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## Bibliography

- Ababsa, M. (ed.), 2013. *Atlas of Jordan. History, Territories and Society*. Beirut: Presses de l'ifpo.
- Abbadi, S., 1986. An Archaeological Survey of Ġabal Qurma. *Archiv für Orientforschung* 33, 259-262.
- Abdelhamid, G., 1999. *The Geology of Wadi Rajil Area Map Sheet No. 3653-IV*. Amman: The Hashemite Kingdom of Jordan Natural Resources Authority (= 1:50,000 Geological Mapping Series Geological Bulletin 45).
- Abu-Azizeh, W., 2013. The South-Eastern Jordan's Chalcolithic–Early Bronze Age Pastoral Nomadic Complex: Patterns of Mobility and Interaction. *Paléorient* 39(1), 149-176.
- Abu-Azizeh, W. & M.B. Tarawneh, 2015. Out of the *harra*: desert kites in south-eastern Jordan. New results from the South Eastern Badia Archaeological Project. *Arabian Archaeology and Epigraphy* 26, 95-119.
- Abu-Azizeh, W., M. Tarawneh, F. Abudanah, S. Twaissi & A. Al-Salameen, 2014. Variability within consistency: cairns and funerary practices of the Late Neolithic/Early Chalcolithic in the Al-Thulaythuwat area, southern Jordan. *Levant* 46(2), 161-185.
- Acconci, A. & E. Gabrieli, 1994. Scavo del cortile bajali a Madaba. *Liber Annuus* 44, 405-520.
- Adams, R.M., P.J. Parr, M. Ibrahim & A.S. Al-Mughannum, 1977. Saudi Arabian Archaeological Reconnaissance—1976: Preliminary Report on the First Phase of the Comprehensive Archaeological Survey Program. *Atlat* 1, 21-40.
- Akkermans, P.M.M.G & M.L. Brüning, 2017. Nothing but Cold Ashes? The Cairn Burials of Jebel Qurma, Northeastern Jordan. *Near Eastern Archaeology* 80(2), 132-139.
- Akkermans, P.M.M.G. & H.O. Huigens, in press. Long-term Settlement Trends in Jordan's North-Eastern *Badia*: The Jebel Qurma Archaeological Landscape Project. *Annual of the Department of Antiquities of Jordan*.
- Akkermans, P.M.M.G., H.O. Huigens, M.L. Brüning, 2014. A landscape of preservation: late prehistoric settlement and sequence in the Jebel Qurma region, north-eastern Jordan. *Levant* 46(2), 186-205.
- Al-Eisawi, D.M., 1985. Vegetation in Jordan. *Studies in the History and Archaeology of Jordan* 2, 45-57.
- Al-Homoud, A.S., R.J. Allison, B.F. Sunna & K. White, 1995. Geology, Geomorphology, Hydrology, Groundwater and Physical Resources of the Desertified Badia Environment in Jordan. *GeoJournal* 37(1), 51-67.
- Al-Jallad, A. 2015. *An Outline of the Grammar of the Safaitic Inscriptions*. Leiden and Boston: Brill (= Studies in Semitic Languages and Linguistics 80).
- Alliata, E., 1991. Ceramica dal complesso di S. Stefano a Umm al-Rasas. *Liber Annuus* 41, 365-422.
- 1992. Ceramica e piccoli oggetti dallo scavo della chiesa dei Leoni a Umm al-Rasas. *Liber Annuus* 42, 227-250.

- Allison, R. J., J.R. Grove, D.L. Higgitt, A.J. Kirk, N.J. Rosser, & J. Warburton, 2000. Geomorphology of the Eastern Badia Plateau, Jordan. *The Geographical Journal* 166(4), 157-211.
- Al-Salameen, Z. & H. Falahat, 2009. Burials from Wadi Mudayfa'at and Wadi Abu Khasharif, Southern Jordan - Results of a Survey and Salvage Excavations. *Mediterranean Archaeology and Archaeometry* 9(2), 85-108.
- Alzoubi, M., S. Al-Maani & H. Al-Qudrah, 2016. Safaitic Inscriptions and Possible Hunting Scenes from the North-Eastern Bādiyah, Jordan. *Rock Art Research* 33(2), 219-228.
- 'Amr, K. & R. Schick, 2001. The Pottery from Humeima: The Closed Corpus from the Lower Church, in E. Villeneuve & P.M. Watson (eds.), *La Céramique Byzantine et Proto-Islamique en Syrie-Jordanie (IVe-VIIIe siècles apr. J.-C.)*. Beirut: Institut Français d'Archéologie du Proche-Orient, 107-127.
- Arce, I., 2009. Qasr al-Hallabat (Jordan): Transformation of a *Limes Arabicus* Fort into a Monastic and Palatine Complex. *Gladius* 13, 155-180.
- 2012. Romans, Ghassanids and Umayyads and the Transformation of the *Limes Arabicus*: From Coercive and Deterrent Diplomacy towards Religious Proselytism and Political Clientelism, in G. Vannini & M. Nucciotti (eds.), *La Transgiordania nei secoli XII-XIII e le 'frontiere' del Mediterraneo medievale*. Oxford: Archaeopress (= BAR International Series 2386), 55-74.
- Asouti, E., C. Kabukcu, C.E. White, I. Kuijt, B. Finlayson & C. Makarewicz, 2015. Early Holocene woodland vegetation and human impacts in the arid zone of the southern Levant. *The Holocene* 25(10), 1565-1580.
- Athanassas, C.D., G.O. Rollefson, A. Kadereit, D. Kennedy, K. Theodorakopoulou, Y.M Rowan & A. Wasse, 2015. Optically stimulated luminescence (OSL) dating and spatial analysis of geometric lines in the Northern Arabian Desert. *Journal of Archaeological Science* 64, 1-11.
- Avissar, M., 1996. The Late Roman and Byzantine pottery, in A. Ben-Tor, M. Avissar & Y. Portugali (eds.), *Yoqne'am I: The Late Periods*. Jerusalem: The Hebrew University of Jerusalem (= Qedem Reports 3), 66-74.
- Avner, U., 1984. Ancient Cult Sites in the Negev and Sinai Deserts. *Tel Aviv* 11, 115-131.
- Avner, U., M. Shem-Tov, L. Enmar, G. Ragolski, R. Shem-Tov & O. Barzilai, 2014. A Survey of Neolithic Cult Sites in the Eilat Mountains, Israel. *Journal of the Israel Prehistoric Society* 44, 101-116.
- Avni, G., 1992. Survey of Deserted Bedouin Campsites in the Negev Highlands and its Implications for Archaeological Research, in O. Bar-Yosef & A.M. Khazanov (eds.), *Pastoralism in the Levant: Archaeological Materials and Anthropological Perspectives*. Madison: Prehistory Press (= Monographs in World Archaeology 10), 241-254.
- 1994. Early Mosques in the Negev Highlands: New Archaeological Evidence on Islamic Penetration of Southern Palestine. *Bulletin of the American Schools of Oriental Research* 294, 83-100.
- 2007. From Standing Stones to Open Mosques in the Negev Desert: The Archaeology of Religious Transformation on the Fringes. *Near Eastern Archaeology* 70(3), 124-138.

- Baca, M., K. Doan, M. Sobczyk, A. Stankovic & P. Węgleński, 2012. Ancient DNA reveals kinship burial patterns of a pre-Columbian Andean community. *BMC Genetics* 13(30), 1-11.
- Bacon, E.E., 1954. Types of Pastoral Nomadism in Central and Southwest Asia. *Southwestern Journal of Anthropology* 10(1), 44-68.
- Ball, W., J. Bowsher, I. Kehrberg, A. Walmsley & P. Watson. 1986. The North Decumanus and North Tetrapylon at Jerash: An Archaeological and Architectural Report, in F. Zayadine (ed.), *Jerash Archaeological Project 1981 - 1983*. Amman: Department of Antiquities, 351-409.
- Balouka, M., 2013. Roman Pottery, in E.M. Meyers & C.L. Meyers (eds.), *The Pottery from Ancient Sepphoris*. Winona Lake: Eisenbrauns, 13-129.
- Banning, E.B., 1986. Peasants, Pastoralists and "Pax Romana": Mutualism in the Southern Highlands of Jordan. *Bulletin of the American Schools of Oriental Research* 261, 25-50.
- 1993. Where the Wild Stones Have Been Gathered Aside: Pastoralist Campsites in Wadi Ziqlâb, Jordan. *The Biblical Archaeologist* 56(4), 212-221.
- Banning, E.B. & I. Köhler-Rollefson, 1992. Ethnographic Lessons for the Pastoral Past: Camp Locations and Material Remains near Beidha, Southern Jordan, in O. Bar-Yosef & A.M. Khazanov (eds.), *Pastoralism in the Levant: Archaeological Materials in Archaeological Perspectives*. Madison: Prehistory Press (= Monographs in World Archaeology 10), 181-204.
- Barfield, T.J., 1993. *The Nomadic Alternative*. Englewood Cliffs: Prentice Hall.
- Barker, G., D. Gilbertson & D. Mattingly, 2007. *Archaeology and Desertification: The Wadi Faynan Landscape Survey, Southern Jordan*. Oxford: CBRL/Oxbow (= Levant Supplementary Series 6).
- Bar-Matthews, M. & A. Ayalon, 2004. Speleothems as palaeoclimate indicators, a case study from Soreq Cave located in the Eastern Mediterranean Region, Israel, in R.W. Battarbee, F. Gasse & C.E. Stickley (eds.), *Past Climate Variability through Europe and Africa*. Dordrecht: Kluwer Academic Publishers, 363-391.
- Bar-Matthews, M., A. Ayalon & A. Kaufman, 1998. Middle to Late Holocene (6,500 Yr. Period) Paleoclimate in the Eastern Mediterranean Region from Stable Isotopic Composition of Speleothems from Soreq Cave, Israel, in A.S. Issar & N. Brown (eds.), *Water, Environment and Society in Times of Climatic Change*. Dordrecht: Kluwer Academic Publishers, 203-214.
- Bar-Nathan, R., 2002. *Hasmonean and Herodian Palaces at Jericho - Final Reports of the 1973-1987 Excavations. Volume III: The Pottery*. Jerusalem: The Hebrew University of Jerusalem.
- 2006. *The Pottery of Masada*. Jerusalem: The Hebrew University Press (= MASADA VII).
- 2011. The Pottery Corpus, in R. Bar-Nathan & W. Atrash (eds.), *Baysân. The Theater Pottery Workshop*. Jerusalem: The Israel Antiquities Authority, 229-344.
- Bar-Nathan, R. & M. Adato, 1986. Byzantine Pottery (Stratum 5), in L.I. Levine & E. Netzer (eds.), *Excavations at Caesarea Maritima: 1975, 1976, 1979 - Final Report*. Jerusalem: The Hebrew University of Jerusalem (= QEDem 21), 132-136.

