A History of the Central Valley Bioregion on Maui

Scott P. Lacasse

Green Mountain College

ENV 5040 Bioregional Theory and Practice

October 16, 2017

> At the time when the earth became hot
> At the time when the heavens turned about
> At the time when the sun was darkened
> To cause the moon to shine
> The time of the rise of the Pleiades
> The slime, this was the source of the earth
> The source of the darkness that made darkness
> The source of the night that made night
> The intense darkness, the deep darkness
> Darkness of the sun, darkness of the night
> Nothing but night. (*The Kumulipo* as quoted in Beckwith, 1992, p.58)

Out of the darkness came the light and separated the earth from the sky; the land rose from the depths of the sea, individual plants and animals were born, and the Hawaiians celebrated their genealogical connection to them all through the *Kumulipo*, a Hawaiian Creation Chant (Beckwith, 1992). The chant began in the night at the beginning of time and scrolled through geological, plant, and animal succession to arrive at their societal climax, the Hawaiian royal family. Capable of making accurate scientific conclusions, the ancient Hawaiians often embedded them within their poetic chants (Culliney, 2006). The *Kumulipo*, in part, reflects their cultural knowledge of species creation across the ages or "wā." It is from this vast and incomprehensible scale that we must link our understanding of the epochs to arrive within a human experience that encourages productive interactions within our local environment.

The Hawaiian Archipelago began its formation 80 million years ago near the end of the dinosaurs' reign. On the Pacific seafloor, over a relatively stationary magmatic hotspot, a plume

of superheated magma has continued to rise from deep within the earth's mantle some 50-60 miles below the Earth's crust and erupt to form 107 islands that stretch 3,800 miles northwest from the island of Hawai'i in the south towards the Emperor Seamounts in the north (Grigg, 2012, Fig1). It is this continual volcanic process and the steady northwesterly movement of the Pacific Plate, at 3.4 inches per year, which continues the creation of a new volcanic summit roughly every 500,000 years (UH Hilo, 1998). The fire goddess, Pele, depicts the formation of the eight main islands of Hawai'i, Maui, Kaho'olawe, Lāna'i, Moloka'i, O'ahu, Ni'ihau, and Kaua'i in early Hawaiian mythologies. The ancient Hawaiians knew she had lived in Kaua'i long ago and visited each volcanic island in search of a safe place to store the sacred fire. Pele needed a deep hole and each time she prepared one on a different island, her angry sister inundated it with water and extinguished the fire. Ultimately, she reached the island of Hawai'i where she made her home in Kīlauea and Mauna Loa (Beckwith, 1970).

