Interzonal Interaction in Pre-Conquest North Central Nicaragua

Daniel Uosukainen

Cover image: Highland landscape in El Tuma La Dalia, department of Matagalpa, Nicaragua.

Interzonal Interaction in Pre-Conquest North Central Nicaragua:

Using archaeological survey data for recognition of interaction and exchange patterns in a multi-environmental region

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Master thesis, final version

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1.0 Introduction

Most of what is currently Nicaragua has been considered part of the 'Intermediate Area', that is neither part of Mesoamerican nor South American culture areas (Haberland 1957; Hoopes and Fonseca 2003; McCafferty 2011; Rouse 1962; Willey 1971). In Nicaragua, most studies have focused on the Greater Nicoya subarea which spans from modern-day western Nicaragua to north-western Costa Rica. This subarea also coincides with the metropolitan area that has had the most established colonial presence since Spanish Conquest, enjoying superior infrastructure in comparison to the rest of the country. It is not a coincidence that the areas which up till now have been the least studied regions of Nicaragua archaeologically, are also logistically the least accessible.

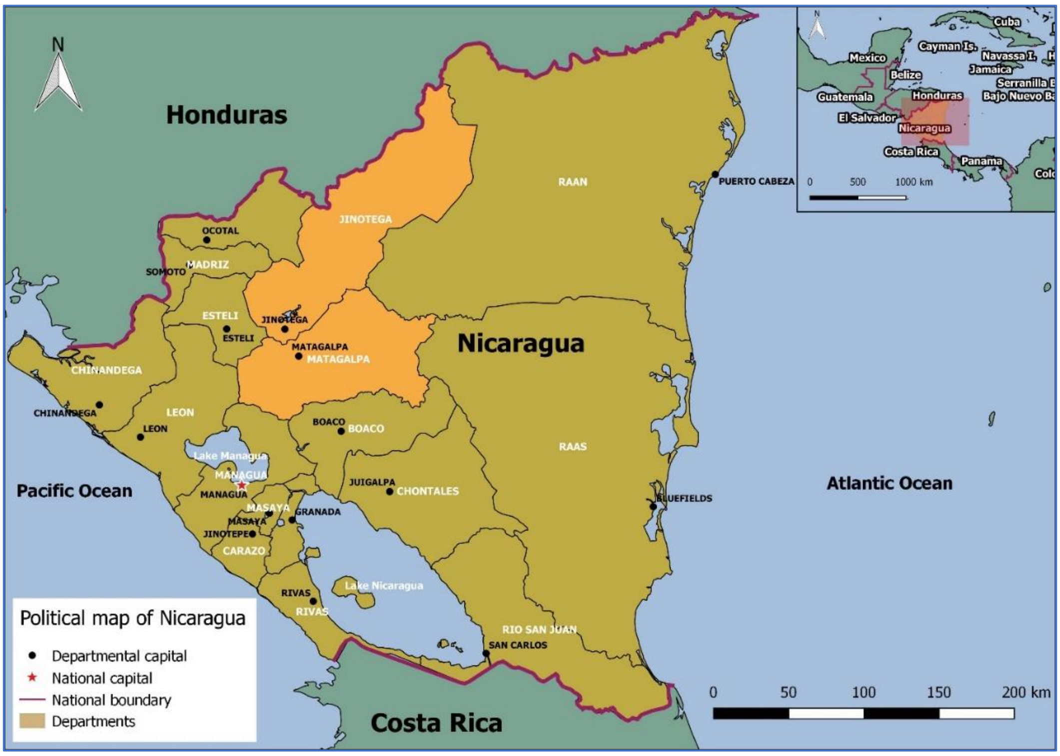


Figure 1: Political map of Nicaragua with the main departments of interest to this thesis highlighted (Natural Earth Data 2015).

The North Central region of Nicaragua includes the smaller departments of Estelí, Madriz and Nueva Segovia, but is mostly contained within the modern departments of Matagalpa and Jinotega (see fig. 1). Relatively little in-depth archaeological research has been conducted in this region, especially in the larger eastern departments of Matagalpa and Jinotega (Fletcher 2010, 516). In these departments, some planned efforts have included limited excavations at mound sites a documentation of a cave site (Baker and Armitage, 2013; Espinoza *et al.* 2014; Koschmeider and Gaméz 2006; Finlayson 1996; Minami *et al.* 2014). The bulk of archaeological research in the region, however, has so far consisted of small-scale surveys documenting surface sites and finds found by locals or by exploring certain proportions of river valleys as well as a rescue excavation with limited sub-surface exploration (Balladares and Lechado 2008; Balladares and Rivera 2011; Espinoza *et al.* 1994; Finlayson 1996; López García 2015; Uosukainen *et al.* 2016).

In recent decades, the archaeological interest for the North Central region has mostly manifested as a local interest including local independent researchers (Kühl 2010, 2012). This interest is also visible amongst the rural population, many members of which have moved into the area in recent decades in search for better soils and watersheds and are curious about the finds dug up in their farmlands. This has motivated some municipal initiatives to explore the local archaeological record (Uosukainen *et al.* 2016). Currently, however, the discourse on the indigenous past of the region is mostly based on linguistic as well as ethnohistorical sources, which are biased in many ways and project a simplistic view of the indigenous societies that inhabited the area in pre-Conquest times (Van Broekhoven 2002). This does not, however, suffice to adequately satisfy the curiosity of those locals interested in the past of the region and indigenous lifeways, nor to explain the archaeological finds and their contexts. Archaeological finds and opinions are currently integrated within a more general historical narrative of the region (Kühl 2010; 2012). Meanwhile, little archaeological literature on the region is available. Therefore, archaeology is largely left without an effective voice in the discourse on the pre-Conquest history of the region, while it could provide an important window into the past to complement and, where necessary, correct this history.

1.1 Interzonal interaction and exchange in a multi-environmental setting

Apart from there being a local appetite for the history of the region, there are also archaeological reasons for why research in North Central Nicaragua is of importance. Until now, the archaeological focus in northern Nicaragua has been culture historic. This focus has sought the territorial boundaries of past ethnic groups described in colonial ethnohistoric sources, or the north-eastern boundaries of the Greater Nicoya subarea (Espinoza *et al.* 1994; Espinoza *et al.* 1996; Fletcher 1993; Kühl 2010; 2012). However, research questions with a specific focus on North Central Nicaragua that go beyond an ethnic focus have so far been overlooked. These include questions considering the environmental and geographic particularities of the region, which lies on the continental and climatic divide, where different tropical climates and ecosystems meet.

Such questions would not only improve the understanding of the pre-Conquest past of North Central Nicaragua but could serve macro-regional discussions as well. An environmental or cultural geographic approach has previously been called for by Lange

(1984, 33) and Geurds and Van Broekhoven (2010, 66) to better understand the development of cultures in the environmentally variable Lower Central American and pan-Caribbean regions. Unfortunately, such an emphasis is still lacking in the vast majority of archaeological studies in these regions. Lange argues that a culture geographical approach is essential to understanding how pre-Conquest cultures inhabiting this region related to this multi-environmental setting and to what extent access to these different zones played a role in exchange practices and "boundary maintenance" between groups (Lange 1984, 33, 59). North Central Nicaragua is particularly well suited for the application of an environmental and culture geographic approach because this region lies on the continental divide and is characterised by the proximity of different ecological zones. Additionally, some of the largest watersheds of Central America are born here, signalling geographical potential for important corridors of mobility and exchange between ecological zones and geographical regions. This also highlights the potential importance of the North Central highland passages and places in terms of centrality within wider networks of exchange. Interregional trade corridors for obsidian, gold, pottery and a number of perishable goods have indeed been suggested for this region by some scholars in the past (Cuddy 2007, 108-109; Incer 1985, 378; Braswell 1997, 27; Kühl 2010, 116-118). However, this has not yet adequately been studied archaeologically. In this sense, a better archaeological understanding of this region could not only provide insights into the lifeways of the cultures living in the North Central region, but also contribute to the interregional understanding of better studied regions both north and south. In this way, comparing the distributions of in the archaeological record and environmental boundaries could even bring spatial clarity to the question of culture areas and subareas which continue to take a dominating role in the archaeological discourse in Nicaragua.

So far, however, the published sources alone on the archaeology of North Central Nicaragua, do not afford many answers. Apart from the few published sources, there is data stored in unpublished reports from some municipalities (see fig. 2) on different types of surface finds and a few sub-surface contexts, to which this thesis will have access (Balladares and Lechado 2008; Balladares and Rivera 2011; López García 2015; Minami *et al.* 2014; Uosukainen *et al.* 2016). The data from these sources does, however, come with limitations. Most of the ceramic materials encountered in these surveys remain unidentified (including stylistically diagnostic ceramic material). The artefacts that have been identified, such as white-slipped polychrome pottery or obsidian flakes, are attributed to better studied outside regions such as the Gran Nicoya subarea to the south or modern-day Honduras to the north. This has led archaeologists to consider the North Central region more in terms of its better studied neighbours to the north and south and less in its own right. In these unpublished reports there has been hardly any further synthesis and interpretation of the data in them. This is partly due its incomplete spatial coverage due to unsystematic and opportunistic nature of data collection strategies and due to strict budgets. Especially the latter has limited systematic collections of materials and the lab work necessary for the study of the remains, allowing to establish a chronology for the region. The lack of new insights has as such discouraged publishing detailed results that could contribute with archaeological insights into the region.

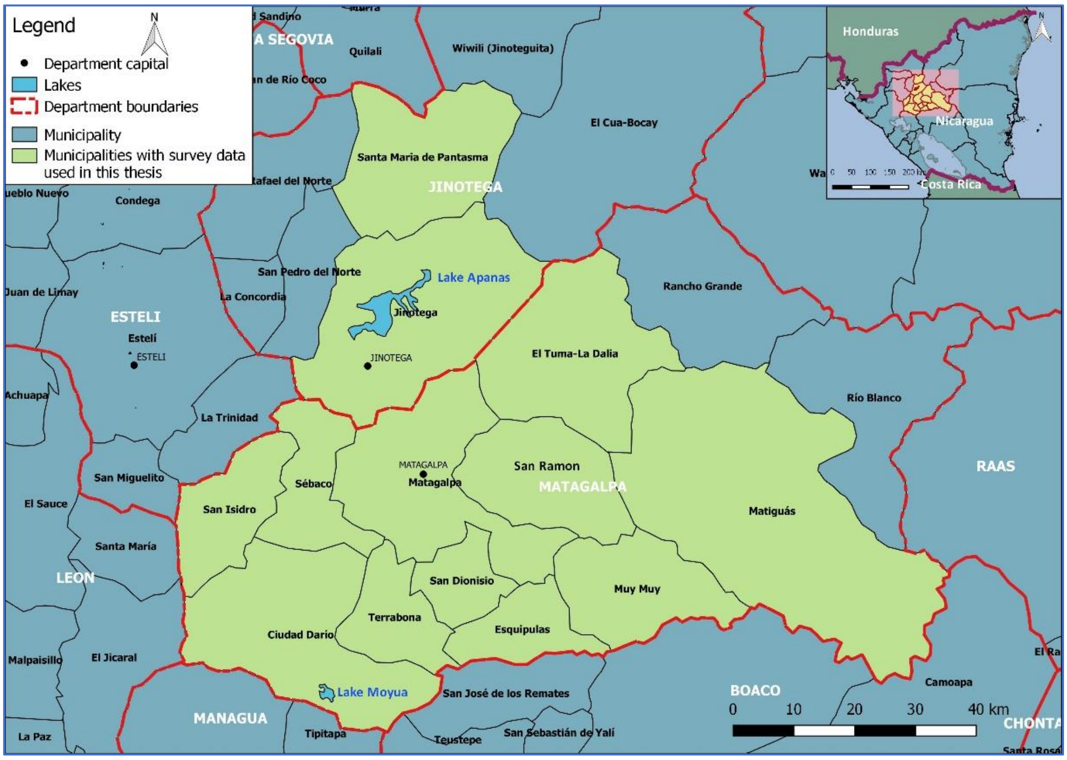


Figure 2: The focus area delimited by the boundaries of municipalities from where survey data is used in this thesis. (Natural Earth Data 2015).

It would be valid to argue that relying on a dataset derived mostly from unpublished sources with serious limitations would invariably lead to unreliable results and interpretations. But although the data recorded in these efforts is limited in many ways, there are important reasons to why this data merits attention and a chance to be analysed and interpreted. Firstly, it is timely to do so because of growing local interest, contrasted by a lack of synthesised and published archaeological information from this region. Secondly, this same lack keeps North Central Nicaraguan archaeology from contributing to meso and macroregional discussions on interzonal interaction and exchange with a much-needed culture geographical and environmental emphasis. Thirdly, the data from the unpublished sources is not useless. Georeferenced find locations already provide an important resource for studying the traces of the past spatially. Geographic Information Systems (GIS) allow us to combine the published and unpublished data and plot it on the same canvas for the first time. While diachronic developments remain restricted in this combining of GIS datasets, the data can at least be viewed in terms of the environmental surroundings of the finds. This will allow us to start considering some of the archaeological questions that are specific to the multi-environmental North Central region, yet macro and meso-regionally relevant. Making use of the unpublished sources would enable archaeology to finally start participating effectively in the discourse of pre-Conquest North Central Nicaragua, which currently dominated by other fields.

1.2 Research aims and exploration of non-systematic survey data

In order to contribute to the discourse of the pre-Conquest past of North Central Nicaragua, this thesis aims to synthesise existing archaeological data from a specific focus area within the North Central region where the largest watersheds of the area meet by combining information from different sources into one dataset. While recognising its limitations, it then adopts a visual exploratory approach to examining the data from North Central Nicaragua with the following research question:

"What can existing survey data reveal about interzonal interaction and exchange in pre-Conquest North Central Nicaragua?"

In order to answer this question, the following sub-questions will be considered:

1. What patterns can be identified from the archaeological record and what is their spatial distribution?
2. How do the archaeological finds and their spatial distributions relate to each other and to the different geographical and environmental settings?

Through answering these questions, this thesis aims to present an overview and preliminary interpretation of the archaeological record in North Central Nicaragua that goes beyond a culture historical approach, includes the variable environment of the area in its analysis and contributes to providing a context for future research in the focus area.

1.3 Contents and sequence

In the following second chapter, the research area will be delimited, and the terrain, ecosystems and climates of North Central Nicaragua will be described using relevant literature. Paleoenvironmental literature will be used to provide an approximation of past climatic and environmental conditions and changes in the region. In addition, ethnohistorical sources are referred to when they can reveal something about the state of these past environment.

In the following chapter, the history of archaeological (and other relevant) research in North Central is reviewed. This will provide an overview of the most important results and findings that are relevant to this thesis, as well as the methodologies and theoretical frameworks used for the surveys and the excavations that resulted in the dataset available. Where relevant, reference will be made to research in adjacent regions to complete the necessary body of background archaeological knowledge that will help interpreting the data examined in this thesis. Through giving an oversight of the research done in North Central Nicaragua, this chapter will provide a preliminary synthesis which will be further developed throughout the thesis.

The fourth chapter will introduce the theoretical and methodological framework used in the thesis. The main aim here is to formulate a framework for an adequate interpretation of the data in terms of the environmental landscape which goes beyond an ethnic focus without losing sight of the limitations of the data used. Concepts that are central to this thesis will be discussed and defined.

The next chapter outlines the methodology used to homogenise, visualise and interpret the data using the theoretical framework in mind. A description of the process in which the information from different sources and formats are digitalised and combined into one dataset, organised according to artefact category as well as relevant environmental information, is provided. This is followed by presenting how the data can be visually examined to facilitate interpretation and overview of the archaeological record so far documented in the focus area.

In the sixth chapter the homogenised data will be visualised plotting the different find categories onto maps to examine their spatial distributions, coupled with analysis and evaluation. The results from the different data projections are then summarized to provide a synthesis of the data analysis.

The final chapter will draw upon the background archaeological and environmental knowledge provided in the first chapters to further interpret and discuss the data with the goal of answering the research questions. This is followed by a reflection towards new avenues of archaeological research in central northern Nicaragua in light of the results of this thesis.

2.0 The focus area and the environment of North Central Nicaragua

This chapter will outline the environment of the focus area. This environment will be examined through its topography, hydrology and climate to gain an understanding of the different environmental zones that make up the focus area. In addition, available paleoenvironmental proxy data will be explored to evaluate possible environmental changes in the past. This latter exercise will provide the basis for a rough historical ecological sketch of the focus area, setting an environmental context for the archaeological evidence from this focus area, explored in the next chapter.

2.1 North Central Nicaragua and the environment of the focus area

Nicaragua, like much of Central America, can be understood in terms of three major and generic ecological zones; the dryer Pacific lowland to the west containing the Nicaraguan depression with the great lakes and highly active volcanic chain, the humid Caribbean lowland to the east and the central highland zone with intermittent plateaus separating them in the middle (Lange 1984, 33; Lange *et al*. 1992; 4).

North Central Nicaragua is part of this generic central zone bordering Honduras in the north and reaching the Río Grande de Matagalpa to the south. This thesis will focus on an area situated in the middle of the North Central Nicaraguan region, where the headwaters of the three largest rivers of the country meet (see fig. 3); The Río Coco (Wanki or Segovia) bordering with Honduras, The Río Grande de Matagalpa and the Río San Juan which eventually borders with Costa Rica. As will be demonstrated further in this chapter, this area has an extraordinarily variable environmental setting. Its western limit, which has been more extensively studied archaeologically, is characterised today by dry and semi-dry climates, while the eastern limit of the focus area is characterised by humid climates. This section of the North Central region thus provides an interesting setting for examining interzonal interaction in ancient Nicaragua, as it is easier to observe possible differences in the archaeological record in correlation with environmental and climatic contrasts.

2.1.1 Topography and hydrology

The focus area lies completely on the eastern side of the continental divide. As can be seen in figure 2, the three major watersheds all drain eventually into the Caribbean, although their headwaters are closer to the Pacific and at a relatively short distance from the river systems draining into the Pacific.

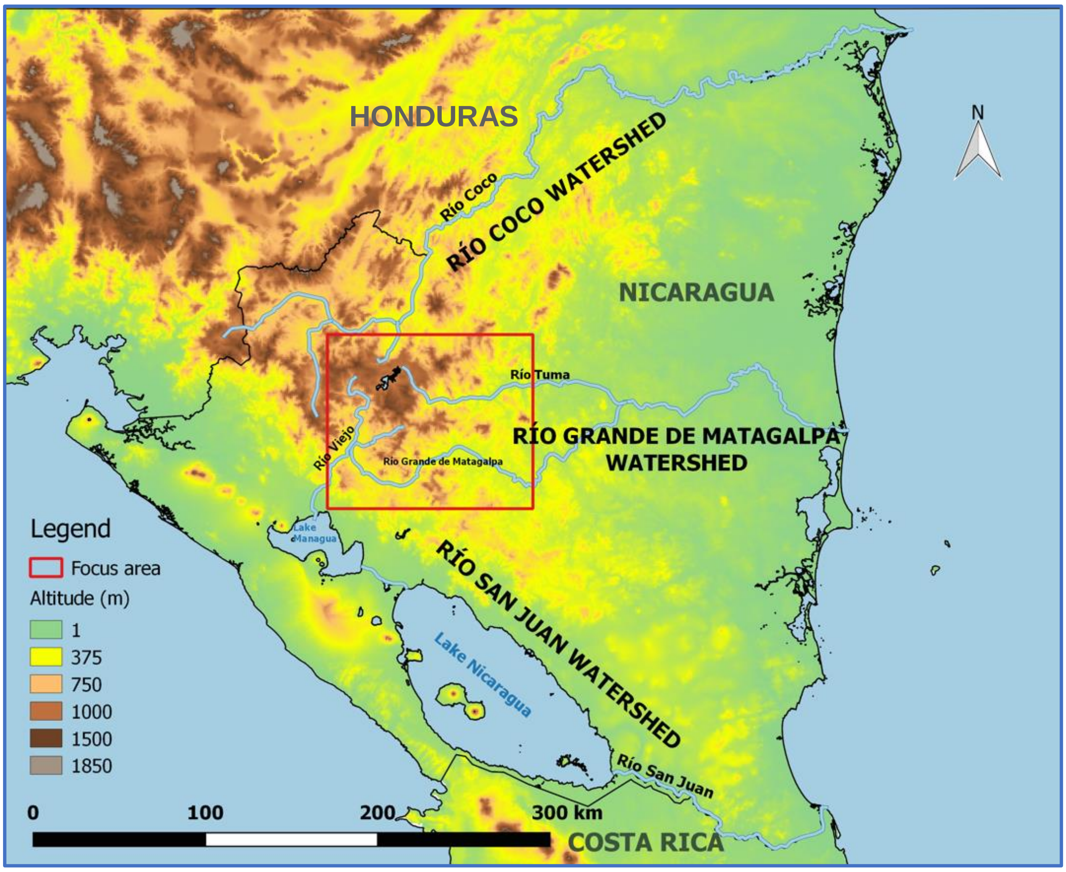


Figure 3: Headwaters of major river systems in Nicaragua with important tributaries. Elevation data from U.S. Geological Survey (USGS) Earth Resources Observation & Science (EROS) Center, GMTED2010 (Danielson and Gesch 2011).

The hydrological continental divide is found at the western side of the highland mass. The headwaters of the three major river systems thus extend across different climatic and ecological zones, made possible by the orographic effect (see below) provided by the mountainous range the rivers eventually pass through to reach the Caribbean lowland.

2.1.2 Climate and rainfall

The Central American Isthmus is dominated by the north-east trade winds which heavily influence overall rainfall patterns, where rainfall typically decreases towards the east across the isthmus (Bundschuh and Alvarado 2007, 3; Lange 1984, 46). Elevated mountain areas also play an important role in determining rainfall, where areas open to the north-east trade winds receive increased rainfall, whereas the western areas protected from these winds by the highest mountains receive notably less rainfall (Newson 1987, 44), creating the orographic effect. Although the region has been subject to climatic variability (see below), the macroclimatic phenomena such as the north-east trade winds are likely to have persisted in the long term.

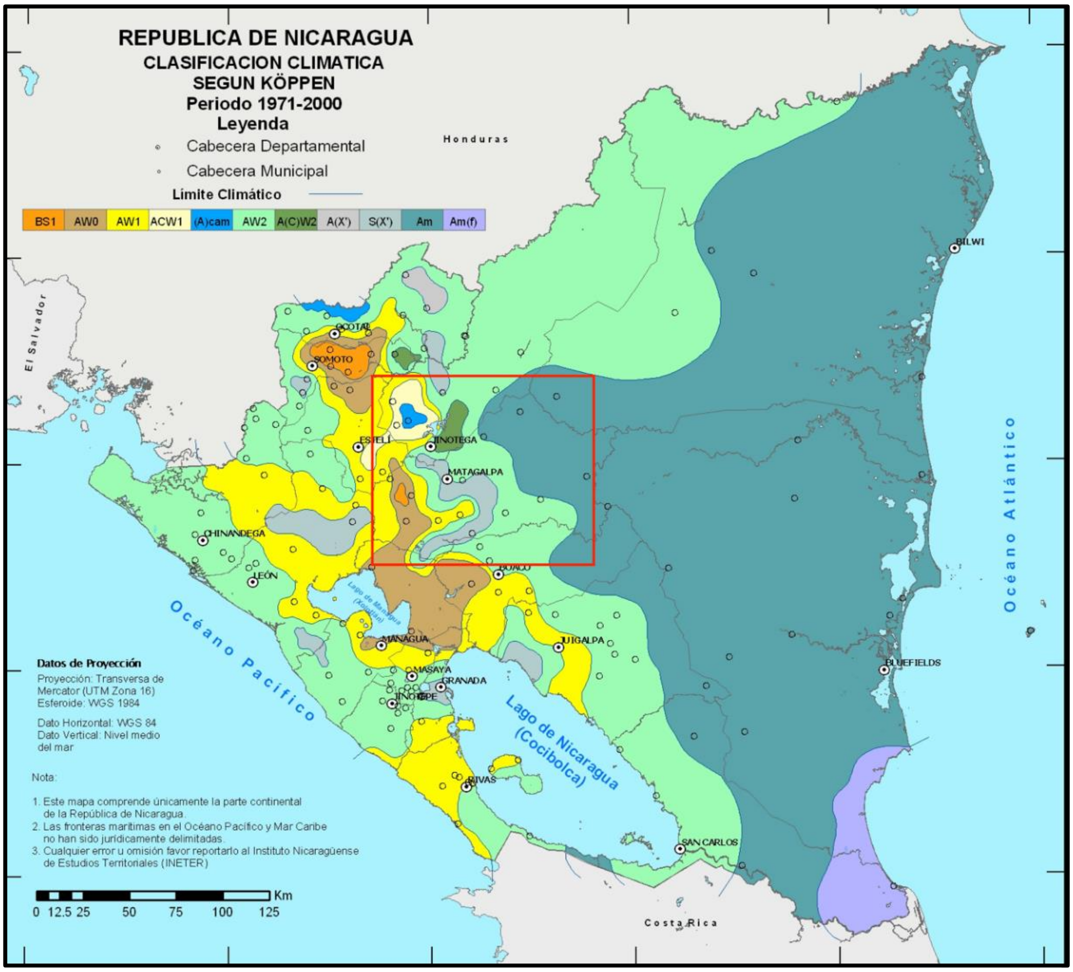


Figure 4: Köppen climate classification for Nicaragua with the focus region, with the focus area indicated by a red rectangle. After INETER (2005).

Currently and possibly in the past as well, the east of the focus area is characterised by a multitude of microclimates (see fig. 4), which are made possible by the mountain ranges creating areas that are each to a different degree sheltered from the trade winds. According to an adapted Köppen climate classification used by INETER (Instituto Nicaragüense de Estudios Terrestres, 2005) these include dry and arid valleys (BS1 according to Köppen climate classification), savannas and sub-humid areas (AW climates) and cool and precipitous mountainous climates (A(X') and (A)cam). Towards the east, the climate is characterised by the monsoon climate (Am) of the Caribbean lowland (INETER 2005).

2.1.3 Ecological zones and vegetation

Ecological zones are influenced by multiple factors. The non-human factors are mainly elevation, soil composition, rainfall and climate. The human factor on the vegetation and ecology is also important, with land use changes having affected local climates and rainfall levels for centuries (see section on environmental history below). General classifications of ecoregions as how non-human factors would produce them have been studied and mapped since the 1950's (Denevan 1961; Taylor 1963). Although classifications are updated and sometimes more complex (or simplified, see Bundschuh and Alvarado 2007, 4) categories are used, the explanatory framework offered by Taylor (1963) based on his land surveys still serves to describe the formation of the varied ecological zones of Nicaragua effectively in table 1.

Table 1: Summarized description of ecological zones of Nicaragua (Taylor 1963, 34)

	Formation				
	Lowland Evergreen Rain forest	Lower Montane Rain forest	Seasonal Evergreen Rain forest	Semi-Evergreen forest	Deciduous forest
Mean annual rainfall (mm)	2000–6000	Above 2000	1800–2600	1250–2500	Below 1250
Dry months	3	3	3–5	5–6	6–7
Elevation	Mostly below 600 m	Mostly above 600 m	Below 1200 m	Below 1600 m	Below 800 m
Predominant soils	Latosols	Latosols	Tropical brown soils latosols + grumosols	Tropical brown soils, grumosols, andosols + regosols	Lithosols, grumosols, regosols and tropical brown soils
Height (m)	35–45	25–40	25–35	25–35	25
Number of tree layers	4	3	3	2	2
Upper tree layer	Essentially evergreen	Evergreen	Small percentage of deciduous species	Up to 75% deciduous	Mostly deciduous
Lower tree layers	Evergreen	Evergreen	Evergreen	Mostly evergreen	Mostly deciduous
Lianas	Abundant	Common	Abundant	Occasional	Rare
Epiphytes	Abundant	Abundant	Abundant	Common	Common

According to Taylor the most important factor for the formation of the ecological communities is the severity and length of the dry season (1963, 32). The least important factor is soil composition, and while dominant soil groups vary from one zone to another, this is often due to climatic reasons (Newson 1987, 41; Taylor 1963, 33). A simplified map of the ecological zones is shown in figure 5.

If Taylor's categorisation is to be used to describe the ecological diversity, all the five major ecological zones (represented through forest types) present in Nicaragua can be found in the focus area. Exceptions include the so called azonal communities such as mangrove forests or Caribbean pine savannahs, which are found mainly in coastal regions, although other pine species do occur in the focus area. As with the variety of climates, it is notable that there seems to be a higher diversity of ecological zones to the west of the orographic divide.

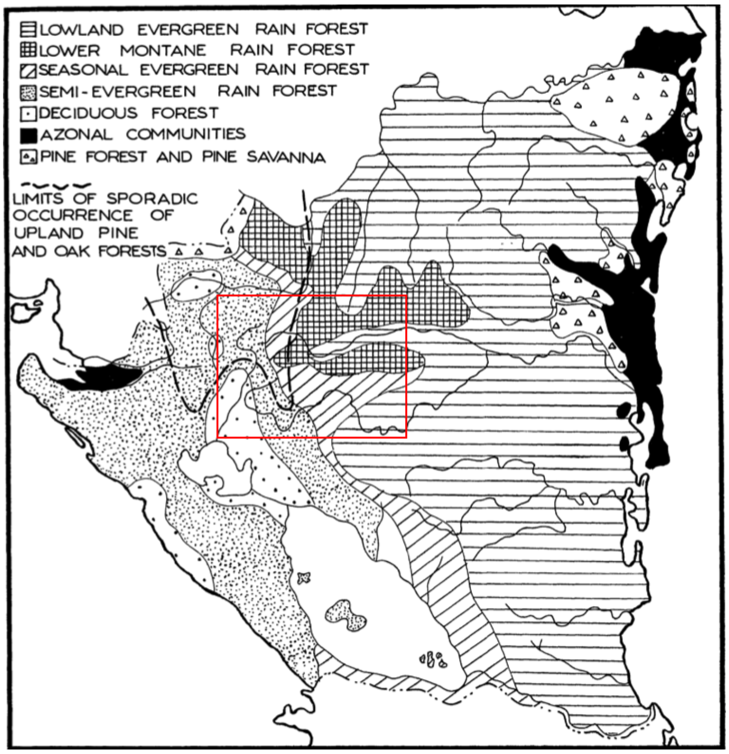


Figure 5: Ecological zones in Nicaragua with focus area indicated by the red rectangle. After Taylor (1963, 33).

2.1.4 Soils and geology

The geology of the focus area is mostly characterized by tertiary cenozoic volcanic rocks, featuring andesite and granite with quartz veins (Bundschuh and Alvarado 2007, 10; Newson 1987, 44). However, more detailed geological studies are in the region are necessary to understand local geological compositions (Bundschuh and Alvarado 2007, 10).

Soil compositions, as climate, are subject to change through time. As mentioned above, the differences between the weathered, infertile and mainly acidic soils are highly determined by climatic factors, and the region has never received any of the fertile volcanic ashes due to the direction of the north-east trade winds (Lange 1984, 40; Newson 1987, 41; Taylor 1963, 33). Soils are also highly affected by erosion and human use. Although high resolution geological and soil maps have been recently produced by Nicaragua's leading institution for terrestrial studies (INETER) in cooperation with the Food and Agriculture Organization (FAO), these have not yet been made available for public use.

An important principle about soil fertility in the region can, however, compensate for the lack of an accurate soil map to some extent. In the undulating terrain, most of the fertile soil can be found accumulated in the river valleys and their alluvial plains and terraces (Denevan, 1961; 289; Espinoza *et al*. 1996, 17; Lange 1984, 40; Newson 1987, 45, 66). Using this principle, fertile soil areas can be predicted and modelled using landform classification tools in GIS software, performed in later chapters.

