

ANCIENT FISHING AND
FISH PROCESSING

BLACK SEA STUDIES

2

The Danish National Research Foundation's
Centre for Black Sea Studies

ANCIENT FISHING AND
FISH PROCESSING
IN THE BLACK SEA REGION

Edited by
Tønnes Bekker-Nielsen

AARHUS UNIVERSITY PRESS

ANCIENT FISHING AND FISH PROCESSING IN THE
BLACK SEA REGION

Proceedings of an interdisciplinary workshop on marine resources
and trade in fish products in the Black Sea region in antiquity,
University of Southern Denmark, Esbjerg, April 4-5, 2003.

Copyright: Aarhus University Press, 2005

Cover design by Jakob Munk Højte and Lotte Bruun Rasmussen

Mosaic with scene of fishermen at sea from a tomb in the catacomb
of Hermes in Hadrumetum (Sousse Museum, inv.no. 10.455). Late
second century AD. 320 x 280 cm. Photo: Gilles Mermet.

Printed in Gylling by Narayana Press

ISBN 87 7934 096 2

AARHUS UNIVERSITY PRESS

Langelandsgade 177

DK-8200 Aarhus N

73 Lime Walk

Headington, Oxford OX2 7AD

Box 511

Oakville, CT 06779

www.unipress.au.dk

The publication of this volume has been made possible by a generous
grant from the Danish National Research Foundation

Danish National Research Foundation's

Centre for Black Sea Studies

Building 328

University of Aarhus

DK-8000 Aarhus C

www.pontos.dk



Contents

Illustrations and Tables	7
Introduction <i>Tønnes Bekker-Nielsen</i>	13
Fish as a Source of Food in Antiquity <i>John Wilkins</i>	21
Sources for Production and Trade of Greek and Roman Processed Fish <i>Robert I. Curtis</i>	31
The Archaeological Evidence for Fish Processing in the Western Mediterranean <i>Athena Trakadas</i>	47
The Technology and Productivity of Ancient Sea Fishing <i>Tønnes Bekker-Nielsen</i>	83
The Reliability of Fishing Statistics as a Source for Catches and Fish Stocks in Antiquity <i>Anne Lif Lund Jacobsen</i>	97
Fishery in the Life of the Nomadic Population of the Northern Black Sea Area in the Early Iron Age <i>Nadežda A. Gavriljuk</i>	105
Fish and Money: Numismatic Evidence for Black Sea Fishing <i>Vladimir F. Stolba</i>	115
The Archaeological Evidence for Fish Processing in the Black Sea Region <i>Jakob Munk Højte</i>	133

A Fishy Business. Transport Amphorae of the Black Sea Region as a Source for the Trade in Fish and Fish Products in the Classical and Hellenistic Periods <i>John Lund and Vincent Gabrielsen</i>	161
Size Matters: Estimating Trade of Wine, Oil and Fish-sauce from Amphorae in the First Century AD <i>Bo Ejstrud</i>	171
Abbreviations	183
Bibliography	185
Contributors	205
Indices	207

Illustrations and Tables

Athena Trakadas: The Archaeological Evidence for Fish Processing in the Western Mediterranean

- Fig. 1. A coin from Abdera, on the southern Spanish coast, which depicts fish (tunny?) as columns of a temple (after Ponsich and Taradell, 1965, Pl. XXIV) 48
- Fig. 2. The sites at *Gades* (Cadiz) have revealed evidence of fish processing starting in the late fifth century BC. Archaeological evidence includes Máña A4-type amphorae (after Muñoz Vicente, *et al.* 1988, fig. 9) 49
- Fig. 3. The fish-processing sites were distributed throughout the Roman provinces of the western Mediterranean 50
- Fig. 4. The fish-processing sites in *Baetica* and *Tarraconensis* 51
- Fig. 5. The “Baños de la Reyna” at the fish-processing site of Punta de l’Arenal, southern Spain (after Martin and Serres 1970, fig. 2) 53
- Fig. 6. The walled city of *Baelo*, with the fish-processing complexes in its southern sector (after Pelletier 1988, fig. 2) 54
- Fig. 7. The six fish-processing installations of *Baelo* (after Ponsich and Taradell 1965, fig. 53) 55
- Fig. 8. The four large circular salting vats at *Baelo*. Note the extant columns (photo: A. Trakadas) 55
- Fig. 9. The four windows in the wall of one of the complexes at *Baelo* (after Ponsich 1976, fig. 1) 56
- Fig. 10. The fish-processing sites in *Lusitania* 58
- Fig. 11. The *cetariae* cut into rock at Praia de Angeiras (after Gil Mantas 1999, fig. 4) 59
- Fig. 12. The main concentration of fish-processing complexes at Tróia (after de Alarcão 1988b, fig. 130) 61
- Fig. 13. The first and second phases of “Factories I and II” at Tróia. During the third phase, the *cetariae* of Factories IA, IB, and IC were further subdivided (after Étienne, *et al.* 1994, figs 55-56) 62
- Fig. 14. A visualisation of parts of Factories IC and IA with roofs, with the adjoining bath complex at the rear (after Étienne, *et al.* 1994, fig. 48) 63
- Fig. 15. The fish-processing sites in *Mauretania Tingitana* 64
- Fig. 16. The extant fish-processing complexes at Lixus (after Ponsich and Taradell 1965, fig. 3) 65

