Identifying Plants as a Process of Cultural Cognition: Comparing Knowledge Production and Communities of Practice in Modern Botanical Science and Nuaulu Ethnobotany

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Abstract. We all seek to identify plants in our ordinary lives, or as professionals, yet what we mean by 'identifications' and our intentions in seeking them are not always the same. Moreover, the 'identifications' we achieve are often subject to disagreement. This paper compares the practices of contemporary professional taxonomists in producing herbarium reference collections, and plant naming among Nuaulu subsistence cultivators in eastern Indonesia. I examine how these communities of practice differ as groups and among themselves in the identifications they make of plants. I argue that the differences between them arise from the way material presents itself in radically different socio-cultural contexts, and the purposes for which the identifications are made. Differences between the groups arise from the ways individuals prioritize different kinds of information as it becomes available. Ethnobotanists often seek to translate between different worlds of identification by seeking one-to-one correspondences between scientific and local categories that we describe as taxa, but sometimes fail because the material used to identify plants, and the purposes of identification, are so different. I conclude by asking how intra-cultural and cross-cultural translation might operate in in-between hybrid spaces, such as para-taxonomy, where different assumptions and practices overlap or collide.

Keywords: plant identification, botanical taxonomy, herbarium practice, Nuaulu ethnobotany, orality and literacy

What do we Mean by Identification?

Cognitive anthropology, through its early pre-occupation with ‘ethnoscience’, has come to address issues in the history of systematic and descriptive natural history in particular (e.g. Atran 1990, Ellen 2004). Much of the published work on how such knowledge is organized focusses on the idea of "classification." Though in practice much informed by classification, I will focus here on "identification" as a distinct cognitive process and set of practical skills.

I want to suggest here that we need to separate identification, classification, and naming as skilled and situated physical and cognitive processes: that we can have identification without either classification or naming, classification without identification and naming, but naming only with both identification and classification (Ellen 1993:65, 2020:156–7). Identification is the placing of an identity on a particular instance of a natural kind: e.g. specimen X is the same as – is identical to – specimen Y. This is typically like object recognition in psychology (see e.g. Hummel 2013): to identify the object, an image matching this particular view must be found, or the incoming stimulus image must be manipulated in some way until a match is found. We match an incoming stimulus with stored representations for the purpose of identification. The theory contends that objects are recognized holistically through a process of comparison with a stored analog: template matching. When a match is found the object is recognized. Such approaches are "viewpoint-dependent," because identification of an object depends critically on the particular perspective of the viewer. The basic notion behind template-matching is that when we encounter some pattern that needs to be identified, the mind rapidly searches through its set of stored templates. When a match is found, the pattern is given the label stored with the template.

Thus, in relation to the domain of plants it is possible to identify something without having a name for it. People may say "I recognize it but do not know its name." All that is

required is that the individual identifier is satisfied that a particular plant is of the same kind that has been identified on a previous occasion. The application of a name detaches the identification from particular individual experiences and shares the accompanying knowledge more widely, thus limiting further the risks that come with an inaccurate identification. However, for most people, and in common parlance, you identify something by giving it a name, names which hopefully correspond to an image or set of features.

By contrast, classification involves the placement of either X or Y in one or more categories. X in this case might for example be a herbarium voucher specimen consistently identified as being in the genus *Syzygium*, even though taxonomists may periodically change their mind as to whether the genus should be placed in MELIACEAE or MYRTACEAE. Similarly, we might always regard Y as a kind of Z (e.g. a beech as a kind of tree), but we may often mistake tree Y_1 for tree Y_2.

The distinction between identification and classification was one that first became evident early on in my work in cognitive ethnobiology. The first attempts to understand ethnobiological classification had tended to assume that culture- or population-wide sharing of natural history knowledge was the norm, since the linguistic conventions to designate natural organisms were shared and, after all, people had to agree to communicate effectively to make decisions and live their lives in the least complicated way possible. Much of my work on ethnobiological classification was specifically around the theme of variation, more specifically intra-cultural variation, and challenging the omniscient speaker-hearer model. In order to make sense of this I initially (Ellen 1979) distinguished three kinds of variation (consistency, sharing, and flexibility) for both identification and classification, to give a six cell matrix (Figure 1). Thus, consistency of identification is the regularity with which a particular person will match a

specimen against another organism as being of the same kind, whereas consistency of classification is the regularity with which that same person reckons a specimen to be a ‘kind of’ some more generalized form. Similarly, sharing in identification is the extent that a group of persons agree that a particular specimen is identical to another, while sharing a classification is the extent to which a group agrees that an individual specimen can be placed in the same category. Finally, flexibility of identification is the way an individual or group adjusts the way it identifies an organism depending on contextual factors, while flexibility of classification is how a single individual person will vary the superordinate classes to which a specimen is allocated depending on contextual factors. Overall, it could be said that classification makes identification faster and more efficient by anticipating sets of associated characters and thereby reducing the number of steps in an identification sequence.

