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Ex-situ Documentation of Ethnobiology

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Migrant speakers of endangered languages living in urban centers in developed countries represent a valuable resource through which these languages may be conveniently documented. Here, we first present a general methodology by which linguists can compile a meaningful set of visual (and sometimes audio) stimuli with which to carry out a reasonably detailed ethnobiological elicitation session in an 'ex-situ' setting, such as an urban university. We then showcase some preliminary results of such an elicitation carried out on the Dumo, or Vanimo, language of north-western Papua New Guinea during a linguistic field methods course at the Australian National University. With the help of a region-specific set of visual stimuli obtained from various sources, it was possible to document many fascinating aspects of the fish, and other marine-biological, knowledge of Dumo speakers, along with detailed ethnographic notes on the cultural significance of marine creatures.

1. INTRODUCTION. Developed countries such as Australia and the United States of America have, in recent decades, become home to numerous ethnic communities of speakers of small, inadequately described or endangered languages (Roberts 2010). The presence of large numbers of such migrants in major urban centers, such as New York, London, or Melbourne, provides exciting opportunities for collaborations between linguists and the speakers of endangered languages, wherein the former document the language of the latter without the great expense of having to travel to a distant, possibly remote, location. For example, the Linguistics departments of institutions such as the Australian National University and the University of Melbourne regularly hold field methods workshops in concert with locally-resident speakers of languages from Papua New Guinea, Bhutan and north-eastern India. Melbourne, in particular, appears to be the preferred Australian destination for refugees from countries like Sudan, and Australia's Department of Immigration and Citizenship estimated that the state of Victoria (of which Melbourne is the capital) received the greatest share of Sudanese migrants during 2001–2006. Somalia, Liberia and Ethiopia are other major sources of African migrants to Victoria, with the vast majority of new arrivals from all four countries choosing to settle within the Melbourne metropolitan area (Borland & Mphande 2006).

Unfortunately, official reports on migrant numbers contain detailed information on only the numerically largest language/ethnic groups, while preferring to lump smaller ones together into unhelpful categories such as 'Unspecified African language' for the sake of convenience. However, as Musgrave & Hajek (2009) have shown in their critique of the

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Borland and Mphande report, a reliance on official statistics—such as the national Census and requests made to translation and interpretation agencies—can underestimate the diversity of languages represented in Melbourne's Sudanese migrant community. Instead of the 15 indigenous Sudanese languages mentioned in the 2006 report, Musgrave and Hajek were able to provide evidence for more than 40 languages by directly interviewing migrants. Some of these were small minority languages, while others had previously not been recorded as being spoken in Sudan. This example shows how a major urban migrant destination such as Melbourne can contain a far greater diversity of endangered minority languages than government reports might indicate.

Language documentation and maintenance programs are being carried out in other major migrant destinations, such as the Netherlands for migrants from Indonesia (Florey 2002) and the United States of America. The Endangered Language Alliance (ELA) was set up in New York City in 2008 to try to document some of the city's estimated 800 languages. Some, such as Vlashki from Croatia, now have more speakers living in New York than in their ancestral homelands (Roberts 2010). Daniel Kaufman, founder of ELA, characterises such migrants as an 'enormous linguistic resource,' which can facilitate the 'ex-situ' documentation of endangered languages, and allow large-scale collaboration with multiple researchers (Kaufman 2009). Nevertheless, Kaufman also warns of some disadvantages of such documentation projects, including his concern that "localized environmental vocabularies (e.g., fauna and flora) are impossible to document beyond the basics". The reasoning behind this statement is probably as follows: in an 'ex-situ' location such as New York, the absence of familiar plants and animals makes it difficult for language consultants to talk about such topics. Lacking appropriate visual stimuli and/or a knowledge of the relevant flora and fauna, it is equally difficult for the linguist to provide points of conversation that could encourage the consultant to provide language material concerning traditional ecological knowledge (TEK). The purpose of this paper is to demonstrate how a preliminary ethnobiological investigation can indeed be carried out with members of a migrant diaspora, without sacrificing much accuracy and/or comprehensiveness. Naturally, we believe that field-based investigations remain the optimal way of collecting ethnobiological data, but the methodology described here could serve as a useful backup.

1.1 PROBLEMS WITH VISUAL STIMULI. One apparently straightforward way to solve the problem of the missing stimuli is to make extensive use of published field guides, pertinent to the home country of the language being documented, and containing illustrations of the plants or animals described therein. However, field guides have their own disadvantages, and a heavy reliance on such resources may lead to the recording of inaccurate descriptions or lexemes. A potential drawback of field guides is that they tend to have a national or state/provincial focus, and may therefore contain a large number of species that are not relevant or familiar to the speakers of the language being documented. This may or may not be an issue, depending on the nature of the taxon being documented. Large mammals and flowering plants can usually be identified with ease from field guides, even by non-expert language consultants, but groups such as small mammals (especially rodents), certain birds, and grasses may pose difficulties because of the visual similarity of many related species, and the lack of other salient information such as vocalizations (for birds), habitat and type of movement (for rodents), and texture and smell (for some grasses). The problems are magnified in cases of language endangerment accompanied by ecological degradation, as many already rare or cryptic species, which were nevertheless culturally significant, may have been forgotten due to local extinction.

Needless to say, it would be a near-impossible task to find a published field guide that exclusively references the plants and animals known to, for instance, the speakers of a small Dravidian language, living in a handful of villages in the mountains of south-western India. A volume such as *Birds of Southern India* (Grimmett & Inskipp 2005) would indeed contain species that are relevant, but the presence of large numbers of birds found in other parts of the country would only serve to confuse and distract. The birds in field guides are grouped together according to their scientific taxonomy, and this often results in the presence of many closely related, similar-looking birds on a single page. Page 85 of the Grimmett and Inskipp volume, for instance, contains six species of very similar-looking nightjar (Great-Eared, Grey, Large-Tailed, Jerdon's, Indian and Savanna), while page 137 presents as many as 30 different images for four eagle species (Indian Spotted, Greater Spotted, Tawny and Steppe). Such a stimulus overload can overwhelm even the most knowledgeable and enthusiastic language consultant, leading him or her to include unfamiliar species in the referential range of a particular bird name. Even when a field guide contains some indication of the general distribution of a species within a country, it should be kept in mind that these are often rough estimates, and in some cases may be based on outdated information. In many cases, an up-to-date field guide may simply not exist—this is usually true of countries that have experienced long-term military conflict, such as Sudan, or those whose governments have maintained isolationist policies—such as Myanmar.

