

# A Critical Reconstruction of Modern Urban Settlement Patterns in Muscat and Al Bāṭinah based on Military Maps

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## ABSTRACT

Urbanisation in Oman started shortly after 1970. The process of urbanisation changed the land-use and settlement patterns in Oman and in particular in Muscat Capital Area. Modern urban geography and urban planning in Oman emerged in the 1980s when the 'rational' Llewelyn-Davies plan of 1981 became the guiding planning framework. The main conceptual strategies and spatial imagination of the territory remained un-questioned in all subsequent plans and strategies up to the present Oman National Spatial Strategy.

This article argues that the limited means of spatial representation of urban planners and geographers in the 1980s also limited the conceptualisation of the urban development strategies. These relied essentially on conventional aerial photography whereas the military already used systematic satellite imagery. US and Soviet military maps based on satellite images have been disclosed at the end of the Cold War and are now accessible. The evaluation of maps produced between 1943 and 1975 allows to reconstruct earlier settlement patterns preceding the 1980s. Hundreds of pre-existing settlement cores integrated hydrographic, topographic and agricultural features across the region of Muscat and Al Bāṭinah. This reconstruction of settlement patterns is highly relevant today: Features of the pre-existing settlement patterns are still dominant in Muscat Capital Area. They form a 'base-layer' of urbanisation and indicate crucial intersections of hydrographic, topographic and agricultural features with settlement areas. This urban network is complex, functionally diversified and sustainable in its use of natural and spatial resources - qualities that are now being recognised as 'remedies' for urban sprawl.

**KEY WORDS:** Oman, Muscat Capital Area, urbanisation, military maps, settlement patterns.

## إعادة بناء ناقدة لأنماط الاستيطان الحضري الحديث في مسقط والباطنة بناءً على الخرائط العسكرية

### الملخص:

بدأ النمو الحضري في سلطنة عمان بعد عام ١٩٧٠م بفترة وجيزة. وقد غيرت عملية التحضر أنماط استخدام الأراضي والاستيطان في عمان. وفي العاصمة مسقط بشكل خاص. وقد ظهرت الجغرافيا الحضرية والتخطيط الحضري الحديث في عمان في الثمانينات من القرن العشرين عندما أصبحت خطة ليولين-دافيز لعام ١٩٨١م الإطار التخطيطي الموجه للتنمية. وظلت الاستراتيجيات النظرية الرئيسية والتصور المكاني للإقليم دون تساؤل في جميع الخطط والاستراتيجيات اللاحقة حتى الاستراتيجية المكانية الوطنية العمانية الحالية.

ويرى هذا المقال بأن الوسائل المحدودة للتمثيل المكاني للمخططين والجغرافيين الحضريين في الثمانينات من القرن العشرين قد حدت أيضاً من تصور استراتيجيات التنمية الحضرية. وقد اعتمدت وسائل التمثيل المكاني هذه أساساً على التصوير الجوي التقليدي، في حين استخدمت القوات العسكرية فعلياً صور الأقمار الصناعية المنهجية. وقد تم الكشف عن الخرائط العسكرية الأمريكية والسوفييتية المعتمدة على صور الأقمار الصناعية في نهاية الحرب الباردة، والتي يمكن الآن الوصول إليها. ويسمح تقييم الخرائط التي تم إنتاجها بين عامي ١٩٤٢م و١٩٧٥م بإعادة بناء أنماط الاستيطان المبكرة التي الثمانينات من القرن العشرين. وقد شملت مئات من الأنماط الاستيطانية التي كانت موجودة من قبل الخصائص الهيدروغرافية، والطوبوغرافية، والزراعية في جميع أنحاء منطقة مسقط والباطنة. وتعتبر إعادة بناء أنماط الاستيطان مهمة اليوم: لا تزال ملامح أنماط الاستيطان الموجودة سابقاً واضحة اليوم في منطقة العاصمة مسقط، وهي تشكل «طبقة أساسية» للنمو الحضري، وتشير إلى التقاطعات المهمة للخصائص الهيدروغرافية، والطوبوغرافية، والزراعية مع المستوطنات. وهذه الشبكة الحضرية معقدة، ومتنوعة وظيفياً، ومستدامة في استخدامها للموارد الطبيعية والمكانية - وتعتبر هذه الملامح صفات تعرف الآن بأنها «معالجات» للتمدن الحضري.

**الكلمات المفتاحية:** عُمان، منطقة العاصمة مسقط، التحضر، الخرائط العسكرية، أنماط الاستيطان.

## INTRODUCTION

Urbanisation in Oman started shortly after 1970 as the country's economy developed. In the following years the population of Oman grew rapidly with fertility rates of 3% annually (Bertelsmann Stiftung 2016; Oman Census 2016). This economic and demographic growth demanded not just the provision of housing but also the allocation of land resources and the development of road infrastructure. The process of urbanisation changed the land-use and settlement patterns in Oman dramatically over a few decades (Nebel and von Richthofen 2016). Previously concentrated settlement cores and vast arid landscapes soon became a continuous urban fabric known as Muscat Capital Area. The resulting urban form has been criticised as un-sustainable urban sprawl (Gharibi 2014) and there are doubts that urbanisation can continue like this in the future (Cummings and von Richthofen 2017).

Current discourses on the development of urban form in Muscat Capital Area point to a succession of urban plans and strategies that originate in the *Capital Area Structure Plan: Major Road Network and Predominant Land Use* designed by Llewelyn-Davies in 1983 (Scholz 1990, Belgacem 2010, 2011, 2013, Abdelghani 2013, Wippel et al. 2014, Gharibi 2014, ETH Studio Basel 2015, Al Shueili 2015, Jafari et al. 2017). This plan determined the future zoning of Muscat Capital Area. This urban planning document and its successor plans were based on the spatial imagination of the territory of the time, an imagination that relied on conventional aerial photography as a means to produce maps. Llewelyn-Davies' spatial imagination was matched by prevailing urban planning doctrines that favoured a modernist approach to planning. Conceptualisation of space for development as clean slate or 'tabula rasa' and the ideology of Rationalism in planning can be traced in Llewelyn-Davies' work. This modernist gaze obliterated attention to hydrographic, topographic and agricultural features in relation to urban planning. Present-day Muscat Capital Area is indeed full of examples where the city 'meets' hydrographic, topographic and agricultural features in rather unplanned and accidental ways. The original urban plan had to be adjusted time and time again to account for 'unprecedented' challenges encountered during the implementation of the planning strategies

[cite]. The current struggle to direct the urban planning for Muscat Capital Area into sustainable paths is a further indication that the Llewelyn-Davies plan and its successors might have overlooked specific spatial features inherent to urbanisation in the region.

This article aims to critically reconstruct settlement patterns preceding the Llewelyn-Davies plan using source material that has not been evaluated in the discourse on urbanisation in Oman to date: Satellite-based military maps produce between 1943 and 1975. These maps have been digitalized and entered into a geo-information system (GIS) for further evaluation. This historic source material is used to underscore an argument about the planning genesis and present spatial structure of Muscat Capital Area. The article is not meant to be an historical research but to contribute to the urbanisation discourse with an alternative lecture of the contemporary urban fabric. The evaluation of preceding settlement patterns visible in the military maps allows to reconstruct modern settlement patterns that preceded the official planning of the 1980s. The compilation of these settlement patterns shows an extended urban network with hundreds of settlement cores. These pre-existing settlement patterns integrated hydrographic, topographic and agricultural features across the region of Muscat and Al Bāṭinah. The importance of this article lies in the understanding and re-evaluation of pre-existing settlement patterns that can lead to a better understanding of the present urban morphology, indicate trends of urban spatial development and contribute to a more sustainable urbanisation of Muscat Capital Area and Oman in the future.