- Fig. 17. The plan of Cotta (after Ponsich and Tarradell 1965, fig. 36) 67
- Fig. 18. The *cetariae* of Cotta around the central workspace. The workspace floor (upper left) has now given away, revealing the cistern (photo: A. Trakadas) 68
- Fig. 19. *Cetariae* construction: *opus signinum* facing over rubble construction, visible in examples at Cotta (photo: A. Trakadas) 71
- Fig. 20. The drainage conduit present in the construction of one of the *cetaria* (No. 2) at Alcazarsegher (after Ponsich and Tarradell 1965, fig. 48) 73

Table 1. Key to site numbers 76-78

Tønnes Bekker-Nielsen: The Technology and Productivity of Ancient Sea Fishing

- Fig. 1. Fishing with a casting-net from shore, Oman, January 2002 (Jørgen Christian Meyer) 85
- Fig. 2. The result of one throw of the casting-net from shore (Jørgen Christian Meyer) 86
- Fig. 3a-b. Using the casting net from a boat, Oman (Daniel J. Bosch) 90-91
- Fig. 4. Two fishers hauling a net (*sagêné?*) on board a boat (*cydarum*). (Drawn from the Althiburus mosaic, reproduced from Duval 1949) 92

Anne Lif Lund Jacobsen: The Reliability of Fishing Statistics as a Source for Catches and Fish Stocks in Antiquity

- Fig. 1. From Frances et al. 2001, 134 99
- Fig. 2. Cod stock decline in the North Sea 1963-2001. *ACFM Report 2003* 100

Nadežda A. Gavriljuk: Fishery in the Life of the Nomadic Population of the Northern Black Sea Area

- Fig. 1. Images of a sheat-fish. 1: tattoo of the body of the man from the 2nd Pazyryk barrow (after S. Rudenko); 2: decoration of the felt coverings of the saddles from a barrow, No. 1 burial grounds Ak-Alakha (Mountain Altai, 5th century BC.) (after N. Polosmak) 108
- Fig. 2. 1: Decoration in bronze from shield, ca. 400 BC, from Ordžonikidze (Terenožkin, Il'inskaja, Chernenko & Mozolevski 1973, 171), 2-3: Decoration in bronze, from Malaja Lepetikha, 4th century BC (Il'inskaja & Terenožkin 1983, 150, 161), 4-5: Decorations in gold from wooden bowls, late 5th century BC. Fig. 2.4 from the Solocho barrow near Velikaya Znamenka (Mantsevič 1987, 96, N 68), Fig. 2.5 from Archangelsk (Kherson region) (Leskov 1972, 56, fig. 31, 32), 2.6: Gold plated silver frontlet from horse harness, from the Solocho barrow, 4th century BC (Mantsevič 1987, 39-42, N 13,16), 2.7: Gold frontlet from horse harness, from Volkovtsi,

4th century BC (Michel 1995, 217, K3), 2.8: Metal applique (Korol'kova 1998) 109

Fig. 3. 1: Fish hook (iron), 2-4: shuttles for knitting fishing nets (bone), 5-10: sinkers (fragments of amphorae walls) 111