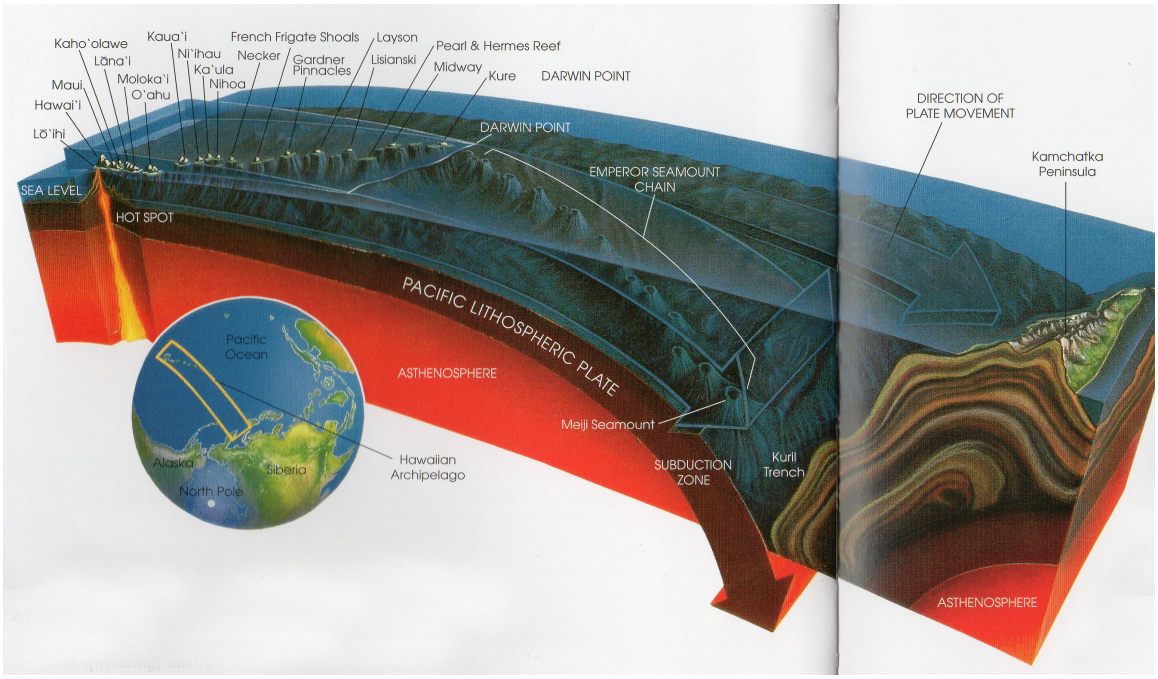

Figure 1 - This illustration depicts the formation of the Hawaiian Archipelago over roughly 65 million years (Grigg, 2012)

The second youngest island at 1.75 million years old, Maui is comprised of two volcanoes, West Maui and Haleakalā, that are connected by a narrow isthmus formed when the Haleakalā lavas banked against the older West Maui's (Macdonald, 1983). During the last ice age of the Pleistocene era, Maui was part of a greater island mass called Maui Nui that was comprised of six volcanoes (Fig 2). While it is believed that Haleakalā experienced Pleistocene glaciations at its summit, there is only circumstantial evidence to support the theory according to Porter (2005). With water trapped in the glaciers over the continents, sea level was nearly 300 feet below its current levels, and as the ice melted 12,000 years ago, the low areas of Maui Nui became the shallow straits between the islands that exist today (Hazlett, 1996). It is on the leeward slopes of Mt. Haleakalā that we find the Central Valley Bioregion of Maui (Fig 3).