## METHODS AND SOURCE MATERIALS

This article reconstructs the spatial urban structure of Muscat and Al Bāṭinah by comparing two groups of source materials: Available urban planning documents and related literature on Oman on one side and previously undisclosed military maps on the other. The contribution of this article is to present the previously undisclosed military maps as source material for a reconstruction of settlement patterns and to compare these to the prevailing discourse on urbanisation in Oman. This comparison is done by extracting relevant features of spatial urban structure from each set of source material and entering them into the GIS.

The sources of available planning documents studied and translated into the GIS include maps from Scholz's geographic description of Muscat of 1990, Weidleplan's Structure Plans of 1991, the Physical Planning Standards by the Supreme Committee of Town Planning, also of 1991 and the Building Regulation for Muscat of 1992. The literature around urbanisation in Oman is referenced throughout the article. Both planning documents and literature on urbanisation serve as a backdrop to understand the genesis and challenges of urbanisation in Muscat and Al Bāṭinah in the first part of this article.

The critical reconstruction of settlement patterns derives from the following military sources:

- U.S. Army Map. "Muscat and Masirah." U.S. Army Map Service. Washington, 1945.
- TPC J-7B. "Oman." Tactical Pilotage Chart. Washington, 1964.
- ONC J-7. "Oman." Operational Navigation Chart. St. Louis, 1973.
- Soviet Army. "Al Bāṭinah." Soviet Military Topographic Maps. Moscow, 1975.
- Weidleplan. 1989. "Muscat Area Housing Study Phase 1 Survey Report." Muscat: Ministry of Housing, p. 35.

These military maps are discussed in detail with respect to their original purpose, content, quality of representation and usefulness for the aim of this article, namely the reconstruction of settlement patterns later in the text.

All maps were found in digitalized format as high-resolution raster images without geo-references. The maps were geo-referenced in the GIS software QGIS with the help printed coordinates and known projection systems of the original cartography techniques. All maps were re-projected applying GIS to the WGS 1984 projection. The perimeter of observation for all maps is the rectangle between 57° and 59° degrees East and 23°20' and 24° North that encompasses the settlement regions of Muscat and Al Bāṭinah. (This rectangle is not to be confused with the administrative boundaries of the present provinces of Muscat, South Al Bāṭinah and North Al Bāṭinah.) Once a common reference framework was established in GIS all relevant features could

be traced, counted and compared. This process was first undertaken using object-based image analysis (OBIA). A second visual comparison of recognised map features and original maps assured the consistency of the sampling. All remaining visible settlements still not sampled were traced, superimposed and validated manually. Each GIS map set can be evaluated to compute settlement classes according to importance and scale. Since the aim of this article is to trace settlement patterns in the most general term, traditional terminology of 'towns', 'villages' and 'hamlets' do not apply. Settlements are therefore classified according to size. These classes are "main" settlements marked on the maps with features of towns along major transport lines and symbolised as triangles; "secondary" settlements marked with minor features still connected to transport lines and symbolised as squares; and "tertiary" settlements remarking the presence of settlements and symbolised as circles. Main settlements usually prevailed and have known names, such as Muscat, Sohar, etc. Secondary settlements also carry names that refer to either a smaller town or landmark such as a castle or a landscape feature. Tertiary settlements do not have known names legible in the maps. In the case of the Soviet maps these "Tertiary" settlements are further subdivided into permanent and semi-permanent settlements symbolised with smaller scales. The available source material was produced at various times.

## CONTRIBUTION TO THE DISCOURSE ON URBANISATION IN OMAN:

This proposed method allows to classify previously unavailable maps for 1945, 1964, 1973, 1975 and 1981. It further allows the superimposition and reconstruction of the pre-existing settlement geography for the period of 1945 to 1981 of the future Muscat Capital Area region for the first time. This exposed pre-existing settlement nodes, links and scales of the settlement network prior to the planning of 1970 (Figure 2 and Table 1). As will be demonstrated, this new view on urbanisation in Oman contrasts the traded narrative of modern urban planning dramatically.

## MODERN URBAN PLANNING IN OMAN

Modern urban planning in Oman started in the 1970s as the country's economy developed and the population grew. Subsequently, Oman established the necessary administrative infrastructure to plan the allocation of land for housing and the planning of necessary urban infrastructure in a series of five year plans. By 1981 the Royal Decree *"To Organize Usufruct over the Sultanate's Lands"* regulated the land allocation process and introduced a plot lottery open to all male nationals over 21 years of age (Royal Decree Oman 1981). The process of urban expansion in Al Bāṭinah became regulated and codified from 1989 to 1992 through *planning standards, structure plans* and *building codes*. The physical planning developed for the Supreme Committee of Town Planning was a short manual that pragmatically covered aspects of town planning (Supreme Committee of Town Planning, Oman and Atkins Int. 1991). It did not contain *any* maps. Without consideration of pre-existing settlement structures the planners recommended that *"A hierarchical pattern of urban development in Oman should be encouraged through planning"* (Supreme Committee of Town Planning, Oman and Atkins Int. 1991, 19). When the German consultancy Weidleplan was commissioned to draft the first physical planning strategy geared to structure Muscat Capital Area<sup>1</sup> considering projected economic, social and spatial developments to the year 2010 the geographic assessment was equally weak (Weidleplan 1991). The urban development zones defined in the Weidleplan reports laid the ground for the deployment of the planning standards across the country. While the physical planning standards and the structure plan regulated the larger scale of urban planning down to the level of a single plot, the building code issued in April 1992 by Muscat Municipality determined the volumetric shape (plot area ratio, set-back distances and building height) of the actual buildings (Muscat Municipality 1992). The planning process was indeed guided by reports more than by geographic information. Al Shueili lists

the many plans, studies and reports: *"It is interesting to show certain trends that emerge from this history of urban planning strategies: 1. 1970 to 1990: 4 regional plans, 7 structural plans, 31 local plans 2. 1991 to 2010: 0 regional plans, 0 structural plans, 3 local plans. Oman National Spatial Strategy (ONSS) floated as tender in 2008 but not yet concluded"* (Al Shueili 2015:146) In this legacy of plans the Llewelyn-Davies plan of 1981 became the guiding planning framework for the development of Muscat Capital Area and was perpetuated in all subsequent plans and strategies. Capacities for this national-scale organizational task in particular during the earlier phase from 1970 to 1990 when the major *regional, structural and local plans* were drafted, but were not actually developed in Oman. GIS was implemented by the Ministry of Housing in Oman in the mid-1990s, but capacities to manage land-use systematically using GIS were lacked until recently (von Richthofen and Scholz 2013).

