Urban, Extractive 1500 CE

Revision of 3.18.16 by Andrew Sluyter.

Smith (2005) lists and analyses the cities of Middle America for 1500 CE. That source comprises a rigorous analysis based on thorough literature review and direct measurement from maps of the population and area of urban centers in Mesoamerica, which stretches from central Mexico eastward to northern Central America. The rest of Middle America did not have settlements large enough to be called cities in 1500 CE. Instead, people lived in numerous villages, on the order of 20-50 houses and 1,000 to 2,000 inhabitants per village (Sauer 1966, 62; Watts 1987, 69). The Late Postclassic period, which Smith defines as 1200-1520 CE, captures the urbanized land use for the target date of 1500 CE. Smith provides estimates for urbanized areas for every known archaeological site for Mesoamerica with an area of 10 hectares (0.1 km^2) or larger that also has at least one public stone building (typically a pyramid). The areas of each settlement are based on the density of the remains of buildings and houses as determined by surface survey and excavation.

Since 10 ha is insignificant for the purposes of LandCover6k (being a mere 0.1 km^2 and, if a square, a little more than 316 m on a side), only the six largest sites, each with total areas equal to or greater than 500 ha (5 km^2) were mapped for LandCover6k, as tabulated below. An area of 500 ha is approximately 8% the size of the grid cells of 8,000 m by 8,000 m (64 km^2/6,400 ha) used to judge the level of generalization appropriate for the project. In the table, "Epicenter area" refers to the central, thoroughly built-up area that contained pyramids, ball courts, and other large stone structures and earthen or paved plazas as well as the quarries used to extract the building stone and lime to build those structures. "Total area" refers to the epicenter plus the surrounding, lower density residential neighborhoods, which might well have contained substantial vegetation cover in the form of house gardens and trees. The largest impacted a total area of 21 km^2 (2,100 ha), which would have, if a square, sides about 4.6 km (4,600 m) long. Even the two smallest of these urban centers directly impacted a total area of 5 km^2 (500 ha), which, if a square, would have sides about 2.25 km (2,250 m) long. Below that 500 ha threshold, the areas of settlements falls off rapidly, with the next nine largest in Smith's "Size Class 1," which contains the largest 15, consisting of Texcoco, 450 ha; Mayapan, 420 ha; Huexotla 300 ha; Eronguaricuaro, 275 ha; Chalco, 250 ha; Otumba, 220 ha; Zempoala 220 ha; Acambaro, 215 ha; and Yautepec, 209 ha.

Rank	Urban Center	Zone	Population	Total area (ha)	Epicenter area (ha)
1	Tututepec	Oaxaca	unknown	2,100	unknown
2	Tenochtitlan-Tlatelolco	Central Mexico	212,500	1,350	16.9
3	Zacapu	West Mexico	20,000	1,100	unknown
4	Tzintzuntzan	West Mexico	30,000	674	34.4
5	El Tigre	Gulf Coast	unknown	500	unknown
5	Santa Rita Corozal	Petén/Belize	7,000	500	unknown

For Tututepec, Joyce et al. (2004) provide a large-scale map that was scanned and georeferenced with the help of the shapefiles for contour lines and streams from the 1:50,000 topographic map for that area (E14D85, Río Grande Piedra Parada, 2015), downloaded from www.inegi.org.mx. Once digitized, QGIS calculated the area of the multipart polygon for the Postclassic site to be 2,186 ha, which is close to the area of 2,100 ha that Smith lists.

For Tenochtitlan-Tlatelolco, Calnek (1986) provides a large-scale map that was scanned and georeferenced. It does not show any present-day landmarks, but the more restrictive Plano del Centro de la Ciudad de Mexico (Alcocer 1935), which focuses on the immediate area of the Zocalo, was also scanned and used to locate common features that allowed Calneck's map to be georeferenced. Once

digitized, QGIS calculated the area of the polygon to be 1,256 ha, which is close to the area of 1,350 ha that Smith lists.

For Zacapu, none of the sources Smith (2005) lists has a large-scale map (Migeon 1991; Pollard 1997). Pollard (1997, 366), however, claims that the Zacapu site is "known as El Palacio" and had an "estimated occupation of the *malpaís* of 11 km^2 and upward of 20,000 people (Michelet 1989, 1995), while the lake marsh below was abandoned." On the Goggle Hybrid base map, the structures in the epicenter of El Palacio are clearly visible on the southeast slope of the volcanic badlands overlooking the present-day town of Zacapu and its lake and wetlands. Another publication (Arnauld and Faugère-Kalfon 1998, fig. 8) provides a map of the Late Postclassic (1200-1450 CE) sites of those badlands as a group of point symbols. That map was scanned and georeferenced to digitize a polygon that encloses the eight sites most closely clustered on the *malpaís*. Once digitized, QGIS calculated the area of the polygon to be 1,033 ha, which is close to the area of 1,100 ha that Smith lists.

