

Athena Trakadas

# In Mauretaniae maritimis

Marine Resource Exploitation  
in a Roman North African Province

Alte Geschichte

Geographica Historica – 40

**Franz Steiner Verlag**

Athena Trakadas  
In Mauretaniae maritimis

# **GEOGRAPHICA HISTORICA**

Begründet von Ernst Kirsten,

herausgegeben von Eckart Olshausen und Vera Sauer

Band 40

Athena Trakadas

# **In Mauretaniae maritimis**

Marine Resource Exploitation  
in a Roman North African Province



Franz Steiner Verlag

Gedruckt mit freundlicher finanzieller Unterstützung von  
University of Southern Denmark's Humanities Faculty Publication Fund  
Viking Ship Museum, Roskilde, Denmark  
E. Lerager Larsens Fund

Bibliografische Information der Deutschen Nationalbibliothek:  
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen  
Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über  
<<http://dnb.d-nb.de>> abrufbar.

Dieses Werk einschließlich aller seiner Teile ist urheberrechtlich geschützt.  
Jede Verwertung außerhalb der engen Grenzen des Urheberrechtsgesetzes  
ist unzulässig und strafbar.

© Franz Steiner Verlag, Stuttgart 2018

Satz: Athena Trakadas

Druck: Memminger MedienCentrum, Memmingen

Gedruckt auf säurefreiem, alterungsbeständigem Papier.

Printed in Germany.

ISBN 978-3-515-10417-3 (Print)

ISBN 978-3-515-12259-7 (E-Book)

## Zum Geleit

Im vorliegenden Band untersucht Athena Trakadas aus dem Blickwinkel der Nutzung mariner Ressourcen die Folgen der Eingliederung des nordwestlichen Maghreb in das Römische Reich für Umwelt, Gesellschaft und Wirtschaft der Region. Neben der Sammlung und Auswertung archäologischen Materials – es reicht von Überresten von Meerestieren über Ausrüstungsgegenstände der Fischer bis hin zu Relikten der Fischverarbeitung – sind Schrift- und Bildquellen, aber auch ethnographische Beobachtungen Basis ihrer Studien. Durch die Kontextualisierung dieser Befunde in der marinen Umwelt wie auch in den Küstenlandschaften und dank ihres diachronen Ansatzes reiht sich diese Untersuchung fugenlos in die Bände zur Ökogeschichte innerhalb der *Geographica Historica* ein.

Eckart Olshausen und Vera Sauer



## Acknowledgements

This volume is a revised and updated version of my PhD thesis, *Piscationes in Mauretania Tingitana: marine resource exploitation in a Roman North African Province*, completed at the University of Southampton in 2009. Since then, new fieldwork campaigns have fortuitously added data relevant to this study, and I am grateful to the many individuals working in the northwest Maghreb and wider Mediterranean who share my interests in past marine resource exploitation and ancient fishing technologies.

In Morocco, I am indebted to Aomar Akerraz, Hassan Limane, Abdelaziz El Khayari and Elarbi Erbati (Institut National des Sciences d'Archéologie et du Patrimoine, Rabat), and Azzedine Karra (Directeur Régional de la Culture à Marrakech) for their continued interest in my research and helpful discussions. I would especially like to thank Aomar Akerraz and Youssef Khiara (Chef de Division des Musées, Ministère de la Culture) for their permission to work with this large body of disparate and unknown find material and conduct site reconnaissance. Between 2006 and 2009, the staffs of the museums and sites were very helpful in facilitating my many "fishing trips": Abdelaziz El Idrissi (Musée de la Kasbah, Tangier), Mehdi Zouak, Nadia Bourkadi and Jamila Devuz (Musée Archéologique, Tetouan), Safir Raoui (Musée Archéologique, Rabat), Hicham Hassini (Musée Archéologique, Larache/Conservateur du site archéologique de Lixus), Mohamed Kbiri Alaoui (*Chellah*) and Rachid Bouzidi (*Volubilis*). I'm grateful to former director Thor Kuniholm and staff of the Tangier American Legation Institute for Moroccan Studies for their open welcome during my repeated research visits and their permission to reproduce the historical maps included in this study. Abdelaziz El Khayari, Josef Eiwanger (Kommission für Archäologie Außer-europäischer Kulturen) and Dirce Marzoli (Deutsches Archäologisches Institut, Madrid) kindly shared their insights and allowed me to visit the excavations at Essaouira in 2007–08; Abdelaziz El Khayari and Hassan Limane generously allowed me to visit the excavations at Dchar 'Askfane in 2005. Nadia Mhammdi and Maria Snoussi (Université Mohamed V – Rabat) helpfully provided marine geological data. I am grateful also to Hicham Hassini, Mohamed Ali Geawhari, Zaïneb Belkhatay and Lloyd Huff for their enthusiastic camaraderie during the Oued Loukkos Survey between 2009 and 2015.

In Spain, Fernando Villada Paredes (Instituto de Estudios Ceutíes, Ceuta), Rocío Gutiérrez and Juan Bellevar Garrido (Museo de Arqueología e Historia, Melilla) kindly offered access to materials and sources. Arturo Morales (Laboratorio de Arqueozoología, Universidad Autónoma de Madrid) generously identified the unpublished ichthyo-archaeological remains of this study.

When the PhD thesis this volume is based on was written at Southampton between 2006–09, many individuals provided helpful discussions, technical assistance and moral



support. I am first and foremost grateful to my supervisors Lucy Blue and Simon Keay for their valuable advice and friendship.

I would like to thank Dario Bernal Casasola (Universidad de Cádiz) and Tønnes Bekker-Nielsen (Syddansk Universitet) for their encouragement, enthusiastic discussions and sharing of source material. I am indebted to Dimitra Mylona (Institute for Aegean Prehistory, Study Center for East Crete) for sharing her insight into fish biology and human behaviour. Judith Powell, Penny Copeland and Dario Bernal Casasola graciously allowed reproduction of their drawings, photos and plans. Aomar Akerraz kindly gave permission for re-use of INSAP images and Ahmed Gadhoum and Samir Aounallah (Institut National du Patrimoine, Tunisia) helpfully facilitated permission for the publication of photos taken in the Musée National du Bardo in Tunis.

The major research stays in Morocco and Spain were supported by grants from the American Institute of Maghrib Studies, the University of Southampton, the Society for the Promotion of Roman Studies and Det Danske Institut i Damaskus. Research fellowships at Det Danske Institut (Rome and Athens), Dansk Arkæologiske Forskningskole (Aarhus University, Denmark), the Tangier American Legation Institute for Moroccan Studies (Tangier) and Kommission für Archäologie Außereuropäischer Kulturen (Bonn) allowed me to write large portions of the original work. I am grateful to Peter Rasmussen and David Gregory for facilitating my tenure at the National Museum of Denmark's Environmental Archaeology and Materials Science section, which enabled me to complete the final revisions of the manuscript. Vera Sauer has been a most patient and attentive editor.

For their constant encouragement and friendship, I owe my thanks to Matthew Harpster, Lloyd Huff, Vibeke Bischoff, Barbara Dimde, Jane Hjarl Petersen and Jørgen Lauritsen.

This volume is dedicated to my parents, for unquestioningly supporting my many years of wanderings through the northwest Maghreb and beyond.