## MODERN URBAN GEOGRAPHY IN OMAN

The modern geographic description of Oman started with colonial gazetteers by Lorimer (Lorimer 1915) and is well documented by Peterson (Peterson, J.E. 2007). Physical geography of Oman was rapidly developed to support geological exploration by the oil and gas industry since the 1960s (Petrol Development Oman 2016). Modern urban geography focussed on the core of historic cities, oasis settlements and nomadic societies and emerged in the 1980s (compare the work of: Scholz 1982, 1984; Gangler 2003; Diener 2003; Peterson, J.E. 2007; Al-Awadhi 2008; Belgacem 2013; Gaube and Sālimī 2013). It was not until 1990 that Scholz wrote the first modern urban geographical description of Oman, and Muscat in particular: *"Muscat, Sultanat Oman: Geographische Skizze einer einmaligen Arabischen Stadt"* (Scholz 1990). His book did not receive the attention it deserved since it was originally published in German and translated into English only in 2014. Scholz identified the pivotal moment of socio-economic transition from medieval to modern in the time-frame 1970-1980. This moment described the transformation and in parts destruction of the historic urban fabric of Muscat, Muttrah and

<sup>1</sup> According to (Scholz 2014, 151): *"The term 'Capital Area' makes its first official appearance in the Statistical Year-Book (1973). [Previously] the designations Metropolitan Capital Area, National Capital Area and Metropolitan and National Capital Area are used."*



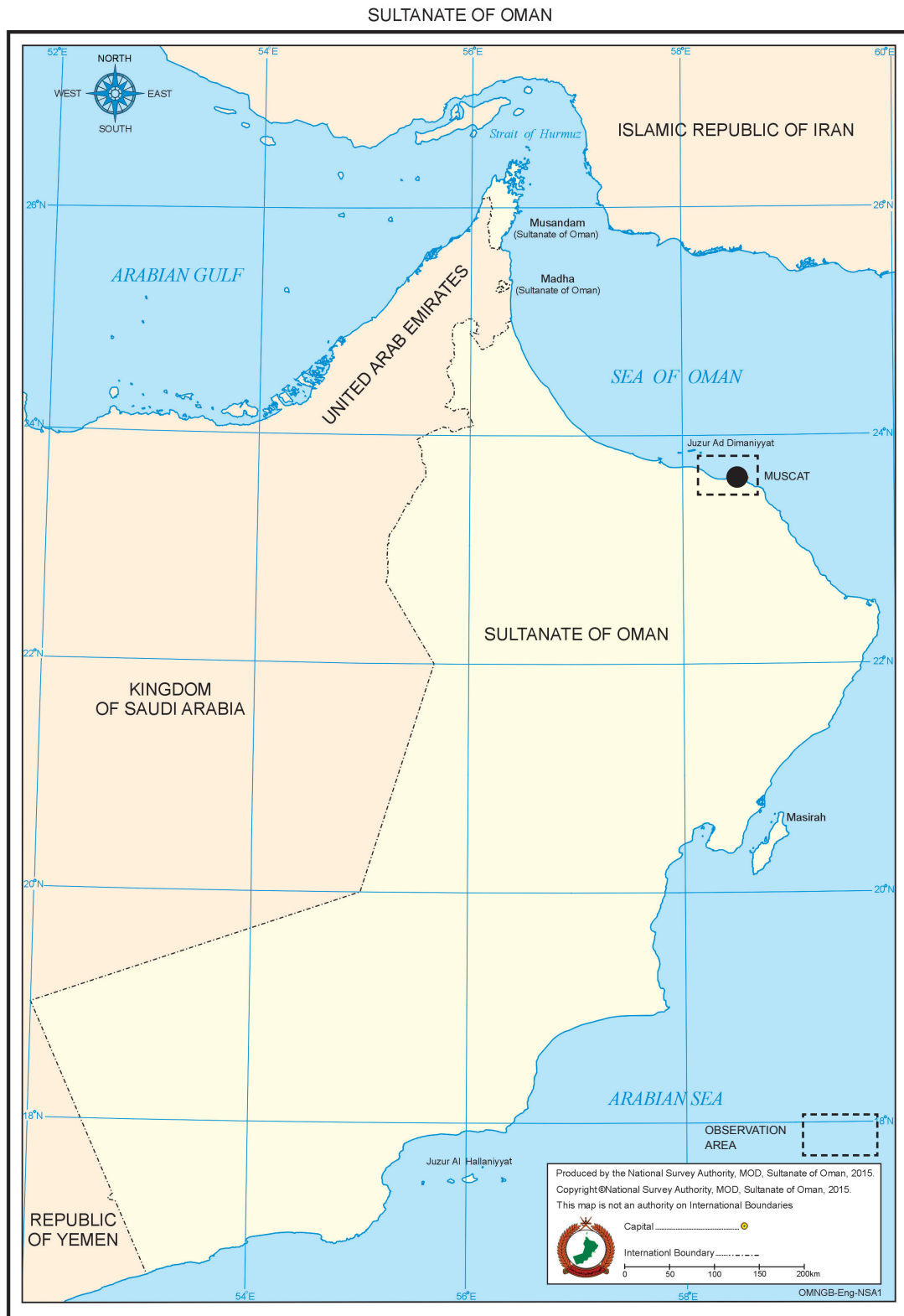


Figure 1. The observation area located in the region of Muscat Capital Area and the plain of Al Batinah in Northern Oman. Source: The Author.

other Omani cities. The coastal plain west of Muscat reaching into Al Bāṭinah offered the space needed for the future urban expansion once inner and outer safety was achieved and infrastructure such as water, electricity and road access were in place. Scholz emphasized the impact of the topography on the later morphology of the city from a functional point of view. The spatial attention he devoted to historic Omani cities was absent when he wrote about the plain of Al Bāṭinah. Scholz followed the views of Cordes and Reichert: “*Westward of Ras al Hamra [where] the mountains recede inland from the coast in a wide southward-facing arc, allowing space for a plain which expands westwards in a coastal plain called Al Bāṭinah. This plain, bounded to the east and south by mountains, together with the Hajar, Bowsher, Landsab, Rusayl and Al Khoud basins that are recessed into the mountains, provide more extensive and more easily developed areas for settlement activity than the exclusively mountainous part of the Capital Area which extends eastwards from Ras al Hamra. The urban expansion of the Capital Area had to take account of these morphological circumstances.*” (Scholz 2014, 140 from Cordes 1983 and Reichert 1978)

Incorporating the few sources available at the time, Scholz reproduced the *Capital Area Structure Plan: Major Road Network and Predominant Land Use* designed by Llewelyn-Davies in 1983 that would determine the future zoning of Muscat Capital Area (Llewelyn-Davies 1983). While Scholz reflected on the functional and organizational aspects of the future plan, he did not extol on the consequences of superimposing such a plan onto an existing fragile settlement network: “*The starting point [of the spatial planning concept] was the idea that social and economic patterns of behaviour and action could be planned and directed, and that it was possible for the elites in the capital (Capital Area) and the hinterland to have identical interests. This development concept was based on theoretical notions of modernisation. This involved giving precedence to a development that could be termed a multi-nuclear rather than uni-polar growth strategy.*” (Scholz 2014, 14). Scholz places the city of Muscat not only in the centre of his narration (hence the main title of the book: *Muscat*) but also geographically at the origin of his morphogenetic

urban development theory. According to Scholz, the growth of Muscat followed a regular concentric growth pattern starting from a poly-nuclear origin (Scholz 1990, 112). This simplified structural model of urban growth was lacking a geographic foundation. Based on Scholz’ mention of “*planned and directed social and economic patterns of behaviour*” his model can be compared to Thünen’s concentric spatial development model, where agricultural and urban functions were located in terms of economic distance and travel costs from the centres (Thünen 1826). In the case of Al Bāṭinah neither were the social and economic patterns homogeneous, nor would the specificity of the terrain in addition to the sea in the north and mountains in the east and south allow unconstrained spatial development. Scholz’ “*theoretical notions of modernisation*” also deserve close study. In the context of urban geography of the 1980s modernisation was seen in opposition to vernacular culture. This contradiction would lead to the destruction of historic settlements, much of which Scholz had already witnessed in historic Muscat. Finally, Scholz’ call for a “*multi-nuclear growth strategy*” repeated the diagrammatic planning of Llewelyn-Davies (Llewelyn-Davies 1983). These consultants vaguely declared Muscat and Seeb as dual centres of urban growth and ignored the pre-existing multi-nodal network of settlements and the functional and social significance of these places. The later *Structure Plans* developed by Weidleplan in 1991 indeed reproduce almost identical road layouts and zoning of land use, and then develop these to a comprehensive set of regional plans, structure plans and housing studies (Weidleplan 1991).<sup>2</sup>

