764
Sub-total (shrub-dominant)	33,974	36,058	16,417
Total (all vegetation types)	168,332	224,591	97,165

[1] Vegetation type named for native Hawaiian plant.

Table 3. Area by land class in 1986.

Land class	Island		
	Oahu	Kauai	Molokai
		acres	
Timberland	27,438	37,226	23,494
Other forest land	70,754	71,480	34,104
Pali land	80,778	134,185	25,540
Cultivated	55,323	64,741	5,898
Grassland	44,916	23,029	71,598
Urban	85,953	11,402	953
Other[1]	4,846	5,025	2,002
Total	370,008	347,008	163,589

[1] Includes dune land, water, bog, and other areas.