- Barth, F., 1961. *Nomads of South Persia: The Basseri Tribe of the Khamseh Confederacy*. Boston: Little, Brown and Company.
- Bartl, K. & P.M.M.G. Akkermans, 2016. Khirbat al-`Umari. The Rediscovery of an Early Islamic Site South of Azraq. *Zeitschrift für Orient-Archäologie* 9, 200-221.
- Bartosiewicz, L. & H.J. Greenfeld (eds.), 1999. *Transhumant Pastoralism in Southern Europe. Recent Perspectives from Archaeology, History and Ethnology*. Budapest: Archaeolingua.
- Beck, A.R., 2004. The evaluation of Corona and Ikonos satellite imagery for archaeological applications in a semi-arid environment. Durham University, unpublished PhD thesis.
- Bell, G., [1907]1919. *Syria. The Desert and the Sown*. London: William Heinemann.
- Bender, F., 1968. *Geologie von Jordanien*. Berlin und Stuttgart: Gebrüder Borntraeger.
- Berlin, A.M., 1997. The Plain Wares, in S.C. Herbert (ed.), *Tell Anafa II, i: The Hellenistic and Roman Pottery*. Portsmouth, RI: Journal of Roman Archaeology (= JRA Supplementary Series 10, II), ix-244.
- 2003. The Hellenistic Period, in S. Richard (ed.), *Near Eastern Archaeology: A Reader*. Winona Lake: Eisenbrauns, 418-433.
- 2005. Pottery and pottery production in the Second Temple period, in B. Arubas & H. Goldfus (eds.), *Excavations on the site of the Jerusalem international convention center (Binyanei Ha'uma): the pottery and other small finds*. Portsmouth, RI: Journal of Roman Archaeology (= JRA Supplementary Series 60), 29-60.
- Betts, A., 1982. Prehistoric Sites at Qa'a Mejalla, Eastern Jordan. *Levant* 14(1), 1-34.
- 1993. The Burqu`/Ruwayšid Project: Preliminary Report on the 1991 Field Season (1). *Levant* 25, 1-11.
- Betts, A. & D. Burke, 2015. Desert kites in Jordan – a new appraisal. *Arabian Archaeology and Epigraphy* 26, 74-94.
- Betts, A., S. Helms, W. Lancaster, E. Jones, A. Lupton, L. Martin & F. Matsuert, 1990. The Burqu`/Ruweishid Project: Preliminary report on the 1988 field season. *Levant* 22, 1-20.
- Betts, A., S. Helms, W. Lancaster & F. Lancaster, 1991. The Burqu`/Ruweishid Project: Preliminary Report on the 1989 Field Season. *Levant* 23, 7-28.
- Betts, A., S. Eames, S. Hulka, M. Schroder, J. Rust & B. McLaren, 1996. Studies of Bronze Age Occupation in the Wadi al-`Ajib, Southern Hauran. *Levant* 28, 27-39.
- Betts, A.V.G., S. Colledge, L. Martin, C. McCartney, K. Wright & V. Yagodin, 1998. *The Harra and the Hamad: Excavations and Surveys in Eastern Jordan, Vol. 1*. Sheffield: Sheffield Academic Press (= Sheffield Archaeological Monographs 9).
- Betts, A. & D. Cropper, 2013. The Eastern *Badia*, in Betts, A.V.G., D. Cropper, L. Martin & C. McCartney, *The Later Prehistory of the Badia. Excavations and Surveys in Eastern Jordan*. Oxford and Oakville: Oxbow Books (= Levant Supplementary Series 11), 179-191.

- Betts, A., D. Cropper, W. Lancaster & F. Lancaster, 2013. Area Survey in the *Hamad*, in Betts, A.V.G., D. Cropper, L. Martin & C. McCartney, *The Later Prehistory of the Badia. Excavations and Surveys in Eastern Jordan*. Oxford and Oakville: Oxbow Books (= Levant Supplementary Series 11), 156-178.
- Betts, A.V.G., D. Cropper, L. Martin & C. McCartney, 2013. *The Later Prehistory of the Badia. Excavations and Surveys in Eastern Jordan*. Oxford and Oakville: Oxbow Books (= Levant Supplementary Series 11).
- Biagetti, S., 2015. Desert pastoralists: the Kel Tadrart Tuareg from south west Libya. *Pastoralism: Research, Policy and Practice* 5(6), 1-4.
- Biagetti, S. & T. Howe, 2017. Variability is the key. Towards a diachronic view of pastoralism. *Nomadic Peoples* 21, 167-172.
- Binford, L.R., 1964. A Consideration of Archaeological Research Design. *American Antiquity* 29(4), 425-441.
- 1980. Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1), 4-20.
- 1990. Mobility, Housing, and Environment: A Comparative Study. *Journal of Anthropological Research* 46(2), 119-152.
- Bintliff, J., 1999. The concepts of 'site' and 'offsite' archaeology in surface artefact survey, in M. Pasquinucci & F. Trément (eds.), *Non-Destructive Techniques Applied to Landscape Archaeology*. Oxford: Oxbow Books (= The Archaeology of Mediterranean Landscapes 4), 200-215.
- Bloch, M., 1971. *Placing the Dead. Tombs, Ancestral Villages, and Kinship Organization in Madagascar*. London and New York: Seminar Press (= Seminar Studies in Anthropology 1).
- Blondel, J. & J. Aronson, 1999. *Biology and Wildlife of the Mediterranean Region*. Oxford: Oxford University Press.
- Blunt, A., 1879. *Bedouin Tribes of the Euphrates*. New York: Harper & Brothers.
- Bookman, R., Y. Enzel, A. Agnon & M. Stein, 2004. Late Holocene lake levels of the Dead Sea. *The Geological Society of America Bulletin* 116(5-6), 555-571.
- Bourgeois, Q.P.J., 2013. *Monuments on the Horizon. The Formation of the Barrow Landscape throughout the 3<sup>rd</sup> and 2<sup>nd</sup> millennium BC*. Leiden: Sidestone Press.
- Bowersock, G.W., 1983. *Roman Arabia*. Cambridge, MA: Harvard University Press.
- Bradley, R., 1998. *The Significance of Monuments. On the shaping of human experience in Neolithic and Bronze Age Europe*. London and New York: Routledge.
- Bradley, R.J., 1992. *Nomads in the Archaeological Record: Case Studies in the Northern Provinces of the Sudan*. Berlin: Akademie Verlag (= Meroitica 13).
- Brusgaard, N.Ø., 2015. Metal remains from QUR-595. Leiden University, unpublished report.

- forthcoming. Images and Interactions: A Material Study of Black Desert Rock Art from North-Eastern Jordan. Leiden University, PhD thesis.
- Butler, S.S., 1909. Bahgdad to Damascus viâ El Jauf, Northern Arabia. *The Geographical Journal* 33(5), 517-533.
- Caraher, W.R., D. Nakassis & D.K. Pettegrew, 2006. Siteless Survey and Intensive Data Collection in an Artifact-rich Environment: Case Studies from the Eastern Corinthia, Greece. *Journal of Mediterranean Archaeology* 19(1), 7-43.
- Carvajal Lopez, J.C., L. Morabito, R. Carter, R. Fletcher & F.A. Al-Naimi, 2015. The Crowded Desert: a multi-phase archaeological survey in the north-west of Qatar. *Proceedings of the Seminar for Arabian Studies* 46, 45-62.
- Casana, J. & J. Cothren, 2008. Stereo analysis, DEM extraction and orthorectification of CORONA satellite imagery: archaeological applications from the Near East. *Antiquity* 82, 732-749.
- Chang, C., H.A. Koster 1986. Beyond Bones: Toward an Archaeology of Pastoralism. *Advances in Archaeological Method and Theory* 9, 97-148.
- Charloux, G. & R. Loreto (eds.), 2014. *Dûma I. 2010 Report of the Saudi-Italian-French Archaeological Project at Dûmat al-Jandal Saudi Arabia*. Riyâdh: Saudi Commission for Tourism and Antiquities.
- 2015. *Duma II. The 2011 Report of the Saudi-Italian-French Archaeological Project at Dûmat al-Jandal, Saudi Arabia*. Riyâdh: Saudi Commission for Tourism and National Heritage.
- Clark, V., 1981. Archaeological Investigations at Two Burial Cairns in the Ḥarra Region of Jordan. *Annual of the Department of Antiquities of Jordan* 25, 235-265.
- Clark, V.A., J.M.C. Bowsher, J.D. Stewart, 1986. The Jerash North Theatre: Architecture and Archaeology, 1982-1983, in F. Zayadine (ed.), *Jerash Archaeological Project 1981-1983, Volume I*. Amman: Department of Antiquities, 205-302.
- Cook, B.I., K.J. Anchukaltis, R. Touchan, D.M. Meko & A.R. Cook, 2016. Spatiotemporal drought variability in the Mediterranean over the last 900 years. *Journal of Geophysical Research: Atmospheres* 121, 2060-2074.
- Cordova, C.E., 2007. *Millennial Landscape Change in Jordan. Geoarchaeology and Cultural Ecology*. Tucson: The University of Arizona Press.
- Crassard, R., H. Guy, J. Schiettecatte & H. Hitgen, 2010. Reuse of tombs or cultural continuity? The case of tower-tombs in Shabwa governate (Yemen), in L. Weeks (ed.), *Death and Burial in Arabia and Beyond*. Oxford: Archaeopress (= Society for Arabian Studies Monographs 10/BAR IS 2107), 173-177.
- Crassard, R., O. Barge, C.-E. Bichot, J.E. Brochier, J. Chahoud, M.-L. Chambrade, C. Chataigner, K. Madi, E. Régagnon, H. Seba & E. Vila, 2015. Addressing the Desert Kites Phenomenon and Its Global Range Through a Multi-proxy Approach. *Journal of Archaeological Method and Theory* 22, 1093-1121.
- Cribb, R., 1991. *Nomads in Archaeology*. Cambridge: Cambridge University Press.
- Cytryn-Silverman, K., 2010. The Ceramic Evidence, in O. Gutfeld (ed.), *Ramla - Final Report on the Excavations North of the White Mosque*. Jerusalem: The Hebrew University of Jerusalem, 97-211.



- Daviau, P.M.M., 2010. *Excavations at Tall Jawa, Jordan: Volume 4, The Early Islamic House*. Leiden and Boston: Brill.
- Davidovich, U., Y Goldsmith, R. Porat & N. Porat, 2014. Dating and interpreting desert structures: the enclosures of the Judean Desert, Southern Levant, re-evaluated. *Archaeometry* 56, 878-897.
- De Maigret, A., 1999. *Arabia Felix. An exploration of the archaeological history of Yemen*. London: Stacey International.
- Della Puppa, C., forthcoming. *The Safaitic Scripts. An Ethno-Palaeographic Investigation*. Leiden University, PhD thesis.
- Dentzer, J.-M., P.-M. Blanc, T. Fournet, M. Kalos & F. Renel, 2010. Formation et développement des villes en Syrie du Sud de l'époque hellénistique à l'époque byzantine: les exemples de Bosra, Suweida, Shahba, in M. al-Maqdissi, F. Braemer and J.-M. Dentzer (eds.), *Hauran V. La Syrie du Sud du Néolithique à L'Antiquité Tardive: Recherches Récentes, Vol. I*. Beyrouth: Institut Francais du Proche-Orient, 139-169.
- De Vries, B., 2000. Continuity and change in the urban character of the southern Hauran from the 5th to the 9th century: the archaeological evidence at Umm al-Jimal. *Mediterranean Archaeology* 13, 39-45.
- Di Lernia, S. & M.A. Tafuri, 2013. Persistent deathplaces and mobile landmarks: The Holocene mortuary and isotopic record from Wadi Takarkori (SW Libya). *Journal of Anthropological Archaeology* 32, 1-15.
- Donner, F.M., 1981. *The Early Islamic Conquests*. Princeton: Princeton University Press.
- 1989. The Role of Nomads in the Near East in Late Antiquity (400-800 C.E.), in F.M. Clover & R.S. Humphreys (eds.), *Tradition and Innovation in Late Antiquity*. Madison and London: The University of Wisconsin Press, 73-85.
- Döpfer, S., 2015. The reuse of tombs in the necropolis of Bat, Sultanate of Oman. *Proceedings of the Seminar for Arabian Studies* 45, 1-10.
- Dunnell, R.C., 1992. The Notion Site, in J. Rossignol & L. Wandsnider (eds.), *Space, Time, and Archaeological Landscapes*. New York: Plenum Press, 21-42.
- Dyson-Hudson, R. & N. Dyson-Hudson, 1980. Nomadic pastoralism. *Annual Review of Anthropology* 9, 15-61.
- Echallier, J.C. & F. Braemer, 1995. Nature et fonctions des « desert kites » : données et hypothèses nouvelles. *Paléorient* 21(1), 35-63.
- Eerkens, J.W., 2008. Nomadic Potters. Relationships between Ceramic Technologies and Mobility Strategies, in H. Barnard & W. Wendrich (eds.), *The Archaeology of Mobility: Old World and New World Nomadism*. Los Angeles: Cotsen Institute of Archaeology (= Cotsen Advanced Seminar Series 4), 307-326.
- Eldar, I., Y. Nir, D. Nahlieli, 1992. The Bedouin and Their Campsites in the Dimona Region of the Negev: Comparative Models for the Study of Ancient Desert Settlements, in O. Bar-Yosef & A.M. Khazanov

