Athena Trakadas

In Mauretaniae maritimis

Marine Resource Exploitation in a Roman North African Province

Alte Geschichte

Geographica Historica – 40

Franz Steiner Verlag

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GEOGRAPHICA HISTORICA

Begründet von Ernst Kirsten,

herausgegeben von Eckart Olshausen und Vera Sauer

Band 40

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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

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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.

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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

Greek and Latin sources

AE	*L'Année épigraphique*
Astr.	Manilius, *Astronomica*
CEIPAC	Centro para el Estudio de la Interdependencia Provincial en la Antigüedad Clásica (http://ceipac.ub.edu/; accessed 1/2017)
CIL II	Hübner, E. (ed.), *Corpus Inscriptionum Latinarum* II: *Inschriften der drei Provinzen der iberischen Halbinsel: Hispania citerior, Baetica und Lusitania* (Berlin 1869–)
CIL IV	Zangemeister, C. & R. Schoene (eds), *Corpus Inscriptionum Latinarum* IV: *Inscriptiones parietariae Pompeianae Herculanenses Stabianae* (Berlin 1871–)
CIL VI	Henzen, G., I.B. De Rossi, E. Bormann, C. Huelsen & M. Bang (eds), *Corpus Inscriptionum Latinarum* VI: *Inscriptiones urbis Romae Latinae* (Berlin 1876)
CIL VIII	Mommsen, T. (ed.), *Corpus Inscriptionum Latinarum* VIII: *Inschriften Nordafrikas ohne Ägypten und die Cyrenaica, d. h. der Provinzen Mauretaniae Tingitana, Caesariensis und Sitifensis, Numidia und Africa proconsularis* (Berlin 1881–)
Cod. Just.	Blume, F.H. (trans.) & T. Kearley (ed.), *Annotated Justinian Code* (2nd edn, Laramie, WY 2009)
Cod. Theod.	Mommsen, T. & P.M. Meyer (eds), *Theodosiani (Codex Theodosianus)* (Berlin 1905)
DRR	*De Re Rustica*
Geo.	Claudius Ptolemy, *The Geography*
HA	Aristotle, *Historia Animalium*
Hal.	Oppian, *Halieutica*
HE	*Hispania Epigraphica* (http://eda-bea.es/; accessed 1/2017)
IAM 1	Galand, L., J. Février & G. Vajda, *Inscriptions antiques du Maroc 1: Inscriptions libyques*, *inscriptions puniques et néopuniques*, *inscriptions hébraïques des sites antiques* (Paris 1966)
IAM 2	Euzennat, M., J. Marion & J. Gascou, *Inscriptions antiques du Maroc 2: Inscriptions latines* (Paris 1982)
ILM	Chatelain, L., *Inscriptions latines du Maroc* (Paris 1942)
ItAnt	*Antonine Itinerary*: Parthey, G.F.C. & M. Pinder (eds), *Itinerarium Antonini Avgvsti et Hierosolymitanvm ex libris manvscriptis* (Rome 1848)

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

Arabic sources

al-Andalousi	Kamal, Y. (trans. & ed.), Abou Hamid al-Andalousi, *Touhfat al-Albāb*. In *Monumenta Cartographica Africae et Aegypti* III, fas. 4 (Cairo 1934): 874
al-Bakrî	De Slane, M.G. (trans.), Abou Abdullah al-Bakrî, *Kitab al-Massālik wa-l-Mamālik* (*Description de l'Afrique septentrionale par Abour-Obeïd-el-Bekri)* (Paris 1965)
al-Housain	Kamal, Y. (trans. & ed.), Ishaq Ibn al-Housain, *Kitāb Ākām al-Mardjān fī Dhikr al-Madā'in al-Machhōūra fī Koll Makōūn*. In *Monumenta Cartographica Africae et Aegypti* III, fas. 2 (Cairo 1932): 623–624
Ibn Hawkal	Kramers, J.H. & G. Weit (trans.), Moh. Abul-Kassem Ibn Hawkal, *Kitāb Sūrat al Ard* (*Configuration de la terre*) (Paris, Beirut 1964)
Ibn Khaldun	Kamal, Y. (trans. & ed.), Ibn Khaldoun, *Kitāb al-'Ibar.* In *Monumenta Cartographica Africae et Aegypti* IV, fas. 3 (Cairo 1938): 1340–1348
Ibn Sa'id	Kamal, Y. (trans. & ed.), 'Ali ibn Sa'id al-Maghribī al-Andalousī, *Kitāb Djōūghrafiyā fi 'l-Aqālim al-Sab.* In *Monumenta Cartographica Africae et Aegypti* IV, fas. 1 (Cairo 1936): 1080–1091
al-Idrîsî	Hadj-Sadok, M. (trans.), Abu Abd Allah Muhammad al-Idrîsî, *Kitāb Nuzhat al-Mushtāq fi Ikhtirāq al-Āfāq (Le Maghrib 6^{e} siècle de l'hégire [12^{e} siècle après J.C.])* (Paris 1983)
al-Khwarezmi	Kamal, Y. (trans. & ed.), Moh. Ibn Mousa al-Khwarezmi, *Kitāb Sōūrat al-Ard*. In *Monumenta Cartographica Africae et Aegypti* III, fas. 1 (Cairo 1930): 519–523
al-Mas^{c}oudi	Kamal, Y. (trans. & ed.), al-Mas^{c}oudi, *Mourōūdj al-Dhahab wa Ma'ādin al-Djawāhir.* In *Monumenta Cartographica Africae et Aegypti* III, fas. 2 (Cairo 1932): 625–629
al-Mukaddasî	Miquel, A. (trans.), Muh. ibn 'Abd al-Hadi al-Mukaddasî, *Ahsan at-Taqāsīm fī Ma'rifat al-Aqālīm (Le meilleure répartition pour la connaissance des provinces)* (Damascus 1963)
al-'Omarī	Gaudefroy-Demombynes, A.M. (trans.), Ibn Fadl Allah al-'Omarī, *Masālik el Absār fi Mamālik el Amsār, Vol.* I: *L'Afrique, moins l'Égypte* (Paris 1927)

al-Sabtī	Lévi Provençal, E., "Une description de Ceuta musulmane au XV[e] siècle (Moh. ibn al-Qāsim ibn ʿAbd al-Malik al-Ansāri al-Sabtī, *Ikhtisār al-Akhbār*)," *Hespéris* 12 (1931): 145–176
Yâk̲ût	Kamal, Y. (trans. & ed.), Yâk̲ût al-H̲amawî, *Muʿd̲jam 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.), Gommes 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 techniche 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	*Bulletin d'Archéologie Marocaine*
BCH	*Bulletin de Correspondance Hellénique*
BCTH	*Bulletin Archéologique du Comité des Travaux Historiques et Scientifiques*
Cat.	Catalogue
CBC	Arévalo, A. & D. Bernal (eds), *Las* cetariae *de* Baelo Claudia. *Avance de las investigaciones arqueológicas en el barrio meridional (2000–2004)* (Cádiz 2007)
Cetariae 2005	Lagóstena, L., D. Bernal & A. Arévalo (eds), *Cetariae 2005. Salsas y salazones de pescado en occidente durante la Antigüedad. Actas del congreso internacional (Cádiz, 7–9 de noviembre de 2005)* (Oxford 2007)
CIEG I	Ripoll Perelló, E. (ed.), *Actas del congreso internacional 'El Estrecho de Gibraltar', Ceuta 1987* (Madrid 1988)
CIEG II	Ripoll Perelló, E. & M.F. Ladero Quesada (eds), *Actas del II congreso internacional 'El Estrecho de Gibraltar', Ceuta 1990* (Madrid 1995)
COPEMED	Coordination to Support Fisheries Management in the Western and Central Mediterranean (FAO/EU)
CRAI	*Comptes rendus des séances Académie des inscriptions et belles-lettres*
DAI-M	Deutsches Archäologisches Institut, Madrid (Spain)
Ex Baetica	García, G.C. (ed.), *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* (Écija 2000)
HAAN V	Desanges, J. (ed.), *Histoire et archéologie de l'Afrique du Nord. Actes du V^e^ colloque international: spectacles, vie portuaire, religions (Avignon, 9–13 avril 1990)* (Paris 1992)
HAAN VI	Trousset, P. (ed.), *Histoire et archéologie de l'Afrique du Nord. Actes du VI^e^ colloque international: L'Afrique du Nord antique et médiévale. Productions et exportations africaines, actualités archéologiques (Pau, octobre 1993)* (Aix-en-Provence 1995)
ICCAT	International Commission for the Conservation of Atlantic Tunas (https://www.iccat.int/en/; accessed 1/2017)
IJNA	*International Journal of Nautical Archaeology*
Inland seas	Bekker-Nielsen, T. & R. Gertwagen (eds), *The inland seas. Towards an ecohistory of the Mediterranean and the Black Sea* (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)
Inst. naut.	Service hydrographique de la marine, *Instructions nautiques: France (côte Sud et Corse), Algérie, Tunisie, Maroc (côte Nord)* (Paris 1932)
JMA	*Journal of Maritime Archaeology*
JRA	*Journal of Roman Archaeology*
JRS	*Journal of Roman Studies*

KAAK	Kommission für Archäologie Außereuropäischer Kulturen (Bonn, Germany)
Lixus Actes	*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* (Rome 1992)
Lixus-1	Aranegui Gascó, C. (ed.), *Lixus. Colonia fenicia y ciudad púnico-mauritana anotaciones sobre su ocupación medieval* (Valencia 2001)
Lixus-2	Aranegui, C. & M. Habibi (eds), *Lixus-2. Ladera Sur* (Valencia 2005)
Lixus-3	Aranegui, C. & H. Hassini (eds), *Lixus-3. Área suroeste del sector monumental [Cámaras Montalbán] 2005–2009* (Valencia 2010)
MAHM	Museo de Arqueología e Historia, Melilla (Spain)
MEFRA	*Mélanges de l'École Française de Rome, Antiquité*
MNI	Minimum number of individuals
NAP	*Nouvelles archéologiques et patrimoniales*
NID I	Naval Intelligence Division, *Morocco,* I. BR 506A Geographical Handbook Series (Oxford 1941)
NID II	Naval Intelligence Division, *Morocco,* II. BR 506A Geographical Handbook Series (Oxford 1942)
NIMA 131	National Imagery and Mapping Agency Publication 131, *Sailing directions (en route): Western Mediterranean* (Bethesda, MD 2000)
NIMA 143	National Imagery and Mapping Agency Publication 143, *Sailing directions (en route): West coast of Europe and Northwest Africa* (Bethesda, MD 1994)
NIMA SOG	National Imagery and Mapping Agency, Chart #52039: *Strait of Gibraltar* (Bethesda, MD 1995)
NISP	Number of specimens
Pescar con Arte	Bernal Casasola, D. (ed.), *Pescar con Arte. Fenicios y romanos en el origen de los aparejos andaluces. Catálogo de le exposición Baelo Claudia, diciembre 2011–julio 2012* (Cádiz 2011)
PSAM	*Publications du Service des Antiquités du Maroc*
Purpureae Vestes I	Alfaro, C., J.P. Wild & B. Costa (eds), *Purpureae Vestes* I: *Actas del I symposium internacional sobre textiles y tintes del Mediterraneo en época romana (Ibiza, 8 al 10 de noviembre, 2002)* (Valencia 2004)
Ramsar	Ramsar Sites Information Services (https://rsis.ramsar.org/ris/1474; accessed 1/2017)
REA	*Revue des Études Anciennes*
Rirha I	Callegarin, L., M. Kbiri Alaoui, A. Ichkhakh & J.-C. Roux (eds), *Rirha: site antique et médiéval du Maroc,* I. *Cadre historique et géographique général* (Madrid 2016)
Rirha II	Callegarin, L., M. Kbiri Alaoui, A. Ichkhakh & J.-C. Roux (eds), *Rirha: site antique et médiéval du Maroc,* II. *Période maurétanienne (V^e siècle av. J.–C.–40 ap. J.-C.)* (Madrid 2016)
Rirha III	Callegarin, L., M. Kbiri Alaoui, A. Ichkhakh & J.-C. Roux (eds), *Rirha: site antique et médiéval du Maroc,* III. *Période romaine (40 ap. J.-C.–fin du III^e s. ap. J.–C.)* (Madrid 2016)
sp.	Species

Tamuda cronosecuencia	Bernal, D., B. Raissouni, J. Verdugo & M. Zouak (eds), *Tamuda. Cronosecuencia de la ciudad mauritana y del castellum romano. Resultados arqueológicos del Plan de Investigación del PET (2008–2010)* (Cádiz 2013)
Thamusida 1	Akerraz, A. & E. Papi (eds), *Sidi Ali ben Ahmed – Thamusida 1. I contesti* (Rome 2008)
Thamusida 2	Gliozzo, E., I. Turbanti Memmi, A. Akerraz & E. Papi (eds), *Sidi Ali ben Ahmed – Thamusida 2. L'archeometria* (Rome 2009)
Thamusida 3	Akerraz, A., S. Camporeale & E. Papi (eds), *Sidi Ali ben Ahmed – Thamusida 3. I materiali* (Rome 2013)
TopoMap	topographic-map.com (http://en-gb.topographic-map.com/; accessed 1/2017)
UAM	Universidad Autónoma de Madrid (Spain)
USNHO	U.S. Navy Hydrographic Office No. 134, *Sailing Directions for the west coast of Spain, Portugal and NW Africa and off-lying islands* (6th edn, Washington D.C. 1952)
W. Div. Med.	Anonymous, "The western division of the Mediterranean – navigation passages from West to East," *Nautical Magazine* 32 (1863): 460–461

Figures

Tables

Chapter 1
Introduction

The northwest Maghreb occupies a unique geographical position. Spanning the corner of the African continent, the region's coastlines border major and diverse marine ecosystems, the Mediterranean Sea and the Atlantic Ocean, which are joined by the narrow Strait of Gibraltar (Fig. 1.1). Inland, to the east and south-east, the Rif and Atlas Mountains have acted as effective geo-political boundaries for much of the region's development, limiting terrestrial movement and contact with the rest of the continent; in essence, giving the northwest Maghreb an 'island-like' orientation.[1] In antiquity, it was largely due to this orientation that populations looked to the sea to facilitate contact and provide sustenance. The region's rich coastal resources, Pliny's *in Mauretaniae maritimis,* were exploited for fish and shellfish.[2] These resources were not only consumed fresh but were also processed, largely into salted dried foodstuffs, sauces and purple dyes.