*Κάθε όνειρο στο χάρτη...*

# Contents

|  |    |
|--|----|
| Abbreviations .....  | 15 |
| Greek and Latin sources .....                                  | 15 |
| Arabic sources .....   | 16 |
| Historical sources .....                                       | 17 |
| General .....  | 17 |
| Figures .....  | 23 |
| Tables .....   | 27 |
| 1. Introduction .....  | 31 |
| 1.1 Material basis and problems .....                          | 31 |
| 1.2 The present study .....                                    | 33 |
| 2. Methodology .....   | 35 |
| 2.1 Previous approaches to marine resources in antiquity ..... | 35 |
| 2.2 Theoretical framework of the present enquiry .....         | 36 |
| 2.3 Methodological approach and research questions .....       | 38 |
| 2.3.1 Chronology .....   | 39 |
| 2.3.2 Site types .....   | 40 |
| 3. Contexts, data sources and applications .....               | 49 |
| 3.1 Environmental context and data .....                       | 49 |
| 3.2 Archaeological data .....                                  | 50 |
| 3.2.1 Marine animal remains .....                              | 50 |
| Preservation and recovery biases .....                         | 52 |
| Quantification issues .....                                    | 53 |
| Present analyses .....   | 54 |
| 3.2.2 Fishing equipment .....                                  | 55 |
| Hook-and-line fishing .....                                    | 56 |
| Nets .....   | 59 |
| Other methods .....  | 68 |
| Fishing boats .....  | 71 |
| Economics of fishing .....                                     | 73 |
| Shore-based activities .....                                   | 74 |
| Present study .....  | 75 |

|       |   |     |
|-------|---|-----|
| 3.2.3 | Fish-salting production .....                               | 75  |
|       | <i>Salsamenta</i> and fish sauces .....                     | 75  |
|       | Purple-dye production .....                                 | 77  |
|       | Fish-salting and purple-dye facilities .....                | 78  |
|       | Quantification issues .....                                 | 80  |
|       | Salt sources .....  | 80  |
|       | Salazón amphorae .....                                      | 81  |
| 3.3   | Descriptive data .....                                      | 85  |
| 3.3.1 | Written sources .....                                       | 85  |
| 3.3.2 | Pictorial representations .....                             | 86  |
| 3.3.3 | Ethnography .....   | 87  |
| 4.    | Historical background .....                                 | 91  |
| 4.1   | Prehistory .....  | 91  |
| 4.2   | The western Phoenician and Punico-Mauretanian periods ..... | 94  |
| 4.3   | The Roman province of <i>Mauretania Tingitana</i> .....     | 98  |
| 4.4   | The Late Roman province .....                               | 103 |
| 5.    | Environmental context .....                                 | 107 |
| 5.1   | The western-most African province .....                     | 107 |
| 5.2   | The geology of the northwest Maghreb .....                  | 110 |
| 5.3   | Coastal topography and maritime environment .....           | 111 |
| 5.3.1 | The Mediterranean coast: Oued Moulouya to Ceuta .....       | 111 |
|       | Mediterranean maritime environment .....                    | 117 |
| 5.3.2 | The Strait of Gibraltar coast: Ceuta to Cap Spartel .....   | 121 |
|       | Strait of Gibraltar maritime environment .....              | 125 |
| 5.3.3 | The Atlantic coast: Cap Spartel to Essaouira .....          | 129 |
|       | Atlantic maritime environment .....                         | 135 |
| 5.4   | Changes in the littoral of the northwest Maghreb .....      | 139 |
| 5.4.1 | Factors affecting the coastal environment .....             | 140 |
| 5.4.2 | The 'reconstructed' ancient littoral .....                  | 151 |
| 6.    | Regional characterisations .....                            | 153 |
| 6.1   | The Mediterranean littoral .....                            | 153 |
| 6.1.1 | Finds .....   | 154 |
| 6.1.2 | Summary .....   | 154 |
| 6.2   | The Strait of Gibraltar littoral .....                      | 163 |
| 6.2.1 | Finds .....   | 163 |
| 6.2.2 | Summary .....   | 163 |
| 6.3   | The Atlantic littoral .....                                 | 170 |
| 6.3.1 | Finds .....   | 170 |
| 6.3.2 | Summary .....   | 173 |
| 6.4   | Discussion .....  | 183 |

|   |     |
|---|-----|
| 7. Case studies .....   | 185 |
| 7.1 <i>Tamuda</i> .....   | 185 |
| 7.1.1 The history of the site .....                                   | 185 |
| 7.1.2 The maritime environment .....                                  | 190 |
| 7.1.3 Evidence of marine resource exploitation .....                  | 192 |
| Marine species exploited: habitats and seasonality .....              | 192 |
| Fishing methods .....   | 196 |
| Fish-salting practices .....  | 196 |
| 7.1.4 Discussion .....  | 197 |
| 7.1.5 Summary .....   | 198 |
| Areas and methods of fishing effort .....                             | 199 |
| The chronology of exploitation .....                                  | 202 |
| 7.1.6 Conclusions: the role of fishing at <i>Tamuda</i> .....         | 204 |
| 7.2 <i>Septem Fratres</i> .....                                       | 206 |
| 7.2.1 The history of the site .....                                   | 206 |
| 7.2.2 The maritime environment .....                                  | 212 |
| 7.2.3 Evidence of marine resource exploitation .....                  | 213 |
| Marine species exploited: habitats and seasonality .....              | 213 |
| Fishing methods .....   | 219 |
| Fish-salting practices .....  | 220 |
| 7.2.4 Discussion .....  | 222 |
| 7.2.5 Summary .....   | 224 |
| Areas and methods of fishing effort .....                             | 224 |
| The chronology of exploitation .....                                  | 228 |
| 7.2.6 Conclusions: the role of fishing at <i>Septem Fratres</i> ..... | 232 |
| 7.3 <i>Lixus</i> .....  | 234 |
| 7.3.1 The history of the site .....                                   | 234 |
| 7.3.2 The maritime environment .....                                  | 239 |
| 7.3.3 Evidence of marine resource exploitation .....                  | 241 |
| Marine species exploited: habitats and seasonality .....              | 242 |
| Fishing methods .....   | 248 |
| Fish-salting practices .....  | 248 |
| 7.3.4 Discussion .....  | 252 |
| 7.3.5 Summary .....   | 254 |
| Areas and methods of fishing effort .....                             | 254 |
| The chronology of exploitation .....                                  | 258 |
| 7.3.6 Conclusions: the role of fishing at <i>Lixus</i> .....          | 262 |
| 8. Discussion .....   | 265 |
| 8.1 The role of marine resources in the northwest Maghreb .....       | 265 |
| 8.1.1 'Fresh' consumption .....                                       | 265 |
| 8.1.1.1 'Fresh' marine resources and other foodstuffs .....           | 271 |
| 8.1.1.2 Discussion .....  | 276 |

