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The initial human settlement of Northwest South America during the Pleistocene/Holocene transition: Synthesis and perspectives

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ABSTRACT

The northwestern corner of South America, represented by the current territory of Colombia, is a key region to assess some relevant issues linked with the initial human peopling of the area, including population dispersals, cultural diversity, and early adaptations to the changing environmental conditions experienced by lowland and highland north-Andean Neotropical ecosystems at the Pleistocene/Holocene transition. The aim of this paper is to present a synthesis of the archaeological research about early peopling carried out in Northwest South America during the last four decades. Specifically, it will focus on the adaptive strategies and the cultural diversity patterns exhibited by the early hunter-gatherer groups that entered the region since late Pleistocene times. The classic ideas about the time of arrival of the first settlers, the dispersal routes, the incidence of the climate change in on the rate of dispersal and colonization of different habitats, and the role of the megafauna in the subsistence will be reviewed, prior to the formulation of new hypotheses about the meaning of the apparent intraregional diversity of the archaeological record and the evolution of economic strategies over time.

1. Introduction

Due to its geographical position and its high environmental diversity, Northwest South America-mostly corresponding to the current Colombian territory-is a crucial area to address the issue of the timing, pattern, and process of early human colonization of South America at the Pleistocene/Holocene transition (ca. 12,000–8000 BP). Much of the current knowledge about the Pleistocene archaeological record from this area is owed to the intense archaeological and paleoenvironmental research carried out by G. Correal and his associates since the late 1960s to the early 1990s, particularly focused on the Sabana de Bogotá (Eastern Andes Cordillera) (Correal and van der Hammen, 1977; Hurt et al., 1977; Correal, 1979, 1981, 1986; Ardila, 1991). With few exceptions, after the latter date the interest in the study of the early peopling of Northwest South America somewhat waned, notwithstanding the fact that over the last two decades the execution of several research projects in different regions of the Colombian territory have contributed to substantially increase the number of findings and data corresponding to Early Holocene times (Salgado, 1988–1990; Cavelier et al., 1995; Gnecco and Mora, 1997; López, 1999; Gnecco, 2000; Mora, 2003; Mora and Gnecco, 2003; Cano, 2004; Aceituno and Castillo, 2005; Aceituno and Loaiza, 2007; Santos, 2010). The particular history of the Paleoindian research in Colombia and the current lack of a coherent program specifically aimed at obtaining information about the settlement patterns and adaptive strategies of early populations, make necessary a thorough and critical review of the available evidence in order to identify the major empirical and interpretive problems that any contemporary archaeological approach to the issue must face. In such a context, the aim of this paper is to present a general view of the Paleoindian record of Northwest South America corresponding to the Pleistocene/Holocene transition, particularly focusing on current knowledge about the different adaptive strategies implemented by early hunter-gatherer groups, the way in which such differences can be explained by environmental factors, and the differential pattern of occupation of highlands and lowlands across the entire region. It is intended to complement a recent paper (Delgado-Burbano et al., in press) that addresses the strengths and weaknesses of the regional radiocarbon database, as part of an effort to lay down the

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foundations for future research on the early colonization of the Colombian territory.

2. Paleoenvironmental reconstructions

The northwest part of South America an environmentally diverse area roughly corresponding to the current Colombian territory, has an approximate surface of 2,070,408 km^2 (Fig. 1). One of the main geographic characteristics of the area is the division of the Andean mountain range into three branches of different geological origin, namely Western, Central and Eastern Cordilleras. There are two main inter-Andean valleys between the Cordilleras irrigated by the two main Colombian Andean rivers: the Magdalena and the Cauca (Domínguez, 1988).

There are two important sectors in terms of biodiversity: the narrow Pacific strip extending from Panamá up to northern Ecuador, and the Orinoco-Amazon basins that are part of the vast Amazon rainforest (Domínguez, 1988). To the eastern side of the Andes extends Llanos Orientales (Eastern plains), a large plain covered with grasses and forested areas along the local rivers (Fig. 1). The remainder of the area is made up of rolling savannahs along the Colombian Caribbean, including the northern arid strip. These physiographic characteristics create dramatic climate variations along the altitudinal gradient producing in turn highly diverse landscapes. Differences in solar exposure, rainfall, and soils make a vertical mosaic of markedly different and narrow tiers, except in the Amazon and eastern plains where the ecosystems are substantially wider (Gnecco and Aceituno, 2006).

Northwest South America has been a subject of detailed paleoenvironmental studies since the second half of the 20th century leaded by T. van der Hammen. Today there is a large amount of paleoclimatic and paleoecological data for almost the entire area covering approximately the last 280,000 years, although a high portion of such studies came from the Sabana de Bogotá region, and surrounding areas (Cundiboyacense High Plateau) in the Eastern Cordillera. For the practical purposes of this section, the focus is on the environmental evolution of Northwestern South America around the first appearance of humans, relying on available palynological, glaciomorphological and diatom evidence (Van der Hammen and González, 1960; Van der Hammen, 1974, 1992; Van der Hammen and Hooghiemstra, 1995; Colinvaux, 1997; Marchant et al., 2001, 2002, 2004; Vélez et al., 2006). The region suffered repeated environmental changes of variable intensity over time, inferred from temperature, moisture and rainfall fluctuations as indicated by different climate proxies. Such fluctuations may have had the potential to cause significant ecological modifications resulting from climate-dependent chorological changes affecting vegetal and animal communities.

In a series of papers, Marchant et al. (2001, 2002, 2004) performed detailed biome reconstructions based on pollen data, indicating at least four chronological periods of important environmental changes in Northwest South America:

1) Last Glacial Maximum (LGM) (ca.18,500–17,500 BP). Grass savannahs, cool mixed forests, and tropical seasonal forests dominated the lowlands. In the mid to highland elevations settings, a shift from tropical seasonal forests to cool evergreen forests and cool mixed forests has been identified, while at locations above 2500 m asl there was a marked increase of the cool grassland–shrub biome. In general terms, the vegetation at this period reflects cold and dry conditions.
2) Early Lateglacial (ca. 15,500–14,500 BP). The paleoenvironmental record from mid-lower elevations suggests that during this time span the cool mixed forest biome became more widespread. The low altitude localities exhibited at that time the same biomes than today such as grassland savannah,

