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'This is not the jungle, this is my *barbecho*': semantics of ethnoecological landscape categories in the Bolivian Amazon

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ABSTRACT

Through a case study with Spanish-speaking Takana indigenous people in the Bolivian Amazon, we explored ethnoecological landscape categories, including their ecological underpinnings, cultural significance and hierarchical organisation. Using field walks and interviews with consultants, we elicited 156 ethnoecological landscape categories, 60 of which related to vegetation types. However, sorting exercises with landscape photographs revealed that vegetation was not a guiding organisation principle. Takana consultants organised ethnoecological landscape categories into geographical regions that contained different landscape features, including vegetation units, topographical or hydrological features. Comparing the documented ethnoecological landscape categorisation with a published scientific botanical classification of vegetation units, we observed some important conceptual differences, which in turn have implications for the management of such landscapes.

KEYWORDS

Landscape classification; folk landscape categorisation; landscape ethnoecology; Takana indigenous people; Amazon rainforest

Introduction

How do people perceive the world around them? Do all people, irrespective of culture, language and background perceive their environment in the same way, or are there differences in how people carve up their surroundings into categories (a question raised by Mark, Turk, Burenhult, & Stea, 2011 in their edited volume 'Landscape and Language')? And if yes, what does this mean for how we represent the world on maps and in Geographic Information Systems (GIS) (Mark et al., 2011; Wellen & Sieber, 2013)? These questions are important, because geographic categories in the form of land use, land cover or landscape classifications have become crucial both for research and policy, for example, in monitoring landscape change (Kienast, Frick, van Strien, & Hunziker, 2015), as well as modelling patterns and processes (Price et al., 2015). Typical examples of landscape categorisations are the European Landscape Classification (LANMAP) or the CORINE land cover data of the European Environmental Agency (Feranec, Jaffrain, Soukup, & Hazeu, 2010). Recently, the US Geological Survey and ESRI published a Global Ecological Land Units classification that divides the global land surface into squares of 250 m containing information on landform, climate and surface rock type, which in turn influence land cover (ESRI, 2015). These landscape categorisations and their definitions are typically based on biophysical properties of landscape and result from negotiations between expert groups, which often makes them difficult to understand for the public. For instance, examples of Ecological Land Units include 'warm dry hills on

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metamorphic rock with sparse vegetation' or 'cool moist plains on carbonate sedimentary rock with mostly deciduous forest'. Such categories seem far removed from common sense geographic concepts used by a broader public (Egenhofer & Mark, 1995). However, the differences between categories people use in everyday language and scientific categorisations have only recently become a focus of research.

In GIScience and physical geography, a basic assumption has long been that landscape categories (and their spatial representations) are objective, value-neutral and apolitical, and that categories such as *forest* and *river* are universal, carved out of the landscape along natural discontinuities (Mücher, Klijn, Wascher, & Schaminée, 2010; Tagil & Jenness, 2008). However, empirical research suggests that there is a large cross-cultural and cross-linguistic variation in landscape categorisation (Johnson & Hunn, 2010; Mark et al., 2011). Indeed, there appear to be few, if any, universal landscape categories, and there is large variation in categorisation between different languages (Bromhead, 2011; Johnson, 2011; Mark & Turk, 2003). Thus, while English distinguishes convex landforms such as *hill* and *mound* based on size, the Australian Aboriginal language Manyjilyjarra distinguishes landforms based on their composition, such as *yapu* (rock-based convex landform) and *tamu* (sand-based convex landform), irrespective of size (personal communication Claire Hill). Many languages have been found to contain highly differentiated local landscape vocabularies. For instance, Gitksan people in Western Canada use the term *ts'iliks* for 'where water barely covers a rock but there is no wave' (Johnson, 2011), and the term *caochan* is Gaelic for 'a slender moor stream obscured by vegetation so that it is virtually hidden from sight' (Macfarlane, 2015). Even within the same language, different landscape categories may be used in different dialects. For instance, the term *beck* (brook or stream often with rugged course) is only used in certain dialects of British English (Bromhead, 2011). Certain dialects name geographic features not recognised in other dialects, such as the English dialect noun *smeuse* (gap in the base of a hedge made by the regular passage of a small animal) (Macfarlane, 2015) or the noun *Tobel* for a funnel-shaped valley with a narrow, canyon-like output used in the Swiss German dialect, not in standard German.

Furthermore, the same term can be associated with different meanings or semantics. Thus, the seemingly simple English term *forest* can be understood differently in different countries, institutions or communities of practice (Comber, Fisher, & Wadsworth, 2005). Such differences in semantics result in different, and often competing, management approaches for the same landscape, empirically shown for landscapes categorised, for example, as *forest* (Robbins, 2001) and *wetland* (Harvey & Chrisman, 1998). The large cultural and linguistic variation in how landscapes are parcelled up into named categories, the different meanings people associate with these categories, and the tangible consequences for management make landscape categorisations an important interdisciplinary research subject for disciplines including geography, linguistics, anthropology and landscape management.

Background

Categorisation has been the subject of study in various fields of research ranging from anthropology (Berlin, 1992; Berlin & Kay, 1969; Hunn, 1975), linguistics (Taylor, 2003) and psychology (Lakoff, 1987; Rosch, 1978), to geography (Mark & Turk, 2003), and information science (Bowker & Star, 2000). But what are categories, and how can we investigate them?

A category is usually identified by a noun (e.g. *animal*) and consists of members sharing some common attributes (Rosch, 1978). One way of investigating categories is through the study of category norms elicited in free listing tasks (Battig & Montague, 1969). A series of studies applied free listings to investigate landscape categorisation in Western industrialised societies (e.g. Smith & Mark, 2001; Wartmann, Egorova, Derungs, Purves, & Mark, 2015; Williams, Kuhn, & Painho, 2012).