Photographs are usually the best two-dimensional visual stimulus for eliciting TEK (Medeiros et al. 2014; Thomas et al. 2007 (see the former for a discussion of the positives and negatives of photographs)), especially when working outside the familiar territory of the language consultant, but many field guides make use of elaborate hand-painted illustrations that have limited utility. Bird field guides are often aimed at a birdwatcher or ornithologist audience, and both groups require highly detailed images of bird species for the purpose of identification. Unfortunately, these brightly coloured, static images of birds, with practically every feather drawn in, are not easily recognised by people who are more accustomed to only seeing fleeting glimpses of the same birds, usually in the shade of the forest canopy, or obscured by branches and leaves. One way around this problem is to use a combination of images and recorded bird calls, as described in Agnihotri and Si (2012), which is further discussed in §1.2. Similarly, botanical field guides often rely solely on black-and-white line drawings, which may cause problems of interpretation for language consultants who are unfamiliar with such formats. Some linguist-consultant teams may be lucky enough to be based in a city that houses a major museum with a significant, publically-accessible flora/fauna collection from the consultant's home country. In such cases, the ideal strategy would be to arrange for a viewing of the relevant collection by the consultant, in the presence of both the linguist and the specialist curator.

In the absence of real specimens, one slightly time-consuming, but worthwhile, alternative is to develop one's own personalised set of stimuli with which to elicit flora and fauna terminology and texts in an 'ex-situ' setting. This involves some prior research into the biodiversity specific to the locality where the language being documented is spoken, and is dependent on the availability of detailed and accurate species checklists for such a locality. Once a checklist is obtained, images, videos and/or audio recordings for the species contained therein can be collected from field guides, or through web-based search engines, such as Google Images. Collaboration with a biologist familiar with the relevant geographical area would be a worthwhile strategy, and even if such a person cannot be found in one's own institution or city, carrying out an online search for a biologist who

carries out fieldwork in the area, and asking him/her for a checklist might yield fruitful results. The following section mentions some key web-based resources that can be used to generate species checklists which should be relevant to speakers of languages from many parts of the world.

1.2 LOCATING APPROPRIATE CHECKLISTS. There are currently numerous web-based resources that provide species checklists for a range of geographical locations. As can be expected, the quality of the available resources varies from region to region, and is dependent on a number of factors, such as the institution hosting the resource, the existence of a long-term biodiversity research project in a particular country, the existence of unique—and therefore scientifically interesting—suites of flora or fauna in a habitat, and so on. Table 1 provides a list of some of the most important online resources that provide biodiversity information from either a global, or country-specific, perspective. Readers will observe that the list is biased towards the Asia-Pacific region; this because is we are most familiar with this region, and Si has, in particular, made use of many of these resources in his own research. Si's research with the Solega people of southern India was, for instance, facilitated by three important checklist resources that were discovered quite by accident. The birds of the area had been listed in Aravind et al. (2001) and Srinivasan and Nuggihalli (2005), which were both accessed online, and the mammals were covered in a thin volume by Srinivasa et al. (1997).

TABLE 1. Some Internet-based resources for compiling or accessing species checklists.

Taxon	**Website URL**	**Scope**	**Notes**
Fish	www.fishbase.org	Global	Photos, state-level lists for USA
	http://malawicichlids.com/	Lake Malawi	Photos
	https://www.conservationgateway.org/Files/Pages/rapid-ecological-assessme.aspx	Bismarck Archipelago, PNG	Some photos
Birds	http://www.xeno-canto.org/	Global	Audio files, distribution maps
	http://avibase.bsc-eoc.org	Global	Detailed regional checklists, audio files, photos
	http://www.birdlife.org/datazone/species/search	Global	
	http://www.michaelmorcombe.com.au/	Australia	Mobile phone app with audio files
	http://www.kolkatabirds.com/	India	State-level checklists, photos
Plants	http://apps.kew.org/wcsp/reportbuilder.do?method=Reset	Global	National and regional checklists

Continued on next page

TABLE 1 – *Continued from previous page*

Taxon	Website URL	Scope	Notes
	http://www.botany.hawaii.edu/faculty/carr/natives.htm	Hawai‘i	Photos, indigenous names
	http://botany.si.edu/myanmar/geography/distribution.cfm	Myanmar	State-level lists
	http://www.flowersofindia.net/	India	Photos, distribution info.
Invertebrates	http://www2.bishopmuseum.org/HBS/invert/list_home.htm	Hawai‘i	
	http://www.desertmuseum.org/center/seaofcortez/searchdb.php	Arizona	
	http://malawicichlids.com/mw12000.htm	Lake Malawi	
	http://zsi.gov.in/publications/book/Marine%20Biodiversity.pdf	India	Some photos
	http://www.mollusca.co.nz/checklist.php	New Zealand	Photos
Mammals	http://www.departments.bucknell.edu/biology/resources/msw3/	Globals	Arr. by taxonomic grouping
	http://zsi.gov.in/checklist/A%20Checklist%20of%20Mammals%20of%20India.pdf	India	Regional distribution info.
Amphibians & Reptiles	http://www.npwrc.usgs.gov/resource/herps/amphibid/index.htm	USA	
	http://research.amnh.org/vz/herpetology/amphibia/	Global	Search function returns country checklists
	http://researcharchive.calacademy.org/research/herpetology/myanmar/project.html	Myanmar	
General	http://www.inaturalist.org/	Global, mostly USA	Photos: searchable by species and region
	http://www.ala.org.au/	Australia	Generates checklists and ID guides with photographs from state to local government level

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TABLE 1 – *Continued from previous page*

Taxon	Website URL	Scope	Notes
	http://biotaxa.org/cl	Global, mostly India, South & Central America	Online open-access journal for checklists
	http://indiabiodiversity.org/observation	India	Photos, regional lists
	http://www.indianaturewatch.net/	India	Photos, distibution info.
	https://www.conservationgateway.org	Global	Some regional marine surveys
	https://www.idigbio.org/portal/search	Global	Generates species lists for many plant and animal groups (particularly invertebrates), some to state/province level; some photos
	http://iobis.org/mapper/	Global	Generates regional checklists for marine habitats; good invertebrate coverage

The most comprehensive online databases exist for fish, birds, and plants, and many of the websites mentioned in Table 1 also contain helpful color photographs that can be used as language elicitation stimuli. Sites such as Xeno-Canto and Avibase also host a large number of audio files, which can be either streamed through the site, or downloaded and played back later. These audio files consist of bird calls and songs recorded in the field in a variety of situations, and provide an additional set of stimuli that complement color photographs. Both songs and calls are worth including in an elicitation session: a 'song' tends to be a longer, more melodious vocalization, produced in the context of breeding or mating, whereas a 'call' is a shorter, simpler vocalization, often used to warn other birds of danger from predators. In many cases, a song or call may be the only aspect of the bird that language consultants may be familiar with, for the simple reason that the bird that produces such a vocalization is rare, cryptic, or migratory. Playing back a recording of a vocalization, while showing a photo of the relevant bird, is likely to yield the best results in terms of nomenclatural accuracy and recall of any associated folklore, much of which may be based solely on birdsong.