- (eds.), *Pastoralism in the Levant: Archaeological Materials and Anthropological Perspectives*. Madison: Prehistory Press (Monographs in World Archaeology 10), 205-217.
- El-Khoury, L., 2014. Byzantine and Umayyad pottery at Barsinia (2006 season of excavation). *Palestine Exploration Quarterly* 146(4), 308-331.
- Elter, R. & K. Al-Jbour, 2013. Un Ensemble Architectural Omeyyade au Nord de Azraq: Qasr 'Ayn as-Sil. *Studies in the History and Archaeology of Jordan* 11, 639-649.
- Enzel, Y., R. Bookman, D. Sharon, H. Gvirtzman, U. Dayan, B. Zib & M. Stein, 2003. Late Holocene climates of the Near East deduced from Dead Sea level variations and modern regional winter rainfall. *Quaternary Research* 60, 263-273.
- Eph'al, I., 1982. *The Ancient Arabs: Nomads on the Borders of the Fertile Crescent. 9th-5th Centuries B.C.* Leiden: Brill.
- Fantone, F., 2014. Jebel Qurma project charcoal samples, preliminary report. Leiden University, unpublished report.
- Finkelstein, I., 1995. *Living on the Fringe. The Archaeology and History of the Negev, Sinai and Neighbouring Regions in the Bronze and Iron Ages*. Sheffield: Sheffield Academic Press (= Monographs in Mediterranean Archaeology 6).
- Finkelstein, I. & A. Perevolotsky, 1990. Processes of Sedentarization and Nomadization in the History of Sinai and the Negev. *Bulletin of the American Schools of Oriental Research* 279, 67-88.
- Fisher, G., 2011. *Between Empires: Arabs, Romans, and Sasanians in Late Antiquity*. Oxford: Oxford University Press.
- Foss, C., 1997. Syria in Transition, A. D. 550-750: An Archaeological Approach. *Dumbarton Oaks Papers* 51, 189-269.
- Fowden, G., 1999. 'Desert kites': ethnography, archaeology and art, in J. Humphrey (ed.), *The Roman and Byzantine Near East, Vol. 2. Some Recent Archaeological Research*. Portsmouth, RI: Journal of Roman Archaeology (= JRA Supplementary Series 31), 107-136.
- Frachetti, M.D., 2008. Variability and Dynamic Landscapes of Mobile Pastoralism in Ethnography and Prehistory, in H. Barnard & W. Wendrich (eds.), *The Archaeology of Mobility: Old World and New World Nomadism*. Los Angeles: Cotsen Institute of Archaeology (= Cotsen Advanced Seminar Series 4), 366-396.
- Galiatsatos, N., 2004. Assessment of the CORONA series of satellite imagery for landscape archaeology: a case study from the Orontes valley, Syria. Durham University, unpublished PhD thesis.
- Gamba, C., E. Fernández, M. Tirado, F. Pastor & E. Aroyo-Pardo, 2011. Ancient Nuclear DNA and Kinship Analysis: The Case of a Medieval Burial in San Esteban Church in Cuellar (Segovia, Central Spain). *American Journal of Physical Anthropology* 144, 485-491.
- Garrard, A.N. & B.F. Byrd, 2013. *Beyond the Fertile Crescent: Late Palaeolithic and Neolithic Communities of the Jordanian Steppe. The Azraq Basin Project Volume 1*. Oxford and Oakville: Oxbow (= Levant Supplementary Series 13).

- Gerber, Y., 2012. Classical Period Pottery, in J.A. Sauer & L.G. Herr (eds.), *Ceramic Finds: Typological and Technological Studies of the Roman Remains from Tell Hesban and Vicinity*. Berrien Springs: Andrews University Press (= Hesban 11), 175-506.
- Geva, H. & M. Herschkovitz, 2006. Local Pottery of the Hellenistic and Early Roman Periods, H. Geva (ed.), *Jewish Quarter Excavations in the Old City of Jerusalem. Volume III: Area E and Other Studies*. Jerusalem: The Hebrew University of Jerusalem, 94-143.
- Geva, H. & R. Rosenthal-Heginbottom, 2003. Local Pottery from Area A, in H. Geva (ed.), *Jewish Quarter Excavations in the Old City of Jerusalem. Volume II: Finds from Areas A, W and X-2*. Jerusalem: The Hebrew University of Jerusalem, 176-191.
- Gil, M., 1992. *A History of Palestine, 634-1099*. Cambridge: Cambridge University Press.
- Grillo, K.M., 2012. The Materiality of Mobile Pastoralism: Ethnoarchaeological Perspectives from Samburu, Kenya. Washington University, unpublished PhD thesis.
- Hammer, E.L., 2012. Local Landscapes of Pastoral Nomads in Southeastern Turkey. Harvard University, unpublished PhD thesis.
- 2014. Local landscape organization of mobile pastoralists in southeastern Turkey. *Journal of Anthropological Archaeology* 35, 269-288.
- Harding, G. L., 1953. The Cairn of Hani'. *Annual of the Department of Antiquities of Jordan* 2, 8-56.
- 1978. The Cairn of Sa'd, in R. Moorey & P. Parr (eds.), *Archaeology in the Levant: Essays for Kathleen Kenyon*. Warminster: Aris & Phillips, 243-249.
- Hegazy, A. & J. Lovett-Doust, 2016. *Plant Ecology in the Middle East*. Oxford: Oxford University Press.
- Helms, S.W., 1981. *Jawa. Lost City of the Black Desert*. London: Methuen.
- Hendricks, H.H., B. Clark, W.J. Bond, J.J. Midgley & P.A. Novellie, 2005. Movement response patterns of livestock to rainfall variability in the Richtersveld National Park. *African Journal of Range & Forage Science* 22(2), 117-125.
- Hendrix, R.E., P.R. Drey & J.B. Storffjell, 1996. *Ancient Pottery of Transjordan. An Introduction Utilizing Published Whole Forms: Late Neolithic through Late Islamic*. Berrien Springs: Institute of Archaeology/Horn Archaeological Museum, Andrews University.
- Holtorf, C. & H. Williams, 2006. Landscapes and memories, in D. Hicks & M.C. Beaudry (eds.), *The Cambridge Companion to Historical Archaeology*. Cambridge: Cambridge University Press, 235-254.
- Honeychurch, W. & C.A. Makarewicz, 2016. The Archaeology of Pastoral Nomadism. *Annual Review of Anthropology* 45, 341-359.
- Houghton, A., C. Lorber & O. Hoover, 2008. *Seleucid coins: a comprehensive catalogue*. Lancaster, PA and London: American Numismatic Society.
- Hoyland, R.G., 2001. *Arabia and the Arabs: From the Bronze Age to the coming of Islam*. London and New York: Routledge.

- Huete, A.R., 1988. A Soil-Adjusted Vegetation Index (SAVI). *Remote Sensing of Environment* 25, 295-309.
- Huigens, H.O., 2013. Stone Structures of the Black Desert: a study of long-term landscape development in the Jebel Qurma region, northeast Jordan. Leiden University, unpublished MA thesis.
- 2015. Preliminary report on a survey in the Hazimah plains: a *hamad* landscape in north-eastern Jordan. *Palestine Exploration Quarterly* 147(3), 180-194.
- 2018. The identification of pathways on *harra* surfaces in north-eastern Jordan and their relation to ancient human mobility. *Journal of Arid Environments*.
- forthcoming. Identifying nomadic campsites from the Classical and Late Antique periods in the Jebel Qurma region, north-eastern Jordan, in P.M.M.G. Akkermans & A. Al-Jallad (eds.), *Landscapes of Survival. The Archaeology and Epigraphy of the Badiya in north-eastern Jordan and Beyond*. Leiden: Sidestone Press.
- Inskip, S., 2015a. Three children from Jebel Qurma. Leiden University, unpublished report.
- 2015b. 2015 Campaign Burial Report. Leiden University, unpublished report.
- 2016. Osteological summary for Qurma 2016. Leiden University, unpublished report.
- Izdebski, A., J. Pickett, N. Roberts & T. Waliszewski, 2015. The environmental, archaeological and historical evidence for regional climatic changes and their societal impacts in the Eastern Mediterranean in Late Antiquity. *Quaternary Science Reviews* 136, 189-208.
- Johnson, B.L., 2006. The Hellenistic to Early Islamic period pottery, in A. Mazar (ed.), *Excavations at Tel Beth-Shean 1989-1996. Volume 1. From the Late Bronze Age IIB to the Medieval Period*. Jerusalem: The Israel Exploration Society, 523-589.
- Junge, A., J. Lomax, R. Shahack-Gross, Z.C. Dunseth, I. Finkelstein & M. Fuchs, 2016. OSL Age Determination of Archaeological Stone Structures Using Trapped Aeolian Sediments: A Case Study from the Negev Highlands, Israel. *Geoarchaeology* 31, 550-563.
- Kaniewski, D., E. Van Campo & H. Weiss, 2012. Drought is a recurring challenge in the Middle East. *Proceedings of the National Academy of Sciences* 109(10), 3862-3867.
- Kehrberg, I., 1989. Selected Lamps and Pottery from the Hippodrome at Jerash. *Syria* 66(1), 85-97.
- Kelly, R.L., 1983. Hunter-Gatherer Mobility Strategies. *Journal of Anthropological Research* 39(3), 277-306.
- Kempe, S. & A. Al-Malabeh, 2010. Hunting Kites ('Desert Kites') and Associated Structures along the Eastern Rim of the Jordanian Harrat. A Geo-Archaeological Google Earth Images Survey. *Zeitschrift für Orient-Archäologie* 3, 46-86.
- Kennedy, D.L., 1982. *Archaeological Explorations on the Roman Frontier in North-East Jordan. The Roman and Byzantine military installations and road network on the ground and from the air*. Oxford: Archaeopress (= BAR International Series 134).
- 1997. Roman Roads and Routes in North-east Jordan. *Levant* 29, 71-93.

