TERRAIN ANALYSIS APPLIED TO THE SITING OF ANCIENT SEAPORT ASHKELON, ISRAEL

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BACKGROUND

OBJECTIVES

To obtain an understanding of the geological and topographical influences impacting the settlement of Ashkelon various geomorphometry and visibility routines were applied to the coastal plain of Israel.

HISTORY & ARCHAEOLOGY

Figure 1 – Chronology of Ashkelon[9]

Tell Ashkelon is an ancient seaport situated along the Pleshet Plain of the central Israel coast, between the Mediterranean shoreline and the Judean foothills (Shefela). The city was established as a trading post between Egypt and Byblos (c. 2650 BC). Canaanites fortified the site and enclosed the Mediterranean shoreline with a 2-km, semi-circular, earthen rampart (c. 1825 BC).

Subsequent cultures occupied Ashkelon from the Bronze Age through the medieval period. The location of Tell Askhelon may be attributed to the localized topographic high composed of kurkar sandstone exposed in cliffs along the beach.

GEOLOGY

A series of low, parallel ridges, known as kurkar, run along the coastal plain of Israel (Figure 4). The ridges are built of cross-bedded, aeolian-sandstone, belonging to the Pleistocene Heffer Formation (Figure 3) that accumulated along the Levant coast with quartz-dominated clastics derived from the Nile littoral cell.

The ridges have been variously interpreted as representing coastal transverse dunes modified from back beach foredunes during Pleistocene marine incursions[10] or longitudinal dunes maintained by coastal winds during dry periods[2,7]. Applying sequence stratigraphic concepts to the distribution and chronostratigraphy of the ridges and associated deposits, Mauz et al. (2013) interpreted the parallel ridges as offlapping, aeolian-beach-ridge complexes representing downstepping 5th order falling stage system tracts (FSST), mostly deposited during the last interglacial/glacial cycle.

Preliminary luminescence dating of the sandstone indicates deposition shortly after 75 ka (pers. comm. N. Porat, 2012), which would place the dune deposits in the Giv 'at Olga Member of the Heffer Formation.

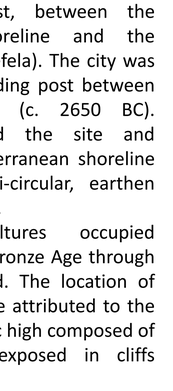

Figure 2 – Study Area

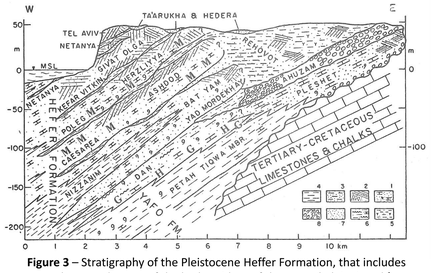

Figure 3 – Stratigraphy of the Pleistocene Heffer Formation, that includes aeolean sandstones of the kurkar ridges of the coastal plain, Israel.[1]

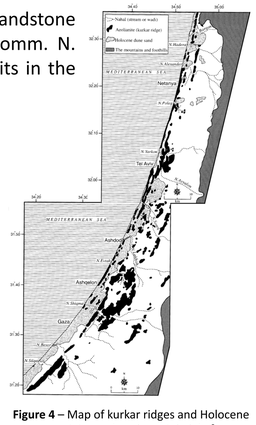

Figure 4 – Map of kurkar ridges and Holocene sand dunes, Israel coastal plain.[8]

METHODOLOGY

TERRAIN ANALYSIS

Slope & Slope Variability

A suite of geomorphometry routines were used to identify regional topographical features that may show the location of Ashkelon as unique. The ASTER 30-m Global Digital Elevation Model (GDEM) was used to perform the analysis.

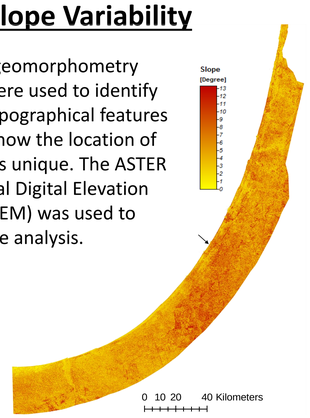

Figure 5 – Slope

Slope Variability (SV) was used to determine the overall topographic roughness. Maximum and minimum values of a 3x3 cell neighborhood were used to obtain the slope variability value at each cell location (Figure 6).

SV = Slope max – Slope min

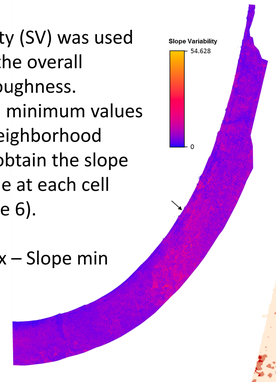

Figure 6 – Slope Variability

An Iso Cluster Unsupervised Classification was used to resolve slope variability values into three integer ranges based on a 10x10 cell neighborhood (Figure 7).

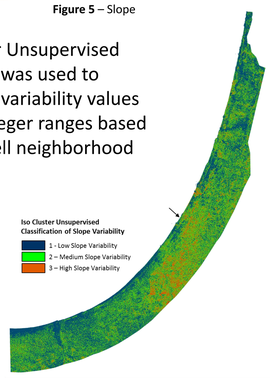

Figure 7 – Iso Cluster Unsupervised Classification

Regional slope variation was identified using majority statistics of a 30x30 cell neighborhood (Figure 8).