[FIGURE 1 ABOUT HERE]

If we confine ourselves to the notion of identification rather than classification, we might begin by distinguishing two models of how we think about the process. The first is an "exact match" model. This is typified by card games such as "Snap" where a point is scored (that is an accurate identification made) where a card is placed on a pile with a card identical to the one that preceded it, e.g. in terms of number cards, a 7 on a 7, a 5 on a 5 and so on. It is what we mean when we say that something is "identical." It thus meets the conditions of ‘object recognition’. Another example of the exact match identification is where a computer file is an exact copy of a another. A second, "best fit" model, applies where an item sufficiently resembles another item from a range of possibilities to permit us to say that it is the same. It is what we mean when we say that something is "like" something else. In this paper I am less interested in assessing the empirical accuracy of forms of identification, whether something is correct or incorrect, than in

separating them out as kinds of process involving different skill and knowledge sets: the memory of a process rather than the memory of data. On the face of it we might associate the "exact match" model with science and the "best fit" model with folk science because of our assumptions regarding precision in identification required of the former. There are differences between how animal and plant identification work as both a scientific and ethno-scientific practice, but for the most part the same arguments apply to animal identification as to plants.

Plant Identification in the Western Scientific Tradition

Scientific botanical identification practices familiar today have their roots in folk knowledge of plants from the European middle ages combined with increasing scholarly codification, usually for medical applications. The earliest means of identification were therefore individual memory and personal and shared experience aided by direct comparison with living plants. The prototypes were consequently culturally established in the mind, and subsequently prompted and reinforced by exosomatic experience, namely the recording of memories outside the brain. Where living plants were re-organized by humans in gardens or fields this could provide more convenient opportunities and contexts to identify plants by direct comparison. As written accounts of plants began to appear so did the idea of the botanic garden as a specific device for identifying plants, often organized according to a particular classification, and in this way incorporated into literary representations of the plant world.

The main and preferable means of achieving identification was, therefore, increasingly literary, and the literary mode and its various conventions were to influence the direction that it would take historically (Ellen 2004). An early influential written genre was the herbal: lists of plants, their main characteristics and virtues, and within which (in the medieval European

tradition) pictures were to play a crucial part. The earliest illustrations of plants to appear in herbals in order to aid identification (both hand-written and printed) were sketchy and more in keeping with the "best fit" model, images exaggerating or highlighting particular features that were important for identification, and with very little detail in the rest. We can see this for example in the sixth century BCE copy of the *Materia Medica* of Dioscorides, in Vienna (Anicia Juliana Codex), and in the seventh century Leiden manuscript *Pseudo-Apuleius Herbarius*, both first written during the early common era. By the fifteenth century manuscript illustrations were becoming more competent and complex, though technical problems with woodcuts used in early printing saw a reversion to cruder graphics, as in Johann Wonnecke von Kaub's *Der Gart der Gesundheit* (1485). By the fifteenth and sixteenth century botanical illustration had become an art form, which served well the identification of the growing number of newly discovered plants arising from European exploration and colonial expansion into the rest of the world (Blunt and Stearn 1994; Saunders 1995).

Botanical illustration also underpinned written descriptions of characteristics of plants that were becoming more-and-more precise, leading to the development of the classic taxonomic description of a new plant as a definitive model for subsequent identification. Actual specimens could thereafter be checked against a published summary of characteristics arranged in a conventional order using standard descriptors, each with a clear (usually agreed) definition (see e.g. Beentje 2010), to begin with mostly in Latin (see e.g. Stearn 1973). An example can be found in the description of the fern *Pleocnemia leuzeana* in *The Flora of China* shown in Figure 2. The point of using scientifically agreed terms, and the argument for Latin, is that in this way precision in identification can be maximized. Thus, terms such as "costule," "abaxial," and "lamina" have widely-shared meanings among botanists. A good concise and well-chosen

description became considered an art-form amongst taxonomic botanists, and it is suggested by Saunders (1995:8) that textual description was often preferred over pictures by the twentieth century . But while the International Code of Botanical Nomenclature (ICBN) exists as a set of rules and recommendations covering the scientific taxonomic names given to plants, and while certain conventions for describing plant parts and how to arrange such descriptions also exist, there is no clear set of conventions for plant terminology used in descriptions such as that for *Pleocnemia leuzeana*. This is largely because plant variation is continuous and as Beentje (2010:vi) says, the differences between, say, "puberulous," "pubescent," and "tomentose" are gradual and not absolute.