Vladimir F. Stolba: Fish and Money

Fig. 1. Greek coins of the Classical and Hellenistic periods. 1) Metapontos, AR; 2) Leontinoi, AR; 3) Pantikapaion, AU; 4) Phanagoria, AR; 5) Kyzikos, EL; 6) Olbia, AE; 7) Sinope, AR; 8) Istros, AR; 9) Gela, AR; 10) Akragas, AR; 11) Kyzikos, AR. (1-2, 11: Gorny & Mosch auctions (126, lot No. 1101; 122, lot No. 1099; 121, lot No. 164), photo courtesy of the Gorny & Mosch Giessener Münzhandlung; 4: in commerce; 3, 6-8: Danish National Museum, Collection of Coins and Medals, *SNG Cop.* 6.20, 6.75, 18.281, 6.191, photo courtesy of the Museum; 5: CNG auction 14.01.2003, lot No. 301, photo courtesy of the Classical Numismatic Group, Inc.; 9-10: after Kraay 1976, pls. 48.826 and 46.797) 116

Fig. 2. Coins of Karkinitis, Olbia and Chersonesos. 1-3) Karkinitis, AE; 4) Olbia, AE; 5) Sturgeon shaped bronze figure from barrow 4 near the village of Ryleevka (West Crimea); 6-7, 10-11) Chersonesos, AR; 8-9, 12-13) Chersonesos, AE. (1: Gorny & Mosch auction 60, lot No. 180, photo courtesy of the Gorny & Mosch Giessener Münzhandlung; 2: Odessa Museum of Numismatics, photo courtesy of the Museum; 3: after Kutajsov 1986, fig. 1; 5: after Koltuchov 1997, 63, fig. 3; 6-8, 11: State Hermitage Museum, Numismatic Department, inv.-nos. 25936-25937, 26075, 25945, after casts; 9: Bibliothèque royal de Belgique, Cabinet des Médailles, L. de Hirsch Collection 850, after a cast; 10: Hess-Leu auction 2.04.1958, lot No. 119, after a cast; 12: Ashmolean Museum Oxford, Heberden Coin Room, May bequest 1961, after a cast; 13: Bibliothèque National Paris, Cabinet des Medailles, after a cast) 118

Fig. 3. Coins of Pantikapaion. 1-2) AR; 3-5) AE. Sturgeon species: a) Beluga; b) Russian sturgeon; c) Starry sturgeon (sevryuga); d) Fringebarbel sturgeon; e) Sterlet. (1-2: after Anochin 1986, nos. 67-68; 3: Museum Narodowe Warsaw, inv.-No. 105512, after a cast; 4: Gorny & Mosch auction 118, lot No. 1150, photo courtesy of the Gorny & Mosch Giessener Münzhandlung; 5: Danish National Museum, Collection of Coins and Medals, *SNG Cop.* 6.35, photo courtesy of the Museum) 122

Fig. 4. Bronze coins of the southern Black Sea littoral. 1) Sinope, Caracalla; 2) Sinope, Geta; 3) Sinope, Maximus; 4) Herakleia Pontike, enlarged 1:1.5; 5) Byzantion, Caligula; 6-7) Byzantion, Plotina; 8) Byzantion, Sabina; 9) Byzantion, Faustina the Younger; 10) Byzantion, Lucilla. (1-3: after Waddington, Babelon & Reinach 1904, pl. 28.4, 10, 18; 4: British Museum, Department of Coins and Medals, *SNG BM* 1639, photo courtesy of the Museum (Andrew

Meadows); 5-10: after Schönert-Geiss 1972, pls. 63.1312/2, 68.1361-1362/2, 69.1374, 73.1420/2, 74.1422/2.) 125

Fig. 5. Bronze coins of Anchialos. 1) Crispina; 2) Julia Domna; 3-5) Maximinus; 6) Gordianus III. (1: after Struck 1912, pl. 6.22; 2: auction Gorny & Mosch 118, lot No. 1631, photo courtesy of the Gorny & Mosch Giessener Münzhandlung; 3: photo courtesy of the Aeqvitas.com (Heather Howard); 4: photo courtesy of Thomas Burger; 5: auction Lanz 102, lot No. 831, photo courtesy of the Numismatik Lanz; 6: in commerce, photo courtesy of the Classical Numismatic Group, Inc.) 127