For Tzintzuntzan, Perlstein Pollard (1993) provides large-scale maps that were scanned and georeferenced with the help of the shapefiles for roads and streams from the 1:50,000 topographic map for that area (E14A22, Pátzcuaro, 2015). The three different types of residential areas and the epicenter as outlined on the maps were digitized, combined into a single contiguous polygon, and QGIS calculated the area to be 639 ha, which is close to the area of 674 ha that Smith lists. Note that in 1500 CE, the level of Lake Pátzcuaro was 15-19 m higher than in the 1990s, and that the Postclassic urbanized area would therefore have been closer to the shoreline than the present-day base map suggests (Pollard 1993, 66).

For El Tigre, Ochoa and Vargas (1985) provide a large-scale map of the epicenter only. The large stone pyramids of the epicenter are clearly visible on the Google Hybrid base map, however. A square polygon of 500 ha was digitized and centered on the epicenter.

For Santa Rita Corozal, Chase and Chase (1988) provide large-scale maps that indicate 238 structures within 16 survey squares, each 25 ha in size. They state that the site was larger in the Postclassic but currently partially covered by the spread inland of the town of Corozal (Chase and Chase 1988, 88). Each survey square is 25 ha, so the total survey area was 400 ha, without subtracting the area of water for the square that intersects the coastline. Chase and Chase (1988, 67, 88) also give the area of the site as approximately 4 km^2. In a later publication, Chase (1990, 205) gives the area of the site as 503 ha: "Mapping has suggested that the most dense Late Postclassic occupation was in the 2.526 km^2 area in the center of Santa Rita Corozal; this was surrounded by an area of slightly lower density occupation (estimated 50% of the core) incorporating at least an additional 2.5 km^2 as well as pockets of settlement in other areas such as along the bay." A polygon was digitized that covered their 16 survey squares as well as 5 more that extended their survey area to the coast at the present-day town of Corazol, removing those parts of any squares that extended past the shoreline. Once digitized, QGIS calculated the area of the polygon to be 510 ha, which is close to the area of 500 ha that Smith lists.

The following table summarizes the results and demonstrates that the polygons digitized for the Urban, Extractive 1500 CE layer are all within +/- 10% of the areas given by Smith.

Rank	Urban Center	Smith (2005) Total area (ha)	Project GIS Total area (ha)	Difference (ha)	Difference (%)
1	Tututepec	2,100	2,186	+86	+4%
2	Tenochtitlan-Tlatelolco	1,350	1,256	-94	-7%
3	Zacapu	1,100	1,033	+67	+6%
4	Tzintzuntzan	674	639	-35	-5%
5	El Tigre	500	500	0	0%
5	Santa Rita Corozal	500	510	+10	+2%

There were few areas equal to or greater than 500 ha of extractive land-use in Middle America in 1500 CE. Although metallurgy and metalworking were sophisticated in Mesoamerica, mines and placers for gold, jade, and other precious metals and stones were small in scale (West 1994). Mining and quarrying for salt, cinnabar, jade, clay, and other materials also impacted mainly small areas (Weigand and Gwynne 1982; Cobean 2002; Williams 2008). The quarries for limestone to use for building stone and processing into lime mortar and plaster were generally located within urban epicenters, near the pyramids and other structures under construction; and in Late Postclassic cities of the northern Yucatan Peninsula that were inhabited in 1500 CE, such as Cobá, quarries impacted areas of less than 10 ha (Folan 1982, 152). Even large Classic period (250-900 CE) sites such as Copan, which was built of tuff from a quarry about 2.5 km north the city, the area impacted by quarrying was only 25 ha (Abrams 1994, 17-18). Moreover, the largest quarries would presumably have been within the largest urban centers, and those with areas of 500 ha and more in 1500 CE have already been mapped on the Urban, Extractive layer.

The only extractive areas that reached the 500 ha threshold in 1500 CE are areas of obsidian mining on the northeastern margin of the Basin of Mexico near Pachuca and Otmuba (Cobean 2002, 41-47, 555-59, fig. 2.2). They were characterized by pits, from 1-4 m in diameter and 0.5-10 m deep, with associated debris piles and workshop and residential structures, that extended over large areas, had been mined for millennia, and were the focus of intensive extraction in 1500 CE. Published maps of those obsidian mining areas and the descriptions of their boundaries in the accompanying texts were used to digitize polygons over which open pits, debris piles, trenches, and shaft openings extended with variable density (Charlton and Spence 1982, 11-12, fig. 1; Cobean 2002, 41-47, 55-59, fig. 2.75).

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