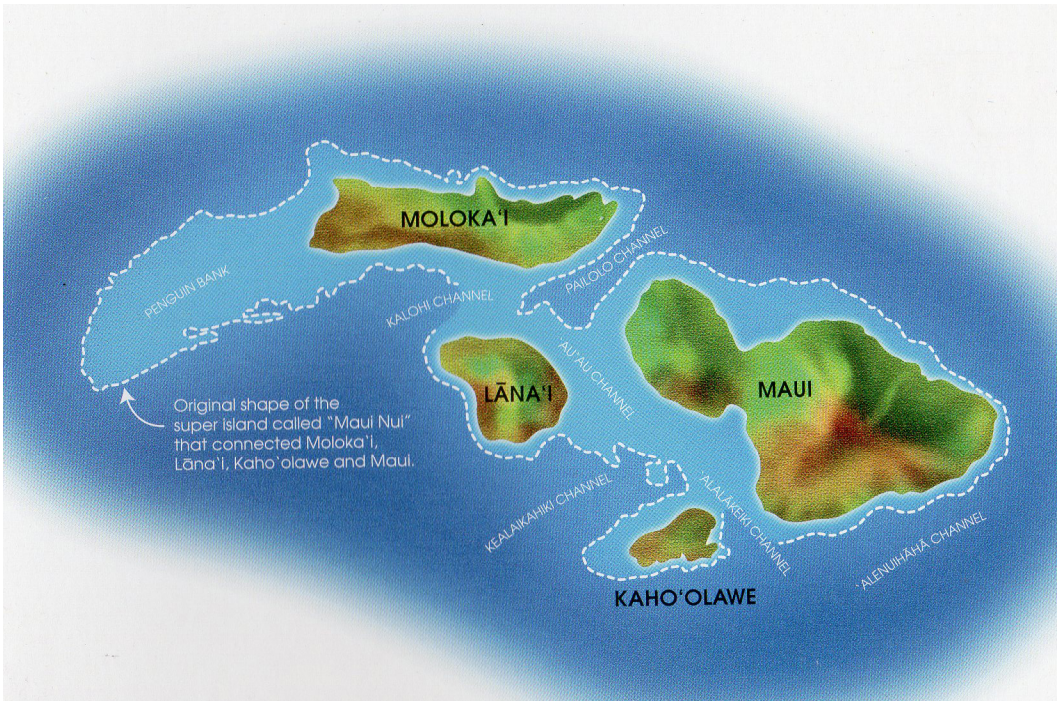

Figure 2 - Maui Nui during the early Pleistocene Era when sea level was 300 feet below current levels. As continental glacial ice melted, sea level rose and filled in the narrow straits between the islands (Grigg, 2012).

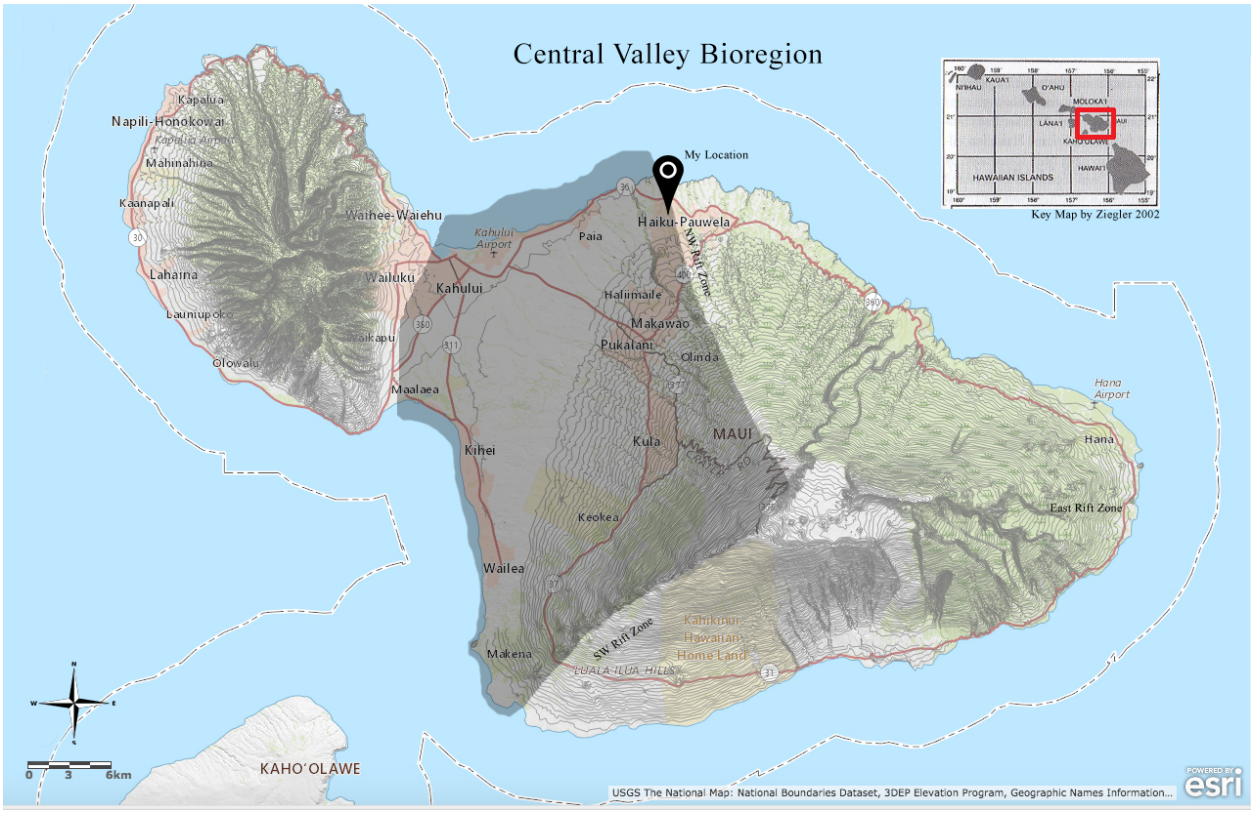

Figure 3 - The location of the Central Valley Bioregion on Maui is delineated by the NW Rift zone, SW Rift Zone, to the base of the West Maui Mtns, to the fringing reefs to the south and 1.5 miles into the sea to the north (map created using ArcGIS Online, 2017