## THE CURRENT DISCOURSE ON URBAN PLANNING IN OMAN IN QUESTION

As we have seen, both modern urban planning and modern urban geography in Oman relied on limited means of spatial imagination at the time. Aerial photography was expensive, slow and incapable of covering larger areas. As such most of the aerial photographs of the time focussed on urban

<sup>2</sup> Scholz omission of the Weidleplan studies (1989 – 1991) can be explained by the fact that these had just started and were probably not published at the time Scholz finalized and published his account of the urbanization of Muscat in 1990.

centres and neglected the hinterland. The urgency to develop urban planning strategies in the 1970s and 1980s can explain the transcription of 'ready-made' urban plans onto an area that was imagined spatially empty and conceptualised as such by Llewelyn-Davies in 1983. This conceptualisation influenced urban geographers such as Scholz and was not questioned by subsequent urban planners, as can be seen in the Weidleplan strategies of 1991. While the work of Scholz and other urban geographers had great merit in documenting vanishing Omani building heritage, it did not, however, contribute more than an anecdotal input to the physical planning strategies for Muscat Capital Area. Scholz' spatial development diagram for Al Bāṭinah can neither be sustained by the reconstruction of spatial settlements based on military maps (as will be shown in this article), nor by later studies based on remote sensing using satellite images for the time-frame of 1984 to 2014 (von Richthofen and Langer 2015). The space of the future development of the modern Muscat Capital Area - the plain of Al Bāṭinah west of historical Muscat - until the 1970 had not been systematically mapped nor described by urban geographers and planners. Both disciplines relied on conventional aerial photography. Airplane surveys had to be approved beforehand by the Ministry of Defence, and collected material had to be screened to be released by the Ministry of Information. Scholz mentioned in an interview that areal images produced with analogue cameras and airplanes for the Llewelyn-Davies plan of 1983 were later classified by the Ministry of Intelligence (Scholz 2016). Recent archaeological campaigns still relied on balloon-mounted cameras that covered at best an area of two square kilometres (Schreiber 2007).

### **MILITARY MAPS AS NEW SOURCE MATERIAL FOR URBAN GEOGRAPHY IN OMAN**

During the early years of the Omani Renaissance the British Army and later the Royal Army of Oman produced military maps. These official military maps were based on ortho-projection of aerial images in the beginning and satellite images later. The

resulting maps were classified material to which urban geographers and planners did not have access (Scholz 2016). In the wake of the Cold War two rivalling global forces gradually became interested in the geo-politically strategic region of Oman. The United States and the Soviet Union started racing for military control of the eastern parts of Arabia and notably the Strait of Hormuz. The evidence are unparalleled military maps such as the U.S. Army map of 1945 the TPC J-7B map of 1964, the ONC J-7 map of Oman 1973 and the Soviet Army maps of 1975.

The maps were part of global mapping compendiums covering more than Oman. In the later part of the time-frame of 1945-1975 satellite photography changed the art of map-making. While the first US map of 1945 and the subsequent one from 1964 relied on conventional data such as explorer accounts, trade information, navigation charts, etc. the later maps showed more accurate information that could have not been gathered from ground reconnaissance only. The 1975 Soviet maps attained a new level of detail and consistency only possible through satellite photography. The Oman series in the Soviet maps were published in 1975 and 1979 but presumably based on the same source material.

The first US Army map was produced by the Army Map Service (AMS) of the US Army Corps of Engineers at the scale of 1:1.000.000. The Tactical Pilotage Chart (TPC) produced at the scale of 1:500.000 from 1964 onwards and was an American global aviation map. It follows the Lambert conform conical Projection and was multi-coloured and detailed, including topographic information with hill-shade and relief and produced by NIMA company (USA). The Operational Navigation Chart (ONC), drawn at a scale of 1:1.000.000 from 1961 - 1980 was another American global map of the Cold War. In addition to the TPC it included natural features, streets and place names in spite of its coarser scale. It also uses the Lambert conform conical Projection and was produced by NIMA (USA). (Landkartenarchiv 2016)

The mapping project *Mir* at a scale of 1:1.000.000, 1:500.000 and in the case of Al Bāṭinah and parts of Oman 1:200.000 was started in 1948

and continuously updated until 1991. This highly accurate map is unsurpassed in topographic detail and features a wealth of symbols and annotations.<sup>3</sup> The map set for Oman was produced in the years 1975 and 1979 (Department of the US Army 1958; Psarev 2005).

While the primary function of these military maps was navigation and the inclusion of elements of tactical importance, in particular the later Soviet maps displayed a high degree of detail. Next to topographic features the maps also accounted for the existing settlements at the time of making. The US maps' emphasis laid on navigation, therefore an additional layer of references and navigable zones was superimposed onto the physical information. The Soviet map was literally a base map displaying only physical features such as topography, hydrography, vegetation and built artefacts. In both cases the transcription of local names from Arabic was easy to decipher. The earlier US map confused locations towards the Omani Interior as well as along the coastline towards the west (Bid Bid with Samail, Suwaik with Sohar etc). Some names disappeared in later maps along the coastline: Wudham, Billah, Rumais, etc. while others became more prominent within the metropolitan area of Muscat: Bowsher, Kuwair, Al Khoud, etc. All maps contain information of great interest to the re-construction of a "pre-oil" Al Bāṭinah, namely on topography, hydrography, vegetation, soil, roads, infrastructure and settlement patterns.

The striking topographic features of the Omani coastline were of utmost importance for naval and later aeronautical navigation. These features were recorded meticulously by previous explorers and travellers and form the base of all maps. The heights of the Hajar Mountains and knowledge of their exact topography were equally important to areal navigation. Heights and topographic lines appear in all maps. The U.S. Map shows contour-lines 500m stepping while the

Soviet map goes down to 20m resolution. All maps share accurate descriptions of hydrographic features as well. Dry river beds (wadis) indicate partially subterranean water and mark the base of valleys. The wadis lead perpendicular to the Sea of Oman. Naturally, the topographic and hydrographic features remain mostly unchanged and re-occur in all maps. In the Soviet maps hydrography was mapped with all possible information on '*surface water conduit, underground water conduit, wells, prominent wells in steppe and desert area, and characteristics, artesian wells, water reservoirs, springs*' as the legend states and as explained in the US manual for decoding the Soviet maps (Department of the US Army 1958, 28). The Soviet maps detailed relief information such as '*index contour lines, dry river beds, spot elevation*'. They also featured extensive information on soils and vegetation '*palm groves, gravel, grassy steppes, semi-desert type of vegetation, desert area consisting of clay, sand, hilly sand, sand dunes and ridges, crescent dunes, porous sand, sand stabilized by grassy vegetation*' (Department of the US Army 1958, 44). In combination, these features allow for a comprehensive morphological description of the territory. As such they complemented the physical geography well developed in Oman by the 1980s.

The description of soil features was less accurate and could not compete with modern geological maps. The 1945 map featured a large 'quick-sands' area in the interior that would certainly not appear on contemporary maps. The 1964 map was more descriptive about vegetation showing the main agricultural zones along the coastline, while only the 1973 map clearly distinguished surface patterns of soil morphology. This information was then refined in the 1975 Soviet maps. Oasis and agricultural areas were marked as crucial landmarks for survival in the otherwise arid landscapes.

