

The Technology and Productivity of Ancient Sea Fishing

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1. *The nature of the sources*

The volume of ancient literature and inscriptions relating to saltwater fishing is not large. This reflects the social context of sea fishing: it was no profession for gentlemen – it does not figure in the writings of the elite; it was not tightly controlled by the state – there are few references to fishing in legal texts;¹ its practitioners were not wealthy – there are few gravestones or epitaphs naming fishermen. The scarcity of our evidence does not reflect a prejudice against fish and fishy matters in general – as shown by Curtis and Wilkins in preceding chapters of this volume, there is a considerable volume of texts relating to processing and consumption of fish, as well as a fair amount of evidence for freshwater fishing, fish-traps, fish-ponds etc. If we were to judge the relative importance of ancient saltwater and freshwater fisheries on the basis of literary sources alone, we might be misled to conclude that freshwater fish played a far greater role in the economy and the diet than sea fish.²

We do, however, have one major treatise on sea fishing, the *Halieutika* of Oppian, composed between 177 and 180.³ The *Halieutika* is a Greek poem of more than 3500 hexameters and preserved in its entirety; for good measure, the last half of a late Roman prose paraphrase has also been handed down to us.⁴ In some respects the *Halieutika* can be compared with the agricultural manuals of Varro and Columella, but the differences between these and the work of Oppian are more telling. Whereas the farm manuals are written by or dedicated to owners of agricultural land, it is quite clear that Oppian was not himself a sea fisherman,⁵ and the poem is dedicated to the emperor Marcus Aurelius – supporting the notion that by this time, if not before, sea fishing rights were in principle imperial property enjoyed by his subjects at the emperor's discretion.⁶ Another striking difference is that whereas the agricultural writers often comment on the economic aspects of farming: choosing the most efficient crops, getting the produce to market etc., Oppian never discusses economic matters such as the price of fish or tools, the relative efficiency of different fishing methods or how the catch is shared among the fishermen after the day's work.

The form and literary style of the *Haliēutika* raise a number of disturbing questions about the nature of the information it provides. First, the use of the hexameter means that technical terms or names of certain species of fish may have been excluded because they did not scan. Second, like many other Greek writers of the second-century AD, Oppian is strongly influenced by the Hellenic revival known as the second sophistic, a retrospective literary movement striving to re-establish or reinvent Greek culture as it had been in the distant, glorious past. He draws on literary models of the classical period and may also have derived some of his factual information from writers of the fifth and fourth centuries BC, but since Oppian gives no source references, we cannot tell. Much of his information may be taken from a lost work by Leonidas of Byzantium (*fl.* c. 100 AD), other parts are clearly dependent on Aristotle. In short, it would be dangerous to assume that Oppian describes the fishing practices of his own day; his information may well be outdated by many centuries. There may also have been important regional variations in fishing technique. Oppian himself hailed from Cilicia⁷ but there is nothing to suggest that he describes the fishing practice of his native region and he gives only a few examples of local fishing techniques – such as the Thracians' use of a beam with multiple tridents to catch tunny (see below p. 89).

The amount of direct archaeological evidence for sea fishing is not large, either. In exceptional environments such as Herculaneum or Egypt, remains of fishing nets have been found; elsewhere only implements made of inorganic materials, such as hooks and net sinkers, have survived. Some wrecked fishing boats may still be lying on the seabed, awaiting discovery or publication, but it is on *terra firma* that we find the most abundant evidence for fishing: the tanks used for processing saltwater fish, the containers used for shipping the finished product (cf. the contributions by Trakadas, Højte, Lund and Gabrielsen in this volume) and pictorial representations of sea fishing and fishing boats. In the Classical and Hellenistic period, such depictions are rare, but with the advent of polychrome mosaic in the first and second century AD, fishing scenes become popular, especially in Sicily and North Africa (cf. Bekker-Nielsen 2002b).

Given that our sources are diverse and widely scattered, the outcome of any attempt to describe ancient sea fishing and its productivity will to some degree be determined by our preconceived ideas about the nature of ancient society and its economy; and in recent decades, the dominating paradigm has been that of the Cambridge or "primitivist" school inspired by the work of the late Sir Moses Finley. Thomas W. Gallant's slim monograph *A Fisherman's Tale* (1985) is a work in this tradition and one of the few recent studies of ancient fishing. Gallant concludes that fishing played a minor role not only in the economy of ancient society as a whole, but even within the fisher's own *oikos*. These conclusions are based partly on modern fishing statistics, partly on technological arguments. Gallant claims that ancient sea fishing was incapable of supplying large amounts of fish because the implements