The formation of Haleakalā, or "House of the Sun," where the demigod Māui ensnared the sun to ensure more daylight, was a geologic process taking over 700,000 years and it is still considered to be an active volcano in its rejuvenated stage (Culliney, 2006). All Hawaiian Islands are classified as shield volcanoes and undergo a similar life cycle "from a deep submarine volcano to a drowned reef-topped island" (Ziegler, 2002, p.23). These shield volcanoes build up slowly over time, layer after layer, as magma oozes from the vent and "spread[s] out in flows rarely more than 30 feet thick" (Hazlett, 1996, p.11). It is the subsequent weathering of these basaltic lavas and volcanic ash that led to the "bountiful arable soils" categorized as mollisols, oxisols, and entisols, within the bioregion (UH Hilo, 1998).

While marine organisms arrived relatively early as Maui broke the surface of the ocean, it took an additional 300,000 years to complete its post-shield-stage development and for erosion to till the land in preparation for the small number of immigrant species that began populating the island during the late Pleistocene epoch (UH Hilo, 1998). These hardy pioneer species, primarily from the Indo-West Pacific, populated reefs and newly formed lava fields with the aid of the wind, the prevailing the Kūrōshio and North Pacific Currents, and ancient island "stepping stones" (Ziegler, 2002).

The native ecosystems, before human contact between 300-500 AD, within the Central Valley Bioregion consisted of six major terrestrial and three marine ecosystems that were developed over time through a combination of ecological succession and vegetation zones (UH Hilo, 1998) (Fig 4). The changes that took place over time in the plant and animal populations contributed to the alteration of nearby surface and habitat development (Culliney, 2006). According to Grigg (2012), the resulting pre-human contact groups of native species are estimated to include:

> […] about 700 species of fungi; 260 mosses; 170 ferns; 1,000 flowering plants; 500 marine plants; 57 reef-building corals and 685 fish; 1,000 land snails; 1,500 mollusks; 5,000 marine invertebrates; more than 100 birds; more than 6,000 insects and arthropods (crabs, shrimp, lobsters, spiders, tics, flies, etc.); 3 reptiles (turtles); 3 mammals (two bats and a monk seal); and several thousand other open-ocean or deep-water species that are not directly dependent on the islands. (pp. 55-56)

To cover the specific successional characteristics and resulting species within each of the nine ecosystems is beyond the scope of this paper. However, some general theories are helpful in understanding the overall process as it relates to terrestrial ecosystem formation on the Hawaiian Islands.

Ziegler (2002) suggests that as recently formed lava cools enough to allow plant growth, spores settle in the moist cracks resulting in the growth of ferns, mosses, various lichen, and fungi (Ziegler, 2002). Ziegler states that after a period of four to five years, numerous flowering plants, trees, and shrubs begin to appear and "establish in small pockets of soil developing from organic material and disintegrating basalt" (2002, p. 170). After 150 years or so, the trees have increased in size and number, and the lower plants begin to be shaded out, and in 300 to 400 years, the ecosystem reaches its climax stage (Ziegler, 2002). Ziegler notes that the climax stage found within Hawaiian ecosystems differs from that of continental succession in that the original pioneering species remain in a Hawaiian ecosystem "instead of being completely different ones" (2002, p.171).

Five distinct vegetation zones; strand, coastal, dryland forest and shrub, mixed mesic forest, cool dry forest, and subalpine/alpine are found within the Central Valley Bioregion (Ziegler, 2002). These distinct regions are primarily formed as a result of elevation and climatic influences on the leeward slope of Haleakalā. Ziegler describes the zones as follows: the strand zone is the area limited to direct ocean spray while the coastal zone is characterized by lowland areas of firmer substrate that are beyond the reach of salt spray; dryland forest lies between 660 and 3,300 feet and is best developed on the leeward sides of the island with an average annual

rainfall of 30-40 inches; the mesic band, located between 2,475 and 4,125 feet with 40-100 inches of rain, is believed to have been the most biologically diverse zone prior to human contact; the cool dry forest can be found just below the inversion layer at 5,610 – 7,920 feet and the rainforest zone is typically developed within the inversion layer, but does not exist on the leeward side of the mountain; finally, the subalpine zone ranges from tree line at 9,000 feet to the summit at 10,023 feet (2002, pp. 172-178). It is from within these zones that we begin to see the incredible impact of human contact (Fig 5).