Fig. 6. Main Black Sea fish species of commercial importance. 1) Beluga, *Huso huso*; 2) Russian sturgeon, *Acipenser gueldenstaedtii*; 3) Starry sturgeon/sevryuga, *Acipenser stellatus*; 4) Fringebarbel sturgeon, *Acipenser nudiiventris*; 5) Sterlet, *Acipenser ruthenus*; 6) Turbot, *Rhombus maeoticus*; 7) Pontic shad, *Alosa pontica*; 8) Flathead mullet, *Mugil cephalus*; 9) Golden grey mullet, *Liza aurata*; 10) Leaping mullet, *Liza saliens*; 11) Atlantic mackerel, *Scomber scombrus*; 12) Black Sea anchovy, *Engraulis encrasicolus*. (1, 4-8, 10-11: after <http://www.internevod.com/rus/academy/bio/opr>; 2-3, 9, 12: after <http://www.fishbase.org>) 129

Jakob Munk Højte: The Archaeological Evidence for Fish Processing in the Black Sea Region

Fig. 1a-b. Maps of the Black Sea and the Kimmerian Bosphoros with indication of the places mentioned in the text 134

Fig. 2. Net weights from Elizavetovka. Left stone weights, right clay weights (after Marčenko, Žitnikov & Kopylov 2000, figs. 75-76) 135

Fig. 3a. Bronze hook from Panskoe I/U7 in Čornomors'ke Museum (author's photo) 136

Fig. 3b. Terracotta figure of a resting fisherman found at Kepoi. Now in Taman' Museum (photo: Jacob Munk Højte) 136

Fig. 4. Bone needles for repairing nets from Elizavetovka (after Marčenko, Žitnikov & Kopylov 2000, fig. 77) 137

Fig. 5. Plan of Tyritake showing the location of the salting vats (after Gajdukevič 1952, 16) 143

Fig. 6. The largest salting installation with originally 16 vats located just inside the southern wall. The vats had a capacity of 155 m³ (courtesy of the Photo Archives of IIMK RAN) 144

Fig. 7. Plan of sector XIII in Tyritake where a high concentration of salting vats was found (after Gajdukevič 1971, fig. 97) 145

Fig. 8a-c. a) Salting unit B in sector XIII in Tyritake. b) Salting unit D in Sector XIII. c) Net weights found in the vicinity of salting vats in Sector XIII (courtesy of the Photo Archives of IIMK RAN) 146-147

Fig. 9. Plan of house of the 3rd-4th century AD with small salting vat built onto the south-western wall (after Gajdukevič 1971, fig. 108) 148

- Fig. 10. Plan of Myrmekion. The single salting unit with eight vats in two rows is located in area 2 (after Gajdukevič 1952, 136) 149
- Fig. 11. Salting unit in Myrmekion with a capacity of 116 m³ (courtesy of the Photo Archives of IIMK RAN) 150
- Fig. 12. Finds from the vicinity of the vats in Myrmekion. Note the tiles that may have belonged to a protective roof, and the limestone blocks that were used to press down the fish during processing (courtesy of the Photo Archives of IIMK RAN) 151
- Fig. 13. Ceramic vessel thought to have functioned as a sieve (courtesy of the Photo Archives of IIMK RAN) 152
- Fig. 14. Cistern A in a house in block XV-XVI in Chersonesos from the first to second century AD (after Belov & Strželeckij 1953, 80, fig. 44) 153
- Fig. 15. *Pithoi* in a storeroom in the house in block XV-XVI in Chersonesos (after Belov & Strželeckij 1953, 79, fig. 43) 153
- Fig. 16. Plan of the salting installation at Zolotoe (after Vinokurov 1994, 158-159, fig. 2) 155
- Fig. 17. Plan of the salting installation at Salatčik (after Vinokurov 1994, 168, fig. 10.2) 155

Bo Ejstrud: Size Matters

- Fig. 1a-b. a) A Dressel 7 containing an average of 16 litres of *garum* (after Martin-Kilcher 1994a, 394). b) A Dressel 20 containing an average of 66 litres of oil (after Martin-Kilcher 1987, 55) 172
- Fig. 2. The colony of Augusta Raurica. General plan with the Rhine, important buildings and roads (redrawn from Martin-Kilcher 1987, 17) 173
- Fig. 3. Wine, oil and *garum* at Augst. Left: The proportion between all fragments (Martin-Kilcher, Abb. 204). Right: The proportion between volumes at AD 30-70 176
- Fig. 4. Relative volumes of oil, wine and *garum* in Western Europe. Modern borders from World Data bank 2 (CIA 1972) 178
- Fig. 5. The relation between oil and *garum* on the five sites 179
- Table 1. Amphorae from Augst. Types not known in first-century context are not shown 175
- Table 2. Estimated annual imports of wine, oil and *garum* in Augst 177
- Table 3. Mean volumes of amphorae at Augst 177
- Table 4. The average imports to Saint-Romain-en-Gal and Rome can be replicated exactly in Augst by simply changing the volumes of wine 179