Fig. 1. Fishing with a casting-net from shore, Oman, January 2002 (photo: Jørgen Christian Meyer).

were primitive and the most efficient of the tools available, the fishing-net, was never used from boats: net fishing was “a completely shore based technology”.⁸ Drawing on data from nineteenth- and twentieth-century fishing statistics, he further argues that the fishing technology of the ancients would have produced risible catches, no more than a few kilos per day; so little that, under normal circumstances, it would barely support a fisherman’s family or make sea fishing a viable full-time occupation. In Gallant’s view, fishing formed a complement to farming, a supplementary source of nutrition and income when the harvest failed. The relevance of modern fishing statistics to antiquity is discussed by Jacobsen elsewhere in this volume; the present paper aims to examine the question of fishing productivity in the light of fishing technology.

2. Fishing from shore and fishing from boats

Gallant’s argument for the inefficiency of ancient fishing technology rests, *inter alia*, on the assumption that net fishing did not take place from boats, but only from shore. Shore-based net fishing can, however, be highly efficient. During a field trip to Oman in 2002, Jørgen Christian Meyer observed fishermen working from the shore of the Persian Gulf with casting nets (Fig. 1). Although modern nets are made from nylon or other man-made fibres instead of flax,



Fig. 2. The result of one throw of the casting-net from shore (photo: Jørgen Christian Meyer).

the technology is similar to that used in antiquity; and in a single throw of the net, the fisher may take fifteen to twenty kilos of fish (Fig. 2).⁹ Oppian's description of fishing for tunny along the coast, quoted below (p. 92-93) also suggests that fishing from shore could be quite productive.

While fishing boats¹⁰ as well as nets¹¹ are mentioned in Greek literature and were no doubt used together from an early date, our present evidence for the combination of nets and boats dates from the first century AD onwards.¹²

The extant sources have very little to say about the size and range of ancient fishing boats. From a passage in Xenophon's *Hellenika* (5.1.23) mentioning fishermen returning to the Piraeus at dawn, we know that by the fourth century BC, if not before, fishing boats were large enough to range into the Saronic gulf and the fishermen sufficiently confident to navigate at night.

Two literary passages describe rulers travelling in fishing-boats: Xerxes crossing the Hellespont on his retreat from Greece in 479, in Justin's *Epitome* of Trogus, and Caesar attempting, unsuccessfully, to cross the Adriatic in 48 BC, as described by Lucan and Ammianus. On closer inspection, they have little historical value, but provide some useful insights into the general perception of fishing vessels in the Roman world.

While the near-contemporary Herodotos (8.117) merely tells us that the Persian army crossed “in ships” (*nêusi*), “as the bridges had been destroyed in a storm”, Trogus elaborates on the dramatic change in the fortunes of Xerxes, illustrated by his choice of transport: the Great King is forced to use a fishing boat to traverse the Hellespont where, on his outward journey, he rode on a bridge of ships:

Ubi cum solutum pontem hibernis tempestatibus offendisset,
piscatoria scapha trepidus traiecit. Erat res spectaculo digna et
 aestimatione sortis humanae, rerum uarietate miranda in exiguo
 latentem uidere nauigio, quem paulo ante uix aequor omne
 capiebat

Having found the bridge broken down by the winter storms, he crossed in the utmost trepidation in a fishing-boat. It was a sight worth contemplation for judging of the condition of man, so wonderful for its vicissitudes, to see him shrinking down in a little [fishing] boat, whom shortly before the whole ocean could scarcely contain (Justin, *Epitome*, 2.13.9-10, ed. M.-P. Arnaud-Lindet, trans. J.S. Watson)

In a similar manner, the story of Julius Caesar’s abortive attempt to cross the Adriatic in 48 BC was transformed and dramatised. According to Plutarch (*Caesar*, 38) he chose a boat “of twelve oars” while in Appian’s *Civil War* (2.56) Caesar sends his servants to fetch “a fast boat”.

The poet Lucan tells a different and more dramatic story of Caesar walking alone on the beach in the darkness and finding a small boat whose owner is sleeping in his simple cottage nearby (*Pharsalia*, 5.504-524).¹³ Ammianus, who had read Lucan,¹⁴ reproduces this version and specifically identifies the boat-owner as a fisherman: *alium anhelante rabido flatu uentorum lenunculo se comisisse piscantis* (16.10.3, ed. Seyfarth): “another [i.e. another emperor than Constantius II, whom Ammianus is comparing unfavourably to his predecessors] in the middle of a raging gale entrusted himself to the small boat [*lenunculus*, dim. of *lembus*] of a fisherman”.

