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Clones within Clones: Cosmology and Esthetics and Polynesian Crop Selection¹

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Abstract: Polynesians living on tropical and temperate high islands in the Pacific traditionally maintained large inventories of cultivars (cultivated varieties) in vegetatively propagated crop species or cultigens. This infraspecific or “within species” diversification has usually been explained in ecological-functional terms, with cultivar selections seen as human adaptive responses to variation in natural and agricultural ecosystems. But recent research reveals little genetic basis to the Polynesian polyvarietal phenomenon and further suggests that functional equivalency existed among some cultivars in agricultural contexts. Hawaiian polyvarietal phenomena are described and crop folk classification is outlined. Utility and perceptual distinctiveness are explored along with indigenous concepts of cosmology and esthetics as criteria that in combination may better account for the large inventories of crop cultivars in Hawaii and Polynesia.

Résumé: Les Polynésiens des hautes îles tropicales et tempérées du Pacifique cultivaient traditionnellement de très nombreuses variétés d'espèces cultivées (ou cultigènes) à reproduction végétative. Cette diversité intraspécifique a souvent été expliquée en termes écologico-fonctionnels, la sélection des multiples cultivars (de l'anglais «cultivated varieties») ou clones étant perçue comme une réponse adaptative aux variations à l'intérieur des écosystèmes naturels et agricoles. Toutefois, d'après des études récentes, la très grande variété polynésienne reposerait sur une base génétique minimale et certains cultivars seraient équivalents d'un point de vue fonctionnel dans des contextes agricoles. Dans le présent travail, nous décrivons le phénomène hawaïen de multiplicité des variétés cultivées et nous présentons la classification vernaculaire de ces variétés. Les explications fondées sur l'utilisation et la différenciation perceptive sont aussi abordées en même temps que les concepts vernaculaires relatifs à la cosmologie et à l'esthétisme. L'ensemble de ces considérations devrait permettre de mieux rendre compte du nombre important de cultivars à Hawaï et en Polynésie.

Whether viewed from the perspectives of horticulture, human ecology or ethnohistory, the diversification of traditional crops into many and even scores of cultivars (cultivated varieties) is a remarkable feature of Polynesian cultural evolution. Excepting the subantarctic Chatham Islands, the selection and maintenance of multiple cultivars within crop species or cultigens occurred everywhere in traditional Polynesia. Especially prevalent in the more massive and ecologically diverse high islands, each Polynesian society—whatever its size and complexity—based its agricultural production on a unique set of crops and semidomesticates chosen from a core group of plant species, most of which had originated outside of Polynesia. During centuries of more-or-less endogenous cultural development following colonization, the people of each of the major Polynesian archipelagoes favoured one or more of these crops with substantial and even lavish attention in the form of polyvarietal selection and maintenance.

In this study I investigate structural and functional aspects of the Polynesian polyvarietal phenomenon. Using as examples five Hawaiian cultigens—banana, kava, sugarcane, sweet potato and taro—I first identify common features of the biology and folk classification of the Polynesian crops. After reviewing the criteria most often proposed to account for polyvarietal crop phenomena in Polynesia and other tropical regions, I introduce cosmology and esthetics as possible important motivating factors in the selection and maintenance of truly large numbers of cultivated varieties in Hawaii and Polynesia.

Shared Features of the Five Hawaiian Crops

Despite being from five unrelated families (Araceae, Convolvulaceae, Musaceae, Piperaceae, Poaceae), the five Hawaiian crops serving as background for this discussion share the following features: all are extra-Polynesian domesticates; all have narrow genetic bases; all



Dr. Adrian Brash, renowned "Hawaiian banana hunter," standing in front of *iholena lele* (*Musa acuminata* x *M. balbisiana*), one of five Hawaiian *iholena* eumusa (AAB genomic group) banana clones. Photo probably taken in the 1950s or 1960s. Courtesy of Bernice P. Bishop Museum.

are polyploids; all are asexually propagated; each was diversified into multiple cultivars; and all are represented in Hawaii by a folk classification of at least three different ranks. Several of these features were noted by the 18th-century European explorers Banks (in Tahiti; Yen, 1991: 67) and Cook (in Hawaii; Agee, 1927: 155), and then by 19th-century "gentlemen farmers" such as Rooke (1855) in Hawaii. Territory of Hawaii horticulturists Pope (1926) and Whitney, Bowers and Takahashi (1939) and the well-known Pacific ethnographer Handy (1940; Handy and Handy, 1972), produced detailed inventories of several Hawaiian cultigens. These publications are complemented elsewhere in Polynesia by the works of Barrau (1956a, 1956b, 1958), Simmonds (1954, 1956), Yen (1960, 1968, 1973, 1980, 1990, 1991) and, to a lesser extent, Brown (1931), all of whom

treated Polynesian crops in wider Oceanian and sometimes world contexts.