Introduction

... like some blameless king, who upholds righteousness,
as the monarch over a great and valiant nation: the earth yields its
wheat and barley, the trees are loaded with fruit, the ewes bring
forth lambs, and the sea abounds with fish by reason of his virtues,
(Homer, *Odyssey* 19.110-114, trans. Samuel Butler)

To any reader familiar with Classical literature, lambs, fruit and ears of corn are familiar symbols of prosperity and fertility. But fish? It would seem that to the hero – and the author – of the *Odyssey*, an abundance of fish was a characteristic of the good city-state and a testimony to the virtue of its ruler.

The Danish city of Esbjerg boasts a fishing port as well as an equestrian statue of the virtuous King Christian IX in the main square. These two features alone, then, would qualify it as the venue for a conference on ancient fishing. In addition, the city is home to a branch campus of the University of Southern Denmark, one of the partner institutions in the Danish National Research Foundation's Centre for Black Sea Studies. It was at the Esbjerg campus that the papers in this volume were first presented in the course of a workshop in April, 2003. Some twenty researchers took part in two days of lively discussions ranging as widely as the travels of Odysseus.

Historians, classicists and archaeologists dealt with the question of ancient fish processing from the viewpoint of their disciplines, but in addition, we were fortunate to have an inspiring presentation on "The biochemistry of fish processing" by Hans Otto Sørensen, biochemist and laboratory manager at Triple Nine Fish Protein, Esbjerg. As the world's second largest producer of fish protein concentrate, Triple Nine undertakes extensive research into the biochemistry of fish processing and fish spoilage. We regret that it was not possible to include Hans Otto Sørensen's presentation in this volume.

After the conference, it was felt that it would be useful to complement the papers with a survey of the prehistory of fishing in the northern Black Sea region. Nadežda Gavriljuk kindly undertook to write a chapter on this subject at short notice.

For the ancient world, much of our information on fish in general is derived from the extensive range of sources dealing with fish as a foodstuff and, from the time of Hippokrates (c. 400 BC) onward, with the medicinal properties of fish. John Wilkins' survey of the textual evidence reveals that among ancient

authors – that is to say, among those whose works have been preserved entirely or in fragments – some possessed a detailed knowledge of numerous types of fish, their origins and their taxonomy. When assessing the wealth of detailed information and culinary advice presented by, e.g., Athenaios, one should keep in mind, however, that the opportunity to pick and choose from a wide variety of fish species was open only to affluent and sophisticated members of the elite, such as Athenaios himself. In this respect, the work of Galen may provide a more realistic impression of ancient dietary habits.

The literary sources for processed fish products such as *garum* are supplemented by a large and growing volume of epigraphical and archaeological evidence, but it is remarkable that – as pointed out by Robert Curtis in his chapter on “Sources for Production and Trade of Greek and Roman Processed Fish” – not until the twentieth century were serious attempts made to relate the testimony of the texts to the archaeological material, or to view them in the light of parallels with contemporary fish processing in Southeast Asia (where fish sauces similar to the ancient *garum* are produced today). In fact, it was not until the 1960’s that the first large-scale systematic study relating the different source categories to each other (Ponsich & Tarradell 1965) was published.

Literary texts and inscriptions of the Roman period indicate that in their time, fish processing took place along the coasts of the empire from the Atlantic to the Black Sea, and archaeological finds corroborate the testimony of the textual sources. They also indicate that the consumption of *garum* and related products was more widespread, in spatial and social terms, than that of fresh or salted fish. As evidenced by the presence of *garum* amphorae in landlocked Augusta Raurica, discussed by Bo Ejstrud in this volume, fish sauces could be transported far inland and were – unlike fish – generally not expensive. A possible modern parallel is tomatoes: in winter, these are still something of a luxury in northern Europe, but tomato ketchup is not.