2.2 Ecological and environmental history of the focus area

Central America is one of the most climatically vulnerable and variable areas of the world due to the immediate proximity of the Pacific Ocean and the Caribbean Sea whose currents greatly influence the local climates of the Central American Isthmus, causing temporary episodes of climatic variations which are still poorly understood. Another important factor affecting local climates and ecosystems is human occupation which mainly by affecting forest coverage can significantly alter local temperatures, rainfall, soil fertility and biodiversity.

It is impossible at this stage to reconstruct a complete and accurate paleoclimatic and paleoenvironmental timeline for the focus area. This is due to the lack of research on the subject in the region. Although the factors affecting local climate and environment are many and complex, making it difficult to create a clear paleoclimatic and paleoenvironmental picture, it is still possible to understand some trends and tendencies across time on a general level. With the current lack of comprehensive research on the subject, any reconstruction of a past environment relies heavily on present-day knowledge of ecosystems, which is summarized above to provide a point of reference. The understanding of past climates and environments can be improved by making inferences from scientific literature such as those on lake core samples taken from Lake Nicaragua, ethnohistoric documents making reference to the presence of specific plants and animals in the early colonial era, and observations provided by chroniclers in more recent centuries. In addition, personal communications with the older generation of the region can provide important and specific details about the potential navigability of rivers in past conditions.

2.2.1 The paleoclimatic record

The vast majority of research on the Central American paleoclimate has been conducted through lake and swamp coring, where climatic events can be detected in the sediment stratigraphies and microscopic remains of organic life. Such research carried out in the last 25 years has concluded that the post-glacial Holocene has been a time of considerable climatic variability (Horn 2007, 424). Some of the environmental change that has been detected is seen as caused by human occupation (Horn 2007, 424). The late Holocene (approx. B.P. 4000 until present) has been marked by a general trend of drying throughout the circum-Caribbean, although there is a high variability in timing and magnitude (Horn 2007, 432). Some events, such as the drought at approximately B.P. 1100 (coinciding with the Maya decline) have been more easily detected in coring ranging from Mexico to Northern South America, whereas other events are more region specific (Horn 2007, 424).

The general trend of drying during the late Holocene is also visible in coring samples from lakes in the Nicaraguan Pacific region (Horn 2007, 432; Slate *et al.* 2013, 148; Stansell *et al*. 2013, 153). However, interesting region-specific events have also been recorded. According to Slate *et al.* (2013, 148) an increase in eutrophic diatoms detected in coring samples from Lake Nicaragua suggest pre-Columbian agriculture in its watershed at around B.P. 5400, coinciding with the intensification of agriculture throughout Central America as interpreted based on coring samples elsewhere. A sample from Lago El Gancho, a closed-basin lake on the Asese peninsula (roughly 10km north-east from the Mombacho volcano) in Lake Nicaragua suggests that a wetter La Niña period reigned from as early as A.D. 600 until A.D. 1250 in Pacific Nicaragua, coinciding with a positive Northern Atlantic Oscillation period and the Medieval Climatic Anomaly in Europe (Stansell *et al.* 2013, 151, 153). This again was followed by a sharp period of drying, after which a more general trend of drying coinciding with that recorded elsewhere in the circum-Caribbean has prevailed until present (Stansell *et al.* 2013, 151).

A swamp coring in Lago Negro close to the Nicaraguan Caribbean coast has also revealed evidence of a paleohurricane around B.P. 3300, which according to Urquhart (2009, 95) would not have been visible in the coring had it not been devastating, leaving behind a visible recovery process of the ecosystem lasting centuries.

The scarce published sources based on coring samples from Nicaragua tell us of exceptional events, such as a paleohurricane and a possible La Niña period when drying was the trend elsewhere in the circum-Caribbean. However, it reveals little about a more general Nicaraguan trend. Also, it is hard to estimate, without local research, precisely how the aforementioned climatic phenomena manifested in North Central Nicaragua. However, it is unlikely that unusual phenomena in the Pacific would have greatly influenced the climate of North Central Nicaragua due to the likely prevalence of the north-east trade winds, blowing towards the Pacific. In general, circum-Caribbean trends of gradual drying would suggest that the overall climate was more humid, but the orographic effect would still imply local climatic differences in North Central Nicaragua.

2.2.2 Historical references

Referring to chroniclers and voyagers from the colonial and historical periods is problematic in many ways. They can be considered ethnocentric, exoticist or tainted otherwise with colonial agendas. In the case of Nicaragua, these biases surrounding the use of ethnohistoric sources as well as the chronicles of later European voyagers to study the past of a region located on the old colonial frontier of the Chontales region are well discussed by Van Broekhoven (2002). However, the biased nature of these sources does not make them utterly useless. The descriptions made by chroniclers and voyagers about their surroundings compensate to some extent for the heavy dependence on inferring the paleoenvironment from present-day ecosystems. The early colonial sources are especially useful in describing the environments before they were extensively changed by the colonists bringing in new lifeways such as cattle ranching. Some specific mentions of plant or animal species can be seen as bio-indicators, which may reveal much about the condition of the surrounding ecosystem and climate. When evaluating these in light of other lines of evidence, they can hold important information in sketching an environmental history for the focus area.

Ibarra's (1994) survey of colonial documents of the 16th century has been particularly useful in respect of finding environmental references for the past of the focus area. In early colonial times the main indigenous informants to the Spaniards referred to the peoples living in the unconquered regions to the east and north as the *chontalli,* a generic nahuatl term used for the peoples that were seen as more "rude" or "rustic", living in the "mountains or foothills of them" according to Fernández de Oviedo in the sixteenth century (Ibarra 1994, 233; Newson 1987, 37). Ibarra cites a document from 1581 describing the unconquered highland region:

> *"…en las montañas hay pinos altos y robles y otros árboles diferentes y en parte de estas montañas se saca mucha brea y alquitrán y trementina. Los ríos son abundantísimos de pescados de diferentes géneros, hay en ellos muchos caimanes. Hay en esta tierra muchos venados, puercos de monte y conejos y armados y guatuzas y perdices y codornices y tigres y leones y adibes (sic). Los indios tienen presquerías en los ríos… Las aves que aquí se han visto son garzas y patos y gavilanes y alcatraces y palomas torcazas y tórtolas y papagayos y catalnicas. En los montes hay ardillas y pavas y cógese mucha miel en los pinales… Los indios de estos pueblos siembran todas legumbres y cogen melones y xicamas y camotes y batatas y piñas y plátanos y Tabaco y otras frutas. Estos indios hablan la lengua chontal, como dicho es"* (AGI, 1581 in Ibarra 1994, 234-235).

Such excerpts hold an abundance of leads for more close inspection, many of which could probably be problematic in terms of trying to find out more about the exact species referred to in the colonial descriptions. An important indicator can be found here, however, in the pine and oak association, which is almost unique to North Central Nicaragua (Denevan 1961; Ibarra 1994, 233; Newson 1987, 45; Taylor 1963, 33). This association, present today in the western areas of the focus area of this thesis, is seen as a result of regrowth after burning and forest clearing in zones where other dominant broadleaf associations would otherwise occur (Denevan 1961, 273-274; Newson 1987, 45). Excerpts like the above and one from an expedition in 1525 finding the area characterised by pines and oaks “highly populated” (Newson 1987, 45), support the argument made by Denevan (1961, 273-274) and Newson (1987, 45) that these forests must have existed long before the arrival of the Spaniards.

For the western part of the focus area the description above would imply that although the environment was heavily influenced by human activities, it was, in contrast with today, still biodiverse and healthy enough to sustain large felines and its watersheds were intact enough to provide the population with fish. It is possible that pine-oak forests once extended beyond the climatic divide into the east of the focus area. However, soil and climate are a factor for pine dispersal and it is likely that broadleaf forests more rapidly took over felled and burned areas (Denevan 1961, 293).

2.2.3 A note on river navigability and local knowledge

Understanding the health of the watersheds is important for evaluating the navigability of the main rivers in the past, as this could be a key element for evaluating the focus area’s mobility and exchange possibilities. The headwaters of the Río Grande de Matagalpa, Río Coco and Río San Juan (Río Viejo) are currently unnavigable by any means most of the year, as the watersheds have been affected by deforestation and dropping levels of rainfall. The ethnohistoric description above already hints to healthier watersheds in early colonial times but lacks more detailed reference to mobility in the region.

Denevan (1961, 290) points out that in the 18th century, the Spanish controlled frontier towns of Matagalpa, Sébaco, Muy Muy, Matiguás and Jinotega lived in constant fear as they were repeatedly attacked by indigenous Miskito groups, often led by British officers, who moved up the Rio Grande de Matagalpa and the Río Coco. The easy incursions by the Miskito and English in the 17th and 18th centuries, which would at times provoke the resettlement or even abandonment of some of the Spanish border towns, would imply that region was easily accessible from the Caribbean up till the very headwaters of the major rivers.

A member of the Bolt family, which was amongst the first to settle in El Tuma (see fig. 6) to raise cattle in the 1950's, still remembers Miskito and Mayangna navigating far up the Río Tuma towards the north-west (Alan Bolt 2016, personal communication). He also claims that at those times the Río Grande de Matagalpa was still navigable beyond Sébaco towards the town of Matagalpa. Local anecdotes like these reveal that the rivers remained navigable until recent times, even when a serious reduction of forest coverage had already taken place. The above references would suggest that the focus area was, at least for those with the necessary riverine navigation skills, relatively easy to reach and traverse in pre-Conquest times as well.

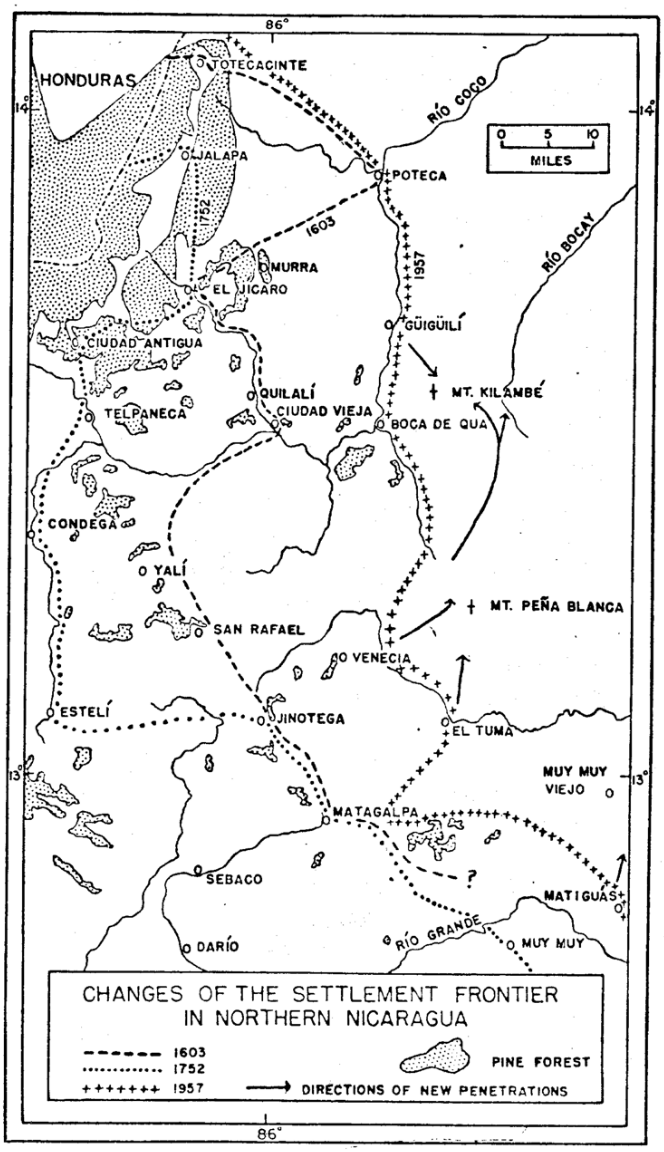


Figure 6: Changes of the settlement frontier in North Central Nicaragua (Denevan 1961, 288). The southern half of the map corresponds to the western half of the focus area.

2.3 Environment of the focus area: Conclusion

This chapter has demonstrated the environmental diversity of the focus area. With areas situated at different altitude levels and climatic zones within a relatively close distance from one another, pre-Conquest peoples must undoubtedly have developed knowledge and practices dealing with this ecological diversity, much like people continue to do in the region today. Although not much can be said about the paleoenvironment of the focus area, it is likely that human activities had a significant influence on forest ecosystems through slash-and-burn farming. Despite the probable use of this form of agriculture, often considered destructive, ethnohistorical references describe a forested landscape with abundant watersheds. The more significant changes to climate and water abundance are thus recent, stemming from the introduction of Colonial agricultural practices and deforestation.

3.0 History of research in the focus area

In this chapter, the pre-Conquest human past in the focus area, touched upon from an environmental point in the previous chapter, will be examined further through a review of archaeological research. In addition to providing an outline of archaeological research that has so far been conducted within the focus area, different approaches which have formed archaeological research and interpretation in North Central Nicaragua will be discussed. The aim of this chapter is to provide the archaeological background knowledge necessary to interpret the survey data presented and analysed in the following chapters.

3.1 North Central Nicaragua in a macroregional frame

North Central Nicaragua has long been featured as a border area in macroregional discourses on Mesoamerica and Lower Central America. When Kirchoff (1943) delimitated the "Mesoamerican culture area", the south-eastern limit of this area ran across modern-day North Central Nicaragua in a rough south-east direction, separating Mesoamerica from the rest of Central America. Decades later, the south-eastern part of the Mesoamerican culture area was denominated the Greater Nicoya subarea Norweb 1961; 1964). As mentioned before, this boundary cutting across North Central Nicaragua also coincided with modern limits between the agriculturally and infrastructurally more developed Pacific Nicaragua and the humid Caribbean watershed. Since then, the exact delineation of the south-eastern Mesoamerican frontier and Greater Nicoya subarea has been adjusted by different scholars, some of which can be seen in figure 7, based on archaeological, historical and ethnological sources (Newson 1987, 24). The Greater Nicoya subarea and its frontiers have continued to remain a topic of

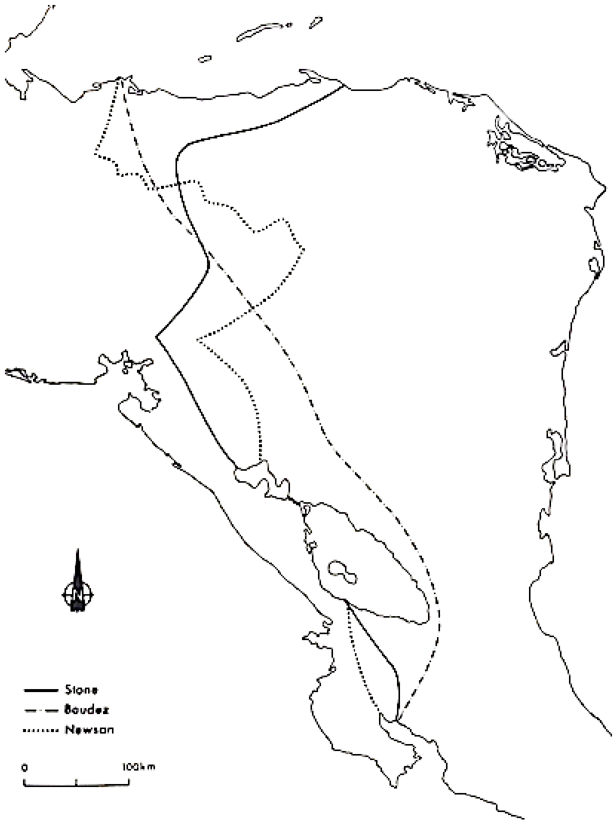


Figure 7: Different projections of the south-eastern boundary of the Mesoamerican culture area (Newson 1987, 24).

search and debate in more recent times. Surveys in the 1990's took place mapping archaeological patterns and assemblages to evaluate the boundaries and internal cultural diversity of the Greater Nicoyan subarea (Braswell 1997; Braswell *et al.* 2002; Espinoza *et al.* 1994; Espinoza *et al.* 1996; Fletcher 1993; Fletcher *et al.* 1994; Finlayson 1996; Lange *et al.* 1992). Many of these extended into the North Central region and will be further discussed in section 3.3.

The Greater Nicoya subarea its relationship to adjacent regions was later also evaluated from an interregional network and world-systems perspective (Wallerstein 1979; 1991), examining economic and socio-political relationships between the regions (Braswell *et al.* 2002; Smith and Berdan 2003; Carmack and Salgado 2006). Carmack and Salgado (2006, 220) place the Greater Nicoyan subarea within the periphery of Mesoamerica, whilst the bordering areas south and east of Gran Nicoya are seen as being inhabited by "frontier people" that "lack systematic relations with that (Mesoamerican) world system". Although Carmack and Salgado mean "no negative connotation" (2006, 220) to be put on the frontier people, this view would place at least parts of North Central Nicaragua in a liminal position in relation to Mesoamerica.

The area south-east of Mesoamerica has indeed long been referred to as the "Intermediate Area" (Haberland 1957; Rouse 1962; Willey 1971), a name which highlights the importance of the Mesoamerican and Andean areas and general ignorance of the understudied area in between (Broekhoven 2002, 23; Hoopes and Fonseca 2003, 51). Even the alternative denomination "Lower Central America" (Baudez 1963; Lange and Stone 1984; Lothrop 1966; Willey 1971) has been taken to reflect an inferior light on the area south-east of Mesoamerica (Hoopes and Fonseca 2003, 51). Later scholars have preferred to name the area according to its own qualities, such as the "Area of Chibchan tradition" (Fonseca 1994) or "Isthmo-Colombian area" (Hoopes and Fonseca 2003) characterised by Macro-Chibchan traits found reaching northern South America. Some scholars have actively started looking after these Chibchan traits in the Greater Nicoya subarea and even North Central Nicaragua (see Ibarra 1994, and Steinbrenner 2010 for the Greater Nicoya subarea). For the most part, however, the existing archaeological literature (see section 3.3) on North Central Nicaragua, still deals with the region in terms of Mesoamerica.

3.2 Archaeological finds in North Central Nicaragua

For as long as people can remember, archaeological objects have been found in the North Central region mainly as a result of agricultural activities. Ceramic vessels, bifaces, grinding stones and other objects found peculiar or that easily catch the attention have often been found by locals and kept in small family collections. In many cases, some of these objects have been offered as casual presents to friends or far-away family members, a practice that is still visible in the modern day rural municipality of El Tuma La Dalia for example. In some cases, the finders have sold the objects to outsiders, which have since travelled far from the region. Small museums with archaeological collections exist, such as in Somoto, Chagüitillo (Sébaco), Condega and Matagalpa, which are open to the public. For the above described dynamics however, the provenience and provenance of these objects have in the clear majority of cases not been documented and little archaeological knowledge is available on these objects at the museums. Exceptions do exist, however, such as the three statues found at the crossing of the Río Tuma and Río Yasica in the modern-day municipality of El Tuma La Dalia (eastern side of the focus area) in 1958, which were then brought to the regional capital Matagalpa, where they can still be seen in the "Parque de Los Monos" (Kühl 2010, 121).

3.3 Somewhere between Greater Nicoya and Mesoamerica: Archaeological investigations in the watersheds of the dry corridor

In the 1990's the first well-documented archaeological efforts in the North Central region were conducted in the so called "dry corridor" running north-west from the grand lakes close and along the Nicaraguan depression, where low-elevation passages were believed to be important for mobility across the isthmus (Fletcher 2010, 513). Close to the Honduran border, the river valleys of the Río Coco headwaters were surveyed under the lead of Laraine Fletcher in the modern-day departments of Estelí and Madriz in 1992 and 1993 (Braswell *et al.* 2002; Espinoza *et al.* 1996; Fletcher 1993; Fletcher 2010; Fletcher *et al.* 1994). Another contemporary survey project (Espinoza *et al.* 1994) around the Lake Managua watershed (belonging to the San Juan watershed) included the Viejo river, entering the south-western zone of this thesis' focus area. The objective of these projects was to define the extents of the Mesoamerican culture area and Greater Nicoyan subarea and establish preliminary ceramic sequences for these regions (Espinoza *et al.* 1994, 160; Espinoza *et al.* 1996; 14; Fletcher 1993, 2-3). These efforts mainly focussed on documenting the sites along the riverbeds and obtaining representative ceramic samples from the surface and from test pits. Smaller surveys including test pits in the islands of Lake Moyua have contributed to the archaeological effort in the south-eastern quadrant of the focus area (Lange *et al.* 1992; Finlayson 1996). In the 2000's more surveys and test pits were repeated in the department of Estelí in 2004 and mound excavations were conducted in the east of the same department in 2006 (Koschmieder and Gaméz 2006; Zambrana 2004). Although the sites documented and studied in most of these efforts lie outside of the focus area, their findings, and the preliminary ceramic sequences produced by them, are key to understanding the archaeological record in the rest of the region.

The surveys conducted in the departments of Estelí and Madriz of the North Central region in the first half of the 1990's reported 90 archaeological sites (Braswell *et al.* 2002, 20; Fletcher *et al.* 2014, 173; Fletcher 2010, 514).[1] The riverbeds of selected branches of the Río Coco headwaters were surveyed systematically, while three hilltops sites were included thanks to local information (Fletcher *et al.* 2014, 178). According to the mound count and observed extension of the sites, a four-tier settlement hierarchy was established with hamlets, towns, nucleated centres and regional centres (Espinoza *et al.* 1996, 29; Fletcher 2010, 514). The settlement pattern was found to correspond to the "Linear Stream" pattern (Flannery 1976). This pattern is observed elsewhere in Mesoamerica, where more central sites (and higher in the site hierarchy) are located on the alluvial banks of the larger rivers or junctures of major tributaries (Espinoza et al 1996, 30; Fletcher 2010, 514). Three sites were chosen for 1x1m units to be excavated in 10 cm arbitrary levels to obtain ceramic samples for the establishment of a preliminary ceramic sequence for the region. This was done to date non-excavated sites and explore past socio-political processes that took place at these sites (Espinoza *et al.* 1996, 47). Cross-dating based on diagnostics related to well-known Honduran diagnostic types such as Usulután and Ulúa polychrome allowed to identify two phases between A.D. 300-800, as seen in table 2 below (Braswell *et al.* 2002, 25; Espinoza *et al.* 1996, 100; Fletcher 2010, 514).

In addition to these two preliminary phases established for the North Central region, pre-A.D. 300 Usulután ceramic types indicated occupation prior A.D. 300 as well. Evidence was also found for occupations up to at least A.D 1000, indicated by shards of later Honduran Ulúa polychrome types and the Delirio Red on White type related to the Quelapa site in El Salvador (Braswell *et al.* 2002, 27-28; Fletcher 2010, 514-515). The presence of types related to modern day Honduras and El Salvador suggest participation in south-east Mesoamerican networks of interaction, which, at least in the later phases, stretched further south to include modern day Granada in the Greater Nicoya region, where similar Honduran and Salvadorian diagnostic types have been found (Dennett 2016; Fletcher 2010, 515).

[1] For unknown reasons, another report on these campaigns (Espinoza *et al.* 1996, 113) reports a total of 110 archaeological sites.

Table 2: Chronologies for the Greater Nicoya region, North Central region and Mesoamerica (Dennett 2016, 64; Espinoza et al. 1996, 111-112).

	Greater Nicoyan chronology	North Central Nicaraguan chronology	Mesoamerican chronology
A.D. 1500	Ometepe		Postclassic Period
A.D. 1400			
A.D. 1300			
A.D. 1200	Sapoá		
A.D. 1100			
A.D. 1000			
A.D. 900			Terminal Classic Period
A.D. 800			
A.D. 700	Bagaces	Casa Blanca	
A.D. 600			Classic Period
A.D. 500		La Mansion	
A.D. 400			
A.D. 300			
A.D. 200	Tempisque		
A.D 100			Late Preclassic Period
A.D. 0			
B.C. 100			
B.C. 200			
B.C. 300			

Post A.D. 1000, little evidence is found in the Río Coco headwater area, which is interpreted as a possible decline related to that experienced by the lowland Maya of the Terminal classic phase (Espinoza *et al.* 1996, 113; Fletcher 2010, 515). In the adjacent area to the south-east of the Lake Managua watershed, however, more evidence has been found for occupations after A.D. 1000 based on diagnostic ceramics associated to the Greater Nicoya region (Espinoza *et al.* 1994; Finlayson 1996, 145; Vasquez *et al.* 1994, 266, 272; Koschmieder and Gaméz 2006, 40). Although ceramic analysis from this area also indicates strong relations to the Estelí and Madriz area of the Río Coco headwaters, the fact that Greater Nicoya types were not found there initially led to the delimitation of the Greater Nicoya subarea at the limit between the watersheds (Espinoza *et al.* 1994, 172). Although later surveys in the north of the Estelí department have detected diagnostic shards of ceramics associated with the Greater Nicoya region of the Sapoá and Ometepe periods, these have been found in very low quantities (Zambrana 2004).

An analysis of obsidian by Braswell (1997) recovered from sites excavated in the Coco river watershed by Espinoza *et al.* (1996) as well as coeval sites from Granada in Pacific Nicaragua by Salgado and Zambrana (1994) show that most of the obsidian arriving to modern-day Nicaragua came from the Guinope source (see fig. 8) in southern Honduras as small nodules and were there transformed into flakes (Braswell 1997, 27). This also seems to be the case in El Tuma La Dalia (north-eastern part of the focus area), where 3 of 4 obsidian flakes sampled from three locations were successfully sourced to Guinope by energy dispersive X-Ray fluorescence, or XRF (Glascock 2015; Uosukainen *et al.* 2016). The decrease of obsidian in frequency from Guinope towards the south-east of Nicaragua is seen to suggest a down-the-line trade in this direction (Braswell 1997, 21). Both the use and trading patterns of obsidian differ from the main Mesoamerican region (Braswell 1997, 29). However, it is unclear whether this reflects a pre-Conquest pattern or a lack of research. It is important to note that a major vain of obsidian trade is depicted to pass through the focus area (fig. 8), although Braswell's study did not include samples from this area.

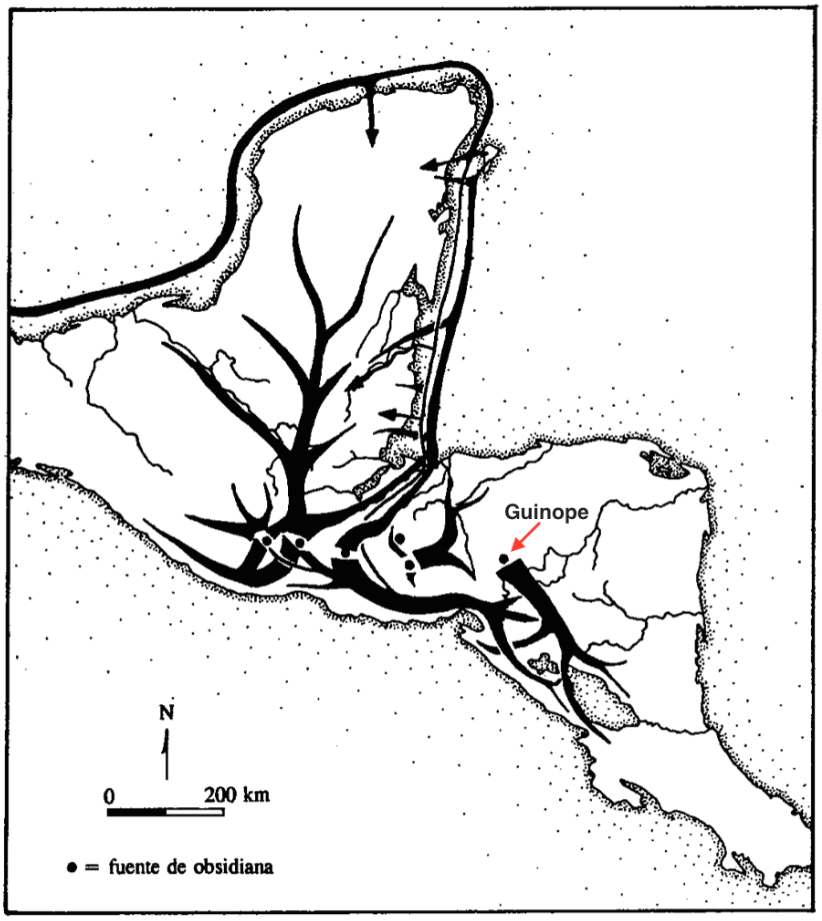


Figure 8: Pre-Columbian trade networks of obsidian in southeastern Mesoamerica and Nicaragua after Braswell (1997, 27). Adapted to indicate the location of the Guinope obsidian source.

3.4 Opportunistic community orientated surveys

Between 2006 and 2010 the CADI-UNAN, the archaeological investigative branch of the Universidad Nacional Autónoma de Nicaragua, conducted a series of community-oriented surveys in the departments of Jinotega and Matagalpa of the North Central region. The main goal was to contribute to a national inventory of archaeological sites in regions preferably where no previous formal documentation of sites had been conducted and where living descendants of indigenous peoples were still present (Balladares and Rivera 2011, 10). The surveys were coordinated with local municipal authorities and willing community leaders to document archaeological sites that locals were willing to share information on. In the case of the municipalities of Jinotega, Pantasma, Matagalpa and San Ramón this was coordinated with the indigenous communities (Balladares and Rivera 2011, 13). In recent years (2013-2017), the CADI-UNAN has collaborated with the University of Kyoto to excavate a mound site in the municipality of Matiguás and participated in surveys in the municipality of El Tuma La Dalia (Minami *et al*. 2015; Uosukainen *et al*. 2016). The results of these opportunistic surveys within the focus area have not been published, and the data from the internal technical reports will form the basis for the data interpreted in this thesis in later chapters.

3.5 Local initiatives and interest

Investigations into the indigenous past of the North Central region have not only been carried out by universities, but also by local scholars and enthusiasts based in Matagalpa. The local historian of German descent Eddy Kühl, influenced by ethnohistoric sources and the studies of the Nicaraguan geographer Jaime Incer (1985; 2003) has argued that the original inhabitants of North Central Nicaragua were the Chontal-Matagalpa a.k.a Ulúa Matagalpa, and sought to investigate their frontiers and lifeways, often making reference to archaeological sources (Kühl 2010; 2012). One of the most common ceramic types found throughout the modern-day North Central departments is called Segovias Naranja, first classified by Edgard Espinoza (see Espinoza *et al.* 1996).[2] According to Kühl (2012, 17)

[2] Espinoza (1994, 168) first describes this type as "orange slip fine paste". Later called Segovias Naranja, this type, found at most sites surveyed in the North Central region, was related with the Sulaco type from Honduras roughly coinciding with the "La Mansion" period A.D. 300 – 600 (Espinoza 1996, 84-86). For vaguely explained reasons, later publications about the North Central region have extended this timeframe to A.D. 1430 (Balladares 2013; Minami *et al.* 2015). This is because the type has been found at a radiocarbon-dated context from the Miraflor site in Estelí, excavated in 1999 as a cooperation between UNAN-Managua and the Universitat Autònoma de Barcelona (Gassiot Ballbè and Palomar Puebla 2000). Brief technical information on this dating

and his proponents, this type was developed by the Ulúa Matagalpa group, to which he also associates the statues found in the Matagalpa department (Kühl 2010, 121).