|  |     |
|--|-----|
| 8.1.2 Processing .....                                     | 277 |
| 8.1.2.1 Fish-salting .....                                 | 277 |
| 8.1.2.2 Possible oil extraction .....                      | 283 |
| 8.1.2.3 Purple-dye production .....                        | 283 |
| 8.1.2.4 Marine resources and agricultural production ..... | 289 |
| Rural production .....                                     | 290 |
| Urban production .....                                     | 293 |
| 8.1.2.5 Discussion .....                                   | 294 |
| 8.2 'Romanisation' and marine resource exploitation .....  | 301 |
| 8.2.1 Punico-Mauretanian period .....                      | 301 |
| 8.2.2 Roman period .....                                   | 305 |
| 8.2.3 Late Roman period .....                              | 308 |
| 8.2.4 Discussion .....                                     | 310 |
| 9. Conclusions .....                                       | 313 |
| Appendix 1. Marine animal remains .....                    | 319 |
| Metadata .....   | 319 |
| Appendix 1.1 Fish bones .....                              | 322 |
| Appendix 1.1.1 Mediterranean .....                         | 322 |
| Appendix 1.1.2 Strait of Gibraltar .....                   | 325 |
| Appendix 1.1.3 Atlantic .....                              | 336 |
| Appendix 1.2 Marine invertebrates .....                    | 355 |
| Appendix 1.2.1 Mediterranean .....                         | 355 |
| Appendix 1.2.2 Strait of Gibraltar .....                   | 370 |
| Appendix 1.2.3 Atlantic .....                              | 381 |
| Appendix 2. Fishing equipment .....                        | 413 |
| Metadata .....   | 413 |
| Appendix 2.1 Mediterranean .....                           | 416 |
| Appendix 2.2 Strait of Gibraltar .....                     | 422 |
| Appendix 2.3 Atlantic .....                                | 425 |
| Appendix 3. Fish-salting production .....                  | 441 |
| Metadata .....   | 441 |
| Appendix 3.1 Fish-salting facilities .....                 | 445 |
| Appendix 3.2 Salt sources .....                            | 459 |
| Appendix 3.3 Salazón amphorae .....                        | 466 |
| Appendix 3.3.1 Kilns .....                                 | 466 |
| Appendix 3.3.2 Amphorae .....                              | 476 |
| Appendix 3.3.2.1 Mediterranean .....                       | 478 |
| Appendix 3.3.2.2 Strait of Gibraltar .....                 | 483 |
| Appendix 3.3.2.3 Atlantic .....                            | 492 |

|  |     |
|--|-----|
| Appendix 4. Written sources .....            | 525 |
| Metadata .....                               | 525 |
| Appendix 4.1 Texts .....                     | 527 |
| Appendix 4.2 <i>Tituli picti</i> .....       | 530 |
| Appendix 5. Pictorial representations .....  | 537 |
| Metadata .....                               | 537 |
| Appendix 6. Ethnography .....                | 545 |
| Metadata .....                               | 545 |
| Appendix 6.1 Mediterranean coast .....       | 547 |
| Appendix 6.2 Strait of Gibraltar coast ..... | 555 |
| Appendix 6.3 Atlantic coast .....            | 556 |
| Appendix 6.4 Southwest Iberian coast .....   | 573 |
| Appendix 7. Historical maps .....            | 577 |
| Metadata .....                               | 577 |
| Bibliography .....                           | 591 |
| Indices .....                                | 647 |
| Literary texts .....                         | 647 |
| Inscriptions .....                           | 653 |
| Marine animals .....                         | 654 |
| Persons and groups .....                     | 658 |
| Places and geographical features .....       | 658 |
| General .....                                | 663 |



## Abbreviations

### Greek and Latin sources

|                    |  |
|--------------------|--|
| <i>AE</i>          | <i>L'Année épigraphique</i>  |
| <i>Astr.</i>       | Manilius, <i>Astronomica</i>   |
| <i>CEIPAC</i>      | Centro para el Estudio de la Interdependencia Provincial en la Antigüedad Clásica ( <a href="http://ceipac.ub.edu/">http://ceipac.ub.edu/</a> ; accessed 1/2017)   |
| <i>CIL II</i>      | HÜBNER, E. (ed.), <i>Corpus Inscriptionum Latinarum II: Inschriften der drei Provinzen der iberischen Halbinsel: Hispania citerior, Baetica und Lusitania</i> (Berlin 1869–)   |
| <i>CIL IV</i>      | ZANGEMEISTER, C. & R. SCHOENE (eds), <i>Corpus Inscriptionum Latinarum IV: Inscriptiones parietariae Pompeianae Herculanae Stabianae</i> (Berlin 1871–)  |
| <i>CIL VI</i>      | HENZEN, G., I.B. DE ROSSI, E. BORMANN, C. HUELSEN & M. BANG (eds), <i>Corpus Inscriptionum Latinarum VI: Inscriptiones urbis Romae Latinae</i> (Berlin 1876)   |
| <i>CIL VIII</i>    | MOMMSEN, T. (ed.), <i>Corpus Inscriptionum Latinarum VIII: Inschriften Nordafrikas ohne Ägypten und die Cyrenaica, d. h. der Provinzen Mauretaniae Tingitana, Caesariensis und Sitifensis, Numidia und Africa proconsularis</i> (Berlin 1881–) |
| <i>Cod. Just.</i>  | BLUME, F.H. (trans.) & T. KEARLEY (ed.), <i>Annotated Justinian Code</i> (2 <sup>nd</sup> edn, Laramie, WY 2009)   |
| <i>Cod. Theod.</i> | MOMMSEN, T. & P.M. MEYER (eds), <i>Theodosiani (Codex Theodosianus)</i> (Berlin 1905)  |
| <i>DRR</i>         | <i>De Re Rustica</i>   |
| <i>Geo.</i>        | Claudius Ptolemy, <i>The Geography</i>   |
| <i>HA</i>          | Aristotle, <i>Historia Animalium</i>   |
| <i>Hal.</i>        | Oppian, <i>Halieutica</i>  |
| <i>HE</i>          | <i>Hispania Epigraphica</i> ( <a href="http://eda-bea.es/">http://eda-bea.es/</a> ; accessed 1/2017)   |
| <i>IAM 1</i>       | GALAND, L., J. FÉVRIER & G. VAJDA, <i>Inscriptions antiques du Maroc 1: Inscriptions libyques, inscriptions puniques et néopuniques, inscriptions hébraïques des sites antiques</i> (Paris 1966)   |
| <i>IAM 2</i>       | EUZENNAT, M., J. MARION & J. GASCOU, <i>Inscriptions antiques du Maroc 2: Inscriptions latines</i> (Paris 1982)  |
| <i>ILM</i>         | CHATELAIN, L., <i>Inscriptions latines du Maroc</i> (Paris 1942)   |
| <i>ItAnt</i>       | <i>Antonine Itinerary</i> : PARTHEY, G.F.C. & M. PINDER (eds), <i>Itinerarium Antonini Avgvsti et Hierosolymitanvm ex libris manvscriptis</i> (Rome 1848)  |



|                |  |
|----------------|--|
| NA             | Aelian, <i>De Natura Animalium</i>   |
| NH             | Pliny, <i>The Natural History</i>  |
| Not. Dig. Occ. | <i>Notitia Dignitatum, Occidentalis</i>  |
| Onom.          | Pollux, <i>Onomasticon</i>   |
| Pomp. Mela     | Pomponius Mela, <i>De Chorographia</i>   |
| Rav. Cosmog.   | <i>Ravennatis Anonymi Cosmographia</i>   |
| RIB II         | COLLINGWOOD, R.G. & R.P. WRIGHT, Vol. II: <i>Instrumentum Domesticum</i> , fas. 6. In S.S. FRERE & R.S.O. TOMLIN (eds), <i>The Roman Inscriptions of Britain</i> (Stroud 1994) |
| SEG            | <i>Supplementum Epigraphicum Graecum</i>   |
| Var.           | Cassiodorus, <i>Variae Epistolae</i>   |