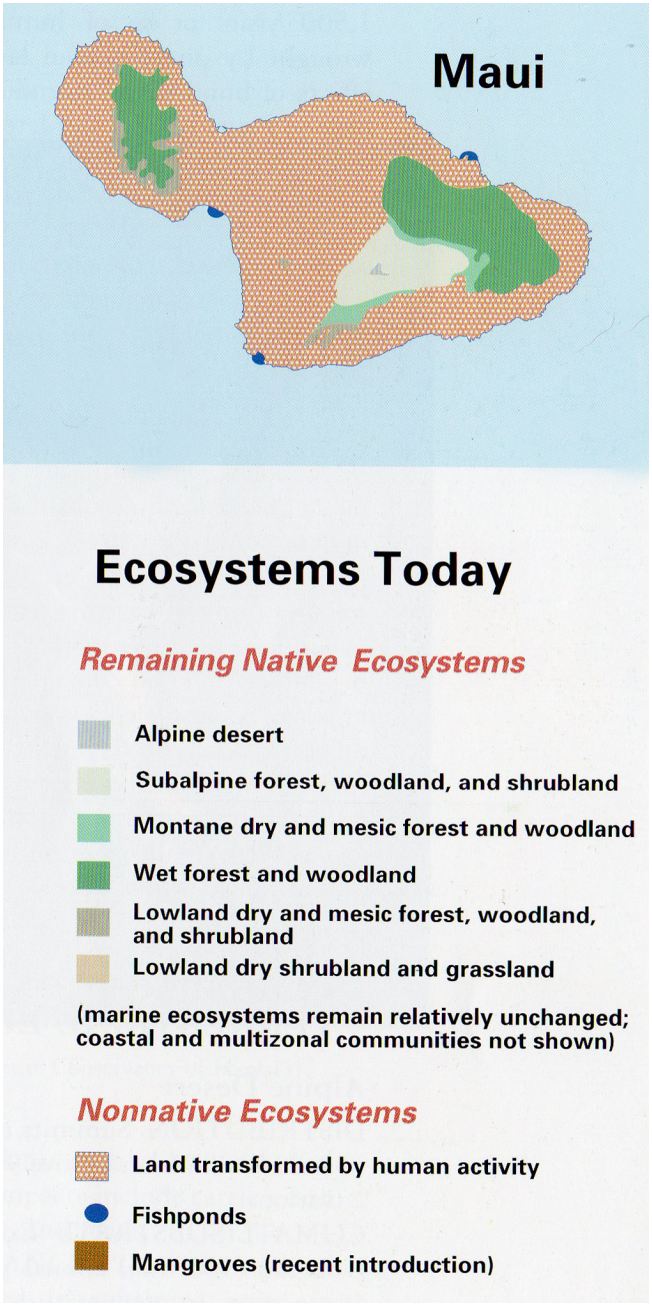

Figure 4 Native vegetation zones prior to human contact (UH Hilo, 1998).

It is generally accepted that the first human colonizers arrived in Hawai‘i from the Marquesas Archipelago, some 2,500 miles to the southeast, between 300-500 AD. They traveled by voyaging canoe and carried with them "pigs, chickens, dogs, and more than two-dozen species of plants which they used for food and to make clothing and tools" (Harrington, 2013, p.4). Pratt & Stone (1990) state that the original population may have been as few as 100 people and the initial impact on the environment was small at first, but after about 1200 AD, with the arrival of the Tahitians, the population began to increase dramatically

by doubling every century. The success of irrigation and subsistence practices and a highly stratified hierarchical system of governing led to a rapid population expansion from 40,000 people in 1200 AD to a peak of 200,000 in 1500 AD (Grigg, 2012). Grigg also states, "As important as the number is, the possibility that it represents a value close to the carrying capacity of the islands for a subsistence economy is even more significant" (2012, p.86).