Apart from using free listing, geographers and anthropologists have used more ethnographic methods to investigate, for instance, local categorisations of soils (Furbee, 1989), landforms (Duvall, 2008) and landscape (Jungerius, 1998). At the intersection of geography, anthropology and linguistics, the field of ethnophysiography has emerged, exploring how people from different cultures categorise landscape features such as landforms, water features and vegetation assemblages, as well as the cultural meanings and beliefs associated with those features (Mark & Turk, 2003). The related research area of

landscape ethnoecology focuses on the ecological foundations of how people make a living on the land, taking into account interactions with certain landscape features (Johnson & Hunn, 2010). Based on this body of work, we define landscape here as an arrangement of biotic, abiotic and cultural landscape elements recognised and referred to by common nouns (generic landscape terms or categories), rather than proper nouns (place names or toponyms). Previous work in landscape ethnoecology investigated 'folk ecotopes' and 'folk ecotopic patches' as culturally recognised units (Hunn & Meilleur, 2010). However, this notion implies a (continuous) field-based view of the world, which may be at odds with how certain peoples conceptualise landscape. For our study, we thus coin the term 'ethnoecological landscape categories' that encompasses all categories relating to landscape, irrespective of whether they are conceptualised as fields or objects.

In the following, we present a case study that investigated ethnoecological landscape categories of Spanish-speaking Takana people in the Bolivian Amazon. Using a triangulation of ethnographic methods for investigating both the ecological underpinnings and cultural significance of landscape categories, our work complements existing research on landscape classifications of Amazonian indigenous peoples (Gilmore, Ríos Ochoa, & Ríos Flores, 2010; Mihas, 2015; Riu-Bosoms et al., 2014), and thus contributes to exploring the relationship between people and their environment in a region considered a global biodiversity hot spot. Furthermore, we compared ethnoecological vegetation units with a scientific botanical classification, highlighting convergence and divergence between the two systems. In the discussion, we underscore the practical relevance of our findings for representing and managing landscapes.

Takana people, landscape and language

The study area is located along the Beni River (Figure 1) in the Bolivian lowland, where altitudes range between 200 and 600 m above sea level and the climate is tropical. The region is characterised by a high diversity of flora and fauna (Parker & Bailey, 1991), which became protected through the Madidi

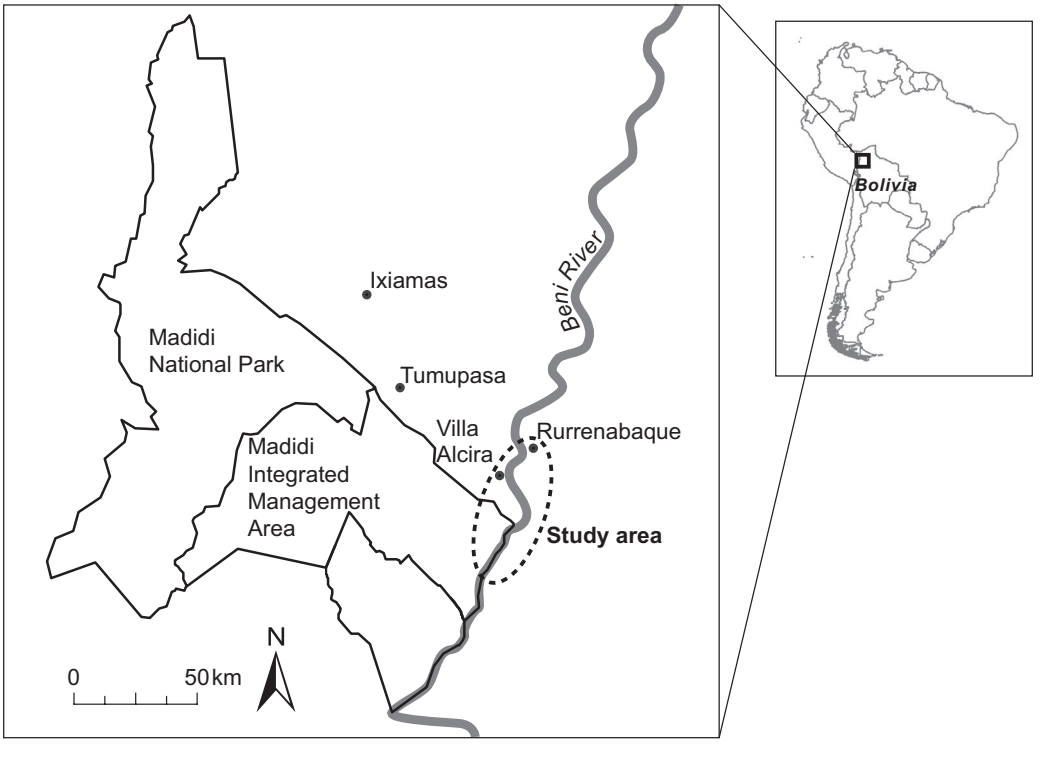

Figure 1. Map of the study area in the Bolivian Amazon along the Beni River (Source: Authors, Data: SERNAP, Bolivia).

National Park and Integrated Management Area in 1995, covering an area of 18 957 km^2, which is almost the size of Wales. Of the indigenous groups living within and around the protected area, we focus on the Takana, who inhabit the area along the Beni River from Rurrenabaque to Ixiamas (Hissink, 1989; Lehm, 2012). Contemporary Takanan lifestyles are based on a mixture of small-scale agriculture, hunting, fishing and wage labour. Despite pronounced acculturation processes, Takana people maintain an extensive knowledge about their environment, for example, about local plants (Bourdy et al., 2000). Of the currently 5000 people self-identifying as Takana, most are monolingual speakers of the Spanish dialect locally known as *Beniano,* a variant of the *Camba* dialect spoken in the Bolivian lowland (Pinto Mosqueira, 2011). For our study, we concentrated on the area along the Beni River where the Madidi protected area partially overlaps with the Takana indigenous territory created in 2003. In this institutionally pluralistic setting, conflicts between park management staff and indigenous people arose about access to resources (Wartmann, Haller, & Backhaus, 2016). The study area is thus an ideal setting to explore landscape categorisations, and for linking this research back to practical and societally relevant management questions.