The website of the Royal Botanic Gardens at Kew[1] provides a very comprehensive, searchable database that is able to generate species checklists (Table 1). However, given

[1] http://apps.kew.org/wcsp/reportbuilder.do?method=Reset

the high species diversity of plants in many parts of the world—especially the tropics—the resultant lists might contain several hundred to a few thousand different species. Understandably, few linguists or ethnobiologists would be prepared to search for images of all the species relevant to their region, and work through them systematically with their language consultants. The checklist-and-photograph approach might still be worth pursuing in such situations, by focusing on a smaller, randomly-selected subset of the comprehensive checklist. Finally, checklists also appear in journal articles and reports to environmental organizations, and it is a good practice to investigate these sources for information that may be specific to a country or region of interest. The Brazil-based journal Checklist (Table 1) for instance, specializes in publishing species lists from around the world, although there is currently a preponderance of articles focussing on India and South and Central America. Websites such as India Biodiversity Portal and Conservation Gateway (Table 1) may also host raw data files or research reports based on ecological assessment surveys that focus on specific field sites.

There appear to be no online checklist databases, with global coverage, of certain groups of organisms, such as terrestrial invertebrates. While online taxonomic resources do exist for important groups such as ants[2], these websites do not allow searches by geographic region, and are of little use to a linguist interested in a very specific location. Regional checklists for such animal groups will need to be sourced from national- or state-level databases, and a few prominent examples are shown in Table 1. Marine invertebrates are represented with varying degrees of coverage on the very ambitious Integrated Digitized Biocollections[3] (iDigBio) and Census of Marine Life[4] websites; the latter hosts the Global Marine Life Database, whose Ocean Biogeographic Information System[5] (OBIS) provides a convenient map-based checklist generator.

A comprehensive global listing of mammal species exists in the form of the online version of Wilson and Reeder's Mammal Species of the World (Wilson & Reeder 2005).[6] Although the version that can be browsed online is arranged entirely by taxonomic grouping (and not by geographical region), the whole database can be downloaded as a spreadsheet, and the entries sorted by country or region, thereby generating a more useful checklist. However, good region-specific mammal field guides, illustrated with photographs, are usually available for many parts of the world (the same cannot be said of the other groups), and may prove to be a more convenient alternative.

Research institutions in developed countries such as Australia and the USA are likely to host their own comprehensive and up-to-date biodiversity databases. These are relatively easy to locate online, and will not be covered here in any great detail. Australian plant lists can be generated by an interactive map tool hosted by Australian National Botanic Gardens,[7] while more comprehensive lists can be obtained from the regional botanical gardens and herbaria located in State and Territory capitals. For instance, data from the 2013 Census of Queensland Flora can be readily accessed from the website of the Queensland Herbarium.[8] Map-based checklist generators also exist for other taxa, including the Atlas

[2]http://antbase.org
[3]https://www.idigbio.org/portal/search
[4]http://www.coml.org/
[5]http://iobis.org/mapper/
[6]http://www.departments.bucknell.edu/biology/resources/msw3/
[7]http://www.anbg.gov.au/maps/locator.html
[8]http://www.qld.gov.au/environment/plants-animals/plants/herbarium/flora-census/index.html

of Living Australia website,[9] and the more regional Museum Victoria's frog checklist[10] and mammal species mapper.[11]

In the next section, we provide a case study carried out with a speaker of a language from northern Papua New Guinea to document ethnobiological terms in her language. The setting was two one-on-one elicitation sessions that were part of a linguistic field methods course held at the Australian National University in Canberra, and led by Professor Nicholas Evans. Lahe-Deklin was the language consultant who took part in the course. The aim of the elicitation sessions was to document the names of (and traditional knowledge associated with) a range of sea creatures, although the primary focus was on fish species.

2. CASE STUDY: FISH NAMES IN THE DUMO LANGUAGE. Here, Lahe-Deklin first describes the language situation in her home village, based on her personal observations, following which she shares her experiences of the ethnobiological elicitation sessions. Lahe-Deklin is a fluent native speaker of the language Dumo (listed in Ethnologue as Vanimo, with 2,670 speakers), which is briefly described in Ross (1980). Lahe-Deklin was born in Lido village (originally called Vanimo village, until the establishment of the nearby provincial capital with the same name), and left in 1964 at the age of 12. Her extended family still lives in the village, and she has returned to Lido on numerous occasions for social and research visits. Si has an Honours degree in Marine Biology, followed by extensive research training in biology and field linguistics.

Lahe-Deklin's father was considered an expert fisherman by the other men in Lido village. Among Dumo people, it is customary for fishermen to hang up trophies of prestigious items of their catch (such as large stingray tails, mackerel tail fins, and swordfish bills) above the door of their house, and Lahe-Deklin's father possessed more of these items than most other Lido fishermen. Lahe-Deklin's mother is one of the handful of coral garden owners (this is described in more detail below) whose traditional claim to the site of the garden goes back many generations. Throughout her childhood, Lahe-Deklin would help her mother catch fish and tend the rock/coral walls of the coral garden at low tide. This went on right to the end of Lahe-Deklin's schooling and university degree in Port Moresby, on her regular visits back to the village.

2.1 LANGUAGE SITUATION IN VANIMO. The Dumo language is spoken in and around the town of Vanimo, which lies on the north-western coast of Sandaun Province of Papua New Guinea, close to the border with Indonesia. There are five different dialects, associated with five villages. Two registers of the language can be identified, the first being ordinary Dumo, which is used for everyday conversation. The second, called *mɛ*, is a ritual register, and has traditionally been used at religious ceremonies and funerals. Following the arrival of Christian missionaries, some church prayers have been composed in *mɛ*. It is also considered a 'poetic language,' and a handful of people are still able to compose love songs using this register, which is otherwise unintelligible to speakers of ordinary Dumo.

Dumo is no longer spoken fluently by young people, even in the villages. Children are educated, and encouraged to read and write, in English, and outside school they prefer to speak in English and also the national language Tok Pisin, because of the prestige associated with these languages. In PNG, state governments can choose to support '*tok ples*

[9] www.ala.org.au

[10] http://flyaqis.mov.vic.gov.au/cgi-bin/texhtml?form=bio_fnvicbio

[11] http://flyaqis.mov.vic.gov.au/cgi-bin/texhtml?form=bio_mammapfly

schools' to teach local languages, but often the teachers at these schools come from the wrong language group. Moreover, there are currently no *tok ples* schools in Vanimo subdistrict. Another recent issue is that as the Dumo-speaking villages are close to the border with West Papua province of Indonesia, Bahasa Indonesia is also being learned by young people and adults. This is encouraged by the fact that many Dumo people have relatives in West Papua. People in Vanimo also depend on cross-border trade, and Bahasa Indonesia has become a local lingua franca. The Dumo language is therefore under intense pressure from, and giving way to, English, Tok Pisin and Bahasa Indonesia simultaneously.