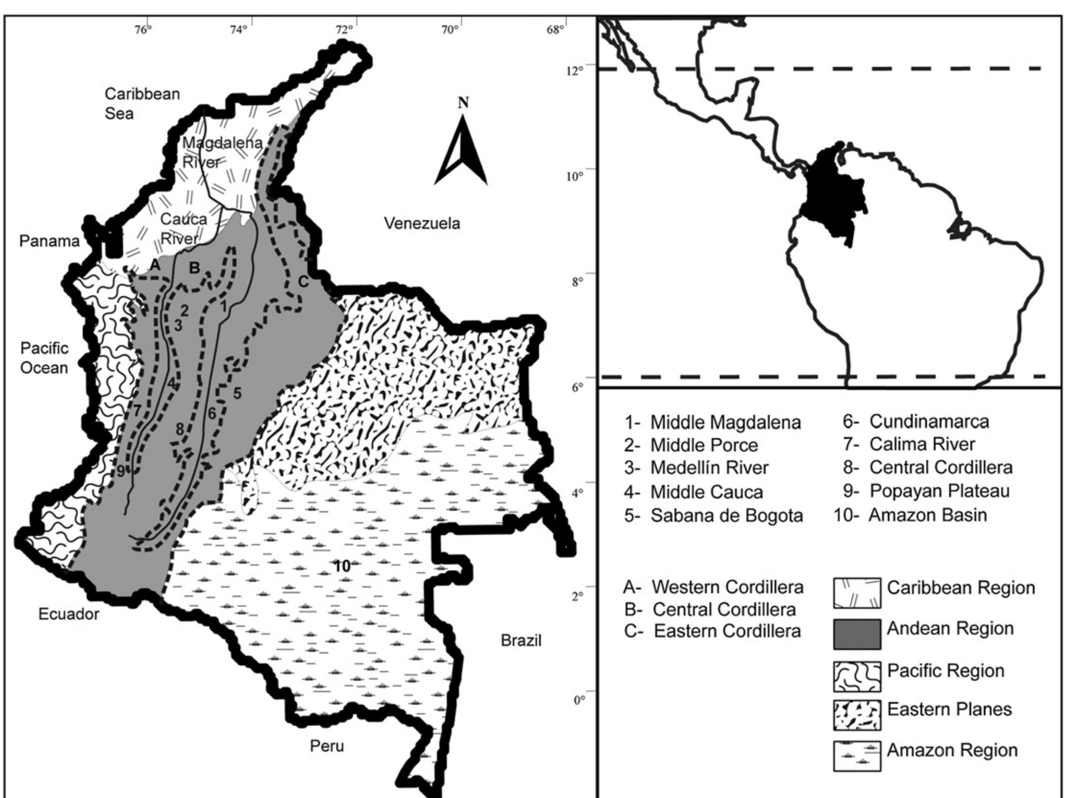

Fig. 1. Colombian geography and archaeological areas distribution.

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cool mixed forest and tropical seasonal forest. Overall, the conditions above mentioned suggest the existence of a cold and dry climate. In summary, the LGM and the earliest part of the Late glacial was a very cold and dry time period, in which some of the investigated localities had very slow sedimentation rates (Marchant et al., 2002).

3) Final Lateglacial (ca.12,500–11,500 BP). Biome reconstructions reveal that the environmental conditions were relatively similar to those of the previous period, although with an increased spread of cool evergreen forest biomes at mid altitudes, thus revealing some climatic amelioration. This is related to the Guantiva Interstadial (12,500–11,000 BP), which is characterized by the increase of average annual temperature (2 °C lower than today) and effective precipitation, as well as altitudinal movements of the upper forest line (Van der Hammen and Hooghiemstra, 1995). In the Sabana de Bogotá (Cundiboyacense High Plateau) for instance, there was an expansion of the forest over the paramo, which was represented by *Alnus,* as well as vegetation typical of marsh environments including low bushes of the genera *Myrica* and *Symplocos.* At Fúquene lake (also in the Cundiboyacense High Plateau) and surrounding areas, the presence of *Dodonaea*, a pioneer of bare soil, is a good indicator of this climatic trend (Van der Hammen, 1974, 1992, p. 45), which has several correlates in other areas of Colombia (Marchant et al., 2002). The end of the Guantiva Interstadial was marked by the return of colder and drier conditions associated with the onset of the El Abra Stadial (~11,000–10,000/9500 BP).

   Average annual temperatures during the E1 Abra Stadial were 4–6 °C lower than today. The upper forest line during this time was some 400–500 m lower than during the Guantiva Interstadial and some 600–800 m lower than today (Van der Hammen and Hooghiemstra, 1995). In the Sabana de Bogotá the forest partially disappeared and was replaced by the low bushes of the subparamo, with many open paramo grasslands of the family Compositae (Van der Hammen and González, 1960; Van Geel and van der Hammen, 1973; Van der Hammen, 1974, 1978). According to Van der Hammen and Hooghiemstra (1995), the Guantiva-El Abra interval is the regional equivalent to the European Allerød-Younger Dryas sequence.

4) Early Holocene (ca. 10,000–8000 BP). During this interval the climate ameliorated again, with a sudden rise in average annual temperature that increased evaporation and caused lakes and swampy areas to dry (Van der Hammen, 1992). The biome reconstructions for the 9500–8500 BP interval reveal that there was a notable expansion of mesic biomes (Marchant et al., 2002). At higher elevations, cool mixed forest spread at the expense of the cool grassland–shrub biome. Below 2570 m asl, the cool grassland–shrub biome formed an association with the cool evergreen forest. At lower altitudes, tropical seasonal forest and tropical rain forests biomes were present, although some increasing in the extent of grass savannah and tropical seasonal forest was detected. According to Marchant et al. (2002, 2004), this interval was clearly characterized by warmer and wetter conditions than those of the last part of the Lateglacial.

Finally, changes in the chorology and composition of animal communities during the Pleistocene/Holocene transition are difficult to establish because most of the archaeological and paleontological records come from undated or non-stratified contexts. This particularly affects the knowledge of relevant aspects regarding Pleistocene megafauna, whose interactions with humans appear to be poorly documented (Correal, 1981, 1993; Van der Hammen, 1986; Piperno and Pearsall, 1998; Van der Hammen and Correal, 2001; Correal et al., 2005). Available evidence shows that extinct mammals like proboscidean gomphotheres (genera *Haplomastodon*, *Stegomastodon*, and *Cuvieronius*), xenarthrans (genera *Gliptodon*, *Propraopus* and *Eremotherium*), and American horses (genus *Equus*) coexisted in certain areas, with still living fauna including cervids (genera *Odocoileus* and *Mazama*), xenarthrans (genus *Dasypus*), lagomorphs (genus *Sylvilagus*), caviomorphs (genera *Cavia* and *Cuniculus*), and cricetids. However, the timing of megafauna extinction and the role of humans in such a process have yet to be determined. Recent archaeological and Quaternary research in other South American areas suggests an extinction pattern regionally differentiated but in general terms implying climate more than human influence (Piperno and Pearsall, 1998; Borrero, 2006, 2008; Barnosky and Lindsey, 2010).

3. The archaeological record at the Pleistocene/Holocene transition

As it was already mentioned, the information about the Pleistocene human settlement of Colombia is still relatively scarce. In very general terms, the archaeological record of early occupations is located in the Sabana de Bogotá the middle Magdalena River Basin (Middle Magdalena), the Central and Western Cordillera, and the Popayan Plateau (Fig. 1). To date, there is almost no information from key regions such as the Caribbean lowlands, a coastal corridor that had to be used by early colonizer groups, as the Joboid tradition on the Venezuelan Caribbean coast suggests (Bryan et al., 1978; Gruhn, 1979; Oliver and Alexander, 2003), the Chocó on the Pacific coast, and most of the Eastern Plains and the Amazon Basin.