Methodology

We adopted methods informed by social anthropology and linguistics to elicit ethnoecological landscape categories in the Spanish *Beniano* dialect, including participatory observation (Jorgensen, 2015), *in situ* elicitation on field walks (Burenhult, 2008) and semi-structured interviews on landscape photographs in combination with sorting exercises (Mark & Turk, 2003). Data were collected during eight months of field work (July 2012–September 2012, January 2013, June–August 2013, August 2015). In a first exploratory phase, participatory observation during over 250 observation hours provided insights into people's activities in the landscape, such as hunting, agricultural tasks, and medicinal plant collection. In a second phase, one woman and three men were selected as knowledgeable Takana guides for field walks, which lasted between half a day to five days in case of journeys to more remote locations. We conducted field walks until new field walks did not result in the elicitation of new categories. Consultants structured the field walks as a learning experience about their knowledge on landscape, indicating terms and their underlying referents, which we photographically documented. The third phase consisted of a research protocol based on interviews with printed landscape photographs taken on field walks (10 × 15 cm). Consultants were shown these photographs and asked *¿Cómo llamaría a un lugar así?*', which approximately translates in English as '*how would you call a place like this?*'. We also asked consultants to provide information about the uses of identified landscape units and their cultural significance. Using this protocol, we conducted 14 interviews (with 10 men and 4 women) and one group discussion (5 women). We determined our sample size based on theoretical saturation, when consecutive interviews with new consultants did not result in new categories. To determine the Takana hierarchical organisation of categories, nine consultants from interviews also completed a sorting exercise, where they freely arranged landscape photographs, named the resulting groups and explained the arrangement.

As agreed with the Takana council, we did not collect herbarium plant samples, and determined scientific plant names for indicator species by comparing local names with existing literature (Bourdy et al., 2000; Fuentes, 2005). To compare the ethnoecological landscape categorisation with a botanical classification, Alfredo Fuentes Claros of the National Herbarium at the Universidad Mayor de San Andrés in La Paz, Bolivia, categorised our set of landscape photographs according to his published classification (Fuentes, 2005).

Results

Ethnoecological landscape categories

Using a combination of participatory observation, field walks and interviews with landscape photographs, we elicited 156 ethnoecological landscape categories. The largest variety of categories

relates to landscape features characterised by vegetation (60 categories), often named after indicator plants with specific uses in local culture. Indicator plants belong to 27 taxonomic families, with more than 10 indicator species from the palm family *(Arecaceae)*.

Linguistically, we observed that in the *Beniano* dialect, as in Standard Spanish, landscape terms consist of nouns that end with the Spanish suffix *-al* (plural *-ales*), meaning an area where the referent of the root of the word is found in abundance (DRAE, 2014). For example, the term *maizal* (maize field) is derived from *maíz* (maize). This strategy is used with Standard Spanish roots to coin landscape terms in the *Beniano* dialect not found in dictionaries of Standard Spanish (DRAE, 2014), such as the term *piedral* (area of stones), derived from *piedra* (stone). Furthermore, this strategy is also productively applied to loanwords. For instance, the Takana term *atarisi* (a type of fern) is the root for the landscape term *atarisal* (area with an abundance of *atarisi* ferns). Other roots were loanwords of Chané origin (*curichi*, *cosorió*), Guaraní (*marayaú, tacuara*), Chiquitano (*bibosi, paraba*) (etymology from Pinto Mosqueira, 2011) and Portuguese (e.g. *ambaibo*).

In the sorting exercise, consultants used few hierarchy levels to group landscape photographs: most consultants used two levels, labelling a group of pictures as a higher level category containing lower level category members. Out of nine consultants, eight formed a group named *monte alto* (rainforest), seven formed a group named *orilla* (riverbank) and six consultants used groups of *chaco* (agricultural area), *barbecho* (fallow plot) and *río* (river). Between one and four consultants made 12 additional groups not reported in detail here, which included distinctions between highland/lowland and substrates (sand, rocks).

In the following, we present ethnoecological landscape categories in more detail, according to the groups that a majority of consultants used in the sorting exercise. Importantly, these groups reflect a Takana conceptualisation of landscape parcelled up into regions containing different landscape elements, and does not mirror more Westernised or scientific notions of landscape divided using categories such as vegetation, soils or hydrographic features.

Ethnoecological landscape categories of monte alto (rainforest)

The category *monte alto* (rainforest, Figure 2) which eight out of nine consultants formed in the sorting exercise encompasses a large variety of ethnoecological landscape categories (Table 1) that range from different vegetation features recognised by indicator species (e.g. *marfilsal* as a stand of *Pytelephas macrocarpa*), to oxbow lakes (*curichis*), topographic features such as ridge (*cuchilla*) and areas with specific substrates inside the forest, such as *barrero* (area of muddy ground). *Monte alto* is important in Takana landscape ethnoecology for two major reasons. Firstly, it is central to Takana livelihoods, as a hunting ground for a variety of animal species, for the collection of medicinal plants, firewood and construction material. For instance, a *jatatal* (place with stands of *jatata* palms, *Geonoma deversa*) is used to collect the *jatata* palm for constructing roof thatching (Figure 3). These thatched roofs for traditional Takana homes are not only produced for personal use, but also sold on local markets, making *jatata* an economically important plant. Although the *jatata* palm grows at low densities throughout the rainforest, Takana people deem it unfeasible to collect plants outside important harvesting sites of the *jatatales*.