The primary objective of this study is to determine the methods, areas and products of this marine resource exploitation within the particular environment of the northwest Maghreb during the mid-1st to late 3rd centuries AD, when the region constituted the Roman province of *Mauretania Tingitana.* By examining and contextualising relevant archaeological and descriptive data, this study identifies the ways in which the practice and role of fishing and consumption of its products were affected by the incorporation of the region into the Roman Empire. What emerges is a diverse portrait of an activity whose role in the social and economic life of the settlements of *Mauretania Tingitana* has been consistently under-appreciated in archaeo-historical studies.

1.1 Material basis and problems

The first historical study of marine resources in the region was published by M. Ponsich and M. Tarradell in 1965, focusing on the evidence for the Roman-period fish-salting industry in northern Morocco. The publication deals almost exclusively with the chronology of seven coastal facilities of the province where fish and shellfish were salted and processed into dried foodstuffs, sauces and purple dyes: Sania e Torres, Ksar-es-Seghir, Zahara, Cotta, Tahadart, Kouass and *Lixus*. Ponsich and Tarradell's work remains a fundamental investigation and important point of departure for such analyses of the industry.[3] Since its

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1 Shaw 1976: 144–145; 1986: 66–67.

2 Pliny, *NH* 9.56.115; see App. 4.1: Text 6.8. In this study, the term 'fish' also includes marine mammals and cartilaginous fish; the term 'shellfish' also includes coral, sea urchin and crustaceans.

3 Ponsich & Tarradell 1965, selectively reprinted in Ponsich 1988.

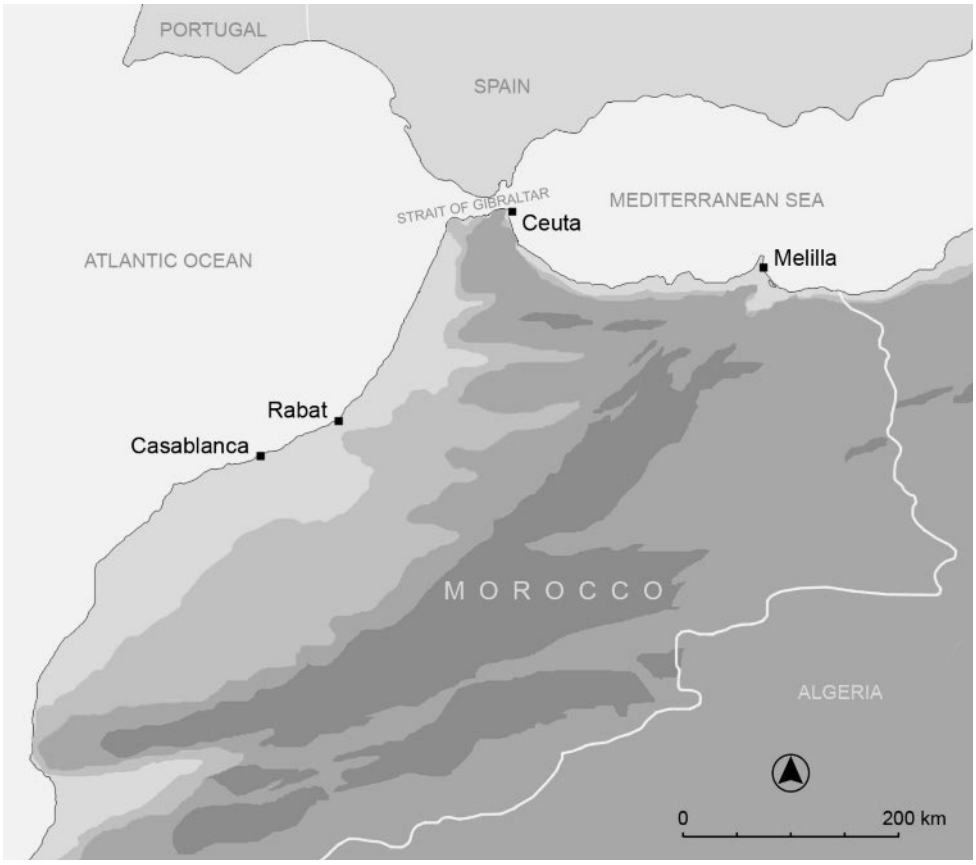

Fig. 1.1: The modern geo-political area of this study: the northwestern Maghreb, encompassing the northern part of the Kingdom of Morocco and the Spanish North African autonomous cities. Image: AT.

publication, however, additional contemporary fish-salting facilities have been identified within *Mauretania Tingitana* at such sites as Metrouna, *Septem Fratres*, Dchar ʿAskfane, Essaouira, and possibly *Banasa* and *Thamusida*.[4]

These data provide an outstanding basis for an examination of ancient marine resource exploitation, but relate exclusively to the fish-salting industry of the province. Firstly, there is no synthetic and comprehensive investigation of all fish-salting sites now known in *Mauretania Tingitana*. Secondly, there exists little overall appraisal of the methods and equipment by which the marine resources were extracted to supply this industry, nor of the location of fishing effort in the past marine environments, the species caught, the relationship between

[4] Rebuffat 1977; Jodin 1967; Hita Ruiz & Villada Paredes 1994; Akerraz & El Khayari 2005; Cheddad 2006b; Bernal Casasola & Pérez Rivera 1999; Bernal Casasola 2006b; Bernal et al. 2008b; Bernal Casasola et al. 2014a; Cerri 2007a; 2007b.

the fish-salting industry and other natural resources required for the processing, such as salt and fresh water.[5] Moreover, there are fundamental lacunae in the previous studies, such as the reconstruction of human actions within the maritime landscapes that impact accessibility and use of specific fishing technology. As is the case with extant archaeologically-oriented regional analyses of the fish-salting industry in the Graeco-Roman world, such approaches ultimately prohibit any attempts to quantify the industry's varied products, even at a general level, and establish the role of these in the ancient economy.[6]

It is only recently that new excavations in the region, at *Lixus*, *Septem Fratres,* Metrouna, *Tamuda,* Essaouira and Rirha, have included the identification of ichthyo-archaeological and malacological finds in their analyses. In addition, several recent kiln discoveries along the Atlantic coastal plain, where amphorae used to transship the salted-fish products were manufactured, have been published. In the last decade, coastal and underwater archaeological surveys in the Strait of Gibraltar have also identified areas and types of ancient fishing methods. Significantly, adjustments to ceramic chronologies and re-evaluations of excavated material have in some cases considerably affected the dating of some of the fish-salting sites that were investigated over 50 years ago.[7] These developments, as well as the state of previous scholarship, demonstrate a clear need for comprehensive re-evaluation and new approaches to analysing marine resource exploitation in *Mauretania Tingitana*.

1.2 The present study

This study's temporal focus is the Roman period in *Mauretania Tingitana*, when the province was annexed in AD 42/43 until the end of the last Imperial governorship at *Volubilis* (AD 277–280). Through the chronological extension of the examined data sets to the preceding Punico-Mauretanian and following Late Roman periods, this study also explores the diachronic changes of the exploitation, from the 5th century BC to the 6th century AD.[8] The analysis of pre- and post-Roman materials makes it possible to determine the impact of 'Romanisation' upon fishing practices, human use of and relationship to the environment, consumption patterns and the urbanisation of the region.[9]

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5 Exceptions include Bernal Casasola 2006a; Hesnard 1998; Bernal et al. 2014b. See Trakadas 2015 for a gazetteer of sites, expanded from Trakadas 2009 (see n. 11).

6 E.g., Curtis 1991; Lowe 1997; Edmondson 1987; Étienne & Mayet 2002; Wilson 2002b.

7 Fish bones/shellfish: Grau Almero et al. 2001; Rodríguez Santana & Rodrigo García 2005; Sagrario Carrasco Porras 2005; Roselló Izquierdo 1992; Chamorro Moreno 1988; Oueslati 2016; Becker & Küchelmann 2010; kilns: Limane & Rebuffat 2004; Mlilou 1991; Kbiri Alaoui 2007; Cerri 2007a; 2007b; Gliozzo & Cerri 2009; El Khayari & Lenoir 2012; underwater surveys: Trakadas 2004a; 2010a; Erbati & Trakadas 2008; re-evaluations: Habibi 2007.

8 With the exceptions of fish-salting at *Lixus* and Sidi Bou Hayel, which date into the 7th century AD.

9 'Romanisation' refers to events or concepts that take many different forms, and has been used to mean not only the introduction of different material culture and urban structures in regions that were Roman provinces or bordering these, but also the assumption of selected identity and language; see Woolf 1997; Fentress 2006: 31–33; Rhorfi 2004a; Fear 1996: 270–276; López Castro 1992: 161; Bowman & Wilson 2009: 17–18; Mattingly 2004; Gozalbes Cravioto 2010. 'Romanisation' is used in this study to refer to the introduction of the Latin language, material goods, governance, intensified urbanisation and establishment of distinct architecture and structures. See also Chapter 4.

A range of sources relating to marine resource exploitation during these periods are compiled and analysed. These include:

1. *Archaeological data:* marine animal remains from archaeological contexts; finds of fishing equipment from the region; fish-salting facilities (and related industries such as salt sources, kilns and salazón amphorae).
2. *Descriptive data:* written sources relating to fishing, marine life and salted products of the northwest Maghreb; pictorial representations of marine life and fishing from the same area; regional ethnographic examples of fishing techniques.

These data are contextualised within the specific marine, estuarine/lagoonal and riverine environments of the province. Through regional characterisations and case studies of topographically-diverse sites, the types of resources sought, the methods used to obtain them and the areas of fishing effort are reconstructed and evaluated. In order to determine the role this exploitation played in the provincial diet/foodways and economy, seafood is compared to the consumption of agricultural goods and processing (salting) is compared to other foodstuff production activities.

This study does not seek to re-analyse the province's fish-salting industry, nor aim to detail the ancient Roman economy of the northwest Maghreb. Rather, it assesses the environmental, social and economic consequences of the Roman incorporation of *Mauretania Tingitana*, its 'Romanisation', through the lens of marine resource exploitation. Although parts of North Africa have been subject to regional-geographical approaches in landscape and resource use in antiquity, such applications have yet to be realised fully in archaeological studies relating to the former province.[10] It is apparent, however, that with the unique geographical situation and wealth of marine resources, such approaches particularly relating to maritime analyses are warranted for furthering our understanding of the region's past.

This study sheds light upon the links and patterns that existed between land and sea through human interaction with the marine environment. Using the landscapes, seascapes, and a diverse body of material culture as a foundation, this study illustrates synthetically the ways in which a key natural resource of *Mauretania Tingitana* was exploited prior to, during, and after the Roman period. The aim of this analysis is to clarify previous assumptions and misconceptions regarding the past marine environment and its exploitation, answer more accurately outstanding questions of the resource's role and raise new paths of enquiry, ultimately affecting interpretations of Roman resource use and economy. Hopefully the results of this comprehensive work will serve as a significant contribution to the environmental, social and economic history of Roman North Africa, perhaps providing a new and relevant theoretical approach for examining past anthropogenic impacts on marine life, the evolution of ancient foodways and the urbanisation of the region.[11]

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[10] Some North African examples include Mattingly 1986; Slim et al. 2004.

[11] This volume is based on a PhD thesis (Trakadas 2009) that has been revised and expanded, with ten sites and 204 catalogue entries from the region added to the previous study. As a result, the present volume provides a much fuller and more nuanced picture of the subject than was possible almost a decade ago. All data and comparanda updated to 2016.

Chapter 2
Methodology

2.1 Previous approaches to marine resources in antiquity

Marine resources in the Graeco-Roman world have been subject to increasing levels and approaches of scholarly enquiry over the last two centuries.[1] Interest in the subject was initiated by philologists who focused upon the collection and decipherment of ancient textual references, treatises or epigraphy related to marine subjects. As early as 1832, studies appeared on the manufacture of dried, salted fish (*salsamenta*) and salted-fish sauces in antiquity within the Black Sea and Mediterranean.[2] Research was also undertaken into the identification of marine species known and sought in antiquity, with the most comprehensive Greek usages compiled by F.A. Wood in 1927–28 and the Latin usages by D.W. Thompson and E. De Saint-Denis in 1947.[3] Within this period, some ancient exploitation methods were discussed, but fishing was treated more as a 'sport' than as a subsistence activity.[4]

Since the 1960s, archaeological studies have contributed greatly to research on marine resources in antiquity. At first, these were applicable almost solely to the fish-salting industry, sometimes with contemporary literary and iconographic sources incorporated as useful comparanda. The first major work in this area in the Mediterranean, published by M. Ponsich and M. Tarradell in 1965, identifies a large number of Roman fish-salting facilities in northern Morocco, southern Spain and Portugal.[5] Following this precedent, publications of similar fish-salting sites have appeared in the last five decades, primarily regarding the Iberian Peninsula but also southern France, Tunisia and the northern Black Sea.[6] Studies of the manufacture of purple dye from *Muricidae* shellfish have also appeared.[7]

Extending from the archaeological analyses, studies in the production events and economics of the fish-salting industry have also been presented. Topics include how processing

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1 For further discussion of the history of this scholarship, see Trakadas 2010b.

2 E.g., Köhler 1832; Cuvier & Valenciennes 1832; Smidth 1876; Besnier 1907; Eberl 1892; Zahn 1910; Grimal & Monod 1952.

3 E.g., Wood 1927; 1928a; 1928b; Thompson 1947; De Saint-Denis 1947; see also other compilations in Clarke 1888; Barbier 1925–26; 1927–28; 1933–36; Cotte 1944; Andrews 1949; Gow 1968; Peurière 2003; Hünemörder 1998.

4 E.g., Blümner 1869; Lafaye 1907; Bunamann 1910; Radcliffe 1921; Horn 1929; Butler 1931; Bohlen 1937; Concoran 1957; 1964.

5 Ponsich & Tarradell 1965; Ponsich 1988.

6 García Vargas & Bernal Casasola 2009; Trousset 1992; 1998; Étienne & Mayet 1998a; 2002; 2007; Arévalo & Bernal 2007a; Lagóstena 2001; regional summaries in Wilson 2002a; 2006; Højte 2005; Sternberg 1998; Trakadas 2005; Curtis 1991.