The Sabana de Bogotá is a high Andean plateau located at 2600 m asl within the Cundiboyacense High Plateau, in the Eastern Cordillera. The oldest dates come from two rockshelters, El Abra II and Tequendama I, and an open air site named Tibitó (Table 1). At El Abra II, 37 lithic flakes and expedient unifacial tools, which gave name to the "Abriense industry" or "edge-trimmed tool tradition" (Correal et al., 1966–1969; Hurt et al., 1977; Correal, 1986), were recovered at the lower levels (7 and 8; *ca.* 12,400 BP) in association with faunal remains of still living species such as deer and small-bodied mammals. Several charcoal samples, mostly small flecks mixed with dark soil particles, were selected for dating, yielding final Pleistocene and Early Holocene ages (Correal et al., 1966–1969; Hurt et al., 1977; Correal, 1986). At Tequendama, Correal and van der Hammen (1977) excavated a group of rockshelters. The lower levels of Tequendama I, dated between ca.12,500 and 10,900 BP, contained faunal remains similar to those found at El Abra II and simple flakes. Between ca.11,000 and ca.10,000 BP appears a different kind of technology, called Tequendamiense, whose main differences with the Abriense artifacts are the use of exogenous materials and the presence of scrapers, thinned flakes and a projectile point fragment (Correal and van der Hammen, 1977, p. 34).

In 1979 Correal excavated Tibitó, an open air butchering site dated 11,740 ± 110 BP, where a number of Abriense stone tools were recovered associated with bone remains of mastodon (*Haplomastodon* sp. and *Cuvieroniu shyodon*), american horse (*Equus* sp.) and deer (*Odocoileus virginianus*) (Correal, 1981). At the Sabana de Bogotá, further investigations in sheltered and open air sites including Sueva I, Gachalá, Galindo I, Neusa, and Checua led to the recovery of contexts characterized by the presence of Abriense artifacts and faunal remains of still living species, with chronologies ranging from 12,000 to 8000 BP, suggesting a continuity of this cultural tradition from the late Pleistocene to Early Holocene times (Table 1).

In the lowlands rainforest of the Middle Magdalena, some important early sites including Nare, La Palestina 1 and 2, San Juan de Bedout, and Peñones de Bogotá were explored and subsequently excavated during the last decade (for a synthesis, see López, 2008).

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Table 1
^{14}C dates from northwest South America at the Pleistocene/Holocene transition.

Site	Region	^{14}C date	Sigma	Calib BC/ AD (OxCal 4.1 95.4%)		References
Pubenza	Cundinamarca	16,400	420	−18,576	−16,731	Van der Hammen and Correal (2001)
El Jordán	Central Cordillera	12,910	60	−14,137	−13,087	Salgado (1998)
El Abra II	Sabana de Bogota	12,400	160	−13,152	−12,021	Hurt et al. (1977)
Tibitó	Sabana de Bogota	11,740	110	−11,872	−11,408	Correal (1981)
Tequendama I	Sabana de Bogota	10,920	250	−11,369	−10,424	Correal and van der Hammen (1977)
El Abra II	Sabana de Bogota	11,210	90	−11,356	−10,891	Hurt et al. (1977)
Tequendama I	Sabana de Bogota	10,730	105	−10,945	−10,476	Correal and van der Hammen (1977)
El Abra II	Sabana de Bogota	10,720	400	−11,438	−9407	Correal et al. (1977)
Tequendama I	Sabana de Bogota	10,590	90	−10,743	−10,202	Correal and van der Hammen (1977)
Tequendama I	Sabana de Bogota	10,460	130	−10,688	−9893	Correal and van der Hammen (1977)
Nare	Middle Magdalena	10,400	40	−10,564	−10,140	López (2008)
Nare	Middle Magdalena	10,400	60	−10,579	−10,111	López (2008)
La Palestina 2	Middle Magdalena	10,400	90	−10,612	−10,048	López (2008)
Nare	Middle Magdalena	10,350	60	−10,471	−10,034	López (2008)
San Juan de Bedout	Middle Magdalena	10,350	90	−10,593	−9878	López (1989)
La Palestina 2	Middle Magdalena	10,300	70	−10,451	−9874	López (2008)
La Palestina 2	Middle Magdalena	10,260	70	−10,436	−9806	López (2008)
PIII0I-52	Middle Porce	10,260	50	−10,424	−9819	Otero and Santos, (2006)
La Palestina 2	Middle Magdalena	10,230	80	−10,432	−9671	López (2008)
Tequendama I	Sabana de Bogota	10,150	150	−10,432	−9317	Correal and van der Hammen (1977)
Tequendama I	Sabana de Bogota	10,140	100	−10,170	−9371	Correal and van der Hammen (1977)
Tequendama I	Sabana de Bogota	10,130	150	−10,429	−9300	Correal and van der Hammen (1977)
El Jazmin	Middle Cauca	10,120	70	−10,075	−9449	Aceituno and Loaiza (2007)
Sueva I	Sabana de Bogota	10,060	90	−10,009	−9374	Correal (1979)
La Morena	Medellín River	10,090	60	−10,074	−9364	Santos (2010)
San Isidro	Popayan Plateau	10,050	100	−10,027	−9312	Gnecco (2000)
San Isidro	Popayan Plateau	10,030	60	−9861	−9322	Gnecco (2000)
Tequendama I	Sabana de Bogota	10,025	95	−10,015	−9299	Correal and van der Hammen (1977)
Tequendama I	Sabana de Bogota	9990	100	−10,007	−9279	Correal and van der Hammen (1977)
La Palestina 1	Middle Magdalena	9820	115	−9760	−8839	CAIN-OCENSA, 1997 in López (2008)
El Jordán	Central Cordillera	9760	160	−9803	−8727	Salgado (1998)
Tequendama I	Sabana de Bogota	9740	135	−9657	−8750	Correal and van der Hammen (1977)
66PER001	Middle Cauca	9730	100	−9377	−8795	Cano (2004)
La Morena	Medellín River	9680	60	−9276	−8837	Santos (2010)
Salento 24	Middle Cauca	9680	100	−9298	−8784	Tabares and Rojas (2000)
Sauzalito	Calima River	9670	100	−9292	−8782	Bray et al. (1988)
Sauzalito	Calima River	9600	100	−9260	−8722	Bray et al. (1988)
San Isidro	Popayan Plateau	9530	100	−9221	−8634	Gnecco (2000)
La Selva	Middle Cauca	9490	110	−9221	−8560	Rodríguez (2002)
Gachalá	Sabana de Bogota	9360	45	−8756	−8485	Correal (1979)
El Abra II	Sabana de Bogota	9340	40	−8731	−8477	Hurt et al. (1977)
El Abra II	Sabana de Bogota	9325	100	−9105	−8294	Hurt et al. (1977)
La Pochola	Middle Cauca	9312	55	−8724	−8348	Aceituno ms.
Sauzalito	Calima River	9300	100	−8786	−8294	Bray et al. (1988)
Peña Roja	Amazon Basin	9250	140	−9119	−8221	Cavelier et al. (1995), Gnecco (2000)
Peña Roja	Amazon Basin	9160	90	−8614	−8244	Cavelier et al. (1995), Gnecco (2000)
Peña Roja	Amazon Basin	9125	250	−9127	−7611	Mora (2003)
Sitio 045	Middle Porce	9120	90	−8619	−8015	Castillo and Aceituno (2006)
El Abra II	Sabana de Bogota	9050	470	−9751	−7080	Hurt et al. (1977)
El Abra II	Sabana de Bogota	9025	90	−8534	−7886	Hurt et al. (1977)
El Jazmín	Middle Cauca	9020	60	−8325	−7968	INTEGRAL (1997)
Sitio 021	Middle Porce	8990	80	−8338	−7836	Castillo and Aceituno (2006)
El Abra II	Sabana de Bogota	8810	430	−9248	−6840	Hurt et al. (1977)
El Abra II	Sabana de Bogota	8760	350	−9114	−7047	Hurt et al. (1977)
El Recreo	Calima River	8750	160	−8256	−7549	Herrera et al. (1992)
Galindo I	Sabana de Bogota	8740	60	−8166	−7597	Pinto (2003)
La Pochola	Middle Cauca	8680	55	−7937	−7587	Aceituno and Loaiza (2007)
La Selva	Middle Cauca	8680	60	−7939	−7586	Aceituno and Loaiza (2007)
39 El RecreoCancha	Middle Cauca	8550	60	−7711	−7498	Herrera et al. (2011)
Peña Roja	Amazon Basin	8510	110	−7935	−7197	Llanos (1997)
39 El Recreo Cancha	Middle Cauca	8480	40	−7587	−7498	Herrera et al. (2011)
Peñones de Bogotá	Middle Magdalena	8480	40	−7587	−7498	López (2008)
Salento 21	Middle Cauca	8430	100	−7606	−7184	Tabares and Rojas (2000)
El Antojo	Middle Cauca	8380	90	−7584	−7187	INTEGRAL (1997)
Neusa	Sabana de Bogota	8370	90	−7581	−7185	Rivera (1991)
PIIIOP-59	Middle Porce	8340	40	−7521	−7311	Cardona et al. (2007)
Checua	Sabana de Bogota	8200	110	−7524	−6834	Groot (1992)
San Germán II	Middle Cauca	8136	65	−7351	−6840	Aceituno and Loaiza (2007)
Peña Roja	Amazon Basin	8090	60	−7303	−6824	Mora (2003)
39 El Recreo Cancha	Middle Cauca	8030	80	−7303	−6824	Herrera et al. (2011)