- 2011. The "Works of the Old Men" in Arabia: remote sensing in interior Arabia. *Journal of Archaeological Science* 38, 3185-3203.
- 2012a. The Cairn of Hānī: Significance, present condition and context. *Annual of the Department of Antiquities of Jordan* 56, 483-505.
- 2012b. Wheels in the Harret al-Shaam. *Palestine Exploration Quarterly* 144(2), 77-81.
- 2014. 'Nomad Villages' in north-eastern Jordan: from Roman Arabia to Umayyad Urdunn. *Arabian Archaeology and Epigraphy* 25, 96-109.
- Kennedy, D. & M.C. Bishop, 2011. Google earth and the archaeology of Saudi Arabia. A case study from the Jeddah area. *Journal of Archaeological Science* 38, 1284-1293.
- Kennedy, H., 1986. *The Prophet and the Age of the Caliphates. The Islamic Near East from the sixth to the eleventh century*. London and New York: Longman.
- Khalil, L. & J. Kareem, 2002. Abbasid Pottery from Area E at Khirbet Yajuz, Jordan. *Levant* 34(1), 111-150.
- Khazanov, A.M., 1984. *Nomads and the Outside World*. Cambridge: Cambridge University Press (= Cambridge Studies in Social and Cultural Anthropology 44).
- King, G., 1990. The basalt desert rescue survey and some preliminary remarks on the Safaitic inscriptions and rock drawing. *Proceedings of the Seminar for Arabian Studies* 20, 55-78.
- Knauf, E.A., 1991. More Notes on Ġabal Qurma, Minaeans and Safaites. *Zeitschrift des Deutschen Palästina-Vereins* 107, 92-101.
- Kuhnen, H.-P., 1989. *Studien zur Chronologie und Siedlungsarchäologie des Karmel (Israel) zwischen Hellenismus und Spätantike*. Wiesbaden: Dr. Ludwig Reichert Verlag.
- LaBianca, Ø., 1993. The Fluidity of Tribal Peoples in Central Transjordan: Four Millennia of Sedentarization and Nomadization on the Madaba Plains, in H. Palva & K.S. Vikør (eds.), *The Middle East – Unity and Diversity. Papers from the Second Nordic Conference on Middle Eastern Studies, Copenhagen 22-25. October 1992*. Copenhagen: Nordic Institute of Asian Studies (= Nordic Proceedings in Asian Studies 5), 206-215.
- Laity, J., 2008. *Deserts and Desert Environments*. Chichester: Wiley-Blackwell.
- Lancaster, W. & F. Lancaster, 1999. *People, Land and Water in the Arab Middle East. Environments and Landscapes in the Bilād ash-Sham*. Amsterdam: Harwood Academic Publishers (= Studies in Environmental Anthropology 2).
- Lapp, N.L., 2008. *Shechem IV. The Persian-Hellenistic Pottery of Shechem/Tell Balāṭa*. Boston: American Schools of Oriental Research (= ASOR Archaeological Reports 11).
- Lash, A., 2009. Restoration and Excavation at al-Azraq Castle during 2008. *Annual of the Department of Antiquities of Jordan* 53, 423-431.
- Leverington, D.W. & W.M. Moon, 2012. Landsat-TM-Based Discrimination of Lithological Units Associated with the Purtuniqu Ophiolite, Quebec, Canada. *Remote Sensing* 4, 1208-1231.

- Lockyear, K., 2012. Dating coins, dating with coins. *Oxford Journal of Archaeology* 31(2), 191-211.
- Macdonald, B., L.G. Herr, D.S. Quaintance, G.A. Clark & M.C.A. Macdonald, 2012. *The Ayl to Ras an-Naqab Archaeological Survey, Southern Jordan (2005-2007)*. Boston: American Schools of Oriental Research (= ASOR Archaeological Reports 16).
- Macdonald, M.C.A., 1992a. The Seasons and Transhumance in the Safaitic Inscriptions. *Journal of the Royal Asiatic Society* 2(1), 1-11.
- 1992b. The Distribution of Safaitic Inscriptions in Northern Jordan. *Studies in the History and Archaeology of Jordan* IV, 303-307.
- 1993. Nomads and the Hawran in the Late Hellenistic and Roman Periods: A Reassessment of the Epigraphic Evidence. *Syria* 70(3-4), 303-403.
- 2004. Ancient North Arabian, in R.D. Woodard (ed.), *The Cambridge Encyclopedia of the World's Ancient Languages*. Cambridge: Cambridge University Press, 488-533.
- 2005. Of rock-Art, “desert kites” and *meşāyid*, in A.V. Sedov & I.M. Smilyanskaya (eds.), *Arabia Vitalis*. Moscow: Rossijskaya Akademiya Nauk, 332-345.
- 2008. Transformation and continuity at al-Namāra: Camps, settlements, forts, and tombs, in K. Bartl & A. Moaz (eds.), *Residences, Castles, Settlements. Transformation Processes from Late Antiquity to Early Islam in Bilad al-Sham*. Rahden: Verlag Marie Leidorf (= Orient-Archäologie 24), 317-332.
- 2010. Ancient Arabia and the written word, in M.C.A. Macdonald (ed.), *The Development of Arabic as a Written Language. Papers from the Special Session of the Seminar for Arabian Studies held on 24 July, 2009*. Oxford: Archaeopress (= Supplement to the Proceedings of the Seminar for Arabian Studies 40), 5-28.
- 2014. ‘Romans Go Home’? Rome and Other ‘Outsiders’ as Viewed from the Syro-Arabian Desert, in J. H.F. Dijkstra & G. Fisher (eds.), *Inside and Out. Interaction between Rome and the Peoples on the Arabian and Egyptian Frontiers in Late Antiquity*. Leuven: Peeters, 145-163.
- Magee, P., 2014. *The Archaeology of Prehistoric Arabia. Adaptation and Social Formation from the Neolithic to the Iron Age*. Cambridge: Cambridge University Press.
- 2015. When was the Dromedary Domesticated in the Ancient Near East? *Zeitschrift für Orient-Archäologie* 8, 252-277.
- Magness, J., 1993. *Jerusalem Ceramic Chronology, circa 200-800 CE*. Sheffield: Sheffield Academic Press.
- 2003. Late Roman and Byzantine Pottery, in H. Geva (ed.), *Jewish Quarter Excavations in the Old City of Jerusalem, Volume II: The Finds from Areas A, W and X-2, Final Report*. Jerusalem: Institute of Archaeology, Hebrew University of Jerusalem, 423-432.
- 2012. *The Archaeology of the Holy Land. From the Destruction of Solomon's Temple to the Muslim Conquest*. Cambridge: Cambridge University Press.
- Maitland, P.E., 1927. The ‘Works of the Old Men’ in Arabia. *Antiquity* 1, 197-203.

- Maraqten, M., 2015. Hunting in pre-Islamic Arabia in light of the epigraphic evidence. *Arabian Archaeology and Epigraphy* 26, 208-234.
- McCorriston, J., T. Steimer-Herbet, M. Harrower, K. Williams, J.-F. Saliège & 'A. Bin 'Aqil, 2011. Gazetteer of small-scale monuments in prehistoric Hadramawt, Yemen: a radiocarbon chronology from the RASA-AHSD Project research 1996-2008. *Arabian Archaeology and Epigraphy* 22, 1-22.
- McNicoll, A.W., R.H. Smith & J.B. Hennessy, 1982. *Pella in Jordan 1: An interim report on the joint University of Sydney and The College of Wooster excavations at Pella 1979-1981*. Canberra: Australian National Gallery.
- Meister, J., D. Knitter, J. Krause, B. Müller-Neuhof & B. Schütt, in press. A pastoral landscape for millennia: Investigating pastoral mobility in northeastern Jordan using quantitative spatial analyses. *Quaternary International*.
- Migowski, C., M. Stern, S. Prasad, J.F.W. Negendank & A. Agnon, 2006. Holocene climate variability and cultural evolution in the Near East from the Dead Sea sedimentary record. *Quaternary Research* 66, 421-431.
- Millar, F., 1993. *The Roman Near East: 31 BC - AD 337*. Cambridge, MA and London: Harvard University Press.
- Miller, B.A., 2014. Semantic calibration of digital terrain analysis scale. *Cartography and Geographic Information Science* 41(2), 166-176.
- Miller, B.A. & R.J. Schaetzl, 2015. Digital Classification of Hillslope Position. *Soil Science Society of America Journal* 79, 132-145.
- Morandi Bonacossi, D. & M. Iamoni, 2012. The Early History of the Western Palmyra Desert Region. The Change in the Settlement Patterns and the Adaptation of Subsistence Strategies to Encroaching Aridity: A First Assessment of the Desert-Kite and Tumulus Cultural Horizons. *Syria* 89, 31-58.
- Müller-Neuhof, B., 2012. The Gardens of Jawa: Early Evidence for Rainwater Harvesting Irrigation. *CBRL Bulletin* 7, 62-64.
- 2013. East of Jawa: Chalcolithic/Early Bronze Age Settlement Activity in al-Ḥarra (North-East Jordan). *Annual of the Department of Antiquities of Jordan* 57, 125-139.
- 2014a. Recent research on the Late Prehistory of the arid regions in Jordan. *Levant* 46(2), 151-160.
- 2014b. A 'marginal' region with many options: the diversity of Chalcolithic/Early Bronze Age socio-economic activities in the hinterland of Jawa. *Levant* 46(2), 230-248.
- Musil, A., 1928. *The Manners and Customs of the Rwala Bedouins* (= Oriental Explorations and Studies 6). New York: American Geographical Society.
- Najjar, M., 1989. Abassid pottery from al-Muwaqqar. *Annual of the Department of Antiquities of Jordan* 33, 305-322.
- Neumann, F.H., E.J. Kagan, M.J. Schwab & M. Stein, 2007. Palynology, sedimentology and palaeoecology of the Late Holocene Dead Sea. *Quaternary Science Reviews* 26, 1476-1498.

- Norris, J. & A. Al-Manaser, 2018. The Nabataeans against the *Hwt* – once again. An edition of new Safaitic inscriptions from the Jordanian Ḥarraḥ desert. *Arabian Epigraphic Notes* 4, 1-24.
- Northedge, A., 1992. *Studies on Roman and Islamic 'Amman - Volume I: History, Site and Architecture*. Oxford: Oxford University Press.
- O'Driscoll, J., 2017. Landscape prominence: Examining the topographical position of Irish hillforts using a cumulative viewshed approach. *Journal of Archaeological Science: Reports* 16, 73-89.
- Ogden, J., 1995. The Gold Jewellery, in C.-M. Bennett & P. Bienkowski (eds.), *Excavations at Tawilan in Southern Jordan*. Oxford: Oxford University Press, 69-78.
- Olávarri-Goicoechea, E., 1985. *El palacio Omeya de Amman II. La arqueología*. Valencia: Institución San Jerónimo.
- Orland, I.J., M. Bar-Matthews, N.T. Kita, A. Ayalon, A. Matthews & J.W. Valley, 2009. Climate deterioration in the Eastern Mediterranean as revealed by ion microprobe analysis of a speleothem that grew from 2.2 to 0.9 ka in Soreq Cave, Israel. *Quaternary Research* 71, 27-35.
- Oxtoby, W.G., 1968. *Some Inscriptions of the Safaitic Bedouin*. New Haven: American Oriental Society.
- Parcak, S.H., 2009. *Satellite Remote Sensing for Archaeology*. London and New York: Routledge.
- Parker, S.T., 1986. *Romans and Saracens: A History of the Arabian Frontier*. Winona Lake: Eisenbrauns (= ASOR Dissertation Series 6).
- 1987. Peasants, Pastoralists, and “Pax Romana”: A Different View. *Bulletin of the American Schools of Oriental Research* 265, 35-51.
- 1998. The Pottery, in B. De Vries (ed.), *Umm al-Jimal. A frontier town and its landscape in Northern Jordan. Volume 1. Fieldwork 1972-1981*. Portsmouth, RI: Journal of Roman Archaeology (= JRA Supplementary Series 26), 204-218.
- 2006. The Pottery, in S.T. Parker (ed.), *The Roman Frontier in Central Jordan. Final Report on the Limes Arabicus Project, 1980-1989*. Washington D.C.: Dumbarton Oaks (= Dumbarton Oaks Studies 40), 329-372.
- Peters, F.E., 1977. The Nabateans in the Hawran. *Journal of the American Oriental Society* 97(3), 263-277.
- Polkowski, P., 2015. The Life of Petroglyphs: A Biographical Approach to Rock Art in the Dakhleh Oasis, Egypt. *American Indian Rock Art* 41, 43-55.
- Porat, N., S.A. Rosen, E. Boaretto & Y. Avni, 2006. Dating the Ramat Saharonim Late Neolithic desert cult site. *Journal of Archaeological Science* 33, 1341-1355.
- Porat, N., U. Avner, A. Holzer, R. Shemtov & L. Kolska Horwitz, 2013. Fourth-millennium-BC ‘leopard traps’ from the Negev Desert (Israel). *Antiquity* 87, 714-727.
- Qi, J., A. Chehbouni, A.R. Huete, Y.H. Kerr & S. Sorooshian, 1994. A Modified Soil Adjusted Vegetation Index. *Remote Sensing of Environment* 48, 119-126.



