# The Effects of Alien Species on Archeology in Hawai`i

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Much has been written about the impacts of alien species on native Hawaiian vegetation (*cf.* Cuddihy and Stone 1990; Smith 1985; Wagner, Herbst, and Sohmer 1990). What has not received as much attention is the impacts of those same alien species on the cultural resources in Hawai`i. To discuss all the alien species that are adversely impacting cultural resources throughout Hawai`i would be a monumental task and is beyond the scope of this paper. Instead this paper will illustrate the problem by discussing a limited number of species and the impacts they are having on the cultural resources in some of the national park areas in Hawai`i.

The species included here are christmasberry *(Schinus terebinthifolius),* lantana *(Lantana camara),* kiawe *(Prosopis pallida),* American or red mangrove *(Rhizophora mangle),* Java plum *(Eugenia cuminii),* koa haole *(Leucaena leucocephala),* and false kamani *(Terminalia catappa).* These species should be well-known to anyone working in the field in Hawai`i, whether they are botanists or archeologists.

Christmasberry *(Schinus terebinthifolius)* was introduced as an ornamental before 1911, but its beauty ends with its red berries. Its seeds are easily bird-borne and in Hawai`i it is now a serious weed in many places. By 1962 it had invaded 42,000 ha (103,740 ac) in Hawai`i. It dominates many abandoned agricultural sites and pasturelands and is an aggressive invader of

most mesic-to-wet lowland environments (Neal 1965:525; Smith 1985:202; Cuddihy and Stone 1990:86; Wagner, Herbst and Sohmer 1990:83, 197). Lantana *(Lantana camara)* was originally brought to Hawai`i for gardens. It was apparently introduced in 1858 and was well-naturalized prior to 1871. It has become an extremely serious weed of the mesic forest, diverse mesic forest, dry shrubland, and other low-elevation, dry, disturbed habitats. It is a thorny shrub that can form impenetrable thickets (Neal 1965:722; Smith 1985:192; Wagner, Herbst, and Sohmer 1990:1320).

Kiawe *(Prosopis pallida)* was first planted in Honolulu in 1828. Although Neal (1965:413) has described kiawe as "the commonest and most valuable tree introduced to Hawaii," few, if any, archeologists would agree with the "most valuable" label. It is a dominant component of the vegetation in low-elevation, dry, disturbed sites. Where there are subterranean water courses in dry areas, dense populations of the tree are found (Smith 1985:200; Wagner, Herbst, and Sohmer 1990:693).

American or red mangrove (*Rhizophora mangle*) was introduced to Hawai`i in 1902. It can dominate coastal marshes and streams and often forms impenetrable thickets excluding all other species. It has significantly altered brackish water ecosystems and fish ponds (Neal 1965:625; Smith 1985:200; Wagner, Herbst, and Sohmer 1990:1099).

Java plum (*Eugenia cuminii)* was cultivated in Hawaii prior to 1871. It has become naturalized in mesic valleys to disturbed mesic forest and forms dense cover, excluding all other species. One area with a heavy infestation is Kalaupapa peninsula (Smith 1985:189; Wagner, Herbst, and Sohmer 1990:975).

Koa haole *(Leucaena leucocephala)* was introduced before 1837 and is one of the most widespread alien shrubs or small trees in the arid lowlands. It often forms dense thickets, excluding all other plants. It grows in dry-to-mesic habitats up to 700 m (2300 ft) in elevation and was deliberately broadcast over lowland habitats in the middle of this century (Neal 1965:411; Smith 1985:193; Cuddihy and Stone 1990:85).

False kamani *(Terminalia catappa)* was cultivated in Hawai`i prior to 1871 and thrives near sandy shores. It is confined to mesic and wet coastal habitats and shades out all other species (Neal 1965:627; Smith 1985:203; Wagner, Herbst, and Sohmer 1990:548).