7 E.g., Fernández Uriel 1995; Alfaro Giner 2002.

was conducted, where and how the products were shipped, who was involved in their transportation and the different scales of the trade. These studies make use of texts, epigraphy (stamps and *tituli picti* in particular, but also some inscriptions) and archaeological sources ranging from the sites themselves to kilns and amphorae distribution.[8]

Fortuitously, ichthyo-archaeological studies have also been gradually incorporated within some of the fish-salting industry analyses.[9] These studies have helped not only to identify scientifically the species of fish found at the processing sites but those found in transport amphorae, mainly preserved from shipwrecks in the western Mediterranean.[10]

Archaeology has also brought to light finds of Graeco-Roman fishing equipment and technology previously attested only in texts or iconography. Fishing equipment studies cover broad geographical regions due to disparate distribution of the preserved evidence; there are, however, regional analyses of the equipment utilised in regions of Spain, Egypt, Tunisia and Italy.[11] Constructed shoreline features, such as weirs or catch basins that kept and trapped fish and shellfish in lagoons or tidal zones are also documented.[12] Related to these shoreline features are sea-water fish ponds, *piscinae salsae* or *maritimae*.[13] Fishing vessels are better understood from texts and iconography, as only a few archaeological finds of these are presently known in the Mediterranean.[14] Unfortunately, limited attention has been paid to fishing rights and access to different marine environments.[15]

Recently, empirical studies have combined archaeological and ethnographic data to examine the levels of productivity of specific fishing techniques.[16] Through literary and archaeological data, scales of exploitation are also beginning to be correlated in order to determine the levels of consumption of seafood amongst communities in certain parts of the Graeco-Roman world; similar data are being correlated to determine the impact of fishing on past marine ecosystems.[17]

2.2 Theoretical framework of the present enquiry

The previous analyses outlined above largely treat the practice of fishing generally or focus specifically on facets of the ancient fish-salting industry. In regards to the former, the material is often treated similarly across regions that possess very different localised topographies

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8 E.g., Étienne 1970; Ben Lazreg et al. 1995; Étienne & Mayet 1998b; Di Stefano 2002; Sternberg 2000; Edmondson 1987; Lowe 1997; Jardin 1961; Curtis 1984; 1984–86; Arévalo González et al. 2004.

9 E.g., Desse-Berset & Desse 2000; Van Neer 1994; Larje 1995; Bernal et al. 2007c.

10 See Delussu & Wilkens 2000; De Grossi Mazzorin 2000; Sternberg 1998.

11 General: Donati & Pasini 1997; Spain: *APEG*; *ANFG*; Egypt: Brewer & Friedman 1990; Bates 1917; Darby et al. 1977; Italy: Rustico 1999; Tunisia: Trousset 1998.

12 Alves et al. 1988–89; Moreno Páramo & Abad Casal 1971; Petriaggi 2004; Rustico 1999; Gazda & McCann 1987; McCann 1979; Trakadas 2006: 265–266.

13 Higginbotham 1997; Lafon 1998; Parslow 1998; Trakadas 2006: 261–264; Kuhn 2000.

14 E.g., Carlson 1999; 2002; see examples discussed in Chapter 3.2.2.

15 Greek fishing rights: Höppener 1931; Lytle 2006: 6–36; Roman fishing rights: Peurière 2002; Ørsted 1998: 14–17; Trakadas 2006: 259–260; review in Marzano 2013: 235–267.

16 See arguments contra Gallant 1985 in Bekker-Nielsen 2002b: 215; 2002a; 2005; Purcell 1995; Lund Jacobsen 2005.

17 Trakadas 2006; Prowse et al. 2004; Wilkins 1993.

and marine environments. In regards to the latter, the methods and logistical and environmental factors of extracting fish, shellfish and other marine species to supply the salting industry are often left unexamined and uncorrelated. Instead, the products are evaluated and quantified without consideration of the broader parameters associated with obtaining the resources. In this respect, illustrations of fishing in the Graeco-Roman world are also often initiated without consideration of the uniqueness of marine habitats or undertaken using general environmental and technological assumptions. This present study considers first and foremost the coastal, riverine and lagoonal environments of the region that became the province of *Mauretania Tingitana* as the framework in which the evidence for marine resource exploitation can be contextualised and analysed.

People live at the edges of and move through the sea and littoral waterways for short or long periods, not only for transportation but also to obtain food by fishing for the animals that live in these waters; the marine and littoral environment, therefore, plays a key role in understanding these actions and relationships and their patterns.[18] It is within this assertion that the concepts significantly recognised by F. Braudel in historical analyses are inherent in this study: the environment has long-term and overriding importance. This *longue durée* is embodied by the coastal landscape and seascape, and it is within these that general conditions are established and are more influential than short-term, socio-political events (*courte durée* or *événements*) and medium-term structures (*moyenne durée*) of demographic cycles.[19]

The influence of Braudel's theory on how maritime environments and relationships are approached, particularly in regard to subsistence, is discussed in J. Rönnby's concept of "maritime durées".[20] The spatial and material parameters most applicable to this present study and in line with Braudel's (and Rönnby's) broader themes, however, are the tenets outlined in C. Westerdahl's "maritime cultural landscape" concept.[21] This approach specifically outlines examination of the sea and the interconnected waterways, the adjacent zones and the associated littoral (human) communities – the 'plot' where fishing took place in lagoons and rivers, from shore, inshore and offshore.[22] Although not intended originally as an analytical tool, however, the maritime cultural landscape concept significantly underscores and includes man-made features on land as much as the underwater environment of the coastal zone in its definition.[23] This present study considers the basic cognitive tenets of this approach whilst asserting that the 'landscape' in respect to fishing does not necessarily include vessels (fishing can take place from a river bank) or follow maritime transport and communication networks (as fishing offshore does not hold to these patterns/anthropologically-constructed corridors).

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18 Aptly stated in Cooney 2004: 323: "But in coastal areas the sea is not just the main means of contact between inhabited places, it is central to the way of human life." See also Pálsson 1997: 14; Hewes 1948: 238–240; Jackson et al. 2001: 629; Erlandson & Rick 2008: 7–9.

19 Braudel 1958; 1992.

20 Rönnby 2007.

21 Westerdahl 1992; 2007.

22 Parker 2001: 23.

23 Westerdahl 2007; 1992: 5–6; 1994: 266; Hunter 1994: 261–262; Adams 2006: 2; Parker 2001: 22.

A further consideration is the ecological systems and particular habitats of animals within the environments of the maritime cultural landscape.[24] The ecological systems of marine life (such as daily, seasonal or annual feeding, migratory and spawning cycles), as well as established habitats (such as oceanic, inshore, lagoonal and riverine) are incorporated in this study as part of the parameters integral to analysing the past marine environment and their influence on the techniques possible and practical for exploitation.

2.3 Methodological approach and research questions

This study first examines the past human interaction with and use of marine resources from the surrounding seas and littoral waterways of Roman *Mauretania Tingitana* in the northwest Maghreb, on the northwest edge of the African continent. The broader analysis of this study ultimately examines the ways in which the practice, products and role of marine resource exploitation was affected by the Roman incorporation of the province. Therefore, data also derive from the preceding Punico-Mauretanian and following Late Roman periods.

Whilst the historical background provides the socio-political, cultural and chronological context of this study (Chapter 4), the marine and littoral environments serve as the primary framework for these *événements* (Chapter 5, Appendix 7). Against this, the extensive archaeological and descriptive sources from or relating to the region (contextualised in Chapter 3 and catalogued in Appendices 1–6) constitute the comprehensive data sets that form the basis of this study's subsequent reconstructions and analyses (Chapters 6–7). Archaeological data include marine animal remains, fishing equipment and fish-salting sites from the former province; descriptive data include written sources, pictorial representations and ethnographic documentation. Because of lacunae and the inherent biases of preservation or media type, these data are therefore intended to be complementary.

The catalogued archaeological and descriptive sources are first applied to broad characterisations of the region, focusing on the Mediterranean, Strait of Gibraltar and Atlantic littorals (Chapter 6). Addressed are the following lines of enquiry:

1. Where did fishing take place: from shore, in rivers, or at sea? What amount of fishing took place where?
2. Where were marine resources and salted-fish products produced and consumed in the region?
3. What was the chronology of marine resource exploitation?

These characterisations serve as the introduction to and context around which the major case studies of the three sites in Chapter 7 are presented: *Tamuda, Septem Fratres* and *Lixus*, situated on the Mediterranean, Strait of Gibraltar and Atlantic coasts, respectively. The following research questions are addressed:

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[24] For various definitions of the term 'ecology', see Lévi-Strauss 1974; Ingold 2000: 19; Butzer 1982: 5, 32. This study follows Rackham (1996: 16–17) in asserting that ecology is, quite simply, the study of living creatures within the environment.

1. What types/species of marine resources were exploited?
2. Based on the identified types/species, what were the habitats exploited and when did fishing take place (seasonality)?
3. What evidence is there for different fishing methods?
4. If fish-salting production took place, what were the processes involved and resources required?
5. What were the areas and methods of fishing effort?
6. What is the overall chronology and role of the exploitation?

The discussion of this study (Chapter 8) assesses the use and role of marine resources in *Mauretania Tingitana*. By including the Punico-Mauretanian and Late Roman evidence presented in the preceding two chapters, comparative analyses identify the patterns and methods of fishing effort over time and contextualise these within a socio-cultural and economic perspective. Addressed in this chapter are the following questions:

1. What was the role of 'fresh' marine resources consumption, and how does this compare to other foodstuffs throughout the province?
2. What were the roles of processed marine resources (including salted-fish products, sauces and purple dye), and how do these compare to other forms of agricultural production throughout the province?
3. What was the impact of the incorporation of *Mauretania Tingitana* into the Roman Empire ('Romanisation') upon marine resource exploitation?

2.3.1 Chronology

As the aims of this study include the identification of changes and/or continuity of marine resource exploitation in *Mauretania Tingitana* in antiquity, evidence pertaining to the Roman period will be compared to that from earlier and later periods. However, a uniform chronology does not exist for the archaeology of the northwest Maghreb: some chronologies are very refined, whilst others are more generalised.[25] In many cases, material included in this analysis was excavated and/or published when diagnostic ceramic chronologies were not as well established as at present. Therefore, to place the archaeological and descriptive data into comparable categories for the present study, the following chronology will be used:

– Punico-Mauretanian: 5th century BC–ca. AD 75
– Roman: ca. AD 75–late 3rd/early 4th centuries AD
– Late Roman: late 3rd/early 4th centuries–6th century AD
– Context Unknown: 5th century BC–6th century AD

The first three periods are based on ceramic chronologies as representative of phases of the Roman socio-cultural influence or "cultural matrix" present in the northwest Maghreb

[25] E.g., at *Lixus*: Aranegui Gascó 2001; 2005a; 2005b; *Thamusida*: Akerraz et al. 2013: xiv, xvii, xxi; generalised dates given in Euzennat 2000.

(Table 2.1).[26] Another category, 'Context Unknown', is included in this study to denote artefacts that cannot be more precisely assigned to fewer than three of the above-cited periods.[27] This study's chronology, applied to the regional characterisations, case studies and appendices, compares to other chronologies previously applied to material from the northwest Maghreb (Table 2.2).

2.3.2 Site types

All sites with archaeological finds discussed in this study are numbered – 67 in total (Table 2.3, Fig. 2.1). These numbers are used to identify sites throughout the text, in tables and on maps.

In this study, the main body of archaeological finds *directly* related to marine resource exploitation are marine animal remains, fishing equipment and fish-salting sites (discussed in Chapter 3.2). These data derive from 33 sites in *Mauretania Tingitana* (Tables 2.4–2.6).[28] (Sites *only* with finds of salazón amphorae are not included in these tables as they represent the consumption of salted foodstuffs, imported as well.[29]) In order to discuss and compare the material in the regional characterisations and case studies (Chapters 7–8), the 33 sites are separated into three groups:

1. *Major sites*: permanent settlements, sometimes walled, and recognised/noted in antiquity as *coloniae*, *municipa* or *oppida* (see Table 2.4).
2. *Minor sites*: 'stations' or small settlements with a few buildings that could be occupied year-round or seasonally, some with built structures used to carry out fish-salting practices, or farms, *villae* and *castella* (see Table 2.5).
3. *Agglomerations*: sites with no permanent structures discernible but ceramics and other artefacts are present, or isolated necropoli (see Table 2.6).[30]

Tables 2.4–2.6 also list the general topographic situation of the sites in relation to the marine systems and the reconstructed littoral (outlined in Chapter 5.4): coastal, riverine, lagoonal and inland. Coastal sites lie within 2 km of the reconstructed littoral; inland sites lie 2 km or more from a major body of water. Some sites possess dual topographical situations.

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[26] Based upon the appearance of finewares and amphorae in the region. The period divisions used in Chapter 4, however, whilst generally applicable to this study's chronology, are based on specific historical events. Note that some fish-salting at *Lixus* and Sidi Bou Hayel might date into the 7th century AD.

[27] Some finds cannot be assigned to any specific context other than a site, and in most cases the chronology of the site extends over all three periods, if not beyond.

[28] Based on data in App. 1, App. 2 and App. 3.1.

[29] Based on data in App. 3.3.

[30] The term "agglomeration" is used broadly in archaeological reports of the region to denote sites both with and without structures; see mentions throughout Ponsich 1970; Tarradell 1960.

Table 2.1: Ceramics indicative of this study's chronology. ARSW = African Red Slip Ware, TS = *terra sigillata* (sources: Fentress & Perkins 1988; Peacock & Williams 1991; Hayes 1972; 1980; Villaverde Vega 1992; *Lixus-1; Lixus-2*; *Lixus-3*; Kbiri Alaoui 2007).

PERIOD	INDICATIVE CERAMICS
PUNICO-MAURETANIAN	*Amphorae:* Mañá-Pascual A4, Mañá C2a-b, Sala 1, Haltern 70, Greco-Italic, Dressel 1-1b, Dressel 7-11, Dressel 20a
	Finewares: Campanian A, first TS *italicas*, black glaze imitations made at Kouass, southern Gaul TS
ROMAN	*Amphorae:* Beltrán IIA/IIB, Dressel 12, Dressel 14
	Finewares: ARSW, TS *hispanica*
LATE ROMAN	*Amphorae:* Almagro 51a-c, Beltrán 72
	Finewares: ARSW D

Table 2.2: This study's chronology compared to other archaeologically-derived chronologies used in the northwest Maghreb.