These stratified open air sites, were dated between 10,400 and 8500 BP (Table 1). Simple flakes, plane-convex scrapers and triangular fishtail projectile points with straight, oblique or rounded wings, and long thin tails, made either on chert or quartz were found without association with faunal or vegetal remains.

During the 1980s and the early 1990s, several sites were excavated in the Colombian southwest and integrated into the discussion regarding the early human settlement in South America. At the Calima (Western Cordillera), a sub-Andean valley about 1600 m asl, two open air sites of early Holocene age, El Sauzalito and El Recreo, were discovered. The sites contained artifact assemblages composed of simple unifacial flakes, hoes, hand stones, hammers, and anvils dated between ca. 9700 and 8800 BP (Salgado, 1988–1990) (Table 1). At the Popayan Plateau (Central Cordillera), about 1600 m asl, lies the site of San Isidro, dated at around 10,000 BP (Gnecco, 1994, 2000, 2003) (Table 1). The lithic material recovered at San Isidro consists of thousands of chert artifacts, among which unretouched and retouched flakes, lanceolate bifaces and handstone tools are included, with no association with faunal remains (Gnecco, 1994, 2000, 2003; Gnecco and Mora, 1997), Mora and Gnecco, 2003. In addition to the artifacts, charred seeds of *Persea* spp. and *Erythrina* and starch grains from *Xanthosoma*, *Ipomea*, *Manihot* and *Maranta* cf *arundinacea* were also identified, as well as other grasses and legumes (Piperno and Pearsall, 1998, p. 200).

Contemporary with the investigations in the Colombian southwest, archaeological research in the Amazon basin led to the discovery of Peña Roja, an open air site located on the middle Caquetá River Basin, dated between 9250 and 8100 BP (Cavelier et al., 1995; Gnecco and Mora, 1997; Mora, 2003, Mora and Gnecco, 2003) (Table 1). At this site, unifacial flakes, choppers, drills, handstones, milling stones, hammers and anvils compose the lithic assemblage (Cavelier et al., 1995). Thousands of charred seeds and macrobotanical remains belonging to different genera of palm trees were also recovered at this site (Morcote et al., 1998), along with phytoliths of *Lagenaria* spp., *Calathea allouia* and *Cucurbita* spp. (Gnecco and Mora, 1997; Piperno and Pearsall, 1998), indicatcing the importance of the vegetal resources among early tropical rainforest hunter-gatherers.

More recently, at the Middle Cauca River Basin (Middle Cauca) and the Middle Porce River Basin (Middle Porce) (Central Cordillera, ca. 1650–2100 m asl), a number of stratified open air sites that date back, in some cases, to the Late Pleistocene were recovered (Tabares and Rojas, 2000; Rodríguez, 2002; Cano, 2004; Castillo and Aceituno, 2006; Aceituno and Loaiza, 2007; Santos, 2010). At El Jazmín (Middle Cauca) (Aceituno and Loaiza, 2007, 2010) and La Morena (Medellin River Valley) (Santos, 2010), both dated at around 10,100 BP, the lithic technology, basically consisting of simple flakes, axes, hoes, hand stones and milling bases, is clearly focused on plant resource exploitation, a clear difference from other early archaeological cultures (Table 1).

There are two other putative Pleistocene sites reported in the archaeological literature. The first is Pubenza, an open air site located in the lowlands of the Middle Magdalena (Cundinamarca) where mastodon bones were found associated with eight stone flakes in a layer dated at 16,460 ± 420 BP (Van der Hammen and Correal, 2001). The second is El Jordan (Central Cordillera) whose lowest layer containing a few stone flakes was dated at 12,910 ± 60 BP (Salgado, 1998, p. 78). In both cases, more detailed stratigraphic and archaeological information is required in order to include these sites in the discussion about the early peopling of Northwest South America.

4. Interregional relationships

The geographical location of sites, radiocarbon dates, and lithic assemblages constitute the most important evidence to assess the spatio-temporal distribution of the late Pleistocene/early Holocene archaeological record across northwestern South America. This distribution is fundamental to understand the timing, pattern, process and tempo of early exploration and colonization of the area, and the way in which different adaptive strategies allowed population expansion and dispersal during the early Holocene.

The available data suggest that the interregional diversity in lithic assemblages, often used to define "traditions", can be explained by geographical and chronological variables, meaning that the nature of the interactions between different regions during the phases of early exploration and colonization of the Colombian territory are still unclear.