Later forming the “Fundación Cientifica Cultural Ulúa-Matagalpa”, the group including Eddy Kühl and Matagalpan archaeologists such as Dr. Rigoberto Navarro have organised presentations and conferences, such as the “Primer Congreso Ulúa Matagalpa” in 2014 (Navarro *et al.* 2017) to gain the attention of both the academic and general public and propose a new culture area (fig. 9). In recent years this Foundation has been increasingly active in the press and social media, spreading positive interest in archaeology in the Matagalpa region and beyond. Between 2015 and 2017 their efforts have included excavations on mound sites in the north of the Jinotega department (Martínez 2015; 2017).

Figure 9: New subarea proposed by the Fundación Cientifica Cultural Ulúa Matagalpa spanning across most of modern-day Nicaragua (Simpson 2014).

Although active in realizing and promoting archaeological research in the region, unfortunately no exact information on their findings has been published except for some locational information on the site of Sulingalpa in the city of Matagalpa, well-promoted in national news outlets (Martínez 2014; 2016). Possible unpublished technical reports, however, have not been made available for this thesis with the exception of a report handed to the INC by a forest ranger, who was aided by local Matagalpan archaeologists (López García 2015).

3.6 A note on Indigenous peoples and the ethnographic potential today

Indigenous peoples of the North Central region have lost most of the lifeways practiced for centuries as a result of colonial activity up till recent times. In the focus area these have led to the extinction of the Matagalpa language and the burning of traditional cotton tree groves to make way for coffee plantations. The degradation of the environment has made fishing and hunting practices virtually impossible in the region.

has only been provided in a footnote in a technical report describing the date as 1040calDC – 1415calDC, beta 140706 (Minami *et al.* 2014, 22). Further information has not been made available to this thesis other than through oral communication (Balladares and Lechado 2015, oral communication).

The descendants of the indigenous peoples are mainly represented today by formally recognized “Comunidades Indígenas” with recognized communal lands in the municipalities of Sébaco, Matagalpa, San Ramón and Jinotega. A statement was made by a representative of the indigenous community of Sébaco (see area 36 in fig. 10) thanking the organisers of the “Primer Congreso Ulúa Matagalpa” (attended by the author in Matagalpa 2014), for finding out he was “Ulúa Matagalpa” and for paying attention to the archaeological sites and the indigenous heritage of the region. Accepting the denomination used by local scholars (Fundación Cientifica Cultural Ulúa-Matagalpa) reflects both a loss in oral tradition and a great trust and reliance on modern scholars for identity building through reference to the past.

Not all traditional practices have been lost however. The author has met an elderly self-identifying Matagalpa descendant from Sébaco (Bernardino Martínez Aguilez, personal communication 2015) establishing traditional *milpa* plots combining maize (*Zea mays*), bean (*Phaseolus sp.)* and squash (*Cucurbita sp*.) and observed the efforts of Matagalpa women from the community of Samulalí (within area 38 in fig. 10) to preserve many varieties of traditional food, spice and medicinal plants in home gardens. As for the eastern side of the focus area, some Mayangna and Miskito that today live deeper east in the Bosawas Biosphere Reserve still identify with areas taken over by the expansion of modern agriculture in the 1950’s and 1960’s, such as Matiguás, which they still pronounce as *Matiswas* (Dionisio Jarquín Gutierrez, Mayangna traditional chief of Sikilta, personal communication 2015; Henry Salomon Taylor, Miskito forest ranger for MARENA, personal communication 2015). The statement made by Espinoza *et al.* (1996, 113) that archaeology is the best option to study the lifeways of the past indigenous societies of North

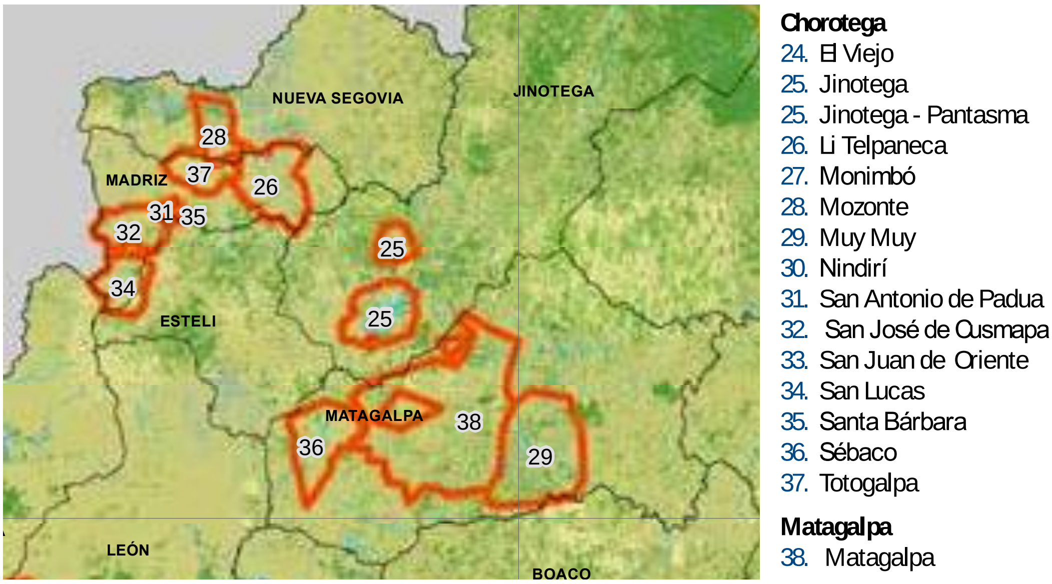


Figure 10: Current distribution of areas with indigenous peoples in North Central Nicaragua, adapted from Williamson et al. (2016, 44).

Central Nicaragua might not hold true for the focus area. Many research foci, such as those focussing on pre-Conquest ethnic boundaries or settlement hierarchies and interregional exchange practices are perhaps best answered through archaeological means (Braswell 1997; Braswell *et al.* 2002; Espinoza *et al.* 1996; Fletcher 1993; Fletcher 2010; Fletcher *et al.* 1994; Kühl 2010). However, other foci such as perception of the landscape, foodways and interaction with the environment would benefit from ethnographic approaches as well.

3.7 Background of the focus area: summary and conclusion

3.7.1 Summary of an environmental and human history in North Central Nicaragua

The focus area includes a relatively unstudied area characterised by a variety of climates and environments for which unsystematically procured archaeological data has been made available for analysis in this thesis. The information outlined in the previous chapters shows most of all that detailed information based on systematic research is scarce for the focus area on almost all fronts of the academic sciences. However, useful points of reference are available both on the past environment and indigenous societies of the North Central region. These allow for a general timeline to be sketched for the focus area, to understand the different formation processes of the historical landscape.

The paleoclimatic record corings in Lake Nicaragua indicate agricultural practices as early as 5400 BP (Slate *et al.* 2013). Although it is likely that much of the eutrophic diatoms detected in the lake sediments indicating agriculture at that time came from elsewhere in the San Juan Watershed, it is possible that some of it also originated from the headwater region towards the focus area. To confirm this, however, archaeological evidence would be required and the very least results similar to those from Lake Nicaragua would be required from corings in Lake Managua at.

So far, the archaeological record shows evidence for human settlements in the North Central region prior to A.D. 300, based on ceramics types related to Honduran Usulután tradition (Fletcher 2010, 514). During the La Mansion phase (A.D. 300 – 600) the appearance of more Honduran related types indicates strengthened relations between that region and North Central Nicaragua (Espinoza *et al.* 1996, 112). The following Casa Blanca phase (A.D. 600 – 800) is characterised by evidence of continuing participation with networks in south-eastern Mesoamerica but also the Greater Nicoya subarea (Fletcher 2010, 515). The absence of diagnostic types associated to post A.D. 1000 periods in the areas of the Río Coco watershed bordering modern day Honduras is taken to indicate a possible decline coeval to that experienced in the Honduran region and by lowland Maya groups (Espinoza *et al.* 1994; Fletcher 2010, 515). However, the adjacent Viejo watershed, better linked to the Greater Nicoya subarea, does feature occupations up till the Ometepe period between A.D. 1350 – 1550 (Espinoza *et al.* 1994; Fletcher 2010, 515). Coring samples in Lago el Gancho suggest that from approximately A.D. 600 – 1250 a wetter La Niña period reigned on the Pacific Nicaragua, while a general drought has been recorded on the Caribbean side of the isthmus (Horn 2007; Stansell *et al.* 2013). However, it is unclear at this time whether this possible climatic anomaly can be related to the differences between occupations in the Coco and Viejo watersheds. In any case, both the climatic and archaeological observations still require confirmation through further research.

Early ethnohistoric sources on the North Central region tell of a highly populated highland landscape with abundant rivers and healthy ecosystems sustaining a wealth of species (Ibarra 1994). Pine and oak forests mentioned in these sources are taken to be a result of human agricultural activity as a result of slash-and-burn agriculture shaping the North Central landscape and leaving its traces to this day (Denevan 1961). However, these sources are limited to the west of the focus area and sources describing the east side of the focus area do not appear until centuries later (Ibarra 1994; Van Broekhoven 2002).

3.7.2 Discussion and conclusion

Past research with a focus on settlement hierarchy, social complexity, extents of culture areas and interregional exchange has not been very revealing in terms of specific local lifeways, practices and ways of relating to the natural environment. However, they have pioneered important advances by describing novel ceramic types and establishing preliminary ceramic sequences, which are highly useful for studies conducted elsewhere in the region (Braswell *et al.* 2002; Espinoza *et al.* 1994; Espinoza *et al.* 1996; Fletcher 1993; Fletcher 2010; Fletcher *et al.* 1994). Based on these ceramic sequences and those from the Greater Nicoya region, pre-Conquest times can be said to be roughly visible archaeologically in the North Central region spanning from somewhere before A.D. 300 and reaching until A.D. 1550, as diagnostic ceramic types detected in the focus area can be placed within this timeframe with some degree of confidence. This, of course, also requires the acknowledgement of the fragility of any analysis based on preliminary sequences. Even if they have been established with the help of radiocarbon dating, they are often subject to later revision and change, as they already are for the Greater Nicoya region (McCafferty and Steinbrenner 2005; Dennett 2016). Furthermore, it should be noted that although the ending of the abovementioned North Central timeframe largely coincides with what is generally referred to as *pre-Columbian* or *pre-Hispanic* times, this thesis rather uses *pre-*

Conquest to refer to the time frame in North Central Nicaragua. This is to acknowledge the different post-Columbian times in which different territories were conquered by European powers, as well as the fragility of any currently established but insufficiently confirmed chronologies.

For the purposes of this thesis and its interest in interzonal interaction and exchange, the abovementioned studies have also been useful in revealing networks of interregional exchange. The presence of different artefacts associated to (cultural) regions outside of the focus area have been detected in areas with specific spatial and geographical characteristics that can serve as important points of reference in the analysis conducted in this thesis.

Other efforts have focussed more on involving the local communities in the creation of site inventories (Balladares and Lechado 2008; Balladares and Rivera 2011; Uosukainen *et al.* 2016). Finally, some focus on promoting the indigenous history of the region in a publicly accessible manner (Kühl 2010; 2012). These efforts might not produce much detailed and systematic archaeological information for the focus area, but they are currently inspiring interest in archaeology which is resulting in the further production of non-systematic data in the region that might one day be accessible. It is this kind of data that is mostly employed in this thesis in order to study the activities of pre-Conquest indigenous societies in environmentally variable landscapes.

4.0 Theoretical framework

The theoretical orientation of this thesis is aimed at formulating an analytical frame which helps explain the archaeological record in the focus area. In order to achieve this, it will first present the analytical frame used to harness and combine the available environmental data and represent the environmental variability characterising the focus area. Second, it will evaluate the biases and opportunities of the archaeological dataset, making conceptual adjustments to the analytical units used to interpret the archaeological record. Third, it will examine theoretical models and interpretations that have previously been used in the Andean, Mesoamerican and Central American archaeology for explaining material distributions and exchange across multi-environmental regions. This framework will then form the guiding principle for methodological approach later used for data processing and analysis.

4.1 Landscape and environmental determinism

The availability of environmental datasets opens many avenues for the contextual understanding of the archaeological record. This is often done using GIS, in which environmental and archaeological datasets and their overlaps can be compared, analysed, and visually represented in different ways in space at any chosen scale.

Landscape is concept often used to describe the active background or milieu surrounding the archaeological context in study, which may include environmental features, human activities and their traces. Landscape can rightfully be called a “usefully ambiguous concept”, which “both invites and defies definition” (Gosden and Head 1994, 113). It is used differently in various disciplines, ranging from geography to sociology and archaeology. The concept can refer both to quantified physical entities such as the topographical terrain in which agents dwell, as well as more conceptual and abstract entities, such as the humanised and experienced world, or even a world in which these different meanings merge into one another (Hu 2011, 80; Kolen and Renes 2015, 12; Thomas 2013, 168). Although there might be a shared, inexplicit understanding of landscape in different disciplines and academic foci, it has no fixed definition. Therefore, landscape is convenient for this thesis which relies on multiple spatially understood elements in order to interpret the archaeological record and can now be combined behind a single concept. However, the ambiguity of the term also warrants a definition, specifically tailored for the purposes of this thesis.

As such, the concept of landscape is used here to mean the active scene of the past human activities that created the archaeological record under study. The elements of this scene, including the human activities, both shape and are shaped by each other. That scene is represented and understood through data available in various resolutions and scales, including geographical features, such as topographical terrain and hydrology, the ecological zones defined (mostly) by a variable climate, possible references from historical sources and finally the archaeological record, which' distribution is delimited in space. Yet, it is not the landscape which is the direct object of study in this thesis. The main focus is on the past human activities and how these were shaped by the landscape as here understood, which includes other human activities taking place therein. Landscape is therefore principally used as a medium or "analytical frame" through which the object is studied under the "productive tension" of the elements held in the landscape (Thomas 2013, 167-169). It is also used as a heuristic expression to visualise observed patterns. In that case, the landscape, as a construct made up of overlapping spatially reorganised elements, will be visually represented as maps in which different aspects can be highlighted according to different analytical needs. The thesis will differentiate between the "past landscape", the hypothetical re-construction of past activities and their environment between A.D. 300 – 1550, and "current landscape", a representation of current environmental and land-use patterns in which the archaeological record is examined in the light of current (post-depositional) processes, activities and conditions.

Since the bulk of what is being used to construct the past landscape is (non-human) environmental data as conceptualised by western science and is easily compatible with a GIS approach, it is invariably burdened by a degree of environmental determinism. In order to substantiate this and nuance it, ethnographic approaches and inferences from ethnohistoric sources are used, although these too have biases. Currently, some GIS methods to limit the degree of environmental determinism do exist, such as viewshed analyses that try to take into account human cognition and the perception of the topographical landscape (Hu 2011, 84). Viewshed analysis and ethnographic research, however, are beyond the scope of this thesis. But even though studies into human cognition of landscape cannot be applied in this thesis, this does not mean the analysis in this thesis will be wholly environmentally deterministic and ethnocentric. Archaeological remains, even when analysed through GIS using environmental data, are not just evidence of human activities taking place at certain locations because the environment, conceptualised in western scientific terms, determined so. The choice for these locations was also a social, human choice, and as proposed in chapter 2, much of the environment of the focus area was likely the subject of restructuration by human agents. A sound analysis of past human activities could therefore not rely solely on the past landscape and the environmental data, as it is known that the paleoenvironment cannot be satisfactorily reconstructed at this time. A use of GIS does not mean rendering the analysis environmentally deterministic, as the overall analysis can look past the information that is available through the technical analytical frame. Background archaeological knowledge (chapter 3) and theory will provide for ample counterweight avoiding overdependence on environmental data. The GIS generated landscape can in this sense also help to see to what extent human behaviour, and the material distributions it left behind, deviated from the boundaries that one might expect the environment to impose on the societies and their activities in the focus area.

4.2 Limitations of and adaptations to the archaeological dataset

The non-systematic survey data used in this thesis is too limited to answer research questions on a local scale, such as those about settlement patterns and settlement hierarchies. Indeed, the data necessary to answer such questions would ideally be collected with those particular research questions in mind, related to a prepared theoretical framework and systematic sampling method.

In the currently available dataset, however, the survey data has been collected with no specific research question in mind, as its aim has been to stimulate local and municipal interests and efforts for preserving the archaeological heritage of the region. As the data collected was mainly based on local knowledge, the distribution of archaeological sites that have been documented is likely to be heavily influenced by current land use patterns and road networks in the current landscape. Before studying the traces of past activities in terms of the past landscape, the effect of current human activities and other post-depositional processes onto the archaeological record must thus be evaluated and understood. Indeed, this is always important when analysing any surface finds (Binford 1979). However, the importance increases when working with non-systematically sampled data, as conditions in the current landscape are likely to have affected the sample more in non-systematic sampling methods due to convenience factors. Nevertheless, taking this into account through a thorough comparison of distributions of land use patterns and the distribution archaeological remains can detect biases relatively easily. Doing so has yielded results in previous studies working with non-systematically collected surface data in Europe (Massagrande 1994; Wanslebeen and Verhart 1998).

These limitations and biases of a convenience sample also has some merits. Following current land use patterns, which nowadays include most elevation ranges and landforms, the data is less restricted to riverbanks and valleys, where some of the previous researchers have focussed their surveys (Espinoza *et al.* 1994; Fletcher 1994). Also, the distribution of documented archaeological sites and finds span across an environmentally diverse area, with a wide range of elevations, climates and ecological zones, factors which can be included in the analysis.

In order to optimally study the archaeological record and compare spatial distributions with other elements in the past landscape, the main analytical unit of "site" should be reconsidered. In the technical reports that provide the data for this thesis, the archaeological record is marked on a topographical map as "sites". In practice, these refer to uninterrupted spatial distributions of archaeological finds on the surface, implying a functional association. These sites are often poorly defined in space for two reasons. One, because the delimitation of these sites relies solely on the surface record, and two, because the only georeferenced spatial recording of these sites is only an estimate of their central point. So called nonsite archaeology or siteless approaches would propose the artefact as the smallest unit of analysis on the landscape instead of the site (McDonald 2015, 21). Many of these approaches call for rigorous methods to systematically survey the terrain surface and document every artefact on the surface to analyse their distributions at different scales (Ebert *et al.* 1987, 169-171; McDonald 2015, 21-24). Unfortunately, the archaeological data used in this thesis has not been recorded in a systematic and quantified manner that allows analysis as proposed by many of the siteless approaches.

However, the site as an analytical unit can still be substituted with more flexible units. Different find categories attributed to the sites that have been recorded in the technical reports can be "extracted", accepting the georeferenced site location as an approximate find location for each find category reported at the site. For most find categories, such as lithics, grinding tools, ceramic or obsidian, only the presence on a nominal level has been noted for each site and no quantified information is available. For ceramics, the presence of a certain type-variety is named if recognised. For most sites, larger objects such as monoliths or mound structures have been counted. Choosing the find category as the main unit of analysis and keeping these categories separate allow their distributions to be examined one at a time in their own resolutions or in different combinations, allowing more information from the archaeological record to be visualised on the past landscape in more versatile manners than with sites as the analytical units (see following chapters). The overlap of different find categories at the same location can still be represented visually, allowing the consideration of their supposed functional cohesion.

Lastly, an important limitation to the archaeological dataset, as pointed out in the previous chapter, is chronology. In the focus area ceramic sequences are incomplete, no radiocarbon dating has been conducted and most of the archaeological data comes from what can be seen on the surface. Although the presence of better-known ceramic types from

Pacific Nicaragua might offer some temporal pointers, little can be done about accurately placing different archaeological distributions and finds into a timeline. The interpretation of the archaeological data will therefore focus on the spatial instead of the temporal, as despite the chronological problem, something can still be said about the spatial spread of certain spheres of activities, represented by different finds.

4.3 Mechanisms of exchange and zonal complementarity

As mentioned above, interpreting the spatial distributions of different find categories will not be done solely in terms of the past landscape and the environmental data. The interpretative frame needs to be widened by examining interpretations and theoretical models used in past archaeological research in the Americas incorporating useful elements that help explain the archaeological record of the focus area. The ideas presented below are particularly useful when considering why certain finds might be distributed in a certain way covering larger swathes of space and across different ecological zones.

On both a regional and macro-regional level, spatial distributions of similar finds in the archaeological record of Nicaragua, such as ceramics of the same type-variety, have predominantly been explained as representing networks of interaction between pre-Columbian groups (Braswell *et al.* 2002; Espinoza *et al.* 1996; Espinoza *et al.* 1994; Fletcher and Salgado 1994). Observations on similarities or dissimilarities in material culture have led to interpretations of political, economic and ethnic unity or disunity between the peoples spread across the Central American Isthmus and their movement across time. In terms of pre-Columbian Nicaragua, such interpretations have been based on studies of settlement patterns (Espinoza *et al.* 1996; Fletcher 1993; Steinbrenner 2010, 100-103), ceramic and lithic assemblages (Braswell 1997; Lange *et al.* 1992) as well as linguistic and ethnohistoric sources (Carmack and Salgado 2006; Ibarra 1994).

As discussed in the previous chapter, similarities observed in the distribution of various find categories have supported the proposal that pre-Columbian Nicaragua was to some extent part of larger culture areas such as Mesoamerica (as discussed above), or subareas such as the Greater Nicoya or the Greater Ulúa Matagalpa areas. These culture areas also function as concepts for examining interregional economic and political interaction through a world-systems theory lens, where the analysis lies on the interaction between a central core and its periphery (Wallerstein 1979; 1991). Seen through this frame, Nicaraguan regions often fall into peripheral or frontier zones that are extra-systemic to Mesoamerica (Braswell 1997; Braswell *et al.* 2002; Carmack and Salgado 2006; Fletcher 1993, 3; Lange 1984; for Honduras see Joyce 1986). This is because of the observed high fragmentation in similarity between zones south-east of the Mesoamerica as interpreted from the material record (Braswell *et al.* 2002, 35; Lange *et al.* 1992, 270). The dissimilarity within these zones, even existing on a subarea level, has often lead to reconsiderations about how to relate the Greater Nicoya culture area to the Mesoamerican region (Braswell 1997, 29; Carmack and Salgado 2006; Lange *et al.* 1992, 268). However, the purpose of this thesis is not to evaluate the position of the focus area within wider cultural area denominations. Instead, the question of focus here is rather what the similarity or dissimilarity in material culture mean in terms of political, economic, or even ethnic interaction.

Geurds and Van Broekhoven (2010, 54) have argued that dissimilarity between the material culture of neighbouring areas does not have to mean a lack of interaction between them, but that instead “differences were actively maintained”. Indeed, the active interaction between heterogeneous and to a significant extent autonomous groups has received attention also amongst other researchers in Nicaraguan “frontier” areas (Braswell 1997; Fletcher *et al.* 1994, 178; Lange *et al.* 1992, 277). An example of this is down-the-line trade, which Braswell (1997, 21) suggests characterises the interaction between groups bordering the Mesoamerica culture area proper. According to Hoopes (1993, 276), the role of this type of exchange is to “support a complex web of social relationships, bolstering insecure hierarchies and cementing relationships between groups that might otherwise be in conflict”. These models are often based on the movement of goods, such as obsidian or white-slipped polychrome pottery, that represent a small proportion of the overall material assemblage in most of areas, including the North Central region (Geurds and Van Broekhoven 2010, 68; Espinoza *et al.* 1994, 170; Espinoza *et al.* 1996; 113). Therefore, models on the circulation of foreign goods only provide a limited understanding of the local context embedded in a patchwork materially, and probably culturally, heterogeneous zones. This situation is not unique for the North Central region, and Geurds and Van Broekhoven (2010, 66) describe the local scenario in the Central Nicaragua Chontales region as follows:

> “…a great deal of variability in social, political, and economic organization is noticeable on the local level. Much of this observed variability appears to be related to basic differences in adaptive strategies and spatial organization, and can be seen as characteristic for dealing with the mosaic pattern of environmental diversity that characterizes Central America. Against these kinds of social and economical backgrounds, contrasts in material culture can arise, but what kind of dynamics are at play between them is one of the questions that certainly still needs to be addressed more profoundly.” (Geurds and Van Broekhoven 2010, 66).

The quote underlines the need for further investigations into the dynamics between the heterogeneous areas, but it also indicates a link between the emergence of local cultural expressions as a result of adaptive strategies to their specific environments. Indeed, such a suggestion is highly important in terms of this thesis, as it attempts to explain material distributions in the past within an environmentally highly diverse landscape. Using the environmental landscape as an analytical frame to explain archaeological distributions might be a relatively novel approach in Nicaraguan archaeology, but it has been used in more explicit ways elsewhere in the archaeology and anthropology of the Americas. Therefore, it is useful to further examine models where cultural expressions and exchange patterns in the archaeological record are viewed across different environmental zones.

The Andean region has a longer tradition in examining archaeological distributions across variable environmental zones. John Murra's (1972) model on the vertical archipelago proposes that Andean societies established colonies in different ecological zones to gain access to a wider variety of resources for the benefit of their subsistence base, resulting in an "archipelago" of different ethnic enclaves across different zones (Buren 1996, 338; Stanish 2005, 227; Storey and Widmer 2001, 23). In more recent models, now referring to "zonal complementarity", the exploitation of multiple environmental zones is still the focal point. However, these models also emphasize the role of exchange between more independent colonies, polities and ethnic groups (Buren 1996, 348; Stanish 2005, 230; Storey and Widmer 2001, 24). Although the Andes region has so far been the main locus for testing the zonal complementarity models, its proponents argue that it is not unique to the Andes, as the use of colonies and complex exchange relationships to widen the subsistence base and acquire goods from other zones is common throughout the world and through time (Brush 1976, 130; Stanish 2005, 231). This has not, however, meant that zonal complementarity models have gained a strong foothold in other ecologically diverse regions of the world, at least not under that name.

In Mesoamerican cases, a similar emphasis has generally been adopted in different geographical approaches. These look at regional or microgeographical variation, such as in the Valley of Mexico or the Maya Lowlands, promoting community specialisation and local exchange (Grove 1991; Storey and Widmer 2001, 25). Also, the identification of "central places" (Christaller 1933) or "centrality" has been important in taking into account settlement location in terms of its immediate environmental zones, as well as its location vis-à-vis other settlements of hierarchical and economic importance (Brown and Witschey 2001; Lange 1984, 56).

Figure 11: Aztec Pochteca trade route across Nicaragua according to Incer (1985, 378). The route crosses the focus area from the Estelí valley into the Sebaco valley, and then onwards from Río Grande de Matagalpa watershed to the Lake Nicaragua (Lake Cocibolca) watershed.

In general, however, long-distance and elite exchange have been the foci in Mesoamerican archaeology and to a significant degree in Central American archaeology as well (Hoopes 1993; Storey and Widmer 2001, 26). As an idea, long-distance elite trade might be informing to this thesis to some degree. For example, Incer (1985, 377-378; 2003, 124) has proposed based on ethnohistoric sources and toponyms that an Aztec *Pochteca* merchant trading route crossed from the Coco watershed into the Grande de Matagalpa and San Juan watersheds (see fig. 11) in the south-western part of the focus area. Similarly, Balladares (2013, 92) suggests an exchange route stretching from the Río Coco headwater area (see section 3.3) to the Caribbean coast along the Río Grande de Matagalpa based on the distribution of the Segovias Naranja ceramic type. As discussed in chapter 3 (section 3.3), however, archaeological evidence based on obsidian so far points to more indirect down-the-line scenarios, which seem more compatible with approaches of zonal complementarity as well as microgeographical variability on more local scales. Closer studies on the preliminarily established Segovias Naranja type as well might come to the same conclusion, with the possibility that more locally based variations of this type exist (with differing chronologies), which would take weight off the argument for a direct, longer distance trade route. Ultimately however, the possibility that longer-range trade routes traversed pre-Conquest North Central Nicaragua persists.

There are more archaeological references suggesting the potential importance of zonal complementarity in Central American context as well, at least between adjacent zones. In the highlands of eastern Honduras, Begley (1999, 192) suspects the largest sites to be located close to the juncture of valley and the mountains in order to benefit from both ecological zones and notes this settlement pattern to be present elsewhere in eastern Honduras as well (Begley 1999, 197, 201). On a larger scale, the peoples along the Central American Caribbean coast seem to have been preferred contact and exchange to inland areas instead of forming networks of exchange along the ecologically similar coastline (Geurds 2011, 49; Lange 1984, 35). Lange describes how the people in the Meseta Central in Costa Rica benefitted of easy access to both the Pacific and Caribbean coasts, as seen in the variety of material recovered from relatively large sites with long occupation periods (Lange 1984, 49-50).

Such archaeological references demonstrating centrality or interzonality are currently lacking for the specific focus area of this thesis, but a brief survey of historical sources would suggest the validity of zonal complementarity models for the focus area as well. Ibarra (1994, 237) notes that 16th century sources mention the Chondal peoples bringing *tile*, a fine carbon extracted from pine wood, to the market places of the Pacific region to trade. There is even mention of the Chondal maintaining a salt refinery on the Pacific coast as well as a possible enclave in Masaya on the Pacific mainland (Carmack and Salgado, 222; Ibarra 1994; 238). In the 19th century, the English explorer Thomas Belt (1911, 182, 227), observed indigenous peoples from Matagalpa travelling through the area of Matiguás and Muy Muy, where rain had been plenty, to buy maize as the crop had failed due to drought in their home area only a few dozens of kilometres north-west. According to Newson (1987, 67), pehibaye or peach palm (*Bactris gasipaes*), was an important crop to the 18th century indigenous Matagalpans, as it is to the Mayangna today. This fruit is still traded from the tropical humid eastern parts of the Matagalpa department to flood the markets of the department's dryer capital area across the orographic divide. These sources suggest that, at least in historical times, zonal complementarity seems to have been an important principle in the North Central region for the provision of both special and subsistence goods. Making use of nearby ecologically different zones was likely to be an important trend in the focus area during pre-Conquest times as well. Although the above-mentioned goods are perishable and not easy to find the archaeological record, the finds considered in this thesis and their exchange could be considered as a proxy for the exchange of more goods, including perishables.

Used here as a flexible heuristic umbrella for different interzonal interaction models, zonal complementarity suits the purposes of this thesis well. First of all, it considers ecological diversity as a factor in the distribution of the archaeological record, which is fitting for a preliminary examination of the past landscape of the focus area in which environmental factors and their variability dominate. Second, it contributes to explaining fragmentary distributions as well as more uniform patterns in the material record across the past landscape, as both community specialisation and the "colonisation" of different ecological zones by the same group are considered. Third, zonal complementary can be applied at multiple scales and therefore is compatible with both local and interregional models of exchange. Here also the role of "prestige goods" can be considered together with subsistence goods in the context of "complex webs of social relationships between groups" (Hoopes 1993, 276) that operate within various ranges. Finally, adopting zonal complementary in the theoretical and interpretative framework has useful implications for future research. Different aspects of zonal complementary models are testable through various lines of evidence. For example, paleoenvironmental studies can improve knowledge about past environmental variability. A focus on foodways, such as through starch analysis or carbon isotope analysis, can determine important staple foods to evaluate to what extent communities where self-sustainable within a given ecological zone. Practice theory-based analyses on pottery and mound-building practices could help shed light on local group identities and ethnicity, which, when same practices are detected in different zones, could tell much about a group's ecological adaptability or inter-group social interaction and exchange. Although these studies are obviously beyond the scope of this thesis, it can contribute to preparing the ground contextually for more specialised future research in the region.