## Arabic sources

|              |   |
|--------------|---|
| al-Andalousi | KAMAL, Y. (trans. & ed.), Abou Hamid al-Andalousi, <i>Touhfat al-Albāb</i> . In <i>Monumenta Cartographica Africae et Aegypti</i> III, fas. 4 (Cairo 1934): 874   |
| al-Bakrī     | DE SLANE, M.G. (trans.), Abou Abdullah al-Bakrī, <i>Kitab al-Massālik wa-l-Mamālik (Description de l'Afrique septentrionale par Abour-Obeid-el-Bekri)</i> (Paris 1965)  |
| al-Housain   | KAMAL, Y. (trans. & ed.), Ishaq Ibn al-Housain, <i>Kitāb Ākām al-Mardjān fī Dhikr al-Madā'in al-Machhōūra fī Koll Makōūn</i> . In <i>Monumenta Cartographica Africae et Aegypti</i> III, fas. 2 (Cairo 1932): 623–624 |
| Ibn Hawkal   | KRAMERS, J.H. & G. WEIT (trans.), Moh. Abul-Kassem Ibn Hawkal, <i>Kitāb Sūrat al Ard (Configuration de la terre)</i> (Paris, Beirut 1964)   |
| Ibn Khaldun  | KAMAL, Y. (trans. & ed.), Ibn Khaldoun, <i>Kitāb al-'Ibar</i> . In <i>Monumenta Cartographica Africae et Aegypti</i> IV, fas. 3 (Cairo 1938): 1340–1348   |
| Ibn Sa'id    | KAMAL, Y. (trans. & ed.), 'Ali ibn Sa'id al-Maghribī al-Andalousī, <i>Kitāb Djōūghrafiyā fī 'l-Aqālim al-Sab</i> . In <i>Monumenta Cartographica Africae et Aegypti</i> IV, fas. 1 (Cairo 1936): 1080–1091            |
| al-Idrīsī    | HADJ-SADOK, M. (trans.), Abu Abd Allah Muhammad al-Idrīsī, <i>Kitāb Nuzhat al-Mushtāq fī Ikhtirāq al-Āfāq (Le Maghrib 6<sup>e</sup> siècle de l'hégire [12<sup>e</sup> siècle après J.C.])</i> (Paris 1983)           |
| al-Khwarezmi | KAMAL, Y. (trans. & ed.), Moh. Ibn Mousa al-Khwarezmi, <i>Kitāb Sōūrat al-Ard</i> . In <i>Monumenta Cartographica Africae et Aegypti</i> III, fas. 1 (Cairo 1930): 519–523  |
| al-Mas'oudi  | KAMAL, Y. (trans. & ed.), al-Mas'oudi, <i>Mourōūdj al-Dhahab wa Maādin al-Djawāhir</i> . In <i>Monumenta Cartographica Africae et Aegypti</i> III, fas. 2 (Cairo 1932): 625–629                                       |
| al-Mukaddasī | MIQUEL, A. (trans.), Muh. ibn 'Abd al-Hadi al-Mukaddasī, <i>Ahsan at-Taqāsīm fī Ma'rifat al-Aqālim (Le meilleure répartition pour la connaissance des provinces)</i> (Damascus 1963)                                  |
| al-'Omarī    | GAUDEFROY-DEMOMBYNES, A.M. (trans.), Ibn Fadl Allah al-'Omarī, <i>Masālik el Absār fī Mamālik el Amsār, Vol. I: L'Afrique, moins l'Égypte</i> (Paris 1927)  |

- al-Sabtī LÉVI PROVENÇAL, E., “Une description de Ceuta musulmane au XV<sup>e</sup> siècle (Moh. ibn al-Qāsim ibn ‘Abd al-Malik al-Ansāri al-Sabtī, *Ikhtisār al-Akḥbār*),” *Hespéris* 12 (1931): 145–176
- Yâkūt KAMAL, Y. (trans. & ed.), Yâkūt al-Ḥamawī, *Muʿdjam al-Buldân*. In *Monumenta Cartographica Africae et Aegypti* III, fas. 5 (Cairo 1935): 946–965
- al-Zouhri KAMAL, Y. (trans. & ed.), al-Zouhri, *Djoughrāfiya*. In *Monumenta Cartographica Africae et Aegypti* III, fas. 3 (Cairo 1933): 801–803

## Historical sources

- Chron. du Pierre KAMAL, Y. (trans. & ed.), Pierre le cruel, *Chronique du Pierre le Cruel ou le Justicier, Roi de Castille, AD 1350–1369*. In *Monumenta Cartographica Africae et Aegypti* IV, fas. 2 (Cairo 1937): 1251–1252
- Leo Africanus PORY, J. (trans.) & R. BROWN (ed.), Leo Africanus, *The History and Description of Africa* (London 1896)
- Lo Conpasso* KAMAL, Y. (trans. & ed.), Anonymous, *Lo Conpasso de Navegare*. In *Monumenta Cartographica Africae et Aegypti* IV, fas. 1 (Cairo 1936): 1108–1111
- de Zurara KAMAL, Y. (trans. & ed.), Gommès Eannes de Zurara, *Crónica da Tomanda da Cidade de Cepta por el Rey Dom Joham o Primiero [end March 25, 1450]*. In *Monumenta Cartographica Africae et Aegypti* IV, fas. 4 (Cairo 1939): 1387–1388

## General

- AEspA *Archivo Español de Arqueología*
- AFFP BEKKER-NIELSEN, T. (ed.), *Ancient fishing and fish processing in the Black Sea region* (Aarhus 2005)
- L’Africa romana* V MASTINO, A. (ed.), *L’Africa romana. L’Epigrafia e la storia delle province romane del Maghreb. Atti del V convegno di studio, Sassari, 11–13 dicembre 1987* (Sassari 1988)
- L’Africa romana* X MASTINO, A. & P. RUGGERI (eds), *L’Africa romana. Civitas: l’Organizzazione dello spazio urbano nelle province romane del Nord Africa e nella Sardegna. Atti del X convegno di studio, Oristano, 11–13 dicembre 1992* (Sassari 1994)
- L’Africa romana* XI KHANOUSSI, M., P. RUGGERI & C. VISMARA (eds), *L’Africa romana. La Scienza e le tecniche nelle province romane del Nord Africa e nel Mediterraneo. Atti del XI convegno di studio, Cartagine, 15–18 dicembre 1994* (Ozieri 1996)
- L’Africa romana* XII KHANOUSSI, M., P. RUGGERI & C. VISMARA (eds), *L’Africa romana. L’Organizzazione dello spazio rurale nelle province del Nord Africa e nella Sardegna. Atti del XII convegno di studio, Olbia, 12–15 dicembre 1996* (Sassari 1998)
- L’Africa romana* XIII KHANOUSSI, M., P. RUGGERI & C. VISMARA (eds), *L’Africa romana. Geografi, viaggiatori, militari nel Maghreb: alle origini dell’archeologia nel Nord Africa. Atti del XIII convegno di studio, Djerba, 10–13 dicembre 1998* (Rome 2000)