While the official narration of Oman states that the Sultanate had barely 5km of paved road by 1970, a closer look at the maps reveals a different story. The 1945 map showed a network of paths linking the coastline doubled by a parallel strand along the mountains. Larger passes such as the Samail and Rumaylah passes were visible as well. Since wadis were natural pathways these had to be added to the

<sup>3</sup> The Soviet Army produced two sets maps for Oman at the scales 1:500.000 and 1:200.000. The exact date of publication can be determined by deciphering the code in the lower right corner. As the manual of the Department of the US Army explains: "Each sheet is identified by the number of the sheet within which it falls, followed by a Roman numeral and the year of publication. Example: M-36-X-58." The two maps of Al Bāṭinah at scale 1:200.000 were published on D-198 IX 75-T = 1975. The two maps of the Omani Interior (located towards the south of Al Bāṭinah) at scale 1:200.000 were published on D-1 IV 79-D = 1979.



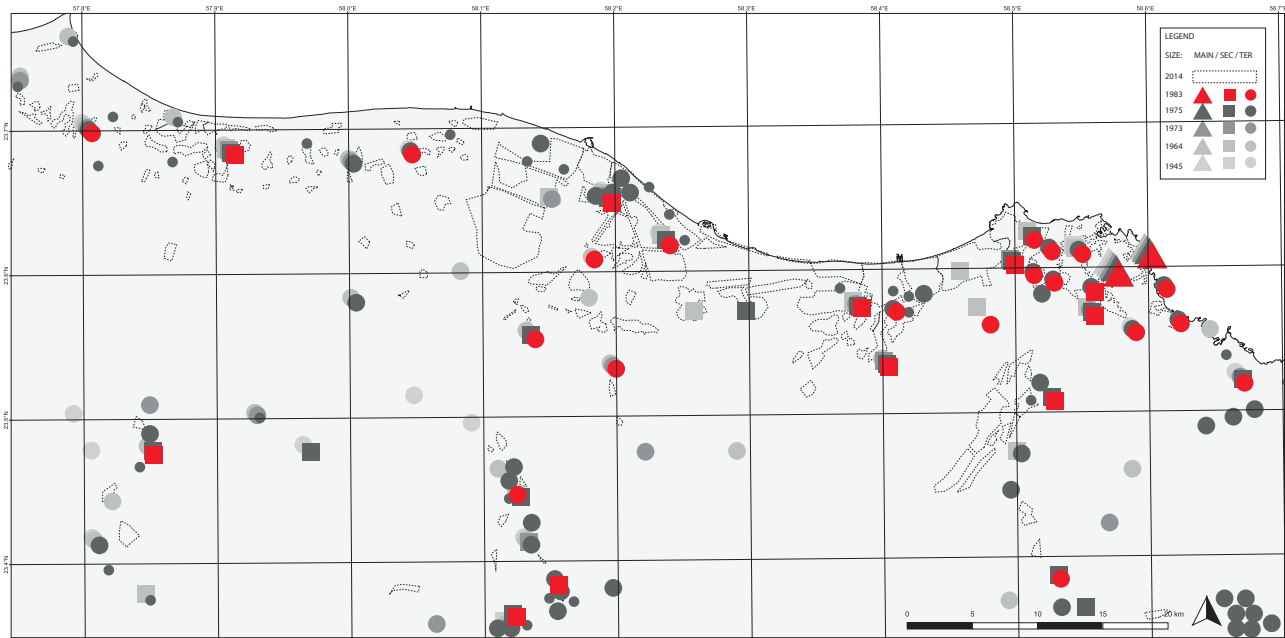


Figure 2. Settlements in Al Bāṭinah, Oman 1945-1988 with present urbanization outline of Muscat Capital Area. Map compiled by the author using QGIS software and digitalized and geo-referenced map sources: U.S. Army Map. “Muscat and Masirah.” U.S. Army Map Service. Washington, 1945. TPC J-7B. “Oman.” Tactical Pilotage Chart. Washington, 1964. ONC J-7. “Oman.” Operational Navigation Chart. St.Louis, 1973. Soviet Army. “Al Bāṭinah.” Soviet Military Topographic Maps. Moscow, 1975. Weidleplan. 1989. “Muscat Area Housing Study Phase 1 Survey Report.” Muscat: Ministry of Housing, p. 35.

Table 1: Settlements in Al Bāṭinah 1945-1988. Compiled by the author.

Map	Year	Main Centres	Secondary Centres	Coastal Village	Mountain Village	Coastal Settlement	Mountain Settlement	Total
U.S. Army Map	1945	1	2	9	9	/	/	21
Tactical Pilotage Chart	1964	2	14	8	18	/	/	42
Operational Navigation Chart	1973	2	5	9	8	/	/	24
Soviet Map	1975	2	24	28	23	18	9	104
Weidleplan Muscat Area Structure Plan	1978 1988	2	11	18	4	/	/	35

Table Sources: U.S. Army Map. “Muscat and Masirah.” U.S. Army Map Service. Washington, 1945. TPC J-7B. “Oman.” Tactical Pilotage Chart. Washington, 1964. ONC J-7. “Oman.” Operational Navigation Chart. St.Louis, 1973. Soviet Army. “Al Bāṭinah.” Soviet Military Topographic Maps. Moscow, 1975. Weidleplan. 1989. “Muscat Area Housing Study Phase 1 Survey Report.” Muscat: Ministry of Housing, p. 35.

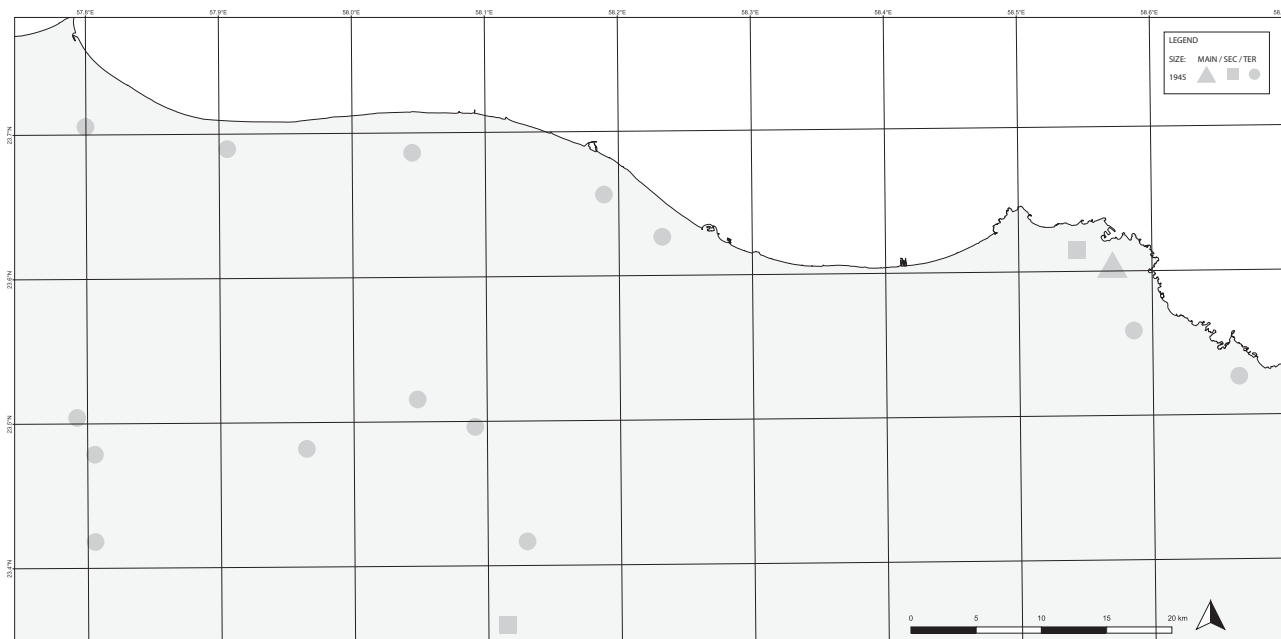


Figure 3. *Settlements in Al Bāṭinah 1945. Map compiled by the author using QGIS software as well as digitalized and geo-referenced map sources: U.S. Army Map. “Muscat and Masirah.” U.S. Army Map Service. Washington, 1945.*

pre-oil circulation network. This formed a dense, ‘ladder’ network of pathways and connectors serving all of Al Bāṭinah. The 1973 and 1975 maps showed the coastal road as paved and the Muscat-Nizwa road as planned. Since the unpaved pathways linked the settlement cores of Al Bāṭinah in the most effective way by navigating flood-plains, topography and valuable agricultural land, it is no surprise that the later paved road-network emerged directly from them. This pre-existing regional circulation network structured the future territory yet was not incorporated into the Weidleplan strategy.