4.4 Theory: Conclusion

This thesis adopts a theoretical orientation that is both flexible and compatible with foci that have guided research in neighbouring regions, which accounts for an environmental focus examining human activities in the past landscape while remaining aware and open to human agency. A comprehensive framework of zonal complementarity is adopted here to view interzonal interaction, which will consider a wide array of possibilities in how people have chosen to interact with those within or outside the ecological zones in which they have settled. This allows for the preliminary testing of various interzonal models discussed above, such as colonization, exchange, long-range trade, specialization and the active maintenance of differences, against the archaeological data in the past landscape of the focus area. As such, a focus can be set upon viewing the past human activities, as indicated by the material remains and their distributions, in terms of the challenges and opportunities offered both by their immediate environmental surroundings as well as by the cultural and historical context which includes the neighbouring regions. Following the theoretical framework, the methodology will focus on adapting the data from technical reports to fit the analytical frame chosen for this thesis, a process which will be discussed in the next chapter.

5.0 Data and methodology

The analysis of the archaeological data relies on the examination of find distributions across the past landscape expressed on maps that are heuristically optimised for visual analysis. The methodology will include the preparatory phases for digitising and adapting both the archaeological and environmental data into formats which can be read, compared and overlapped in GIS and spreadsheet software. This chapter will explain how the data from different sources is combined and which heuristic principles behind the visualisation of the data are used. The process mainly employs Quantum GIS, SAGA GIS and MS Excel as main software, although different combinations of equivalent software can be used to achieve the same results.

5.1 The archaeological data

The archaeological information that is available in the technical site reports and publications and will be accounted for is the following:

- Site name and code
  In most of the cases a name has been given to the site by its documenters. These sites have also been given a code that is either designated by the INC (Instituto Nicaragüense de Cultura) or a preliminary code given by the documenters.

- Site type
  A category that does not specify a function. This mainly reflects the main characteristic of the site, such as “mound site” or “material on the surface”.

- Mounds
  Information on mound structures is available in different degrees of resolution. In the best of cases, their size, orientation, shape, construction material, number and distribution has been documented. However, in many cases only their presence has been mentioned.

- Ceramics
  In general, no systematic collections with quantified data is available for ceramics. Exceptions include three sites where test pits were excavated in the fringes of the Sébaco valley and their results published and systematic surface collections from three sites in El Tuma La Dalia (Espinoza et al 1994, Finlayson 1996, Koschmieder

and Gaméz 2006, Uosukainen *et al.* 2016). The presence of ceramic types is either designated by the name of their type-variety or under a preliminary description. It is very likely that some of these shards would under closer study be associated to known types, especially those with a white or red slip. Some ceramic finds with exceptional incised patterns have also been noted if encountered at multiple locations. Although these possibly new types are preliminary, it is helpful to compare their distributions with those of known types. If no degree of classification has been done, ceramics are usually described by colour and degradation, and designated as unknown, non-diagnostic ceramics.

Quantified data on ceramics will be disregarded in the data homogenisation as this not available in the vast majority of cases. Finally, it is important to mention that after his riverine survey of the Río Viejo in the Sébaco Valley, Edgard Espinoza Perez has instructed the identification of ceramic type-varieties in most of the surveys within the survey area (Balladares and Lechado 2008; Balladares and Rivera 2011; Espinoza *et al.* 1994). Therefore, most of the ceramics have been identified along the same procedures and criteria.

- <u>Lithics</u>

  As with ceramics, lithic finds have not been systematically collected or quantified. The presence of lithic find types (fragment, flake, blade, nucleus or biface) and their material (a chert type, basalt, quartz or obsidian) is mentioned in most cases. In many cases the use of the type categories is inconsistent. In the case of obsidian, it is unsure in most cases if fragments might sometimes refer to nodules, cobbles or another type of fragment. This information would be useful to have distinguished as cobbles and nodules are typical for the Güinope source, for example (Quinn *et al.* 2014, 5). Also, in the case of bifaces, it is not always clear whether this refers to large, axe-type tools or smaller arrow heads.

- <u>Grinding tools</u>

  Grinding tools, such as mortars, pestles and grinding stones, are often mentioned, but seldom in numbers.

- <u>Monoliths</u>

  Monoliths refer to large, usually longitudinal, movable stone objects, which at times show some degree of sculpting or paint (Minami *et al.* 2014; Finlayson 1996). Monoliths are probably derived from columnar basalt or andesite, of which sources have at least been detected in El Tuma La Dalia (Uosukainen *et al.* 2016, 6). These are not to be confused with fully elaborated and sculpted statues, which have so far not been detected in situ during the surveys themselves. As the reports do hint to probable original statue locations, they will be included. Monoliths have been counted at each find location in most cases.

- Statues

  Statues are a much discussed archaeological find amongst local enthusiasts, and a number of possible locations have been mentioned for their origin (Kühl 2010). In most cases, however, the exact provenience of these statues has never been tracked down. The original number of statues at the site location, if known by locals, is mentioned in the reports.

- Petroglyphs

  Petroglyphs are seldom quantified and although in some cases photographs have been taken, their iconography has usually not been described or discussed.

- Caves

  Caves have been documented at many locations with or without archaeological evidence of human occupation or use.

- Rock shelters

  Rock shelters are distinguished in the reports from caves due to their shallow depth in comparison to the caves.

- Rock paintings

  Rock paintings, so far documented, have been made using red paint, as described by Baker and Armitage (2013).

- Elevated platforms

  Elevated platforms are observed to be completely artificial, instead of an adaptation to or consolidation of natural landforms (see below). It is uncertain how the category of elevated platforms differs from more commonly documented rectangular mounds. However, these have been visualised as separately, since a distinction has been made between them in the field and the documentation process. These have also been described in adjacent departments to the north-west (Fletcher and Salgado 1994, 183).

- Landform levelling or consolidation

  Different types of landform consolidations and levelling activities have been mentioned in the reports. In some cases, these refer to small hilltops that have clearly been levelled to host other activities. In other cases, these refer to alluvial terrace consolidations. These are characterised by a stone facing of a natural feature formed by the movement of the river and deposition of alluvial sediments. The stone facing consolidating these natural landforms have until now found to be consisting of different sized stones readily available in the adjacent rivers. The spaces protected by these consolidations, sometimes called terraces, in most cases host mound structures, but in some cases are also found without them (see also Fletcher and Salgado 1994, 183).

- Non-defined stone and earth features

  At a few locations, small accumulations of stone and earth have been documented as artificially produced features. There is no cohesive description of these features, as they vary in size and form. They have not been categorized as mound structures for their small size (<3m in diameter). Similar features have been described in the Chontales region, where possibilities for their formation as a result of post-Conquest processes have been considered, such as the removal and redeposition of stones out of the way of agriculture (Vlaskamp 2014, 47). In El Tuma La Dalia, one site exhibited small stone and earth accumulations next to pits of the same dimensions, suggesting the accumulations being a direct result of the digging of these trenches. For another location in El Tuma La Dalia, similar accumulations without pits were suggested to be funerary tombs for their ovalar shape and dimensions that would conveniently cover a human body. In the last instance, this category serves to highlight features that require further research into their relation to other archaeological features, which have until now always been found at the same locations.

  As with the accumulations, non-defined stone alignments represent features that have so far eluded explanation. Rarely measured, it is unknown whether these are remnants of pre-Conquest mound structures, landform consolidations or other artificial structures, or whether they are completely unrelated to pre-Conquest activities. Nevertheless, they have been included as to be representative of the documentation process carried out in the field, distinguishing between stone or earth accumulations and alignments.

- Site preservation
  When an evaluation of a site's preservation has been made, this has been expressed in three ordinal values from poor to good.

- Current land use of site location
  The reports often briefly describe the current land use context in which the site was found and recorded, which can be noted textually in the briefest possible manner.

5.2 Environmental data

In addition to archaeological data, the dataset will be complemented with freely available environmental data. This fill the gaps left by the reports concerning environmental contextual information on the find locations. Although not all the additional environmental information is directly necessary to answering the main research question of this thesis, adding this information will allow to create a comprehensive template for a potentially growing dataset of archaeological find locations serving future archaeological research interest.

- Hydrology
  The hydrological network consists of major rivers, tributaries, creeks and other stationary water bodies. This data includes detailed information about water bodies, some of which have disappeared today but can be included in the dataset for the past environment. This especially applies to small creeks, that have recently dried out as a result of climate change and deforestation. On the other hand, some water bodies are known to be artificial and dating from recent times. This includes the lake of Apanas in the southern end of the department of Jinotega created for hydroelectric purposes using the headwaters of the Río Tuma. Using earlier maps from the 1960's (see fig. 6 in chapter 2), the original course of the Río Tuma will be reconstructed. Similarly, the irrigation canals in the valley of Sébaco (western Matagalpa department) built in recent times will not be visualised in the past landscape. On the scale of the entire focus area, the total hydrological network constitutes a complex major visual feature, which needs to be reorganised ordinally for both analytical and heuristic purposes. In this thesis, the hydrology is split into permanent wide main rivers, permanent

tributaries or streams, seasonal streams and lakes. The proximity of the sites to these water bodies are added as an attribute to the archaeological dataset.

Apart from the network of waterbodies and rivers, this thesis also considers the watershed basins (also known as catchments), which are the drainages that channel water towards a particular point, determined by the topography of the area (Wagener *et al.* 2007: 902). The scale chosen here is specific to the focus area and the major rivers flowing through it, delineating the drainages that contribute to them. The GIS tool used here to delineate the watershed basin is the Fill Sinks tool developed by Wang and Liu (2006) in SAGA GIS. It makes necessary adjustments to the DEM (Digital Elevation Model, see below) to accurately calculate the limits of the (macro) basins within the area given by the spatial extension of the DEM.

- <u>Land form</u>

  Land form information will be derived from the NASA JPL 30m (1 Arc second) resolution Shuttle Radar Topographic Mission (SRTM) DEM by performing a land form classification in GIS software. In this case, the TPI (Topographical Position Index), developed by Guisan *et al.* (1999) and Weiss (2000), is calculated using SAGA GIS. This is done with a 1000m neighbourhood to determine the relative position of each raster cell of the DEM within this range. As a result, the DEM is newly categorised into zones highlighting different landforms such as river valleys and hilltops. To complement the more limited information provided about land forms in the reports and to add to the dataset, this information was categorised into slope position and land form categories.

- <u>Modern day tree canopy cover and land use</u>

  This data is used to compare current land use and tree cover patterns with the distribution of archaeological sites. The tree canopy cover data (Hansen *et al.* 2013) has been re-categorised into 0-20%, 20-40%, 40-60%, 60-80% and 80-100% tree coverage for the purposes of this thesis.

The sources for both the archaeological and environmental data are summarised in the table below.

Table 3: Sources used in data analysis

Data source	**Description**
Reports and publications	Technical reports, manuscripts or publications by the following authors: Balladares and Lechado 2008; Balladares and Rivera 2011; Cruz Olivas 2013; Espinoza *et al.* 1994; Finlayson 1996; López García 2015; Uosukainen *et al.* 2016
Municipal data	Spatial vector data of the Matagalpa and Jinotega departments, their municipalities, hydrology and geography shared with author by the municipality of El Tuma La Dalia. Apart from municipal boundaries, this data is mostly derived from 1:50 000 topographic maps produced by INETER, complemented by digitised features from Google satellite imagery.
OSM	Open Street Map spatial data on roads, rivers and other features in their current state
NASA SRTM 30m DEM (NASA JPL 2013)	Digital Elevation Model generated by NASA's Shuttle Radar Topography Mission at 30m resolution
NREL 2010	Data on land use and hydrology compiled and published by NREL (National Renewable Energy Laboratory), most of which has been derived from data handed over by the Nicaraguan Comision Nacional de Energia in 2004.
Hansen/UMD/Google/USGS/NASA	Tree canopy cover from year 2000 from: Hansen *et al.* (2013)

5.3 Data combination and corrections

Combining archaeological and environmental data entails extracting and combining information from the different sources into a digital spreadsheet. The spreadsheet will be saved in CSV (.csv) file format, which is readable by most GIS software, where the data can be projected in space according to the given coordinates. In the GIS programme, the

CSV will be converted to a vector file format (computer-drawn and measured shapes with attribute data in textual or numerical form), in this case ESRI shapefile (.shp), which opens more possibilities of editing, visualising and organising the data. The contents of the spreadsheet, the units used and the sources of each type of data are presented in the following table (table 4).

Table 4: Structure of the dataset

Field name	**Content description**	**Type of data**	**Data source**
ID	Unique numeric ID given for each find location	Number	Author
SITE_N	Name as given in Reports	Text	Reports
CODE_SITE	Official site code as designated by INC	Text	Reports
CODE_PREL	Preliminary site code used by documenter if not yet designated by INC	Text	Reports, Author
N_MUNIC	Municipality in which the find location is located	Text	Reports, Municipal data
DOCUMENTED	Author(s)/reporters and year	Text	Reports
X_COOR	Longitudal coordinates of estimated central location of the site in projection NAD 27 / UTM zone 16N	Number	Reports
Y_COOR	Latitudal coordinates of estimated central location of the site in projection NAD 27 / UTM zone 16N	Number	Reports
ELEV_GPS	Elevation in meters measured in the field using a hand-held GPS device	Number	Reports
ELEV_DEM	Elevation in meters given by Digital Elevation Model	Number	NASA SRTM 30m DEM
LANDF_DOC	Landform description as /if given in the Reports	Nominal category in text	Reports
LANDF_TPI	Topographic Position Index based landform classification with 1000m neighbourhood	Nominal category in text	NASA SRTM 30m DEM
TPI_SLOPEPOS	Topographic Position Index based slope position with 1000m neighbourhood	Nominal category in text	NASA SRTM 30m DEM
INCL_DEG	Inclination in degrees	Number	NASA SRTM 30m DEM
PWRIVER_PROX	Proximity in meters to permanent wide stream	Number	Municipal data, OSM data, NREL 2010
PWSOURCE_PROX	Proximity to permanent water source	Number	Municipal data, OSM data, NREL 2010

ANYWSOURCE_PROX	Proximity to any water source, including seasonal	Number	Municipal data, OSM data, NREL 2010
EXT_SITE	Estimated extension in square meters of site as/if given in report	Number	Reports
CHAR_SITE	Main site characteristic as given in report	Text	Reports
PRESERV_SITE	Preservation state of site as/if given in report	Ordinal category in text	Reports
MOUNDS	Presence of mound structures	Binary, yes (1) / no (0)	Reports
STRUC_OTH	Presence of structures other than mounds	Binary, yes (1) / no (0)	Reports
CAVE	Presence of caves	Binary, yes (1) / no (0)	Reports
ROCK_SH	Presence of rock shelters	Binary, yes (1) / no (0)	Reports
CER	Presence of ceramic finds	Binary, yes (1) / no (0)	Reports
LIT	Presence of lithic finds	Binary, yes (1) / no (0)	Reports
GRD_ST	Presence of grind stones and pestles	Binary, yes (1) / no (0)	Reports
PETR	Presence of petroglyphs	Binary, yes (1) / no (0)	Reports
OST	Presence of osteological remains	Binary, yes (1) / no (0)	Reports
PAINT	Presence of rock paintings	Binary, yes (1) / no (0)	Reports
PALEO	Presence of paleolontological finds	Binary, yes (1) / no (0)	Reports
STAT	Presence of statues	Binary, yes (1) / no (0)	Reports
MONOL	Presence of monoliths	Binary, yes (1) / no (0)	Reports
NOTES_GEN	General comments on site/find location	Text	Reports
SEG_NAR	Presence of Segovias Naranja ceramics (A.D 300 – 1430)	Binary, yes (1) / no (0)	Reports
PAPAG_P	Presence of Papagayo polychrome ceramics (A.D. 800 – 1350)	Binary, yes (1) / no (0)	Reports
PATAKY_P	Presence of Pataky polychrome ceramics (A.D. 800 – 1350)	Binary, yes (1) / no (0)	Reports
MOTUSE_EST	Presence of Motuse Striated ceramics (A.D. 600 – 800)	Binary, yes (1) / no (0)	Reports
VALLEJO_P	Presence of Vallejo polychrome ceramics (A.D. 1350 – 1550)	Binary, yes (1) / no (0)	Reports
ULUA_P	Presence of Ulua polychrome ceramics (A.D. 300 – 800)	Binary, yes (1) / no (0)	Reports

COMBO_COL	Presence of Combo colador ceramics (A.D. 1200 – 1550)	Binary, yes (1) / no (0)	Reports
OM_RED_INC	Presence of Ometepe Red Incised (A.D. 1350 – 1550)	Binary, yes (1) / no (0)	Reports
CACAOLI	Presence of Cacaoli red on orange ceramics (A.D. 600 – 800)	Binary, yes (1) / no (0)	Reports
LEON_P	Presence of Leon Punctate ceramics (A.D. 300 – 800)	Binary, yes (1) / no (0)	Reports
SACASA_EST	Presence of Sacasa striated ceramics (A.D. 800 – 1350)	Binary, yes (1) / no (0)	Reports
CASTILLO_ENG	Presence of Castillo engraved ceramics (A.D. 1350 – 1550)	Binary, yes (1) / no (0)	Reports
SANANT_NEG	Presence of San Antonio negative ceramics (A.D. 300 – 600)	Binary, yes (1) / no (0)	Reports
BABILONIA_P	Presence of Babilonia polychrome ceramics (A.D. 550 – 950)	Binary, yes (1) / no (0)	Reports
BANDA_P	Presence of Banda polychrome ceramics (A.D. 1350 – 1550_	Binary, yes (1) / no (0)	Reports
SCH_INC	Presence of Schettel incised ceramics (B.C. 2000 – 500)	Binary, yes (1) / no (0)	Reports
PUERTO_B_R	Presence of Puerto black on red ceramics (A.D 0 – 800)	Binary, yes (1) / no (0)	Reports
CHAVEZ_W_R	Presence of Chavez white on red ceramics (A.D. 300 – 800)	Binary, yes (1) / no (0)	Reports
POTOSI_APP	Presence of Potosi applique ceramics (A.D. 300 – 800)	Binary, yes (1) / no (0)	Reports
CESARES_P	Presence of Cesares polychrome ceramics (A.D. 800 – 1350)	Binary, yes (1) / no (0)	Reports
DELIRIO_R_W	Presence of Delirio red on white ceramics (A.D 625 – 1000)	Binary, yes (1) / no (0)	Reports
USUL_NEG	Presence of Usulutan negative ceramics (B.C. 500 – A.D. 300)	Binary, yes (1) / no (0)	Reports
ND_WSLIP	Presence of non-defined white slipped ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports
ND_ORSLIP	Presence of non-defined white slipped ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports
ND_BSLIP	Presence of non-defined white slipped ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports
ND_RSLIP	Presence of non-defined white slipped ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports
ND	Presence of unidentified non-diagnostic ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports
ND_CONC_VESSEL	Presence of concave shaped ceramic vessel (unknown time period)	Binary, yes (1) / no (0)	Reports
ND_CHEV_INC	Presence of chevron incised ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports
ND_BRAID_INC	Presence of braided incised ceramics (unknown time period)	Binary, yes (1) / no (0)	Reports

TV_TOTAL	Total number of identified type varieties at find location	Number	Reports
MOUNDS_NR	Number of mound structures at find location	Number	Reports
MOUNDS_OR	Evidence of more mounds than counted	Binary, yes (1) / no (0)	Reports
MOUNDS_CIR	Presence of circular mounds	Binary, yes (1) / no (0)	Reports
MOUNDS_OV	Presence of ovalar mounds	Binary, yes (1) / no (0)	Reports
MOUNDS_REC	Presence of rectangular mounds	Binary, yes (1) / no (0)	Reports
MOUNDS_E	Presence of earthen mounds	Binary, yes (1) / no (0)	Reports
MOUNDS_E_S	Presence of mounds of earth and stone	Binary, yes (1) / no (0)	Reports
MOUNDS_S	Presence of stone mounds	Binary, yes (1) / no (0)	Reports
MOUNDS_HEI	Maximum height in meters of mounds at location	Number	Reports
MOUNDS_DIAM	Maximum diameter in meters of mounds at location	Number	Reports
HEAPS_SMALL	Presence of small earthen or stone accumulations at location	Binary, yes (1) / no (0)	Reports
PLATF	Presence of elevated platforms at location	Binary, yes (1) / no (0)	Reports
TERR_PLAT	Presence of levelling or terracing	Binary, yes (1) / no (0)	Reports
CON_RIV	Presence of riverbed terrace consolidation	Binary, yes (1) / no (0)	Reports
ND_S_AL	Presence of non-defined stone alignments	Binary, yes (1) / no (0)	Reports
ART_OTH	Presence of other non-defined structures or artificial formations	Binary, yes (1) / no (0)	Reports
STAT_NR	Number of statues at find location	Number	Reports
MON_NR	Number of monoliths at find location	Number	Reports
NOTES_STR	Additional comments regarding structures	Text	Reports
CHER	Presence of chert finds	Binary, yes (1) / no (0)	Reports
OBS	Presence of obsidian finds	Binary, yes (1) / no (0)	Reports
BAS	Presence of basalt finds	Binary, yes (1) / no (0)	Reports
QUAR	Presence of quartz finds	Binary, yes (1) / no (0)	Reports

FRAG	Presence of lithic fragments	Binary, yes (1) / no (0)	Reports
BLA	Presence of lithic blades	Binary, yes (1) / no (0)	Reports
FLA	Presence of lithic flakes	Binary, yes (1) / no (0)	Reports
NUC	Presence of lithic nuclei	Binary, yes (1) / no (0)	Reports
BIF	Presence of lithic bifaces	Binary, yes (1) / no (0)	Reports
CHER_FRA	Presence of chert fragments	Binary, yes (1) / no (0)	Reports
CHER_BLA	Presence of chert blades	Binary, yes (1) / no (0)	Reports
CHER_FLA	Presence of chert flakes	Binary, yes (1) / no (0)	Reports
CHER_NUC	Presence of chert nuclei	Binary, yes (1) / no (0)	Reports
CHER_BIF	Presence of chert bifaces	Binary, yes (1) / no (0)	Reports
OBS_FRA	Presence of obsidian fragments	Binary, yes (1) / no (0)	Reports
OBS_BLA	Presence of obsidian blades	Binary, yes (1) / no (0)	Reports
OBS_FLA	Presence of obsidian flakes	Binary, yes (1) / no (0)	Reports
OBS_NUC	Presence of obsidian nuclei	Binary, yes (1) / no (0)	Reports
OBS_BIF	Presence of obsidian bifaces	Binary, yes (1) / no (0)	Reports
BAS_FRA	Presence of basalt fragments	Binary, yes (1) / no (0)	Reports
BAS_BLA	Presence of basalt blades	Binary, yes (1) / no (0)	Reports
BAS_FLA	Presence of basalt flakes	Binary, yes (1) / no (0)	Reports
BAS_NUC	Presence of basalt nuclei	Binary, yes (1) / no (0)	Reports
BAS_BIF	Presence of basalt bifaces	Binary, yes (1) / no (0)	Reports
QUA_FRA	Presence of quartz fragments	Binary, yes (1) / no (0)	Reports
QUA_BLA	Presence of quartz blades	Binary, yes (1) / no (0)	Reports
QUA_FLA	Presence of quartz flakes	Binary, yes (1) / no (0)	Reports
QUA_NUC	Presence of quartz nuclei	Binary, yes (1) / no (0)	Reports

QUA_BIF	Presence of quartz bifaces	Binary, yes (1) / no (0)	Reports
Sources for ceramic chronologies: Balladares 2013; Fletcher and Salgado 1994; Vasquez *et al.* 1994; Salgado 1996; Espinoza *et al.* 1994; 1996			

The complete dataset has been uploaded to the DANS EASY archive (https://easy.dans.knaw.nl/ui/home). Once published, it can be accessed with the title of this thesis and the following DOI: https://doi.org/10.17026/dans-zzd-jger.

As can be seen in table 4, most of the data has been entered in binary (yes: present vs. no: not present) form. This is because quantified data, as outlined in section 5.1, is not available. Also, should quantified data ever be created for these finds locations, it does not automatically nullify the binary data presented here, as quantified data can be subject to changes. If the presence of certain finds on locations are noted that have been marked as being absent at a location in this database, it can easily be corrected by changing the binary status.

Before proceeding to the visual analysis, steps undertaken to enhance or correct the data will be explained. During the digitising process, inconsistencies in the technical reports are encountered that need to be dealt with in order to integrate the data into a single, digitally readable format. The first inconsistency encountered concerns the elevation of each find location. Elevation data recorded in the field using a commercial hand-held GPS device, as well as elevation data extracted from a DEM are unable to accurately record elevation but should stay within a similar margin of error (±30m). As can be seen in the graph below (fig. 12), the GPS and DEM elevation data are consistent for most find locations. For some locations however, there are great deviations. For those locations, the elevation data was compared with that of a topographical map (INETER), showing that the DEM data was more consistent with the elevation indicated by the topographical map, and that abnormal errors were only detected in GPS recorded elevation data. Also, a GPS recording for elevation was not available for each find location (seen as zero values for elevation in figure 12). Therefore, any analysis needing elevation data should rely on the DEM derived data in this homogenised dataset.

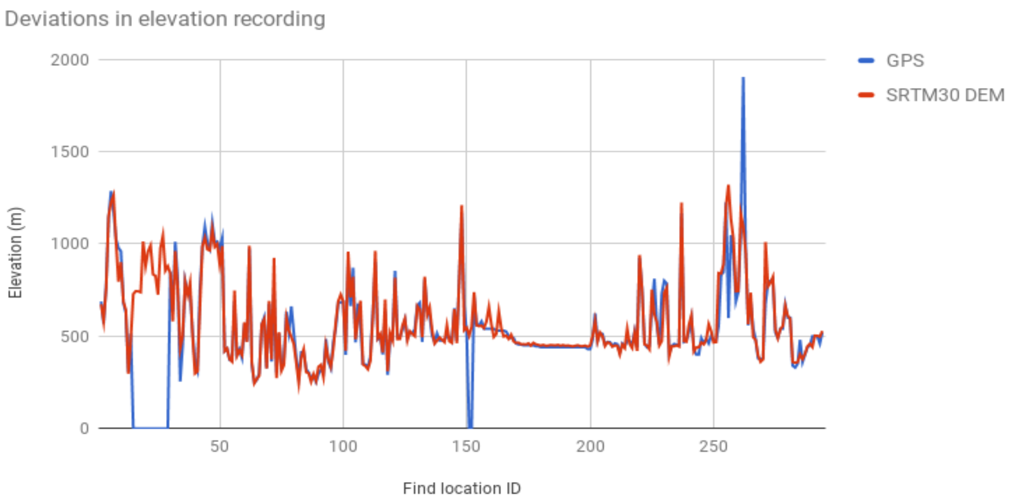


Figure 12: Comparison between elevation data recorded with a hand-held GPS device and elevation data extracted from a Digital Elevation Model (Balladares and Lechado, 2008; Balladares and Rivera 2011; NASA JPL, 2013).

Another possible error to be avoided in the successful combination of data from different reports concerns double entries for the same find location. These have occurred in cases where different communities have led the archaeologists to the same location, or to a location already registered during a previous survey. In most cases, the same site name was given for the double as well as a reference to the previous visit. These later documented doubles are deleted and their information (if anything new was discovered) integrated with the information of the first entry. These actions have subsequently been recorded in the "General notes" field of the spreadsheet.

A common error in the administrative information provided for each find location in the technical reports is reporting the wrong municipality. This has been an easy mistake to make in the field, as the archaeologists have been led to locations by locals, unaware of whether and where they have crossed a municipal boundary. Correcting the administrative information is important, as cultural resource management falls under the responsibilities of the respective municipalities according to the Nicaraguan heritage law (Nicaraguan National Assembly 1982). This information has been updated and the change noted in the "General notes" field using an updated digital layer of municipal boundaries.

Finally, coordinates provided for find locations in the technical reports should be double checked. Errors might occur in the textual technical reports, where a matter of one wrong digit in the coordinate, can push the find location off its real location on the map, leading to inconsistencies with the other information provided, such as the reported community, elevation, vicinity to main road etc. This information is corrected, and the correction noted in the "General notes" field with the originally reported (incorrect) coordinates.

5.4 Method: Data visualisation and analysis

Most of the data has been entered in binary form to indicate the presence of a find category at a find location. Although coding in the data in this way is cumbersome, it makes it easily readable and manipulatable in GIS software, allowing for as many combinations and comparisons in the visualisation and analysis process as possible. Viewing the distributions of different find categories at once can also reveal potentially interesting patterns, such as distributions of certain finds overlapping in a certain area. Theoretically, a vast number of combinations could be viewed and presented, but not all distributions should be visualised at once. This is to avoid a visual chaos which would analysis difficult and therefore only sensible combinations are visualised together thematically, e.g. structures, ceramic types, obsidian finds, etc.

The following is important to consider: As the same data is not available for each find location, only the find locations with the queried find categories will be visualised. Also, the spatial extent of the maps is defined by the extent of all find locations included in the dataset, not the extent of municipal boundaries, which are only indicative of the survey areas but not the results. Some of the survey area boundaries will thus not be visible on the maps. These boundaries can be observed in figure 2. Finally, the pie diagrams visualising find diversity at a location might not accurately pin point the exact find location, as the GIS software is set to avoid overlaps of the diagrams when rendering the visualisation.

The visual analysis process will involve the following steps:

<u>1. Creating a model of expected patterns and zones within the focus area based on environmental information</u>

Looking at the topography, hydrology and landforms will allow to detect and delineate different environmental zones and likely passages from one to another. These are mapped for two reasons. Firstly, analysing the terrain and mapping zones and possible areas and channels of interzonal interaction will make the environmental hypothesis about expected archaeological distributions explicit, adding to what can be later tested against the data. Second, it will divide the focus area in a way that will help referring to specific zones within it, facilitating the description of the spatial placement of the archaeological distributions.

<u>2. Detecting the biases and limitations of the archaeological dataset in the current landscape</u>

In this step, the archaeological find locations will be projected onto the current landscape in order to understand how current land use practices and possible documentation biases have affected data coverage and data reliability. Find locations are visualised equally with the same symbol and colour.

3. Visualisation of the distributions of different find categories in the past landscape

As mentioned above, distributions will be examined in combinations of find categories grouped thematically. Different find categories are represented at different find locations by a circle of a unique colour in each visualisation. If different find categories present themselves at the same location, their simultaneous presence is visualised by a pie diagram with these unique colours in equal segments. As mound structures have been quantified at almost all locations where they have been documented, this quantified data will be represented by differing sizes of the circular symbol according to the number of mounds.

4. Summarising distributions and subarea profiling

In this step, the different patterns observed during the previous step, delimited by line patterns of different type and colour, are visualised all at once. This is done to summarise the results of the visual analysis and better examine the overlaps of all clearly detected patterns. Of the different overlaps that emerge, different material subareas will be loosely defined and described. Visualised against the past landscape and the orographic divide, their relationship to each other and environmental features will be examined to facilitate the discussion leading to the answering of the research question.

The entire analysis is thus based on maps, which will be produced at various stages of each step to facilitate the analysis and discussion of the results.

5.5 Data and Methods: Discussion and conclusion

This thesis largely follows the principles of Tukey's (1977) Exploratory Data Analysis through a visual approach, allowing the presentation and evaluation of data in an efficient and centralised manner. This chapter has outlined how the non-systematic survey data from different sources will be combined into a digital dataset and how this dataset is enriched by freely available environmental data to facilitate future research. An exploratory visual analysis will allow a qualitative approach in which attention is paid to the different environmental contexts within which the distributions may overlap. This method allows answering the central research question making careful and nuanced use of non-systematic data. By producing various maps visualizing the past landscape, a context can be provided for future archaeological finds in the focus area. The limitation of the non-systematic nature of the data and the largely descriptive methodology is, however, that these contexts cannot always be clearly delimited despite guiding environmental boundaries. The statistical significance of the patterns and distributions are therefore hard to assess. However, this method can be expected to bring indicative answers to the research question that provide important testable hypotheses and inform future research in the focus area.