- L'Africa romana* XIV KHANOUSSI, M., P. RUGGERI & C. VISMARA (eds), *L'Africa romana. Lo Spazio marittimo del Mediterraneo occidentale: geografia storica ed economia. Atti del XIV convegno di studio, Sassari, 7–10 dicembre 2000* (Rome 2002)
- L'Africa romana* XV KHANOUSSI, M., P. RUGGERI & C. VISMARA (eds), *L'Africa romana. Ai confini dell'Impero: contatti, scambi, conflitti. Atti del XV convegno di studio, Tozeur, 11–15 dicembre 2002* (Rome 2004)
- L'Africa romana* XVI AKERRAZ, A., P. RUGGERI, A. SIRAJ & C. VISMARA (eds), *L'Africa romana. Mobilità delle persone e dei popoli, dinamiche migratorie, emigrazioni ed immigrazioni nelle province occidentali dell'Impero romano. Atti del XVI convegno di studio, Rabat, 15–19 dicembre 2004* (Sassari 2006)
- L'Africa romana* XVII GONZÁLEZ, J., P. RUGGERI, C. VISMARA & R. ZUCCA (eds), *L'Africa romana. Le Ricchezze dell'Africa. Risorse, produzioni, scambi. Atti del XVII convegno di studio, Sevilla, 14–17 dicembre 2006* (Rome 2008)
- L'Africa romana* XVIII MILANESE, M., P. RUGGERI & C. VISMARA (eds), *L'Africa romana. I luoghi e le forme dei mestieri e della produzione nelle province africane. Atti del XVIII convegno di studio, Olbia, 11–14 dicembre 2008* (Rome 2010)
- L'Africa romana* XIX BASTIANA COCCO, M., A. GAVINI & A. IBBA (eds), *L'Africa romana. Trasformazione dei paesaggi del potere nell'Africa settentrionale fino alla fine del mondo antico. Atti del XIX convegno di studio, Sassari, 16–19 dicembre 2010* (Rome 2012)
- AJA *American Journal of Archaeology*
- AJP *American Journal of Philology*
- ANFG BEKKER-NIELSEN, T. & D. BERNAL CASASOLA (eds), *Ancient nets and fishing gears. Proceedings of the international workshop on 'Nets and fishing gears in Classical Antiquity: a first approach', Cádiz, November 15–17, 2007* (Aarhus 2010)
- ANP L'Agence nationale des Ports (<http://www.anp.org.ma/En/Services/Mohammediaport/Pages/Presentation.aspx>; accessed 1/2017)
- AntAfr *Antiquités Africaines*
- APEG BERNAL CASASOLA, D. (ed.), *Arqueología de la pesca en el Estrecho de Gibraltar de la prehistoria al fin del mundo antiguo* (Cádiz 2009)
- App. Appendix
- ARSW African Red Slip Ware
- ASHM I BERNAL, D., B. RAISSOUNI, J. RAMOS & A. BOUZOUGGAR (eds), *Actas del I seminario Hispano-Marroquí de especialización en arqueología* (Cádiz 2006)
- ASHM II BERNAL, D., B. RAISSOUNI, J. RAMOS, M. ZOUAK & M. PARODI (eds), *En la orilla africana del Círculo del Estrecho. Historiografía y proyectos actuales. Actas del II seminario Hispano-Marroquí de especialización en arqueología* (Cádiz 2008)
- ASHM III BERNAL, D., B. RAISSOUNI, M. ARCILA, M.Y. IDRISI, J. RAMOS, M. ZOUAK, J.A. LÓPEZ SÁNCHEZ, M. MAALOUK, A. EL KHAYARI, B. EL MOUMNI, M. GHOTTES & A. AZZARIOHI (eds), *Arqueología y turismo en el Círculo del Estrecho. Estrategias para la puesta en valor de los recursos patrimoniales del Norte de Marruecos. Actas del III seminario Hispano-Marroquí (Algeciras, abril de 2011)* (Cádiz 2011)

|                      |   |
|----------------------|---|
| AT                   | Athena Trakadas   |
| BAM                  | <i>Bulletin d'Archéologie Marocaine</i>   |
| BCH                  | <i>Bulletin de Correspondance Hellénique</i>  |
| BCTH                 | <i>Bulletin Archéologique du Comité des Travaux Historiques et Scientifiques</i>  |
| Cat.                 | Catalogue   |
| CBC                  | ARÉVALO, A. & D. BERNAL (eds), <i>Las cetariae de Baelo Claudia. Avance de las investigaciones arqueológicas en el barrio meridional (2000–2004)</i> (Cádiz 2007)   |
| <i>Cetariae 2005</i> | LAGÓSTENA, L., D. BERNAL & A. ARÉVALO (eds), <i>Cetariae 2005. Salsas y salazones de pescado en occidente durante la Antigüedad. Actas del congreso internacional (Cádiz, 7–9 de noviembre de 2005)</i> (Oxford 2007)   |
| CIEG I               | RIPOLL PERELLÓ, E. (ed.), <i>Actas del congreso internacional 'El Estrecho de Gibraltar', Ceuta 1987</i> (Madrid 1988)  |
| CIEG II              | RIPOLL PERELLÓ, E. & M.F. LADERO QUESADA (eds), <i>Actas del II congreso internacional 'El Estrecho de Gibraltar', Ceuta 1990</i> (Madrid 1995)   |
| COPEMED              | Coordination to Support Fisheries Management in the Western and Central Mediterranean (FAO/EU)  |
| CRAI                 | <i>Comptes rendus des séances Académie des inscriptions et belles-lettres</i>   |
| DAI-M                | Deutsches Archäologisches Institut, Madrid (Spain)  |
| <i>Ex Baetica</i>    | GARCÍA, G.C. (ed.), <i>Congreso internacional 'Ex Baetica Amphorae'. Conservas, aceite y vino de la Bética en el Imperio Romano. Sevilla – Écija, 17 al 20 de diciembre de 1998</i> (Écija 2000)  |
| HAAN V               | DESANGES, J. (ed.), <i>Histoire et archéologie de l'Afrique du Nord. Actes du V<sup>e</sup> colloque international: spectacles, vie portuaire, religions</i> (Avignon, 9–13 avril 1990) (Paris 1992)  |
| HAAN VI              | TROUSSET, P. (ed.), <i>Histoire et archéologie de l'Afrique du Nord. Actes du VI<sup>e</sup> colloque international: L'Afrique du Nord antique et médiévale. Productions et exportations africaines, actualités archéologiques</i> (Pau, octobre 1993) (Aix-en-Provence 1995) |
| ICCAT                | International Commission for the Conservation of Atlantic Tunas ( <a href="https://www.iccat.int/en/">https://www.iccat.int/en/</a> ; accessed 1/2017)  |
| IJNA                 | <i>International Journal of Nautical Archaeology</i>  |
| <i>Inland seas</i>   | BEKKER-NIELSEN, T. & R. GERTWAGEN (eds), <i>The inland seas. Towards an ecohistory of the Mediterranean and the Black Sea</i> (Stuttgart 2016)  |
| INRH                 | Institut National de Recherche Halieutique (Casablanca, Morocco)  |
| INSAP                | Institut National des Sciences d'Archéologie et du Patrimoine (Rabat, Morocco)  |
| INSTAP               | The Institute for Aegean Prehistory, Study Center for East Crete (Pacheia Ammos, Greece)  |
| <i>Inst. naut.</i>   | Service hydrographique de la marine, <i>Instructions nautiques: France (côte Sud et Corse), Algérie, Tunisie, Maroc (côte Nord)</i> (Paris 1932)  |
| JMA                  | <i>Journal of Maritime Archaeology</i>  |
| JRA                  | <i>Journal of Roman Archaeology</i>   |
| JRS                  | <i>Journal of Roman Studies</i>   |