Regarding the time of arrival of the first human groups to the area, there is some uncertainty derived from the interpretation of both technological and radiocarbon evidence. On the basis of the Sabana de Bogotá data and the dates associated with the Jobo tradition, a pre-Clovis age of the earliest occupations of northwest South America is suggested, although it is yet largely undemonstrated with high quality, undisputable data (Dillehay, 2000; Delgado-Burbano et al., in press). Chronological differences between the Abriense and Joboid traditions do not indicate whether the two "cultures" belong to some pre-Clovis migration wave that reached South America following the Caribbean coast line, entering the mainland through the large river basins (i.e. Magdalena and Cauca), to go along and cross the northern Andes (Fig. 2). These routes are supported by Dahl et al. (2011: 221) who argue that the geographical location and separation of language families may suggest entry routes and possible migration pathways. In this particular case, the *Chibcha* family language is related to the Magdalena River Route (Ch in Dahl et al., 2011,p. 218) and the *Páez* language (pbb in Dahl et al., 2011,p. 218) may explain the separate Cauca River Route (Fig. 2).

Fig. 2. Suggested entry routes to Northwest South America.

In terms of spatial relationships, the links between the Sabana de Bogotá and other Colombian regions during the Late Pleistocene are not yet clearly understood. A certain flow of raw materials from the Magdalena River Basin to the Cundiboyacense High Plateau can be demonstrated, as they are present in artifacts from the Tequendamiense assemblages (around 10,000 BP). However, very little is known about the technological relationships between the Abriense and the Magdalena River traditions, given the absence of data from the latter region prior to 10,400 BP. Regarding the relationships between the central area represented by the Cundiboyacense High Plateau and the Middle Magdalena with southern areas, the paucity of data from the latter precludes meaningful comparison. Notwithstanding the fact that two sites from the Middle Magdalena (Cundinamarca) and the Central Cordillera, Pubenza and El Jordan respectively, have dates well in excess of 11,500 BP, only the sites from the Cundiboyacense High Plateau with comparable dates are reliable (Figs. 3 and 4; Table 1) (see discussion in Delgado-Burbano et al., in press).

In general terms, the amount of dates, as well as sites, increases from 11,000 to 10,000 BP (Fig. 4). In this time frame, the corridors marked by the two major river basins, namely Magdalena and Cauca, are highlighted, given the dates and sites located along them. During this period, the Tequendamiense (Sabana de Bogotá) and the Middle Magdalena lithic traditions appear in the archaeological record, bearing some technological similarities, such as the bifacial reduction, pressure flaking, as well as the use of the Magdalena River Basin raw materials (Correal, 1986; López, 1999). As an important technological feature that may be related to this time period is the surface recovery of several stemmed projectile points at the Middle Magdalena (Fig. 5A–G). In the Middle Porce, a fluted stemmed point was recovered associated with a 10,260 BP date (Fig. 5H). Within the Central Cordillera in the Middle Cauca and Medellin River, a lithic tradition began, characterized by the presence of waisted hoes and other plant processing tools. To these findings can be added the surface recovery of two projectile points, with striking similarities to those found in the Middle Magdalena lithic tradition but recovered within in the Medellin River (Fig. 5I–J) (Ardila and Politis, 1989; Ardila, 1991). At San Isidro in the Colombian southwest on the Popayan Plateau, Gnecco (2000) recovered (Fig. 5) flaked bifacial stone tools including several projectile points (e.g. Fig. 5M–O), manufactured on chert and obsidian.

These lithic traditions account for a considerable human expansion in this time period, 11,000 to 10,000 BP (Fig. 4) that increased even further during the early Holocene, coinciding with the cooling of the El Abra Stadial and the extinction of the megafauna. The Magdalena Valley is the key region to establish the space-time relationships between regions, in this case with Cordillera Central. The projectile points found at the Medellin River Valley and Middle Porce (Fig. 5H–J) allow a hypothesis that such remains were discarded by hunter-gatherers from the Magdalena River during the exploratory incursion in search of new territories and resources during the Pleistocene/Holocene transition, an unstable climate time period that strongly affected the natural

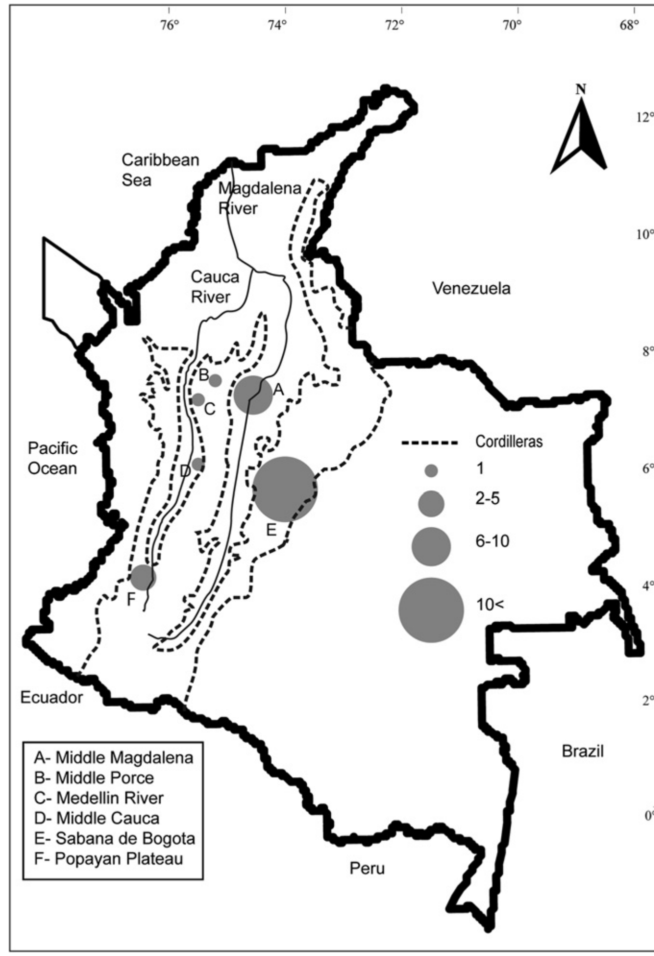

Fig. 4. Amount of dates between 12,000 and 10,000 BP by geographical location.