One aspect of fish as food that was not dealt with in any of the presentations but taken up in the discussions was the definition of “fresh” fish in antiquity. As pointed out by Hans Otto Sørensen, attitudes to freshness in foodstuffs are largely culturally determined. Fish at a certain stage of incipient spoilage might be rejected in one culture, but considered edible (or even preferable to the fresh article) in another. The popularity of *garum* suggests that compared with modern southern Europeans, ancient Romans had a greater tolerance towards strong smells in fish (and no doubt elsewhere in their daily environment) and thus might be less inclined to reject fish on olfactory criteria alone; on the other hand, the rarity of references to food poisoning in the literature and the practice of night fishing suggest that the ancients’ criteria for freshness were not too far from our own – but the topic deserves further research.

In her survey of the archaeological evidence for fish processing in the western Mediterranean, Athena Trakadas focuses on the remains of salting installations in present-day Morocco, Portugal and Spain. Studying large

processing complexes such as Lixus or Cotta can offer valuable clues for interpreting similar installations in the Black Sea area, e.g. at Tyritake, Myrmekion or Chersonesos. It is notoriously difficult to estimate production capacity from the remains of salting vats, or to relate potential capacity to actual production, but a rough comparison of the cubic capacity at western Mediterranean salteries with those of the Black Sea salteries may nonetheless provide a useful basis for comparison.

Trakadas also discusses the question of origins: did fish processing take place in the Punic period, or was it introduced to the western Mediterranean by the Greeks? Scholars of an earlier period, when diffusionism and Greek cultural superiority were taken for granted, favoured the notion that fish processing was a Greek innovation, but the archaeological evidence points to Punic origins.

The numerous and well-documented fish processing sites in the west permit certain generalizations about chronology and spatial location. Athena Trakadas identifies common factors determining the location of processing sites: proximity to the sea, plentiful freshwater resources and salt; also fuel for concentrating liquids through evaporation. Kilns for producing amphorae are often found in conjunction with processing sites, and these in turn again require fuel as well as suitable clay. The most important input is obviously fish, and in the last analysis, large-scale fish processing depends on the ability of the fishermen to supply large quantities of suitable species. It has been claimed (Gallant 1985) that ancient sea fishing technology was inherently inefficient, but starting from the most important literary source, the *Halieutika* of Oppian (second century AD), Tønnes Bekker-Nielsen demonstrates that the ancient fishing gear – which would include lines with multiple hooks and seines worked by two teams of fishermen – was sufficiently advanced to produce sizeable catches of fish for salting or *garum* production. In fact, the most important constraint on the further expansion of the ancient fishing sector was the inability to conserve fish for any length of time, a constraint that could be partly overcome by drying, smoking or salting fish, or by converting them into fish sauce.

The theme of fishing productivity is continued by Anne Lif Lund Jacobsen's paper on the use of modern fishery statistics as an indication of ancient catch sizes in the same waters. Jacobsen has worked with fishing statistics in the early modern period and warns against simplistic assumptions that present catches will correspond to actual or potential catches in history. The potential productivity of a fishery is determined by a number of interrelated factors: the state of the marine ecosystem, human exploitation of fish stocks, efficiency of the fishing gear. Because environmental factors play such a large part, fishing statistics from, e.g., Malaysia, are irrelevant to fishing in the Mediterranean or Black Sea. She identifies a number of other problems inherent in such diachronic comparisons and also points out that (contrary to the assumption underlying T.W. Gallant's analysis of nineteenth and twentieth-

eth-century catch statistics, which led him to conclude that the average catch would hardly feed the fisherman and his family) the fish consumed on board or in the fisherman's household are not normally included in the official catch figures. Fishing statistics thus indicate the marketable surplus after the needs of fishermen and their dependents have been met, not the total harvest from the sea.

With Nadežda Gavriljuk's contribution, our geographical focus shifts to the northern Black Sea region and the indigenous nomads of the steppe zone. Generally "fish" and "sea" are not concepts associated with "steppe" or "nomad"; the extent and importance of pre-Greek fishing activity in the northern coastal regions of the Black Sea has been overlooked – and, Gavriljuk argues, underestimated. Fish motifs in Scythian ornaments indicate that fish had a place in the self-perception of the nomadic population, and the rivers of the steppe zone would offer excellent prospects for catching freshwater and migratory fish. Such fishing activities, however, took place within the *oikos* economy. Fishing on a larger scale is not, at present, attested before the late fifth and early fourth century, when we find evidence of fishing and fish processing on a substantial scale at Elizavetovka, a site that is discussed in greater detail by Jakob Munk Højte. On the lower Dnieper, fishing on a "commercial" scale is attested in the second century BC. Gavriljuk concludes that while "subsistence" fishing formed part of the nomad economy at an early date, cultural and commercial contacts with the Greeks were the driving force behind the transition to "commercial" fishing.