- Rabba', I.A., 1998. *The Geology of Al Umari (Abar al Hazim) Map Sheet No. 3453-III*. Amman: The Hashemite Kingdom of Jordan Natural Resources Authority (= 1:50,000 Geological Mapping Series Geological Bulletin 43).
- 2005. *The Geology of Umm Nukhayla and Wadi al Qattafi Areas Map Sheets No. 3453-II and 3453-I*. Amman: The Hashemite Kingdom of Jordan Natural Resources Authority (= 1:50,000 Geological Mapping Series Geological Bulletin 62).
- Raswan, C.R., 1930. Tribal Areas and Migration Lines of the North Arabian Bedouins. *Geographic Review* 20(3), 494-502.
- Rees, L.W.B., 1929. The Transjordan Desert. *Antiquity* 3, 389-407.
- Ren, H. & G. Feng, 2015. Are soil-adjusted vegetation indices better than soil-unadjusted vegetation indices for above-ground green biomass estimation in arid and semi-arid grasslands? *Grass and Forage Science* 70, 611-619.
- Renel, F., 2010. La céramique antique de Syrie du sud de la période hellénistique à la période byzantine: (IIe s. av. J.-C. - VIe s. apr. J.-C.). Étude de cas: le Jebel et le Leja, in M. Maqdissi, F. Braemer & J.-M. Dentzer (eds.), *Hauran V. La Syrie du Sud du Néolithique à l'Antiquité Tardive: Recherches Récentes, Volume I*. Beyrouth: Institut Français du Proche-Orient, 515-544.
- Reynolds, P. & Y. Waksman, 2007. Beirut Cooking Wares, 2nd to 7th Centuries: Local Forms and North Palestinian Imports. *Berytus* 50, 59-81.
- Richter, T., 2014. Margin of Centre? The Epipalaeolithic in the Azraq Oasis and the Qa' Shubayqa, in B. Finlayson & C. Makarewicz (eds.), *Settlement, Survey, and Stone. Essays on Near Eastern Prehistory in Honour of Gary Rollefson*. Berlin: ex oriente, 27-36.
- 2017. The Late Epipalaeolithic and Early Neolithic in the Jordanian *Badia*: Recent Fieldwork around the Qa' Shubayqa. *Near Eastern Archaeology* 80(2), 94-101.
- Riemer, H., 2013. Lessons in landscape learning: The dawn of long-distance travel and navigation in Egypt's Western Desert from prehistoric to Old Kingdom times, in F. Förster & H. Riemer (eds.), *Desert Road Archaeology in Ancient Egypt and Beyond*. Köln: Heinrich-Barth-Institut (= Africa Praehistorica 27), 77-106.
- Roberts, N., W.J. Eastwood, C. Kuzucuoglu, G. Fiorentino & V. Caracuta, 2011. Climatic, vegetation and cultural change in the eastern Mediterranean during the mid-Holocene environmental transition. *The Holocene* 21(1), 147-162.
- Rohmer, J., 2011. Late Hellenistic Settlements in Hawrân (Southern Syria). Survival of Proto-historic Urbanism and Village Architecture in a Hellenized Context. *Bolletino di Archeologia Online* 1,1-12.
- Rollefson, G., 2013. Late prehistoric aggregation patterns in Jordan's Eastern *Badia*. *Syria* 90, 211-230.
- Rollefson, G., Y. Rowan & A. Wasse, 2014. The Late Neolithic colonization of the Eastern *Badia* of Jordan. *Levant* 46(2), 285-301.

- Rollefson, G.O., C. Athanassas, Y.M. Rowan & A.M.R. Wasse, 2016. First chronometric results for 'works of the old men': late prehistoric 'wheels' near Wisad Pools, Black Desert, Jordan. *Antiquity* 90, 939-952.
- Rosen, S.A., 1987. Byzantine Nomadism in the Negev: Results from the Emergency Survey. *Journal of Field Archaeology* 14(1), 29-42.
- 1993. A Roman-Period Pastoral Tent Camp in the Negev, Israel. *Journal of Field Archaeology* 20(4), 441-451.
- 2003. Early multi-resource nomadism: Excavations at the Camel Site in the central Negev. *Antiquity* 77, 749-760.
- 2007. The Nabataeans as Pastoral Nomads: An Archaeological Perspective, in K.D. Politis (ed.), *The World of the Nabataeans: Volume 2 of the International Conference The World of the Herods and the Nabataeans held at the British Museum, 17-19 April 2001*. Stuttgart: Franz Steiner Verlag (= Oriens et Occidens 15), 345-373.
- 2017. *Revolutions in the Desert. The Rise of Mobile Pastoralism in the Southern Levant*. New York and London: Routledge.
- Rosen, S.A. & G. Avni, 1993. The Edge of Empire: The Archaeology of Pastoral Nomads in the Southern Negev. *The Biblical Archaeologist* 56(4), 189-199.
- Rosen, S.A., A.B. Savinetsky, Y. Plakht, N.K. Kisseleva, B.F. Khassanov, A.M. Pereladov & M. Haiman, 2005. Dung in the Desert: Preliminary Results of the Negev Holocene Ecology Project. *Current Anthropology* 46(2), 317-327.
- Rosen, S.A., Y. Avni, F. Bocquentin & N. Porat, 2007. Investigations at Ramat Saharonim: A Desert Neolithic Sacred Precinct in the Central Negev. *Bulletin of the American Schools of Oriental Research* 346, 1-27.
- Roskin, J., I. Katra & D.G. Blumberg, 2013. Late Holocene dune mobilizations in the northwestern Negev dunefield, Israel: A response to combined anthropogenic activity and short-term intensified windiness. *Quaternary International* 303, 10-23.
- Rosser, N.J., 2002. The geomorphology of coarse clastic surfaces in arid environments. Durham University, unpublished PhD thesis.
- Rossi, C. & S. Ikram, 2013. Evidence of desert routes across northern Kharga (Egypt's Western Desert), in F. Förster & H. Riemer (eds.), *Desert Road Archaeology in Ancient Egypt and Beyond*. Köln: Heinrich-Barth-Institut (= Africa Praehistorica 27), 265-282.
- Rouse, J.W., R.H. Haas, J.A. Schell & D.W. Deering, 1974. Monitoring vegetation systems in the Great Plains with ERTS, in S.C. Freden & E.P. Mercanti (eds.), *Third ERTS Symposium*. Washington D.C: National Aeronautics and Space Administration (= SP-351 I), 309-317.
- Rowan, Y.M., 2013. Eastern Badia Archaeological Project: Maitland's Mesa, Jordan, in G. Stein (ed.), *The Oriental Institute 2012-2013 Annual Report*. Chicago: The Oriental Institute of the University of Chicago, 32-39.

- Rowan, Y.M., G.O. Rollefson, A. Wasse, W. Abu-Azizeh, A.C. Hill & M.M. Kersel, 2015. The “land of conjecture:” New late prehistoric discoveries at Maitland’s Mesa and Wisad Pools, Jordan. *Journal of Field Archaeology* 40(2), 176-189.
- Rowan, Y.M., G. Rollefson, A. Wasse, A.C. Hill & M. Kersel, 2017. The Late Neolithic Presence in the Black Desert. *Near Eastern Archaeology* 80(2), 102-113.
- Rowe, A.G., 1999. The exploitation of an arid landscape by a pastoral society: the contemporary eastern Badia of Jordan. *Applied Geography* 19, 345-361.
- Saidel, B.A., 2008. The Bedouin Tent. An ethno-archaeological portal to antiquity of a modern construct?, in H. Barnard & W. Wendrich (eds.), *The Archaeology of Mobility. Old World and New World Nomadism*. Los Angeles: Cotsen Institute of Archaeology at UCLA (= Cotsen Advanced Seminar Series 4), 465-486.
- Saidel, B.A. & T. Erickson-Gini, 2014. A note on the excavation of an Ottoman and British Mandate period Bedouin campground at Nahal Be’erotayim West in the Negev desert, Israel. *Arabian Archaeology and Epigraphy* 25, 138-145.
- Salzman, P.C., 1983. Labor formations in a nomadic tribe. *Nomadic Peoples* 13, 35-59.
- 1996a. Introduction: Varieties of Pastoral Societies, in U. Fabietti & P.C. Salzman (eds.), *The Anthropology of Tribal and Peasant Pastoral Societies: The Dialectics of Social Cohesion and Fragmentation*. Como and Pavia: Ibis, 21-37.
- 1996b. Peasant Pastoralism, in U. Fabietti & P.C. Salzman (eds.), *The Anthropology of Tribal and Peasant Pastoral Societies: The Dialectics of Social Cohesion and Fragmentation*. Como and Pavia: Ibis, 149-166.
- 2002. Pastoral nomads: some general observations based on research in Iran. *Journal of Anthropological Research* 58(2), 245-264.
- Sartre, M., 2005. *The Middle East under Rome*. Cambridge, MA: Harvard University Press.
- Schilman, B., M. Bar-Matthews, A. Almogi-Labin & B. Lutz, 2001. Global climate instability reflected by Eastern Mediterranean marine records during the late Holocene. *Palaeogeography, Palaeoclimatology, Palaeoecology* 176, 157-176.
- Schilman, B., A. Ayalon, M. Bar-Matthews, E.J. Kagan & A. Almogi-Labin, 2002. Sea-land paleoclimate correlation in the Eastern Mediterranean region during the late Holocene. *Israel Journal of Earth Sciences* 51, 181-190.
- Schmid, S.G., 2000. *Die Feikeramik der Nabatäer – Typologie, Chronologie und kulturhistorische Hintergründe*. Mainz: Verlag von Philip von Zabern (= Terra Archaeologica IV).
- 2008. The Hellenistic Period and the Nabataeans, in R.B. Adams (ed.), *Jordan: An Archaeological Reader*. London and Oakville: Equinox, 353-411.
- Shahack-Gross, R. & I. Finkelstein, 2008. Subsistence practices in an arid environment: a geoarchaeological investigation in an Iron Age site, the Negev Highlands, Israel. *Journal of Archaeological Science* 35, 965-982.