Secondly, the *monte alto* is of high spiritual significance, as Takana people believe that spirits, which need to be treated respectfully, dwell in the forest. When entering the *monte alto*, hunters chew coca leaves and smoke tobacco as a form of protection against spirits such as the *dueño del monte* (Master of the Forest). Small children and babies are usually not taken to the *monte alto*, as malevolent spirits are believed to cause *malviento* (lit. 'bad wind'), a sickness characterised by fever, vomiting and diarrhoea, which Takana believe can only be treated by an experienced *curandero* (medicine man). An area of particular importance inside the forest is a *salitral* (salt lick, mineral lick), where different animal species come to nibble at the substrate. *Salitrales* are culturally significant for hunters and are believed to be inhabited by spirits. Consequentially, certain behavioural rules have to be followed, including

Figure 2. Typical example of the *monte alto* ethnoecological landscape category.

avoiding killing and skinning animals there. Oxbow lakes (*curichis*) are believed to be a dwelling place for malevolent spirits, and Takana often avoid them when traversing the forest.

Several consultants also mentioned that the *monte alto* was important for their (mental) well-being, as Joaquín stated: 'If I don't go to the forest for more than a week I get a headache, I need to be in the *monte alto*, there I am at peace, there I feel well'. Other consultants mentioned aspects such as the beauty of the *monte alto*. These statements speak to the importance of aspects of the landscape linked to well-being and aesthetic beauty, which go beyond the immediate use of certain landscape units.

Ethnoecological landscape categories of chacos (agricultural areas)

Thirty ethnoecological categories refer to agricultural areas and orchards (Table 2). The types of *chacos* (agricultural plots) are named according to the planted crop. For instance, the term *arrozal* (rice plot) is derived from the Spanish *arroz* (rice). In their *chacos,* Takana people may plant rice in the first growing season and later maize, yucca, beans or pineapple, which produce good yields for around four years.

Ethnoecological landscape categories of barbechos (fallow plots)

After cultivation, agricultural plots are left fallow for years or even decades, depending on the needs of the family cultivating the plot. Fallow plots are called *barbechos* and are areas at the intersection between agriculture and rainforest set aside for potential future use that are associated with traditional land rights. The descendants of the person who first cleared the plot derive use rights from the labour invested in clearing the forest, even if the plot has been left fallow for decades. Miguel, a Takana consultant, stated that:

> All that I have done, you can see well that I have worked here. It's the plants that testify how long we have lived here. Show me your *barbecho* […] and I will believe you that you have lived here.

The Takana distinguish *barbechos* from the old-growth forests of *monte alto* by their species composition (*Cecropia* spp., *Ochroma pyramidale*), relative species abundance, growth form of certain

Table 1. Categories for *monte alto* (rainforest).

Local Spanish term	Approximate English equivalent	Plant family (for categories named after indicator plants)
achachairusal	Stand of *Garcinia guacopary* (S. Moore) M. Nee	*Clusiaceae*
altura	Highland, areas of higher elevation	
arroyo	Small stream	
asaisal	Stand of *Euterpe precatoria* C. Martius	*Arecaceae*
atarisal	Stand of ferns of the *Polypodiaceae* family and ferns in general, usually dense stands of *Gleicheniaceae* or *Pteridium arachnoideum* (Kaulf.) Maxon, *Cyclopeltis semicordata* (Sw.) J. Sm.	*Polypodiaceae* *Gleicheniaceae* *Dennstaedtiaceae* *Tectariaceae*
bajada	Descent, slope	
bañero de chanchos	Lit. pig's pool (small body of standing water inside the forest where peccaries and other animals take a mudbath)	
barreal	Area where there are many *barreros*	
barrero	Area of mud, muddy ground (inside the forest and along rivers)	
bejucal	Area of lianas	*Bigoniaceae* and others
bibosisal	Stand of *Ficus* sp., e.g. *Ficus maxima* Miller, *F. pertusa* L.f.)	*Moraceae*
bisal	Stand of *Genipa americana* L., also called *manzana del monte*	*Rubiaceae*
cachichiral	Stand of *Sloanea obtusifolia* (Moric.) K. Schum	*Elaeocarpaceae*
camururusal	Stand of *Garcinia madruno* (Kunth) Hammel	*Clusiaceae*
cañada	Ravine, gully	
catarata	Waterfall	
cedral	Stand of *Cedrela odorata* L.	*Meliaceae*
cerro	Mountain, hill	
chaparral	Type of wet forest	
chaquillal	Stand of *Physocalymma scaberrimum* (Pohl)	*Lythraceae*
chimal	Stand of *Bactris gasipaes* Kunth	*Arecaceae*
chontal	Stand of *Astrocaryum murumuru* Mart. Or *A. ulei* Burret	*Arecaceae*
chumirisal	Stand of *Trema integerrima* (Beurl.) Standl.	*Ulmaceae*
comedero	Feeding place for animals below fruit trees	
copal	Stand of *Iriartea deltoidea* Ruiz & Pav. (also called *pachiuba*)	*Arecaceae*
cortaderal	Stand of *Cyperaceae* spp.	*Cyperaceae*
cuchilla	Ridge	
cueva	Cave	
cumbre	Mountain top	
curichal	Area of oxbow lakes	
curichi	Oxbow lake	
derrumbe	Land slide	
desbarrancada	Area of land slides	
enredaderal	Area with a lot of lianas	
espinal	Area of spiny or thorny plants (various species, frequently *Fabaceae-Mimosoideae* such as *Senegalia* spp.)	*Fabaceae*
evantal	Stand of *Angostura longiflora* (K. Krause) Kallunki	*Rutaceae*
gabetillal	Stand of *Aspidosperma excelsum* Benth., *A. rigidum* Rusby	*Apocynaceae*
huellero	Area with animal tracks	
jatatal	Stand of *Geonoma deversa* (Poit.) Kunth, *G. interrupta* (Ruiz & Pav.) Mart.	*Arecaceae*
ladera	Slope, hillside	
llanura	Plain	
loma	Hill	
majal	Stand of *Oenocarpus bataua* Mart.	*Arecaceae*
manantial	Well, spring	
maral	Stand of *Swietenia macrophylla* King	*Meliaceae*
marayausal	Stand of *Bactris major* Jacq., *B. concinna* Mart., also *marayabú*	*Arecaceae*
marfilsal	Stand of *Pytelephas macrocarpa* Ruiz & Pav.	*Arecaceae*
matorral	Scrubland, shrubland	
momoquisal	Stand of *Caesalpina pluviosa* DC.	*Fabaceae*
montaña	Mountain	
monte alto	Forest	
monte alto raso	Forest with clear understory	
monte alto tupido	Forest with dense understory	
monte espeso	Forest with dense understory	
pacaysal	Stand of *Inga spp.* Such as *Inga nobilis* Willd.	*Fabaceae*
pajonal	Scrubland	
palmar	Stand of palm trees	*Arecaceae*

(*Continued*)

Table 1. (*Continued*).