PERIOD (this study)	Ponsich 1970	Rebuffat 2001	Aranegui Gascó 2005a	Akerraz et al. 2013
PUNICO-MAURETANIAN (5th c. BC–AD 75)	Punico-Mauretanian (late 5th/early 4th c.–146 BC)	Mauretanian (12th c. BC–AD 40)	Punic (325–175 BC)	Period 1 (Mauretanian: 1st c. BC/AD–Tiberius/Claudius)
			Ancient Mauretanian 1 (175–130 BC)	
	Mauretanian (146 BC–AD 40)		Ancient Mauretanian 2 (130–80 BC)	
			Ancient Mauretanian 3 (80–50 BC)	
			Middle Mauretanian (50 BC–AD 10)	
			Recent Mauretanian (AD 10–50)	
ROMAN (AD 75–late 3rd/early 4th c. AD)	Roman (AD 40–late 3rd/early 4th c. AD)	First Roman provincial (AD 40–285)	Roman (1st–3rd c. AD)	Period 2 (Roman: Tiberius/Claudius –late 3rd/early 4th c. AD)
LATE ROMAN (late 3rd/early 4th–6th c. AD)	Late Empire (late 3rd/early 4th–5th c. AD)	Second Roman provincial (AD 285–429)	Late Roman (3rd–6th c. AD)	Period 3 (Late Antique: 4th–7th c. AD)
		Vandalo-Byzantine (AD 429–681)		

Table 2.3: Site list: all sites with archaeological finds discussed in this study. Specific types of finds noted as: M = marine animal remains, E = fishing equipment, FS = fish-salting site, A = salazón amphorae. Modern site names given in parentheses; alternative site spellings separated by a slash, where the first listed is used throughout this study (continued on next page).

SITE #	SITE	TYPE OF FIND	REGION
1	Berkane	A	Mediterranean
2	Ed Dahar Taifant	A	
3	El Aabid	A	
4	*Rusaddir* (Melilla)	M, E, A	
5	Sidi Moulay Baghdad	A	
6	Sidi Driss	A	
7	Emsa	M, FS, A	
8	Sidi Abdeselam del Behar	M, E, FS, A	
9	Metrouna	M, E, FS, A	
10	Kitzan/Kitane	M, A	
11	*Tamuda*	M, E, A	
12	Loma Amarilla	A	
13	Zbar d'Akwizan	A	
14	Krira d-Jouimec I	A	
15	Costa Rincon	M, E	
16	Sania e Torres	M, FS, A	
17	Sidi Bou Hayel	M, FS, A	
18	Koudia Talâa	A	
19	*Septem Fratres* (Ceuta)	M, E, FS, A	Strait of Gibraltar
20	Bay of Benzú	A	
21	Île Perekhil	A	
22	El Marsa	M, FS	
23	Kerka	M, A	
24	Rhalala	A	
25	Ksar-es-Seghir/Alcazarsegher	M, FS, A	
26	Dchar 'Askfane	M, E, FS, A	
27	Zahara/Sahara	M, FS, A	
28	Leliak	FS, A	
29	Oued Liam	A	
30	Kankouz	FS, A	
31	*Tingi* (Tangier)	A	

SITE #	SITE	TYPE OF FIND	REGION
32	Cap Spartel	A	Atlantic
33	Cotta	M, E, FS, A	
34	Jorf el Hamra	A	
35	Petit Bois	A	
36	Djebila	M	
37	Tahadart	M, E, FS, A	
38	Kouass	M. E, FS, A	
39	*Zilil* (Dechar Jedid)	M, E, A	
40	Aïn Mesbah	A	
41	En Nkhella	A	
42	Kridissa bir Mitkal	A	
43	Suiar	M, E, A	
44	*Tabernae*	E	
45	Bled Riat el Khemis-Ras Rmel	A	
46	*Lixus*	M, E, FS, A	
47	Property of Ben Driss Islami	A	
48	Mbarec	A	
49	Azib Slaoui	A	
50	Oued Mdâ	A	
51	Nzalet Bin Ammar area	A	
52	Oued Riahi	A	
53	Ouled Aïssa area	A	
54	Sidi Yahia del Gharb area	A	
55	Sidi Slimane Arbaoua	A	
56	*Banasa*	M, E, FS, A	
57	*Thamusida*	M, E, FS, A	
58	Sidi Slimane	E, A	
59	Sidi Kacem	A	
60	Rirha	M, A	
61	*Volubilis*	M, E, A	
62	Volubilis valley	M, A	
63	Mhaya	A	
64	*Exploratio Ad Mercurios* (Khedis)	A	
65	Rabat	A	
66	*Sala*	M, E, A	
67	Essaouira/Îles Purpuraires	M, E, FS, A	

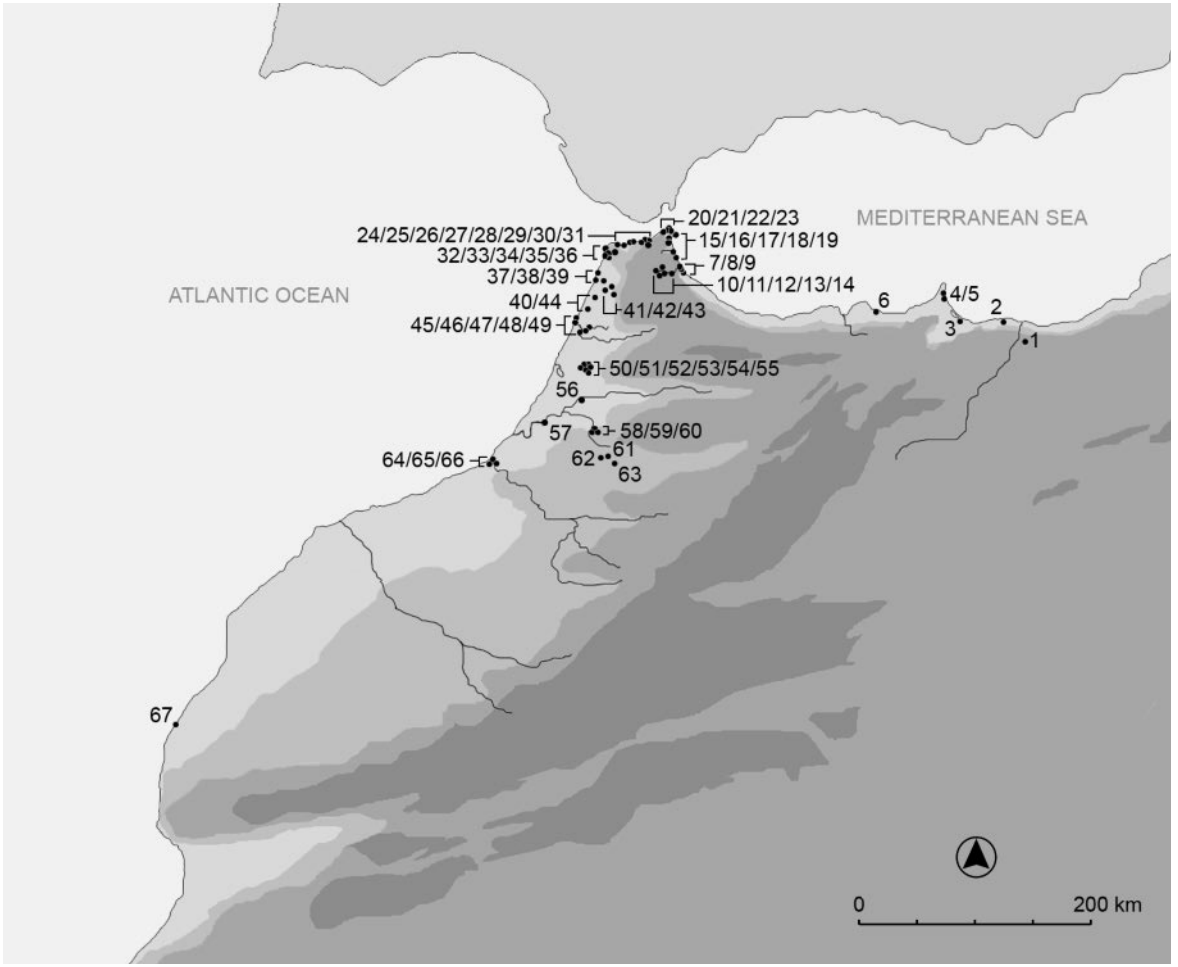

Fig. 2.1: Distribution map of all sites with archaeological finds discussed in this study (see Table 2.3). Image: AT.

Table 2.4: 'Major sites' in the northwest Maghreb that have evidence of marine resource exploitation.

SITE #	SITE	SITUATION	DESCRIPTION
4	*Rusaddir*	coastal	Punico-Mauretanian settlement/port; Roman port on the Mediterranean coast – possibly an *oppidum* – likely made a *colonia* in the 2nd century AD (Gozalbes Cravioto 1991: 142–143; 2005: 24–25).
11	*Tamuda*	riverine/ inland	Punico-Mauretanian settlement with agricultural sites upriver from the Mediterranean on the Oued Martil; Roman and Late Roman *castellum* (Morán & Giménez Bernal 1948; Tarradell 1956; Bernal et al. 2008a).
19	*Septem Fratres*	coastal	Phoenician agglomeration; Roman fishing station/port on the Strait of Gibraltar coast, developing into a settlement and possibly a *municipium* by the 3rd century (Hita Ruiz & Villada Paredes 1994; Bernal Casasola & Pérez Rivera 1999).
39	*Zilil*	lagoonal	Walled Punico-Mauretanian settlement near the Oued Hachef lagoon on the Atlantic coast; Roman *colonia;* Late Roman activity (Akerraz et al. 1981–82; Depeyrot 1999).
46	*Lixus*	lagoonal/ riverine	Walled Phoenician and Punico-Mauretanian settlement/ port on the Oued Loukkos lagoon near the Atlantic coast; Roman *colonia* and Late Roman settlement (M. Lenoir 1992; Aranegui Gascó & Habibi 2004).
56	*Banasa*	riverine/ inland	Walled Punico-Mauretanian settlement on the Oued Sebou in the Rharb plain; Roman *colonia* (Euzennat 1957a: 50; Arharbi & Lenoir 2004; Thouvenot 1954).
57	*Thamusida*	riverine/ inland	Punico-Mauretanian site; walled Roman settlement and military camp on the Oued Sebou in the Rharb plain (Rebuffat 1968–72: 56; 1977; Callu et al. 1965).
61	*Volubilis*	inland	Walled Punico-Mauretanian settlement; Roman *colonia* and seat of provincial government in the western Atlas foothills (Jodin 1987: 33–38; Étienne 1960).
66	*Sala*	riverine/ inland	Walled Roman *colonia* on the Oued Bouregreg upriver from the Atlantic coast; Late Roman military camp (Boube 1966; 1999).

Table 2.5: 'Minor sites' in the northwest Maghreb that have evidence of marine resource exploitation (continued on next page).

SITE #	SITE	SITUATION	DESCRIPTION
7	Emsa	coastal/ riverine	Small Punico-Mauretanian station (likely fish-salting activity) on the Oued Emsa near the Mediterranean coast (Kbiri Alaoui 2008; Tarradell 1966: 440–443).
8	Sidi Abdeselam del Behar	coastal/ riverine	Punico-Mauretanian station (likely fish-salting activity) on the Mediterranean coast at old mouth of the Oued Martil; Roman/Late Roman station (possible fortification?) (Tarradell 1960: 86–95; Villaverde Vega 2001: 237–239; Bernal et al. 2008b: 317–319, 336).
9	Metrouna	coastal/ riverine	Roman fish-salting and purple-dye facility on the Mediterranean coast at an old mouth of the Oued Martil (Bernal et al. 2008b: 332–335).
10	Kitzan	riverine/ inland	Small Punico-Mauretanian and possible early Roman settlement upriver from the Mediterranean on the Oued Martil (El Khayari et al. 2011: 344–364).
16	Sania e Torres	coastal	Roman fish-salting facility on the Mediterranean coast (Ponsich & Tarradell 1965: 75–77).
17	Sidi Bou Hayel	coastal/ riverine	Roman and Late Roman *villa* or settlement with possible fish-salting activity on the Oued Negrón near Mediterranean coast (Bernal et al. 2011a: 431–458).
22	El Marsa	coastal	Small Punico-Mauretanian, Roman and Late Roman settlement on the Strait of Gibraltar coast, with possible fish-salting activity (Bernal Casasola 2011a: 42–43; Raissouni et al. 2011: 310–311).
23	Kerka	coastal	Small Punico-Mauretanian settlement on the coast of the Strait of Gibraltar with a later military character (Bernal et al. 2015: 376–380).
25	Ksar-es-Seghir	coastal	Roman fish-salting facility on the Strait of Gibraltar coast; small Roman and Late Roman settlement nearby (Ponsich & Tarradell 1965: 71–75).
26	Dchar 'Askfane	coastal/ riverine	Punico-Mauretanian fish-salting facility on Oued El Kazar near the Strait of Gibraltar; Roman *villa*/fish-salting facility; Late Roman *centenarius* (Akerraz & El Khayari 2005: 37–38; El Khayari & Akerraz 2013).
27	Zahara	coastal	Roman-period building with fish-salting activity on the Strait of Gibraltar coast (Ponsich & Tarradell 1965: 68–71; Ponsich 1988: 159–160).
28	Leliak	coastal	Small Roman settlement with possible fish-salting activity on the Strait of Gibraltar coast (Raissouni et al. 2011: 315).
30	Kankouz	coastal	Small Roman settlement or *villa* with possible fish-salting activity on the Strait of Gibraltar coast (Raissouni et al. 2011: 317–318).

SITE #	SITE	SITUATION	DESCRIPTION
33	Cotta	coastal	Roman fish-salting complex with possible small settlement with necropolis on the Atlantic coast; Late Roman agricultural production site with peristyle house (Ponsich 1964b: 266–267; 1970: 206–212, 276–290, 319–335; Ponsich & Tarradell 1965: 55–68).
37	Tahadart	coastal/ lagoonal	Six late Punico-Mauretanian, Roman and Late Roman fish-salting complexes on the Oued Hachef lagoon adjacent to the Atlantic coast (Ponsich & Tarradell 1965: 40–45; Arharbi 2002a; 2002b).
38	Kouass	coastal/ riverine	Punico-Mauretanian kiln site; Roman fish-salting complexes, watering station/camp on the Oued Garifa adjacent to the Atlantic coast (Ponsich & Tarradell 1965: 38–40; Ponsich 1968; Kbiri Alaoui 2008).
43	Suiar	inland	Roman and Late Roman *castellum* (*Ad Novas*?) in the northern Rharb plain (Villaverde Vega 2001: 111–114).
44	*Tabernae*	inland	Roman and Late Roman *castellum* inland in the northern Rharb plain (Ponsich 1966a: 418).
60	Rirha	riverine/ inland	Possibly *Gilda* – Punico-Mauretanian and Roman settlement on a plateau oxbow on the Oued Beth in the southeastern Rharb plain; area surrounded by farms (Girard 1985; Callegarin et al. 2016b; 2016c).
62	Volubilis valley	inland	Small Punico-Mauretanian, Roman and Late Roman sites to the north, south and west of *Volubilis* near the Atlas foothills: watch towers, *vici*, villages, hamlets and isolated farms (Rebuffat et al. 1986).
67	Essaouira	coastal (island)	Phoenician station; small Punico-Mauretanian settlement; Roman *villa* and purple-dye/fish-salting facility; Late Roman *villa* on island just off the southern Atlantic coast (Jodin 1966c; 1967).