Origin and Biology

It has long been recognized that most of the traditional Polynesian crops are not Polynesian domesticates at all (Buck, 1938; Yen, 1991). However, there are a few cases of local polyvarietal development within native Polynesian plant species: New Zealand flax (*Phormium tenax* Forst.) is perhaps the best example. But the great majority of the traditional Polynesian crops are Indo-Malayan and Melanesian domesticates that were transported eastward during the Austronesian and the later prehistoric Polynesian colonization of the south-central and eastern Pacific islands (Yen, 1991). Reduced fertility common to many of the non-cereal tropical energy crops, combined with sequential island hopping involving long distance open sea voyaging, undoubtedly resulted in the unusually narrow genetic bases now seen as characteristic of most Polynesian cultigens. For example, Hawaiian bananas and kava are sterile, while sugarcane, sweet potato and taro demonstrate extremely low rates of flowering and seed set. Each of these crops is effectively reproduced in Hawaii through lateral bud, ratoon or stem propagation involving human intervention, though dispersed feral populations of banana and kava have persisted sporadically after abandonment up until today. Sterility and near-sterility resulted from the mutually reinforcing natural effects of autopolyploidy and interspecific hybridization coupled with human selection which favoured reduced flowering, parthenocarpy, plant products other than seeds and vegetative vigour.

Recent studies indicate or suggest exceedingly narrow genotypes in Hawaiian kava (Lebot, Aradhyia and Manshardt, 1991), sugarcane (Wood and Strand, 1988), and taro (Lebot and Aradhyia, 1991), while a slightly larger, though still very limited, genetic base is found within the Hawaiian bananas (Lebot et al., 1993; Lebot, Meilleur and Manshardt, 1994).

Despite observations of low levels of seed production in Pacific sweet potato and taro (Bulmer, 1966; Handy, 1940; Handy and Handy, 1972: 21; Yen, 1968: 390), presumably the result of sexual processes, somatic mutation in meristematic tissue is now recognized as the principal source of phenotypic variation. Like their counterparts throughout Polynesia, Hawaiian farmers recognized this variation—most obvious in colour and form—and then selected and maintained it through isolation, propagation and dissemination of cultivars. While each cultigen's exceedingly narrow genetic base is remarkable in biological and horticultural terms, one can-

not but also be impressed by the breadth of phenotypic variation in the form of morphotypes or cultivars selected and maintained by Hawaiians within the five crops. The Polynesian cultigens are thus excellent examples of the need for care to be shown in assuming equivalency between phenotypic variation and genetic diversity in crops, as has sometimes been done in the social sciences (Boster, 1984a; Brush, Carney and Huaman, 1981; Hames, 1983: 28).

Cultivar Numbers

Based on both naming patterns and observed variation, widely divergent claims have been made regarding the number of cultivars traditionally maintained in Hawaii in the five crops. Citing the high ends, 300-plus varieties have been claimed for taro (Krauss, 1993; but see Fornander, 1918-19; Greenwell, 1947; Handy, 1940; MacCaughey, 1917; Pukui, 1967; Whitney, Bowers and Takahashi, 1939), 50-plus for sweet potato (Rooke, 1855; Thrum, 1879; but see Handy, 1940), 70-plus for banana (Kalokuokamaile in Pope, 1926, 1927), about 40 for sugarcane (Handy, 1940; Moir, 1933) and 15 for kava (Handy, 1940; Handy and Handy, 1972). Similarly high figures have been cited for these same and other crops throughout Polynesia (Berridge, 1913; Brown, 1931; Colenso, 1880; Henry, 1928; Walsh, 1902) and Oceania (Bascom, 1948; Plucknett, de la Pena and Obrero, 1970; Spier, 1951; Warner, 1962). With the role that synonymy probably played in inflating these figures now better understood (Abbott, 1992: 25; Boster, 1984b: 42), and following some unknown (but probably not catastrophic) amount of genetic erosion (Whitney, Bowers and Takahashi, 1939), it is believed today that Hawaiian taro varieties number around 80 to 100 (Lebot and Arahadya, 1991), sweet potatoes perhaps 25 to 30, bananas about 25 (Lebot, Meilleur and Manshardt, 1994), sugarcanes around 30 (Wood and Strand, 1988) and in kava cultivars number between 10 and 15 (Lebot and Levesque, 1989). Despite the differences between the earlier and later assessments, by any reasonable standard even the modern, lower figures are impressive. The numbers alone compel us to acknowledge that ancient Hawaiians carefully attended to their crops and, for reasons not yet well understood, selected and maintained large inventories of cultivars in each of them. Later sections of this article will examine the possible underlying bases for this Polynesian polyvarietal phenomenon. For now, I assess the general importance of the Hawaiian crops and describe related features of their folk classification.