Locating, identifying, studying and managing the archeological resources in the national park units in Hawaii presents us with many interesting challenges. The challenge that has received the most attention is that of lava flows inundating areas where archeological resources are present (Ladefoged, Somers, and Lane-Hamasaki 1987; Carter and Somers 1990; Masse, Carter, and Somers 1991; Somers 1991). The effects of other natural phenomena, such as earthquakes and tsunamis, have also been discussed (Somers 1991). This paper provides a welcome forum to discuss one of the other great challenges, i.e., alien plants.

Alien plants affect archeological resources by: (1) making it difficult to find and record the resources; (2) causing damage to stone structures; and (3) making it difficult to understand what the vegetation was like before historic introductions became established. This paper will address these issues one at a time.

Obviously, before we can manage the archeological resources in the parks we must know where and what the resources are. Just finding and recording the archeological resources can be a major chal-

lenge because of the alien plants that have overgrown portions of the parks. The worst alien plants in this regard are christmasberry, lantana, kiawe, and koa haole. Anyone doing much archeology in Hawai`i will rapidly come to hate these plants, especially christmasberry.

A park that illustrates this point especially well is Kalaupapa National Historical Park on the island of Moloka`i. From October 1983 to May 1984 the U.S. National Park Service undertook an intensive archeological survey of 142 ha (350 ac) of the park along a corridor from Waihanau Valley to and through Kalaupapa Settlement (Figure 1) (Somers 1985). The purpose of the survey was to locate, identify, and record archeological sites so that a waterline could be routed within the corridor in such a way so as to affect the fewest number of sites. The predominant vegetation within that portion of the peninsula consists of christmasberry, lantana, and koa haole. Smith's (1985:192, 202) descriptions of christmasberry as an aggressive invader, of lantana's capability of forming impenetrable thickets, and of koa haole's ability to form dense thickets apply to Kalaupapa exceptionally well.

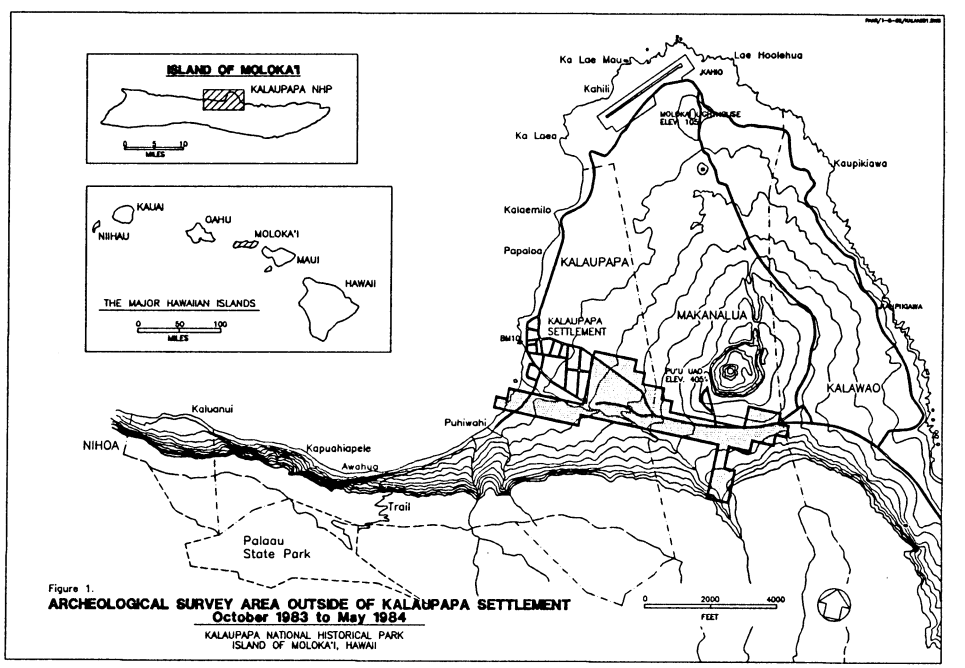


Figure 1.
**ARCHEOLOGICAL SURVEY AREA OUTSIDE OF KALAUPAPA SETTLEMENT**
**October 1983 to May 1984**
KALAUPAPA NATIONAL HISTORICAL PARK
ISLAND OF MOLOKA'I, HAWAII