6.0 Data results and analysis

In this chapter the data, as discussed in the previous chapter, will be represented on maps for visual analysis. Here, the results of the analysis will be presented, with the observed patterns highlighted and visualised onto a map to provide a heuristic aid for discussing the data results.

6.1 The past landscape: Environmental zones of the focus area and expected results

In chapter 2, the environment of the focus area was described as well as the likely changes that have occurred in it since pre-Conquest times. In this section, a modelled hypothetical past landscape is shown, which will form the background for data projections in later sections. The major environmental features are indicated in figure 13, so as to facilitate the spatial description of the distributions throughout the chapter. A discussion will follow as to what distributions might be expected based on the environment of the focus area.

The focus area is divided into different watershed basins. Since major rivers were potentially important channels for mobility (riverine transportation and pedestrian navigation) and the diffusion of materials and lifeways, these basins constitute a relevant division of the landscape that is important to consider when studying the spatial distribution of the survey finds. In many areas where the divisions of the watershed basins are paired with considerable topographic obstacles, differences in material distributions can be expected. An example of this is the division between the Viejo and Coco watershed basins, where Espinoza *et al.* (2014: 172) once hypothesised the limit of the Greater Nicoya region based on ceramic distributions.

However, the watershed basins do not always correlate with the topographic divisions of the landscape. The Río Grande de Matagalpa watershed basin is divided by a mountain chain roughly running north to south. This also coincides with the orographic and climatic divide, which is modelled here based on the topography and current climatic divides, as presented in figure 4 in chapter 2. The Sébaco valley seems like a hydrological oddity when observed on the scale of the focus area, as the same valley is shared by two watershed basins without a considerable topographic divide. It is likely that in these cases the watershed basin limits will be found not to be a dividing factor behind differences in find distributions.

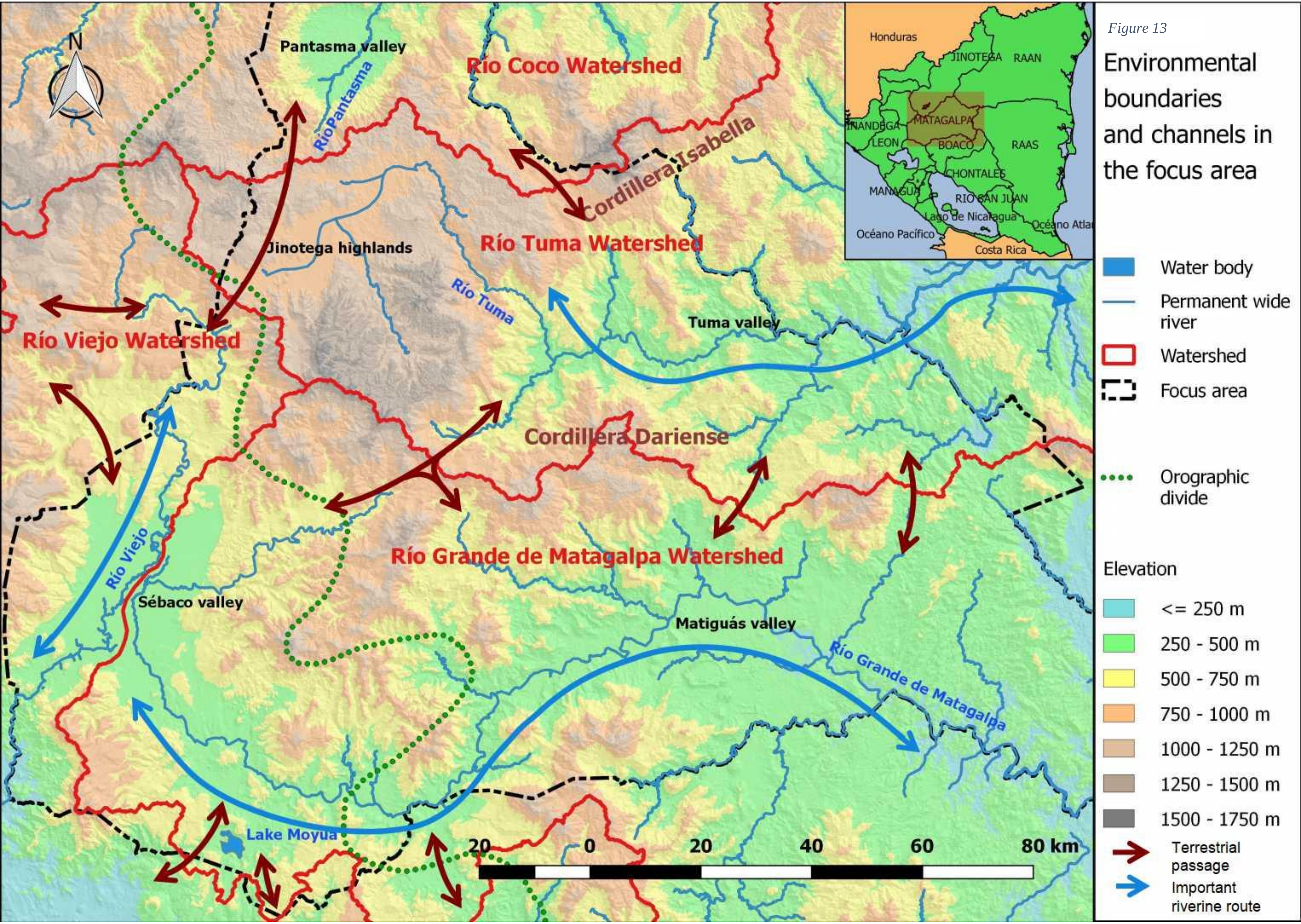


Figure 13
Environmental boundaries and channels in the focus area
N
Pantasma valley
Río Coco Watershed
RíoPantasma
Cordillera Isabella
Jinotega highlands
Río Tuma Watershed
Río Tuma
Tuma valley
Río Viejo Watershed
Cordillera Dariense
Río Grande de Matagalpa Watershed
Río Viejo
Sébaco valley
Matiguás valley
Río Grande de Matagalpa
Lake Moyua
20 0 20 40 60 80 km
Honduras
JINOTEGA
RAAN
CHINANDEGA
MATAGALPA
LEON
BOACO
RAAS
CHONTALES
MANAGUA
RIO SAN JUAN
Lago de Nicaragua
Océano Pacífico
Costa Rica
Water body
Permanent wide river
Watershed
Focus area
Orographic divide
Elevation
<= 250 m
250 - 500 m
500 - 750 m
750 - 1000 m
1000 - 1250 m
1250 - 1500 m
1500 - 1750 m
Terrestrial passage
Important riverine route

Instead, the proximity of two major river systems in a shared valley can be seen as a potential factor facilitating exchange, which might manifest as a larger diversity of materials in this valley and overlaps in material distributions. Similarly, overlaps in different material distributions can be expected in areas of interzonal transition, as the people there possibly had more ready access to materials from more than one environmental zone. For example, such overlaps might occur near to the centre-west of the focus area where the Sébaco, Matiguás and Tuma valleys and the headwaters of their related river systems meet, and where the topography would suggest logical terrestrial passages from one valley to another. Potential passages are also suggested beyond the focus area, such as those between the Sébaco valley and Estelí and Condega (to the north-west) valleys. These are important to consider when linking the results of the following analysis back to the literature and findings from other regions.

6.2 The current landscape: detecting biases in the distribution of find locations

6.2.1 Distribution of find locations in the current landscape

Figure 14 shows the spatial distribution of the find locations in terms of their current circumstance. The road network and tree coverage function as proxies for the distribution and intensity for modern land use activities, helping to visually survey their relation to the distribution of site locations in the different modern-day municipalities of the region.

The road networks are most dense in the urban centres of Sébaco, Ciudad Dario, Matagalpa and Jinotega in the municipalities of the same name. However, we do not see many find locations registered in within the urban areas, probably because they have been paved long ago. An exception to this tendency exists within the centre of Matagalpa, where a petroglyph stands out in the Rio Grande de Matagalpa river that runs through the city. Most find locations are located in the rural areas within close reach of the road network. Accessibility has greatly influenced the ability of the archaeologists to reach participating communities and report their finds, as well as for individuals to report their finds to the municipal authorities in their respective urban centres. This pattern is most striking in the municipality of El Tuma La Dalia, where almost all find locations are dotted along the main road network.

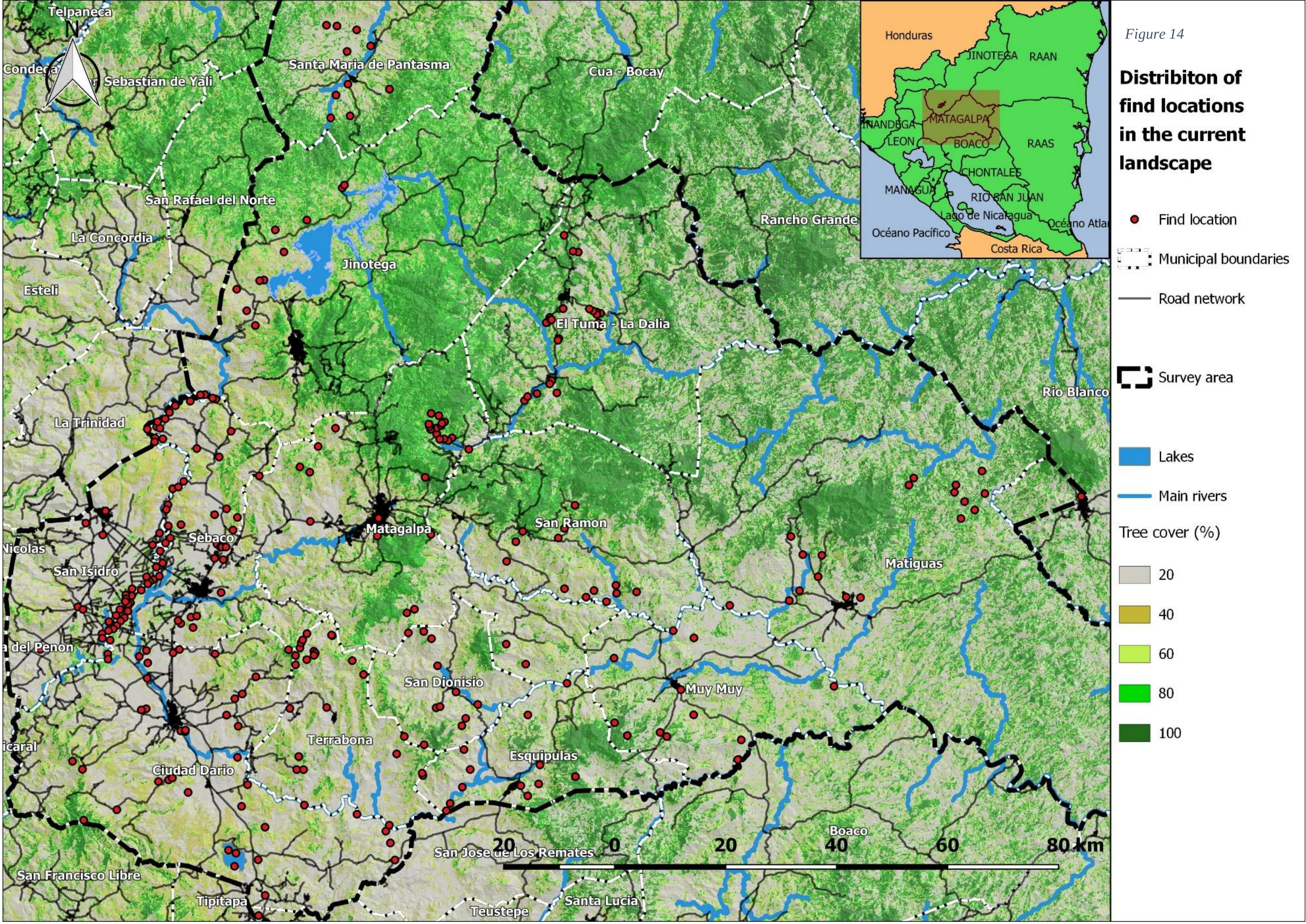


Figure 14
Distribiton of find locations in the current landscape
Find location
Municipal boundaries
Road network
Survey area
Lakes
Main rivers
Tree cover (%)
20
40
60
80
100
Honduras
JINOTEGA
RAAN
MATAGALPA
LEON
BOACO
RAAS
CHONTALES
MANAGUA
RIO SAN JUAN
Lago de Nicaragua
Océano Pacífico
Costa Rica
Telpaneca
Santa Maria de Pantasma
Cua - Bocay
Sebastian de Yali
San Rafael del Norte
La Concordia
Jinotega
Rancho Grande
Esteli
El Tuma - La Dalia
Rio Blanco
La Trinidad
Matagalpa
San Ramon
Sebaco
San Isidro
Matiguas
San Dionisio
Muy Muy
Terrabona
Esquipulas
Ciudad Dario
Boaco
San Jose de Los Remates
San Francisco Libre
Tipitapa
Santa Lucia
Teustepe
20 0 20 40 60 80 km

Another important factor for site distribution is the intensity of land use practices. Areas with a high degree of tree coverage feature few find locations in comparison to areas with low tree coverage. This is best seen in Matagalpa, San Ramón and Jinotega, even when in reach of road networks. Again, exceptions exist in the north of the municipality of Matagalpa and in El Tuma La Dalia, where finds have been reported in well-shadowed coffee plantations. The areas with the highest degree of tree coverage largely coincide with the rugged mountainous areas at the highest elevations, least preferred for agricultural practice, except for that of coffee culture. While coffee-growing areas are linked to road networks and finds can easily be spotted on the surface in these plantations, the rugged terrain increases travel time and costs. It is therefore likely that this has discouraged community participation from these areas, for which community leaders have had to sign up at meetings organised at the municipal centres outside of these areas at lower elevations.

6.2.2 Preservation and known post-depositional processes

The effect of land use practices onto the archaeological record can be evaluated on visually by cross-examining the find locations colour coding according to their state of preservation. This is combined with a simple land use layer of the region as well as Denevan's information on the advance of the settlement frontier (fig 15). Badly preserved find locations are found mostly in the south west of the region in municipalities such as Sébaco, Ciudad Dario and Terrabona that have the longest history of Colonial agricultural practices and critically eroded lands. Similarly, in northern Matagalpa and El Tuma La Dalia, where coffee and agricultural systems are highly intensified, are characterised by low preservation rates. In the minimally ploughed cattle-ranching areas in Muy Muy and Matiguás, find locations tend to be better preserved. The archaeological record in areas where predominantly grains and fruits are grown, such Santa Maria de Pantasma and San Dionisio, already show consistent improvement in the condition of the archaeological record in comparison to the areas surrounding the Sébaco valley in the south-west.

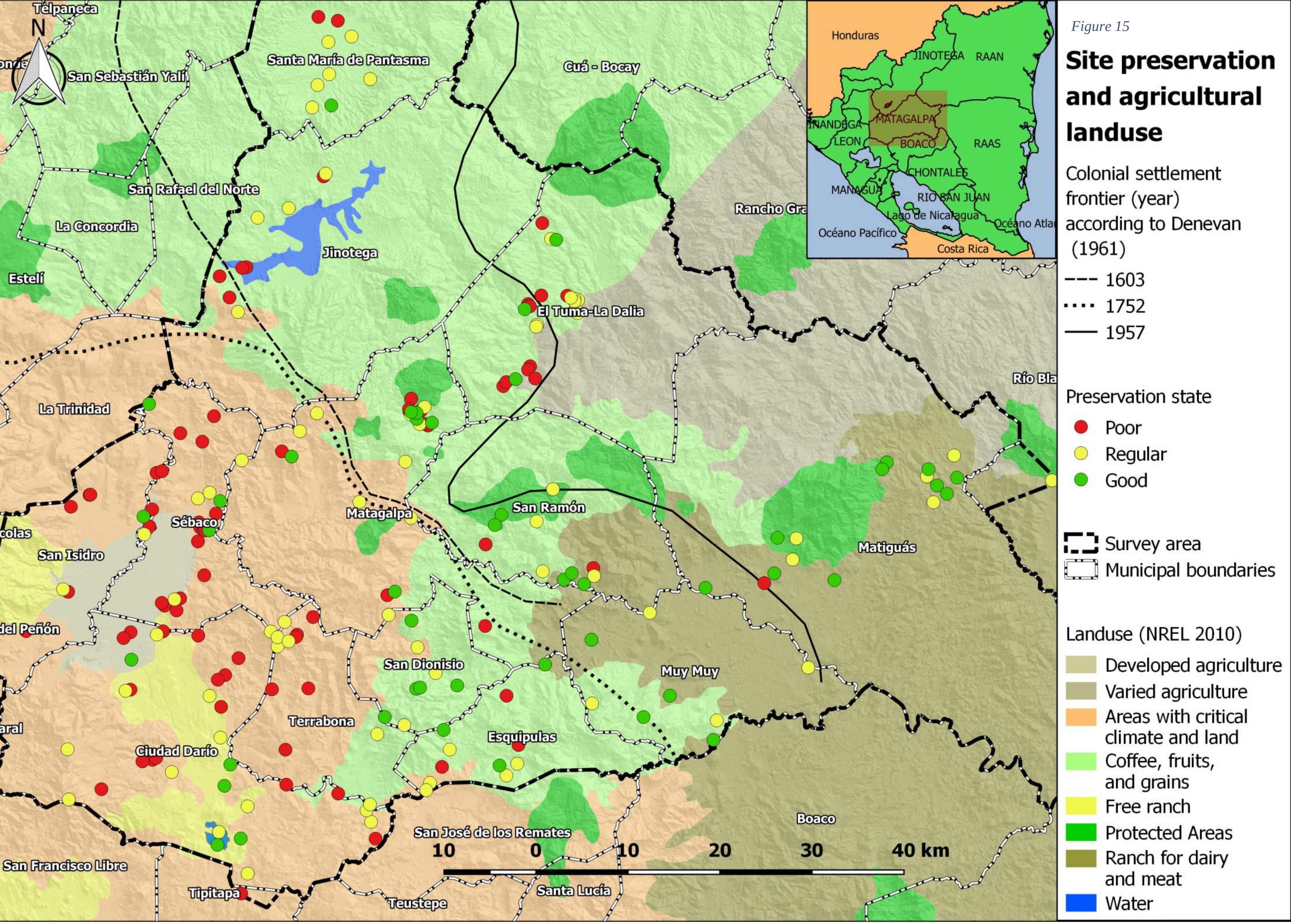


Figure 15
Site preservation and agricultural landuse
Colonial settlement frontier (year) according to Denevan (1961)
1603
1752
1957
Preservation state
Poor
Regular
Good
Survey area
Municipal boundaries
Landuse (NREL 2010)
Developed agriculture
Varied agriculture
Areas with critical climate and land
Coffee, fruits, and grains
Free ranch
Protected Areas
Ranch for dairy and meat
Water
Honduras
JINOTEGA
RAAN
MATAGALPA
CHINANDEGA
LEON
BOACO
RAAS
CHONTALES
MANAGUA
RIO SAN JUAN
Lago de Nicaragua
Océano Pacífico
Océano Atlántico
Costa Rica
Telpaneca
Santa María de Pantasma
Cuá - Bocay
San Sebastián Yalí
San Rafael del Norte
La Concordia
Jinotega
Rancho Grande
Estelí
El Tuma-La Dalia
Río Blanco
La Trinidad
Sébaco
Matagalpa
San Ramón
San Isidro
Matiguás
San Dionisio
Muy Muy
Terrabona
Esquipulas
Ciudad Darío
Boaco
San José de los Remates
San Francisco Libre
Tipitapa
Teustepe
Santa Lucía
10 0 10 20 30 40 km
N

This examination would suggest a rough tendency of the state of preservation of the archaeological record getting worse with a longer history of colonial occupation and land use. Extensive ploughing and the destruction of archaeological heritage is well known in the Sébaco valley, with the longest history of colonial occupation, and is mentioned by Espinoza *et al.* (1994) as well as Balladares and Lechado (2008). Mechanized intensive agriculture is suspected to have destroyed several mound sites along the main rivers in the valley, of which none could be recorded (Espinoza *et al.* 1994, 160). The destructive effect of intensive agriculture on the state of preservation in other areas has been observed by the author but is only roughly visible on the map, mostly because of the low resolution and simplification of available land use data.

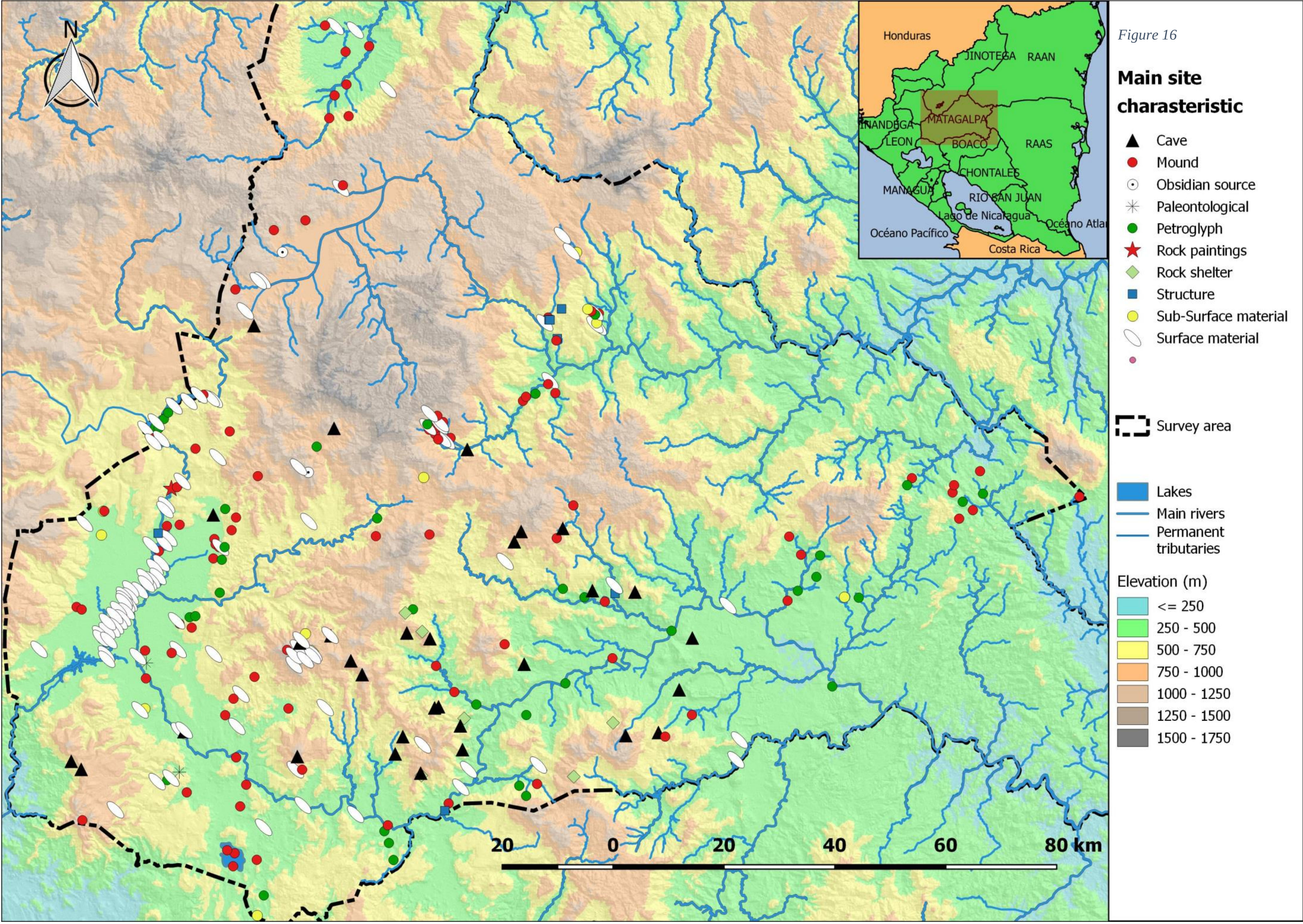
6.3 The past landscape: examining the distributions

6.3.1 Site diversity within the survey area

In figure 16, the find locations are represented according to the main site characteristic as indicated in the source reports. Little conclusions can be drawn from the visualisation of the data according to a location's main characteristic as the visualisation results too complex and as the symbols representing the different site characteristics overlap each other in dense clusters. Representing a find location by its main characteristic is not only a subjective judgement of the surveyor, it also doesn't reflect the function of a site or the activities undertaken in the past and undermines the complexity of the surface record of the indicated location. Some merit to this type of visualisation exist, however. The visualisation of the data according to the main site characteristic pointed out by the surveyors acts as an introduction to the diversity in the archaeological record on a regional level. Also, sites that consist of mere fragmented surface materials, against those that feature more prominent finds, are clearly visualised. In reference to the previous section for example, it is easy to note the dense, linear pattern of surface material locations in the Sébaco valley along the Rio Viejo recorded by Espinoza *et al.* (1994) and seeing where mound sites might have been, had they not been erased by intensive agriculture.

6.3.2 Petroglyphs, rock paintings, caves and rock shelters

Figure 17 shows the distributions of petroglyphs, rock paintings, caves and rock shelters together with their possible co-occurrence with more common finds, such as mounds and ceramics, of the same find location.



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RIO SAN JUAN
Lago de Nicaragua
Océano Pacífico
Océano Atla
Costa Rica
20
0
20
40
60
80 km
Figure 16
Main site charasteristic
Cave
Mound
Obsidian source
Paleontological
Petroglyph
Rock paintings
Rock shelter
Structure
Sub-Surface material
Surface material
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750

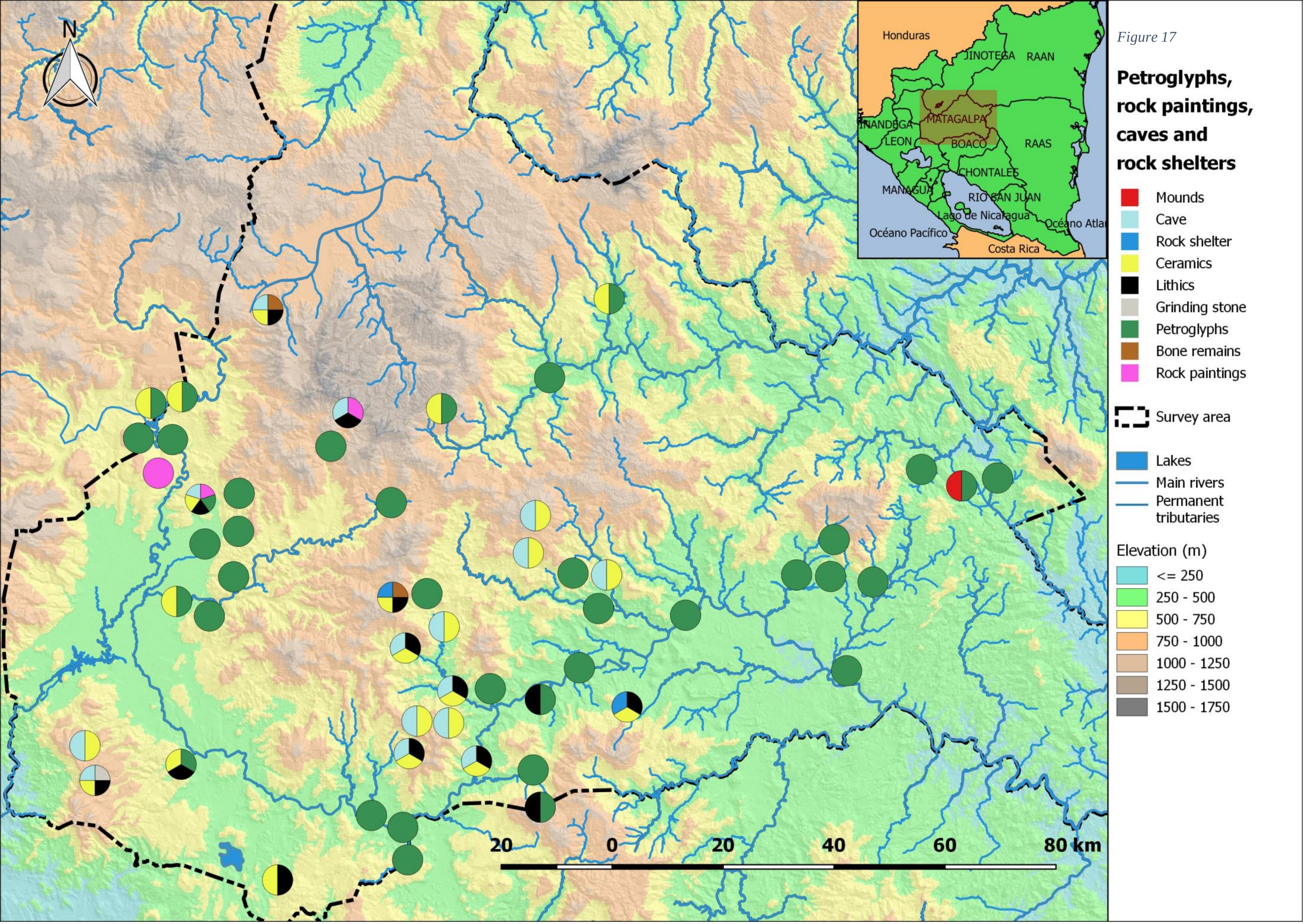


Figure 17

Petroglyphs, rock paintings, caves and rock shelters

Petroglyphs have been found throughout the region, except for the low-lying parts of the Sébaco valley and the valley of Santa Maria de Pantasma. No direct mention is given in the reports is given as to why these areas do not feature these finds. Petroglyphs in the focus area are most often the only type of find at their location, and where they are found in the vicinity of another find category (such as mounds in the Matiguás valley), one can only speculate on the relationship between these categories. This is because it is nearly impossible to date petroglyphs in Nicaragua and most of the engravings appearing on them, without ending up with a time-frame spanning several centuries (Vlaskamp 2014, 43). Furthermore, the engravings of the petroglyphs are inconsistently documented, making it difficult to categorise different engravings and see whether some of these are area specific. Nevertheless, engraving stones in their natural locations appears to have been a common practice throughout the past landscape at locations where suitable rocks appear. In most cases this is a river, but petroglyphs on cave entries and rock faces have also been documented. As can be seen in the previous map (fig. 16) as well, caves and rock shelters have been documented mostly in rugged mountainous areas. A significant concentration of caves with archaeological finds has been documented in the south-central part of the focus area, while others appear to the west and north-west. Although the mountain chain extends far beyond the south-central part of the focus area, it is possible that the geology favours the formation of caves apt for human use. However, both systematic archaeological surveys and more precise geological studies are necessary to investigate the concentration caves with anthropic evidence in the south-central sector. So far, only one cave site has been found with diagnostic ceramic material (Motuse striated, A.D. 600-800) that can be associated to any time frame (Espinoza *et al.* 1996, 97). Caves have so far hosted finds that are generally rare for the region, such as osteological remains (unidentified) and rock paintings. It is possible caves have sheltered these finds and made their preservation possible. Rock paintings only appear in a relatively small area north of the valley of Sébaco. These are important finds to note for future research, since their pigments represent a potential source for radiocarbon dating. Such pigments have already been successfully dated to A.D. 680 – 905 and A.D. 1440 – 1520 north-east of the focus area in the department of Jinotega (Baker and Armitage 2013, 309).