Cultivar Numbers as Indices of Cultural Significance of the Hawaiian Crops

In the absence of figures on surface areas planted, quantities produced, amounts consumed, nutritional contributions or other types of evidence which alone or in combination could demonstrate Hawaiian crop importance during the traditional period, cultivar numbers per cultigen can be used as very rough indices of cultural significance. Assuming that the selection of multiple varieties and the resulting folk classificatory elaboration are positively correlated with cultural significance, as has been demonstrated elsewhere (Berlin, Breedlove and Raven, 1974: 99-100; Hames, 1983: 16-17), that the five cultigens were introduced to Hawaii at approximately the same time, and that their rates of mutation are essentially equivalent, we can rank each crop in Hawaii by its importance in terms of the number of cultivars maintained (Table 1). This simplistic assessment ranks taro as the most important crop, sweet potato and sugarcane approximately tie for second, banana is third and kava is the least important of the five Hawaiian crops that were subjected to significant infraspecific diversification.²

Table 1
Cultural Importance of Hawaiian Crops
Based on Cultivar Numbers

| Cultigen | Number of Cultivars |
|---|---------------------|
| <i>Colocasia esculenta</i> /taro/kalo | 80-100 |
| <i>Ipomoea batatas</i> /sweet potato/'uala | 25-30 |
| <i>Saccharum officinarum</i> /sugarcane/kō | Perhaps 30 |
| <i>Musa acuminata</i> x <i>M. Balbisiana</i> / (Eumusa) banana/mai'a | About 25 |
| <i>Piper methysticum</i> /kava/'awa | 10-15 |

While ranking of Hawaiian crops in this way roughly parallels impressionistic assessments of earlier writers (Handy, 1940; Handy and Handy, 1972), somewhat more specific statements about cultural significance can be made by examining the complexity of crop folk classification.

Classificatory Similarities

I begin this topic with a simple lexical analysis of each of the classificatory lexicons of the five crops. This follows literature searches that established lists of varietal names, determinations of synonymy and assessments of folk classificatory relationships based on available evidence.

The cultivars in each crop can be arranged hierarchically in rough, partial classifications according to lexical complexity, as in the tree diagrams shown in

Figures 1-5. These classifications may reflect some features of the cultivar selection process in Hawaii as it occurred through time. For example, let's assume that taro, or *kalo*, was introduced to Hawaii by Polynesians perhaps 2,000 years ago in an undifferentiated state or much less differentiated state when compared to today, that is, as a single or a few clonally propagated cultivars which were originally the sole Hawaiian representatives of *Colocasia esculenta*. We can thus locate the Hawaiian lexeme *kalo* at level 0 in our scheme. Preliminary analysis suggests that the crop may have been segregated into around 25 varieties, but it is not possible to determine the rate or the period of time over which this differentiation may have occurred in Hawaii. These folk segregates are placed at the subspecific -1 level in our scheme, and constitute a contrast set. Whitney, Bowers and Takahashi (1939), also recognizing the possible temporal priority of these folk segregates with regard to later taro selections, variously called these -1 level clones "groups," "group names" or "groupings." I'll call them cultivar groups. Collectively, these cultivar groups appear to represent a first wave of taro selection in Hawaiian history. Whitney, Bowers and Takahashi (1939) essentially describe them in terms of what folk taxonomists now call "monomially labeled folk specifics" (Berlin, 1992: 118). Such monomials occur in the Hawaiian classifications of crop plants immediately below the monolexemic (and generic) head terms, like *kalo*, which are often silent but inferred. Examples are (*kalo*) *lauloa*, (*kalo*) *mana*, (*kalo*) *piko*, (*kalo*) *kumu*, etc. About eight cultivar groups of taro now appear to remain in Hawaii. The other possible 15 original cultivar groups or so now seem either to be represented by single clones, have been lost, or nomenclatural information is too fragmentary to determine much about them.

Following this presumed first wave of taro selection in Hawaii, many of the -1 level cultivar groups, such as *lauloa* and *piko*, seem to have been subjected to at least one more round of selection by Hawaiians. The new cultivars selected from the -1 level clones constitute a second contrast set of -2 level clonal variants. These are usually identifiable by their binomial names, formed by the cultivar group name followed by a secondary, descriptive epithet. *Lauloa hā* is an example.

Somatic mutants from a small number of -2 level clones appear to have continued to be selected by Hawaiians during prehistory, forming a contrast set of -3 level clonal variants. Lexically, these cultivars are trinomially formed by the addition of a tertiary, descriptive epithet to the binomial, such as *lauloa ha 'ele'ele*.

Once the five crop lexicons are arranged in this manner, we can make two simple calculations. In the first, we

Figure 1
Example of Presumed Taro (*Colocasia esculenta*) Folk Classification in Ancient Hawaii

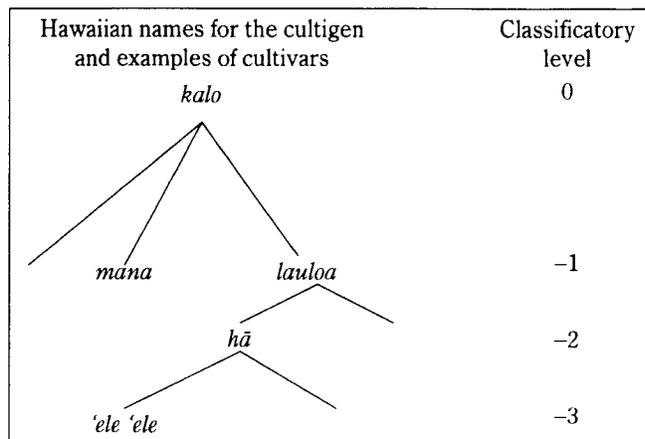


Figure 2
Example of Possible Sweet Potato (*Ipomoea batatas*) Folk Classification in Ancient Hawaii