2.2 EXPERTS, CHILDREN'S KNOWLEDGE, AND DOCUMENTATION OF THE ETHNOBIOLOGICAL LEXICON. The ethnobiological literature contains occasional references to the level of expertise of indigenous consultants, with some authors advocating documenting information only from people who are regarded by their peers as experts in their field (Davis & Wagner 2003). It has also been demonstrated that there are key qualitative and quantitative differences in the knowledge of experts and novices, or even between experts belonging to different professions (Boster & Johnson 1989; Medin et al. 1997; Shipman & Boster 2008). However, the last three studies were carried out in first-world, urban settings in Storrs, Connecticut and Chicago, Illinois, with university students, botanists, horticultural experts or recreational fishermen, and it could be argued that the distinction between 'expert' and 'novice' is either far more blurry, or at least should be applied in a different way, in a community like Lido village. After all, knowledge and authority can interact in a very different way compared to the descriptions in the above studies, as exemplified by Sillitoe's (2002) experiences with the 'intellectual egalitarianism' of the Wola of Papua New Guinea.

The concept of expertise also has implications for a topic discussed in the preceding section, namely the use of field guides in ethnobiological lexical elicitation, either in the field, or 'ex situ.' It could be argued that the phenomenon of stimulus overload discussed in §1.1 can be used to the researcher's advantage to separate experts from non-experts. Presumably, an expert would be able to state confidently that bird X on a particular page of the field guide "does not live here" and hence "has no name." A non-expert, on the other hand, would either appear more uncertain, or be reluctant to say that s/he does not know the name of something. Apart from the obvious problem that these criteria are vague, highly subjective, and therefore unrealistic (see Agnihotri & Si 2012 for a discussion of inter-speaker variation in the naming of birds in southern India), there also exists the issue that a community simply may not have 'experts' for certain domains of ecological knowledge. The Solega of southern India know many bird names and numerous myths surrounding birds, but as these creatures are not systematically hunted, and since practically all human-bird interactions are fleeting and long-distance, it is pointless to try and locate a Solega 'bird expert'. Similarly, bees and yams are also important, but honey is harvested either by groups of men of varying composition or opportunistically by individuals walking through the forest, while all community members are aware of where yams grow, what they are called, and when to harvest them. There may well have been experts in hunting mammals, but this practice has stopped due to a government ban.

As mentioned above, Lahe-Deklin's father was indeed regarded as an 'expert' fisherman by the other inhabitants of the village, due to his frequent catches of highly prized large species such as shark, mackerel, stingray, and so on. His expertise may have arisen from his exclusive, explicit knowledge of special techniques and fishing spots, or from his intuitive grasp of weather conditions and sea currents—Dumo women do not go out to sea to fish, and Lahe-Deklin is unable to provide details of men's fishing techniques. On the

topic of coral gardens and their use by Dumo women to catch small reef fish and intertidal sea creatures, however, she is confident that a common system of knowledge is shared by all women who tend such gardens. The question of 'expert knowledge' simply does not arise, and the women who are able to harvest the best and most produce are those who own, either through luck or through inheritance, gardens that are favorably located with respect to geographic position, depth, and tidal movement, or contain substrate complexity-enhancing features[12] such as large coral bommies[13] or seaweed.

A critical reader might point out that Lahe-Deklin, having left Lido village at the age of 12, might not have received the full complement of fish-related knowledge possessed by the average adult Dumo woman. This argument can be countered by citing the numerous studies, from various parts of the world, that show how children living in hunter-gatherer or subsistence agricultural societies far from major urban centres generally possess knowledge about culturally relevant plants and animals comparable to that of adults (Fagbemissi & Price 2011; Setalaphruk & Price 2007; Zarger & Stepp 2004). In contrast, the 'novice' university students tested in the Shipman and Boster paper were unable to name more than a handful of very common trees, in spite of being residents of a town situated in a thickly forested part of Connecticut. Lahe-Deklin's experiences working in her mother's and mother's sisters' coral gardens more than qualifies her for carrying out the tasks described in the latter half of this paper. As Lauer and Aswani (2009) point out, (ecological) knowledge is a "process intrinsic to the socially situated activities of people engaging with one another and with their biophysical environments"(326), rather than a static, delineated corpus of information that is formally transmitted to a younger person.

A linguist trying to document an endangered language may well have goals that differ significantly from those of an ethnobiologist. The former may be interested in documenting language on biological topics as it is used by the wider community, while the latter, as in the case of Davis and Wagner (2003), may wish to develop environmental management policies on the basis of their findings, thus requiring that the validity of their sources (i.e., expert consultants) stand up to public scrutiny. The methods employed in language documentation should also stand up to public scrutiny, but as variation and diversity in the documented corpus is acceptable, and even desirable (Himmelmann 1998), the requirement for an expert is often reduced. Indeed, an expert may simply not be available among speakers of small languages in 'ex-situ' settings. If the linguist suspects that the speaker's level of expertise on a given topic could have an effect on the quality of the information being recorded, caveats in the form of detailed metadata (about the consultant's life history, relevant experiences, etc.) should accompany the documented material. This is precisely what we have done in the present paper, even in the absence of such concerns.

2.3 WHY FISH NAMES ARE IMPORTANT. The Dumo people are sea people, and sea creatures make a significant contribution to people's dietary requirements, as well as being culturally very important. While a large number of invertebrate species (mollusks, crustaceans, corals, and worms) are also recognized, named, and utilized, the following sections will focus on Dumo fish lore. Traditionally, seafood has been the main source of protein, and species such as flying fish and sharks are important totemic symbols. Men enjoy going fishing at night—in boats and by torchlight—as they always have, and many sell fish for a living, while women still tend coral gardens, and gather small reef fish stunned by the juice

[12] Complex substrates that provide diverse hiding places and habitats are generally thought by ecologists to support greater biological diversity.

[13] These are coral outcrops that rise above the surrounding substrate.

of a vine. A young man's initiation ritual involves an expedition to catch a particular kind of shark called *mūū mo* in the open ocean, which represents the man 'marrying the woman from the sea.' The shark has to be dispatched in a particular way that meets of the approval of the older men accompanying the initiate—the shark is hauled out of the water alive, lain on the floor of the canoe, and killed instantly with a single blow to the head with a club. Sharks are attracted with wooden rattles and a bait containing coconut, and the bigger the shark, the more prestige the initiate enjoys.