- Shahack-Gross, R., E. Boaretto, D. Cabanes, O. Katz & I. Finkelstein, 2014. Subsistence economy in the Negev Highlands: the Iron Age and the Byzantine/Early Islamic period. *Levant* 46(1), 98-117.
- Simms, S.R., 1988. The Archaeological Structure of a Bedouin Camp. *Journal of Archaeological Science* 15, 197-211.
- Slim, F., F. Kooistra & C. Çakırlar, 2014. Jordan Jebel Qurma bone samples. University of Groningen, unpublished report.
- Smith, R.H., 1973. *Pella of the Decapolis Volume 1. The 1967 Season of The College of Wooster Expedition to Pella*. Wooster: The College of Wooster.
- Smith, R.H. & L.P. Day, 1989. *Pella of the Decapolis Volume 2. Final Report on the College of Wooster Excavations in Area IX, the Civic Complex, 1979-1985*. Wooster: The College of Wooster.
- Smith, S.E., 1978. The Environmental Adaptation of Nomads in the West African Sahel: A Key to Understanding Prehistoric Pastoralists, in W. Weissleder (ed.), *The Nomadic Alternative: Modes and Models of Interaction in the African-Asian Deserts and Steppes*. The Hague and Paris: Mouton Publishers, 75-96.
- Spooner, B., 1971. Towards a Generative Model of Nomadism. *Anthropological Quarterly* 33(3), 198-210.
- Steimer-Herbet, T., 2001. Des milliers de tombes préhistoriques aux portes du désert. *Archéologica* 382, 38-47
- 2011. Les Tombes-Tours du Harra Syrien: Étude Préliminaire d'un Paysage Désertique à l'Aide des Scènes Satellitaires à Haute Définition. *Syria* 88, 111-121.
- Treadgold, W., 1997. *A History of the Byzantine State and Society*. Stanford: Stanford University Press.
- Tucker, D., 2009. Tracking Mobility in the Syrian Desert. Potential of Simple Features for Mapping Landscapes of Mobile Pastoralists. Published online at [http://archive.caaconference.org/2009/articles/Tucker\\_Contribution222\\_c%20\(2\).pdf](http://archive.caaconference.org/2009/articles/Tucker_Contribution222_c%20(2).pdf).
- Tushingham, A.D., 1972. *The Excavations at Dibon (Dhībān) in Moab: The Third Campaign 1952-53*. Cambridge: American Schools of Oriental Research (= The Annual of the Schools of Oriental Research 40).
- Villeneuve, F., 1985. l'Économie rurale et la vie des campagnes dans le Hauran antique (I<sup>er</sup> siècle av. J.-C. – VII<sup>e</sup> siècle ap. J.-C.). Une approche, in J.-M. Dentzer (ed.), *Hauran I. Recherches Archéologiques sur la Syrie du Sud à l'Époque Hellénistique et Romaine, Vol. I*. Paris: Paul Geuthner, 63-136.
- Vokaer, A., 2010-2011. Byzantine cooking ware imports in Syria: the "Workshop X". *Berytus* 53-54, 213-232.
- Von Oppenheim, M., 1899. *Vom Mittelmeer zum Persischen Golf. Durch den Haurān, die Syrische Wüste und Mesopotamien, Band I*. Berlin: Dietrich Reimer.
- Walker, B., 2012. The Islamic Period, in J.A. Sauer & L.G. Herr (eds.), *Ceramic Finds: Typological and Technological Studies of the Roman Remains from Tell Hesban and Vicinity*. Berrien Springs: Andrews University Press (= Hesban 11), 507-596.

- Walmsley, A., 2000. Production, Exchange and Regional Trade in the Islamic East Mediterranean: Old Structures, New Systems?, in I.L. Hansen & C. Wickham (eds.), *The Long Eighth Century: Production, Distribution and Demand*. Leiden: Brill (= The Transformation of the Roman World 11), 265-343.
- 2005. The Village Ascendant in Byzantine and Early Islamic Jordan: Socio-Economic Forces and Cultural Responses, in J. Lefort, C. Morrison & J.-P. Sodini (eds.), *Les Villages dans l'Empire byzantine (IV<sup>e</sup>-XV<sup>e</sup> siècle)*. Paris: Lethielleux (= Réalités Byzantines 11), 511-522.
- 2007a. Economic Developments and the Nature of Settlement in the Towns and Countryside of Syria-Palestine, ca. 565-800. *Dumbarton Oaks Papers* 61, 319-352.
- 2007b. *Early Islamic Syria. An Archaeological Assessment*. London and New York: Bloomsbury.
- Watson, P., 2008. The Byzantine Period, in R.B. Adams (ed.), *Jordan: An Archaeological Reader*. London and Oakville: Equinox, 443-482.
- Wendrich, W. & H. Barnard, 2008. The Archaeology of Mobility: Definitions and Research Approaches, in H. Barnard & W. Wendrich (eds.), *The Archaeology of Mobility. Old World and New World Nomadism* (= Cotsen Advanced Seminars 4). Los Angeles: Cotsen Institute of Archaeology, 1-21.
- Western, D. & T. Dunne, 1979. Environmental Aspects of Settlement Site Decisions Among Pastoral Maasai. *Human Ecology* 7(1), 75-98.
- Western, D. & V. Finch, 1986. Cattle and Pastoralism: Survival and Production in Arid Lands. *Human Ecology* 14(1), 77-94.
- Wickham, C., 2005. *Framing the Early Middle Ages. Europe and the Mediterranean, 400–800*. Oxford: Oxford University Press.
- Wilkinson, T.J., 1999. Demographic trends from archaeological survey. Case studies from the Levant and Near East, in J. Bintliff & K. Sbonias (eds.), *Reconstructing Past Population Trends in Mediterranean Europe (3000 BC – AD 1800)*. Oxford: Oxbow (= The Archaeology of Mediterranean Landscapes I), 45-64.
- 2000. Regional Approaches to Mesopotamian Archaeology: The Contribution of Archaeological Surveys. *Journal of Archaeological Research* 8(3), 219-267.
- 2003. *Archaeological Landscapes of the Near East*. Tucson: The University of Arizona Press.
- Willcox, G., 1999. Charcoal analysis and Holocene vegetation history in southern Syria. *Quaternary Science Reviews* 18, 711-716.
- Woolfenden, W.B. & L. Ababneh, 2011. Late Holocene vegetation in the Azraq Wetland Reserve, Jordan. *Quaternary Research* 76, 345-351.
- Woronko, B., 2012. Late-Holocene dust accumulation within the ancient town of Marea (coastal zone of the South Mediterranean Sea, N Egypt). *Quaternary International* 266, 4-13.
- Zarins, J., 1992. Pastoral Nomadism in Arabia: Ethnoarchaeology and the Archaeological Record, in O. Bar-Yosef & A.M. Khazanov (eds.), *Pastoralism in the Levant: Archaeological Materials and Anthropological Perspectives*. Madison: Prehistory Press (= Monographs in World Archaeology 10), 219-240.

Zerbini, A., 2013. Society and economy in marginal zones: a study of the Levantine agricultural economy (1st-8th centuries AD). Royal Holloway University of London, unpublished PhD thesis.

## Appendix A: GIS procedures

This study has used various digital methods to store, model and analyse geographic information. This was carried out in a geographic information system (GIS). The GIS used in this study is ArcGIS, version 10.2, produced by Esri company. All imagery and geographic data was stored and displayed in the WGS 84 coordinate system and Universal Transverse Mercator projection.

### Georeferencing and orthorectification

Georeferencing refers to relating coordinates from maps, aerial photographs and imagery to coordinates on the ground, in order to accurately store and project the imagery. Georeferencing is required when such coordinates are not incorporated in the digital imagery files, for example when it includes scanned files of hardcopy maps of photographs. For this study, scans of topographic maps and geological maps, Corona imagery, and aerial photographs were processed this way using the 'Georeferencing' tool in ArcGIS. This tool is also to orthorectify georeferenced raster data. Orthorectification entails creating a geometrically correct projection of the raster. This is required when, for example, oblique aerial photographs are stored in the GIS, in which case the scale differs (i.e., the foreground has a smaller scale than the background). In this case the imagery needs to be warped to create an equal scale over the entire raster. In some cases a DEM was used to further reduce image distortions that result from topographic variations.

### Surface Cover Classification based on Landsat 8 imagery following a supervised classification procedure (Chapter 2, Fig. 2.16)

Image classification entails the classification of cell values of a raster dataset in a number of classes. In a supervised classification these classes are predefined by 'teaching' ArcGIS cell values that should represent different classes. This is done by manually creating signatures. In the case of a surface cover classification different types of surface cover are given a different signature. These signatures are then used in ArcGIS to classify the image.

The following procedure was used to create a classification in terms of surface cover:

1. Image selection: Landsat 8 imagery with no 0% cloud cover and as little water as possible. The selected image for this purpose was LC81730382013194LGN00, taken on July 13 2013.
2. Create a composite raster of bands 7, 6 and 5 (following Leverington & Moon 2012) in RGB, using the ArcGIS 'Image Analysis' toolbar.
3. Create a polygon shapefile to define signatures.
4. Manually draw polygons over areas for which the surface cover was known, based either on geological maps or on Ikonos satellite imagery. 13 classes were defined:
  1. Basalt (Qurma formation)
  2. Chert (Umm Rijam formation)
  3. Mudflat
  4. Limestone/sandstone
  5. Agriculture
  6. Desert pavement
  7. Alluvial gravel
  8. Sand
  9. Basalt (Wisad formation)
  10. Chalk (Wadi Shalalah formation)
  11. Water
  12. Alluvial chert gravel
  13. Basalt & sand
5. Create Signatures for the areas indicated through the signature polygons using the 'Create Signatures' tool
6. Classify the Landsat imagery (Bands 7-6-5) based on the created signature file using the 'Maximum Likelihood Classification' tool.

### **Hillslope Position Classification of WorldDEM data (Chapter 2, Fig. 2.14)**

Hillslope Position Classification (HPC) is a method developed by physical geographers Bradley Miller and Randall Schaetzl (Miller 2014; Miller & Schaetzl 2015) in which absolute elevations, slope degrees and slope curvatures are classified in order to create a model that differentiates between different topographic classes, being:

1. Summits (or other topographic highs)
2. Shoulders (or ridges)
3. Backslopes (or steep slopes)
4. Footslopes (or modest slopes)
5. Toeslopes (or topographic lows)

A Toolbox that can be used in ArcGIS was developed by Miller for creating a Hillslope Position Classification. This 'Relief Analysis' toolbox was downloaded from <http://www.geographer-miller.com/relief-analysis-toolbox/>.

The following procedure was used to create a HPC of WorldDEM data, using the 'Relief Analysis' toolbox:

1. Project the WorldDEM raster to UTM\_Zone\_37N using the 'Project Raster' tool, with a bilinear resampling method.
2. Create a slope degree raster based on the projected WorldDEM using the 'Slope' tool.
3. Classify the slope degree raster using the '3 Class by Breaks' tool of the Relief Analysis toolbox. Three classes were defined:
  1. < 5 degrees ('flat' areas)
  2. > 5 < 15 degrees (modest slopes)
  3. > 15 degrees (steep slopes)
4. Create a curvature raster based on the projected WorldDEM using the 'Curvature' tool.
5. Classify the curvature raster using the '2 Class by Breaks' tool of the Relief Analysis toolbox. Two classes were defined:
  1. < 0.5 ((near-)linear or concave areas)
  2. > 0.5 (convex areas; i.e. shoulders)
6. Clean up the classified curvature raster using the 'Majority' tool three consecutive times. Residual pixels are thus cleared from the raster.
7. Calculate the relative elevation of areas (topographic highs and lows) using the 'Relative elevation' tool of the Relief Analysis toolbox, using a Neighborhood setting of 500 m on the map.
8. Classify the relative elevation raster using the '2 Class by Breaks' tool of the Relief Analysis toolbox.
9. Create a HPC raster based on the three classified rasters (slope degree, curvature and relative elevation) using the 'Manual classification Method' tool of the Relief Analysis toolbox. The resulting raster has five classes:
  1. Topographic highs : high regions relative to their immediate surrounding, with less than 5° of slope
  2. Ridges: areas with a very convex slope curvature, i.e., > 0.5
  3. Steep slopes: areas with a slope degree higher than 15°
  4. Modest slopes: areas with a slope degree between 5° and 15°
  5. Topographic lows: low regions relative to their immediate surrounding, with less than 5° of slope
10. Clip the Hillslope Position Classification raster to remove erroneous cells resulting from edge effects.

### **Modelling of drainage systems based on WorldDEM data (Chapter 2, Fig. 2.23)**

For landscape models related to the drainage networks of the study area, including wadi courses, major drainage basins, as well as tributary drainage basins (or small valleys) and closed (or endorheic) basins, WorldDEM data was used. The Hydrology toolbox in ArcGIS allows for the reconstruction of the direction and accumulation of water flows. However, endorheic basins are not modelled correctly by these tools, as the 'Flow Accumulation' tool forces endorheic basins to 'spill out' into adjacent drainage basins rather than to drain internally. Therefore endorheic basins had to be defined manually to some extent before they could be incorporated into a model (see below).