Local Spanish term	Approximate English equivalent	Plant family (for categories named after indicator plants)
palmareal	Stand of *Mauritia flexuosa*	*Arecaceae*
pampa	Flat area inside the forest (also used for large grasslands outside study area)	
pantano	Swamp, wetland	
parabal	Cliff where red-and-green macaws (*Ara chloropterus*) nest	
picapical	Stand of *Urera baccifera* (L.) Gaudich. Ex Wedd.	*Urticaceae*
planicie	Flat land, plane (typically of large extent)	
quebrada	Mountain ridge	
salitral	Mineral salt lick	
sanjón	Gully, ravine inside the forest	
secarrón	Dry area	
selva	Primary rainforest / jungle	
serranía	Mountain range	
sertenejal	Undulating terrain	
tupisión	Dense vegetated area	
uñagatal	Stand of *Uncaria guianensis* (Aubl.) J.F.Gmel, *U. tomentosa*	*Rubiaceae*
vainillal	Area of vanilla (*Vanilla planifolia* Jacks. Ex Andrews)	*Orchidaceae*

Figure 3. A *jatatal* is an important harvesting site for *jatata* (*Geonoma deversa*).

plants (e.g. *Attalea phalerata*) and colour of the vegetation resulting from previous agricultural use. Furthermore, types of *barbechos* are distinguished according to the height of vegetation (Table 3).

Ethnoecological landscape categories of orillas (riverbanks)

Takana consultants grouped pictures of riverbanks and areas along rivers together (Table 4), including areas characterised by specific substrates, such as *arenal* (area of sand), derived from the term *arena* (sand) and *pedregal* or *piedral* (stony riverbank), as well as areas characterised by riverine vegetation, such as *ambaibal* (area of *Cecropia* plants) and *charral* (area of *Gynerium sagittatum*). Hunters consider *charrales* good areas for spotting tapirs resting during the day, but such areas are otherwise avoided because of the difficulty of traversing them without established trails.

Table 2. Categories for *chacos* (agricultural areas).

Local Spanish term	Approximate English equivalent
arrozal	Rice field
breva	Plot with first growth plantain
chaco	Agricultural plot, field
chaco quemado	Burnt plot
chaco remontado	Overgrown plot
chaco rozado	Cleared plot
chaco tumbado	Logged plot
cañaveral	Sugarcane plantation
chaqueado	Agricultural plot, field
chocolatal	Cacao plantation
frijolsal	Bean field
frutal	Fruit orchard
limpio	Area cleared of vegetation, *limpio* (adj., clean) is used also as a noun in *Beniano*
maizal	Maize field
mangal	Mango orchard
motacúsal	Stand of *motacú* trees
naranjal	Orange orchard
papaysal	Papaya plantation
pastizal	Grazing area
piñal	Pineapple plantation
platanal	Plantain plantation
potrero	Grazing area
rastrojo	Stover
rozado	Cleared plot (synonymous to *chaco rozado*)
toronjal	*Toronja* (variant of grapefruit or *pomelo*) orchard
yucal	Yuca (*Manihot esculenta*) field

Table 3. Categories for *barbechos* (fallow plots).

Local Spanish term	Approximate English equivalent
barbechal	Area of fallow plots
barbecho	Fallow ground, fallow plot
barbecho alto	Old (lit. high) fallow plot
barbecho medio	Intermediate fallow plot
barbecho nuevo	New fallow plot
barbecho viejo	Old fallow plot

Ethnoecological landscape categories of ríos (rivers)

Major navigable rivers (*ríos*) have served as important transportation routes for Takana in the past, when many Takana men were working as *balseros* (boatmen) transporting goods on the Beni River. Rivers are also preferred fishing spots for larger fish species, including the favoured species locally known as *pacú* and *surubí*. Smaller streams in the forest (*arroyos*) provide drinking water and are a source of smaller fish that are often used as bait for larger river fish. Small streams also serve for orientation in the forest and are preferred as efficient travel routes when the riverbed is dry or the water level low. Consultants distinguish different categories for water bodies, and areas with specific flow patterns (Table 5), such as a *rebullo* (area of upwelling water) or remanso (*eddy*).

Comparison of ethnoecological categories with a scientific botanical classification

Comparing the ethnoecological categorisation of vegetation with a scientific botanical classification by Fuentes (2005), a commonality is the use of indicator plants for identifying vegetation units (Table 6), which are often visually salient and easily recognisable plants. For instance, the ethnoecological landscape category *charral* is identified by the *charo* plant (*Gynerium sagitattum*), which is also an indicator species for the botanical classification as 'Pioneer riverine reed area of *Gynerium sagittatum*

Table 4. Categories for *orillas* (riverbanks).