On one point, then, these texts are unequivocal: to the average Roman (and presumably also the average Greek) a fishing boat was a *small* boat and not for the faint-hearted. In the opening verses of the *Haliutika*, Oppian describes “fearless” (*aphrastoi*) fishers taking to the sea in “tiny” (*baioi*) wooden fishing boats (*Hal.* 1.9; 1.41). Their small craft are directly contrasted with the large and comfortable boats used for “regal” fishing in waters where the fish are fed regularly while waiting for their owners to catch them.¹⁵ The same impression is gained from a study of the pictorial evidence. Though the boats shown on the late Roman mosaics that form the main body of our pictorial evidence are stylized and their crews reduced to a few persons,

they nonetheless give some impression of the relative size of fishing vessels compared to other boats.

In the mosaics, most fishing boats have no sails or masts. In the Althiburus mosaic, in effect a catalogue of ship types in pictorial form giving the name of each type (cf. fig. 4), the two types that can be identified as fishing vessels are rowboats, though other boats in the mosaic have masts (some also have stays, indicating a large sail).¹⁶ In the “Mosaïque de la Toilette de Venus” found at Djemila (Culcul), two ships, one a warship, are shown with square sails but the two fishing-boats working a seine in the opposite border of the mosaic are rowboats.¹⁷ A fishing scene forming part of a third-century African mosaic showing Bacchus fighting pirates¹⁸ is unusual in showing three fishermen working from a large, square-rigged boat, while a fourth-century mosaic from Carthage shows two persons fishing from a boat with a mast and two stays.¹⁹ Some boats may have had a small mast and a sail that could be raised if the wind was favourable for going to and from the fishing grounds.²⁰

3. *Getting the catch ashore*

Ancient fishermen could only range over a limited area, restricted not only by the limited size of their craft but also by the short time within which the catch must be brought to market. This critical time frame could be expanded by gutting the fish immediately after the catch, by keeping them alive in baskets or creels, and by keeping the catch cool, e.g. by concentrating fishing activities in the coolest hours of the day. A passage of Galen, already quoted by Wilkins in his contribution to this volume, refers to “pickled fish or ... fish that can be kept in snow until the next day”.²¹ Given the difficulty of obtaining snow or ice for packing, the second option was not open to our average fisherman. One notes, however, the implication that unless preserved in one way or another, fish will not keep overnight.

Fish in fact begin to deteriorate within a few hours of being caught, but if gutted immediately after the catch the rate of deterioration is reduced.²² For table fish and some varieties of salt fish, one would assume that ancient fishermen gutted their catch on board, but the process is not described by Oppian or in pictorial sources, nor are the flocks of sea-birds that follow a boat to catch the guts as they are thrown overboard. In the production of *garum* the whole fish was used and there was no need to gut the fish at sea.

The rate of spoilage increases with the ambient temperature, so fishing at night or just before dawn, when the temperature is lowest, will increase the fisher’s chances of getting his catch ashore in good condition. From Xenophon’s mention of fishers coming into port in the morning, we know that as early as the fourth century BC, fishermen supplying the markets of Athens worked at night. Oppian (3.50-52) also mentions fishing late at night or early in the morning. With passive implements (ground-nets, creels, traps) set overnight, fish remain alive in the water until the fisher comes to check his

nets in the morning – cf. Oppian’s description (3.86-87) of nets bringing large rewards to their sleeping master. Fish could be kept alive *en route* to market in creels or well boxes (cf. p. 137 below), but although Oppian mentions creels, *kyrtoi*, several times and even explains how to make one (3.341-343) he does not mention their use for storage purposes. Roman mosaics²³ show fishers emptying creels, but the contexts imply that these, too, have been used for catching fish, not for keeping them: the creels are being emptied while the boat is still at sea.

4. Spears and hooks

In several passages, Oppian mentions the use of tridents to catch small sharks, swordfish, whales and young tunny (*Hal.* 3.552-554; 4.252-253). Dolphins, too, could be caught in this way. Killing a dolphin was anathema to a true Greek, but the fishermen of the Black Sea region were less sensitive in this respect. Oppian relates that “Thracians and the inhabitants of Byzantium” (*Hal.* 5.521-522) catch dolphins, and dolphin bones have been found at processing sites in Chersonesos.²⁴ Spears and tridents could of course also be used in shallow water and in estuaries, e.g. for catching sturgeon. Oppian mentions an ingenious device used by Thracian fishermen in the Black Sea to catch young tunny: a beam with multiple tridents attached dropped from above into the shallow water, its teeth impaling or trapping the fish (4.535-548).