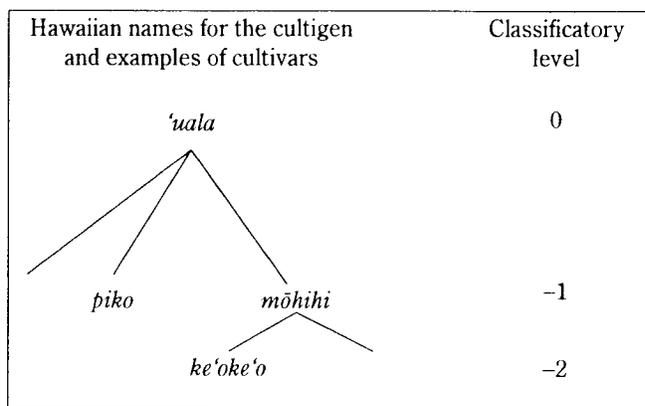


Figure 3
Example of Possible Sugarcane (*Saccharum officinarum*) Folk Classification in Ancient Hawaii

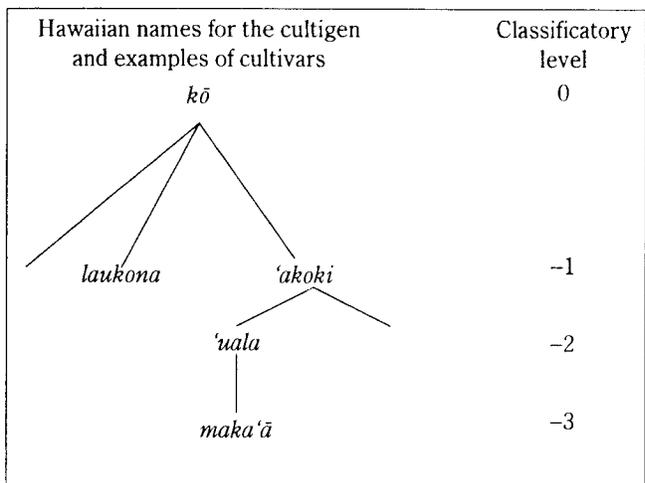


Figure 4
Example of Presumed Banana (*Musa* sp.)
Folk Classification in Ancient Hawaii

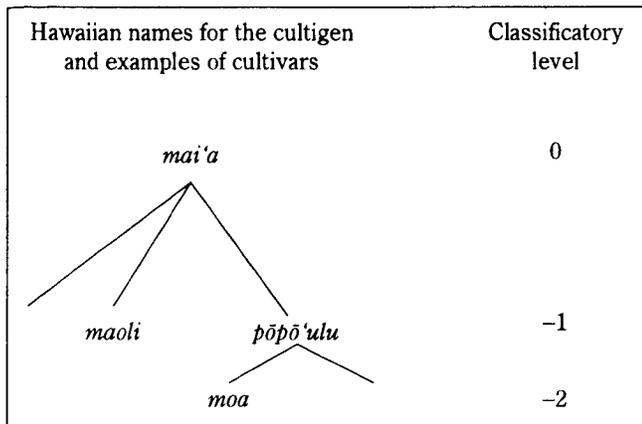
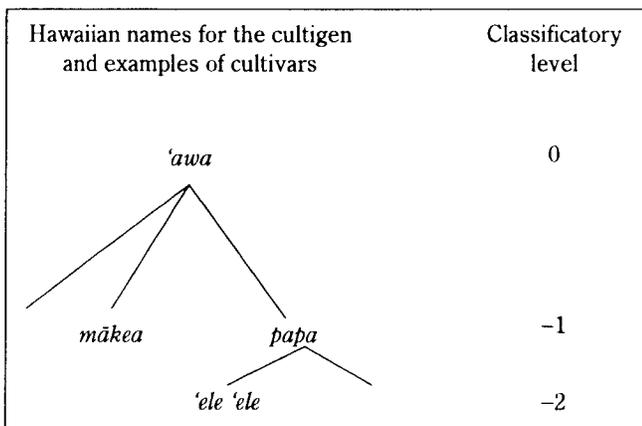


Figure 5
Example of Possible Kava (*Piper methysticum*)
Folk Classification in Ancient Hawaii



count the number of levels at which cultivar selection appears to have occurred in each crop. In the second, we note the number of cultivars selected at each level. While we cannot know how much of this process occurred prior to Polynesian colonization of Hawaii, one outstanding feature is immediately recognizable: Hawaiians subjected at least two of the five crops (taro and sugarcane) to three levels of infraspecific selection, seemingly practising a sort of serial elaboration of varieties that might be described for these two cases as clones within clones within clones.

Since we assumed that classificatory elaboration of crop species is directly correlated with cultural significance in Hawaii, by determining the number of levels of selection per crop and the number of cultivars per level, somewhat clearer statements about the degree of selective attention shown to each of the five Hawaiian crops are possible. Such an assessment complements earlier

impressionistic statements on relative crop importance in Hawaii by establishing degrees of cultural attention shown by Hawaiians toward their crops.