Local Spanish term	Approximate English equivalent	Plant family*
ambaibal	Stand of *Cecropia concolor* Willd., *C. membranaceae* Trécul	*Urticaceae*
arenal	Beach, sandy area	
bajío	Lowland, areas of lower elevation that are often seasonally flooded	
barranco	Steep river embankment	
balsal	Area of Ochroma pyramidale (Cav. Ex Lam) Urb.	*Malvaceae*
cahuaral	Stand of *Tessaria integrifolia* Ruiz & Pavon	*Asteraceae*
cañuelal	Area of grass, various species such as *Hymenachne amplexicaulis H. donaciifolia, Polygonum* spp.	*Poaceae Polygonacae*
chaquillal	Stand of *Physocalymma scaberrimum* (Pohl)	*Lythraceae*
charillal	Stand of depauperated *Gynerium sagitattum* growing on dry and poor soils	*Poaceae*
charral	Stand of *Gynerium sagittatum* (Aubl.) P. Beauv. (synonymous for *chuchial*)	*Poaceae*
chuchial	Stand of *Gynerium sagittatum* (Aubl.) P. Beauv. (synonymous for *charral*)	*Poaceae*
cosorial	Stand of *Erythrina fusca* Lour., *E. dominguezii* Hassl., *E. peoppigiana* (Walp) O.F. Cook	*Fabaceae*
fangal	Area of slurry (typically occurring along flowing water bodies)	
gredal	Area of clay	
japainal	Stand of *Heliconia episcopalis* Vell.	*Heliconiaceae*
ladera del río	Riverside, riverbank	
lodal	Area of mud	
orilla del río	Riverbank	
orillera	Riverbank	
patujusal	Stand of *Heliconia rostrat*a Ruiz & Pavon	*Heliconiaceae*
pedregal	Area of stones	*Asteraceae*
peña	Cliff, rock (typically along rivers and streams)	
peña colorada	Coloured rock, cliff (typically along rivers and streams)	
peña pelada	Bare cliff, bare rock (typically along rivers and streams)	
penenal	Stand of *Guadua* sp. Kunth	*Poaceae*
piedral	Area of stones, rocks	
planura	Flat land, plane (typically between the river and higher elevations)	
playa	Beach	
playón	Large beach	
puerto	Landing site for tying boats	
ribera	Riverbank	
saucesal	Stand of *Salix humboldtiana* Willd.	*Salicaceae*
tacuaral	Stand of *Guadua weberbaueri* Pilg.	*Poaceae*
yomomal	Stand of *yomomo* plants	*Pontederiaceae, Poaceae*
yupural	Stand of *Calliandra angustifolia* Spruce ex Benth.	*Fabaceae*

*For categories named after indicator plants.

Table 5. Categories for *ríos* (rivers).

Local Spanish term	Approximate English equivalent
arroyito	Small stream
arroyo	Stream, creek
boca del río	River mouth
brazo del río	River arm
cañada	Streambed
embocada	River mouth
huarasta	Rapids
isla	Island
lago	Lake
palizada	Pile of driftwood
pozo	Pool
rebullo	Area of upwelling water
remanso	Eddy
remolino	Whirlpool
riachuelo	Stream
río	River

Table 6. Examples of ethnoecological vegetation categories (this study) and scientific botanical classification of vegetation units based on Fuentes (2005).

Ethnoecological vegetation categories	Scientific botanical classification of vegetation units
ambaibal	Riverine pioneer forest dominated by *Cecropia* spp.
atarisal	Reasonably well-drained herbaceous Amazonian forest understory with *Cyclopeltis semicordata*
barbecho	Secondary Amazonian forest usually on flat areas with humid soils
cahuaral	Pioneer riverine vegetation with *Tessaria integrifolia*
charral	Pioneer riverine reed area of *Gynerium sagittatum* on sandy soils
evantal	Somewhat poorly drained Amazonian forest
japainal	Herbaceous understory of seasonally flooded Amazonian forest (varzea) with *Heliconia episcopalis*
jatatal	Well-drained Amazonian forest with *Geonoma deversa*
marayausal	Poorly drained to seasonally flooded Amazonian forest with *Bactris concinna*
marfilsal	Palm forest with *Phytelephas macrocarpa*
motacúsal	Poorly drained Amazonian forest with *Attalea phalerata*
tacuaral	Bamboo shrubbery with *Guadua weberbaueri*
vizal	Palm forest in marsh area with *Mauritia flexuosa*
yupural	Pioneer riverine shrubbery on pebble beach with *Calliandra angustifolia*

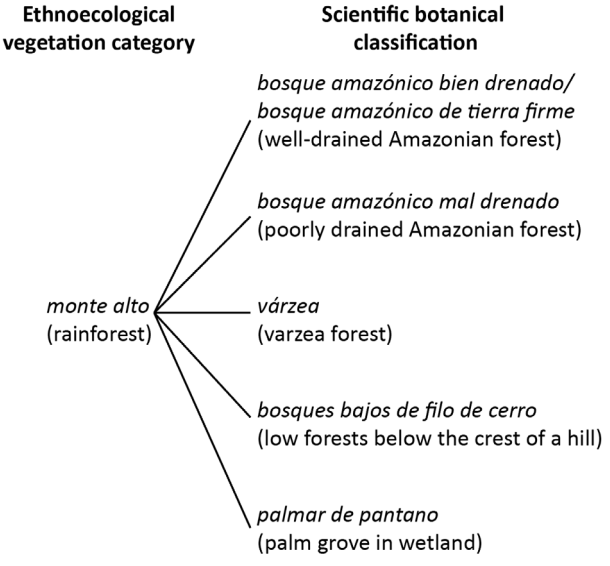

Figure 4. Different scientific botanical categories by Fuentes (2005) all referred to as *monte alto* in the ethnoecological landscape categorisation.

on sandy soils'. The ethnoecological categorisation system almost always relies on indicator plants for identification. The scientific system uses phrases, consisting of a general classification of the vegetation type (e.g. pioneer riverine vegetation), the edaphic regime (e.g. sandy soils) and sometimes an indicator species. The degree of differentiation varies between the two systems, but not consistently. For instance, the scientific classification differentiates between distinct broad types of old growth forest all referred to as *monte alto* in the ethnoecological categorisation (Figure 4).