[FIGURE 2 ABOUT HERE]

Not long after the first printed herbals we get the appearance of the first herbaria: collections of pressed plants on paper with written annotations, for example that of Luca Ghini, and later elaborated by Linnaeus who adopted a set of additional conventions, such as the large herbarium sheet (rather than a page in a bound volume) that could be flexibly moved between cabinets according to taxonomic criteria and between botanists (see e.g. Bridson and Forman 1998). In order to accommodate plants on the page and to make them legible, whole plants cannot always be shown and even with small plants, parts have to be removed to better show distinctive features, to remove thick fleshy vegetative clutter from the page to effect better preservation and storage, and to improve the overall appearance of the specimen. Specimens are often partial and deformed, lose their color, and during preparation will be bent, cut and squashed to fit onto a herbarium sheet of pre-determined dimensions. Thus, a three-dimensional object is rendered in two dimensions, often to aesthetic effect. Indeed, aesthetic qualities became important in the construction of herbaria, as did standardisation in the label and other

information on an herbarium sheet, such as color coding and measurement scales. The twentieth century more generally saw greater focus on "alpha" taxonomy, the detection, description and classification of taxa, and less on other functions of collections. Nevertheless, the voucher remained indefinitely as a crucial piece of evidence in a permanent herbarium, to "confirm the identity" of a plant, enabling "verifiable identification"… less prone to ambiguity than vernacular names (Nesbitt 2014:313–4). Botanists since Linnaeus have measured a "correct identification" using the concept of a unique type specimen to which all new material is referred and checked. A "type" in plant taxonomy is therefore "an anchor to the identity of a name; 1. an element, usually a herbarium specimen, on which a species name is based; 2. [a] species on which a genus name is based; [and] 3. a genus on which a family name is based (Beentje 2010:125)."

Plant identification under field conditions requires rather different skills and equipment. The main staple has been the field handbook, the main technical device of which is the key, and the process of "keying-out." In cognitive anthropology and semantics, "key" has acquired a special meaning borrowed from biology: a kind of catalogue or finding list "ordered by successive and usually dichotomous exclusion," though not necessarily taxonomically significant (Conklin 1962; also Kay 1969:80–2). In this sense we might see keys as just another "artificial" method for grouping plants, but with the historical development and influence of the "natural system" there was – at least in Britain – some resistance to all artificial methods, and a separation of the process of identifying species from indicating plant relatedness (Scharf 2009:92). Classic twentieth century guides, such as Clapham, Tutin, and Warburg (1962) for the British flora arrange plants according to the most visually obvious characteristics, and permit the collector to arrive at a determination through a series of decisions regarding distinctive

characters. A hypothetical decision tree is shown in Figure 3. Generally-speaking, identifications under field conditions are always provisional, sufficiently accurate to allow their transfer to appropriate experts in an herbarium, usually at the family level. Herbarium specimens collected are also ideally accompanied by detailed written descriptions on the label, as in many cases the plants themselves may be too large to collect in their entirety or lose their characteristics once collected and pressed. The first field guides contained sparse illustrations, but the introduction of first line drawings, then painted illustrations and finally photographs has increased the extent to which overall visual comparison is possible rather than relying on successive dichotomous decisions. There are in addition other variations on the field guide format implying different versions of the key concept (Hawthorne 2006:91–120).

[FIGURE 3 ABOUT HERE]

The role of herbaria, field guidebooks and more conventional taxonomic approaches have been challenged since the 1970s by more automated methods. Herbarium sheets can be digitised and taken into the field either as laminated sheets or in digital format on a computer or hand-held device. There are programs that will provide an identification based on a picture (automated image-based plant identification). The *Flora Incognita*, for example (Katal et al. 2022), claims to identify 79.6 % of specimens correctly to the species level. More significantly for botanical science and taxonomy has been the rise of molecular identification (see e.g. de Vere et al. 2015). Using specific regions of DNA to locate markers (for land plants two sections of coding regions within the chloroplast, part of the genes rbcL and matK sequences) barcoding has been employed to identify species. However, plant records are still considered more reliable when accompanied by an herbarium voucher.

But despite the efforts made by taxonomic biologists during the nineteenth and twentieth centuries to achieve accuracy in identification there remains enormous scope for inaccuracy in plant identification (e.g. Goodwin et al. 2010). To give one specific example:10 % of voucher specimens were "incorrectly identified" in Poland between 1874–1975 (Lukasz 2010). The problem is compounded by the extent of synonymy, making some estimates of numbers of taxa rather precarious. Even many molecular studies fail to provide supporting voucher references (e.g. Pleijel et al. 2008).

For many botanists identification is the process through which a name for a particular plant or specimen is established. The process may involve both a holistic or gestalt approach involving many different parts of the plant, and identification through a systematic rule-based method, requiring a sequence of considerations about individual characters. In either case naming the plant is crucial. Nevertheless, the separation of determining a name from identifying a plant that we find in the theory of modern nomenclature does not always translate well to practice, and it is widely assumed that if you have named something you have nailed it – what we might call a Rumpelstiltskin approach. If you give something a name you have somehow captured its essence, an idea which echoes familiar philosophical debates around natural kinds and essences. Indeed, if natural kinds are just "out there" with non-ambiguous essences, all we need to do is find and name them.

The exact match model became increasingly important as herbaria and botanical illustration developed. But scientific botanical identification is, above all, nowadays informed by multiple-level taxonomic classification. Scientific plant identification, in summary, works through "radical simplification" like other forms of scientific methodology, ruthlessly re-defining the (abstract) context but ensuring that context and its terminological and procedural

underpinnings are understood and executed by all practitioners. We might, therefore, follow Daston and Galison (1992:84) in observing that what is significant about identifying specimens is learning the relevant perceptual conventions, in other words … "selecting and constituting working objects", a process through which real world objects are "made safe for science."