The iconographical theme is taken up again in Vladimir Stolba's survey of "Fish and money", demonstrating that fish species depicted on coins of the Pontic Greek cities are often realistically rendered and can be securely identified, the most popular being the various species of sturgeon. While this clearly testifies to a general interest in fish, Stolba warns against jumping to conclusions about the place of fish in the local economies – or to the absence of fishing in cities that do *not* strike coins with fish emblems. Fish and marine species have a vast range of potential symbolic, mythological and religious connotations, as evidenced by the "eagle and dolphin" emblem used, *inter alia*, by the cities of Sinope, Histria and Olbia (and as the emblem of the Danish National Research Foundation's Centre for Black Sea Studies).

From the abstract spheres of mythology and symbolism, we pass to the practical aspects of fish processing, as Jakob Munk Højte takes us on a guided tour of the salting facilities along the northern Black Sea coast. Many of the excavated fish processing tanks have been covered up to protect them from the rigours of the Pontic climate; and what appears to be the largest site, Chersonesos, has not yet been completely excavated. The dimensions of the processing complexes testify to the extent of the Crimean fish salting operations: the combined cubic capacity of the salting vats at Tyritake was 457 cubic metres, and for Chersonesos an estimated 2,000 cubic metres, whereas the largest of the western Mediterranean complexes, Lixus, had a combined

cubic capacity of just over a thousand cubic metres. Unfortunately, as Højte points out, we do not know whether vats were always filled to capacity, nor how many times a year. It may be speculated that in the cooler climate of the Crimea, the annual number of *garum* production cycles would be less than in Spain or North Africa.

In chronological terms, too, comparison between fish-processing sites of east and west are instructive: Athena Trakadas found that fish processing in the western Mediterranean lagged in the second century BC but was revitalised under the early Empire while the Crimean salteries seem to have attained their maximum capacity in the second century AD.

Amphorae, the most common form of transport containers in the ancient world, form an important category of sources for economic history. Surprisingly, they offer very little positive evidence for Pontic fish processing before the Christian era. This paradox is examined in depth by John Lund and Vincent Gabrielsen: while we have textual evidence for the import of *tarichos* and other fish products from the Black Sea to the Aegean, no amphora types have been convincingly identified as containers for fish products. Taking the textual evidence for a Pontic salt-fish trade at face value, Lund and Gabrielsen offer two possible explanations for the absence of transport amphorae: either fish products were transported in re-used wine or oil amphorae (as may be the case with an amphora from the Varna shipwreck); or they were packed in other types of containers, for instance, baskets (for *tarichos*) or barrels (for *garum*). The notion of recycled amphorae is attractive but there are no ancient parallels for large-scale re-use of amphorae in this manner (in contrast to the re-use of individual amphorae for a plethora of domestic purposes). Therefore with our present state of knowledge, the latter hypothesis appears the most likely.

“Vanished” amphorae also form the subject of Bo Ejstrud’s chapter on “Estimating trade of wine, oil and fish-sauce”, but in his case wine, not fish is missing from the equation. Taking the large and well-documented body of amphora fragments from Augusta Raurica (modern Augst in Switzerland, near Basle) as a starting point, Ejstrud first discusses the relationship between amphora finds and actual volumes, then turns to the relative importance of wine, oil and fish-sauce. Even when allowance has been made for the different size of the containers, the volume of fish-sauce attested at Augst is remarkably large in relation to the amount of wine. Since there is no good reason why consumption patterns in the Roman veteran colony at Augst should differ from comparable settlements elsewhere in the western Empire, the conclusion that a considerable amount of wine remains undocumented imposes itself. Presumably the inhabitants of Augst did not only import wine in amphorae but also in other containers, such as barrels.

The lesson to be learned from the contributions by Lund, Gabrielsen and Ejstrud is that while the importance of amphorae as archaeological source material remains undisputed, focusing on this one category of containers may

in fact provide a distorted picture of commodity flows at a given site or date. As pointed out by Stefanie Martin-Kilcher (1990), it is quite possible that the dramatic drop in the number of *garum* amphora fragments in the course of the third century that can be observed at many central European sites, does not reflect a corresponding decline in consumption but a changeover from southern European suppliers to fish sauce produced in northern Gaul, which was shipped in barrels.