Criteria for Selection of the Five Hawaiian Crops

But while we now know a bit more about their origin and can better gauge their traditional cultural importance, how do we explain the selection and maintenance of so many cultivars in the five Hawaiian crops. Anthropologists especially have studied aspects of polyvarietal phenomena among native peoples in the tropics, and their published works among others provide background for the discussion that follows.

Three principal avenues of investigating polyvarietal phenomena are distinguished here. The first approach focuses on human ecological explanations. In these, the selection and maintenance of multiple varieties are viewed as strategies by which human societies adapt their crops (and themselves) to variation in natural and agricultural ecosystems (agroecosystems) and thus augment or diversify their own economic production. Fairly detailed claims have been made which link polyvarietal cropping systems to crop loss risk reduction, enhancement of crop resistance to pathogens, adaptation to diverse substrates or water regimes, prolongation of growing seasons, shortening of maturation times, increase in overall yield and so on. In the second approach, polyvarietal phenomena are linked to expanded cultural (but non-ecological) roles for cultivars and their products. And in the third approach, formulated mostly by the cognitive anthropologist James Boster, the varietal selection process itself is studied. I summarize and discuss each of these approaches in turn. I then examine Hawaiian notions of cosmology and esthetics as possible criteria that may complement already proposed explanations in accounting for the selection of Hawaiian cultivar numbers which seem to exceed what were necessary for material success.

Agroecological Links to Polyvarietal Phenomena

Quite a bit has been written about infraspecific selection as a means by which people match the flexible agronomic qualities of certain cultigens to environmental variation. Most versions of this view are deterministic (Hames, 1983: 32), that is, cultivar selection is seen as an adaptive response by humans to natural or anthropogenic environmental diversity. Statements seeking to account for polyvarietal phenomena in Polynesia usually assert this linkage in some form (Handy, 1940; Pukui, 1967: 433;

Rooke, 1855; Walsh, 1902: 13). The strongest proponent of this position in Hawaii is Handy (1940: 9), who states that "Hawaiian planters . . . consciously select . . . the varieties that grow best under given circumstances," and that "varieties [were] adapted to planting in every type of soil" (Handy and Handy, 1972: 79). However, in Polynesia such contentions are made in the near absence of substantiating data (but see Handy, 1940: 46, 54 for maturation time differences in Hawaiian taros, presumably derived from empirical observation). For instance, to validate their claims, Handy (1940: 14, 143, 220-225) and Handy and Handy (1972: 109-110, 128) describe examples which link microenvironments and just two taro varieties. In making similar statements about sweet potato, no supporting information is furnished. On the other hand, though they acknowledge a range of responses among the taro cultivars to different agroecological conditions, the horticulturists Whitney, Bowers and Takahashi (1939) do not draw deterministic conclusions, and Pope (1926) in his work on bananas avoids the issue.

Assertions by Handy and others that Hawaiian cultivar elaboration was a cultural response to agroecological variation presuppose two features of Polynesian horticulture that have not been well substantiated: that Polynesians recognized differences in yield among cultivars in diverse environments and that Polynesians experimented with newly mutated clones in view of expanding their horticultural activities into new environments or of using existing agricultural lands more efficiently. Though these suppositions may be true, they have almost no documented factual basis in Polynesia. Moreover, a review of the background literature on polyvarietal phenomena elsewhere in the tropics reveals that cultivars are not universally viewed as having been selected and maintained for the purpose of microenvironmental adaptation.

In a series of papers on Aguaruna manioc varieties, Boster (1984a, 1984b, 1985) argues that "environmental response characteristics of manioc seem to be of little concern to the [people, even though] . . . the cultivars did differ in their response to soil conditions" (1984b: 40). Yen (1968: 406) seems to draw a similar conclusion after investigating fungal action on Pacific sweet potato cultivars. Though differentially resistant to laboratory infection, he noted that the varieties did "not indicate a selection for resistance." Like-minded conclusions have been made with regard to the polyvarietal aspects of the Andean potato (Brush, 1992; Zimmerer, 1991: 36-37) and ensete ("banana") cultivation by the Ethiopian Ari (Shigeta, 1996: 264). Thus, while agroecological explana-

tions for polyvarietal phenomena in Hawaii are plausible and intuitively attractive, in the absence of substantiating data it is inappropriate, as Hunn (1982: 831) has stated, to assign "motives to human actions based solely on their consequences, biological or otherwise." Along with continued work such as that of de la Pena et al. (n.d.) which has demonstrated yield and taste differences in Hawaiian taro grown under uniform conditions, controlled experimentation and field work with contemporary Polynesian farmers practising traditional methods would be useful in helping to confirm that agroecological adaptation, whether intentional or not, is the driving force behind Polynesian polyvarietal selection.