Nuaulu Plant Identification: Under the Macroscope

I have undertaken anthropological and ethnobiological fieldwork among the Nuaulu on the east Indonesian island of Seram since 1970, from 1975 focussing mainly on animal classification, and from 1996 on plant classification. The Nuaulu are a clan-based people and linguistic group numbering somewhat in excess of 2000 individuals, who subsist mainly through a combination of sago extraction, hunting and swiddening in a tropical rainforest environment. Throughout the period of my research those I worked with were almost entirely non-literate, schooling being introduced from 1980. While basic literacy is now standard, exposure to biological or published work in any format that might influence notions of plant identification is rare.

A major project beginning in 1996 permitted the creation of the Nuaulu Ethnobotanical Database (NED), completed in 2021. Throughout, this work has raised practical (procedural and methodological) and theoretical (and I suppose one must say philosophical) questions about what we mean by identifying a natural organism. In collecting the plants that contributed to the database and fixing scientific identifications I adhered as best I could to the conventions and standards discussed in the preceding section of this paper, but it was impossible not to be influenced by judgments made by the Nuaulu themselves. And of course a large part of the work involved working out the process by which ordinary Nuaulu identified plants. Part of what I have to say here draws on arguments also explored in the resulting monograph (Ellen 2020).

For the most part Nuaulu identify the common plants of daily life entirely through comparison, with a combination of memorized prototypical images and individual distinctive features, checked periodically against the orally-transmitted knowledge of others. The memory load of single individuals can be impressive, and although I did not have the research capacity to test the hypothesis, the mean population memory for plant-based knowledge is overall high. Where an initial identification cannot be determined from an assessment of overall form, it will be narrowed down and confirmed by taking into account a range of visual features: leaf, stem/trunk, fruit and flower, but also a whole lot of non-taxonomic features: where is it growing, what it is growing in (substrate), what it smells like, feels like (tactility, texture), tastes like, or even sounds like; time of year and time of day (Ellen 2020:165). Nuaulu adult perceptions of plants are therefore multi-sensorial, and identification informed by shallow hierarchies of classification, The use of features in a classic binary form (present/not present) is important, particularly for folk-varieties of common cultivated species, and when encountering more unfamiliar plants. For some plants, an overall visual assessment is not always possible, as in close forest where the form of a single tree is occluded by the presence of others. Also crucial to Nuaulu plant identification are utilitarian qualities, their role as affordances. When a Nuaulu examines the wood of a tree, or the fibre of a rattan they do so knowing that some of the most important properties are only evident because the plant is used for some purpose. That fact is material to the process of identification.

And the logic of binary contrast is generally the way disagreements about identification are resolved. However, disagreements about identification are less exceptional occurrences than a normal part of everyday routine, integral to the process. Nuaulu have no "types" or banks of images that can be shared or serve as a common reference point. When two individuals agree

that a specimen of *Lawsonia inermis* is *naka-naka* they are simply comparing the actual plant before them to similar specimens seen on other occasions, or to a set of characters regarded as typifying the plant and widely articulated linguistically. But where there is no physical reference point, accuracy of an identification is only achieved through a preponderance of identifications, usually flagged by a number of names that can be selected from. In such a circumstance, we might wonder how it is possible to recognize an error? When Nuaulu describe a specimen of *Lawsonia inermis* to me as a kind of *naka-naka*, I can only test the validity of that statement by having an independent second identification from another person, and the more independent confirmatory statements I receive the more I am likely to accept that there is enough culturally-shared agreement to allow me to conclude that the identification is "correct." But if one informant says that X is Y and another that X is Z, what should I conclude? It will be clear from the context in certain cases that we are dealing with synonyms (for example where gender or another social relationship specify using one word rather than another), in others repeated questioning of a longer series of informants will establish an identification through preponderance, but in other cases it might be that there is no shared 'correct' view and that different people identify and name the plant differently.

The process of identification is in effect finding a correct name ("what do you call it?"). However, for most people, and in common parlance, you identify something by giving it a name, names which hopefully correspond to an image or set of features. These images are necessarily simpler than any empirical reality, but because Nuaulu folk species do not require comparison with a fixed reference "type" to be successfully identified, can be more complex and flexible. One individual may consistently identify a species using the same name, such that in the context of their own working ontology similarity is being correctly recognized, but the name may not be