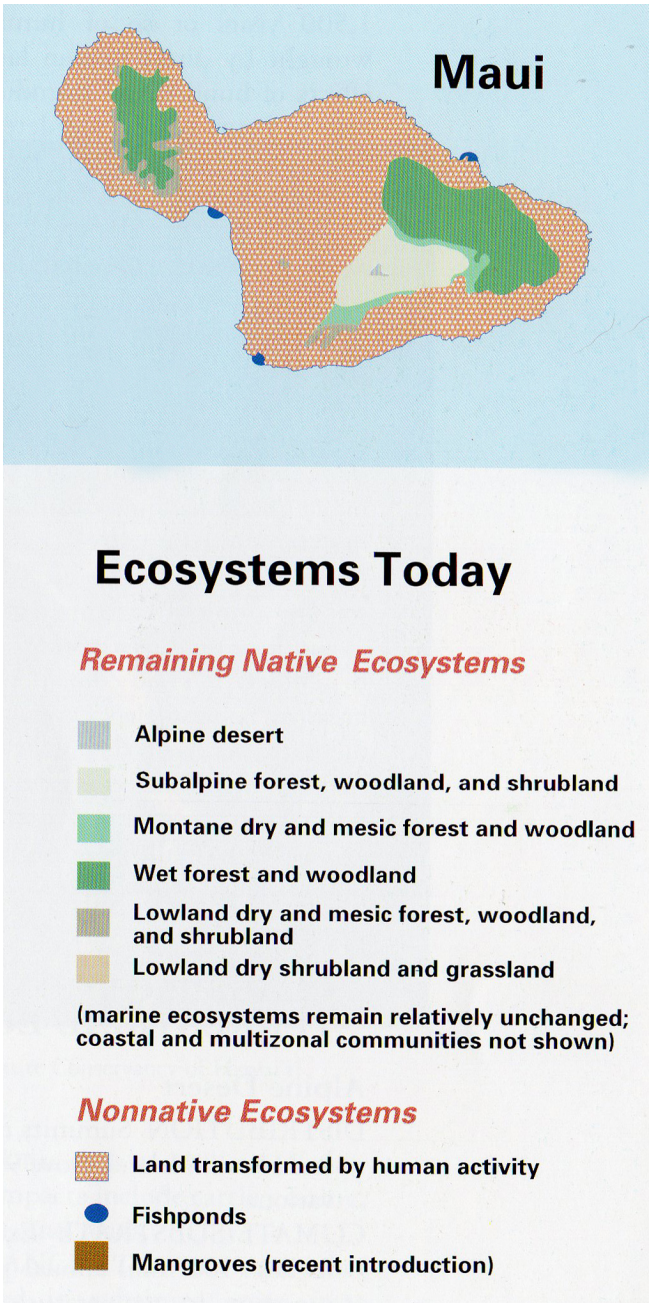

Figure 5 - Remaining native vegetation after human contact (UH Hilo, 1998)

The ahupua‘a were political and agricultural land divisions that usually extended from mountain summits through fertile valleys and into the sea (Fig 6). They ranged in from 100 to 100,000 acres in size and made their appearance during the expansion period after the conquest by Tahitians in 1200 AD (UH Hilo, 1998). The Central Valley Bioregion area was historically divided into four moku and further subdivided into roughly twenty-seven ahupua‘a (DLNR, 2017). According to Kamehameha Schools:

> Ahupuaʻa contained nearly all the resources Hawaiians required for survival. Freshwater resources were managed carefully for drinking, bathing, and irrigation. Wild and cultivated plants provided food, clothing, household goods, canoes, weapons, and countless other useful products. Many land and sea creatures utilized for food also provided bones, teeth, skin, and feathers for tools, crafts, and ornamentation. (1994, p.VI)