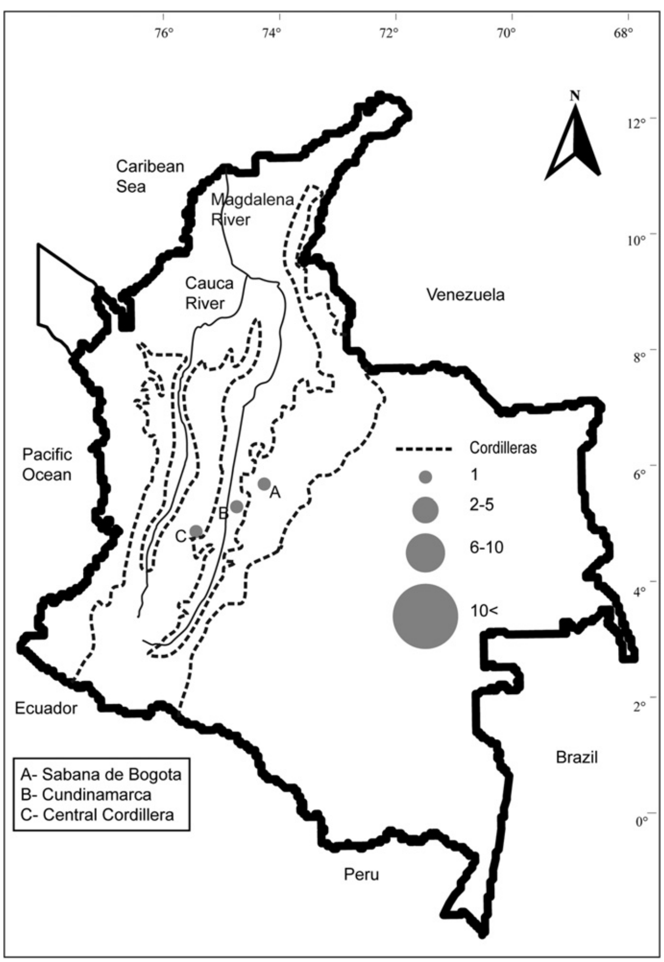

Fig. 3. Amount of dates over 12,000 BP by geographical location.

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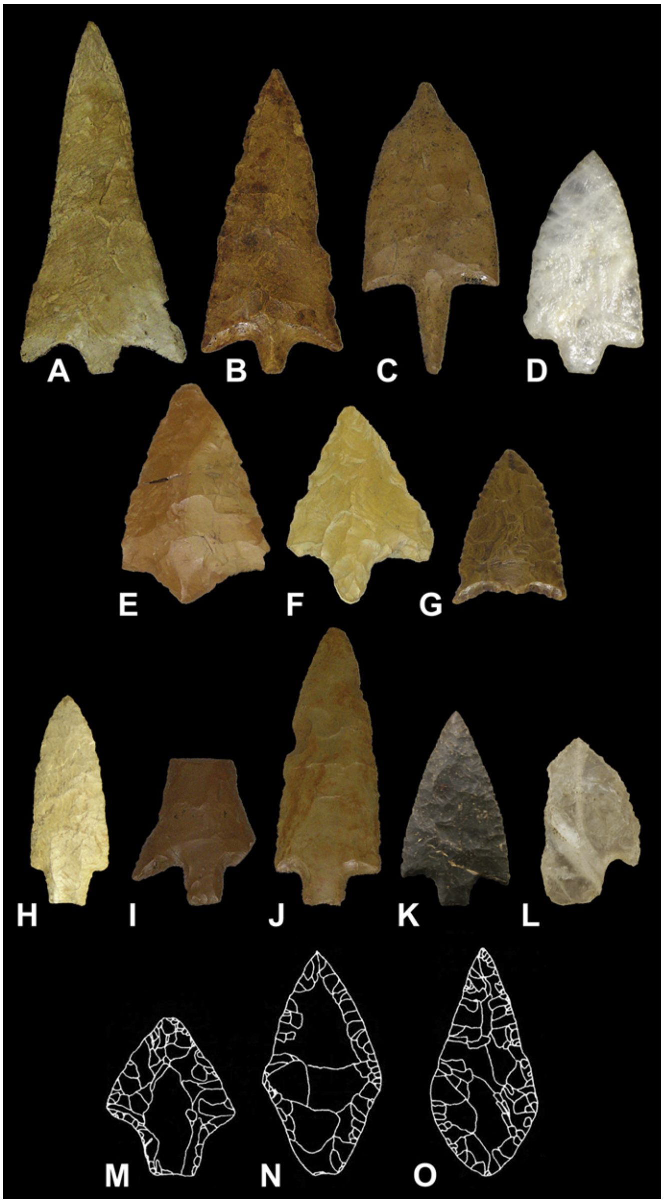

Fig. 5. Projectile Points. A–G Middle Magdalena (surface collection), H Middle Porce (10,260 BP), I–J Medellin River (Surface Collection), K Middle Cauca (Excavated, no date), L Middle Cauca (ca. 8000–8500 BP), M–O Popayan Plateau (ca. 10,000 BP).

resources distribution of the entire North-Andean region (Van der Hammen, 1974, 1978; Piperno and Pearsall, 1998, p. 91; Aceituno and Loaiza, 2007). In the case of the tradition of the Popayan Plateau (Fig. 5M–O), there is not a clear relationship with the debitage technology from the other contemporary occupations in Colombia. However, the identification of macro and microbotanical plant remains connects this tradition with the contemporary occupations at Middle Cauca and the Medellin River.

Because it is hard to identify which region held the source population(s) during the late Pleistocene, the establishing of the possible early interregional relationships can be useful. Accordingly, the archaeological record suggest a connection between Central and Eastern Cordilleras, articulated mainly through the Magdalena River Valley (Fig. 4), but using the entire basin and the small inter-Andean valleys as connections between regions along the altitudinal gradient in both Cordilleras.

Colombian early Holocene sites (10,000 to 8000 BP) increase in number compared to Pleistocene sites and are located mainly on the Andes, except for Peña Roja in the Amazon Basin (Cavelier et al., 1995; Mora, 2003) (Fig. 6). In general terms, the sites are located on five major areas: middle Cauca River Basin (Cano, 2004; Aceituno and Loaiza, 2007, 2008, 2010), Magdalena River Basin (López, 1999; Ranere and López, 2007), Middle Porce (Aceituno and Castillo, 2005; Castillo and Aceituno, 2006; Otero and Santos, 2006), Calima River Basin (Salgado, 1988–1990, 1995; Gnecco and Salgado, 1989) and the Sabana de Bogotá (Correal and van der Hammen, 1977; Correal, 1979; Groot, 1992) (Table 1) (Fig. 6).

Lithic industries at the Sabana de Bogotá and Magdalena remain the same with their formalized debitage structure, and apparently were oriented to procure faunal resources. Nonetheless, this traditional assumption is being revised for the Sabana de Bogotá and it is now suggested that the technology was oriented towards a broad spectrum adaptive strategy, and even with an emphasis on plant exploitation (Nieuwenhuis, 1998, 2002; Cárdenas, 2002; Delgado-Burbano, 2012). In the other regions, lithic technology seems to be mainly oriented to procure plant resources with a high frequency of grinding stones axes and adzes, with several unformatted flakes that could be used for various purposes (Salgado, 1995; Vergara and Tabares, 1995; INTEGRAL, 1997; Aceituno, 2001; Cano, 2004; Castillo and Aceituno, 2006; Aceituno and Loaiza, 2007; Santos, 2010). The recent findings in the Middle Cauca include two stemmed projectile points (Fig. 5K–L), both recovered in excavations. One has been dated between ca. 8000 BP and 8500 BP (Herrera et al., 2011), while the other one still remains undated. This suggests that even though activities were mainly