For obvious reasons these military maps were undisclosed until the collapse of the Soviet Union in the early 1990s. Geographers like Scholz in the 1980s or the planning team of Weidleplan up to 1991 did not have access to them at the time of their research. Scholz used hand-held photography made during a plane survey of various parts of Oman to document his aerial photo atlas and even Gangler used cameras mounted on rope-tied balloons to create aerial photos of oasis settlements (Scholz 1978, Gangler 2003). Sensitive information like the one collected systematically by US and Soviet satellites was inaccessible.

With the collapse of the Soviet Union most of the map material was released to the public and is now accessible online. Similarly, earlier US maps have been de-classified and are now also available for research. These military maps from 1945 – 1973 now allow for the reconstruction of the settlement patterns in Al Bāṭinah prior to the oil-induced change of the period following 1970. Their systematic evaluation is the aim of this article.

### **FINDINGS: RECONSTRUCTED SETTLEMENT PATTERNS FOR MUSCAT AND AL BĀṬINAH BETWEEN 1945 TO 1981.**

The 1945 US map showed an even distribution of place names. Four locations were marked having particular importance: Muscat, Mutrah, Sarur and Khaburah. All other place names relate to villages and forts, most of which are still recognizable today such as the settlements of Bid Bid, Halban and As Seeb. Settlements like Rumais and Billah can no longer be found on modern maps. The total number of place names within the observation perimeter on the 1945 map was 21 settlements (Figure 3). Since

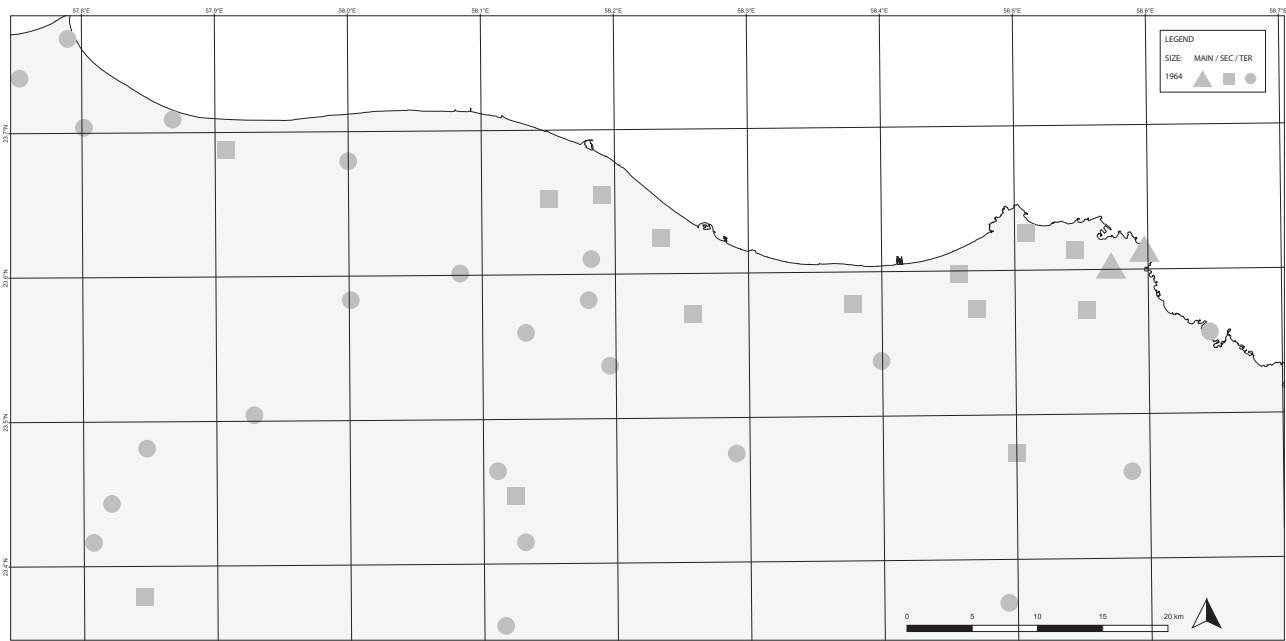


Figure 4. *Settlements in Al Bāṭinah 1964. Map compiled by the author using QGIS software as well as digitalized and geo-referenced map sources: TPC J-7B. “Oman.” Tactical Pilotage Chart. Washington, 1964.*

this map is based on ground-gathered data these places must have had socio-economic significance.

The 1964 US map showed the emergence of two twin centres, Muscat and Mutrah, in addition to 16 settlements merging into a larger urbanized strip. The total number of settlements within the observation perimeter increased to 42. The map showed an additional 21 settlements that did not show on the 1945 map (Figure 4). All settlements paralleled the coastline and the mountain baseline. This map showed the adjacency of settlements and agricultural zones in the coastal area.

The 1973 US map contained 24 settlements less than the 1964 map, due to different classification standards used to draft them (Figure 5). But the distribution of urbanization patterns and parallel of coastline and mountain baseline remained.

The 1975 Soviet maps marked a considerable increase in scale and detail. They showed 77 larger and more than 27 smaller settlements, thus 104 built-up areas and dwellings over the observation area (Figure 6). At a scale of 1:200.000 these maps distinguished ‘large cities, summer settlements, rural settlements, camps’ and ‘scattered settlements, built-up areas with fireproof buildings predominant, built-

up areas with non-fireproof buildings predominant, partly demolished buildings, demolished buildings’ and ‘individual dwellings, non-dwellings, tents’. (Department of the US Army 1958, 12). This inventory of built structures developed by the Soviet cartographers indexed every possible trace of human inhabitation. The size of the lettering indicated population sizes: ‘Cities with population under 20.000, urban settlements, market towns and large villages, suburbs, rural settlements over 400 (200, 100, 20) households’. In the context of Al Bāṭinah these features are crucial to reconstruct the sparse and sometimes temporary settlement patterns. Thus, as shown in Table 1 the total count of settlements compiled from military maps in the region of the future Muscat Capital Area was 21 (1945), 42 (1964), 24 (1973) and 104 (1975). The total number of settlements compiled from the Weidleplan map amounts to just 14 localities named and a number of settlement areas graphically delineated totalling 35 (Weidleplan 1989, 35).