Table 2.6: 'Agglomerations' in the northwest Maghreb that have evidence of marine resource exploitation.

SITE #	SITE	SITUATION	DESCRIPTION
15	Costa Rincon	coastal	Small agglomeration of Punico-Mauretanian artefacts on the Mediterranean coast; no structures (located at M'diq) (Tarradell 1966: 435–437).
36	Djebila	coastal	Phoenician and Punico-Mauretanian necropolis on the northern Atlantic coast (Ponsich 1967b: 141–222; 1970: 72–79).
58	Sidi Slimane	riverine/ inland	Punico-Mauretanian necropolis on the Oued Beth, in close proximity to Rirha in the Rharb plain (Luquet 1973–75a: 254–257).

Chapter 3
Contexts, data sources and applications

3.1 Environmental context and data

Geographically, this study encompasses the area of the northwest Maghreb that was the fullest extent of the province of *Mauretania Tingitana,* from ca. AD 42/43 to ca. 280.[1] The provincial territory therefore included the northern portion of the present Kingdom of Morocco and the Spanish North African autonomous cities.

The sources utilised in describing this study's environmental context (Chapter 5) within this geographical area are varied. Quantitative data include geological and palaeo-botanical studies, bathymetric and hydrographic data, as well as finds from underwater and terrestrial archaeological surveys. Complementing these are qualitative data: inscriptions from the province, ancient textual sources such as Strabo, Pliny, Claudius Ptolemy, Pomponius Mela and the *Antonine Itinerary,* medieval Arab geographical treatises and historical texts such as Portuguese navigational treaties and English travellers' accounts. Additionally, historical maps from the 17th–19th centuries are examined (Appendix 7).

Throughout this study, source material and analyses are organised by the three main hydrographical and ecological systems that surround the former province: the Mediterranean Sea, Strait of Gibraltar and Atlantic Ocean. In Chapter 5.3, the present coastal geography, topography and offshore and littoral environments of the region are first described. In addition to the coastal terrestrial features, the marine systems and maritime conditions function as environmental parameters, constituting the ecological habitats for marine life but also the seascape in which people navigated by boat or came in contact with the littoral zone. Weather patterns are noted to determine the daily and seasonal possibilities of navigation to reach particular fishing grounds and return to shore; their effect on fishing practices are discussed in the regional characterisations and case studies (Chapters 6–7).

Within this environmental context, it is maritime-related *moyenne durée* structures – ports, anchorages or landings – that can provide the framework for determining the logistics and spatial relationships of marine resource extraction and indicate points of land-sea interface.[2] In some cases, these sites indicate navigation routes (coastal as well as riverine) and specific areas of fishing effort (safe harbours/landings in proximity to fishing grounds). Here, larger transit points and settlements, identified through their archaeological remains, are described in the maritime landscape; smaller agglomerations of finds are included in this study to note other possible points of past land-sea interface or coastal-zone activities.

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1 For the specific topographical features delineating the province, see Chapter 5.1.

2 Westerdahl 1992: 6; Parker 2001: 23.

These same sources are then analysed to determine the causes and impacts of past sea-level and geo-morphological changes to the littoral over the last ca. 2,000–2,500 years. These changes, not fully considered in previous studies pertaining to the province's Roman period, can not only impact navigation, but also littoral topography, marine habitats and past fishing grounds.[3] From the data, a 'reconstructed' littoral is presented that serves as the study's base map (Chapter 5.4). Within this framework, the collated data from the archaeological and descriptive sources (described below), are analysed in Chapters 6–7 in order to assist in the visualisation of the coastal land- and seascapes, and the interpretations of ecological, spatial and social relationships.

3.2 Archaeological data

The archaeological material compiled in this study derives from publications of excavated finds within the northwest Maghreb, as well as a large amount of unpublished artefacts from earlier regional excavations that are presently stored in museums and site dépôts of Morocco and the Spanish North African autonomous cities of Ceuta and Melilla.[4] The discussion of relevant sites derives from published information and site reconnaissance.[5]

3.2.1 Marine animal remains

The primary archaeological data examined in this study are comprised of the identified remains of marine resources: fish bones (including marine mammals and cartilaginous fish) and marine invertebrates (shellfish, sea urchin, coral and crustaceans) (Fig. 3.1). The initial studies regarding marine resource exploitation in the province do not really address this evidence: M. Ponsich and M. Tarradell generally mention fish bones and shellfish in their 1965 publication, and *Muricidae* shells (*murex* and *purpura* species) are documented in A. Jodin's work at Essaouira but no quantities are given and specific contexts are lacking.[6] Over the last two decades, studies have been conducted on the faunal remains from the *Septem Fratres* fish-salting sites, at *Tamuda*, Metrouna and Rirha, as well as from the Phoenician and Punico-Mauretanian levels at *Lixus* and Kouass, and the Phoenician levels at Essaouira.[7] In this present study, published and unpublished material is catalogued in Appendix 1.1: Fish bones and Appendix 1.2: Marine invertebrates. These finds will first

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[3] Van Neer et al. 2004: 12; for such previous studies in Morocco, see Luquet 1973–75b; Roget 1924; Euzennat 1962; 2000; Mauny 1970; Schmitt 1973.

[4] Morocco: Musée de la Kasbah, Tangier; Musée Archéologique, Tetouan; Musée Archéologique, Larache; Musée Archéologique, Rabat, and the dépôts at the sites of *Volubilis* and *Chellah* (*Sala*, in Rabat). The Spanish North African autonomous cities: Museo Municipal de Ceuta and Museo de Arqueología e Historia, Melilla. For unpublished artefacts that were not clearly labelled, chronology was determined by associated ceramics.

[5] Carried out by the author with kind permission of INSAP and Instituto de Estudios Ceutíes.

[6] Ponsich & Tarradell 1965; Ponsich 1988; Jodin 1967.

[7] Roselló Izquierdo 1992; Grau Almero et al. 2001; 2010a; 2010b; Rodríguez Santana & Rodrigo García 2005; Carrasco Porras 2005; Bernal et al. 2011b; Bernal Casasola et al. 2014a; 2014b; Oueslati 2016. Publication of recent campaigns at Essaouira and Kouass are still awaited; see, however, Becker & Küchelmann 2010; Bridoux et al. 2014.

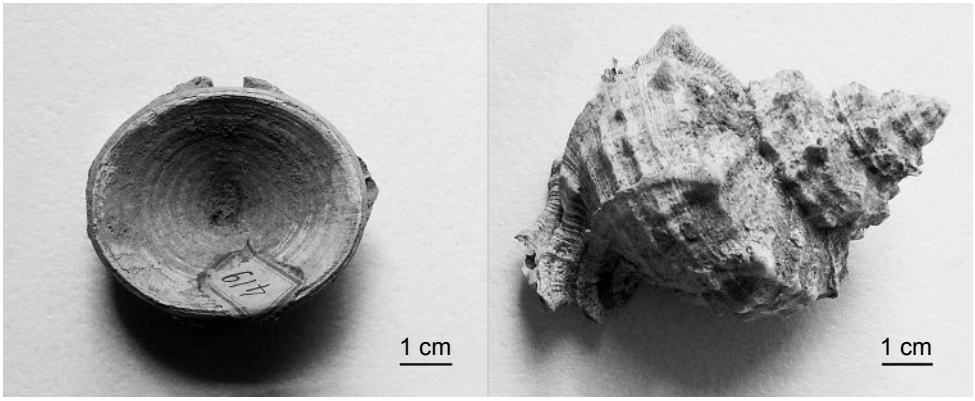

Fig. 3.1: Fish bone (bluefin tuna, *Thunnus thynnus*), left, from Punico-Mauretanian layers at *Tamuda*. Shellfish (banded dye-murex, *Murex trunculus*), right, from Roman layers at *Lixus*. Photos: AT.

serve to identify the species fished during different periods and where in the region; their contexts demonstrate human dietary choices and other forms of possible consumption, such as for bait or oil, or remains used as tools, decoration or pottery temper.[8]

By considering the specialised habitats and behaviour of the various marine species recovered it is possible to reconstruct the areas exploited by fishermen and determine the methods likely used to catch them. In turn, these finds can lead to inferences regarding seasonality, and thus human understanding of seasonal movements.[9] For example, shellfish, as relatively more sessile animals than fish, make their exploitation by humans somewhat easy.[10] There are species that live near the shoreline, in marine and estuarine environments, and in the intertidal zone (to ca. 5 m depth).[11] Other species live in the infratidal zone, below 5 m depth and are not immediately accessible by humans from the shoreline.[12] For a short period every spring, shellfish such as oysters and mussels are suitable for fresh consumption, before their spawning cycles. *Muricidae* shellfish are an optimal catch, if used for dye, in late winter or early summer when the animals' hypobranchial glands produce desirable liquid; sea urchin is best in winter, when the gonads develop.[13] The presence of such species in the archaeological record over time suggests that there was clearly human understanding of seasonality, 'consumability' and use, and this is also echoed by ancient authors.[14]

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8 Wheeler & Jones 1989: 7–8; Karali 1999: 11, 43; Reitz & Wing 2008: 134.

9 Dincauze 2000: 460; Noe-Nygaard 1983; Cerón-Carrasco 1998: 75; Sternberg 2002: 98–99; Wheeler & Jones 1989: 4–6, 9–10; Cione 2006; Kohen & Cione 2006.

10 Erlandson 2001: 293–295.

11 As the Atlantic tidal range is ca. 3 m (NIMA 143: 200), ca. 5 m depth could allow for direct human access to intertidal species at low tide using tools such as a rake (see below).

12 Karali 1999: 10.

13 Aristotle, *HA* 5.12; 8.13; Pliny, *NH* 9.62.133–135; Cassiodorus, *Var.* 1.2; Vasconcelos et al. 2008: 289; Siliani et al. 2016.

14 Andrews 1948: 299–300; Aristotle, *HA* 5.11–12; 6.17; 8.12–13; Pliny, *NH* 9.62.133–135.

Compared to marine invertebrates, fish are much more mobile animals, in that there are littoral, schooling and open-water species that can go through trans-oceanic migrations and transition from shallow rivers to deep ocean waters. Occupation of habitats may change or expand during their daily, annual or life cycles.[15] In the northwest Maghreb, members of the *Scombridae* (tunnies, some mackerels, bonitos), *Carangidae* (dentex, some mackerels) and *Clupeidae* (herring, sardine, shad, menhaden) families pass along the shores during their oceanodromous migrations in the late spring and early summer. The return migration for the *Scombridae* is in late summer/early autumn. These migrations would also include pelagic predators that follow the fish, such as shark.[16] In the spring, some members of the *Clupeidae* (shads) and *Anguillidae* (eels) families migrate upriver to spawn.[17]

Species' specific habitats and behaviour were certainly understood in antiquity: fish are classified by their environments by Aristotle in his 4th-century BC work *Historia Animalium,* and this importance is noted in the 1st century AD by Columella in Book 8 of his *De Re Rustica,* and followed by Oppian in the 2nd century AD in the first book of *Haleutica*.[18] This ecological information often determines the fishing gear employed (discussed below), and such accumulated knowledge was handed down through generations of fishermen.

Preservation and recovery biases

Biases are present in the deposition and preservation of archaeological marine animal remains that in turn affect their analyses. Larger, more robust fish bones tend to be preserved, whereas small bones (and sometimes small fish) or scales are not; additionally, fish bones tend to survive in sediments only if they are quickly buried, but shells tend to be more durable in the archaeological record.[19] The preservation of shellfish over fish bones means that they are more likely to be collected in archaeological excavations – and this imbalance can lead to an interpretation that exaggerates their importance in the ancient diet and economy.[20]

Recovery methods also can determine whether marine animal remains are retained for analyses.[21] In many cases, archaeological collection of fish bones is done by hand – a method biased towards preserving larger species. Sieving, especially with a small-gauge mesh, will preserve small bones and even scales of a variety of sizes of fish. It is very possible that fish were part of the diet of people inhabiting a particular site, but this will remain unknown if during excavation no sampling strategy that included the examination of dietary remains was practised.[22]

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15 Wheeler & Jones 1989: 28; Reitz & Wing 2008: 89–91.

16 A. Morales (UAM), pers. com.; see Chapter 7.1.

17 Loukili & Belghyti 2007; Rodríguez et al. 2006: 885–886, 892; Guennoun 2006: 1911–1912; Timoule 1985: 61; Srour & Abid 2002: 3; De la Serna et al. 1999: 16–17.

18 Reitz & Wing 2008: 88; Columella, *DRR* 8.16.6–9. This arrangement is also demonstrable in a late 3rd-century BC inscription of fish tariffs from Akraiphia, Boeotia (Greece), where the species are organised by broader environments (ocean and freshwater), and thereunder by their specific habitats; see Lytle 2006: 196–227.

19 Locker 2007: 141–142; Van Neer et al. 2002: 61–62; Dincauze 2000: 433.

20 Bailey & Parkington 1988: 4.

21 Amorosi et al. 1996: 130; Wheeler & Jones 1989: 38–40.

22 Locker 2007: 141–142; Beech 2004: 178.

The methods of collection and sampling of the unpublished finds from the earliest excavations in the region are not known, making it impossible to determine the sampling bias. In addition, the provenance of some finds from the museum collections is unknown, or only general find-sites are noted. At sites such as *Lixus*, recent excavations have included ichthyo-archaeological and/or malacological studies where sediment was sieved but these have focused only on Phoenician, Punico-Mauretanian and medieval layers; other Roman and Late Roman material from this site, far fewer in quantity, derives from earlier excavations where the sampling strategy is unknown. These recovery biases, as well as sample size, also affect how one can interpret diversity at each site, and therefore comparison between sites.