In recent years, however, there has been some change in fishing-related practices, and in attitudes towards seafood. Lahe-Deklin recalls a time when lobster meat used to be considered a 'rubbish food,' so much so that people would be embarrassed to offer it to friends or visitors. In modern times, lobsters are a highly prized catch because of the prices they fetch in the export market. Much fishing is now carried out with modern methods, including the use of motor boats and modern fishing lines or big nets. Night-time fishing is aided not by the traditional coconut-leaf torch, but by high-powered electric torches or gas lamps. People are now able to travel to more open waters, where new, more commercial species like yellowfin tuna are being targeted. The result of this intensified fishing pressure is that the local waters around Vanimo are being fished out, making it harder for subsistence fishermen and women to feed their families. A related issue is that a modern cash economy has allowed people to purchase new types of protein from shops, including wild pig, wildfowl eggs, and cassowary meat from inland PNG. Traditional foods are also being replaced by rice, tinned fish, and junk food from across the border in Indonesia. Ironically, the best (by Dumo culinary standards, which often overlaps with international tastes, as in the case of large fish like mackerel) locally-caught sea produce is sold at markets, instead of being consumed by Dumo people. A potential impact of these changes is that, in spite of some continuing traditional fishing practices, the language and knowledge associated with the sea and its creatures may not be transmitted, or transmitted with different values and beliefs, to the next generation of Dumo speakers.

2.4 EXPERIENCE WITH THE FISH-NAMING TASK. The first step in preparing for the fish-naming task was to obtain a checklist of reef fish species known to inhabit the waters close to where Dumo is spoken. The species list was generated from the book *The fishes of Papua New Guinea: a revised and annotated checklist* (Kailola 1987), which contained separate species lists for each province of PNG. A random selection of about 130 fish was compiled, covering all the biological families listed as occurring in Sandaun Province, and color photographs of these species were obtained from the Fishbase website (Table 1). These were printed on a color printer as small, roughly 6x4cm images, and individually cut out. Some care was taken to accurately represent the relative differences in size between the various fish species, but this was naturally not feasible in the case of very large species, such as sharks and cod. Two elicitation sessions were held, spaced four months apart. The reason for this gap of time will be made clear below. The first elicitation procedure involved handing these images one at a time to Lahe-Deklin, and asking her to name the fish in the picture. She was free to group the pictures together on the table in front of her as she saw fit.

Lahe-Deklin's reaction to the stimuli was generally positive, and she was able to provide names for most of the pictures shown to her. It soon became apparent that many Dumo 'generic' reef fish names (*sensu* Berlin 1992) correspond to biological families, rather than biological genera or species. Some of these are shown in Table 2 below. While a number of the fish were easily recognized from the pictures alone, there were several instances where

Lahe-Deklin required additional information. The most frequent question regarded the absolute size of the fish, and on several occasions Si was required to consult Randall et al. (1990), which contains information on many species that are found in PNG. Lahe-Deklin would often inquire about some additional physical characteristics of a fish: whether the skin was leathery or scaly, whether it had spines near the tail, whether it had few or many teeth, whether it was flat or full-bodied, and so on. Clearly, the static two-dimensional color images lacked some crucial information that Dumo speakers routinely rely upon to make a positive identification of any given fish. Nevertheless, once the relevant information had been provided, a large number of Dumo fish names, along with a great deal of traditional knowledge concerning the biology of the fishes, could be documented.

TABLE 2. List of species named by Lahe-Deklin, belonging to the Dumo folk taxon *mű̱*. Tone markings shown in the table (but omitted from the text for clarity) are based on Ross (1980) and Donohue & Van Vugt (1992). The 'Stimulus species' column gives all the images selected by Lahe-Deklin as belonging to a particular named category in the first elicitation session. Species names followed by asterisks (*) indicate stimuli that were probable mis-identifications, and not used in the determination of the biological referents. Family names in the 'Biological referent' column indicate that the Dumo names include *some* species of those families as their referents.

Dumo name	**Stimulus species**	**Biological referent**	**Relevant cultural/biological information**
mű̱ lú ji	*Variola louti, Cephalopholis urodeta* (Serr.) *Plectrorhinchus orientalis** (Haemul.) *Cephalopholis leopardus* (Serr.)	cod; Fam. Serranidae	
á wõ	*Caesio lunaris* (Caesion.)	identified as fusilier *Caesio lunaris*, possibly also mackerel	edible, scaly fish with oily flesh, swims in schools, called *makao* in Tok Pisin; can be 'called' to shore by specialized practitioners at times of special feasts
á mɛ	*Lutjanus bohar* (Lutjanid.) *Lutjanus gibbus* (Lutjanid.)	red emperor; Fam. Lutjanidae	edible; category of all large red fish, except for cod
gú̱ mo̱ű̱ mo̱ű̱	*Cheilinus trilobatus* (Labrid.), *Cetoscarus bicolour* (Scarid.), *Scarus flavipectoralis* (Scarid.), *Cheilinus fasciatus* (Labrid.), *Thalassoma jansenii* (Labrid.), *Scarus niger* (Scarid.), *Gomphosus varius* (Labrid.)	large wrasses and parrotfish; Fams. Labridae and Scaridae	edible; mature forms of *gɯ̱ t̪aɛ* (see text below for explanation)

Continued on next page

TABLE 2 – *Continued from previous page*

Dumo name	**Stimulus species**	**Biological referent**	**Relevant cultural/biological information**
gúɪ̱ ṯáɛ	*Zebrasoma scopas** (Acanth.), *Chaetodon auriga* (Chaetod.), *Dascyllus reticulates** (Pomacent.), *Forcipiger flavissimus** (Pomacent.), *Heniochus chrysostomus* (Chaetod.), *Pygoplites diacanthus** (Pomacanth.), *Halichoeres hortulanus* (Labrid.), *Chaetodon kleinii* (Chaetod.), *Chaetodon trifasciatus* (Chaetod.), *Diproctacanthus xanthurus* (Labrid.), *Chaetodon ornatissimus* (Chaetod.), *Thalassoma hardwicke* (Labrid.), *Labroides dimidiatus* (Labrid.), *Chaetodon baronessa* (Chaetod.)	butterflyfish and cleaner wrasses; Fams. Chaetodontidae, Labridae	edible; colorful, small mouth (pointy or blunt); range of shapes; possess very fine scales or smooth bodies
mṹɪ̱ máɛ bi	*Balistapus undulates* (Balistid.), *Melichthys vidua* (Balistid.), *Sufflamen bursa* (Balistid.)	Fam. Balistidae	edible; possess thick skin, but no caudal spine
mʉ̃ hwɜ̀	*Plectroglyphidodon lacrymatus* (Pomacent.), *Chromis margaritifer* (Pomacent.), *Pomacentrus moluccensis* (Pomacent.), *Pomacentrus lepidogenys* (Pomacent.), *Pomacentrus vaiuli* (Pomacent.), *Amblygliphidodon leucogaster* — big version (Pomacent.), *Cephalopholis argus** (Serr.), *Centropyge bicolour** (Pomacanth.), *Neoglyphidodon melas* (Pomacent.)	Fam. Pomacentridae	edible; small scales, but bigger than *gɯ ṯaɛ*