"Deforestation and erosion were the natural results of Hawaiian agriculture," states Pratt & Stone (1990, p.25). The destruction of the lowland native forests for food cultivation by controlled burning and the resulting filling in of estuarine lagoons with eroded sediment were all but complete by 1650 AD (Culliney, 2006). The Hawaiians' introduction of plant and animal species, directly and indirectly, affected native ecosystems. Fire was also an essential practice in the leeward lowlands to stimulate the growth of pili grass, a thatching material and was also used to clear land for arrowroot to be used as pig food (Pratt & Stone, 1990). Kirch (1985) called vegetation alteration for agriculture "the greatest force leading to environmental change in pre-contact times."

Subsistence agriculture in the first few decades following Western contact in 1778 gave way to commercial harvesting of resources for trade. The export of goods such as sandalwood, pulu (pillow and mattress stuffing), firewood, endemic olonā for ship's cordage, and agricultural provisioning of whaling and trading vessels with pigs, bananas, taro, and sweet potatoes dominated the early to mid 19th century (Pratt & Stone, 1990). "Beginning in the 1850's, modern agriculture, ranching, and varied forest management practices, […] brought rapid and large-scale

land use changes to Hawai‘i” (Pratt & Stone, 1990, p.41).

The mechanism that brought about such large-scale land use changes was called “The Great Māhele (division) of 1848.” Westerners complained that the ahupua‘a system hampered their business ventures and they required the establishment of fee simple land ownership to become profitable. In response, the land was divided: 24% went to the kings, 37% to the government, and 38% to the ali‘i (Harrington, 2013). Over the next few decades, the consequent sale of land led to the privatization of vast tracts of territory that were utilized for their native resources and agricultural value.

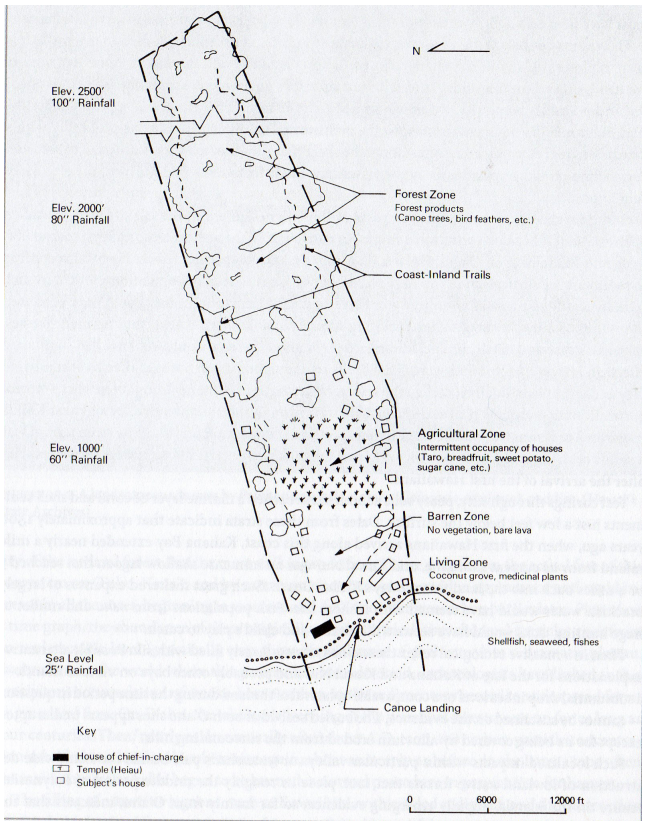

Figure 6 Schematic sketch of a typical ahupua'a layout (Culliney, 2006).

Modern sawmill technology facilitated the rampant clearing of upland forests in the Central Valley Bioregion during the 1850’s. The koa trees were exported for their beautiful wood and the land that was cleared made way for the expansion of the rapidly growing sugarcane, ranching, pineapple, potato, and wheat industries on the leeward slopes of Haleakalā (Culliney, 2006). “The reduction of native forest area was blamed for the diminished flow of water available for irrigation [...]” (Pratt & Stone, 1990, p.48). Extensive irrigation ditches were

built in response, and to this day transport millions of gallons of water from the adjacent bioregion into the Central Valley (Harrington, 2013).