6.3.3 Structures and stationary objects

Mound structures appear throughout the focus area. In figure 18, they are presented as a generic category including several types of mounds that differ in morphology and construction materials, which will be examined later in more detail. It is, however, important to note here that most other types of structures and stationary objects appear in association with mounds.

Figure 18 shows two locations for statues. In the case of one of these locations, the statues were still kept at the house of the landowner. For the other case, the removal of the statues to a local church (where they still stand) is a locally well-known event. These two locations are both found in vicinities of the Sébaco valley, where other possible locations for similar statues have been reported towards the north-east in the municipality of Matagalpa, and across the orographic divide in current day El Tuma La Dalia. Although for the latter cases the exact location cannot be pinpointed, it is enough to suggest that statues were not unique to the Sébaco valley.

For the exception of one location in the Matiguás area, monoliths are documented co-occurring with mound structures. The monoliths that have been documented outside of the concentration to the Matiguás area are almost located on the orographic divide. Monoliths, some of which still are found in their upright state, are attention attracting features and many local stories from the municipality of Matiguás tell about their removal from their original position and reuse in modern contexts. Monoliths are told to have existed in municipalities between Matagalpa and Muy Muy as well, but so far these haven't been documented for the exception of one in San Ramón (Cruz Olivas 2013; Geurds 2011, 4). It is also possible that these monoliths, so sizeable that their moving implied a significant collective effort, are found more frequently in the Matiguás area because the local geology is abundant in suitable raw materials (Geurds 2011). One of such sources is known in the adjacent municipality of El Tuma La Dalia, for example (Uosukainen *et al.* 2016, 6). Except for the monoliths found standing in Matiguás, it is impossible to tell whether all were once erected vertically.

Levelled and consolidated surfaces, either on hilltops or slopes, appear in the rugged mountainous terrains. In the hills north-east of Sébaco, in Matagalpa and in El Tuma La Dalia, these levelled and consolidated surfaces on hill slopes feature mound structures. Two separate hilltop locations in El Tuma La Dalia show levelling and consolidation with rock material without hosting other structures. However, ceramics, lithic debris and grinding stone fragments indicate them being a locus for possibly a variety of pre-Conquest activities.

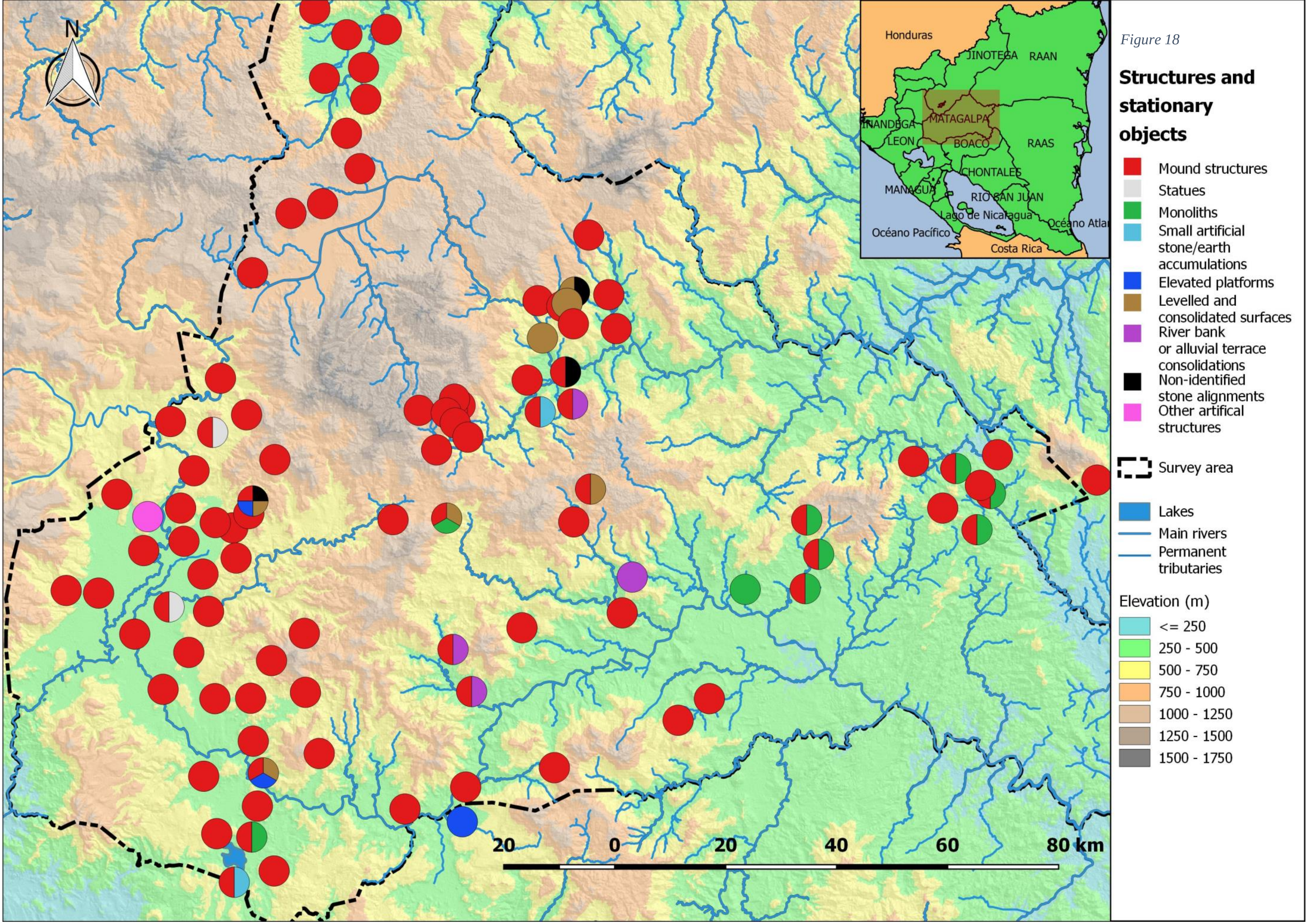


Figure 18

Structures and stationary objects

Two of the elevated platforms appear in low-lying riverine areas of the Rio Grande de Matagalpa watershed, whereas the third is built on a consolidated natural platform on top of a hilltop to the east of the Sébaco valley. Little can be deduced from the distribution of these structures as it is also still unclear how they relate to structures designated as rectangular mounds. More research is needed here. The same holds for non-defined stone alignments and artificial accumulations of stone or earth that are reported at locations with other find categories present.

Until now, alluvial terrace consolidations have been found in the narrower river valleys traversing the mountainous areas to the east of the orographic divide. As rainfall averages are likely to have been higher here, it is possible such consolidations have been necessary. The locations where these consolidations have been documented are found downstream of a considerable catchment of smaller rivers and creeks, where rapid flooding due to heavy rainfall and resulting erosion might have necessitated such structures.

Only one find location found in the valley of Sébaco features an "other artificial structure", referring to the remains of a church.

6.3.4 Mound counts

In almost each case where pre-Conquest mound structures were documented, they were also counted. These counts are represented on the map above (fig. 19) categorised in different ranges, together with the counts at locations where mounds are known to have been destroyed in modern times, or where for some reason not all mounds could be counted. For the most part, all categories (ranges) have been documented throughout the focus area, with the exception of the largest site numbering a 120 mound structures in the south of the Sébaco valley. So far, this count is exceptional to the focus area, as all other locations have 53 or less mounds. The Sébaco valley also features most of the locations where the mound count is known to underrepresent probable higher numbers appear in this region. It is therefore possible that the pattern of many locations with a lower (14 or less) mound count in the Sébaco valley is due to the destruction of mounds through the agricultural intensification process, rather than pre-Conquest settlement patterns.

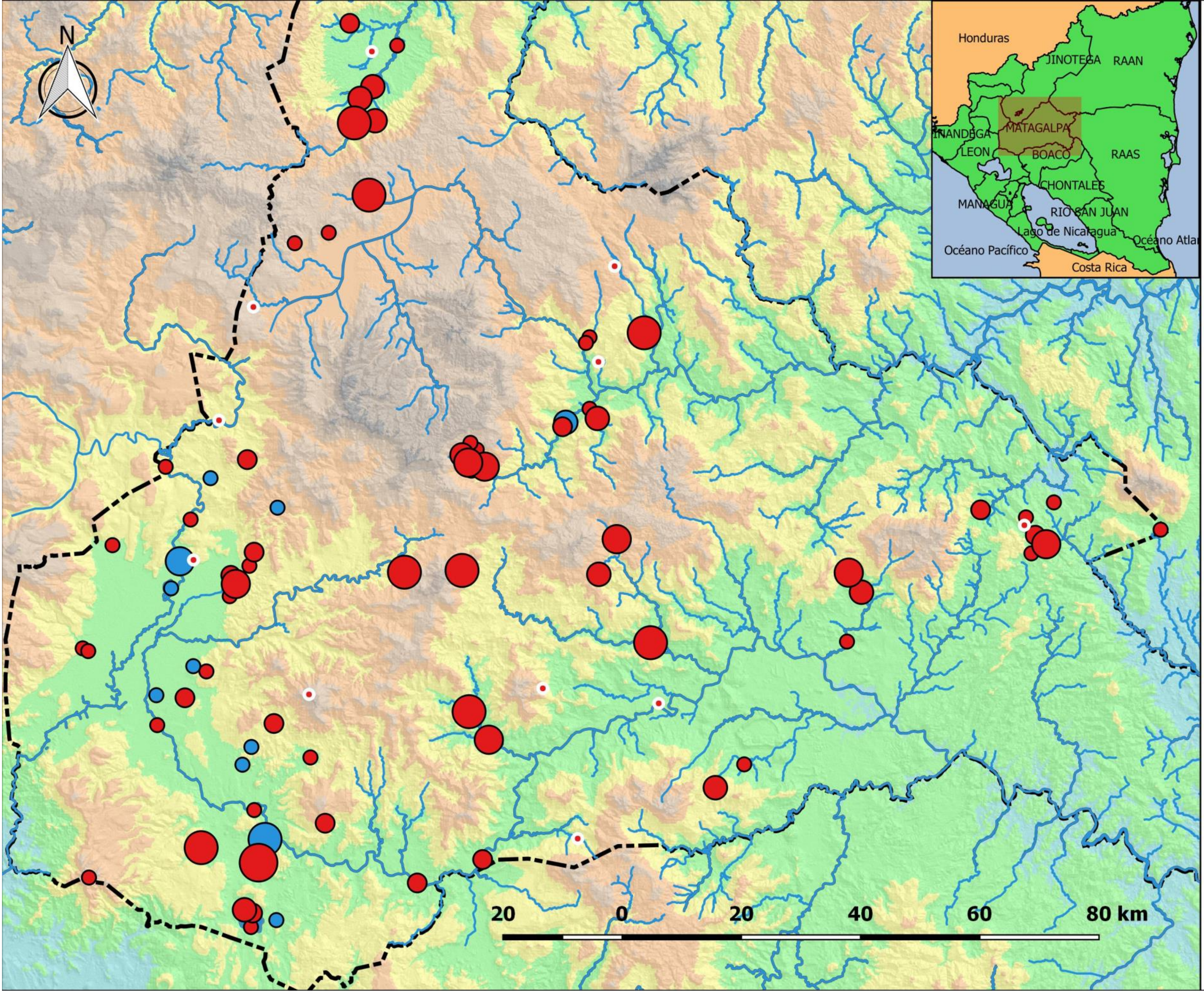


Figure 19

Mound counts

Mound count at location [81]
- 1 [11]
- 2 - 8 [30]
- 9 - 14 [15]
- 15 - 24 [9]
- 25 - 33 [7]
- 34 - 53 [8]
- 54- 120 [1]

Underrepresented mound counts at location [11]
- 1 [0]
- 2 - 8 [8]
- 9 - 14 [0]
- 15 - 24 [1]
- 25 - 33 [1]
- 34 - 53 [1]
- 54 - 120 [0]

Survey area

Elevation (m)

Permanent tributaries

Main rivers

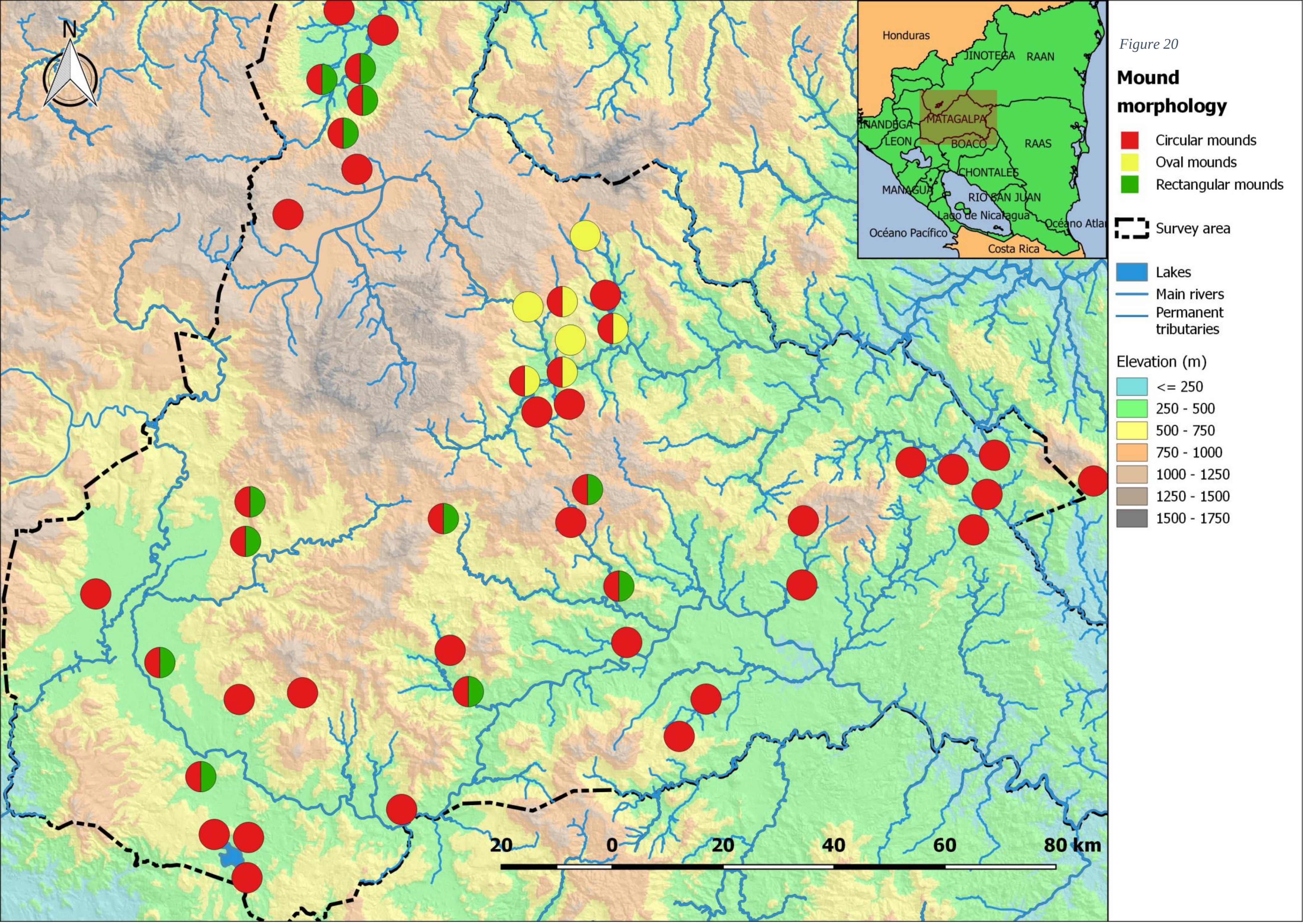
Lakes

6.3.5 Mound morphology

The morphology of mound structures has also been described in most cases, allowing the comparison throughout the focus area in figure 20. Mounds categorised as "oval" are only reported in the area of modern day El Tuma La Dalia. However, this pattern is problematic for a number of reasons. The first reason concerns the categories used by the documenting team (including the author), which in the case of the survey in El Tuma La Dalia used the category "oval", whereas in other areas these mound structures would have been described as "vaguely or apparently circular" or "rectangular". The other reason concerns mound morphology in general. Post-depositional processes, such as ploughing or exploiting the stones visible and "available" on the mounds, might have significantly altered the original morphology of mound structures. It is possible that at locations that are currently poorly preserved, "oval" mounds were originally rectangular or circular, or vice versa.

Alongside the problems concerning the current degree of resolution of information on mound morphology, two other interesting patterns are visible. Circular mounds appear in all areas, whereas rectangular mounds are absent in the areas coinciding with the modern-day municipalities of El Tuma La Dalia and Matiguás. These areas also do not feature elevated platforms (see fig. 18). The second pattern concerning rectangular mounds is that they never occur without circular mounds at the same location. However, if the possibility were taken into account that elevated (rectangular) platforms (see above) are synonymous to rectangular mounds, this would provide some exceptions to the observation of rectangular mounds never appearing alone.

To conclude, it is possible that the categorisation of mound morphologies downplays the reliability of the patterns observed here. Some of the observations might prove meaningful, such as the clear absence of mounds or structures other than circular in the very eastern part of the focus area might prove meaningful. However, mound shape descriptions are highly susceptible to errors and differences in documentation, especially when clear and uniform criteria for morphological description have not been used.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Lago de Nicaragua
Océano Pacífico
Océano Atla
Costa Rica
20
0
20
40
60
80 km
Figure 20
Mound morphology
Circular mounds
Oval mounds
Rectangular mounds
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750

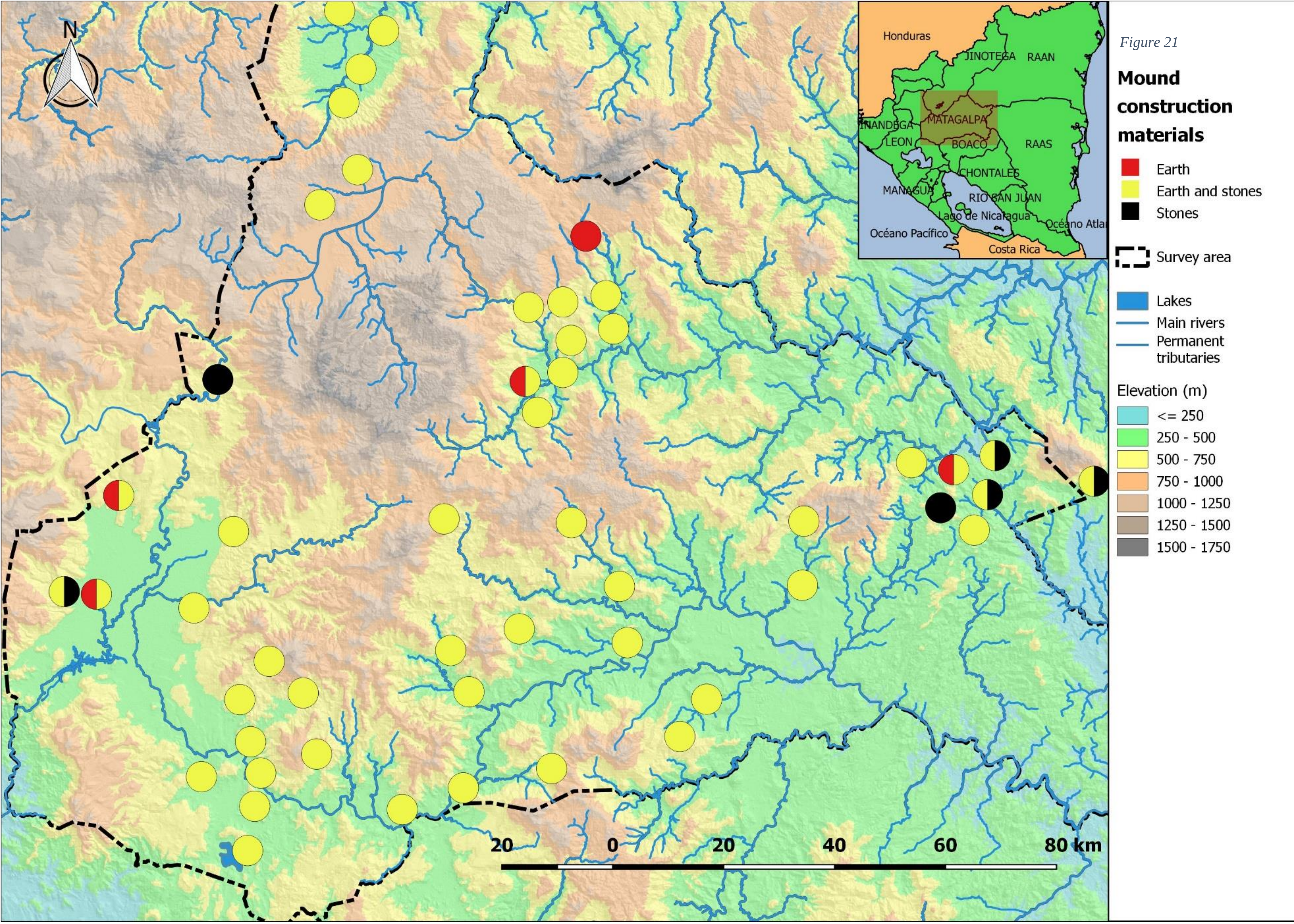
6.3.6 Mound construction materials

Mounds can also be visualised in terms of their construction material (fig. 21). This information has been documented largely based on surface observation, with some exceptions in the case of sub-surface probes or when mounds have been partially damaged.

Most locations had mounds that were constructed with both earth and stone. Mound structures that have been observed to be purely of earth or stone are rare and have only been documented in the periphery of the focus area. Purely stone mounds are found concentrated in the east of the focus area, and to a lesser extent in the west. Mound structures fully made of stone or fully made of earth have also been documented as the only construction material type at their respective locations, but in most cases, these appear at locations where also stone and earth mounds are found.

Very little can be said about mound constructive material based on surface data alone. Both stones, usually river cobbles, and useful soils are available in the entire focus area. Therefore, it is possible that choosing a single material to build a mound reflects a conscious choice, perhaps for a specific function. In some cases, small excavations on mounds have been realised, where stones are found to act as a retention or a perimeter as well as a layer covering the otherwise earthen mound (Koschmieder and Gaméz 2006, 5; Uosukainen *et al.* 2016, 77). However, several thorough mound excavations are needed to find out more about how they were constructed and used. Mound data could be examined in the light of other finds found at the same location, to see whether this gives clear indications towards some of the possible purposes of these mounds. However, at the current data resolution specific finds cannot be connected to specific mounds, which complicates adequate comparisons of mounds within and between locations.

The concentration of locations with stone mounds in the east of the focus area again coincides with the area that deviates from other areas to the west in terms of the other find categories. As with monoliths, it is possible that the relatively high preservation rate in this area plays a role in the appearance of more stone mounds than in other areas, entertaining the possibility that in other areas stone mounds were easily removed and their material reused. The survival of these mound types around the heavily degraded Sébaco valley would, however, undermine this hypothesis.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Lago de Nicaragua
Océano Pacífico
Océano Atlan
Costa Rica
Mound construction materials
Earth
Earth and stones
Stones
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
20
0
20
40
60
80 km

Figure 21

6.3.7 Ceramic type varieties

As can be seen in figure 22, the focus area is dominated by the Segovias Naranja type, found at almost every location in all areas. In the very east of the focus area, this has been the only recognizable ceramic type. Other known types gradually start appearing towards the west and the Sébaco valley stands out as more ceramically diverse than other areas if surface material alone is considered.[3]

The degree of variety in recognized ceramic type-varieties present at a location or in an area cannot be taken as a direct indicator of the richness in ceramic variety at those locations. A significant degree of ceramic variety has been preliminarily reported from both the municipalities of El Tuma La Dalia and Matiguás, but no type-variety classification has been made for the novel types from these areas (Minami *et al.* 2014, 22-23; Uosukainen *et al.* 2016, 131). The data does, however, suggest significant differences within the focus area in terms of the degree of distribution of known ceramic type-varieties, which are known and identifiable because these are found in better researched regions in the Pacific or regions north-west towards the Honduran border. In this light, the Sébaco valley seems to have hosted the most intense traffic in ceramic types associated to other regions. This does by no means directly indicate disconnection or isolation of those areas where such degree of variety in known ceramic types does not appear, as the wide distribution of the Segovias Naranja type would suggest the exchange of pottery practices, ideas and/or goods throughout the focus area, at least when longer time periods are considered.

Assuming that the types have been correctly identified and the validity of their chronologies, through further studies, are reinforced, pre-Conquest presence in the Sébaco valley might have started as early as 2000 B.C., as given by the presence of the Schettel Incised type found at one location. Another possible indicator of pre-Tempisque period (A.D. 300 – 800) presence at the same location is the presence of the Puerto variety of the Charco red on black type, if this can be said to be coeval with Salgado's findings of this type in Pacific Nicaragua (1996, 211-213). The only other possible indicators of pre- A.D 300 presence in the valley has been found in sub surface contexts at Lake Moyua, as given by Usulutan types, also present in sub-surface contexts in the east of the focus area (Matiguás), which is otherwise absent of any other identified types but Segovias Naranja (Minami *et al.* 2015, 9; Finlayson 1996, 142). The other locations in this valley mostly indicate post- A.D. 300 presence throughout the Bagaces, Sapoá and Ometepe periods.

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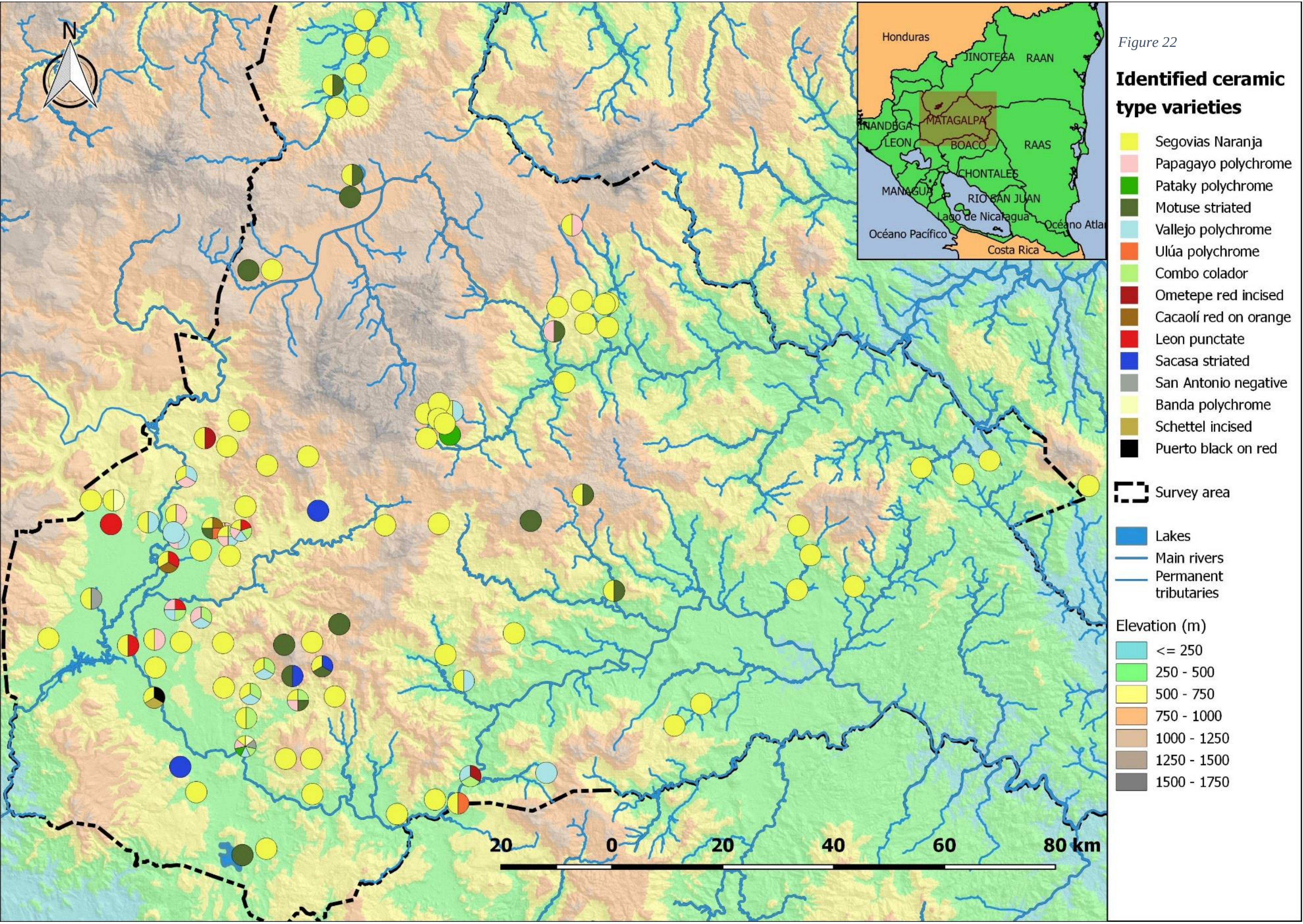
[3] Sub-surface finds for some sites have been obscured from this analysis, but are included in the overall dataset, in which case this has been indicated in the "general notes" field. The highest variety of types can be found at two locations at lake Moyua, in the south of the municipality of Ciudad Dario. At these locations, as well as one located north the the Sébaco valley at the western border of the focus area, data was also obtained from sub-surface test units, adding to a longer list of type-varieties considered in the dataset than represented in figure 22 which only considers surface finds.


Identified ceramic type varieties
Segovias Naranja
Papagayo polychrome
Pataky polychrome
Motuse striated
Vallejo polychrome
Ulúa polychrome
Combo colador
Ometepe red incised
Cacaolí red on orange
Leon punctate
Sacasa striated
San Antonio negative
Banda polychrome
Schettel incised
Puerto black on red
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
Honduras
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BOACO
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MANAGUA
RIO SAN JUAN
Lago de Nicaragua
Océano Pacífico
Costa Rica
N
20
0
20
40
60
80 km
Figure 22

6.3.8 Preliminary ceramic types

In figure 23 some clear patterns are visible. Firstly, the very east of the focus area is absent of preliminary ceramic categories. Secondly, variety in preliminary types increases again towards the west, where the Sébaco valley and its surroundings exhibit the highest variety. Some preliminary types, namely those indicated by their incisions or morphology, have so far only been documented in areas towards the north and east of the Sébaco valley.