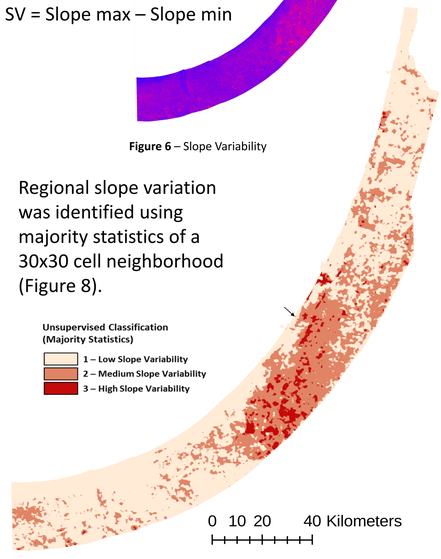

Figure 8 – Regional Slope Variability

Topographic Position Index (TPI)

Topographic Position Index is used to identify landforms by comparing the elevation of a cell to the mean of the surrounding neighborhood. An index number is assigned to each cell with positive values, indicating the cell is above the neighborhood average, and negative values, indicating the cell is below neighborhood average. Large or small neighborhoods should be determined based upon the characteristics of the region being analyzed[9].

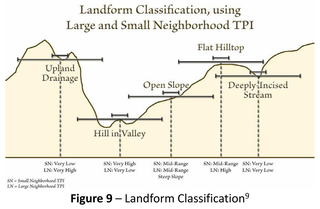

Figure 9 – Landform Classification[9]

Combining both large and small neighborhood TPI values is useful to identify the nature of identified landforms (Figure 9). For example, a small neighborhood high value combined with a large neighborhood low value reveals a local ridge or hill in a large valley[3].

The Kurkar ridges are clearly defined in the TPI map as upper slopes and the areas identified in the Slope Variability analysis as rough terrain have widely varying landform classifications.

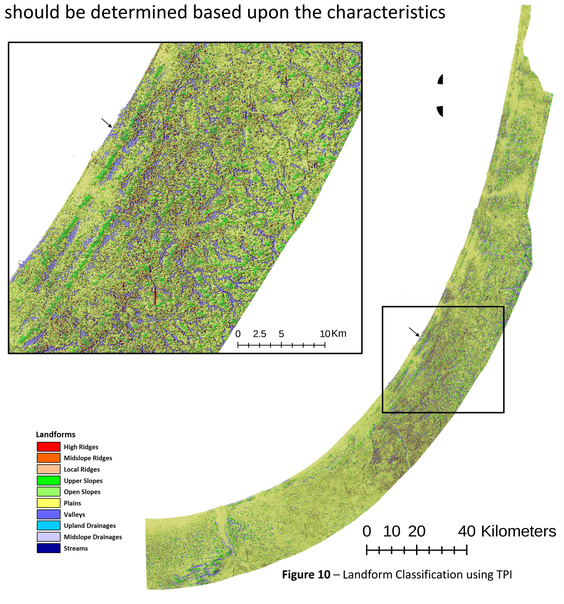

Figure 10 – Landform Classification using TPI

VIEWSHED ANALYSIS

It has been proposed that the establishment of Tell Ashkelon as a port city was due to a natural topographic high (the North Tell), making the location an ideal landmark to seafarers. Interpretation of soil borings at the site suggest that the original elevation of the North Tell was 20 meters above sea level[5]. The modern elevation of the North Tell is 25 meters above sea level. The visibility study was limited to seaward analysis due to the influence of urbanization on the ASTER DEM elevations.

Port of Entry Line of Sight

A viewshed study was conducted to determine the farthest distance at which a person at sea may observe coastal kurkar landforms along the shoreline. The viewshed was calculated from each coastal observer point to the horizon. Offset from sea level due to position of sea observer to coastal observer point (~4m) was not accounted for.

The viewshed from the North Tell encompasses approximately 443 km^2 of seaward visibility. Observation points along the coast ~19 km to the south of Ashkelon have an average of 288 km^2 of seaward visibility and observation points to the north have an average of 451 km^2 of seaward visibility. These findings suggest that the immediate vicinity of Tell Ashkelon is at the crux of a shift from the sandy southern coast to the exposed kurkar ridges along the shoreline to the north.

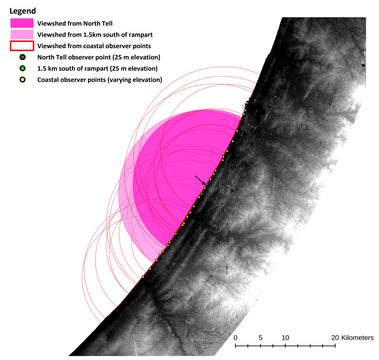

Figure 11 – Seaward Visibility from Coastal Observer Points

DISCUSSION

The topographic and visibility studies conducted display several important conclusions that contribute to the understanding of the settlement of Ashkelon:

1) The slope variability study reveals that Ashkelon is nested at the edge of a region of greater slope variability (or rough terrain). These regions of rough terrain surround the city to the east and south. This likely limited access to the city to the coast and in from the wadi located approximately 7 km due south.

2) Further, the analysis demonstrates a working theory that the common route inland was established running due south of Ashkelon and in along the wadi (Figure 10)[6].

3) The port of entry visibility study reveals that observation points along the coast trend towards higher visibility to the north of Ashkelon and lower visibility to the south.

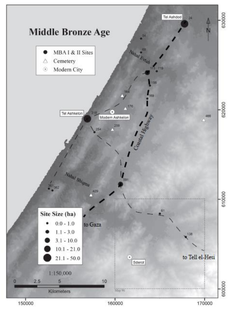

Figure 12 – Proposed Travel Routes of the Middle Bronze Age[6]

While Ashkelon may have been a gateway city linking a terrestrial hinterland with maritime trade, this study makes it clearer that the maritime linkages were far more important to the placement of the site than any terrestrial connections. This emphasizes its role as a transhipment stop on the route from Egypt to Lebanon as the initial purpose rather than as an outlet from markets to the south and east.

References

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