Quantification issues

The best-studied material in this study derives from later work at *Lixus* and *Septem Fratres* (Ceuta), where NISP (number of specimens) or MNI (minimum number of individuals) are given for a variety of fish species.[23] At other sites, the total number of all fish bones may be given, with no attempt made to determine individual specimens amongst these.[24] In many cases, mention is made in the published material only of "fish bones" or "fish scales", with no indication of species or quantities. The differences in the data available for this study, therefore, make it extremely difficult to compare material that derives from one site or even between sites. In order to reconcile these disparate data, the NMI, NISP or bone count numbers are noted in this study's data tables; in the analyses, however, each species, regardless of this number, is treated simply as a singular occurrence in the chronological period to which it is assigned. This "heterogeneous approach" removes biases and discrepancies, making it possible to compare layers and sites, as the aim of the study is not quantification, but to give an indication of possible species presence and diversity.[25]

Shellfish data are less difficult to determine using NISP counts, with quantification focusing on non-repetitive elements. Gastropods are more easily quantified in publications, as identification derives from the apices or columella (the inner axis of the whorl of the shell). Bivalves, however, pose more difficulty as it is not known from many of the sites included here if the umbo fragments or hinge area were counted or identified to determine if the half-shells belonged to more than one specimen. As with fish bones, fragmentation can

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[23] *Lixus* and *Septem Fratres*: Roselló Izquierdo 1992; Rodríguez Santana & Rodrigo García 2005; Grau Almero et al. 2001; Bernal Casasola et al. 2012a; Zabala Giménez et al. 2010. For discussion of MNI, see Desse & Desse-Berset 1994: 72–74; King 1999: 168–169; for NISP, see Reitz & Wing 2008: 156–157; for the debate between the application of MNI and NISP for the quantification of taxonomic abundance, see Marshall & Pilgram 1993; Rose 2000: 497; Morales-Muñiz & Roselló-Izquierdo 2008: 252; Cione 2006: 103–104, 121.

[24] E.g., 25 vertebrae of tope shark are preserved from *Lixus*, but these do not indicate 25 different sharks as they all in fact derive from the spine of one specimen. Bone counts can also result in the over-counting of a species if it has more bones than another; the approach to "tempering the eel effect" (a species with twice as many bones as average fish species) is generally accepted as using NISP; see Locker 2007: 144.

[25] For discussion of this approach, see Morales et al. 2007: 119–120. For a critique of quantification analyses of human impact on the marine environment, see Erlandson & Rick 2008.

Table 3.1: Vocabulary used throughout this study referring to fish habitats and behaviour (source: FishBase Glossary, http://www.fishbase.org/search.php; accessed 1/2017).

Amphidromous	Moving between fresh and salt water during life cycle, but not for breeding.
Anadromous	Ascending rivers from the sea for breeding.
Benthopelagic	Occurring on the bottom or midwaters.
Catadromous	Living in fresh waters and going to the sea to spawn.
Demersal	Living near the sea bottom, usually in schools.
Diadromous	Travelling between salt and fresh waters.
Epipelagic	Inhabiting the top layer of the ocean zone to 200 m depth.
Euryhaline	Able to live in waters with a wide range of salinity.
Mesopelagic	Of or relating to oceanic depths from about 200 to 1,000 m.
Neritic	Region of shallow water adjoining seacoast.
Oceanodromous	Migrating within the seas only.
Pelagic	Living and feeding in the open sea; associated with the surface or middle depths of a body of water, not the bottom.
Potamodromous	Migrating within fresh waters only.

lead to false number counts.[26] Some published material from the region is merely recorded as present, with specimen numbers or shell counts not given. As with the unpublished fish bones, the sampling strategies are largely unknown; it is likely that larger and intact shells were collected as examples, as opposed to incomplete and smaller species.[27] The numbers of marine invertebrate specimens are noted in the data tables, but again, each species is simply treated as one occurrence in analyses.

Present analyses

In the analyses of the marine animal remains, species (or identifications to the class/order/family/genus level) are designated as living in three different habitats: marine, estuarine and freshwater.[28] However, some animals can live in a broad range of salinity, and therefore can be found in a combination of these environments and several can live in all three depending on the stage in their annual or life cycles; these are designated in this study as marine/estuarine and marine/estuarine/freshwater.

Vocabulary used throughout this study refers to various habitats and behaviour of fish (Table 3.1). The marine invertebrates discussed here are divided into major and minor

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26 Glassow 2000: 407–410.

27 E.g., collecting only a few complete shells as representative 'examples' was done at Dchar 'Askfane; A. El Khayari (INSAP), pers. com. An exception is at Metrouna, see Bernal et al. 2011a.

28 The specific habitats and behaviour of the fish and shellfish are given in the tables in App. 1.1–1.2. The sources for these data and the notations used in the tables are discussed in App. 1: Metadata at the beginning of appendix.

Table 3.2: Vocabulary used throughout this study referring to habitats of marine invertebrates (source: FishBase Glossary, http://www.fishbase.org/search.php; accessed 1/2017).

Intertidal	Shore area between high- and low-water marks (ca. 5 m below mean high water); shallow areas along the shore and in estuaries that are alternately exposed and covered by the tides (can also be referred to as "interlittoral").
Infratidal	The zone below the lowest tide (from ca. 5 m below mean high water); always inundated by water, often used to refer to substrata of the continental shelf which reaches depths between 150 and 300 m (can also be referred to as "infralittoral").

environments. The major environments follow those discussed above (marine, estuarine, freshwater) and generally describe where these species live; the minor environments are determined as intertidal and infratidal and specifically describe the depths at which these animals live and therefore the possibility of human access to them (Table 3.2). Marine invertebrates can also live in both habitats designated above, and these are noted throughout the analyses as intertidal/infratidal.

3.2.2 Fishing equipment

As marine species inhabit such diverse environments, specialised implements are needed for catching and collecting them; these also must be constructed in a particular way and made of materials adaptable to aquatic conditions.[29] Fishing equipment can encompass a broad range of artefacts of diverse manufacture used at different stages in the exploitation process: nets, net weights, portable traps, fish hooks, line sinkers, barbs, needles, navettes, purpose-built trap installations on shores or in rivers and estuaries and even fishing vessels. Often this equipment is constructed in a specialised manner so as to be used when targeting specific types of marine species, those that have a particular behaviour, are a specific size or live in specific habitats.[30] Some of these implements could be used independently of each other or in combination. In addition, the types of apparatuses reveal whether fishing was an independent activity, practised by individual fishermen using simple or small devices, or a group activity that required cooperation between a few or numerous individuals.[31]

Fishing is today classified by active or passive techniques. Passive techniques, which require little human action, can be types of set nets or traps; active fishing includes the participation of the fisherman in operating the fishing gear, such as collecting, spearing and hand-lining. Plato, in his 5th-century BC work *Sophist*, first 'classified' fishing techniques by general active and passive methods: 'striking' fish that included using hooks or 'enclosing'

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29 Hewes 1948: 238.

30 For a general review, see Morales Muñiz 2010.

31 Cooperation of fishermen might be demonstrated by *piscatores* guilds (not known in *Mauretania Tingitana* but demonstrated in *Carthago Nova, Parion* and elsewhere), but fishermen did not necessarily have to work together to be members of these guilds. It is likely that most fishermen were not members of guilds, which have been demonstrated instead to have had more economic and social purposes (Augustan inscription at *Carthago Nova*: *CIL* II Suppl., 5929; for *Parion*, see Bekker-Nielsen 2010: 194–195; Horsley 1989: 102).

fish by the use of traps and nets.[32] Both of these approaches, in antiquity as well as today, rely on a human understanding of fish behaviour, habitat and the marine environment.[33]

Oppian, in the 2nd-century AD *Halieutica,* identified four main types of fishing methods: hook-and-line, nets, weels (traps) and tridents.[34] These divisions are followed by Aelian throughout his early 3rd-century treatise, *De Natura Animalium*. These and other methods are described below, as are the material evidence for them, their preservation biases and the context of their application in this study.

Hook-and-line fishing

The most common form of fishing was by hook-and-line (*piscatus hamatilis,* ἀγκιστρεία), where fishermen (specifically *hamiotae,* or more generically *piscatores*) used a line with a hook at its end that could be paid out by hand (hand-lining) or attached to a rod (angling) (Fig. 3.2).[35] Lines could be made of flax, esparto grass or horse-hair; rods could be made of cornel-wood, pine, juniper or reeds.[36] Fishing lines, as well as nets and traps, with few exceptions, do not survive in the Mediterranean climate.[37] Extant in the archaeological record instead are fish hooks (*hamus*, ἄγκιστρον), which are usually bronze, although some larger examples are of iron.[38] The shape of hooks has remained fairly constant from prehistory until today: the basic form is a half-circular or "J" shape, with an eye at the top or a spade-shaped tip (through or under which the line is tied) and a straight shank which curves to a point with a barb (Fig. 3.3).[39] Large iron hooks and even chained hooks (*hami catenati*) are mentioned in relation to catching large fish such as tunny and even whales, whilst small hooks were for small-mouthed fish like grey mullet.[40]

Although modern fish hooks are classified by gape width (distance between the shank and tip of the barb), this study uses the length of the shank as a factor of determining possible fish size, as the gape distance only gives an indication of the mouth size of animal – and large fish can have small mouths and vice-versa. For this study's discussion, fish hooks are specifically broken down into three sizes:[41]

– Small hooks (< 5 cm shank length)
– Medium hooks (5–7 cm shank length)
– Large hooks (> 7 cm shank length)

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32 Plato, *Sophist* 219–221.
33 Bekker-Nielsen 2010: 188–198; Powell 1996: 77–78; Ayodeji 2004: 72–73.
34 Specified in Oppian, *Hal.* 3.72–91.
35 Aelian, *NA* 12.43; Plautus, *Rudens* 299; 310; Lafaye 1907: 490; Sahrhage 2002: 45–52.
36 Lines: Oppian, *Hal.* 3.72–78; flax, horse-hair, esparto: Aelian, *NA* 1.23; 12.43; rods: Aelian, *NA* 1.23; 12.43; 13.2; Oppian, *Hal.* 3.72–75.
37 Bekker-Nielsen 2005: 84; there are a few exceptions, however, see below.
38 Ausonius, *Mosella* 126; Martial, *Epigrams* 2.40.4; Aelian, *NA* 1.23; 13.16; Oppian, *Hal.* 3.73; 3.143; 3.174; 3.285–286; Lafaye 1907: 489.
39 Ayodeji 2004: 87–90; Bernal Casasola 2010a: 91–95.
40 Large hooks: Aelian, *NA* 13.16; Oppian, *Hal.* 3.285; 5.135–138; chained hooks: Pliny, *NH* 9.17.44; Oppian, *Hal.* 5.137–147; small hooks: Oppian, *Hal.* 3.482–485.
41 See discussion on sizes in Ayodeji 2004: 88; Powell 1996: 127; Bernal Casasola 2010a: 89–90.

Fig. 3.2: Fishing methods: trident (left), hook-and-line/angling (centre and left) and cast net (right). Depicted in a mosaic from Dougga, Tunisia (House of Dionysus and Ulysses), ca. AD 260–280. Photo: AT (permission courtesy Musée National du Bardo, Tunis).

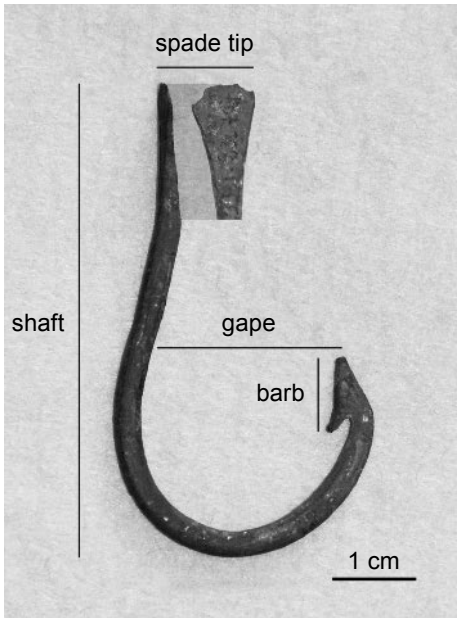


Fig. 3.3: Bronze fish hook from the Roman layers at *Banasa*, with terminology. Photo: AT.

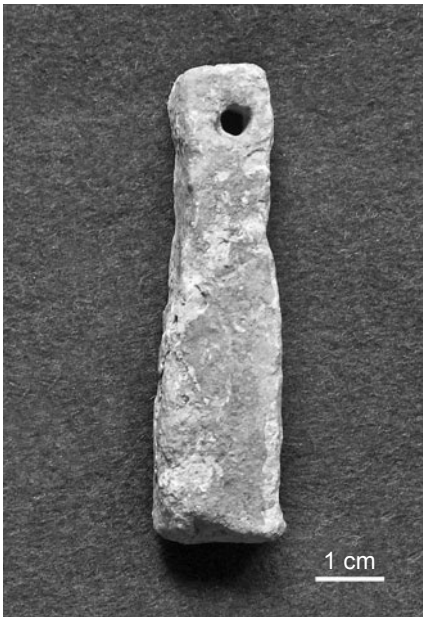


Fig. 3.4: Lead weight, likely a line sinker, from the Roman/Late Roman layers at Essaouira. Photo: AT.

Hooks could be baited with small fish, molluscs, fish intestines and even sea grass; bait-less fishing also was practised.[42] Lines could be weighted with lead, stone or terracotta plummets (κάθετος, *perpendiculum*); some are round or pyramidal in shape with holes for the line to pass through at the top, but these can be hard to distinguish in the archaeological record

[42] Aelian, *NA* 14.22; fish as bait: Oppian, *Hal.* 3.184–193; bait-less fishing: Oppian, *Hal.* 3.173–174.