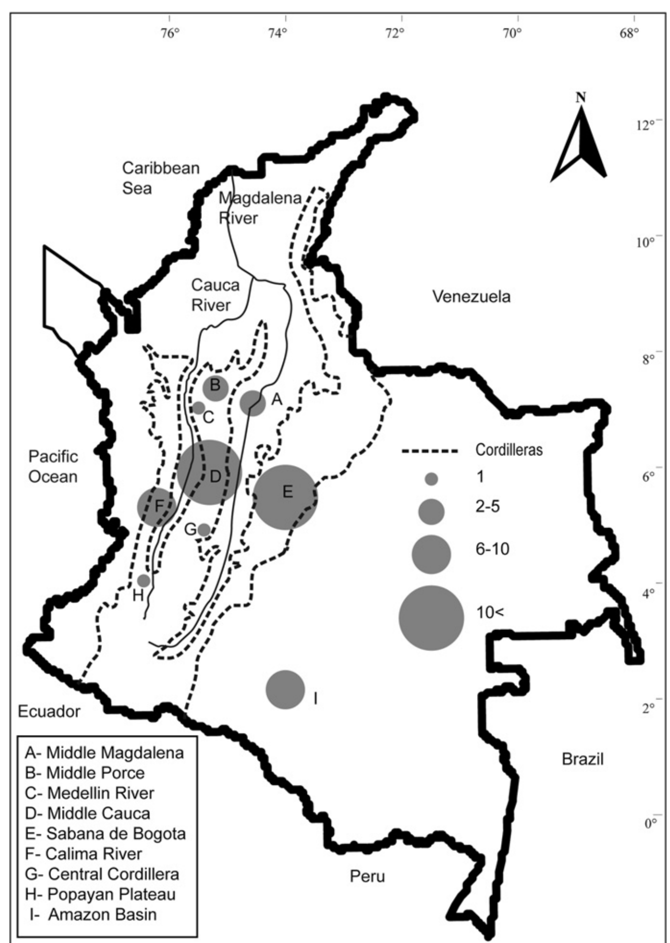

Fig. 6. Amount of dates between 10,000 and 8000 BP by geographical location.

focused on plant resources, hunting may still have played some role on the adaptive strategies.

The increasing archaeological visibility between 10,000 and 8000 BP likely suggests demographic shifts (i.e. population increase) and dispersals, especially in the Andean region where the bulk of the early Holocene record is located (Fig. 6). Based on the economical orientation suggested by the technology, a dispersal model is proposed which entails multidirectional displacements of groups with broad spectrum economies that moved and settled, initially, the low and highland Andean forests through the inter-Andean river valleys and subsequently reached rich ecosystems located along the two greatest river basins in Colombia: Magdalena and Cauca (Anderson and Gillam, 2000; Dillehay, 2000; Aceituno, 2007; Aceituno and Loaiza, 2007). The early Holocene findings of several projectile points in Middle Porce (Fig. 5), one of which was manufactured on what is likely Magdalenian yellow chert, as well as hundreds of quartz tools similar to the ones in the Magdalena River (Otero and Santos, 2002), reinforces the hypothesis of the arrival of the of lowland groups from the Magdalena region using secondary river valleys as expansion routes through the Andes.

The increase of archaeological sites (Fig. 6) indicates that this was a period of expansion and population growth along the Cordilleras (Aceituno, 2007; Aceituno and Loaiza, 2007). The archaeological record shows a high heterogeneity in terms of lithic technology between regions, highlighting the emergence in some cases and the increased use in others, of the plant processing stone tools. The new environmental conditions imposed by an increase in temperature and rainfall, and the subsequent expansion of the rainforests (Van der Hammen, 1992) led the human groups to make adaptive adjustments depending on the characteristics of the new ecosystems, including: a) plant resource management in tropical and premontane forests (Cavelier et al., 1995; Gnecco, 2003; Mora, 2003; Castillo and Aceituno, 2006; Aceituno and Loaiza, 2007, 2008; Santos, 2008), b) the increased hunting of minor species and the gathering of gastropods in the Sabana de Bogotá (Correal and van der Hammen, 1977; Correal, 1986, 1990) and c) the riverine adaptations of the human groups in the Middle Magdalena River Basin (López, 1999; Otero and Santos, 2002).

In summary, the early archaeological record of Colombia spread throughout the Andean region of northwestern South America indicates that there were interregional relationships since the Pleistocene/Holocene transition. Those relationships were intensified during the early Holocene, coinciding with an increase in temperature and rainfall, and the expansion of tropical forests, bringing significant ecological adjustments to the tropical ecosystems of Northwestern South America.

5. Discussion

The initial human peopling of Northwest South America is still not well known. Because several questions about the arrival of the first human groups and the penetration routes into mainland South America remain unanswered, it is clear that more evidence is necessary. Some additional questions such as: can the cultural diversity shown by the archaeological record be explained by a single migration? If not, how many were there? Where did the source populations come from? How did the first settlers expanded? How did the adaptive strategies between late Pleistocene and early Holocene evolved?, also require further investigation.

Nonetheless, some advances in certain topics, such as the adaptive strategies of early hunter-gatherers in the tropical forests, have increased knowledge. This topic is extremely important because adaptive strategies are indicators of ecological relationships and adjustments associated with the territorial expansion of the early groups and can provide information on idiosyncratic traditions.

On the arrival of the first human groups, not much more can be added given the absence of new discoveries during the past 15 years. On the one hand, the few dates over 12,000 BP have little impact in the big picture because they require both comprehensive and detailed reports and controlled contexts. On the other hand, the earliest dates from the Sabana de Bogotá still are the reference point, as they mark the first human arrival to Northwest South America. In addition, redating programs and modeling the probable routes of entry are the next steps in order to change the current scenario (e.g. Politis, 1999; Aceituno, 2001, 2007; Ranere and López, 2007).

A decade ago, some authors presented interesting hypotheses on the time of entry and the possible routes taken by the first settlers. For instance, Anderson and Gillam (2000) presented a GIS based least-cost path analysis highlighting coastal routes (the Caribbean coast line, which explains the Joboid tradition and along the Pacific coastline, that has not yielded any evidence so far) and inter-andean corridors (following the Magdalena River Basin) as well. On the other hand, Steele et al. (2000) and Surovell (2003) through modeling analyses indicated dispersing people at about the time of first appearance of Clovis sites in the north and dispersals from Central America following a coastal route. These authors also stressed a scenario of Paleoindian range expansions characterized by high mobility, low population densities, and low to moderate population growth rates. However, even today the available data are too scarce to test such hypotheses.

Adaptive strategies in the time period between 12,000 and 8000 BP seem to be complex due to the abrupt climate changes and strong environmental adjustments occurred during the Pleistocene/Holocene transition. Human groups suffered the late Pleistocene climatic changes associated with the Guantiva interstadial and Abra stadial, whose uneven incidence affected mainly the highlands above 2000 m asl. However, the real impact that these changes produced on natural resources within Northern Andes is not well known.