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TABLE 2 – *Continued from previous page*

Dumo name	**Stimulus species**	**Biological referent**	**Relevant cultural/biological information**
mű̱ ṯáɛ bi	*Zanclus cornutus** (Zanclid.), *Heniochus varius** (Chaetod.), *Ctenochaetus striatus* (Acanth.), *Acanthurus dussumieri* (Acanth.), *Acanthurus nigricans* (Acanth.), *Acanthurus pyroferus* (Acanth.), *Naso lituratus* (Acanth.)	surgeonfish and leatherjackets; Fam. Acanthuridae	edible; possess caudal spines and thick skin
mű̱ hja	*Sargocentron caudimaculatum* (Holocent.), *Myripristis murdjan* (Holocent.), *Neoglyphidodon nigroris** (Pomacent.), *Monotaxis grandoculis** (Lethrin.), *Cirritichthys oxycephalus* (Cirrhit.), *Paracirrhites arcatus* (Cirrhit.), *Cirrhitichthys falco* (Cirrhit.)	Fams. Holocentridae, Cirrhitidae	edible; possess big eyes that stick out the top of the head, spines along the back
ṯaɛ daɛ	*Lutjanus monostigma* (Lutjan.), *Pomacentrus bankanensis** (Pomacent.), *Lutjanus semicinctus* (Lutjan.)	Fam. Lutjanidae	edible
á pli	*Dasyatis kuhlii* (Dasyatid.), *Taenuria lymna* (Dasyatid.)	stingrays; Fam. Dasyatidae	edible; tails are kept as trophies
mű̱ mɔ̀	*Carcharhinus amblyrhynchos* (Carchar.), *Carcharhinus melanopterus* (Carchar.)	sharks; Fam. Carcharhinidae	edible; key role in men's initiation ceremony
mű̱ ṯé ṯé	offered by Lahe-Deklin	hammerhead sharks	found near coral reefs
mű̱ pí lú lu	offered by Lahe-Deklin	'small brown shark'	edible; hides in seaweed
ṯaɛ̀ ló	*Elegatis bipinnulata* (Carangid.)	mackerel; Fam. Carangidae?	edible
mű̱ ṯo	offered by Lahe-Deklin	'yellowfin tuna'	edible
mű̱ la	offered by Lahe-Deklin	'swordfish'	edible; the sword is kept as a trophy

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TABLE 2 – *Continued from previous page*

Dumo name	**Stimulus species**	**Biological referent**	**Relevant cultural/biological information**
l̥ǽ hví t̪ò	*Parupeneus multifasciatus* (Mullid.), *Parupeneus bifasciatus* (Mullid.), *Neoniphon samara** (Holocent.), *Synodus binotatus* (Synodont.), *Cheilodipterus quinquelineatus* (Apogonid.), *Bodianus mesothorax** (Labrid.), *Amblygobius decussatus* (Gobiid.)	assorted substrate-dwellers; Fams. Mullidae, Apogonidae, Synodontidae, Gobiidae	edible
mű̱ be	offered by Lahe-Deklin	?	edible; big, brown fish that hides in seaweed; mostly seen in June/July; has sweet, soft flesh
mű̱ mɛ	*Gymnothorax flavimarginatus* (Muraenid.)	moray eel; Fam. Muraenidae	edible, but a dispreferred food as it is too bony
mű̱ l̥iə	*Caranx melampygus* (Carangid.)	trevally; Fam. Carangidae	edible
mű̱ pò	*Arothron nigropunctatus* (Tetraodontid.)	pufferfish; Fam. Tetraodontidae	part of the head of the larger species is eaten; the spines are used as needles to lance boils, or as toothpicks
á nű̱̃	offered by Lahe-Deklin	'small pufferfish'; Fam. Tetraodontidae	not eaten
mo ŋu	offered by Lahe-Deklin	stonefish; Fam. Synanceiidae	edible, but a dispreferred food, as the spines are poisonous
mű̱ si	*Tylosurus pacificus* (Belonid.)	'big needlefish'; Fam. Belonidae	edible; possess no scales; caught at night, using flying fish as bait
mũ̱ mlã	offered by Lahe-Deklin	'smaller needlefish'; Fam. Belonidae	edible; possess no scales

Continued on next page

TABLE 2 – *Continued from previous page*

Dumo name	**Stimulus species**	**Biological referent**	**Relevant cultural/biological information**
mɯ̃ ɗù	offered by Lahe-Deklin	'smaller needlefish'; Fam. Belonidae	edible; possess scales
mɯ́̃ pliə̌	offered by Lahe-Deklin	mudskipper	edible; easily caught on land, and considered an 'old people's fish'
mɯ́̃ piə̌	offered by Lahe-Deklin	'flying fish'	totemic; edible; has big eyes; females bearing eggs are usually caught in the rainy season
mo ŋi	offered by Lahe-Deklin	'flying fish'	edible; caught year-round
á yi	offered by Lahe-Deklin	sardines	edible; appear in large numbers close to shore in the rainy season
gɯ́ pli pli	*Scarus niger* (Scarid.)	'dark-coloured fish'; poss. *Scarus niger*	edible; also a kind of *gɯ m̥ɯ̃ m̥ɯ̃*
mɯ́̃ wɪ́ ɗã	*Gomphosus varius* (Labrid.)	*Gomphosus variosus*	edible; also a kind of *gɯ m̥ɯ̃ m̥ɯ̃*
mɯ́̃ l̥o	offered by Lahe-Deklin	'kingfish'	edible
mɯ́̃ hù	offered by Lahe-Deklin	'large fish'	edible if caught; fish of the open ocean, that represent the mature forms of *mɯ̃ hliə, mɯ̃ lu yi, a me, gɯ m̥ɯ̃ m̥ɯ̃, mɯ̃ si*
mɯ̃ gu	offered by Lahe-Deklin	sea snakes	not eaten
mɯ̃ l̥ã	offered by Lahe-Deklin	'turtle with yellow plastron'	a high status catch; caught and eaten on special occasions such as initiation ceremonies; eggs also eaten
mɯ̃ bi bi	offered by Lahe-Deklin	'big turtle'	edible, but harder to catch; eggs also eaten