The vegetation was so thick in the project area, the only way to get through it and be able to see and record the archeological sites hidden beneath was to cut lines using chain saws, machetes, and sickles (Figures 2 and 3). Grid units that were 100 m (328 ft) on a side were established using a transit to align them to the four cardinal directions. After the primary hectare-sized grid unit was established, intermediate grids every 25 m (82 ft) were aligned using tapes and compasses, and then cut. These grid lines were necessary to allow access to the areas that had to be examined, and also provided reference lines from which the identified features could be mapped. Without the lines you could not have penetrated the vegetation effectively and even if you found a site you would not have been able to determine where you were.

**Figure 2. Aerial view of grid lines cut to facilitate archeological survey, Kalaupapa National Historical Park.**

**Figure 3. Ground view of grid line cut to facilitate archeological survey, Kalaupapa National Historical Park.**

A similar approach was used to conduct archeological surveys through dense vegetation at Hawai`i Volcanoes National Park on the island of Hawai`i (Ladefoged, Somers, and Lane-Hamasaki 1987) and at Haleakala National Park on the island of Maui (Rosendahl 1976). Although this method is quite effective, it is also very labor-intensive and time-consuming. At Kalaupapa, in the area outside the settlement, the survey took an average of about 10 person-days per hectare (4 person-days per acre) (Somers 1985:37). At Haleakala, in the Kipahulu District, a similar survey took an average of about 6.5 person-days per hectare (2.6 person-days per acre) (Rosendahl 1976:5, 10). The existing records are not good enough to determine what the person-day-per-hectare rate was at Hawai`i Volcanoes, but it was probably similar to the Haleakala rate.

The best way to put these figures into perspective is to compare them to average survey rates

that are used in the arid southwestern United States where vegetation is usually not a problem. According to George Teague (pers. comm. 1992), an archeologist at the Western Archeological and Conservation Center in Tucson, Arizona, the average figure they use for estimating the rate of coverage for surveys is 25–40 acres per person-day (10–16 hectares per person-day). If the above rates for Hawai`i are converted to acres per person-day, instead of person-day per acre, they would be 0.25–0.38 acres per person-day (0.1–0.15 hectares per person-day). In other words, the average archeological surveyor in the desert Southwest could cover 100 times as much area in a day as the average surveyor could in the Hawaiian parks discussed above. Although the density of archeological sites is a factor in the different rates of coverage, the primary reason for the difference is the density of the alien plants in the Hawaiian parks.

At Kaloko-Honokohau National Historical Park on the island of Hawai`i, the major problems around the fish ponds are red mangrove and kiawe. Wagner, Herbst, and Sohmer's comment that red mangrove "often forms impenetrable thickets" (1990:1099) is borne out at Kaloko fish pond. Within the last 15 to 20 years red mangrove became established at Kaloko fish pond and completely took over the edges of the fish pond and the seawall and cross-walls associated with it (Figure 4). The U.S. National Park Service

**Figure 4. Kaloko fish pond showing dense stand of red mangrove, Kaloko-Honokohau National Historical Park.**

has been manually removing the mangrove since 1988 and still has about 25% of it left to go. Before its removal, the mangrove completely obscured the archeological features associated with the fish pond, and its impenetrable nature made it impossible to get to the features from the water side of the pond. It was also difficult to get to the features from the land side of the pond because immediately inland from the mangrove was a dense stand of kiawe. An even denser stand of kiawe and pockets of dense mangrove also are present around Aimakapa fish pond.

Two other alien plants, Java plum and false kamani, are also widespread, especially at Kalaupapa, and they are both a blessing and a curse. Unlike the other species discussed so far, these two trees form a dense cover, or overstory, which shades out other species. The landscape under them tends to be open and easy to walk through. On the other hand, however, their roots are widespread and cause considerable damage to archeological resources.