The 20th and 21st centuries saw a rise of mixed-use development on the isthmus of the Central Valley in support of the growing sugarcane, pineapple, and tourism industries. Culliney (2006) states that "Major threats come from an invasive community of international private enterprise, exemplified by large resource extractors and land developers, in affiliation with certain agencies of federal, state, and county governments" (p.343). Residential, retail, and industrial areas have sprawled across Maui's best arable soils, and the recent end of the sugarcane industry has us all wondering if the valley is slated to rival Oahu in development density and if Wailea is to become the next Waikīkī.

“By the end of nature I do not mean the end of the world. The rain will still fall and the sun shine, though differently than before” (McKibben, 1990, p.8). Humanity has occupied the Central Valley Bioregion for a little over 1,500 years and has managed to drastically affect ecosystems in nearly immeasurable ways. Despite the impacts by traditional Hawaiians, history has proven them to be relatively good stewards when compared to Western cultures. However, theirs was a subsistence culture which supported 1/7th of today's population. What lessons can we learn from them that can be applied to safeguard Hawai‘i’s remaining natural treasures and our future on this island planet? In the spirit of Hawaiian culture, I offer a phrase from the traditional chant of Nā ‘Aumākua requesting guidance from the ancestors:

> [...] May the heavens flourish,
> May the earth flourish,

May the whole archipelago of Hawai‘i flourish.

Grant me the knowledge,

Grant me the strength,

Grant me the expertise,

Grant me true understanding,

Grant me deep insight,

Grant me spiritual power.

References

Beckwith, M. W. (1970). *Hawaiian mythology*. Honolulu: University of Hawaii Press.

Beckwith, M. W. (1992). *The Kumulipo: a Hawaiian creation chant*. Honolulu: Univ. of Hawaii Pr.

Culliney, J. L. (2006). *Islands in a far sea: the fate of nature in Hawai'i* (Rev. ed). Honolulu: University of Hawai'i Press.

DLNR. (2017). *Ahupua'a of Maui* (map). Accessed at https://dlnr.hawaii.gov/shpd/files/2015/06/Ahupuaa_Maui.pdf

Grigg, R. W. (2012). *In the beginning: archipelago : the origin and discovery of the Hawaiian Islands*. Waipahu, Hawai‘i: Island Heritage.

Harrington, D. (2013). *Timeline Hawaii: an illustrated chronological history of the islands*. Honolulu, HI: Mutual Pub.

Hazlett, R. W., & Hyndman, D. W. (1996). *Roadside geology of Hawai'i*. Missoula, Mont: Mountain Press Pub.

Kamehameha Schools/Bernice Pauahi Bishop Estate (Ed.). (1994). *Life in early Hawai'i: the ahupua'a* (3rd ed). Honolulu: Kamehameha Schools/Bernice Pauahi Bishop Estate, Kamehameha Schools Press.

Kirch, P.V. 1985. *Feathered gods and fishooks. An introduction to Hawaiian archaeology and prehistory.* Honolulu: University of Hawaii Press.

Macdonald, G. A., Abbott, A. T., & Peterson, F. L. (1983). *Volcanoes in the sea: the geology of Hawaii* (2nd ed). Honolulu: University of Hawaii Press.

McKibben, B. (1990). *The end of nature* (1st Anchor Books ed). New York: Anchor Books.

Porter, S. (2005). Pleistocene snowlines and glaciation of the Hawaiian Islands. Quaternary International, 138, 118-128.

Pratt, L. W., & Stone, C. P. (1990). *Alteration of native Hawaiian vegetation: effects of humans, their activities and introductions*. Honolulu, Hawaii: University of Hawaii, Cooperative National Park Resources Studies Unit.

University of Hawaii at Hilo, Department of Geography, Juvik, S. P., Juvik, J. O., & Paradise, T. R. (1998). Atlas of Hawaiì. Honolulu: University of Hawaiì Press.

Ziegler, A. C. (2002). *Hawaiian natural history, ecology, and evolution*. Honolulu: University of Hawai'i Press.