Continued on next page

TABLE 2 – *Continued from previous page*

Dumo name	**Stimulus species**	**Biological referent**	**Relevant cultural/biological information**
mʉ̄̃ pí lɯj	offered by Lahe-Deklin	'dugong'	not eaten
mʉ̄̃ lɯ	offered by Lahe-Deklin	'dolphin?'	not eaten
l̥a	offered by Lahe-Deklin	'whales'	not eaten

The reef fish named by Lahe-Deklin were grouped together under the superordinate category *mʉ̃ mo*, which also included marine mammals, sea turtles, and sea snakes. The English and scientific family names listed in the third column of Table 2 represent the consensus identifications arrived at after excluding incorrectly identified members of labeled categories, which were probably included by Lahe-Deklin due to inadequacies in the stimulus pictures. For instance, early in the elicitation session, she grouped the pictures of four species together (*Variola louti, Cephalopholis urodeta, Cephalopholis leopardus*, and *Plectrorhinchus orientalis*), calling them by the Dumo name *mʉ̃ lu ji*. Of these, the first three were 'cods' of the Family Serranidae, and only the last was a member of the 'sweetlips' Family Haemulidae. It is reasonable to assume that the latter fish was included in the *mʉ̃ lu ji* category because the picture used provided misleading information concerning the size of the fish relative to the Serranidae. Hence, the third column of Table 2 only lists members of the Family Serranidae as the referent of the label *mʉ̃ lu ji*. In a handful of instances, the membership of a 'generic' category was found to be quite mixed, so that no clear consensus could be reached concerning the biological referent of the category. Particularly difficult categories included *mʉ̃ hwã* (originally said to include members of the Families Pomacentridae, Serranidae and Pomacanthidae), *gɯ t̪aɛ* (Families Acanthuridae, Chaetodontidae, Pomacentridae, Pomacanthidae and Labridae) and *mʉ̃ hja* (Families Holocentridae, Pomacentridae, Cirrhitidae and Lethrinidae).

A second elicitation was carried out roughly four months after the first, primarily in order to clear up the confusion surrounding the three Dumo folk taxa, the exact identity of whose referents remained unclear: *mʉ̃ hwã*, *gɯ t̪aɛ* and *mʉ̃ hja*. It was hoped that the four-month gap would allow Lahe-Deklin to forget her responses from the first session, thus allowing her to participate in the second session without any prior biases. Realizing that his line of questioning in the first elicitation session may have been as much to blame as the stimulus materials for the mixed responses from Lahe-Deklin, Si tried a new approach. Now, Lahe-Deklin was shown the stimulus pictures one at a time as before, but the question posed by Si was, "Which of these fish is called *mʉ̃ hwã/gɯ t̪aɛ/mʉ̃ hja*?" This change in the line of questioning is analogous to the situation where a linguist spends an extended period of time at a field site—early questions might consist of "What do you call that?", which usually yields lexical items whose precise semantic range the linguist is unsure of (Quine 2013). With greater familiarity with the language and the field situation, the linguist might then move on to more focused questions, such as "Is this also X?" and "What other kinds of X are there?" to rule out spurious meanings, and more precisely identify the referent. At the end of the first elicitation session, Si suspected—based on the relative frequencies

of the different Families—that the referent for *mũ̄ hwã* included members of only one Family, the Pomacentridae (i.e., Lahe-Deklin had been misled by the stimuli), but that *gɯ̄ t̪aɛ* was indeed a label for fish from a variety of Families (i.e., her initial responses correctly reflected this linguistic reality). The new question, with the lexical items used as probes, allowed Si to test these hypotheses. The new responses were more concentrated on fewer Families, and made it easier for a referent to be determined more precisely for the above categories. The difference in responses for the three categories between the two elicitation sessions is shown in Figure 1. In brief, the referents of *mũ̄ hwã* and *gɯ̄ t̪aɛ* are shown much more convincingly, in session two, to be those given in Table 2, while the situation for *mũ̄ hja* showed a slight improvement. By this, we mean that the single species of the Pomacentridae (which, as established previously, should belong to the *mũ̄ hwã* group) was now excluded from the *mũ̄ hja*. Further discussion between us also led to the exclusion of the sole representative of the Lethrinidae—this species grows to a much bigger size than the other *mũ̄ hja*, and lives in deeper water. These important facts were obscured by the nature of the stimulus provided.

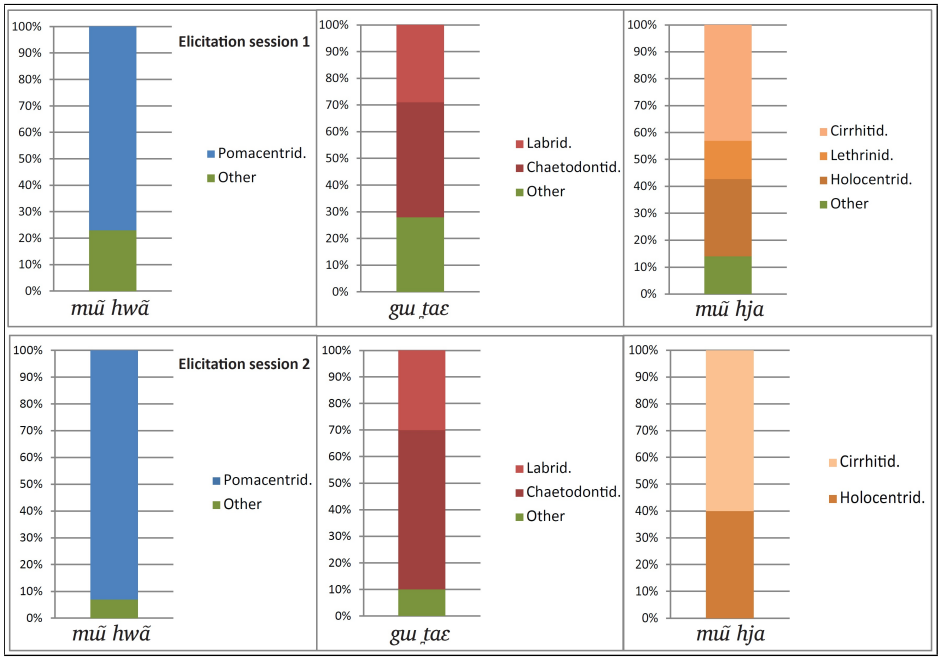

FIGURE 1. Changes in the referents of three fish category labels over two elicitation sessions. There is an overall trend of reduced variation (reduction in the proportion of the 'Other' category) in the species included in these categories, indicating a higher level of precision in elicitation session 2.