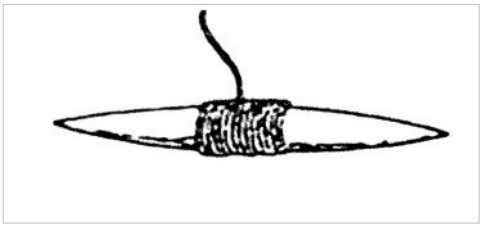
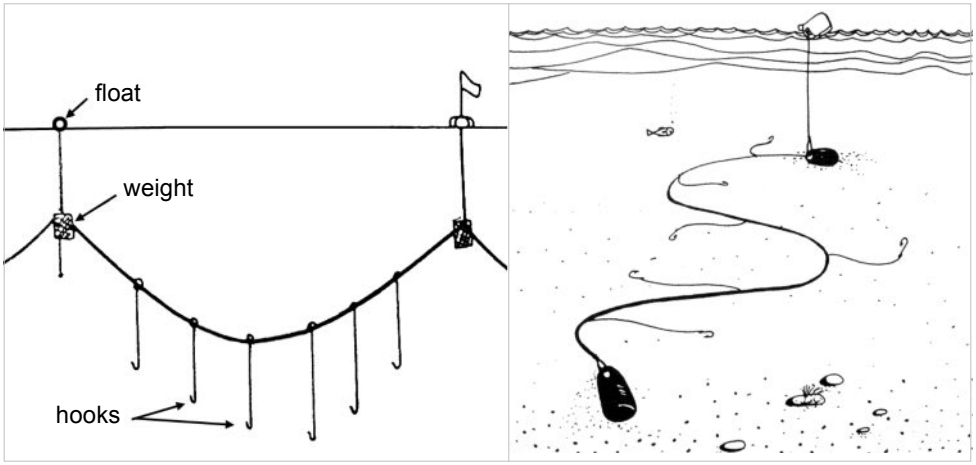


Fig. 3.5: Left: example of a gorge rigged to a line (Powell 1996: fig. 79a).

Fig. 3.6: Below: a floating long-line (left) and a long-line weighted on the seabed (right) (Powell 1996: fig. 84).



from net weights (ethnographic studies indicate, however, that line weights are generally heavier than their net counterparts) (Fig. 3.4).[43] In addition, bone gorges were used: a line would be tied around the centre of the gorge, which was covered by bait. The intention was to have it swallowed whole so it would lodge in a fish's stomach or throat (Fig. 3.5).[44]

Hook-and-line fishing could take place from shore or from a boat, and is the only fishing gear that can operate at any depth. Hand-lining is mentioned in association with catching large fish from boats, although angling allows one to cast the line farther, which is ideal from shore.[45] In some instances, a single line had multiple hooks (πολυάγκιστρον).[46] This technique, long-lining, requires shorter hooked "branch" lines called snoods to be set with hooks to a single main line. Small hooks are usually used for this method, and time and labour is involved in baiting them. Long lines can be set with weights on the sea bottom, or set vertically or horizontally in the water column from a boat, using floats and weights to

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43 Oppian, *Hal.* 3.76–77; 3.138; Kuniholm 1982: 308; Lafaye 1907: 489: a weight is also referred to as μολίβου κύβος (Oppian, *Hal.* 4.221–222). Ethnographic comparison shows that some line sinkers can weigh up to 1 kg (Ayodeji 2004: 126).

44 Radcliffe 1921: 32–33; Powell 1996: 124; Soria Trastoy 2011.

45 Oppian, *Hal.* 3.144–148; 3.205–280; 3.313–315; Aelian, *NA* 12.43; Homer, *Iliad* 16.406; Arévalo González et al. 2004: 277; Martínez Maganto 1992: 225; Ayodeji 2004: 101, 116.

46 Long-lining attested by a find at Herculaneum: Bernal Casasola 2010a: 120–121; in texts: Sidonius, *Epistulae* 2.2.12; Oppian, *Hal.* 3.78; 3.465–481; Aristotle, *HA* 9.37. See App. 6.3: Cat. 28.

suspend the lines (Fig. 3.6). Trolling involves trailing a line with a hook or hooks from the stern of a vessel as it moves through the water.[47]

Hand-lining or angling was carried out by individual 'hook' fishermen (*hamiotae*).[48] From a fishing boat, however, the crew size could vary from an individual to a small group. For example, Aelian describes long-lining and hand-lining undertaken by a single fisherman who requires a crew of unknown size to man the oars of his vessel, whom the fisherman directs.[49] Then, as today, it was necessary to have enough people to operate the gear and navigate the vessel, but still have space inside the boat to hold the catch.

Nets

Nets, like fishing lines, are not generally preserved in the archaeological record, although a few have survived; these are known to have been made of flax (*linea, linum*), esparto, hemp but also animal hair (θρίξ).[50] Generally, organic net material has to be durable in the marine environment, but also its specific gravity is important: a low specific gravity is undesirable when a net is required to sink rapidly, such as with cast nets. Other nets, such as gill nets, are required to be lighter so that there is greater net area compared to weight.[51]

Archaeological evidence for nets is largely based on the tools used to manufacture them, such as navettes and needles, as well as weights that lined their edges. A navette (χήλευμα, χηλή) is a bronze tool with tongs at both ends that are sometimes off-set 90º from those at the opposite end (Fig. 3.7).[52] Between these tong ends, the line for the net was strung and then paid out as the net was being tied. Importantly, ethnographic studies demonstrate that the space between the tangs of a tong end is the equivalent width of the mesh gauge.[53] This dimension is important as mesh size indicates the species of fish that the net is intended to target: with a large mesh, large fish are caught but small species can escape. The smaller the gauge, the more species will be caught.[54] Light, small-meshed nets are required to catch schooling species such as sardine or anchovy; heavier nets with a larger mesh size are intended for catching large fish such as tunny.[55]

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47 Kron 2008: 205; Powell 1996: 123; Sternberg 1998: 96; Bernal Casasola 2011b. Trolling off the sides of a boat is described by Aelian (*NA* 15.10) as a method for catching pelamyds (tunny).

48 Aelian, *NA* 12.43; Plautus, *Rudens* 299; 310; Lafaye 1907: 490; Sahrhage 2002: 45–52.

49 Aelian, *NA* 15.10.

50 Seneca, *Hercules Furens* 159; Pliny, *NH* 9.26.59; 19.2.10–11; 19.9.31; 19.56.173–175; Aelian, *NA* 1.2; 1.23; 12.43; Oppian, *Hal.* 1.54; 4.654–657; Grattius, *Cynegetica* 1.34–60; Varro, *DRR* 3.5.11; Alfaro Giner 2010: 65–66. Graeco-Roman archaeological finds of nets in the Mediterranean: in Spain, La Albufereta and *Caesaraugusta*/Zaragoza: Alfaro Giner 2010: 71–75; in Italy, Herculaneum: Deiss 1966: 102 and Pompeii: Radcliffe 1921: 235, n. 1; in Egypt, general: Brewer & Friedman 1990 and Red Sea: Wendrich & Van Neer 1994; Thomas 2010.

51 Ayodeji 2004: 136.

52 Pollux, *Onom.* 1.99–100; 7.83.

53 Ayodeji 2004: 151–152.

54 Examples from the Adriatic in the 19th century: the mesh of anchovy nets is 10 mm diagonal, sardine 15–20 mm diagonal, fry 8 mm diagonal and mullet 38 mm diagonal (Faber 1883: 107–110). Examples from the northeast coast of Tunisia in the late 20th century: the mesh of beach seine nets is 2.2–2.4 cm diagonal and cast nets are less than 1.6 cm diagonal (Romdhane 1998: 72–73).

55 Oppian, *Hal.* 4.562–563; Ayodeji 2004: 128, 131.

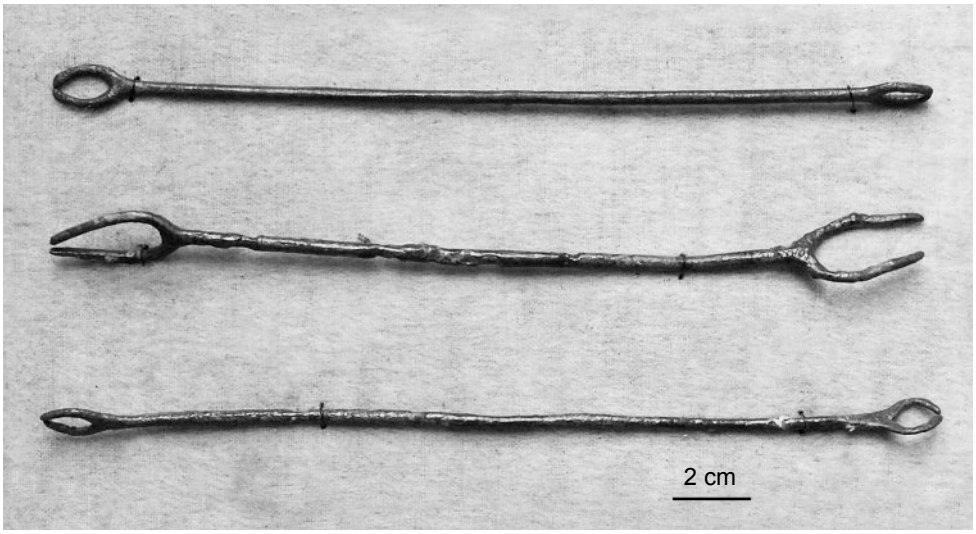

Fig. 3.7: Three bronze navettes from the storage magazine at the Musée Archéologique, Tetouan. The provenance of these artefacts is unknown: they may be from M. Tarradell's excavations at *Lixus* in the 1950s–60s, *Tamuda* in the 1940s, or *Zilil* in 1950. Photo: AT.

Fig. 3.8: A bronze double-eyed needle (top) and a bone double-eyed needle (bottom) from the Punico-Mauretanian layers at *Tamuda.* Photo: AT.

Bone and bronze needles, with double eyes, were also used to manufacture nets (Fig. 3.8). It has been suggested that needles were more usually used to repair nets, with the double eye used for threading different diameters of twine.[56] Unlike navettes, needles used for making and repairing fishing nets are much harder to identify in the archaeological record, as they are very similar to those used to work textiles or leather. In these instances, the find-spot is of the utmost importance for establishing a needle's use.[57] Additionally, nets could also be made, as they are today, by hand, using reef-knots; this technique and the use of needles, however, make it impossible to determine mesh gauges if no net is preserved.[58]

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56 Possibly depicted in a 2nd/3rd-century grave stele, Ilôt St. Jacques, France; Sahrhage 2002: Abb. 28.
57 Martínez Maganto 1992: 230; Arévalo González et al. 2004: 114–115; Ayodeji 2004: 154.
58 Libert & Maucorps 1973: 4; Alfaro Giner 2010: 61–64.

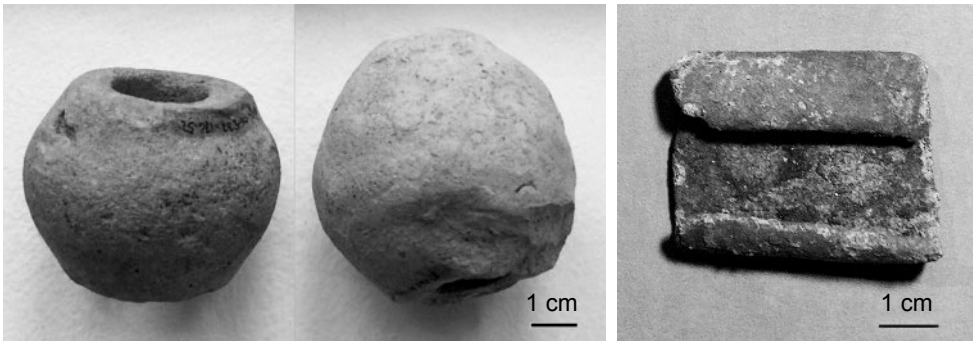

Fig. 3.9: Net weights: doughnut-shaped ceramic types from Roman layers at *Rusaddir* (left); lead strip type from Punico-Mauretanian/Roman layers at Tahadart (right). Photos: AT.

Weights, made of terracotta, stone and lead, are used to sink a net rapidly or anchor it in the water; as mentioned above, these can also weigh fishing lines, although net weights tend to be lighter than line sinkers (Fig. 3.9). These weights can vary extensively in size and shape, and these criteria, as well as the number used, depend on the net, the type of waterway, and how the net is used and set. For example, due to density, fewer lead weights are needed to weigh a net than those made of terracotta; the former are less bulky but likely more costly to produce, although the latter are used because they are light when dry, but absorb water quickly to sink.[59] Conical-shaped weights are never used for cast nets, but folded weights or lead strips and "split buckshot" types are, as an even distribution of weight around the edge allows the net to fall uniformly. Larger pulled nets, such as seines, can use a variety of weights, including rocks that have line tied around them, attaching them to the net.[60]

Because of their specific applications, weights come in a variety of shapes: some are doughnut-shaped with a central hole for a line to attach them to the net, trapezoidal or bun-shaped with several holes near the top for the lines, or small and disc-shaped with a central hole. Lead weights are of similar shapes and also were manufactured without holes (to be 'woven' into the outer edge of a net), or as narrow, folded-over strips that lined the outer edge. Weights can also be simply a stone with a line tied around it or 'woven' into the net's edge.

The shapes discussed above can make it difficult to determine an artefact's use, as weights can be used for many other purposes, and materials are often reused. Textile loom weights, spindle whorls and fishing weights are often identical, so their use is determined by find context.[61] In some cases, the date of the object might be helpful for identification, as warp-

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59 Powell 1996: 106; Ayodeji 2004: 156–158.

60 Kuniholm 1982: 306–307; Ayodeji 2004: Table 8; Bernal Casasola 2008b; 2010a: 96–117; for lead, see App. 6.1: Cat. 5; App. 6.4: Cat. 41–42; for rocks, see App. 6.1: Cat. 6; App. 6.3: Cat. 34.

61 E.g,, those found at fish-salting sites are thought to have been used for nets; see Davidson et al. 1943: 65–79, 93–94; Wild 2002: 8; 2003: 12, 15; Arévalo González et al. 2004: 116–117, 222; Benoit 1959: 98; Sternberg 1998: 90; Alfaro Giner 2010: 76–79. To my knowledge, there have been no analyses of textile manufacture within *Mauretania Tingitana*; no fulleries have yet been identified, although an inscription attests a fuller's guild existed at *Volubilis* (*IAM 2*, 581; Johannesen 1954: 158–159; see Chapter 8.1.2.2).

weighted looms went out of use in the Mediterranean in the 2nd century AD or possibly a century earlier.[62] Also, the weight of loom weights is important: they are uniform and cannot be too heavy as they will pull the fibres in the cloth (although this uniformity is a similar requirement for net weights). Generally, Greek and Roman loom weights weigh between 70–250 g, with up to 70 used in a set for one loom.[63] Ethnographic comparison in northern Morocco indicates that terracotta and lead cast net weights weigh ca. 24 g each; lead rolls and stone weights used on the foot rope/lead line of beach seine nets weigh between 190 g and 2–3 kg, respectively. Seine and set net weights can weigh between 100–250 g.[64]

This artefact type is the most tenuous identification within the archaeological group examined in this study due to its similarity in form to other artefacts not associated with fishing. The criteria for the inclusion of weights here are based on factors discussed above: shape, weight and find-spots (although some locations remain unknown). In many cases, these finds are included in order to demonstrate the types of weights possibly used for fishing; uncertain identifications are discussed in the case study analyses (Chapter 7). Throughout this study, weight shapes are classified as follows: disc, doughnut, bun, tombstone, trapezoid, truncated cone, sphendonoidal (pod), tube, strip and pyramidal.[65] The weights are categorised in three sizes:

– Small weights (< 50 g)
– Medium weights (50–250 g)
– Large weights (> 250 g)

Floats (*indicium*) are used to hold the top edge of a net (or suspend fishing lines) in the water.[66] As these are also made of organic material, they are not usually preserved in the archaeological record.[67] Iconography shows that floats were used, and they are mentioned by ancient authors: e.g., seine net floats were called φελλοί. A few archaeological finds and ethnographic comparison demonstrate that they were made of bark or cork.[68]

Writers such as Oppian and Aelian name a number of fishing nets used in antiquity. Oppian especially notes that there are a large number of nets, but he presumably lists what he considers to be the main ones, although it is hard to decipher some of his descriptions.[69]

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62 For 1st-century date: Hoffman 1964: 321, 322–323; Davidson 1952: 147; for 2nd-century date: Wild 2002: 10–11. In *Gaul* and Iberia, almost all datable loom weights are from the 1st century AD, and this might be the case for *Mauretania Tingitana*; see Alfaro Giner 1984: 99–102.