Such detailed information about rural settlements up to the grain size of 20 households in the 1975 Soviet maps had not been matched by any other global mapping project. The analysis reveals a persistent

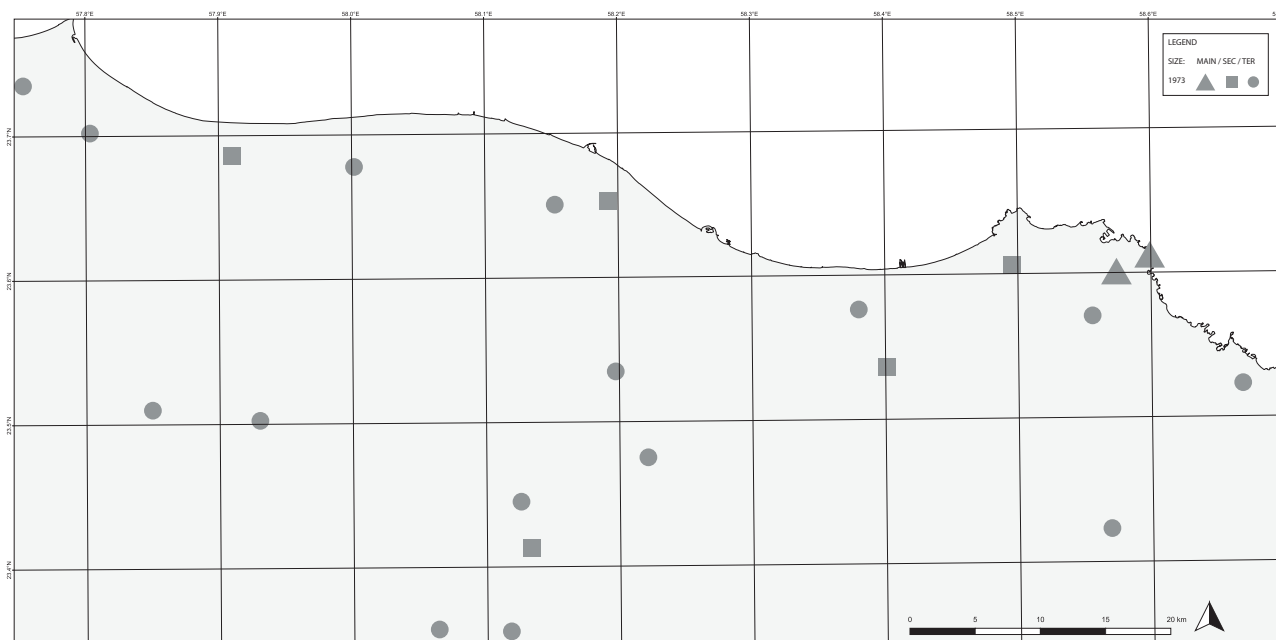


Figure 5. *Settlements in Al Bāṭinah 1973. Map compiled by the author using QGIS software as well as digitalized and geo-referenced map sources: ONC J-7. “Oman.” Operational Navigation Chart. St.Louis, 1973.*

parallel of coastline and mountain settlements and a perpendicular pattern of wadis with smaller settlements. To a large extent these settlements had names indicating their relevance, permanence and history. Further the maps marked the location of oasis plantations outside the larger agricultural areas. Such plantations again indicated the agricultural and economic relevance of the places. Further an extensive network of connecting pathways linked coastline and mountains along wadis reaching far into the hinterland. Strategic locations were marked with forts and watchtowers, a further index of the significance of these corridors. The count of settlements across the maps differed of course due to different cartographic conventions. Yet, the Tactical Pilotage Chart and the Soviet military maps revealed a multiplicity of places of high density of people, goods and information across Al Bāṭinah.

## DISCUSSION: REVIEWING MUSCAT CAPITAL AREA PLANNING

The military maps show an extended urban network across the region of the future Muscat Capital Area prior to the implementation of modern

planning strategies. The study of the maps reveals a network of nodal settlement cores not at all limited, but rather enabled by the very features of the territory, topography and hydrography, that allow for human settlements in the first place. The urban origins are therefore poly-nuclear and evenly spread across the territory of Al Bāṭinah.

All maps show the parallel of corridor links between coastal and hinterland settlements. These links have been described as one-to-one correlations of twin settlements by Dutton in the study in “Changing Rural Systems in Oman – The Khabura Project” (Dutton 1999). The regional level of interdependencies and support was characterized by the co-existence and symbiotic relationship of various tribal groups: The pastoral beduin living in the mountain areas, the *Shawawi*; The *falaj* oasis communities of the interior; The Al Bāṭinah coastal settlers of fishermen and farmers. These groups were further linked by an active merchant network emerging from tribal clans: “*Merchant and entrepreneurial activity was extraordinarily strong almost everywhere in Oman. For most of Oman’s history, long-range mobility has been a normal feature of life for the people of northern Oman, including both maritime and overland trade*



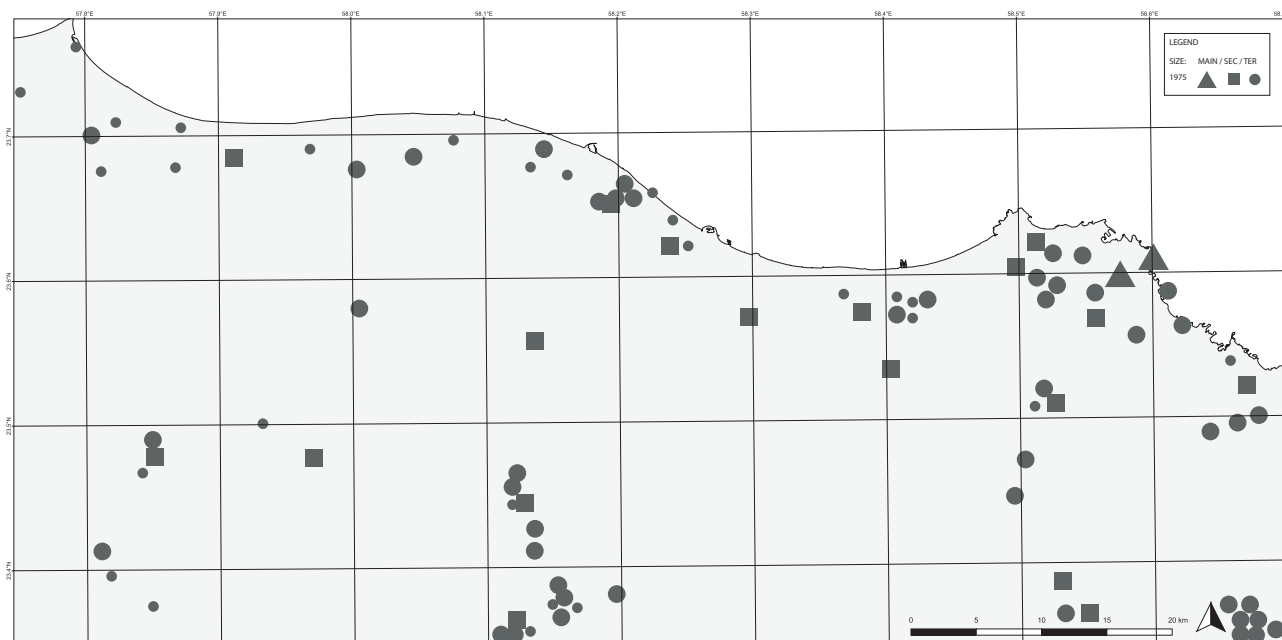


Figure 6. Settlements in Al Bāṭinah 1975. Map compiled by the author using QGIS software as well as digitalized and geo-referenced map sources: Soviet Army. “Al Bāṭinah.” Soviet Military Topographic Maps. Moscow, 1975.

links. This mobility and these links had been greatly strengthened by economic and technical changes within Oman. In consequence, the consumer market in Oman was, in attitude, remarkably open to import penetration.” (Dutton 1999, 47). This socio-economic base and its consequence to the spatial structure of the region had, by 1991, not yet been translated into modern planning. Dutton describes village life prior to modernization in his account of Al Bāṭinah: “Omani villagers retained full responsibility for the management of their rural resources on which they depended for their livelihoods and for life itself, and had evolved effective communal systems for their development and conversation. These were exemplified by regulations governing the traditional *falaj* water supply network. People worked interdependently, responding to the contributions made by other members of the rural communities in a system of mutual self-reliance. They also lived in harmony with their environment in a manner which time had proven to be truly sustainable.” (Dutton 1999, 1)