The following procedure was used to create these models:



1. Project the WorldDEM raster to UTM\_Zone\_37N using the 'Project Raster' tool, using a bilinear resampling method.
2. Ensure hydrological consistency of the projected WorldDEM raster using the 'Fill' tool.
3. Create a direction of flow raster based on the projected and filled WorldDEM raster using the 'Flow Direction' tool.
4. Create a model of wadi courses based on the Flow Direction raster using the 'Flow Accumulation' tool.
5. Model major drainage basins in a raster based on the Flow Direction raster using the 'Basin' tool.
6. Create manually defined pour points in a point shapefile to define tributary valleys and endorheic basins. Tributary valleys were defined through visual inspection of the WorldDEM raster, while endorheic basins were defined through visual inspection of mudflats on Ikonos imagery.
7. Model tributary valleys and endorheic basins in a raster based on Flow Direction and the manually defined pour points using the 'Watershed' tool.
8. Convert the raster delineating valleys and basins into polygons using the 'Raster to Polygon' tool.

### **Cost Surface raster classification based on WorldDEM data and Surface Cover Classification (Chapter 2, Fig. 2.21)**

In a cost surface raster the relative costs of movement through a landscape are modelled based on parameters influencing cost of movement, which in this case were slope degree and surface cover. For this model WorldDEM data and the surface cover classification based on Landsat 8 (see above) were used.

The following procedure was used to create a cost surface raster:

1. Project the WorldDEM raster to UTM\_Zone\_37N using the 'Project Raster' tool, using a bilinear resampling method.
2. Create a slope degree raster using the 'Slope' tool.
3. Classify the slope degree raster into 10 classes using the 'Reclassify' tool, using a quantile classification method.
4. Create a cost surface raster based on the classified slope degree raster and the classified surface cover raster using the 'Weighted Overlay' tool, setting the influence of both rasters to 50%. The 13 classes of the surface cover raster were divided over a 1 to 10 scale (1 = lowest cost; 10 = highest cost) as follows:

1. Basalt	8
2. Chert	3
3. Mudflat	1
4. Limestone/sandstone	3
5. Agriculture	/
6. Desert pavement	3
7. Alluvial gravel	5
8. Sand	10
9. Wisad basalt	8
10. Chalk	3
11. Water	10
12. Alluvial chert gravel	3
13. Basalt & sand	10

### **Cumulative viewshed analysis for Visual Prominence Classification (Chapter 2, Fig. 2.26)**

In a viewshed analysis the visible and non-visible cells of a DEM from a number of observer points are calculated. In the resulting raster, the value of each cell shows from how many observer points the cell is visible. In a cumulative viewshed analysis the outcomes of multiple viewshed analyses are combined in a single raster dataset. In the resulting raster, the value of each cell is the sum of the raster values of the separate viewshed analyses.

A cumulative viewshed analyses can be used to visualize locations in the landscape that are more prominent than others, by creating viewsheds of a number of randomly created observer points within a DEM and creating a cumulative viewshed from the resulting rasters (Bourgeois 2013; O'Driscoll 2017). The resulting raster may

then be classified into a Visual Prominence Classification (VPC) raster, showing areas with different degrees of visual prominence.

For the VPC of the Jebel Qurma region 10 viewsheds were created on the basis of 10 sets of randomly created points within the extent of the WorldDEM dataset. This DEM was also used for the viewshed analyses. The resulting rasters were combined to create a cumulative viewshed, which was subsequently classified into five classes indicating the degree of visual prominence.

The following procedure was used to create the VPC raster:

1. Create ten sets of random points on the WorldDEM data extent using the ArcGIS 'Create Random Points' tool. Each set contained 100 points with a minimal spacing of 250 m.
2. Create ten viewshed rasters of the ten randomly created collections of observer points, using the WorldDEM as surface, with the ArcGIS 'Visibility' tool. A surface offset of 1.5 m was used, and an observer offset of 1.7 m. 'Frequency' was used as the analysis type, so that each resulting cell contained a value indicating the number of observer points to which the cell was visible.
3. Create a cumulative viewshed raster by combining the ten viewsheds, using the ArcGIS 'Raster Calculator' tool.
4. Classify the resulting raster into 5 classes using a Jenks classification method. These classes were labelled as follows to indicate the degree of visual prominence: 1) Very low; 2) Low; 3) Medium; 4) High; 5) Very high.

### **Skyline analysis of WorldDEM data (Chapter 2, Fig. 2.27)**

The WorldDEM dataset was used to determine dominant skylines in the Jebel Qurma region, i.e., ridgelines of prominent hills cresting the horizon of observers is low-lying areas. This was done by performing a skyline analysis in ArcGIS. This analysis determines which elements of the landscape are visible along the horizon from a number of observer points. These observer points were placed in areas that were defined as topographic lows in the HPC, as described above.

The following procedure was used:

1. Create a total of 60 observer points by manually placing these within areas defined as 'topographic lows' in the HPC.
2. Convert these observer points into 3D features, i.e., containing z-values required for the skyline analysis. The ArcGIS 'Extract Values to Points' tool was used here, extracting the z-values from the WorldDEM cells to the corresponding point features. Added to these z-values was a value of 1.7 m, representing the estimated height of an average observer. The ArcGIS 'Feature to 3D by Attributes' tool was subsequently used to create 3D features based on the extracted z-values.
3. Create skylines using the ArcGIS 'Skyline' tool, using the default settings, without any surface constraints. The 60 3D observer points were used and the WorldDEM raster as surface dataset. The results are a total of 60 polylines each representing the skyline of an individual observer point.
4. Create points from the resulting vertices. The ArcGIS 'Feature Vertices to Points' tool was used to convert the skyline polylines into points, with each point representing a spot on the horizon visible from an observer point.
5. Remove points along the edges of the WorldDEM raster. False points were present on the edges of the WorldDEM raster as a result of edge effects. These points were manually removed.
6. Define skylines in the landscape. The ArcGIS 'Kernel Density' tool was used to calculate the density of points with a search radius of 50 m around each point along each of the 60 skylines. The densities were classified using Jenks classification, resulting in a raster that highlights the dominant skylines in the study area.

## Appendix B: Description of find contexts of consulted ceramic parallels

For this study a variety of published pottery corpora were consulted for the purpose of dating ceramics from the Jebel Qurma region on typological grounds (see § 3.4.1.). Care was taken in using reliable sources, i.e., materials from secure stratigraphic and well-dated contexts. Presented below are descriptions of these contexts, ordered chronologically.

### Late Iron Age II period (539 - 332 BC)

Tell Balata, Stratum V, Field VII (Lapp 2008, Pl. 2.10:4). This context represents a fill sealed by a Hellenistic surface. The stratum was dated between 525-475 BC, based on limited numismatic evidence and imported Attic wares.

### Hellenistic period (332 BC – AD 106)

Pella, Area XIII: the Jebel Sarbata fortress (McNicoll et al. 1982, Pl. 127). Although the precise contexts of the ceramics are not reported, the entire corpus was dated on typological grounds to the Hellenistic period.

Beth She'an (Scythopolis), the *tell*, Area P, Stratum P-5 (Johnson 2006, Fig. 51.1-51.5). These ceramics are from a well stratified domestic context that was dated on the basis of imported fine ware types and numismatic evidence between the 3<sup>rd</sup> and 1<sup>st</sup> centuries BC.

Tell Anafa, Stratum HEL1A (Berlin 1997, Pl. 57:PW80). This is a stratified context sealed by the Stuccoed Building of the Late Hellenistic period. The date of this stratum was further established through coins.

### Late Hellenistic period (100 BC – AD 106)

Tell Anafa, Stratum ROM1A (Berlin 1997, Pl. 68:PW536). This stratum is associated with buildings 1 to 5, and was dated between the late 1<sup>st</sup> century BC to the early 1<sup>st</sup> century AD on the basis of imported fine wares and coins.

Jericho, Stages 2 to 7 of the Hasmonean Palace complex (Bar-Nathan 2002, Pl. 11), Herod's Third Palace (Bar-Nathan 2002, Pl. 27), including circular room B68 (Bar-Nathan 2002, Pl. XI). These represent stratified remains dated on typological grounds between the 1<sup>st</sup> century BC and the first half of the 1<sup>st</sup> century AD.

Jerusalem, the National Convention Centre, ceramic phases 2-4 (Berlin 2005, Figs. 6 & 9). These are ceramics from stratified remains which were dated on typological grounds between the late 1<sup>st</sup> century BC to AD 70. However, it is not made explicit how the 'ceramic phases' relate to the stratigraphy at the site.

Jerusalem, the Jewish Quarter. Area A, strata 4 and 4a (Geva & Rosenthal-Heginbottom 2003, Pls. 6.9-6.10) are well stratified remains separated by floor levels. Numerous coin finds indicate an early 1<sup>st</sup> century AD date. Area E, stratum 2 (Geva & Herschkovitz 2006, Pl. 4.13) represents the fill of Pool L.742, dated between 1-70 AD on the basis of numismatic evidence and ceramic typology.

Masada, Zealot occupation levels in the Western Palace (Bar-Nathan 2006, Pl. 29:37-43; Pl. 32). These are remains from a number of floor contexts, dated on typological grounds to the third quarter of the 1<sup>st</sup> century AD.

### Late-Hellenistic – Early Roman period (100 BC – AD 200)

Petra, ez-Zantur (Schmid 2000). The domestic complex yielded a large number of ceramics that were published in great detail. They represent a well-stratified corpus that could be dated on the basis of coins and imported fine wares.

Sepphoris, Western Summit (Balouka 2013, Pls. 8-12). These are well-stratified remains retrieved from the residential area. They were dated on typological grounds and through coins between 70-135 AD.

### Early – Late Roman period (AD 106 – 324)

Sepphoris, Western Summit (Balouka 2013, Pls. 13-15, 17-27). These ceramics are from refuse layers in the cisterns, dated on the basis of ceramics, including well datable lamps, between 135-300 AD.

Umm al-Rasas (Kastron Mefa'a), Church of the Lions (Alliata 1992, Fig. 9:15-38). From the fill above the floor of an atrium to the west of the church came a number ceramics. Their typology indicated that the fill should be dated to the 3<sup>rd</sup>-4<sup>th</sup> century AD.

### **Late Roman – Byzantine period (AD 200 – 634)**

Jerusalem, the Jewish Quarter, Area W, Stratum 2 (Magnez 2003, Pl. 18.2:1-22). This stratum represents a fill between Byzantine wall remains. Although this fill was not sealed it contained a fairly homogeneous set of ceramics dated with coins and imported fine wares between the 4<sup>th</sup> and early 6<sup>th</sup> century AD.

El-Lejjun, Area P, the East Vicus Building (Parker 2006, Fig. 16.37). Soundings in several rooms of a building in the vicus at the Roman fort at al-Lejjun exposed a number of contexts that could be dated, on the basis of numismatic evidence, between 284 and 363 AD.

Madaba, Bajali courtyard. Stratum US12 (Acconci & Gabrieli 1994, Fig. 24) was situated outside a Byzantine house and yielded ceramics from the Late Roman and Byzantine period. The stratum could only be dated on relative terms, i.e. on typological and stratigraphic grounds. Stratum US10 (Acconci & Gabrieli 1994, Fig. 27) was situated in Cistern I and was dated, again on relative terms, between the 3<sup>rd</sup> and 5<sup>th</sup> centuries AD.

Sepphoris, Area 84 on the Western Summit (Balouka 2013, Pls. 28-32). Area 84 yielded well-stratified remains from the Late Roman and Byzantine period, some of which were sealed by earthquake destruction layers. Other dating evidence included coins, lamps, and imported fine wares.

Beth She'an (Scythopolis), the *tell*, Area P, Strata P-3 and P-4 (Johnson 2006, Fig. 15.6). Excavations on the shoulder of the *tell* yielded stratified remains that could be dated, on the basis of imported fine wares and amphorae, between the 4<sup>th</sup> and 6<sup>th</sup> centuries AD.