used by others. This may only be clear when information is exchanged, so it is possible that one term may be employed for two or more species, but that sociolinguistic interaction in contexts where the species is a focus is insufficient to resolve nomenclature and agree on a shared identification with a single name (Ellen 2020:112–13; see also Sillitoe 1980:138–45, 1995:205–7). There is a marked absence of agreement in some areas, particularly when labelling "terminal categories" (those that are sub-divided no further), and especially where these labels are folk binomials applied to different cultivars of the same species. Some of this apparent confusion might be accounted for by methodological indeterminacy, some may arise because some cultivars are less common than others and therefore provide fewer opportunities for sharing knowledge, while some crop species hybridize and diversify through cloning more readily than others. These all exacerbate the difficulties of achieving fixed correspondences between local names and sub-specific and specific taxa. For example, in *Codiaeum variegatum* (*sinsinte*) variation is continuous between types and therefore assigning an identification in terms of leaf form and color is often tricky. We might sometimes agree that an identification is just plain wrong: the attempt of a young child yet to learn how to distinguish one plant from another, or even a deliberate falsehood to deceive a researcher, or it might be a random guess by a non-expert. During focus groups I held in 1996 after our daily hikes into the forest to collect specimens, we began by placing everything with the same name in a separate pile on the floor (Ellen 2020:157). Despite specimens having been identified in situ by those accompanying me when the collections were made, often by several people who took into account the many factors only knowable to those who were there with me, the focus group would still argue about correct names and identifications during pile-sorting. Specimens would move from pile-to-pile or be seen as distinct piles as a result of arguments – sometimes quite loud and vociferous – but

eventually resulting in some kind of consensus, even if those who conceded did so reluctantly.[1] Although focus groups designed to identify plants were, to my knowledge, unprecedented in Nuaulu social life, they did highlight the tension between isolated individual identification decisions informed by memorized knowledge resulting from sharing, and decisions actively arrived at through debate within increasingly larger groups.

Nuaulu do however agree more readily on the kinds of characters that best effect an identification. They seldom rely on or start with flowers or other sexual organs, the underlying basis of the Linnaean scheme for flowering plants. They never identify a plant devoid of ecological context, as a herbarium scientist might. A particular habitat will generally be understood – a swidden, far forest, the riverside, the littoral, the sago swamp. Neither does, identification take place in a cognitive or social vacuum, within some domain of specialised thought or practice insulated from everyday contexts and multiple stimuli that might motivate people to classify in different ways. Whatever regularities might be assumed they are repeatedly tested against experience during production, exchange and consumption, and against various competing demands to employ sense data in different ways. While in scientific identification the visual sense has become increasingly dominant as pictures and written descriptions have become central, and other senses such as hearing, touch, smell and taste suppressed, this is not so for Nuaulu. An individual "Nuaulu is not born into a world of separated taxonomically determined plant types ordered visually, but into a phenomenal context of profuse and varied plant growth, one might say of 'vegetativeness' regardless of species, the whole experienced multi-sensorially (Ellen 2020:47)."

Folk classification often provides a useful set of prompts in order to stepwise identify a plant, but not always. Let us take the example of trees as a life-form category. Nuaulu possess a

high level of tree identification skill. In documenting knowledge of vernacular tree names in a survey of 11 different kinds of forest plot, 7 plots yielded 100 percent agreed identification, with a mean level of 97.5 % overall (Ellen 2020:74). Nuaulu identify around 423 kinds of tree. Of these 143 are labelled with uninomials and 59 binomials of the form *ai* (tree) + [qualifier], e.g. *ai osi*. Pandans and palms are not regarded as *ai*. This leaves approximately 202 unaffiliated tree categories. But in order to navigate this diversity they interpose few intermediate complexes between the life-form and terminal levels: just a small number of (very approximately family-level) named groups, such as "figs" and *ahutaune* (*Calophyllum*). This is counter-intuitive given psychological theories of "chunking" or Miller's Rule of Seven (Miller 1956). They are nevertheless able to discern relatively discrete types, mainly based on clusters of features, even though this is difficult in a forest context where the continuous character of the canopy and the close proximity of species of different kinds occludes the visibility of individual trees. Given the general absence of intermediate larger categories through which to organize cognition, tree types are memorized and information about them articulated through the appropriate contexts in which they are found. In some cases we might say that certain categories mark the existence of complexes but because of their geographic remoteness or lack of direct interest for Nuaulu, are not linguistically elaborated. In some cases unaffiliated terminal categories occur in pairs not necessarily closely related botanically, though a particular physical feature, ecological association or common use may motivate the classificatory linkage. An example of this is the pairing of *hukila* (a species of *Eugenia*, and *kawasa* (*Archidendron clypearia*), both used in shield-making. Also, types of tree recognized as domesticates or semi-domesticates are commonly paired with types of tree in more remote forest which superficially resemble them but

which are not closely related phylogenetically, such as *tom-tom* (*Flacourtia rukam, F. inermis*) and the marked *tom-tom wesie* (*Phyllanthus borneensis, Glochodion* sp.).

Where Identification Protocols Overlap and Collide

In the preceding two sections I have examined how identification works in two "communities of practice," a term derived from the situated learning theory of Lave and Wenger (e.g. Lave 1991), but now so well established that it hardly requires referencing. The notion is apt in the present context as it emphasises identification as a socially-shared, processual and practical task, both contextually embedded and embodied, placing emphasis on the doing rather than the thinking. Members of the two communities attempt to achieve outcomes that have relevance to their everyday activities rather than engaging in abstract theorising, but the "everyday" here is very different in each case: the professional practices of a formally trained occupational group and those of a group of subsistence, collectors and hunters closely-connected through kinship, with the relevant skills being distributed more generally through the wider population undivided by "occupations."