An unplanned, but positive outcome of the elicitation session was the fact that the pictures prompted Lahe-Deklin to remember the names of other fish that were not represented in the stimulus set, along with a great deal of related cultural and ecological knowledge linked with the named species. For instance, she volunteered the 'small pufferfish,' two kinds of flying fish and two additional kinds of needlefish upon seeing images of related species. Many of these fish types remain to be definitively linked to biological species,

but the detailed descriptions Lahe-Deklin provided of the physical and ecological attributes of these fish should facilitate any future attempts to scientifically identify these fish. Accounts of differing fishing practices among men and women, the cultural significance of key species, and beliefs regarding the unusual life cycles of certain large fish species were also obtained.

2.5 FOLK TAXONOMY AND TRADITIONAL KNOWLEDGE. The final section of this paper briefly summarizes some aspects of the folk taxonomy and ethnobiological knowledge of marine creatures according to Lahe-Deklin, as documented in the Canberra field methods course. A hierarchical taxonomy of Dumo fish categories could indeed be constructed if one so desired, but the resulting schema would show major departures from the universal folk taxonomy suggested by Berlin (1992). The most obvious difference is that the lexeme *mũ̄*, used to label the category that includes fish, marine mammals, and marine reptiles, appears in the names of most of the subordinate categories that label individual fish families or species. The inclusion of *mũ̄* in the subordinate labels is strictly obligatory. *Mũ̄* is the closest approximation in Dumo to a 'life form' taxon such as fish (*sensu* Berlin), and according to the constraints on 'life forms' and their subordinate 'generic' taxa, there should be no nomenclatural relation between *mũ̄* and any of the named fish types—Table 2 provides ample evidence that this is clearly not the case.

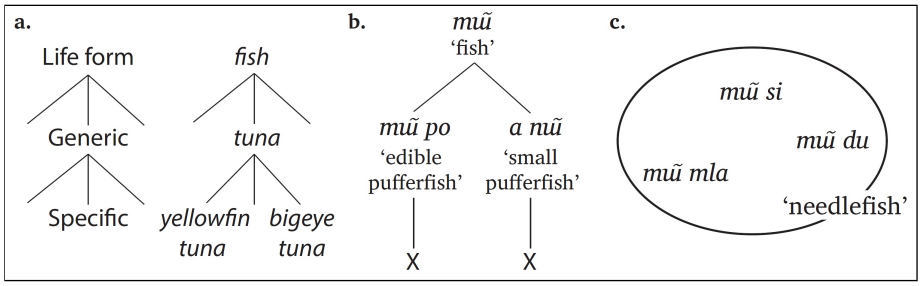

FIGURE 2. **a)** Idealized folk taxonomy according to Berlin (1992). **b)** The taxonomy of pufferfish in Dumo. **c)** Needlefish names in Dumo, and the lack of any nomenclatural relation between the three named categories.

Another point of difference is that 'generic' taxa are supposed to be labeled by mononominals, while any subordinate 'specific' taxa should be labeled by binominals whose names bear a clear relation to the 'generic', and therefore to each other (Figure 2a). The 'generic' fish names in Table 2, such as *mũ̄ n̪tæ bi* and *mũ̄ ho* are binominals at least, the names consisting of the superordinate category label *mũ̄* (the broad label applied to all fish and many other sea creatures), in addition to a usually semantically opaque element. The same holds true for any categories that could be considered 'specific' taxa, as in the case of the pufferfish. However, Dumo has no generic, mononomial 'pufferfish' label, even though the two named types are said to belong together (Figure 2b). The two pufferfish categories also show no relation, in terms of their nomenclature, to each other. In the case of the three needlefish types (Figure 2c) and the two flying fish types, there is no obvious nomenclatural relation between the 'specific' categories, while the relevant 'generic' category appears to be unnamed (i.e., there is no general term for 'needlefish' or 'flying fish'). Berlin's model deals with such phenomena by allowing the analyst to posit 'covert' (unnamed) categories, but the data presented in this paper can only be explained by the creation of numerous

unnecessary covert groupings. Could such covert groupings turn out to have real names, names that might be known to elderly or expert consultants who haven't as yet been interviewed? This is certainly a possibility than needs to be borne in mind when carrying out this kind of 'ex-situ' research (although Lahe-Deklin denies that this could be the case for Dumo). The main issue here is that our preliminary data fail to support two of Berlin's strong claims: that "the taxonomy of the Western scientist should be nearly identical to that of [an] indigenous ethnozoologist" (82) and that cross-linguistically, ethnobiological classification and naming systems will resemble each other in certain very specific ways (i.e., that there are taxonomic and nomenclatural universals). Instead, we find a utilitarian interpretation to be far more useful and realistic: that Dumo people (or any culture for that matter) have singled out and named species that are important to them, and that the ways in which species have been grouped together or named depend on a range of historical accidents, typological features, and cultural preoccupations.

Certain aspects of Dumo folk science regarding the life cycles of some fish groups cannot be easily reconciled with Berlin's idealized classification scheme. Chief among these is the Dumo belief that certain named fish groups are the mature forms of other named groupings of smaller fish. For instance, *gɯ m̥ũ m̥ũ* 'large wrasses and parrotfish' are meant to be the older forms of the smaller *gɯ n̪ɑɛ* 'butterflyfish and cleaner wrasses,' both groups being found close to the shore. *gɯ m̥ũ m̥ũ*, in turn, along with *mũ lu ji* 'cod,' a me 'red emperor,' *mũ l̥iə* 'trevally,' and *mũ si* 'big needlefish' are believed to migrate to the open ocean, where they reach maturity and grow to a monstrous size—at this stage, these fish from diverse families are known as *mũ ho*. *Mũ ho* is not a general grouping of all large pelagic species, however, as sharks and whales are excluded from this category.

3. CONCLUSIONS. This paper has demonstrated that it is possible to carry out meaningful ethnobiologically-focused language documentation even in 'ex-situ' contexts, such as a university field methods course. While such an enterprise requires effort on the part of the linguist prior to the start of the documentation process, the expended effort will likely result in the elicitation of a rich, varied, and accurate linguistic/ethnobiological corpus. During the documentation process, linguist and language consultant will need to work closely to overcome the drawbacks associated with working with artificial stimuli. The linguist, in particular, will have to be flexible with his/her methodology, and will have to constantly monitor the elicitation protocol for any factors that might cause a well-intentioned language consultant to produce erroneous responses. The information presented in the second half of this paper is only a small fraction of the sea-lore possessed by Dumo speakers such as Lahe-Deklin, but it shows how suitable preparation, with the help of freely available online resources, can allow linguists to document some ethnobiological knowledge of migrant speakers of endangered languages.

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