Several ethnoecological categories refer to specific areas of typically small spatial extent within the *monte alto*, which are not recognised in the scientific botanical classification (Figure 5). For instance, the ethnoecological category *evantal* (stand of *Angostura longiflora*) is classified as 'Amazonian forest' in the botanical classification. Other examples where the ethnoecological categorisation is more

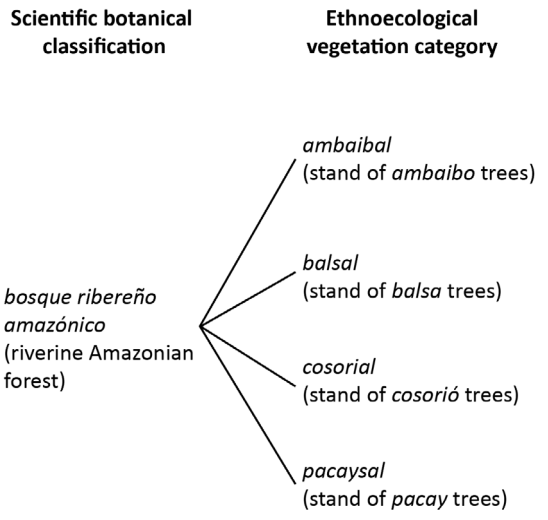

Figure 5. Different ethnoecological categories all referred to as *riverine Amazonian forest* in the scientific botanical categorisation by Fuentes (2005).

Figure 6. Landscape unit identified as a *barbecho* (fallow field) in the ethnoecological landscape categorisation.

differentiated include ethnoecological categories such as *ambaibal*, *balsal* and *cosorial* all referred to as 'riverine Amazonian forests' in the botanical classification.

We also observed differences that have practical implications for how these areas are being managed. We illustrate this with an example of a field walk with Aurelio, one of our Takana consultants. Aurelio lives in an area where the indigenous territory and the Madidi protected area overlap. He is upset about the fact that scientists often do not seem to recognise fallow plots (*barbechos*), but instead classify them as 'primary rainforest' in rapid botanical assessments. Consequentially, protected area staff assigned these areas a high conservation priority in the GIS used for decision-making and prohibited local use,

including the clearing of fallow plots. Thus, when Aurelio wanted to clear a plot his grandfather had once cultivated which had since been left fallow, protected area staff informed him that this area consisted of primary rainforest and he was not allowed to clear the forest. Aurelio pointed to a patch of forest (Figure 6) and said: 'They think it is jungle and they want to protect it. But this is not the jungle, this is my *barbecho*!' This example is illustrative of the divergence in the semantics of ethnoecological landscape categories as culturally important areas that are all categorised as primary rainforest by park management staff, which is a category associated with conservation. Thus, differences between categorisations are not merely interesting curiosities, but have important consequences for how areas are classified and how they are managed.

Discussion

Using a triangulation of participatory observation, field walks and interviews on landscape photographs, we elicited 156 ethnoecological landscape categories of Spanish-speaking Takana people. It is important to note that this paper does not report a static, or complete compilation of landscape categories for this speech-community. It is in the nature of landscape vocabularies that they are constantly changing, with new words being added and others forgotten (Macfarlane, 2015), for example, through acculturation processes resulting in inter-generational differences in ethnoecological knowledge (Wellen & Sieber, 2013).

A potential limitation of our study is the use of photographs for category elicitation in interviews. We reduced this bias by combining interviews on photographs with field walks. Moreover, consultants were highly familiar with the landscape and the photographs triggered memories related to the landscape, resulting in the listing of categories not shown in photographs, which has also been reported for video elicitation of landscape categories (Williams et al., 2012).

Most elicited ethnoecological landscape categories were linguistically transparent and monolexemic, especially those for vegetation and agricultural areas, suggesting they are good candidates for basic-level categories, postulated to be the most fundamental and informative level of categorisation (Tversky & Hemenway, 1983). However, this finding contrasts with Berlin's work on ethnobiological classification and other ethnoecological research (Abraão, Shepard, Nelson, Baniwa, & Andello, 2010; Berlin, 1992), which postulates that for coining basic vegetation terms, predominantly the plant genus (e.g. birch), rather than the species (e.g. silver birch) is used. Thus, what is considered 'basic' may differ between different groups of people (Tanaka & Taylor, 1991), and should be determined using specific experimental elicitation methods (Rosch, 1978).

The sorting exercises produced five groups of ethnoecological landscape categories recognised by a majority of consultants. Such a flat hierarchy is similar to previous work in ethnobotany and ethnozoology (Furbee, 1989; López, Atran, Coley, Medin, & Smith, 1997; Medin et al., 2006) demonstrating how folk biological hierarchies are often flatter than expected by theory (Berlin, 1992). However, Duvall's study (2008) on physical geographic features documented several hierarchical levels, some of which were not labelled, and therefore covert categories. In this study, there was no indication of covert categories, because consultants labelled all groups of photographs, although not as consistently as individual photographs. While other Amazonian groups were reported to consistently lexicalise category organisation through the use of classifiers, for instance, using a suffix for 'running water feature' (Mihas, 2015) the Takana did not lexicalise their higher level landscape categorisation. Moreover, vegetation or water was not an organisation principle, but geographical regions, which has been reported as an organisational principle before (Jungerius, 1998). Compared with previous research on hierarchies of folk categories that relied on labelled cards, which may lead to consultants sorting categories based on lexical similarity (López et al., 1997), we used photographs of underlying referents. Despite the apparent advantages of using photographs for sorting exercises, there are also possible disadvantages, such as the potential interpretation as specific places or instances, rather than categories. However, this did not seem to be the case in this study, as consultants were presented photographs of mostly unknown locations.

Table 7. Number of identified landscape units based on vegetation of different groups in the Amazon.