In this section I look at how intra-cultural and cross-cultural translation might operate in in-between hybrid spaces, where different assumptions and practices overlap and collide. This subject converges with recent discussion by Ludwig and El-Hani (2020) relating to "partial overlaps" in ethnobiology when looked at philosophically in terms of epistemology, ontology and normative reasoning. My overlaps and collisions involve epistemic practices of plant identification and knowledge creation about plants which also generate overlaps and collisions in plant categories and plant ontologies. The apparent narrowing of the subject from classification in general to a focus on the physical practice of identification enables us to shed further light on

these connections, and the complex issues surrounding the integration of those heterogenous knowledge systems that underpin the prospects for effective participatory research and co-management of resources.

It has been said before that ethnobotanical research is a kind of translation between different regimes of plant perception and practice. Processes similar to those described for the Nuaulu take place regularly in scientific herbaria receiving plants for identification. These often involve errors arising from mis-labelling or misreading field tags. There were many examples encountered in creating the Nuaulu Ethnobotanical Database. Indeed, plant taxonomists often disagree on identifications, both within herbaria on different occasions, and between herbaria, as between Bogor and Kew in my own data. As a result, I have had to judge which to accept given conflicting determinations from different places for specimens that I know to have come from the same plant. On different occasions other taxonomists will decide that a name given to a specimen needs to be changed, sometimes several times over a period of years, perhaps because information from new specimens makes this timely, but also through reinterpretation of the original specimen. Nomenclature may also change in accordance with the International Code of Botanical Nomenclature (both ICBN, and for cultivated plants the ICNCP), rules often agreed after the herbarium sheets were initially prepared and the specimens named. And there are other reasons why nomenclature alters. Consider for example the name changes for Nuaulu specimens of the fern *ahane* in the Kew Herbarium since 1970 (Figure 4; Ellen 2020:157). In each case the changes seek incremental clarity as to the "correct" identification of a plant given a fairly tight set of rules operating within an institutional and professional system that is relatively closed, rules invented to ensure that information about plant names can be freely exchanged on a global scale without ambiguity. "Accepted" names, however, create problems for local and practical

end-users of taxonomic data, such as farmers, phytopharmacologists, horticulturalists, home gardeners, nutritionists, even ethnobotanists, who all find a virtue in consistency and in stable names. During the period that I have been collecting voucher specimens with Nuaulu co-researchers, and seeking determinations from taxonomists working in international herbaria, plant names, including family names, have changed frequently.

[FIGURE 4 ABOUT HERE]

Although there is a good deal more in common between the way in which professional botanists identify plants in the field and how non-botanists (including non-literate but knowledgeable subsistence people) do the same, than we might at first assume, there are also major differences. Whereas professional taxonomists work with fragments of plants, sometimes at a level where an eye-glass is required, albeit against the knowledge of the entire living or dead specimen, Nuaulu work with whole living plants, and are unfamiliar with keys that start, for example, with leaves. Taxonomists start with a global post-Linnaean model of the plant world. Procedurally, in practice herbaria begin with a gross sort at family level made by "generalists," who then pass specimens on to family specialists. Taxonomists also have a rigorously developed and tested set of lexical distinctions to ensure that they are describing plants in the same way, have shared explicit concepts of taxonomic levels and terms to describe those levels. Most folk classifications of plants are "shallow," with few ranks, and do not rely extensively on the family level as a unit of classification or identification. Professional botanists therefore have managed to develop a virtual domain of knowledge which most share, and which excludes many of the uncertainties and variables that are important to others when identifying plants.

However there is leakage across the boundaries between otherwise clearly defined communities of practice, and for botanists to work in a non-specialist setting their world has to be translated into other contexts. There are cases where traditional techniques of plant identification and those of the professional botanist overlap or confront each other. For example, until relatively recently many local assistants working for colonial and post-colonial research institutes such as the Bogor Herbarium had little formal academic training, but did develop a remarkable ability to identify plants, not through book knowledge, but through practical experience gained in their personal lives, or by being community experts (see also Pfeiffer and and Uril 2003). We might properly describe these as "parataxonomists," in contrast to the sense employed by Daniel Janzen (Krell 2004; also Martin and Pimbert 1993) to describe basically-trained local staff used to collect and prepare specimens for rapid biodiversity assessment. However, while botanists have in practice often relied on traditional non-scientific identification skills they have not always understood how folk botany works as a body of knowledge, content to rely on the unexamined basis of how traditional experts work, assuming that folk naming practices can be seen as working like scientific names. Beginning with colonial era written accounts, folk names were routinely incorporated into the labels of herbarium specimens, and thereafter into descriptive accounts of local flora, or gazetteers of regional flora and useful plants. Folk names were often a beginning point when identifying plants, but questionable in the extent to which local names (especially names in a lingua franca such as Malay or Indonesian) spoken over wide areas were a reliable guide. In some cases local vernacular names have become "official" non-scientific names over a wider area through the publication of lists in works of scientific reference, for example those published by forestry departments. The common errors in documenting folk plant names have now been exposed by several generations of ethnobotanists,