In Hawai`i the archeological resources are predominantly stacked stone structures built without any mortar. Consequently, they are particularly vulnerable to damage by root action. The stones in walls and platforms are spread apart and shifted by roots and are dislodged when tree limbs or entire trees fall on them. A particularly vicious cycle, which has been repeated in Hawai`i more than once, occurs when one-time money is received to clear the vegetation from a site, but there is no money to maintain it in that condition and the vegetation is allowed to grow back. When the vegetation is removed, the stones often settle in upon themselves. Then when the plants are allowed to grow back, the roots spread the rocks apart again, further weakening the wall or platform.

Although walls and platforms can be rebuilt, thus restoring their original appearance, there is an irretrievable loss of archeological data whenever a wall or platform is broken apart and falls down. The structure itself, whether a wall or platform, can be thought of as a large artifact. Two characteristics that should be noted when recording such an artifact are how it was constructed and what are its dimensions. When a wall or platform has been reduced to rubble, it is often no longer possible to record those characteristics. In those cases, what could have been originally recorded has been seriously compromised by the collapse; in terms of recording, fact has been replaced by supposition or speculation.

Finally, if you are able to get through the vegetation and find the sites, and they have not been reduced to rubble by roots and other factors, then you are still faced with the problem of trying to determine what the vegetation was like when the sites were occupied. What is present today usually has little or no relationship to what was present when the Hawaiians were occupying and using the sites. Obviously, cultivated plants that require tending will not survive long after a site has been abandoned and is no longer used. Unfortunately, because of the historically introduced species, the cultivated species were rarely replaced by native or even Polynesian-introduced species. Instead plants that are considered noxious weeds tend to dominate the disturbed landscape. The descriptions of the plants at the beginning of this paper illustrate this point.

Christmasberry dominates many abandoned agricultural sites; lantana is a serious weed in low-elevation, dry, disturbed habitats; kiawe is a dominant component of vegetation in low-elevation, dry, disturbed sites; Java plum is naturalized in disturbed mesic forest; and koa haole thrives in all of the above environments. This often applies not only

to the archeological sites themselves, but to the landscape surrounding them. Since the Hawaiians lived and farmed predominantly between sea level and 2,000 feet (and this is the area in Hawai`i where historically introduced species are most prevalent), we are not often even able to study remnant pockets of relevant vegetation. Instead we must rely on sketchy early written accounts of the vegetation, tree molds, pollen, and wood remains to try to reconstruct a completely altered landscape.

The profession of archeology is often very challenging and in that regard conducting archeological studies in Hawai`i is no different from anywhere else. What the archeologist in Hawai`i does face, however, are challenges that are somewhat different from many other places. On the island of Hawai`i, for example, historic lava flows have buried hundreds, and probably thousands, of archeological sites. In addition, landscapes and the archeological sites present on them have changed due to earthquakes, landslides, and tsunamis. How these actions have skewed the archeological record is something that must be addressed by archeologists working in Hawai`i (Somers 1991). There are other challenges, such as the lack of effective temporal dating techniques, to add to that presented by alien plant species.

Sites can be difficult to find, record, and interpret because they are obscured and damaged by alien plants. (Although native plants can do the same thing to archeological sites, they are not nearly the problem alien species are.) Although some of the problem species have been established in Hawai`i for over 100 years, two of the more noxious and rapidly expanding species, christmasberry and red mangrove, have only become established since 1900. As the archeological professional struggles to identify, record, and understand the remains of the prehistoric Hawaiian culture, these species are expanding and making the task even more difficult. Because of the dominance of alien species in the areas where most of the archeological sites in Hawai`i are found, archeologists working in Hawai`i not only need to know how to use a transit, compass, and other standard archeological equipment, but a chain saw, machete, and sickle. The ability to crawl on your hands and knees and sometimes on your belly is also a very useful skill.

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