### **Early Byzantine period (AD 324 – 500)**

'Amman (Philadelphia), Area C (Northedge 1992, Fig. 123). An abandonment context on a floor of a building was dated on typological grounds between the middle of the 4<sup>th</sup> to the early 5<sup>th</sup> centuries AD.

### **Early – Late Byzantine period (AD 324 – 634)**

Caesarea Maritima, Stratum 5 (Bar-Nathan & Adato 1986, Figs. 1 & 2). These are fairly poorly stratified remains from a modestly exposed area, yet broadly datable on the basis of numismatic evidence between the 5<sup>th</sup> and 6<sup>th</sup> centuries AD.

Dhiban (Dibon), Areas S3 and S4 (Tushingham 1972, Figs. 9-12). These represent stratified remains from an open area outside the church complex wall. The strata were dated on the basis of imported fine wares and seriation with other excavated parts of the site.

Beth She'an (Scythopolis), the *tell*, Stratum H-2 in Area H (Johnson 2006, Fig. 15.13) and Stratum L-2 in Area 2 were both dated on typological grounds to the Byzantine period.

Pella, East Cemetery, Stratum IIA (Smith 1973, Pls. 43 & 44). These are remains from a small domestic structure, represented by ca. 10-20cm of occupational debris covering a plastered floor. This layer was dated to the Byzantine period on the basis of ceramic typology.

### **Late Byzantine period (AD 500 –634)**

Caesarea Maritima, Area V/4 (Magnez 1994, Fig. 1:16-17). These ceramics are from Locus 4061, a well-stratified context above the foundation trench of the Byzantine city wall. The corpus was dated on typological grounds between the 6<sup>th</sup> and early 7<sup>th</sup> century AD.

Pella, Area IX: The Civic Complex. Loci 77, 101 & 105 from the Baths (Smith & Day 1989, Pls. 52 & 53) are stratified remains that were dated on typological grounds to the 6<sup>th</sup>-early 7<sup>th</sup> century AD. Loci 44, 52 and 62 (Smith & Day 1989, Pls. 46-51) are refuse layers in the Classical Odeum that were also dated, in this case on the basis of numismatic evidence, to the 6<sup>th</sup>-early 7<sup>th</sup> century AD.

### **Late Byzantine – Umayyad period (AD 500 – 750)**

Yoque'am, Area E, Phase 3 (Avissar 1996, Fig. XII.7:5). This pottery came from mixed layers underneath the crusader period church, which were dated on the basis of imported fine wares between the 5<sup>th</sup> and 7<sup>th</sup> centuries AD.

Beth She'an (Baysan), the Pottery Workshop, fill of Kiln 4, Locus 50618 (Bar-Nathan 2011, Fig. 11.3:1, 11). These are well-stratified remains, dated by numismatic evidence to the 6<sup>th</sup> or 7<sup>th</sup> century AD.

Barsinia (El-Khouri 2014, Fig. 9). Little contextual information is available for this pottery corpus, and it seems it was dated solely on typological grounds.

Umm al-Rasas (Kastron Mefa'a), St. Stephen church complex, Room F (Alliata 1991, Fig. 18:1-14). This is a context sealed between a floor and a destruction layer. It was dated through many coin finds between the 6<sup>th</sup> and 8<sup>th</sup> centuries AD.

Jerash (Gerasa), kiln area, phases 2 and 3 (Ball et al. 1986, Fig. 3). The strata were dated on the basis of coin evidence and ceramic typology between the late 6<sup>th</sup> and early 8<sup>th</sup> centuries AD.

Jerash (Gerasa) Hippodrome, carceres area (Kehrberg 1989, Fig. 5). Late Byzantine and Umayyad remains came from a layer sealed by the tumble of the starting gates of the hippodrome, which was destroyed in AD 749.

### **Umayyad period (AD 634 – 750)**

'Amman citadel (Olavarri-Goicoechea 1985). These represent well-stratified remains within the Umayyad palace. The stratum dates are based solely on ceramic typology.

Dhiban, North Church. Sherds from an abandonment phase of the church (Tushingham 1972, Fig. 6:1-10, 14-23) were dated on typological grounds to the Umayyad period. The sherds from debris in room A (Tushingham 1972, Fig. 7:1-20) were dated on the basis of a destruction event to the early 8<sup>th</sup> century AD.

Madaba, Bajali courtyard, Stratum US20 (Acconci & Gabrieli 1994, Fig. 46). These are well-stratified remains from the Umayyad period House H. The stratum was dated on the basis of ceramic typology.

Pella (Tabaqat Fahl). Remains between two destruction layers related to earthquake events dated to 717 and 746/747 AD were encountered in a number of areas in the Civic Complex (McNicoll et al. 1982, Pls. 140-141; Smith & Day 1989, Pls. 54, 55, 58, 59). Another context that was sealed by earthquake events came from the West Church Complex, Area I (Smith 1973, Pls. 30-33), and was dated between the mid-7<sup>th</sup> and the mid-8<sup>th</sup> century AD. This date is corroborated by numismatic evidence. Pottery sherds from the South Building, Area IB (McNicoll et al. 1982, Pls. 145 & 146) were found in a destruction layer related to a 746/747 AD earthquake, and is therefore said to represent early 8<sup>th</sup> century material.

Umm al-Jimal (Parker 1998, Figs. 155-157). This is well-stratified material from contexts within three buildings. The dates of the strata were based on ceramic typology.

Jerash, North Theatre, Phase 5 (Clark et al. 1986, Fig. 21). This phase represents the pottery workshop area at the Classical theatre, dated on typological grounds to the first half of the 8<sup>th</sup> century AD.

Beth She'an (Baysan), the Theatre Workshop. Pottery from various stratified contexts was retrieved from the pottery workshop. Locus 60669 (Bar-Nathan 2011, Fig. 11.13:3; Fig. 11.6:6) represents a latrine waste deposit dated on the basis of coins to the Umayyad period. Locus 50620 (Bar-Nathan 2011, Fig. 11.3:10) represents an early 8<sup>th</sup> century use phase of Kiln 2, sealed by a 749 AD earthquake destruction layer. Strata 7-5 in Unit 2 (Bar-Nathan 2011, Fig. 11.4:6) cover a destruction layer of a 659/660 AD earthquake, and were further dated with coins between the late 7<sup>th</sup> and early 8<sup>th</sup> centuries AD.

Humaymah, Lower Church, Room 5 ('Amr & Schick 2001, Fig. 9:20-21). These sherds are from a context that was covering a floor and was sealed by debris from a conflagration event. This sealed context was dated on typological grounds to the early 7<sup>th</sup> century AD.

### **Umayyad – Abbasid period (AD 634 – 969)**

Tell Jawa, Building 600 (Daviau 2010, Figs. 8.7, 8.9, 8.10). This 'Early Islamic House' yielded rich and well-stratified pottery finds. The dates of the strata were largely based on numismatic evidence, and were mostly from the 8<sup>th</sup> century AD.

Beth She'an (Baysan), the *tell*, Area P, Stratum P-2 (Johnson 2006, Fig. 15.14). Part of an Early Islamic building was excavated here. Its date is based solely on ceramic typology.

Ramla, Area 82.1, Strata IV and V (Cytryn-Silverman 2010, Pl. 35:1-10). These are well-stratified ceramics associated with Umayyad period architecture that remained in use during the Abbasid period. The strata were dated on the basis of ceramic typology.

### **Abbasid period (AD 750 – 969)**

Ramla, Square O-2 (Cytryn-Silverman 2010, Pl. 9.18). These sherds are from a fill above natural soil, sealed by a plaster floor that was dated to ca. 800 AD. The ceramic typology furthermore suggests a late 8<sup>th</sup> century date for this context.

Khirbat Yajuz, Area E (Khalil & Kareem 2002, Figs. 8-22). A late 8<sup>th</sup> to 10<sup>th</sup> century settlement phase was covering a destruction layer associated with a 749 AD earthquake event. This date of this phase is partially based on limited coin evidence.

Al-Muwaqqar palace, Area IV, square H14 (Najjar 1989, Figs. 5-8). An Abbasid occupation phase of the palace was exposed in this area, which was dated on the basis of glazed wares and lamps to the late 8<sup>th</sup>-early 9<sup>th</sup> century AD.

### **Other sources**

A number of parallels were found in a typo-chronological study by Kuhnen (1989) on excavated contexts of the Carmel region of Northern Israel. Other parallels come from a typo-chronological study by Magness (1993) on published material from excavations in Jerusalem. The same holds for the study by Renel (2010) that includes ceramics from various excavated contexts in the Hauran region of Southern Syria.

Parallels were also found in the extensive pottery reports from the excavations at Tell Hisban (Gerber 2012; Walker 2012). These ceramics were excavated in the 1970s, but because their original contexts are largely unknown (Herr 2012, 5) they could only be dated on the basis of the original typology of the Tell Hisban ceramics and comparative evidence from other sites. Nevertheless, the publications appear to be thorough in terms of the large number of cited parallels, and were therefore considered for comparative purposes as well.

### **Other dating criteria**

Two types of decoration were encountered numerously on the ceramics from the Jebel Qurma region, and these could be attributed to the Byzantine and Early Islamic periods. The first is painted decoration, executed in various colours including orange/red, brown, purple, and grey, applied on a lightly-coloured surface. In a regional comparative study by Hendrix et al. (1996) this kind of painted decoration is dated to the Late Byzantine period, when multiple colours and motifs were used on differently coloured wares, including white paint on grey ware, and red-orange paint on buff ware. Subsequently, during the Umayyad period painting occurs in red, white, purple and brown, and is applied in different motifs. This type of painting continues into the Abbasid period. Limited painting occurs in the Fatimid period, and is discontinued altogether after that (Hendrix et al. 1996, 238-79). These observations are largely paralleled when looking at a number of individual sites. At Dhiban so-called “red-on-light” painted ceramics already appear at the very end of the 6<sup>th</sup> or early 7<sup>th</sup> century and continue into the Umayyad period (Tushingham 1972, 67-76). At Pella, so-called “red-on-cream” ware seems to continue into the 8<sup>th</sup> century (Smith 1973; Smith & Day 1989). Parker contends that this red-on-cream painted decoration should be attributed to the 8<sup>th</sup> and 9<sup>th</sup> centuries, while white-on-grey paint can be dated more generally to the Late Byzantine and Early Islamic period (Parker 1998, 215). It thus seems that the ceramics from the Jebel Qurma corpus that show painting in various colours on light wares can be safely attributed to the Late Byzantine, Umayyad or Abbasid periods (see § 3.6.).

The second type of decoration is represented by lightly incised parallel lines characterised as “combing”. In the regional comparative study by Hendrix et al. (1996) combing is shown to appear already in limited amounts in the Early Byzantine period and is widely attested in the Late Byzantine, Umayyad and Abbasid period. Fatimid and later ceramics do not have combed decoration. They also show that combing was usually applied on large jars and basins (Hendrix et al. 1996, 238-79). Looking at individual sites, combing appears in Pella in the 6<sup>th</sup>-early 7<sup>th</sup> century (Smith & Day 1989, Pl. 50:24), and perhaps even earlier at Beth She’an where it is dated to the Byzantine period (Johnson 2006, Fig. 15.13:274, 275). At Dhiban combing seems to continue into the 8<sup>th</sup> century (Tushingham 1972), and at Ramla combing also appears on Abbasid ceramics (Cytryn-Silverman 2010, Pl. 9.10:4). At Khirbat Yajuz combing is also attested on Abbasid pottery, where it continues into the 10<sup>th</sup> century (Khalil & Kareem 2002). Summarising, it seems safe to ascribe a Byzantine to Early Islamic date to sherds with combed decoration.