and experts in local languages have shown that when incorporated into regional works of reference many names prove to be highly inaccurate (see, for example, Verheijen 1993). Ideolectal, dialectal and geographic variants are often treated as separate names; there are errors in transcription, especially by linguistically naive collectors, synonyms are listed as indicating separate plant names, deliberate errors are sometimes introduced by interlocutors either to avoid prohibited words or to please or confuse the collector. The local specificity of names is misunderstood: that the same name may be used in a very different way in two geographically separated populations. And although ethnobotanists like to collect vernacular partonyms (lexical items for "parts-of" something) to reveal the intricacy of local botanical knowledge among non-literate peoples, equivalents to the descriptive terms of taxonomists (such as Latinate "subtuse," "lanceolate," and "oblongate") are rarely found in folk botany, which tends to rely on descriptors that have wider cross-domain meanings and connect with the vocabulary of social cognition.

With Nuaulu plant identifiers and classifiers (Ellen 2020:157) there is a built-in flexibility enabled by the absence of a particular ultimate physical reference point, or indeed a tight detailed permanent description that must be consulted to reach an accurate identification. Nuaulu operate as if names are stable, and some have clearly been so for many years, but in effect the relationship between name and plant is only as good as the last identification, and the frequency with which that name is applied. For both Nuaulu and professional taxonomists, plant identification is a work of constant revision, partly because biodiversity itself changes as plants continue to vary genetically and are selected for in different ways in particular environments, but also because the boundaries of those entities we call "species" or "varieties" change over time depending on the criteria we select to determine them. The scientific taxonomist is faced with the same practical and cognitive problems as the ethnotaxonomist. However, botanical systematists

are experts who for much of their professional life specialize in only several genera or families, and while they accumulate much detailed knowledge of plants in these groups, use a more abstract knowledge template to cope with the rest. Whereas professional taxonomists are constantly referring back to earlier physical specimens and descriptions, the Nuaulu are on the whole generalists, relying on a more fluid process, informed by what memories they have established from previous experience, and as confirmed or revised with benefit of other people's personal experiences.

The idea of identification conceptually distinct from classification has become clearer within the practices of scientific taxonomy. This has occurred through separation of the pragmatic devices that botanists use to "identify" plants (such as field keys) from attempts to reconstruct evolutionary phylogenies. As naturalists have deliberately discarded "artificial" and "practical" schemes, they have been replaced with forms consistent with a logic internal to the practice and theory of science, whether (to begin with) Linnaean dependency on the primacy of sexual organs or (later) the Darwinian model based on common ancestry as revealed in morphology or DNA. These radical simplifications expunged classifications developed by those who used plants for particular purposes, and while the Linnaean scheme was initially conceptualised as a convenient artificial device, it subsequently proved to be a basis for inferring "natural" classifications, what remained once the need to prioritize everyday usefulness had disappeared (Ellen 2020:111). With the ascendency of Linnaean classifications any role for utility has been actively rejected, a position reinforced over the last three decades by theories of folk classification that assert that these too, in their "general-purpose" form are "natural" (e.g. Atran 1990). As we have noted, identification does not take place in isolation, and in the process

of making an identification various cultural representations or classifications will be part of that context, and therefore influence decisions.

A final difference between Nuaulu identifiers of plants and professional taxonomists is that the former do not commit descriptions of plants to writing, to which they can later refer, or create images of their diagnostic characteristics. The application of writing and the graphic illustration that often accompanies it has had a massive impact on how we think about and execute acts of identification. While there are many ways in which Nuaulu group plants above the species level, in the absence of written versions (Nuaulu or scientific) it is difficult to claim that Nuaulu themselves conceive of a particular overarching classification of plants.The concept of "*a* classification" is difficult to articulate except through its literary iterations and all descriptions of "folk classifications" are necessarily in the literate mode, where the impulse to classify has everywhere resulted in "overwhelming" systematisation (Goody 1982:111). Scientific literacy has extracted individual plants from one set of contexts processed through episodic memories and re-classified them on the basis of abstract features as mimetic memory, has permitted the comparison of various versions of events, and enabled lists, tables and certain kinds of lexically annotated diagram (Goody 1977). Knowledge absorbed or deliberately acquired for use in oral reservoirs has been distorted and simplified by new media and models. The background conventions of literacy have also had implications for the recognition of names, as text is a physical medium and once plant names have been written they become more permanent, more discrete and obviously "things" (Olson 1994:76). Informal descriptions are more likely to become accepted names if they are archived, even when not shared by all members of a speech community. The perception and representation of images in literate culture

are shaped mainly through physical appearance, while names are treated as if we were "seeing" them, marginalizing the other senses. Writing also enables the encoding new kinds of mistakes.