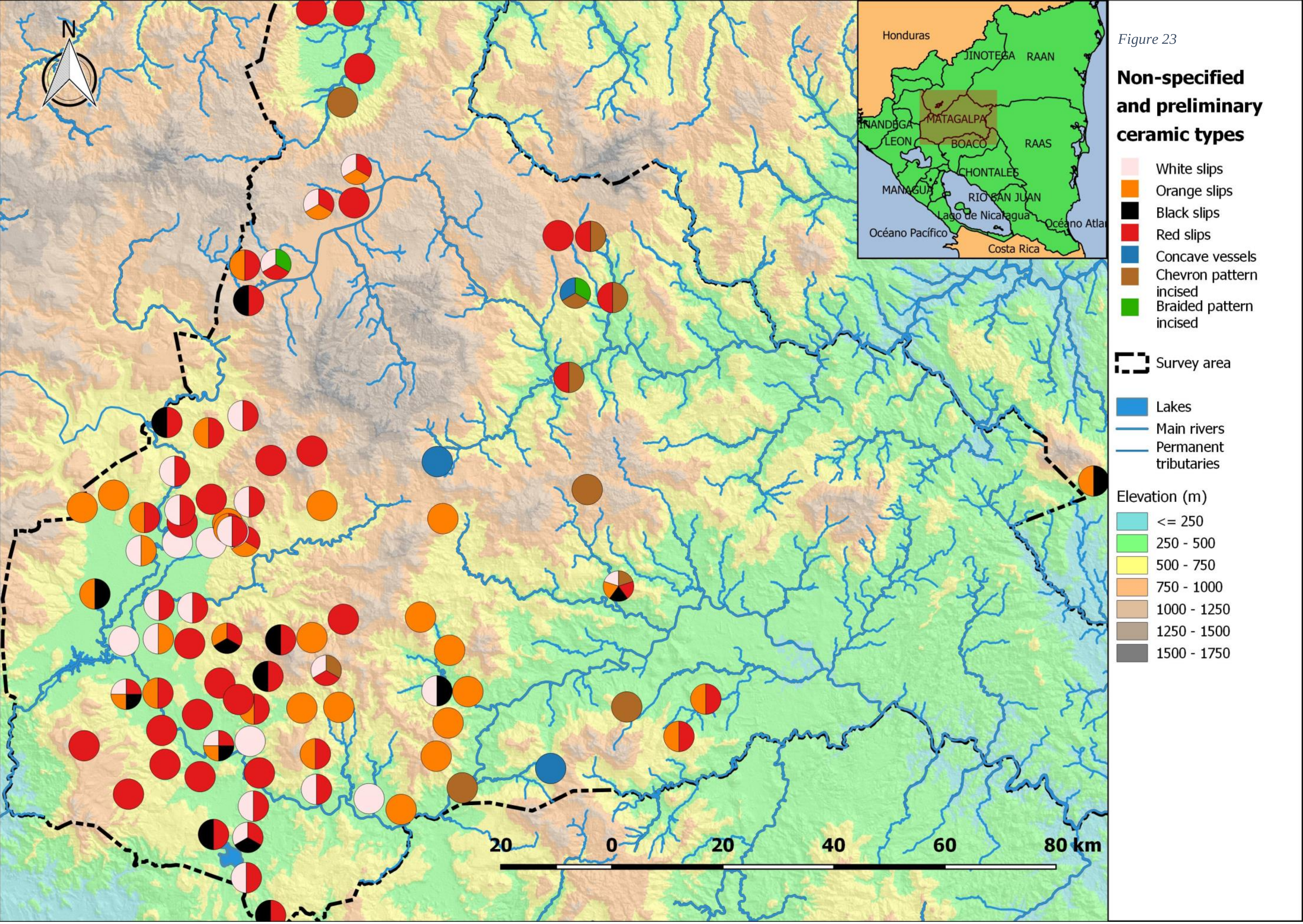
There is some similarity to the pattern observed in the distribution of known type-varieties, and with non-defined preliminary types with variety increasing towards the Sébaco valley. However, any pattern observed in the distribution of these preliminary types should be considered with caution, as it relies on preliminary classifications made without a thorough ceramic analysis.

6.3.9 Lithic finds: Chert

In the distribution of lithic chert finds across the focus area (fig. 24), the clearest pattern is that of bifaces being mostly limited to the Sébaco valley, where also the overall variety in chert finds is higher. This pattern extends towards the north of the Sébaco valley, reaching the area which is today characterised by the lake of Apanas. Other lithic finds are distributed in a relatively even manner in the focus area.

6.3.10 Lithic finds: Obsidian

Some clear patterns can be seen in the distribution of obsidian finds, visualised in figure 25. Both obsidian nuclei and blades are limited to the west of the focus area, concentrating in the Sébaco valley and having presence at some locations to the very north of the focus area. Two obsidian sources have been reported relatively close by. Although small obsidian nuclei and fragments were found at these sources, it is uncertain whether they played an important role in the provision of obsidian in the region.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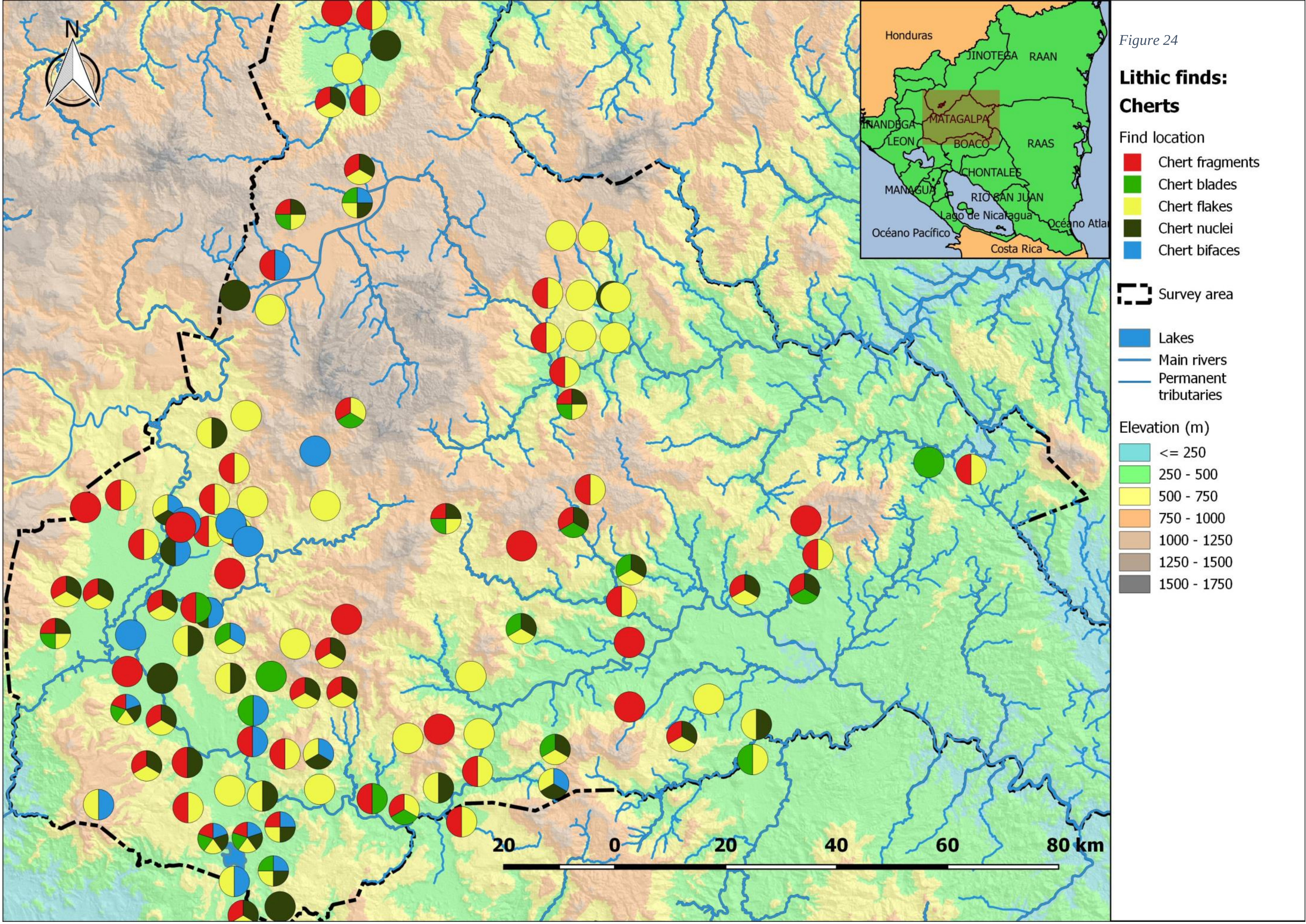
Lago de Nicaragua
Océano Pacífico
Océano Atla
Costa Rica
20
0
20
40
60
80 km
Non-specified and preliminary ceramic types
White slips
Orange slips
Black slips
Red slips
Concave vessels
Chevron pattern incised
Braided pattern incised
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750

Figure 23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Lago de Nicaragua
Océano Pacífico
Océano Atla
Costa Rica
Lithic finds:
Cherts
Find location
Chert fragments
Chert blades
Chert flakes
Chert nuclei
Chert bifaces
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
20 0 20 40 60 80 km
Figure 24

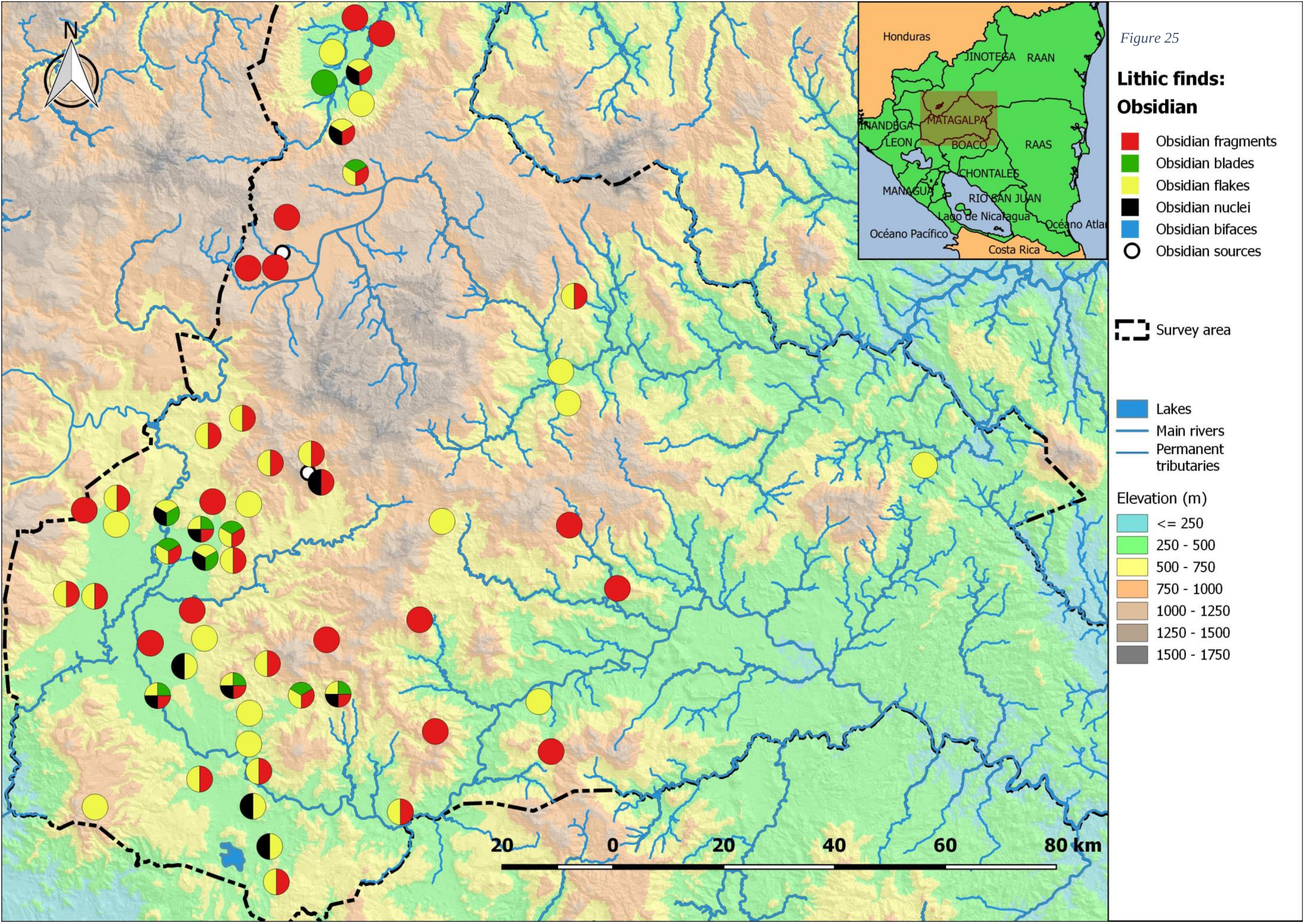


Figure 25
Lithic finds: Obsidian
Obsidian fragments
Obsidian blades
Obsidian flakes
Obsidian nuclei
Obsidian bifaces
Obsidian sources
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
Honduras
JINOTEGA
RAAN
CHINANDEGA
MATAGALPA
LEON
BOACO
RAAS
CHONTALES
MANAGUA
RIO SAN JUAN
Lago de Nicaragua
Océano Pacífico
Costa Rica
20 0 20 40 60 80 km
N

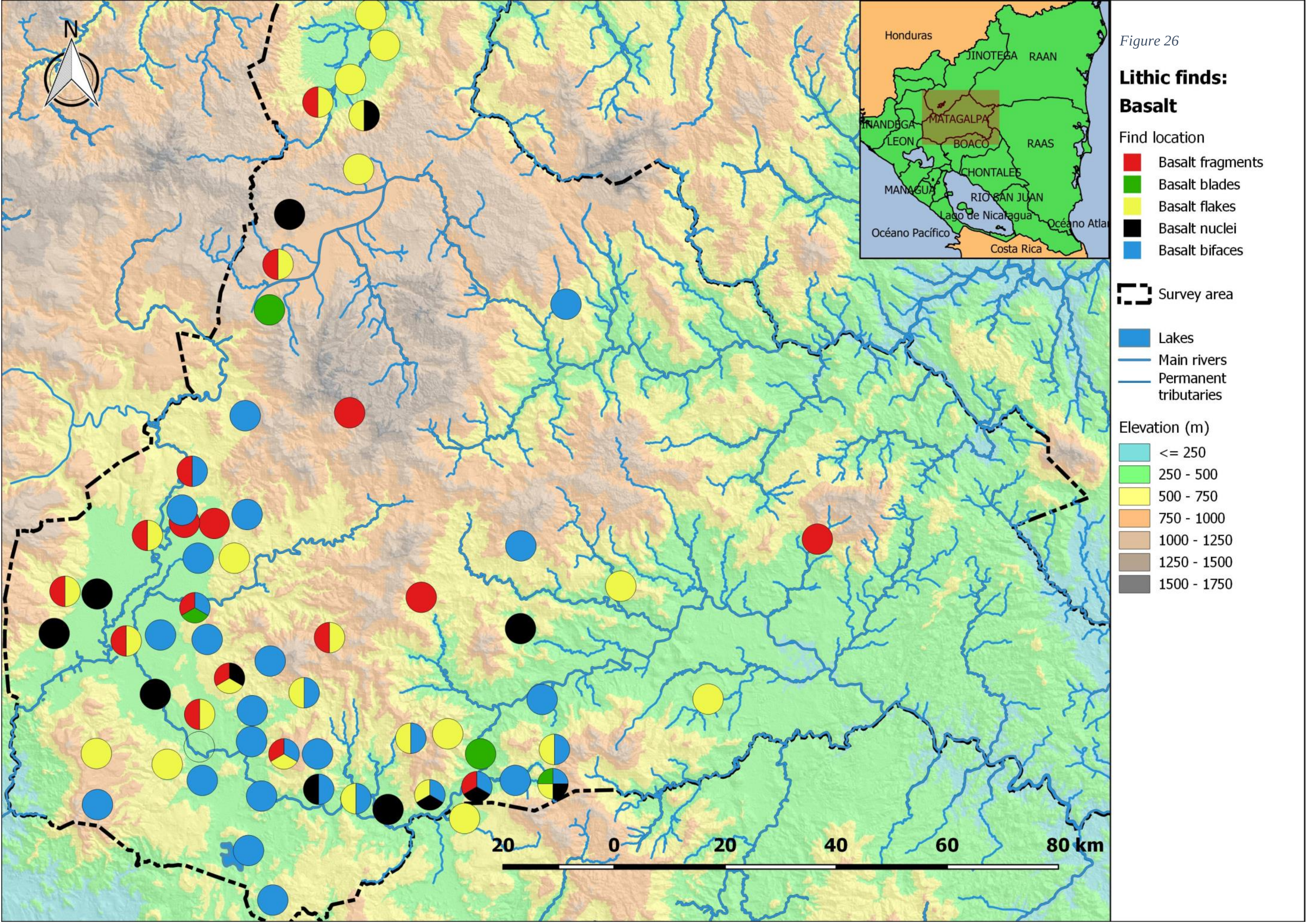
As mentioned earlier, sourcing analysis on obsidian artefacts has only been conducted on four flakes from El Tuma La Dalia, three of which were sourced to the Guinope source bordering Nicaragua in Southern Honduras (the last did not match any known source) (Glascock 2015; Uosukainen *et al.* 2016). It is likely that most of the obsidian in the focus area originates from Guinope, as is the case for most Nicaragua, because of reasons of quality necessary to produce desired objects and tools. However, more research into obsidian use and sourcing is necessary to gain insight into the importance of obsidian in the focus area. The north-south pattern observed however, might be an indication of an interzonal exchange route along the Río Pantasma and the Río Viejo and across the Jinotega highlands.

6.3.11 Lithic finds: Basalt

The distribution shows a clear concentration of all types of basalt tools towards the Sébaco valley (fig. 26), stretching both north and to some extent east along the Rio Grande de Matagalpa watershed. Basalt finds are scarce in other areas. It is possible that basalt tool finds are concentrated to the west of the focus area because the raw material was more readily available there. It is also possible that more intensive agricultural practices on post-Concquest times, like ploughing, have surfaced more lithic finds in the west of the focus area, resulting in the observed pattern. This could also apply for other movable ceramic and lithic finds, as distributional patterns also show larger concentrations towards the west of the focus area and the Sébaco valley specifically.

6.3.12 Lithic finds: Quartz

Most quartz finds are found within the mountainous areas (fig. 27). It is, again, possible that the distribution is best explained geologically, with quartz being a raw material used opportunistically (not necessarily preferred over chert etc.), that occurs mostly in the mountainous area with more rocky outcrops. The concentration along the Río Grande de Matagalpa in the southern focus area is interesting, as this could mean that the quality and availability of quartz here might be exceptionally good and as a raw-material, might have been distributed further from here along the watershed.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Océano Pacífico
Océano Atla
Costa Rica
Lithic finds:
Basalt
Find location
Basalt fragments
Basalt blades
Basalt flakes
Basalt nuclei
Basalt bifaces
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
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750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
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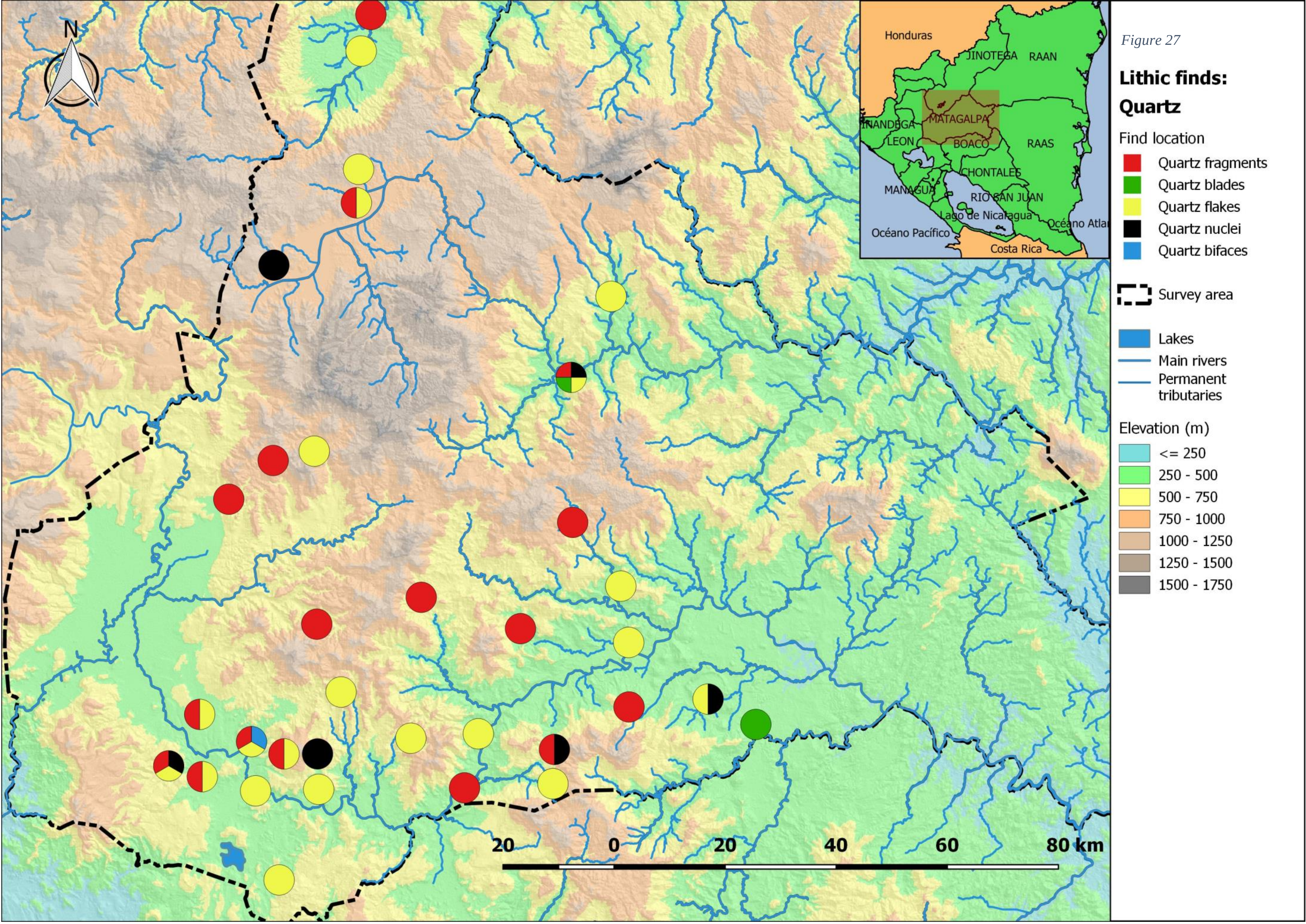
60
80 km

Figure 26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Océano Pacífico
Océano Atla
Costa Rica
Figure 27
Lithic finds:
Quartz
Find location
Quartz fragments
Quartz blades
Quartz flakes
Quartz nuclei
Quartz bifaces
Survey area
Lakes
Main rivers
Permanent tributaries
Elevation (m)
<= 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
20
0
20
40
60
80 km

6.4 Material distributions and subarea profiling

The results of the visual analysis above are summarized in figure 28 with the different patterns observed in the distributions discussed above. These clearly observed patterns represent the absence or high concentrations of a find, or the so far exclusive area within a find can be found. It is important to note that some patterns observed and discussed above are not taken to account. These include patterns that are the result of a known bias or based on information that could not be directly confirmed in the field, such as the original location of statues or the distribution of oval-shaped mounds. Based on the outlined patterns, the focus area can be described in terms of different, loosely delineated subareas where more than one pattern and their overlaps can be considered to distinguish this area from others according to its archaeological characteristics. Such subarea profiling is not meant to establish fixed and unique archaeological areas but is used to summarize the data and act as a heuristic aid for discussing and comparing the results of the visual analysis.

Based on the examination of the distribution of different find categories in the focus area, four subareas can be said to have more than one characteristic distinguishing it from its neighbours. These subareas and the distributions characterising them will be described and discussed, after which they will be evaluated against the environmental hypotheses provided in the beginning of this chapter (section 6.1).

6.4.1 Subarea 1

This zone covers the Sébaco valley and its surrounding foothills. It is mostly limited to the south-west of the orographic divide, where the Río Grande de Matagalpa and the Río Viejo meet, slightly extending across the orographic divide along the Río Grande de Matagalpa watershed leading towards the Matiguás valley. Subarea 1 is defined by the following characteristics:

- <u>Highest diversity of identified ceramic type varieties</u>

  These are ceramic type varieties that have mostly been defined in previous studies outside of the focus area and were therefore identified accordingly during the surveys. Subarea 1 is characterised by locations where several of the identified type varieties have been found,

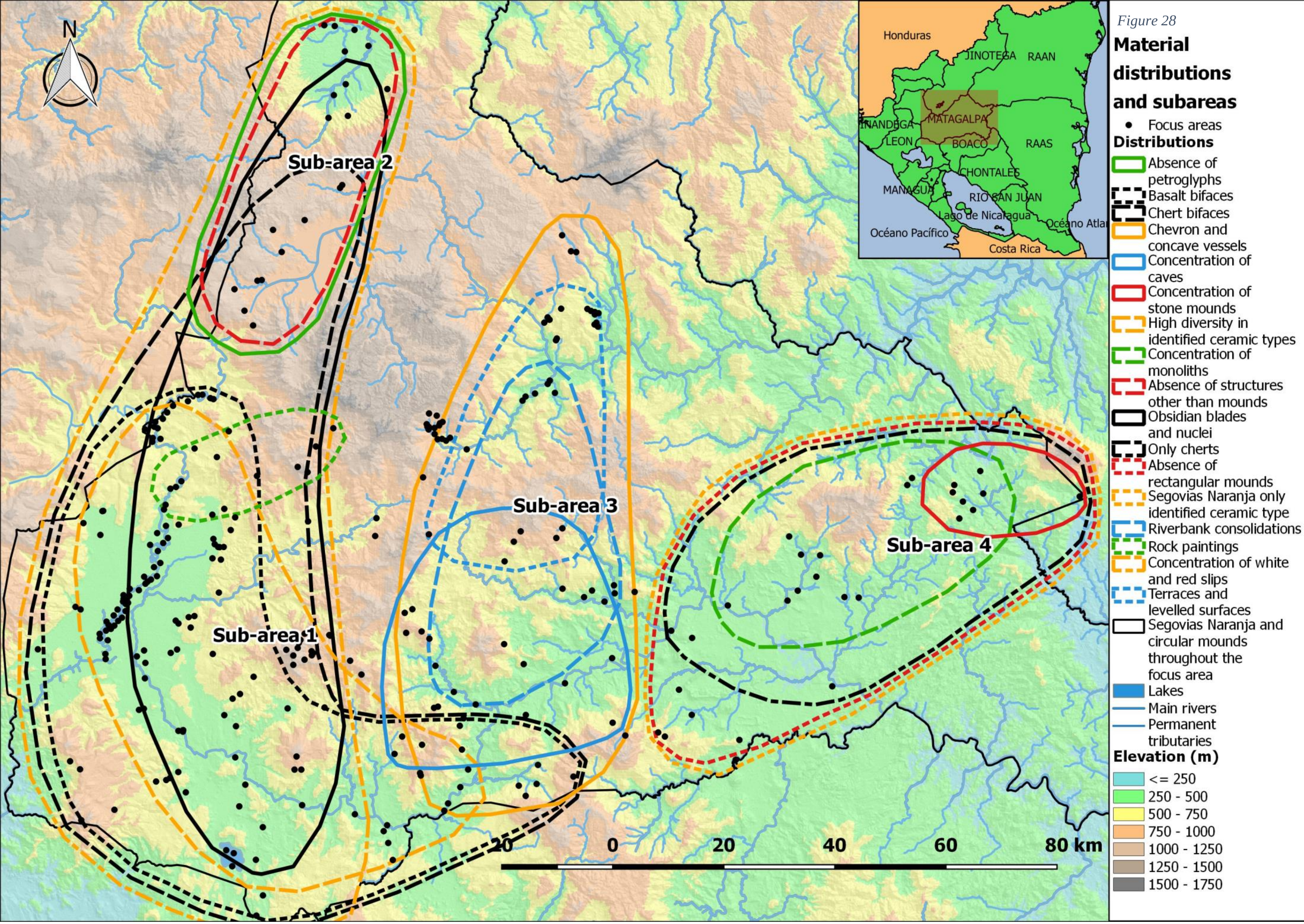

Figure 28

Material distributions and subareas

whereas in other zones no more than two of these varieties have been found at a given location (see 4.3.7).

- <u>Concentration of white and red slipped ceramics</u>

Most of the area where these are found concentrated lies within subarea 1, extending further to subarea 2. There is a number of locations with white and red-slipped ceramics outside of this pattern (see 4.3.8), found mostly in subarea 3 described below (section 6.4.3).

- <u>Concentration of chert bifaces</u>

Most of the focus area's locations with chert bifaces are found concentrated in subarea 1, with the concentration pattern extending into subarea 2. One outlier from this pattern is found in the south of subarea 3 (see 4.3.9).

- <u>Obsidian blades and nuclei</u>

These are found exclusively in subareas 1 and 2, where most of the locations hosting these finds are located in subarea 1 (see 4.3.10).

- <u>Concentrations of basalt bifaces</u>

Locations where basalt bifaces are found are concentrated throughout subarea 1. Two outliers to this pattern are found in the Tuma and Matiguás valleys (see 4.3.11).

Subarea 1 is furthermore the only one within the focus area where rock paintings have been found, but as these are found in only a small concentration within the subarea, they are not to be considered to characterise the whole subarea.

6.4.2 Subarea 2

Subarea 2 lies in the northernmost corner of the focus area, extending from the valley of Pantasma of the Coco watershed, to the transition zone in the Jinotega highlands of the Tuma watershed and bordering with the Viejo watershed. Subarea 2 is characterised by:

- <u>Absence of petroglyphs or rock paintings</u>

No petroglyphs have been found in this subarea, in contrast to the other subareas (see 4.3.2).

- Absence of structures other than mounds

No other pre-Conquest structure types have been found within this subarea (see 4.3.3).

- Concentration of white and red slipped ceramics

This pattern is shared with subarea 1 to some extent, where white slips have not been encountered in the valley of Pantasma (see 4.3.8).

As described above, the patterns representing the concentrations of chert and basalt bifaces partially extend into subarea 2.

6.4.3 Subarea 3

Subarea 3 is located to the east of subareas 1 and 2 just across the orographic divide. It covers the headwaters of the Tuma watersheds and tributaries of the Río Grande de Matagalpa in a rugged terrain cut by several smaller river valleys. It is characterized by the following patterns:

- Chevron pattern incised ceramics and concave shaped vessels

Although these are preliminary types, these ceramic finds are easy to identify and form a loose concentration in a rough north-south pattern in subarea 3. Two outliers are represented by chevron patterned vessels found in subareas 1 and 2 (see 4.3.8).

- Concentration of human used caves and rock shelters

Caves with archaeological evidence cluster south of the Dariense chain and the western end of the Matiguás valley, which also the only rock shelters with archaeological evidence are found. The concentrated pattern includes caves and rock shelters to the east of the orographic divide, overlapping with patters mostly characterising subarea 1. Outliers to this concentration are found to the west across the orographic divide in subareas 1 and 2 (see 4.3.2).

- Riverbank consolidations

These are found in a limited area exclusively in this subarea (see 4.3.3).

- Concentration of levelled surfaces and terraces

These constructions are found in a tight concentration in the western end of the Tuma valley, with two other locations not far to the south along the Dariense chain having been included into this pattern. Two outliers are found at greater distance from this pattern and each other in subarea 1 (see 4.3.3).

Subarea 3 is further characterised by occasional finds that are found more commonly in subareas 1 and 2.

6.4.4 Subarea 4

This subarea lies between the Tuma and Grande de Matagalpa watersheds further east from the orographic divide where the topographic landscape is defined by two separate but well-defined mountains. Its defining characteristics are:

- Absence of known ceramic types

So far, Segovias Naranja has been the only known ceramic type that has been identified within this subarea (see 4.3.7).

- Concentration of locations with monoliths

Although monoliths have been found also in the transition zones between subareas 1 and 3, in subarea 4 there is a notable concentration of locations with monoliths (see 4.3.3).