63 Wild 2008: 471; F. Handly-Earl (Univ. of Southampton), pers. com.; A. Nørgård (Viking Ship Museum, Roskilde), pers. com.

64 Cast nets documented at Moulay Bouselham (Roullot & Fahfouhi 1984: 118) are comparable to those used in Greece today, at ca. 25 g (Powell 1996: 107). Seine net weights documented near Oued Laou (Roullot & Fahfouhi 1984: 59–60).

65 Following Kuniholm 1982; Ayodeji 2004: 156; see also Bernal Casasola 2008b.

66 Lafaye 1907: 489; Ausonius, *Mosella* 253.

67 Some floats of wood and cork have been identified at *Myos Hormos* (Quseir al-Qadim, Egypt), on the Red Sea; see Thomas 2010: 145–146.

68 Aelian, *NA* 12.43. Pine bark is known from Roman levels at Pisa and poplar bark from Lake Constance; papyrus from Egypt; see Alfaro Giner 2010: 76; Pottier 1907: 852; Yacoub 1995: 239.

69 Oppian, *Hal.* 3.79–84; Bekker-Nielsen 2002a: 32.

Fig. 3.10: Fishing with a cast net (extended shape shown in inset), depicted in a late 4th-century AD mosaic from Carthage, Tunisia. See also App. 6.4: Cat. 42. Photo: AT (permission courtesy Musée National du Bardo, Tunis) (inset, Powell 1996: fig. 60b).

This study follows T. Bekker-Nielsen's identifications of the most-discussed of Oppian's net types (Figs 3.10–3.13, Table 3.3).[70]

Nets are designed to catch specific species in specific environments. For example, cast nets can be used from a boat, but mainly in neritic waters (sandy shorelines and lagoons), but are rarely used in rocky areas and have a small mesh gauge to target a wider range of fish size. Gill or trammel nets are set nets that function well in calm waters (such as in or at the mouth of a river), and used to target migrating species.[71] Beach seines are restricted to sand and mud bottoms, and purse seines require calm waters and tend to target schooling fish. These non-mechanised nets are seldom used in water deeper than a few fathoms.[72]

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70 Bekker-Nielsen 2002b; see also discussion of generic net names in Alfaro Giner 2010: 55–61. Special mention should be made here of nets listed in Table 3.3: the identification of the gill/trammel net is not agreed upon. Gallant (1985: 20–21) identifies it as a gill net, whereas Powell (1996: 103, 107–108) identifies it as a trammel net; see also App. 6.3: Cat. 18. The origin of pound nets in southern Iberia might be as early as the 3rd century BC (García Vargas & Florido del Corral 2010: 211–213), or, with a *chambre de la mort* as late as the 9th century AD (Purpura 2008: 549–550). For possible archaeological evidence for fixing nets to the shore in Sicily, see Felici 2012. Following Aelian's description (*NA* 15.5) of the use of large fixed and seine nets to catch tunny in the Black Sea, see Lytle 2006: 56–60; an inscription from *Parion* in Asia Minor also suggests a large group was needed for fishing offshore (Lytle 2006: 68–92). Between 80 and 150 fishermen were needed in the 18th and 19th centuries to operate the *almadraba* off Ceuta (Cámara del Río 2007: 85) and there are also large numbers needed off Ras Achakar (Étienne & Mayet 2002: 341; see App. 6.3: Cat. 12–14; App. 6.2: Cat. 11).

71 Bekker-Nielsen 2005: 91; Romdhane 1998: 72; Powell 1996: 103; Ayodeji 2004: 179–181, 205.

72 Coull 1972: 44; Powell 1996: 33.

Fig. 3.11: Fishing with a beach seine net, depicted in a 2nd-century AD Nilotic mosaic from El Alia, Tunisia. Notice the floats and weights (see also App. 6.1: Cat. 6–7; Fig. 3.20). Photo: AT (permission courtesy Musée National du Bardo, Tunis).

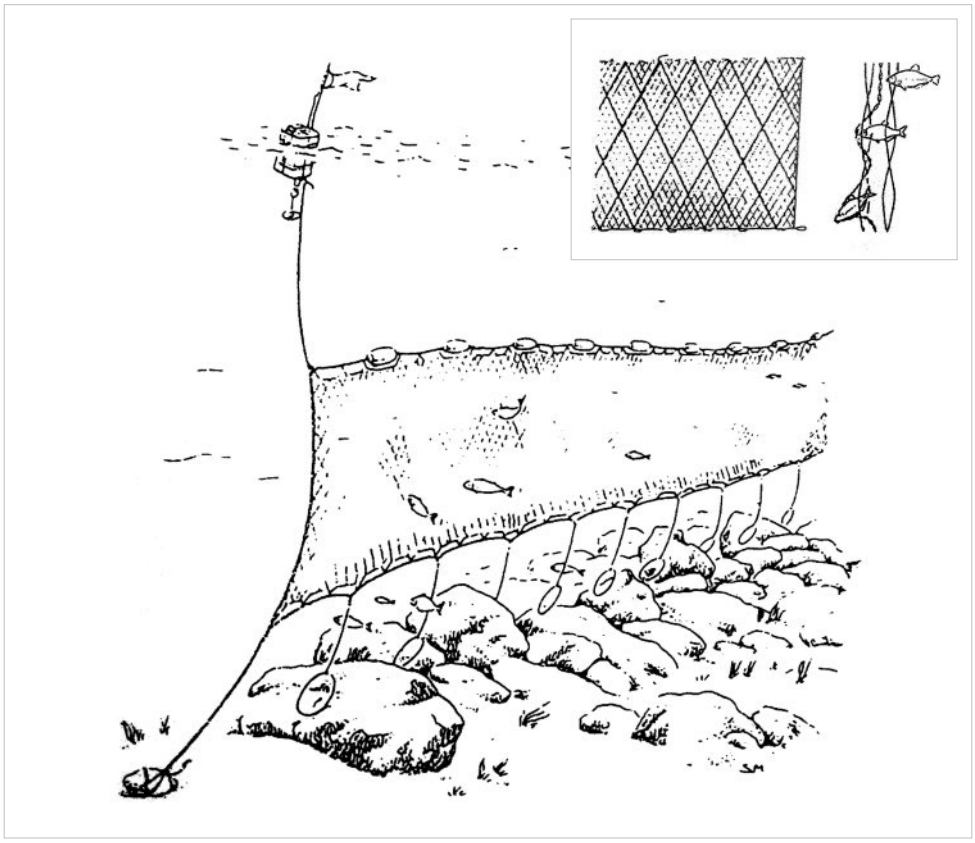

Fig. 3.12: A set gill net with weights (see also App. 6.3: Cat. 18, 39). Inset: a trammel net and detail (Powell 1996: figs 60e, 77).

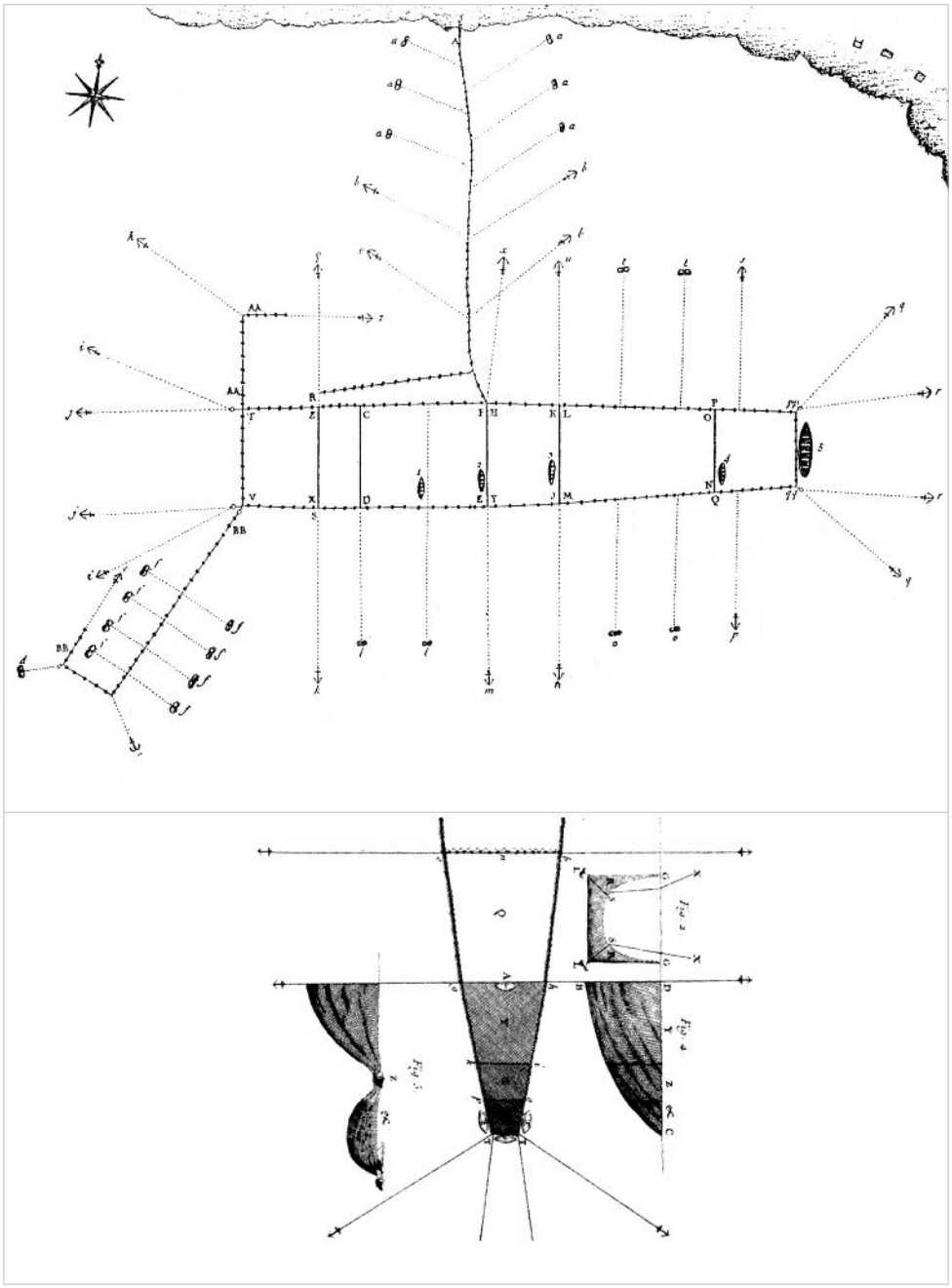

Fig. 3.13: Pound nets: (top) plan of an 18th-century *al-madraba* net with anchors, used off southern Iberia (Ponsich 1988: fig. 11); (bottom) detail of the lift net contraption in the *chambre de la mort* from a 1777 plan and profile (Étienne & Mayet 2002: fig. 8; see also App. 6.3: Cat. 12–14).

Table 3.3: The identified types of nets used in the Graeco-Roman world (continued on next pages).

MODERN NET TYPE	GREEK/LATIN NAME	ANCIENT REFERENCE	DESCRIPTION
Cast	ἀμφίβολον, ἀμφίβληστρον, *iaculum, funda*	Pollux, *Onom.* 1.97; 10.132; Oppian, *Hal.* 3.80; Herodotus 1.62; 2.95; Plautus, *Truculentus* 35–36; Virgil, *Georgics* 1.141	A round net with outer edges lined by weights with a line attached to the middle, used by an individual fisherman in shallows, but sometimes used from a boat in shallow water. Plautus tells of a fisherman who "throws a casting net in a fish pond, and when it goes to the bottom, tightens the rope" (see also Bekker-Nielsen 2005: fig. 3a-b).
Cover	κάλυμμα	Oppian, *Hal.* 3.82	Possibly a mesh net made of fine material that is a small version of a cast net, but maybe any net that lightly floats in the water and can be operated by a single fisherman.
Round bag *or* scoop	ὑποχὴ περιηγής	Oppian, *Hal.* 4.251	Oppian describes this net as small, and "pulled" through the water. It is thought to resemble a small hand-held net on a circular frame, used by a single fisherman to scoop fish out of the water next to a boat or from shore.
Draw	γρῖφος	Oppian, *Hal.* 3.80; Plutarch, *De Tranquillitate Animi* 471d	A generic term for a seine net used by Oppian, but described as used alongside a seine by Plutarch; thought to be a small seine operated by two or four people. As with larger seines, the rectangular net is weighted and has floats; sometimes wooden spreaders at ends hold the net open (Kuniholm 1982: 307; mosaics from Tunisia show two to four people operating nets, see Yacoub 1995: figs 115, 121–122).
Gill *or* trammel	λίνοι, λίνον, πάναγρον	Oppian, *Hal.* 3.577–605; Homer, *Iliad* 5.487	Type thought to be a gill net; Oppian describes it as trapping fish in its mesh; Homer describes an "all-catching net" and "many-meshed snare". These are stationary rectangular nets set out at night by one or two fishermen and checked in the morning after tidal changes; mesh size is just wide enough for a fish head to protrude, before it gets stuck by its gills when trying to back out. Trammel nets are similar, but with several net layers of different mesh gauges (see Fig. 3.12; Kuniholm 1982: 307).