We now understand how "much of the work of natural historians from Europe ... re-inscribed information developed by other people in other cultures ... making it objective and exchangeable (Cook 2005:118)," and how in the shift in representation from early to late Linnaeus (and well after), European botany rode "a wave of 'objectification' " by which "specimens were wiped clean of cultural complexities in order to be pasted neatly into folios of European herbaria, and included in European classificatory systems ... (as the) Linnean system worked only by disregarding the material circumstances of particular locales (Cook 2005:7; see also Ellen 2004, Ellen and Harris 2000)." By the time of Linnaeus it was widely accepted that the fundamental task of natural history was "arrangement and designation" based on visually recognizable features (Olson 1994:226). In much work in ethnobiological classification there has been a tendency to casually retrofit the operations of oral folk classification within the conventions of the written mode, but problems arise when assuming that the conventions of the written mode necessarily also apply to the oral. This is well-exemplified in relation to notions of hierarchy and level, in overlap of categories, and in the suppression of dimensionality in two-dimensional representations on paper, whether using dendrograms, Venn diagram or any other graphical device. It also applies to what we mean by "identification."

Conclusion

I have argued here that we can distinguish cognitive and practical aspects of processes of identification from classificatory activity, for both professional botanical taxonomists and for pre-literate Nuaulu users of plants. The differences between the methods of identification found

in the two groups arise from the way material presents itself in two radically different socio-cultural contexts, and the purposes for which the identifications are sort, and from the ways individuals prioritize different kinds of information as this becomes available. Ethnobotanists often seek to translate between these two worlds of identification by seeking one-to-one correspondences between scientific and ethnoscientific categories that we describe as taxa, but sometimes fail because the material used to identify plants and the purposes of identification are not entirely the same.

We now understand that the strict focus on formal cognition that came with the early ethnoscience-informed phase of ethnobiology underplayed the relevance of bodily knowledge and practical skills – and indeed emotional and aesthetic knowledge – for how we achieve something as mundane as a plant identification. Identification and classification operate in both systems as distinguishable processes, but in the special case of scientific literacy, classification effectively overwhelms identification and often conflates the two. It does this by interposing additional levels that need to be taken into account to achieve an accurate identification, because the physical presentation of prepared specimens involves assumptions regarding classification (for example in the labelling), and because naming and nomenclature carry a heavy burden of classificatory assumption. The mistakes as well as the distinctions which accompany the technical and cognitive processes that are integral to plant identification are essentially the same whether we are dealing with local folk biologists, ethnobotanists such as myself trying to make sense of the Nuaulu system, or professional modern plant taxonomists working from living specimens, herbarium vouchers or even with biomolecular data. This approach moves us away from essentialism, and is much better accommodated through versions of the pluralistic attribute or criteria clustering model (Dupré 1993, Ellen 1993:72–5) with its recognition of different ways

of doing identification that require skill and graduated matching rather than the exact matching we find in a game of Snap. This is so regardless of whether the process involves generalised cognitive prototypes, combinations of precise distinctive features or both, and recalls more the notion of polythetic classification (Ellen 1993:128–9). Such an approach is rather different from "convergence metaphysics" in the Berlin tradition, which seeks to explain cross-cultural similarities through shared recognition of the same biological discontinuities (Ludwig 2018), and which has tended to focus only on the overlaps. It is also different from the "radical alterity" position of the ontological turn (Ellen 2016), which tends to focus only on what is not shared and on collisions of understanding. My account, therefore, connects with what Ludwig and others have been discussing as 'partial overlaps' in philosophy, and reinforces the critique of the false opposition perpetuated by arch relativists and universalists (Ellen 1986:93, 1993:215–34).

Notes

1. David Ludwig has drawn to my attention a passage in Berlin (1992:9) that highlights the contrast between this account of "intergroup variation" and Berlin's "intergroup agreement." Berlin writes: "Museum skins of several species of brightly colored Amazonian birds [...] are dumped from a basket in a heap on a table. [...] A student volunteer is called from the class and asked to simply "classify" the collection. […]The student's efforts always result in a series of neatly stacked groups of individual birds, usually lined up in a row. The piles correspond perfectly to the groupings recognized by scientific ornithologists, as well as to those of the Huambisa and Aguaruna Jivaro from whom the specimens were collected."

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Figure captions

Figure 1. A matrix distinguishing different kinds of variation in the identification and classification of natural organisms (modified from Ellen 1993:130).

Figure 2. Description of the fern *Pleocnemia leuzeana* in *The Flora of China* (Wu Zhengyi, Raven, and Hong Deyuan 2013, vol 2-3, p. 731); credit: eFloras (2008), published on the Internet http://www.efloras.org [accessed 01 October 2022], Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA.

Figure 3. ‘Decision tree’ or ‘flow diagram’ model underlying the plant field guide (Adapted from Hawthorne 2006:102).

Figure 4. Successive identifications of voucher specimens in the Nuaulu Ethnobotanical Database for the fern Nuaulu call *ahane* [POLYPODIACEAE].