Other researchers have shown interest in multiple cultivar phenomena among indigenous and peasant peoples by studying the distribution and merits of polyculture and multicropping in the tropics. For example, the mixing of sweet potato and other varieties has been described as a positively reinforced behaviour which contributes to increased harvest security (Clawson, 1985; Zimmerer, 1991: 27). Indeed, Western horticulturists and agronomists have long recognized the value of expanded phenotypy in widening agroecological response, and especially so in asexually propagated tropical crops with narrow gene pools (Altieri, Letourneau and Davis, 1983: 47; but see Hames, 1983: 14). In Polynesia, Yen (1968: 406) observed that mixed varietal stands of sweet potato tended to show reduced disease incidence, and Whitney, Bowers and Takahashi (1939: 7), and Handy and Handy (1972: 103, 134), noted that Hawaiian planters sometimes mixed varieties. However, none of these writers make especially strong statements about the supposed benefits of polyculture as a motive for the selection of multiple varieties. While multicropping in the tropics has been well investigated, polyculture has been much less so, and polyvarietal phenomena in relation to polyculture even less. Given the ubiquity of polyvarietal phenomena in Polynesia, and that polyculture and multicropping seem to have been similarly widespread, the Pacific islands would appear to be a particularly well suited region for investigating these phenomena and their relationships.

Other researchers describe relevant features of the polyvarietal phenomenon through a second approach. In this approach, infraspecific crop diversification is tied to the expansion or improvement of non-agroecological cultural roles for cultivars and their products.

Expanded Cultural Utility and Polyvarietal Phenomena

Many forms of non-agroecological cultural utility have been proposed as forces motivating the selection and maintenance of crop cultivars. These range from protection against human theft of bitter varieties of Amazonian manioc (discussed in McKey and Beckerman, 1993: 95) to establishing and reinforcing human cultural identity through Andean potato cultivars (Brush, 1992; Zimmerer, 1991), with all types of everyday material applications in between.

Similarly, substantial functional differences have been attributed to cultivars within the five Hawaiian crops, especially in the context of the domestic economy. Pick any one of the five cultigens and one can find that some of its varieties were used as food, others as medicine or in rituals, many were prepared in different ways for different occasions, etc. While most Hawaiian cultivars were probably, in this regard, multipurpose, there are also examples of varieties that seemed to occupy tightly restricted roles within Hawaiian culture. For example, Greenwell (1947: 283) describes the taro variety *'ohe* as being used solely for suppositories. However, given our understanding of the Hawaiian crops' narrow genetic bases, and the known material uses to which crops were put, we can ask ourselves two questions. Dispersed even as they were across eight main islands with much environmental variation, was it ecologically or economically necessary for Hawaiians to select and maintain 80 to 100 taro varieties or 30 sweet potato cultivars? And was it biologically possible and materially meaningful for the Hawaiians to have selected and maintained such a plethora of presumed functionally distinct varieties from crops with such narrow genetic bases? While these questions cannot be answered in the current paucity of detailed field or experimental data, it is worth returning to the unpublished taro yield results of de la Pena et al. (n.d.) for some indication on how we might proceed in trying to answer these questions in the future.

Functional equivalency among almost any set of cultural objects is difficult to demonstrate under the best of circumstances and it is always a more-or-less relative concept. Nevertheless, while showing a range in yield differential of over 3:1 within 42 Hawaiian taro cultivars grown under controlled conditions (*maea* = .95 lbs/corm vs. *manini uluuli* = 3.23 lbs/corm), de la Pena's data permit preliminary clustering of the 42 cultivars into six sets in which yield does not differ within each set by more than 5 percent. Two of these groups are composed of more than 10 cultivars. While indicating only that

many Hawaiian varieties yield similarly under identical conditions, these results nevertheless suggest that substantial functional equivalency may have existed among many of the Hawaiian taro varieties in their agroecological performance.³ If, after further research, this proves to be true within the taro cultivars, we would expect to find clustering like this in the material aspects of the other Hawaiian cultigens, as Lebot and Levesque (1989) found in their kava work which grouped 11 Hawaiian morphotypes into five chemotypes. If, through further research, functional equivalency in material applications can be clearly demonstrated within the Hawaiian cultigens, non-material bases for selection will need to be more thoroughly studied for their potential roles in motivating varietal diversification in Hawaii, Polynesia and elsewhere. Indeed, as we will see below, I believe it is probable that cosmology and esthetics played important historical roles in inflating traditional Hawaiian cultivar inventories. However, quite a different approach was taken by Boster in describing aspects of Aguaruna manioc selection in the Peruvian Amazon.

A Cognitive Approach, and Variability for Its Own Sake

In his work on Aguaruna manioc cultivars, Boster describes and analyzes what he calls selection for perceptual distinctiveness, an important notion prefigured in the works of Harlan (1975: 110) and Yen (1968: 394). Boster's point (1985: 311) is that "cultivars must be distinguishable before they can be selected on the basis of utility." He does not refute the agroecological or the expanded utility selection arguments, rather, he takes another tack, mostly examining the process of varietal diversification instead of its causes. By proposing a predictable sequence of cognitive and practical events which begin with the "selection of combinations of characters that allow the cultivars to be perceptually distinguished" (1984b: 44), Boster describes a two-step process in which morphological markers are first recognized by Aguaruna and then selected by them. In step one, selection is of visual characters that permit cultivar recognition and is unconscious, while in step two, selection occurs of the now-distinguishable cultivars based on utilitarian criteria, followed by the prolonged maintenance of some cultivars, and is deliberate. He argues that if cultivars are not in some way readily distinguishable, step two selection cannot occur.