|                           |   |
|---------------------------|---|
| KAAC                      | Kommission für Archäologie Außereuropäischer Kulturen (Bonn, Germany)   |
| <i>Lixus Actes</i>        | <i>Lixus. Actes du colloque organisé par l'Institut des Sciences de l'Archéologie et du Patrimoine de Rabat avec le concours de l'École française de Rome, Larache, 8–11 novembre 1989</i> (Rome 1992)              |
| <i>Lixus-1</i>            | ARANEGUI GASCÓ, C. (ed.), <i>Lixus. Colonia fenicia y ciudad púnico-mauritana anotaciones sobre su ocupación medieval</i> (Valencia 2001)   |
| <i>Lixus-2</i>            | ARANEGUI, C. & M. HABIBI (eds), <i>Lixus-2. Ladera Sur</i> (Valencia 2005)  |
| <i>Lixus-3</i>            | ARANEGUI, C. & H. HASSINI (eds), <i>Lixus-3. Área suroeste del sector monumental [Cámaras Montalbán] 2005–2009</i> (Valencia 2010)  |
| MAHM                      | Museo de Arqueología e Historia, Melilla (Spain)  |
| MEFRA                     | <i>Mélanges de l'École Française de Rome, Antiquité</i>   |
| MNI                       | Minimum number of individuals   |
| NAP                       | <i>Nouvelles archéologiques et patrimoniales</i>  |
| NID I                     | Naval Intelligence Division, <i>Morocco</i> , I. BR 506A Geographical Handbook Series (Oxford 1941)   |
| NID II                    | Naval Intelligence Division, <i>Morocco</i> , II. BR 506A Geographical Handbook Series (Oxford 1942)  |
| NIMA 131                  | National Imagery and Mapping Agency Publication 131, <i>Sailing directions (en route): Western Mediterranean</i> (Bethesda, MD 2000)  |
| NIMA 143                  | National Imagery and Mapping Agency Publication 143, <i>Sailing directions (en route): West coast of Europe and Northwest Africa</i> (Bethesda, MD 1994)  |
| NIMA SOG                  | National Imagery and Mapping Agency, Chart #52039: <i>Strait of Gibraltar</i> (Bethesda, MD 1995)   |
| NISP                      | Number of specimens   |
| <i>Pescar con Arte</i>    | BERNAL CASASOLA, D. (ed.), <i>Pescar con Arte. Fenicios y romanos en el origen de los aparejos andaluces. Catálogo de la exposición Baelo Claudia, diciembre 2011–julio 2012</i> (Cádiz 2011)                       |
| PSAM                      | <i>Publications du Service des Antiquités du Maroc</i>  |
| <i>Purpureae Vestes I</i> | ALFARO, C., J.P. WILD & B. COSTA (eds), <i>Purpureae Vestes I: Actas del I symposium internacional sobre textiles y tintes del Mediterraneo en época romana (Ibiza, 8 al 10 de noviembre, 2002)</i> (Valencia 2004) |
| <i>Ramsar</i>             | Ramsar Sites Information Services ( <a href="https://rsis.ramsar.org/ris/1474">https://rsis.ramsar.org/ris/1474</a> ; accessed 1/2017)  |
| REA                       | <i>Revue des Études Anciennes</i>   |
| <i>Rirha I</i>            | CALLEGARIN, L., M. KBIRI ALAOUI, A. ICHKHAKH & J.-C. ROUX (eds), <i>Rirha: site antique et médiéval du Maroc, I. Cadre historique et géographique général</i> (Madrid 2016)   |
| <i>Rirha II</i>           | CALLEGARIN, L., M. KBIRI ALAOUI, A. ICHKHAKH & J.-C. ROUX (eds), <i>Rirha: site antique et médiéval du Maroc, II. Période maurétannienne (V<sup>e</sup> siècle av. J.-C.–40 ap. J.-C.)</i> (Madrid 2016)            |
| <i>Rirha III</i>          | CALLEGARIN, L., M. KBIRI ALAOUI, A. ICHKHAKH & J.-C. ROUX (eds), <i>Rirha: site antique et médiéval du Maroc, III. Période romaine (40 ap. J.-C.–fin du III<sup>e</sup> s. ap. J.-C.)</i> (Madrid 2016)             |
| sp.                       | Species   |

|                     |   |
|---------------------|---|
| <i>Tamuda</i>       | BERNAL, D., B. RAISSOUNI, J. VERDUGO & M. ZOUAK (eds), <i>Tamuda. Crono-cronosecuencia de la ciudad mauritana y del castellum romano. Resultados arqueológicos del Plan de Investigación del PET (2008–2010)</i> (Cádiz 2013) |
| <i>Thamusida 1</i>  | AKERRAZ, A. & E. PAPI (eds), <i>Sidi Ali ben Ahmed – Thamusida 1. I contesti</i> (Rome 2008)  |
| <i>Thamusida 2</i>  | GLIOZZO, E., I. TURBANTI MEMMI, A. AKERRAZ & E. PAPI (eds), <i>Sidi Ali ben Ahmed – Thamusida 2. L'archeometria</i> (Rome 2009)   |
| <i>Thamusida 3</i>  | AKERRAZ, A., S. CAMPOREALE & E. PAPI (eds), <i>Sidi Ali ben Ahmed – Thamusida 3. I materiali</i> (Rome 2013)  |
| TopoMap             | topographic-map.com ( <a href="http://en-gb.topographic-map.com/">http://en-gb.topographic-map.com/</a> ; accessed 1/2017)  |
| UAM                 | Universidad Autónoma de Madrid (Spain)  |
| USNHO               | U.S. Navy Hydrographic Office No. 134, <i>Sailing Directions for the west coast of Spain, Portugal and NW Africa and off-lying islands</i> (6 <sup>th</sup> edn, Washington D.C. 1952)  |
| <i>W. Div. Med.</i> | Anonymous, “The western division of the Mediterranean – navigation passages from West to East,” <i>Nautical Magazine</i> 32 (1863): 460–461   |



## Figures

|           |  |     |
|-----------|--|-----|
| Fig. 1.1  | The modern geo-political area of this study .....  | 32  |
| Fig. 2.1  | Distribution map of all sites with archaeological finds .....  | 44  |
| Fig. 3.1  | Fish bone from Punico-Mauretanian layers at <i>Tamuda</i> .....  | 51  |
| Fig. 3.2  | Fishing methods: trident, hook-and-line/angling and cast net .....                                     | 57  |
| Fig. 3.3  | Bronze fish hook from the Roman layers at <i>Banasa</i> .....  | 57  |
| Fig. 3.4  | Lead weight, likely a line sinker, from the Roman/Late Roman<br>layers at <i>Essaouira</i> .....       | 57  |
| Fig. 3.5  | Example of a gorge rigged to a line .....  | 58  |
| Fig. 3.6  | A floating long-line and a long-line weighted on the seabed .....                                      | 58  |
| Fig. 3.7  | Three bronze navettes .....  | 60  |
| Fig. 3.8  | A bronze double-eyed needle and a bone double-eyed needle .....  | 60  |
| Fig. 3.9  | Net weights from Roman layers at <i>Rusaddir</i> .....   | 61  |
| Fig. 3.10 | Fishing with a cast net .....  | 63  |
| Fig. 3.11 | Fishing with a beach seine net .....   | 64  |
| Fig. 3.12 | A set gill net with weights .....  | 64  |
| Fig. 3.13 | Pound nets: plan of an 18 <sup>th</sup> -century <i>al-madraba</i> net .....                           | 65  |
| Fig. 3.14 | A scene possibly depicting the use of weels or creels .....  | 69  |
| Fig. 3.15 | Types of fishing boats .....   | 72  |
| Fig. 3.16 | Some of the large <i>cetariae</i> of Complex 8 at <i>Lixus</i> .....                                   | 79  |
| Fig. 3.17 | Oualidia lagoon, on the Atlantic coast .....   | 79  |
| Fig. 3.18 | Punico-Mauretanian, Roman and Late Roman <i>salazón</i> amphorae .....                                 | 84  |
| Fig. 3.19 | A fishing mosaic from <i>Volubilis</i> .....   | 87  |
| Fig. 3.20 | Fishing with a seine net from the beach at <i>Amtar</i> .....  | 88  |
| Fig. 4.1  | Locations of some of the prehistoric sites in the northwest Maghreb .....                              | 92  |
| Fig. 4.2  | The major river systems of the northwest Maghreb .....   | 92  |
| Fig. 4.3  | The megalithic dolmen chamber tomb at <i>M'zora</i> .....  | 94  |
| Fig. 4.4  | Western Phoenician and Punico-Mauretanian sites and find-places<br>of the northwest Maghreb .....      | 95  |
| Fig. 4.5  | Sidi Driss: looking east over remains of the settlement .....  | 96  |
| Fig. 4.6  | The <i>coloniae</i> and larger settlements within the province of<br><i>Mauretania Tingitana</i> ..... | 99  |
| Fig. 4.7  | <i>Volubilis</i> : looking east over houses towards the <i>forum</i> area .....                        | 101 |