A similar problem is that of the missing salting tanks, discussed by Jakob Munk Højte. The Crimean fish-salting industry probably did not reach its maximum capacity until the late second century (at the same time as, or slightly later than, its Iberian and African counterparts) and no processing facility has been dated earlier than the first century AD. Yet fishing (attested by finds of fishing tackle) and fish processing (attested by literary sources) is known to have taken place – but where? One explanation could be that earlier processing facilities were primitive, along the lines of those found at Elizavetovka, and have been obliterated by later, more permanent structures. Fish salting originally took place within the *oikos*, and the diversification into market-oriented *garum* production requiring large capital outlays may have provided the impetus to relocate and concentrate activities in urban centres.

It also needs to be remembered that salting is not the only means of preserving fish; reducing the relative water content of the fish by smoking or drying will have similar effects to salting. At the Elizavetovka site, the remains of a smokehouse have been tentatively identified; as for drying, this requires little equipment except some wooden racks that would, at the most, leave a few post-holes. Fish drying requires no input of salt and produces a commodity that (unlike salt fish, which must be soaked and cooked) is immediately edible and can be used as animal fodder. In the twentieth century, dried fish was produced in large quantities in the North Atlantic (e.g., Newfoundland, Iceland). Great quantities were also produced in south Russia: it is reported that during a fuel shortage in the aftermath of the 1917 revolution, the Bolshevik authorities in Turkestan seized large stocks of dried sturgeon awaiting export and used them as locomotive fuel.¹ Since it leaves so few traces in the archaeological record, the extent of ancient fish drying is difficult to establish. Given the limited number of references to dried fish in the literary sources, it may primarily have been produced within the household, perhaps as a supplementary food in times of famine or poor fishing, or as a staple item of the lower-class diet – Lif Jakobsen reminded us that in some modern fishing communities, dried fish was considered “trash food”. We might, however, also see fish drying as a first stage in a sequence of technological development and increasing market orientation: dried fish for the household economy – salt fish for the regional market – *garum* for the distant markets of the Roman Empire.

In the history of fish processing along the Black Sea, a key question concerns the genesis of the Crimean *garum* industry: whether its origin was

supply-driven or demand-driven. Did Crimean fish salters turn to *garum* production in response to a glut of smaller fish that could not be sold as table fish or processed into *tarichos*; or did they diversify from their core operation to exploit a growing demand for a new culinary ingredient *à la mode*? The implications of this debate extend far beyond the kitchen table, since the two positions reflect two fundamentally different conceptions of the Roman economy. On the one hand, we have the “primitivist” view that Roman primary producers walked a thin line between prosperity and famine, adapting to the exigencies of a changing economic environment. In recent years, this has been combined with the environmental history approach focusing on natural phenomena such as epidemics and climate change to explain past economic behaviour. Within this frame of interpretation, the introduction of *garum* production could be local producers’ response to a Pontic “fish bonanza” such as those that have occurred throughout history (the Baltic herring bonanza of the Middle Ages being one example). Recurrent windfalls of fresh fish might stimulate fish-salters to develop new products.

A “modernist” interpretation, on the other hand, would not necessarily look for the causal factor in the marine environment of the Black Sea, but view the introduction of *garum* as an active response by informed Crimean fish-salters to a growing market for *garum* in the Mediterranean world. The salting cisterns of Myrmekion or Tyritake were clearly not built by destitute fishermen, but by members of the elite with access to technology, capital and information about distant markets. By combining a cheap, plentiful – but perishable – commodity (fish) with an easily obtainable raw material (salt), resulting in a product with higher unit value and longer storage life (*garum*), they were able to exploit those markets.

The current stage of our knowledge favours the notion that the diversification from fish salting into *garum* production was driven by demand, but our picture of ancient fishing and fish processing along the shores of the Black Sea is far from complete. Future research may come up with different answers, even pose entirely different questions. The present volume is not intended as the last word on Pontic fish processing, and if it provokes academic controversy and scholarly discussion on its subject, it will have served its purpose well. It is hoped, however, that the surveys of source material and overviews of the *états des questions* provided in the individual contributions as well as the consolidated bibliography will serve as useful aids to future researchers in a field that still has much to offer.

University of Southern Denmark, Esbjerg
November 2003

Tønnes Bekker-Nielsen

Notes

- 1 Blacker 1922, 266; Brun 1930, 109.