Though not the emphasis of his work on manioc, Boster does nevertheless suggest some reasons why so many varieties are selected and maintained by the Aguaruna. While recognizing the potential motivating

roles of agroecological adaptation and other forms of utility, he claims that Aguaruna view cultivar selection and maintenance as desirable unto themselves, as a sort of bio-agricultural insurance policy, and this is mostly sufficient to account for the large manioc cultivar inventory. In his words, "it would not be adaptive to eliminate alternatives [which] might never be recovered . . . if the manioc varieties are decided against." Other observers of tropical agriculture have also proposed that infraspecific crop variability is selected and maintained for its own sake by indigenous peoples (Shigeta, 1996: 262). In Polynesia, Handy (1940: 149) felt simply that variety appealed to Hawaiian planters, and Harlan (1975: 110) and Yen (1968: 408) describe the novelty of "strange and bizarre" forms and the interest shown toward them by traditional farmers (see also Brush, 1992: 180). Indeed, the pride and prestige in discovering new, unusual varieties, and then in maintaining highly valued ones, is a characteristic of traditional agricultural societies throughout the tropics (Bascom, 1948: 217; Boster, 1984a: 355; 1984b: 43; Handy and Handy, 1972: 23; Shigeta, 1996: 257; Warner, 1962: 410; Zimmerer, 1991: 34).

There is nothing inherently implausible about any of the explanations thus far described, but just how does one prove or disprove them, or calculate the part that one or the other of the motivating forces may play in the processes of cultivar selection and maintenance? I will return to this question in my concluding remarks, but first, let's look at the roles that cosmology and esthetics may have played in creating the polyvarietal phenomenon in Hawaii.

Cosmology and Esthetics as Bases for Selection and Maintenance of Polynesian Cultivars

Cosmology and esthetics are cultural features which are rarely considered as bases for polyvarietal phenomena. Because they are so thoroughly interconnected in Polynesia, they are treated here together. Hawaiian crops and cultivars were not limited in their cultural significance to the more common material applications as food, medicine and so on. Many were heavily implicated in traditional Hawaiian ritual which penetrated nearly every aspect of life. For instance, it is well known that many cultivars and their products could be consumed or used solely by the chiefly classes. And, at the species or cultigen level, under certain circumstances, several of the Hawaiian crops were well known to be *kinolau*, or tangible manifestations of one or more of the Hawaiian gods (e.g., taro as Kane; sweet potato as Lono), as were many wild

plants and animals. However, such cultigen-level aspects of the linkage between Hawaiian cosmology and plants may have only a limited bearing on the Polynesian polyvarietal phenomenon which resides at infraspecific levels. At least three instances of cultivars as *kinolau* can be found in the literature, and I believe that these examples are potentially significant to our understanding of multiple cultivar inventories in Hawaii and Polynesia. What they demonstrate is that Hawaiian cosmological concepts penetrated well below the level of species in folk classificatory terms, and in these cases, to the -1 and -2 levels of the folk classification. It is also known that in certain ritual contexts individual cultivars were specifically required (Green and Beckwith, 1926: 180; Ii, 1983: 45; Pukui, 1967: 433). This suggests that some varieties, perhaps functionally equivalent with other cultivars in agricultural or other material contexts, were considered to be functionally unique cosmologically. We might see support for this speculative argument in Handy's (1968: 49) contention that if more were known about Hawaiian religion, "every . . . form of life [would have been found to be] an embodiment of a particular god or demigod," presumably occupying a distinct cosmological role in ritual contexts.

Colour and form were important morphological dimensions of the relationship among gods, chiefs and cultivars. Chiefs and gods were closely but variously associated with black, red and yellow, as well as with mixes of colours that were suggestive of rainbows. Given this background, we can ask ourselves how fortuitous it is that the three chiefly and ritual colours, and their various combinations, are so common in the ubiquitous striped patterns found in cultivars of all the five crops. The most explicit example of this relation is that of the red-coloured taro varieties that were reserved for chiefly consumption of *poi* (cooked and fermented taro paste) and as offerings to gods (Greenwell, 1947: 281), but many similar cases can be found among the other cultigens.

We should also consider what the Hawaiian theory might have been to account for the appearance of such visually stimulating multicoloured sports alongside established varieties. Elsewhere, in Melanesia (Haudricourt, 1964: 99), and in South America (Boster, 1984b: 43), such morphological changes in clonal variants are attributed to divine action. While we do not have specific evidence for this in Hawaii, Hawaiian evolutionary theory, as represented in the *Kumulipo* (the Hawaiian creation chant), attributes the creation of all known entities to cosmological forces (Beckwith, 1951; Valeri, 1985), and it is likely that the advent of new and remarkable

clonal variants would have been similarly viewed. Though again speculative, Hawaiian cosmological beliefs may actually have required the maintenance of newly recognized phenotypes.