|           |   |     |
|-----------|---|-----|
| Fig. 5.1  | The province of <i>Mauretania Tingitana</i> with major settlements . . . . .                                    | 108 |
| Fig. 5.2  | The earthwork system south of <i>Sala</i> . . . . .   | 108 |
| Fig. 5.3  | The topography of the northwest Maghreb . . . . .   | 110 |
| Fig. 5.4  | The Mediterranean coast . . . . .   | 112 |
| Fig. 5.5  | The Sebkha bou Areg lagoon . . . . .  | 113 |
| Fig. 5.6  | Pointe des Pêcheurs . . . . .   | 115 |
| Fig. 5.7  | The Oued Martil valley . . . . .  | 116 |
| Fig. 5.8  | The Oued Smir coast . . . . .   | 116 |
| Fig. 5.9  | The bathymetry of the Sea of Alboran . . . . .  | 118 |
| Fig. 5.10 | Surface currents from the Gulf of Cádiz to the Sea of Alboran . . . . .   | 118 |
| Fig. 5.11 | The Strait of Gibraltar coast . . . . .   | 122 |
| Fig. 5.12 | Looking east through the Strait . . . . .   | 122 |
| Fig. 5.13 | The Strait of Gibraltar . . . . .   | 123 |
| Fig. 5.14 | The bay at Ksar-es-Seghir . . . . .   | 124 |
| Fig. 5.15 | Looking west across Tangier Bay . . . . .   | 124 |
| Fig. 5.16 | The bathymetry of the Strait of Gibraltar . . . . .   | 126 |
| Fig. 5.17 | The Atlantic coast . . . . .  | 130 |
| Fig. 5.18 | The mouth of the Oued Loukkos and modern city of Larache . . . . .  | 132 |
| Fig. 5.19 | The Oued Bouregreg as it meets the Atlantic façade . . . . .  | 132 |
| Fig. 5.20 | The site of <i>Sala</i> . . . . .   | 133 |
| Fig. 5.21 | The high sandstone cliffs of the Meseta plateau . . . . .   | 134 |
| Fig. 5.22 | The islands at Essaouira . . . . .  | 134 |
| Fig. 5.23 | The bathymetry of the eastern Atlantic . . . . .  | 136 |
| Fig. 5.24 | The ‘reconstructed’ Mediterranean littoral . . . . .  | 150 |
| Fig. 5.25 | The ‘reconstructed’ Strait of Gibraltar littoral . . . . .  | 151 |
| Fig. 5.26 | The ‘reconstructed’ Atlantic littoral . . . . .   | 152 |
| Fig. 6.1  | Distribution and chronology of finds of fish bones from the<br>Mediterranean littoral . . . . .                 | 156 |
| Fig. 6.2  | Distribution and chronology of finds of marine invertebrates<br>from the Mediterranean littoral . . . . .       | 158 |
| Fig. 6.3  | Distribution and chronology of finds of fishing equipment<br>from the Mediterranean littoral . . . . .          | 160 |
| Fig. 6.4  | Distribution and chronology of fish-salting sites along the<br>Mediterranean littoral . . . . .                 | 161 |
| Fig. 6.5  | Distribution and chronology of finds of salazón amphorae<br>from the Mediterranean littoral . . . . .           | 162 |
| Fig. 6.6  | Distribution and chronology of finds of fish bones from the<br>Strait of Gibraltar littoral . . . . .           | 166 |
| Fig. 6.7  | Distribution and chronology of finds of marine invertebrates<br>from the Strait of Gibraltar littoral . . . . . | 166 |
| Fig. 6.8  | Distribution and chronology of finds of fishing equipment<br>from the Strait of Gibraltar littoral . . . . .    | 168 |

|           |   |     |
|-----------|---|-----|
| Fig 6.9   | Distribution and chronology of fish-salting sites along the Strait of Gibraltar littoral                    | 169 |
| Fig. 6.10 | Distribution and chronology of finds of salazón amphorae from the Strait of Gibraltar littoral              | 170 |
| Fig. 6.11 | Distribution and chronology of finds of fish bones from the Atlantic littoral                               | 174 |
| Fig. 6.12 | Distribution and chronology of finds of marine invertebrates from the Atlantic littoral                     | 175 |
| Fig. 6.13 | Distribution and chronology of finds of fishing equipment from the Atlantic littoral                        | 179 |
| Fig. 6.14 | Distribution and chronology of fish-salting sites along the Atlantic littoral                               | 181 |
| Fig. 6.15 | Distribution and chronology of finds of salazón amphorae from the Atlantic littoral                         | 182 |
| Fig. 7.1  | <i>Tamuda</i> and other relevant sites  | 186 |
| Fig. 7.2  | Aerial view of <i>Tamuda</i>  | 188 |
| Fig. 7.3  | Composite site plan of the excavated areas of <i>Tamuda</i>   | 189 |
| Fig. 7.4  | View south-east across the Oued Martil  | 191 |
| Fig. 7.5  | Relative presence of fish and marine invertebrate family/species at <i>Tamuda</i>                           | 194 |
| Fig. 7.6  | Relative number of marine invertebrate family/species at <i>Tamuda</i> , by major environment               | 195 |
| Fig. 7.7  | Relative number of marine invertebrate family/species at <i>Tamuda</i> , by minor environment               | 195 |
| Fig. 7.8  | <i>Septem Fratres</i> and other relevant sites  | 207 |
| Fig. 7.9  | Aerial view of Ceuta  | 208 |
| Fig. 7.10 | Composite site plan of the excavated areas of <i>Septem Fratres</i>   | 209 |
| Fig. 7.11 | Two <i>cetariae</i> from the Paseo de las Palmeras site   | 214 |
| Fig. 7.12 | Relative presence of fish and marine invertebrate family/genus/species at <i>Septem Fratres</i>             | 217 |
| Fig. 7.13 | Relative number of fish family/species at <i>Septem Fratres</i>   | 217 |
| Fig. 7.14 | Relative number of marine invertebrate family/genus/species at <i>Septem Fratres</i> , by major environment | 218 |
| Fig. 7.15 | Relative number of marine invertebrate family/genus/species at <i>Septem Fratres</i> , by minor environment | 218 |
| Fig. 7.16 | <i>Lixus</i> and other relevant sites   | 235 |
| Fig. 7.17 | Aerial view of the site of <i>Lixus</i>   | 236 |
| Fig. 7.18 | Composite site plan of the excavated areas of <i>Lixus</i>  | 237 |
| Fig. 7.19 | Overview of the lower Oued Loukkos  | 239 |
| Fig. 7.20 | View south-west of the ten excavated fish-salting complexes   | 240 |
| Fig. 7.21 | Relative presence of fish and marine invertebrate class/order/family/species at <i>Lixus</i>                | 245 |

|           |   |     |
|-----------|---|-----|
| Fig. 7.22 | Relative number of fish class/order/family/species at <i>Lixus</i> . . . . .                              | 247 |
| Fig. 7.23 | Relative number of marine invertebrate family/species at <i>Lixus</i> ,<br>by major environment . . . . . | 247 |
| Fig. 7.24 | Relative number of marine invertebrate family/species at <i>Lixus</i> ,<br>by minor environment . . . . . | 248 |
| Fig. 8.1  | An overview of the chronologies and activities of the<br>fish-salting sites . . . . .                     | 290 |
| Fig. 8.2  | An overview of the chronologies of the kilns and proposed kilns . . . . .                                 | 297 |
| Fig. 8.3  | The total number of sites with finds of salazón amphorae . . . . .  | 299 |
| Fig. 8.4  | The number of unique class/family/genus/species<br>of marine resources . . . . .                          | 303 |
| Fig. 8.5  | The total number of sites with fishing equipment finds . . . . .  | 304 |