Group	Identified landscape vegetation units	Reference
Baniwa	90 'vegetation types'	Abraão et al. (2010)
Kayapó	26 'folk ecozones'	Posey (1985)
Lokono	9 'folk ecotopes'	Rybka (2016)
Matsés	47 'rainforest habitats' (of total 178)	Fleck and Harder (2000)
Matsigenka	69 'habitats' (of total 115)	Shepard et al. (2001)
Mosetén	56 (of 189 'ethnoecological landscape categories')	Wartmann (2016)
Spanish-speaking Takana	60 (of 156 'ethnoecological landscape categories')	Wartmann (2016; this study)
Takana	66 (of 181 'ethnoecological landscape categories')	Wartmann (2016)
Tsimane'	88 'ecotopic patches'	Riu-Bosoms et al. (2014)

Comparing our findings with previous studies, different Amazonian groups have exhibited similar levels of differentiation, at least for the categorisations of vegetation units (Table 7). However, comparing the absolute number of terms across studies is difficult, because the methodologies between these studies differ considerably. Qualitatively, vegetation categorisations of different Amazonian groups exhibit some similarities. For example, palm species (*Arecaceae* ssp.) seem to be especially important as indicator species and for local use (Fleck & Harder, 2000; Shepard, Yu, Lizarralde, & Italiano, 2001). Furthermore, fallow fields are important features of the landscape for many Amazonian groups, who distinguish different stages of fallow fields and other patches with gradations of human influence (Posey, 1985), which we showed the Takana associated with important informal land rights. Focusing on a variant of Spanish spoken by indigenous Takana people and relying on extensive fieldwork to arrive at a bottom-up categorisation of landscape without imposing Westernised concepts of landscape organisation, our study thus complements previous ethnoecological work in the Bolivian Amazon (e.g. Mihas, 2015; Riu-Bosoms et al., 2014).

Some ethnoecological landscape categories used by the Takana referred to subject matters saturated with meanings, such as the *monte alto* (rainforest) as the dwelling place of mythological beings, in line with previous empirical evidence of other Amazonian groups (Descola, 1996; Gilmore et al., 2010; Mihas, 2015; Riu-Bosoms et al., 2014). Our results suggest landscape provides far more than straightforward ecological affordances (Gibson, 1977), such as shelter, or food, but that Takana culture and identity are deeply entrenched in the landscape. While the importance of specific, named places for the formation of identity and sense of place has been documented, for instance, in Keith Basso's work with Apache people in the United States (Basso, 1996), our work contributes to the documentation and analysis of the importance of certain landscape types in the landscape ethnoecology of local groups (Johnson & Hunn, 2010).

We approached the speech community in the study area as being homogenous, because we found the level of consensus to be high in describing landscape photographs. However, even for different villages within a geographically limited area, there may be considerable differences in ethnoecological knowledge (Reyes-García et al., 2005). Future research should also consider differences in categorisation between villages and speakers in the same village, such as gender, age groups and occupation. Focusing on a local dialect of a majority language such as Spanish extends existing work in ethnophysiography (Mark & Turk, 2003) and landscape ethnoecology (Johnson, 2000, 2011; Johnson & Hunn, 2010), which has focused on indigenous and often endangered languages, with only few studies exploring ethnoecological knowledge in standard languages and their variants, such as English, French or Spanish (e.g. Meilleur, 2010 on French).

The question remains as to how the interplay of language, livelihoods and the specific physical environment shape the diversification of local landscape categories (Burenhult & Levinson, 2008; Johnson, 2011). We suggest that for comparative reasons, a follow-up study could be conducted in a landscape with distinct biophysical properties in the language area of the Spanish *Beniano* dialect. For instance, around the settlement of Santa Ana de Yucuma in the Bolivian lowland, the landscape

consists of riverine habitats and open grasslands, which may provide insights into the influence of the biophysical landscape and cultural preoccupations on ethnoecological landscape categorisations.

Comparison of local and scientific categories: implications for management

Both the ethnoecological and the scientific botanical categorisation (by Fuentes, 2005) relied on visually salient plants as indicator species. In general, ethnoecological vegetation categories were more diversified, and may thus provide valuable information for developing more detailed formal botanical classification systems (Shepard , Yu, & Nelson, 2004). Apart from differences in degrees of differentiation, we also observed important conceptual and semantic divergences between the two categorisation systems that have implications for landscape management. For instance, although *monte alto* can be translated as *primary rainforest* in English, the semantics of the two categories differ. *Monte alto* essentially refers to a cultural landscape which provides sustenance and well-being when interacted with in a culturally accepted manner, which includes respecting spiritually sanctioned taboos and following certain rituals. These meanings differ considerably from the category of 'primary rainforest', based around an ecological categorisation of the natural environment and associated with biodiversity in need of protection from human disturbance. Moreover, we showed how the classification of underlying referents may differ, with Takana recognising different stages of fallow plots (*barbechos)* associated with traditional use rights, which are all categorised as primary rainforest by park management staff, resulting in Takana people being prohibited from using such areas for agriculture.

Landscape categories are thus more than 'just categories', but crucial ways of structuring knowledge underpinning spatial representations on maps and in GIS. As local perceptions and uses are not represented on maps and in GIS, they are often overlooked in decision-making processes, with serious consequences for people living in these areas (Hoeschele, 2000; Robbins, 2001). Scholars have therefore argued that categories on maps and in GIS should as far as possible be locally grounded (e.g. Wellen & Sieber, 2013). Ethnoecological landscape categories should form the basis for developing potentially more culturally appropriate GIS that may be used as important tools for landscape and natural resource management.

Conclusions

Ethnoecological landscape categories elicited with Spanish-speaking Takana people in the Bolivian Amazon are imbued with meaning and linked to specific locally embedded management approaches. This knowledge about local uses and meanings associated with certain landscape types is shared among Takana people, but may not be apparent to other groups, including park staff, who then enforce strict protection of such areas, resulting in the exclusion of local inhabitants from formerly used and culturally important areas. By bringing to the fore such links between different landscape categorisations and management approaches, this study takes a first step on the way towards integrating local categorisations and related uses of landscape into management. However, there is a need to consider how ethnoecological landscape categories can be represented in computational environments such as GIS used for decision-making and management.

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