As in other regions of the continent, the presence of megafauna in archaeological contexts has been the basis for raising the traditional Paleoindian hypothesis suggesting that the early inhabitants of South America were big-mammal hunters (Borrero, 2006, p. 9). In Colombian archaeology, this hypothesis has been supported mainly by López (1998, 1999), despite the fact that only at Tibito is there an undisputable association with megafauna remains with anthropogenic evidence. For the Middle Magdalena, it has been suggested that the natural conditions of the basin were suited for big-mammals, but there is no palynological evidence that reconstructs the natural environment, and the geomorphological reconstructions are not clear (López and Realpe, 2006), besides the fact that no hunting or butchery site has been reported. All these data support Borrero (2006, p. 9) when he states that the paleoindian hypothesis in Colombia is, at the most, inconclusive.

However, regardless of the debate on the importance of megafauna in the survival strategies of the Pleistocene human groups, the abundant remains of fauna found in the archaeological record of the Sabana de Bogotá (Correal, 1986), suggest that these highlands were well suited for reliance on hunting resources, which could be a factor to explain the arrival of the first human groups to this high Andean plateau during the Guantiva interstadial. During the early Holocene, on the one hand the zooarchaeological record shows continuity in the use of animals, but on the other hand, contrary to what was thought until recently, traceological analysis recently conducted suggest that plant resources were also an important weight in the diet of the early groups of the Sabana de Bogotá (Nieuwenhuis, 1998, 2002).

The increase in the archaeological record starting at the Pleistocene/Holocene transition is associated with an expansion of human groups along the river valleys that cross the Cordilleras of the Northern Andes. In terms of adaptive strategies, lithic technology, and archaeobotanical data recovered in several regions (i.e. Middle Cauca, Middle Porce, Medellin River, Popayan Plateau, Amazon Basin and Calima River) indicate a strong focus on plant resources in a time of climate change in the neotropics marked by the expansion of tropical forests (Piperno and Pearsall, 1998, p. 106). The palynological record from the Middle Cauca, Calima River and Popayan Plateau seems to be in agreement to this hypothesis. Some evidence show forest alteration, such as forest clearing, burning and cultural selection of key resources increasing the forest's carrying capacity, which has served to raise the hypothesis that hunter-gatherers altered the local ecosystem as part of their strategies for expansion and adaptation (see Dillehay, 2000; Gnecco, 2000, 2003). These data suggest the importance of plants and the alteration of tropical forests as an adaptive strategy, questioning the stereotype of highly mobile hunter-gatherers with a strong orientation towards hunting of animals, which has dominated most studies of the early colonization of America (Gnecco and Aceituno, 2004).

In this regional context, the Magdalena Valley record does not show any significant change in lithic technology or even in the number of recorded sites. The continuity in lithic technology and the absence of Pleistocene megafauna in the archaeological record has been used as an argument to doubt the existence of specialized hunters in this region of Colombia (Otero and Santos, 2002). According to this, evidence indicates that the Holocene occupation of the Magdalena Valley was focused on the use of aquatic resources such as fishing, hunting and gathering (Otero and Santos, 2002).

The similarities in material culture and chronologies allow establishment of relationships between sites and regions, but as discussed before, the fragmentation of the available data does not permit the establishment of clear routes of entry and dispersals, or even the possible origins of the Andean human groups who settled in Northwest South America. The adaptive strategies inferred from the archaeological record are associated with different types of environments, such as the highlands of the Sabana de Bogotá, the lowlands of the Middle Magdalena and Amazon Basin, and sub-Andean valleys of Central and Western Cordilleras.

Recent studies on the morphological patterns of the early and middle Holocene populations from the Northwest region support high biological diversity consistent with more than one source population (Delgado-Burbano, 2012, in press). These samples show important spatial and temporal differences in their dental and craniofacial morphology, suggesting on the one hand, different morphologies (ancestors?) entering to the region at the Pleistocene/Holocene transition and on the other hand, the key role of non-random factors (i.e. selection and plasticity) in the population differentiation. Specifically, the remarkable morphological differences detected during the early Holocene also were noted, subsequently suggesting, in agreement with the archaeological record, that the processes of population diversification continued throughout the Holocene (Delgado-Burbano, 2012) In addition, several genetic studies are in agreement to the morphological evidence and suggest both a final Pleistocene age for the source population(s) and significant within region population differences (Ruiz-Linares et al., 1999; Mesa et al., 2000; Keyeux et al., 2002; Torres et al., 2006; Barreto et al., 2007). This view highly contrasts with other studies that suggest an *in situ* microevolution and the negligible role of microevolutionary forces in the population differentiation (Neves et al., 2007; Rodríguez, 2007).

In ecological terms, the human groups of the early Holocene, on the one hand, show continuity with Pleistocene occupations, such as the cases of the Sabana de Bogotá and Middle Magdalena. On the other hand, they exhibit novel strategies that alter forest ecosystems, such as in the Middle Cauca, the Middle Porce and the Calima River, associated with territorial expansion with similar occupation strategies coincident with the increase in temperature, rainfall and the expansion of tropical rainforests. In summary, the increase of human groups as inferred from the archaeological record, the continuity of lithic technology (i.e. Sabana de Bogotá Middle Magdalena), and the survival strategies in tropical ecosystems, the Pleistocene/Holocene transition was not a dramatic period that required costly adaptive adjustments.

6. Conclusions

Currently, the early peopling of Northwest South America is secondary in the study of pre-Columbian societies in Colombia. As shown throughout this paper, both the discussion and the debate about the arrival of the first human groups have had little progress in recent years due to the small amount of data produced in recent decades. However, the increase in archaeological sites in the time frame between ca.11,000 and ca. 8000 BP shows also an increase on the diversity of lithic traditions that reflect the dynamism and complexity of the human populations of Northwest South America. Based on the characteristics of the archaeological record, some interregional relationships associated to the population expansion of the early Holocene have been suggested. However, there are issues that are still not well known, such as the origin of these populations and the relationships to Pleistocene populations.

To explain the variability in cultural traditions, two alternatives have been suggested that are in no way mutually exclusive and that cannot be confirmed or denied with the available data. The first one suggests that the variability is the result of alternate adaptive strategies to cope with the changing conditions of the Pleistocene/Holocene transition. The second one suggests that variability is the result of the encounter in a short period of time of several different populations entering South America with unknown origin.

At the beginning of the Holocene, the archaeological record shows a territorial expansion into sub-Andean valleys of the Northern Andes and innovative adaptation strategies that match the increase in tropical forests. The most remarkable facts are the alteration of local ecosystems and the weight of the plants in the surviving strategies of the early human groups that serve as the prelude to the origin of plant cultivation. These new insights are enabling a review of the traditional conception of hunter-gatherers in this period as highly mobile groups devoted mainly to hunting. There now are better elements to understand the complex and diverse adaptive strategies of hunter-gatherers, some based on intentional alteration of ecosystems.

Finally, it is necessary to stress that many of the ideas argued throughout the text are contrasted with data that are still scarce. Therefore it is imperative to encourage research on early people in Colombia in order to move forward on issues such as arrival dates, routes taken, the actual role of the late Pleistocene megafauna, and the impact of climate change on both resource availability and adaptive changes and adjustments of human groups, in order to determine the population dynamics of Northwest South America, a region which considering its geographical position must have been a crossroads of peoples, manners, and ideas.

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