## Tables

|           |   |     |
|-----------|---|-----|
| Table 2.1 | Ceramics indicative of this study's chronology .....  | 41  |
| Table 2.2 | This study's chronology .....   | 41  |
| Table 2.3 | Site list: all sites with archaeological finds discussed in this study .....                            | 42  |
| Table 2.4 | 'Major sites' in the northwest Maghreb .....  | 45  |
| Table 2.5 | 'Minor sites' in the northwest Maghreb .....  | 46  |
| Table 2.6 | 'Agglomerations' in the northwest Maghreb .....   | 47  |
| Table 3.1 | Vocabulary used throughout this study referring to fish habitats and behaviour .....                    | 54  |
| Table 3.2 | Vocabulary used throughout this study referring to habitats of marine invertebrates .....               | 55  |
| Table 3.3 | The identified types of nets used in the Graeco-Roman world .....                                       | 66  |
| Table 3.4 | Archaeological finds of Mediterranean Graeco-Roman fishing-boat assemblages .....                       | 72  |
| Table 3.5 | Types of salazón amphorae included in this study and their respective chronologies .....                | 83  |
| Table 5.1 | Evidence for geo-morphological changes along the Mediterranean coast .....                              | 142 |
| Table 5.2 | Evidence for geo-morphological changes along the Strait of Gibraltar coast .....                        | 144 |
| Table 5.3 | Evidence for geo-morphological changes along the Atlantic coast .....                                   | 146 |
| Table 6.1 | The Mediterranean littoral: number of family/species of fish and marine invertebrates .....             | 155 |
| Table 6.2 | The Mediterranean littoral: number of sites with finds of fish bones .....                              | 155 |
| Table 6.3 | The Mediterranean littoral: number of sites with finds of marine invertebrate family/species .....      | 157 |
| Table 6.4 | The Mediterranean littoral: finds of equipment and the main fishing techniques .....                    | 159 |
| Table 6.5 | The Mediterranean littoral: fish-salting sites .....  | 159 |
| Table 6.6 | The Strait of Gibraltar littoral: number of family/genus/species of fish and marine invertebrates ..... | 164 |

|            |  |     |
|------------|--|-----|
| Table 6.7  | The Strait of Gibraltar littoral: number of sites with finds of fish bones .....                               | 165 |
| Table 6.8  | The Strait of Gibraltar littoral: number of sites with finds of marine invertebrate family/genus/species ..... | 167 |
| Table 6.9  | The Strait of Gibraltar littoral: finds of equipment and the main fishing techniques .....                     | 168 |
| Table 6.10 | The Strait of Gibraltar littoral: fish-salting sites .....   | 169 |
| Table 6.11 | The Atlantic littoral: number of class/order/family/species of fish and marine invertebrates .....             | 171 |
| Table 6.12 | The Atlantic littoral: number of sites with finds of fish bones .....  | 172 |
| Table 6.13 | The Atlantic littoral: number of sites with finds of marine invertebrate class/family/species .....            | 176 |
| Table 6.14 | The Atlantic littoral: finds of equipment and the main fishing techniques .....                                | 178 |
| Table 6.15 | The Atlantic littoral: fish-salting sites .....  | 180 |
| Table 7.1  | The source evidence related to marine resource exploitation at <i>Tamuda</i> .....                             | 193 |
| Table 7.2  | Fish from <i>Tamuda</i> .....  | 193 |
| Table 7.3  | Marine invertebrates from <i>Tamuda</i> .....  | 194 |
| Table 7.4  | Fishing equipment finds from <i>Tamuda</i> .....   | 197 |
| Table 7.5  | The source evidence related to marine resource exploitation at <i>Septem Fratres</i> .....                     | 214 |
| Table 7.6  | Fish from <i>Septem Fratres</i> .....  | 215 |
| Table 7.7  | Marine invertebrates from <i>Septem Fratres</i> .....  | 216 |
| Table 7.8  | Fishing equipment finds from <i>Septem Fratres</i> .....   | 220 |
| Table 7.9  | Chronologies of the fish-salting complexes and preparation areas at <i>Septem Fratres</i> .....                | 221 |
| Table 7.10 | The source evidence related to marine resource exploitation at <i>Lixus</i> .....                              | 242 |
| Table 7.11 | Fish from <i>Lixus</i> .....   | 244 |
| Table 7.12 | Marine invertebrates from <i>Lixus</i> .....   | 246 |
| Table 7.13 | Fishing equipment finds from <i>Lixus</i> .....  | 249 |
| Table 7.14 | Chronologies of the fish-salting complexes at <i>Lixus</i> .....   | 250 |
| Table 8.1  | The evidence for 'fresh' marine resource consumption from Mediterranean sites .....                            | 267 |
| Table 8.2  | The evidence for 'fresh' marine resource consumption from Strait of Gibraltar sites .....                      | 268 |
| Table 8.3  | The evidence for 'fresh' marine resource consumption from Atlantic sites .....                                 | 268 |
| Table 8.4  | Class/family/species of fish and marine invertebrates determined to be for 'fresh' consumption .....           | 270 |

|            |  |     |
|------------|--|-----|
| Table 8.5  | Evidence of other meat foodstuffs consumed in the northwest Maghreb . . . . .  | 273 |
| Table 8.6  | Evidence for agricultural consumption and production in the northwest Maghreb . . . . .  | 274 |
| Table 8.7  | The evidence for processed marine resource consumption from Mediterranean sites . . . . .  | 279 |
| Table 8.8  | The evidence for processed marine resource consumption from Strait of Gibraltar sites . . . . .                                  | 280 |
| Table 8.9  | The evidence for processed marine resource consumption from Atlantic sites . . . . .   | 281 |
| Table 8.10 | Class/family/genus/species of fish and marine invertebrates determined to be for processed marine resource consumption . . . . . | 282 |
| Table 8.11 | Sites with finds of <i>Muricidae</i> shellfish . . . . .   | 284 |
| Table 8.12 | Rural fish-salting production at sites with <i>cetariae</i> . . . . .  | 291 |
| Table 8.13 | Urban fish-salting production at sites with <i>cetariae</i> . . . . .  | 293 |
| Table 8.14 | Marine resources from the northwest Maghreb, Punico-Mauretanian period . . . . .   | 302 |
| Table 8.15 | Marine resources from the northwest Maghreb, Punico-Mauretanian/Roman period . . . . .   | 303 |
| Table 8.16 | Fishing methods from the northwest Maghreb . . . . .   | 304 |
| Table 8.17 | Marine resources from the northwest Maghreb, Roman period . . . . .  | 306 |
| Table 8.18 | Marine resources from the northwest Maghreb, Roman/Late Roman period . . . . .   | 307 |
| Table 8.19 | Marine resources from the northwest Maghreb, Late Roman period . . . . .   | 309 |