The potential role of esthetics in Hawaiian cultivar selection should also be considered in this context. Hawaiians, like all the tropical and temperate high island Polynesians, developed sophisticated art forms, engaged in elaborate body decoration and ornamentation often involving plant products and systematically constructed an oral literature full of subtle notions of environmental beauty. And, as Kaepler (1978a, 1978b, 1989) has repeatedly stated, it is impossible to divorce Polynesian esthetics from cosmology, ritual and social organization. While concepts of environmental and natural resource esthetics have been little explored in Polynesia, parallels can be readily established between decorative elaboration in the classical Polynesian art forms and colour and formal patterns in Hawaiian cultivars. For example, Kaepler continually draws our attention in her work on Polynesian music, dance and sculpture to elaborate, even exaggerated, decorations of the art forms which she believes to be unnecessary to their role in communicating ritual themes. And when she (1978b: 272) describes Tongan art as imbued with "levels and levels of decoration upon decoration," it is hard not to associate this "artistic" behaviour with the serial selection and then maintenance of scores of unusually formed and colourful Hawaiian crop cultivars (e.g., clones within clones).

In Polynesia and other tropical regions, beauty has occasionally been recognized as a possible basis for cultivar selection. Both Handy and Handy (1972: 313) and Pukui (1967: 433-434) briefly noted traditional Hawaiian appreciation of beauty in several crop cultivars, and elsewhere in the literature on indigenous tropical horticulture similar attributions can occasionally be found (Boster, 1984a: 355; Dodds, 1965: 131). I argue that esthetics and cosmology deserve much more serious attention by researchers as potential criteria for understanding selection of multiple cultivar inventories in Hawaii, Polynesia and elsewhere in the tropics.

Conclusions

In the first half of this study I showed that the Hawaiian cultivars were numerous, that they were selected within five crops from unrelated families, that they existed through a process of serial, infraspecific selection of somatic mutants, and that certain of their lexical aspects are useful in assessing their overall cultural significance. In the second half of the work I exposed the principal approaches employed to account for and analyze poly-

varietal phenomena in Hawaii, Polynesia and the tropics, and introduced cosmology and esthetics as possible further motivating features in the development of the phenomenon. I hope what emerges from this is a broader appreciation for the complexity of infraspecific crop selection in the tropics, and an awareness that more rigorous problematics are needed to establish cause and effect in crop cultivar elaboration everywhere. We can no longer argue backwards claiming intentionality of selection from a handful of cultivar examples that are poorly linked to vaguely specified, but supposed, environmental differences. While I do not have immediate answers regarding the bases for Hawaiian and Polynesian polyvarietal phenomena, a broader view of the problem is needed and several new avenues for exploration were proposed to achieve this. If functional equivalency in material applications can be demonstrated among cultivars of the same crop, it will be especially important to carefully examine potential non-material bases for selection. In all likelihood, infraspecific selection of cultigens for micro-environmental adaptation, cultural utility including cosmological applications and esthetic values, and the maintenance of variability for its own sake, are all somehow implicated in this interesting phenomenon.

This article was stimulated by an appreciation I have gained over the years for the cultural and horticultural elaboration embodied in the Hawaiian crop cultivars. The cultural renaissance currently underway in Hawaii is generating intense interest, pride and rejuvenation in carving, dance, music and other forms of crafts and performing arts, and rightly so. It is difficult not to want to add traditional Hawaiian agricultural practices, and especially the selection of multiple crop cultivars, to these other forms of sophisticated Polynesian cultural achievements.

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Notes

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- 2 At least three other Polynesian introductions seem to have been subjected to some amount of infraspecific diversification (or arrived as such) in Hawaii: *Broussonetia papyrifera*

- (L.) Venten./paper mulberry (Meilleur, Maigret and Manshardt, 1997), *Cocos nucifera* L./coconut and *Dioscorea alata* L./yam (Abbott, 1992: 39). The Hawaiian breadfruit (*Artocarpus altilis* [S. Parkinson ex Z] Fosb.) inexplicably was not subjected to cultivar selection in Hawaii as it was elsewhere in Polynesia, even though among its many uses it was once an important food crop in several parts of the archipelago. These crops are not included in this discussion.
- 3 Richards' (1996: 301) work with West African rice cultivars suggests another possible explanation for similarities in yield and other features of agroecological performance among the Hawaiian taro cultivars. In Sierra Leone, Richards concluded that many names which appeared to label distinct rice cultivars were, in fact, synonyms or nomenclatural equivalents for the same cultivars that had been collected from diverse agroecological and social landscapes, and that yielded similarly under uniform growing conditions. But synonymy among identical clones as opposed to functional equivalency seems to be a much less likely explanation for some of de la Pena's taro yield results because in the Hawaiian case: (1) only 42 taro samples were grown out of a presumed set of 100-plus aboriginal cultivars, (2) to my knowledge each of the 42 samples was morphologically distinct and (3) long-standing oral and written tradition links most of the samples to fairly well-documented Hawaiian names, some of which possess known synonyms.

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