- Concentration of locations with stone mounds

A small concentration of locations featuring mounds made only of stones is found within subarea 4. Two other separated locations with stone mounds are located in subarea 1 (see 4.3.6).

- Near absence of lithic raw materials other than cherts

Other than chert lithic finds are near absent in subarea 4. Exceptions include an obsidian flake and a basalt fragment (see 4.3.9, 4.3.10, 4.3.11 and 4.3.12).

- Absence of mounds that are not circular

In contrast to subarea 4, other subareas all feature rectangularly shaped mounds in addition to circular ones (see 4.3.5).

For the exception of the smaller concentration of locations with stone mounds, all patterns characterise the totality of subarea 4 and are exclusive to it.

6.4.5 Comparing the environments of the subareas

The above described subareas are both separated and connected by different environmental zones. Subareas 1, 2 and 3 are separated by a mountain range or highland area. Although heights do act as local barriers, the subareas do not correlate with different watersheds basins as each subarea extends to connect with at least two watershed basins. Heights are likely, however, to have acted as important climatic barriers. The only subarea to the west of the orographic divide is subarea 1. Subareas 2 and 3 are both on the rain receiving side close to the divide itself to the east but separated from each other by a highland mass that might well have might a climatic difference, as it is today. Since subarea 3 is itself divided by the Dariense chain, it is possible that microclimatic differences were present. Subarea 4 is further from the divide to the east outside the highland zone at lower elevations, which would mean higher temperatures and probably a different rainfall regime from the other subareas. Lastly, each subarea is topographically different. Subarea 1 mostly covers the Sébaco valley, subarea 2 the crater valley of Pantasma and part of the highland plateau of Jinotega, subarea 3 is marked by river valleys and subarea 4 by a few peaks standing out in an undulating lowland area. In short, each zone can be said to be fairly different from each other in an environmental sense.

6.4.6 Comparing the materiality of the subareas

The subareas have differing degrees of relation In terms of archaeological finds. Here subareas 1 and 2 can be said to share more characteristics with each other than with the other subareas, which can be seen in the distribution of obsidian blades and nuclei, white and red slipped ceramics and chert and basalt bifaces. Still, there are important differences between these subareas as subarea 1 has a notably higher variety of structures and known ceramic type varieties.

Subareas 1 and 3 are marked by stark differences in that both have patterns that are absent on the other. However, important links can also be observed. The outliers of the pattern that characterise one subarea are often found in the other. For example, caves, levelled surfaces and terraces are found in a more concentrated pattern in subarea 3, but also in a few more separated locations in subarea 1. On the other hand, basalt and chert bifaces, as well as white and red slipped ceramics that are found concentrated in subarea 1 are found in more residual patterns in subarea 3. Similar finds are thus found in both subareas across the orographic divide, but in differing intensities. Unlike subarea 2, subarea 3 also features finds that are not present in subarea 1, such as riverbank terrace consolidations.

Finally, subarea 4 stands out by many unique patterns, most of which signify a large degree of absence of finds that are otherwise found in all other subareas, such as rectangular mound structures and known type varieties other than Segovias Naranja. Subarea 1 and 4 stand out as polar opposites in the sense that almost any find type of the focus area can be found in subarea 1, whereas subarea 4 is characterised by the lowest variety in find types of all the subarea.

6.5 Data analysis: Conclusion

In this chapter, the data combined and digitized from different reports has been visualised and analysed. Looking at and comparing the distributions of different archaeological finds in the focus area has highlighted different areas in which the presence of certain finds is concentrated, sporadic or absent. For purely descriptive and comparative purposes, four subareas have been designated which are characterised by different patterns observed in the distributions of archaeological finds. So far, the biggest difference in terms of archaeological finds between the subareas can be observed between subareas 1 and 4, which are also the most spatially distant subareas from one another.

Subareas also differ from each other environmentally and as hypothesised, are to a large degree separated by topographic features. However, a separation between distributions can also occur in an environmentally unexpected manner, as seen between subareas 3 and 4. These subareas are not divided by significant topographical obstacles and are in fact connected by a large river with significant potential for similarity in terms of finds. This clearly deviates from the hypothesis. If the climatic division of the focus area in pre-Conquest times resembled anything to that of today, climate would represent the only consistent environmental difference between the subareas. This is not unlikely, as all subareas fall under different altitude levels or are separated by orographically significant topographic barriers.

The focus of this chapter has been on presenting and describing the results of the analysis, in preparation for an answer of the research question with a focus on interzonality and exchange. The results will be discussed further in this light in the following, final chapter.

7.0 Discussion and Conclusion

The objective of this thesis has been to detect patterns revealing something about the interaction between the peoples separated by these different, but relatively close by zones. The analysis has made use of often disregarded and non-systematically collected surface data, which comprises the bulk of data available for this region. The visual examination of this data has adopted a fairly detailed unit of analysis (find category) on a large scale which spans several environmental zones, to examine the distributions of archaeological finds across these zones. This conclusive chapter will further discuss and evaluate the findings of the analysis both in terms of the focus area itself and in terms of neighbouring regions, to which some of the finds can be attributed. Finally, concluding remarks will be made regarding future research in the focus area as well as the use of exploratory visual analyses using non-systematically produced datasets.

7.1 Interzonal interaction in focus area and beyond

7.1.1 Patterns within the focus area

As demonstrated in the previous chapter, there are distributions of archaeological finds which, when forming consistent overlaps of at least two categories, are described as subareas. At least some environmental barrier, whether it is a significant topographic obstacle or a probable climatic and ecoregional difference, can be found separating one subarea from another. This is a strong indicator of different cultural trajectories in different areas, which are also environmentally more or less different from each other. There are also significant micro-geographical differences within each of these subareas, as higher elevation mountains or plateaus and lower elevation river valleys and plains are found enclosed within the subareas showing a fair degree of archaeological unity. On the scale of a subarea, non-systematic data doesn't allow much to be said about settlement patterns and whether there is a tendency for settlements to be placed optimally between micro-environmental zones as seems to be the case in eastern highland area of Honduras, for example (Begley 1999, 192). However, it seems likely that at these distances, direct access to different environmental zones played a significant role in subsistence and exchange practices, at least on a seasonal basis if not a daily one for the locations more optimally placed between these environments.

One the scale of the focus area, however, it is better to look at the distributions of specific finds or find groups to answer questions on interzonal interaction and exchange. The first important indicator of zonal complementarity in the focus area can be seen in the patterns of lithic finds that cross ecological boundaries. The distribution of obsidian across the focus area indicates differential use and access patterns between the peoples inhabiting different zones. Obsidian blades and nuclei are found concentrated in the two western subareas, whereas obsidian is found mostly as smaller fragments and flakes across the orographic divide towards the east. Larger nuclei are found more often in subareas 1 and 2, through where the more direct route for the obsidian raw material from Guinope to the Tuma valley would have led. This points to the possibility that subareas 1 and 2 played a role in refining obsidian into smaller products and trading them onwards. A similar pattern can be seen in the distributions of bifaces made of cherts and basalt, which span from the Jinotega highlands and follow the Río Grande de Matagalpa towards the Matiguás valley. The concentration of these end products in the Sébaco valley strengthens the case for the west of the focus area, and subarea 1 in particular, having been important in terms of lithic manufacture and refinement. This microgeographical specialization might be significant when viewed in terms of zonal complementarity models, implying an interdependency between zones. In both chert (fig. 24) and basalt (fig. 25) biface distributions, outliers to the concentration in the west can be seen across the mountain range in the east. This could be interpreted as these bifaces being trade items originating from the Sébaco valley.

This interpretation also works well when considering the down-the-line trade model, especially when looking at obsidian distributions alone. However, it must be said that in terms of the flow of goods, a relevant scale of analysis when looking at obsidian might be meso-regional, as most of the obsidian probably came from Guinope or beyond, as the quality of obsidian necessary for producing blades most likely came from Mesoamerica (Braswell 1997; 1999). This pattern will therefore also be discussed in the next section in the context of that scale. However, it must be recognized here that interregional exchange likely played a local role, as obsidian played a role in interzonal interaction.

As with lithics, the distributions of ceramic types are also found across ecological zones. Ceramic types established in studies outside of the focus area are found concentrated again in the Sébaco valley. Some white-slipped polychrome types (Pataky, Papagayo and Vallejo polychromes, fig. 22) found at locations across the orographic divide in areas close to topographical passages that would seem like obvious channels of mobility between the ecological zones. The preliminary ceramic type "chevron pattern incised" constitutes the only type that is found more often in the east of the divide than in the west. Thus, as with lithic finds, ceramic types characterising subareas in the west of the focus area are found more often across the orographic divide than vice versa. As with obsidian, a local dynamic cannot be seen disconnected from an interregional one as white-slipped polychromes constitute a widely exchanged export item produced in the north and south-west in the Gran Nicoya or south-western Honduras (Dennett 2016). White-slipped polychromes from the Gran Nicoya area have been reported ending up in the Caribbean watershed also elsewhere in the Lower Central American Isthmus in Costa Rica and Honduras and have been treated as likely prestige goods (Cuddy 2007, 114; Hoopes 1993; Snarskis 1984). In the case of north-east Honduras, Interestingly, Cuddy has also noticed the absence of local pottery in other regions, despite the presence of foreign (white-slipped polychrome) pottery there (2007, 116).

So far, the patterns discussed indicate trade from one ecological zone to another with an emphasis on non-perishable and movable goods moving east across the orographic divide rather than a two-way pattern exchange patter, that could be interpreted as mutual, reciprocal exchange. It also begs the question: What was traded back in exchange? If exchange in the focus area worked in a down-the-line fashion, one could envision each event of passing down a good as part of a more complex interaction involving the exchange of other, possibly perishable goods or even political interaction between groups. Under the zonal complementary models, which often emphasize some degree of interdependency through trade in terms of subsistence goods, this would suggest that the goods traded back were perishable, no longer visible in the archaeological record. Such questions cannot adequately be answered with the available data. Some possible perishable goods are interesting to mention, however, such as dugout canoes which have a long tradition of being traded by Mayangna and Miskitus of the Caribbean lowland, where suitable tall trees of the right wood type can be found (Sweeney 2004). Another perishable good mentioned as an important commodity was cacao (Incer 1993, 253; Kühl 2010, 116), which in modern-day El Tuma La Dalia and Matiguás is of exceptional quality and based on local varieties. Charred remains of cacao seeds, although from disturbed context, were recovered in a rescue excavation in El Tuma La Dalia (Uosukainen *et al.* 2016, 59). Finally, one might consider plumes of birds unique to highland and humid tropic environments, such as the resplendent quetzal (*Pharomachrus mocinno*), which still exists in the forests of the Isabella chain (Kühl 2010, 119). Hardwood canoes and plumes are also important to mention here, as these might also have implied connections to as far as the Caribbean coastal lowlands (Lange 1984, 56), to which the Río Grande de Matagalpa grants access.

The patterns discussed above also merit to be viewed from the angle of the more traditional zonal complementarity model, in which one group sent a colony to another ecoregion in order to benefit from the unique resources available there. Especially in terms of obsidian and white-slipped ceramic type-varieties, the finds on the eastern side of the focus area are found at a relatively close distance to the orographic divide and in many cases with reasonable access to a riverine or terrestrial passage leading to the western areas. Do these patterns in the distributions of movable goods indicate settlement in the east of the orographic divide by groups from the western side? What kind of relations were maintained with kin in the west? Answering this question would surely require proper quantification of ceramics at these locations to see whether white-slipped polychromes are found only in trace amounts or in more significant quantities. Also, an analysis of their use and source would be needed.

Most types of stationary objects and structures are found either across the entire focus area or limited to only one subarea (see figs. 17, 18, 20 and 21). Only a few find types leave some clues to speculate about interzonal interaction. The most striking distribution in this sense is seen in the spread of the by monoliths, which are concentrated in the very east of the focus area (subarea 4). However, two outliers are found in interesting locations when considering interzonal interaction. One outlier is found at the La China site in the highlands of San Ramón, that connects passages to the Tuma and Sébaco valleys, the second outlier is found on Isla Honda in Lake Moyuá in the southern end of the Sébaco valley (see fig. 18). Could this be seen as a sign of an established settlement, or was it a trade post in an interzonal strategic or central place? In the case of Lake Moyuá, the variety of foreign ceramic types and obsidian finds found in sub-surface contexts gives reason to believe that interzonal and interregional exchange was an important part of the activities that played out at this location (Finlayson 1996). At La China, a similar diversity of goods is as yet to be accounted for (Cruz Olivas 2013). Another problem concerning monoliths and their association to interzonal exchange or zonal complementarity, concerns the uniqueness of monoliths to the Matiguás area (subarea 4). Although monoliths are classified here as stationary finds, they are movable enough to have been removed from several locations (see section 6.3.3). These post-depositional problems also concern stone mounds (fig. 21), which are often re-used in modern rural contexts, such as posts.

The distributions of movable goods and their penetrations into adjacent ecological zones clearly indicate some form of interzonal exchange. In all likelihood, interaction and exchange was frequent between people living in different but close-by ecological zones. This has been shown to be a trend in most mountainous areas worldwide, and an isolated life without exchanging with other zones specialised in one way or another would most likely render the development of society in any of these zones very challenging (Brush 1973; Lange 1984). Even some degree of occupation of adjacent zones by members of the same group is likely at these distances when considering intermarriage, as earlier proposed for the Chontales area by Geurds and Van Broekhoven (2010, 65-66). But although it is possible that colonies were established in the east of the focus area by groups from the west, or similar actions undertaken by eastern groups in strategic locations in interzonal transition areas, it is safer to assume at this stage that the traditional vertical archipelago model was less likely to apply than zonal complementarity through exchange between different groups from different ecological zones.

7.1.2 Exchange in an interregional context

Many of the ceramic and obsidian finds directly link the focus area to an interregional context. In the case of white-slipped polychromes for example, it is likely these were produced in the Greater Nicoya area or southern Honduras (Dennett 2016). Similarly, the source of most of the obsidian in the focus area is also likely to have been outside, as indicated by samples from El Tuma La Dalia which were sourced to Guinope, following the common Nicaraguan trend (Braswell 1997; 1999; Glascock 2015; Uosukainen *et al.* 2016; Quinn *et al.* 2015). In any case, it is clear evidence of participation in interregional networks of exchange in both goods and ideas. In this sense, the Sébaco valley stands out has having the widest diversity of almost any find type presented in the previous chapter, and the concentration of obsidian finds form a concentration in the west, extending from the Sébaco valley to the Coco watershed (fig. 28). Obsidian and known ceramic type distributions give reason to previous considerations of the Sébaco valley having been an important passageway for interregional exchange (Balladares 2013, 92; Braswell 1997, 27; 1999; Kühl 2010; Incer 1985, 377-378; 2003, 124).

Participation in these networks is clearly more visible in the archaeological record in the western areas of the focus region. For the focus area, interregional exchange and interzonal interaction are closely related, as access to foreign resources likely played a role in the interaction between groups occupying different zones with a differing degree of participation in networks spanning across the region and beyond. Centrality, provided by a geographically optimal location, is likely to have played an important role in favouring one area over another in terms of participation in interregional networks and the flow of foreign goods, people and ideas. In this view, the Sébaco valley is an optimal choice for an exchange hotspot as two river systems accessing Pacific Nicaragua and the Caribbean watershed run alongside each other at a very close distance in a valley where potential terrestrial passages head towards the valleys of Estelí and Condega towards the north-west, Pantasma to the north and Tuma to the north-east (fig. 13). If indeed the differences in material distributions observed here are the result of access to different material cultures and groups with different polities, one might well imagine trade in the context of a complex and possibly multi-ethnic political landscape envisioned in Central America by Lange (*et al.* 1992, 270) and Hoopes (1993, 276).

An abundance of passages in multiple directions is important when considering the likely down-the-line trade between groups inhabiting the different valleys and ecological zones in the North Central region. This is because multiple options for moving goods awards economic resilience and centrality to a place within an exchange network. An example is provided when considering a third-party trading group, such as the Pochteca suggested by Incer (1985, 377-378; 2003, 124). Having alternatives, if a deteriorated relationship with a group controlling a certain passage blocked the movement of goods and people, meant that at least exchange and access to other regions could continue. Incer's route for the Pochteca (fig. 11) for example, which in the North Central region is closely aligned with the route (fig. 8) for obsidian trade by Braswell (1997, 27), crosses into Sébaco from the Estelí and Condega valleys in the Coco watershed. However, obsidian blades and nuclei form a clear pattern between the Sébaco and Pantasma valleys (fig. 25 and 28), which means this could have acted as an alternate route to the Coco watershed, linking the focus area to the Guinope obsidian source in multiple ways. This scenario works particularly well considering indirect, down-the-line trade.

Incer's idea of a Pochteca route merits some further entertainment here also because it has interesting implications in terms of interzonality on an interregional scale. To a large extent it seems to navigate the highlands on the (south)western side of the isthmian orographic divide, not just in the focus area, but across Nicaragua. Could this be for reasons of centrality, and does climate play a role in this? Lange has pointed out the benefits of traveling along elongated ecosystems in the length of Central America as the traveller would be likely to encounter societies that were more similar, at least terms of subsistence strategies (Lange 1984, 59). However, taking the "middle way" close to the orographic divide would also grant access to passages leading to multiple watersheds and diverse environments, and thus an advantageous opportunity to interact with different specialised peoples and have access to their goods. Furthermore, following the western side of the orographic divide would avoid the driest conditions towards the Pacific, as well as the most humid conditions to the east, sheltered from the worst hurricanes. This would provide logistical advantages on long journeys with fresh, perennial water sources and some degree of shelter from extreme temperatures and humidity, protecting perishables along the way. Or would a potential cross-isthmian trading route take the middle-way because this crosses important settled areas placed in ideal locations with sheltered climates? The Sébaco valley, much like the Mayales valley in the department of Chontales might prove to be examples for such areas. However, it might eventually be more of a chicken *and* the egg-case, as mobilities and sedentarism are often interdependent and closely related to each other.

How, then, do we consider access to interregional networks of exchange in light of the humid, eastern zone of the focus area? Subarea 4 seems to make a clean break from the other subareas in terms of material culture, featuring structures that are nearly absent in other zones and shining with the absence of many movable finds present in the areas towards the west (fig. 28). Is this the border of the Mesoamerican area, as proposed by Newson (1987, 24 see fig. 7)? Does the east of the focus area fall into the "frontier", as described by Carmack and Salgado (2006), enjoying a lesser degree of interaction with more Mesoamericanised groups? One should not fall into the "similarity trap" (Geurds and Van Broekhoven 2010), thinking that a lack of similarity in the material record equates with a lack of interaction. Actually, the east of the focus area also shares important aspects in the material record with all the other areas. Segovias Naranja ceramics and circular mound building are common throughout the focus area, as well as in the entire, so far investigated North Central region, pointing to a sphere of commonality and interaction including subarea 4 through material similarity. The presence of Usulutan ceramics and obsidian, even when found at just one location in this subarea, confirm some degree of inclusion in interregional networks. However, Geurds and Van Broekhoven (2010, 54) are right to suggest that selectively rejecting some aspects of material culture and adopting others is an essential part of inter-group interaction, which could also explain differences between subareas 1 and 2 for example.

Finds found in the focus area that can be linked to an interregional context, such as white-slipped ceramics and obsidian, demonstrate that interzonal interaction in the focus area cannot be considered without discussing meso-regional dynamics. This is because participation in interregional networks of exchange likely impacted local dynamics and inter-group relations. Furthermore, the flow of goods such as obsidian invites discussion on interregional trade routes passing through the focus area. This topic is important to address in terms of Central American geography and the centrality of places such as the Sébaco valley, for example. However, it must be stressed that the data from the focus area only affords so much discussion on the topic. Finally, considering the interregional flow of goods also highlights areas where such goods for one reason or another have not been found, even when the geography has been permitting.

7.1.3 Summary and conclusion

This thesis has used an exploratory visual analysis of mostly non-systematic survey data through a zonal complementarity perspective to answer the central research question:

"What can existing survey data reveal about interzonal interaction and exchange in pre-Conquest North Central Nicaragua?"

Using a large scale of analysis and a thorough evaluation of data biases has helped to minimise the spatially distorting effect that non-systematic survey data can have on smaller scales. Furthermore, using available environmental data has allowed to take into account the multi-environmental landscape of North Central Nicaragua into the analysis of the archaeological data.

So far, there are clear indications that in most cases environmental barriers have acted as boundaries between different material distribution groups. These are referred to as subareas for purely descriptive purposes, within which some degree of micro-geographical variation can be seen, but that largely occupy different ecological zones. If these subareas are taken to represent different pre-Conquest groups, the data would indicate both micro-geographical as well as ecological specialisation.

The distribution of movable, non-perishable goods across subareas and ecological zones are an indication of interzonal exchange between the peoples occupying these different zones. However, these finds are unevenly distributed. The Sébaco valley stands out here as having the highest diversity of lithic finds and known ceramic types, and this diversity decreases in areas across the orographic divide, where in the Matiguás valley this diversity is lowest. Different models offer possible explanations for this unequal distribution. These include interzonal down-the-line trade model involving interregionally traded goods, putting the Sébaco valley in a central and perhaps even a dominant position. More mutual zonal complementarity scenarios would suggest non-perishable goods were exchanged for perishable commodities, implying an interdependent relationship between peoples occupying different ecological zones. As these perishables are not visible in the archaeological record however, there is currently no evidence to support this model. Similarly, the traditional model of zonal complementary suggesting the colonisation of an ecological zone by groups originating from another cannot be supported with the data available at this time.

The data also shows possible signs of active “boundary maintenance” (Lange 1984, 59) between groups. This is most visible between subarea 4 in the Matiguás valley, showing stark material differences with the other subareas, despite the absence of clear environmental obstacles for mobility. Interzonal interaction was therefore not only a matter of exchange, but also the regulation thereof.

Much research is obviously still needed to verify the observations made above, which rely heavily on the absence and diversity of finds within loosely defined special areas. Systematically collected quantifiable data is necessary to statistically evaluate the strength and significance of the observed patterns. However, considering the existing survey data with all of its limitations has still been beneficial. It has allowed to introduce a new section of a Central American region that is currently underrepresented in the archaeological discourse in an exploratory but comprehensive manner. Furthermore, this has been done by adding an environmental perspective to the archaeological discourses mostly concerned with the circulation of goods on an interregional scale and with territorial ethnic considerations. This has helped to consider environmental zones and boundaries as more than just territorial markers, but also as corridors for mobility, exchange, opportunity and diversity, and as a factor in the interaction between groups. As future research in the focus area advances both in detail and quality, an interzonal focus will remain valid for asking relevant questions about the life of pre-Conquest societies. This is not just relevant for pre-Conquest North Central Nicaragua, but also other regions of Central America, which is one of the most environmentally diverse regions of the world.

7.2 Final remarks: Limitations and opportunities

7.2.1 Results in relation to current land use patterns

As previously discussed (see 6.2.2), it is possible that different land use processes in the current landscape, also divided by (agro)ecological regions, highlight different finds in different subareas and introduce a bias into the archaeological record. This would promote a view of the past in which ecoregional divides are also cultural divides. The down-the-line trade as well as zonal complementarity models operate well within this multicultural and environmentally variable landscape, and mixed finds on ecological transition zones, such as between subareas 1 and 3, promote the ideas of cultural transition and exchange. However, the possibility of a land use related bias does not nullify the meaningfulness of the patterns observed. Possible exchange corridors and “hotspots” do not just occur on the ecoregional transition zones. They seem to occur where other (topographical and hydrological) conditions are the most favourable for interregional exchange and mobility, for which the Sébaco valley remains the prime example even today. There is reason to argue that both pre-Conquest presence and geographical factors lead to path-dependencies, where more recent choices for road building, settlement and agriculture are reproduced. This again influences the biases in the documentation of the archaeological finds (see 6.2.1), but then again, the observed distributions would make a lot of sense in terms of the pre-Conquest past as well.

There are also some specific examples showing that the surface record can be taken seriously as a proxy for sub-surface finds. Firstly, the recent introduction of intensive agriculture across the ecoregional divide in El Tuma La Dalia has not yielded the same variety of foreign ceramics as in the heavily ploughed valley of Sébaco and have in fact contributed to the preliminary detection of varieties not seen in elsewhere (Uosukainen *et al.* 2016). Secondly, excavations in Matiguás on relatively well-preserved mounds have also not presented an assemblage of ceramic finds comparable to the western areas (Minami *et al.* 2015). This does not mean that polychromes, for example, will not be found in the Matiguás valley in the future, but they can be expected in trace amounts.

7.2.2 Visual exploratory analysis of non-systematic data

There are both advantages and disadvantages for using the method for the focus area specifically. For the visual analysis of non-systematic survey data the varied environment and scale of the focus area has been particularly useful, as this helps detecting and “capturing” particular distributions and rooting them in an environmental and geographic context. In a more monotone environment this might have been more difficult. Also, the large scale of analysis increases the likelihood of different patterns to be detected across space. It also minimises the distorting effect of non-systematic spatial patterns that might normally be confusing on a smaller scale, but which the varied environment on a large scale helps make meaningful.

Another advantage that the focus area has had in terms of the dataset, is that most of it was produced using similar standards. This greatly facilitated the data combination process and added to the confidence that finds had been identified according to a consistent way (exceptions do exist, as can be seen with the use of oval mounds as a category in El Tuma La Dalia only). This means that any errors in find misclassification would likely apply to the entire focus area, and might later be corrected accordingly.

Disadvantages for the method in the focus area at the scale used include the highly complex topography. A baseline was set for a DEM derived landform classification for the focus area using loose parameters and categories. This was done in order to add to the dataset for possible future purposes, and to complement inconsistencies in the information provided by the reports. Although a landform classification can be used as a visual background to assess distributions, at the scale of the analysis the topography would have been too complex for an effective visual exploratory approach, even when using simplified categories. Using a landform classification would therefore work better at smaller scales with parameters set specifically to meet the needs of the analysis and to best represent the terrain in question. Preferably, any visual assessment on a scale smaller than used in this thesis would make use of a systematically acquired dataset, so that using landform in the analysis would serve more than just indicative purposes and contribute to a more complete settlement pattern analysis.

Lastly, a more obvious disadvantage for using the method in the largely unresearched focus area is that the chronologies are particularly unclear for many North Central ceramic types encountered, if established at all. Timeframes could be better taken into account in the overall analysis if the visual analysis was done in a region where ceramic chronologies are better understood.

7.2.3 Assumptions and suggestions for future research in the focus area

Research in the focus area is still in its exploratory phase and relies on certain assumptions in order to explore interzonal interaction, detect knowledge gaps and formulate hypotheses. Future research will have to test these assumptions to make viable research in the focus area possible in general. Some suggestions are made below.

This thesis has invested some degree of trust into ceramic chronologies, which in the case of northern central ceramic types have been established largely without radiocarbon dating. Therefore, one of the most important research areas in the future should address ceramic chronologies and dating contexts. Also, many of these types, like the Segovias Naranja, lack in-depth research saying more about where they were produced and whether some possible sub-varieties differ in use and timeframes. Compositional analysis and sourcing are needed next to radiocarbon dating from associated contexts and are also important for better established varieties such as the white-slipped polychromes, in order to establish exactly where they were produced.

There are some assumptions regarding the observed distributions and their overlaps. Firstly, different sets of overlapping distributions are taken to represent different material cultures and different groups. However, more research is needed to confirm this. secondly, non-systematically sampled data makes it hard to confirm whether the observed distributions actually constitute statistically significant entities. This is because more sites have been discovered in the western areas than in the east due to biases related to opportunism and modern land use patterns (however, see above 7.2.1). Sub-surface research with consistent sampling methods from these different subareas and zones should be conducted to confirm whether the differences observed on the non-systematic surface record are valid. If sub-surface contexts prove that areas in different zones were actually very similar, this would still have significant implications in terms of zonal complementarity if the same group is assumed to occupy different zones. To check this latter assumption, a practice approach could be helpful in assessing differences in for example mound building, ceramic production and settlement patterns in different zones to see whether the archaeological record was produced as a result of the same practices or clearly different ones.

In considering mobility and exchange in terms of the geography and the terrain, this thesis has assumed that (linear) topographical depressions and crevices, often paired with the hydrological network, are the most viable passages while navigating across the highland region. From an energy consumption and distance point of view, the best path leading from one point to another can be calculated with least cost path and least cost corridor analyses in GIS software using freely available DEM data. Although exchange routes might very well have deviated from these calculated routes optimising access to certain communities, resources etc., using these analyses could provide important evidence to support of challenge assumptions made in this thesis. Pin pointing exact routes would, of course, benefit from a systematic dataset and settlement pattern analysis.

Additionally, local foodways (and differences between zones) can be studied through isotopic analyses on bone samples (providing that these can be recovered) revealing dominant diets and whether C_4 crops associated with dryer environment, such as maize (*Zea mays)*, was consumed. This might have further implications on zonal complementarity, at least on a micro-scale, as cultivating this crop in some of the higher elevation humid zones is not viable. Furthermore, starch analyses on grinding tools, which are widely found throughout the focus area, can also reveal much about which crops were consumed.

Finally, this thesis has made a highly simplified, binary reconstruction of the past climate, dividing it according to the orographic phenomenon into a dryer west and a more humid east, further assuming differences between elevation levels. Although these assumptions can be said to be reasonable, climatic variation and human impact on past environments cannot be underestimated. Paleoenvironmental and paleoclimatic research would be very helpful in assessing differences between zones at different times, which would enlighten any interzonal analysis. This could be done through paleobotanical analysis, such as by collecting pollen samples, or looking at the climate record saved in speleothems in caves, such as those studied by Baker and Armitage (2013).

8.0 Abstract

North Central Nicaragua has long been on the fringes of the researched world and this region is still largely underrepresented in discourses on Central American archaeology. These have traditionally put the emphasis on defining ethnic territories and boundaries across the isthmus, often obscuring local diversity. The existing knowledge on the pre-Conquest societies of North Central Nicaragua rely heavily on linguistic sources and biased colonial accounts. An archaeological effort to understand the pre-Conquest past of the region would not only contribute to the writing of local history, but also contribute to archaeological discussions on an interregional scale.

Most of the archaeological data available for the Matagalpa and Jinotega departments are found in unpublished survey reports. These have been largely disregarded due to the non-systematic survey strategies used and lacks in a chronological understanding of the archaeological sites and finds. This thesis adopts a visual GIS approach that makes use of these data sources, in order to combine existing survey data and explore the pre-Conquest past in the Matagalpa and Jinotega departments of North Central Nicaragua. A flexible framework is used to analyse the survey data, accounting for its limitations and considering the particularly variable environmental zones that characterise this region. Considering different models of zonal complementarity and interregional exchange, the visual analysis seeks to gain an understanding of pre-Conquest interzonal interaction and exchange in the research area.

The analysis reveals different patterns of interzonal interaction. Distributions of movable finds penetrate different environmental zones, indicating exchange between groups occupying different environmental zones. Finds linked to interregional networks are found in differing degrees of diversity in different parts of the research area, suggesting differing degrees of centrality and access to goods from outside regions. The available data supports interregional down-the-line trade models taking place in an environmentally and most likely also socially and culturally heterogeneous landscape.

This thesis contributes to closing a knowledge gap on the pre-Conquest past both on a local and interregional scale. Combining existing archaeological data helps archaeology to participate more effectively in current discourses about pre-Conquest North Central Nicaragua. Interregionally, this thesis contributes by presenting a comprehensive data exploration in an underrepresented region through an environmental and geographical perspective. This perspective helps seeking new avenues in Central American archaeology that allow the consideration of local diversity without losing sight on interregional dynamics.

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