It is clear that the pre-urban systems described by the analysis of military maps prior to 1981 could only support a limited number of inhabitants. “By 1970 a population of approx. 40.000 inhabited the

coastal strip that is now considered the Capital Area in a punctual fashion, concentrated on the two port cities of Muscat (ca. 7.500) and Muttrah (ca. 25.000) as well as smaller, isolated and loosely arranged rural settlements.” (Scholz 1990, 162) This estimate is based on observed occupancy rates within historical parts of Muscat, extrapolated to the recorded settlements and including only nationals at the time. This arguably low number of inhabitants could be considered as a *natural sustainable baseline population* (Allen 2009). Considerations of population limits in the Weidleplan strategy on the contrary were based on economic projections of fossil fuel exports. The first reliable census was conducted by Llewelyn-Davies (Llewelyn-Davies 1981). Both Weidleplan and Scholz refer to the same study, yet including the expatriate population of ca. 100.000: “1981 around 230.000 people were living in the Capital Area occupying around 26.000 dwelling units and 4.400 barracks. The main concentration of the population was found in the Eastern Capital Region [e.g. historic Muscat, Muttrah and Ruwi] either in terms of absolute numbers or in terms of occupancy, which reached the highest values there.” (Weidleplan 1989, 26) based on (Llewelyn-Davies

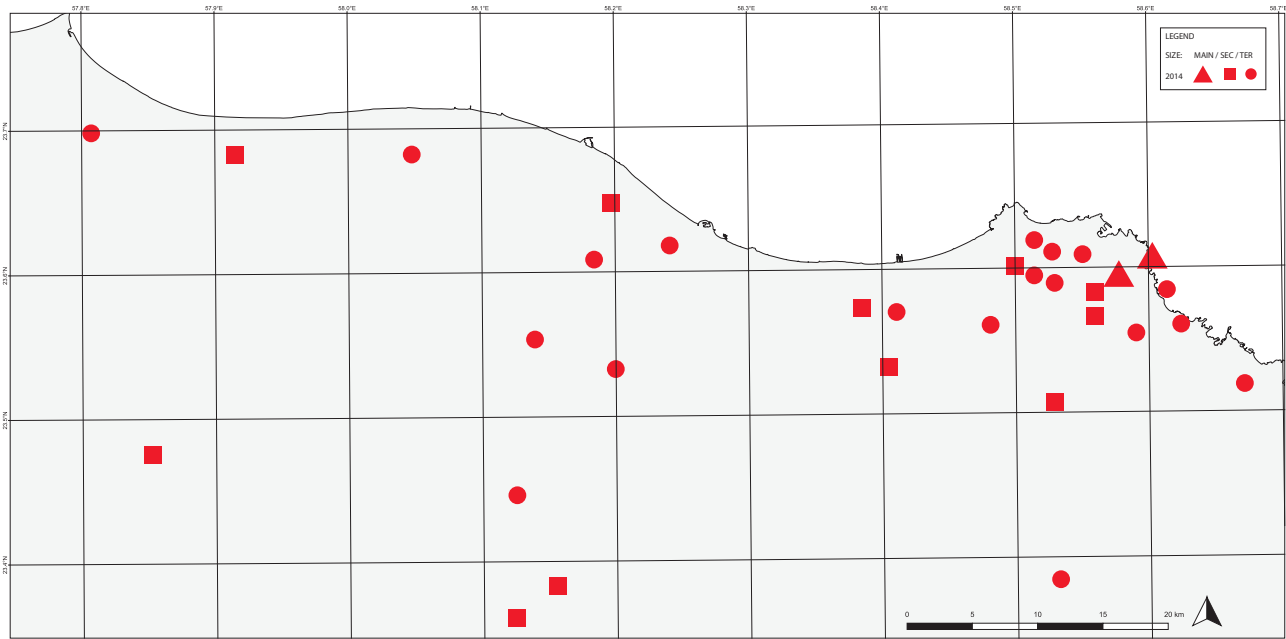


Figure 7. Settlements in Al Bāṭinah 1981. Map compiled by the author using QGIS software as well as digitalized and geo-referenced map sources: Weidleplan. 1989. "Muscat Area Housing Study Phase 1 Survey Report." Muscat: Ministry of Housing, p. 35.

1981). By the 1980s the population of Muscat Capital Area had long surpassed a natural sustainability threshold. Therefore, an urban planning strategy was indeed necessary to develop a modern urban fabric. Weidleplan acknowledged their limited access to data. Their report was based solely on: "Statistical Yearbook, Five Year Plan, Annual Reports of the Oman Housing Bank, Annual Reports of the Central Bank of Oman, Housing Study 1981 conducted by Llewelyn-Davies and a Socio Demographic Survey for the Capital Area 1984 conducted by the Development Council." (Weidleplan 1989, 17) For lack of cartographic base material the urban geography and spatial concepts of the 1980s were speculative with respect to pre-existing spatial resources. As shown in Figure 7 Weidleplan recorded only about 1/5 of the settlements mentioned by the Soviets five years before.

## CONCLUSIONS

The critical reconstruction of modern urban settlement patterns in Muscat and Al Bāṭinah based

on military maps offers insights into the spatial distribution and temporal evolution of settlements. The evaluation of these sources for the urbanisation discourse allows to reconstruct distinct pre-existing settlement patterns. Through comparison one can see that the first modern urban planning strategies dating from 1981 clashed with pre-existing settlement patterns. The compilation of settlement patterns visible in the military maps shows an extended urban network with hundreds of settlement cores that were not acknowledged in the planning strategies of the 1980s and thereafter. The reconstructed settlement patterns show that pre-existing settlements integrated hydrographic, topographic and agricultural features across the region of Muscat and Al Bāṭinah. Planning strategies from the 1980s onwards thus faced many challenges in Muscat Capital Area. A critical reconstruction and comparison of pre-existing settlement patterns with new planning strategies allows to draw the following relevant conclusions.

1. Features of the pre-existing settlement patterns are still visible in Muscat Capital Area today. They form a 'base-layer' of modern

urbanisation and indicate crucial intersections of hydrographic, topographic and agricultural features with settlements. The recognition of these features and their integration into urban planning strategies is urgently needed, as the controlled linear urban development planned by Llewelyn-Davies and Weidleplan cannot be considered a valid urbanization goal any longer. The reconstructed settlement patterns can thus form a starting point for a critique and possibly review of current urbanisation models in Oman.

2. By proposing a network model of urbanization based on pre-existing settlement patterns one can develop an *alternative settlement geography* that differs radically from the diagrams that formed the base of the urban planning of Muscat Capital Area in 1991. The inherent redundancy as well as spatial and functional resilience are crucial aspects of sustainable extended urban systems. The reconstructed settlement patterns and their interpretation as *alternative settlement geographies* offer starting points for an alternative spatial conception of Muscat Capital Area that might lead to a more sustainable urbanization process in the future.

3. Muscat Capital Area has been characterized as unsustainable urbanisation (Al Gharibi 2014; Al Shueili 2015; Nebel and von Richthofen 2016). The spatial conception of Muscat Capital Area needs to overcome hierarchical centre-periphery models of urbanization that failed to describe urbanization processes outside of the confined spaces of conventional cities. The reconstructed settlement patterns describe an urban network that is complex, functionally diversified and sustainable in its use of natural and spatial resources. These aspects are qualities that are now being recognised as ‘remedies’ for urban sprawl.

Thus, the understanding and revaluation of pre-existing settlement patterns can lead to a critique of the status quo of urbanisation in Oman, the development of alternative settlement geographies and remedies towards more sustainable urbanisation of Muscat Capital Area and Oman in the future.

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