Fishing with hook and line from a boat is a quite efficient method, especially if the fishermen are after large table fish. It is obviously less efficient for catching the smaller species such as mackerel, anchovies or sardines since the effort of baiting the hook remains the same regardless of the size of the fish to be caught. Efficiency also varies with the number of hooks: a line or rod with one hook is generally less productive than a line with multiple hooks.

To judge from the assertion that “line fishing is a technique incapable of output beyond a very low level”,²⁵ T.W. Gallant apparently assumes that when fishing with hook and line, only one hook was used at a time; however, the use of multiple-hook lines is attested to not only by Oppian but by the finds of large stocks of fish-hooks on archaeological sites. In the south-eastern quarter of Chersonenos, for instance, excavators found c. 140 hooks along with 50 sinkers.²⁶ Such large numbers can only be explained by the use of multiple-hook lines. Assuming that the sinkers were combined with floats (of organic material such as wood or cork,²⁷ which will have perished) a multiple hook line could be trailed after a boat or even left overnight and drawn in next morning.

In book three of the *Halieutika* (3.78; 3.468ff) Oppian discusses the use of hooks and lines, from a boat and from shore. He gives a graphical description of how a line with multiple hooks is used to fish a shoal of saddled sea bream:



3a-b. Using the casting net from a boat, Oman, 1966 (photo: Daniel J. Bosch).

In his hand [the fisherman] holds ready a thin rod and a thin line of light hair all untwined, whereon are strung numerous light hooks. On these he puts the same bait as before he cast in the water, and lets it down into the deep turmoil of the waves. Seeing it the *Melanurus* immediately rush upon it and snatch – their own destruction. (Mair's translation)

Taking Oppian's description at face value, this should be a quite efficient way of catching fish. One fully grown saddled sea bream (*Oblada melanura*) weighs 0.75-1kg.

5. *Nets and creels*

In the context of fish processing, however, our main interest must focus on nets. Nets can be adapted to almost any size of fish and a net is by far the most efficient implement for catching the smaller species often used for the production of *garum*. The widespread use of the net in antiquity is attested, *inter alia*, by the extent of the vocabulary used to describe the different types. Oppian claims that the different nets are *myria*, innumerable, but gives a short list of some of the most important types (3.79-84)



Fig. 3b.

ἀμφίβληστρον: Wurfnetz, casting-net²⁸

γρίφος: Ziehnetz, draw-net

γάγαμον: Schleppnetz, drag-net

ὑποχή περιηγής: runder Sacknetz, round bag-net

σαγήνη: Zieharn, seine

κάλυμμα: Decknetz, cover-net

πέζα: Grundnetz, ground-net

σφαιρῶν: Ballnetz, ball-net

σκολιδός πάναγρος: gekrümmter Allfangnetz, crooked trawl

Some of these types can also be identified from the pictorial evidence.²⁹ The *amphiblêstron* is a simple and efficient device, still in use today: a casting-net that can be used either from shore (Fig. 1) or from a boat (Fig. 3a). To ensure that it sinks quickly before the fish can escape, its edges are weighted. In still waters, the edges should strike the surface of the water at the same moment (Fig. 3b); this takes some skill in casting and requires that the weights are of equal weight and evenly distributed along the edge of the net. Used from shore the casting net requires only one person, but when it is used from a boat, the mosaics typically show that at least two persons are required: one rowing, one casting the net.³⁰



Fig. 4. Two fishers hauling a net (*sagênê*?) on board a boat (*cydarum*). (Drawn from the Althiburus mosaic, reproduced from Duval 1949).

The *gangamon* and the *hypochê periêgês* are likewise small nets that can be handled by one person. The *sagênê*, whence the modern word *seine*, is a larger net requiring the effort of several persons (Fig. 4), or the crews of two separate boats. In Mair's translation, Oppian describes the use of the seine as follows (4.491-496):

Now when the fishermen behold them huddle together, they gladly enclose them with their hollow seine-nets and without trouble bring ashore abundant booty and fill with the fry all their vessels and their boats and on the deep beaches pile up heaps, an infinite abundance of spoil.

Judging from its name, the *kalymma*, "veil" would appear to be a net of unusually fine material, perhaps for catching very small fish. The *peza* or "ground" net was presumably a stationary net, weighted to the sea-bed and kept upright by floats. The *skolios panagros*, "hollow all-catching net" is rendered in Mair's translation as a "crooked trawl" but was no trawl in the modern sense of that word. The trawl is an active fishing implement dragged after the boat; it trails deeply in the water, along the sea bed. The *skolios panagros* on the other hand hangs just below the surface, suspended from cork floats along its edge.³¹ Instead of moving the net itself, the fishers could attempt to shoo a shoal into the net, as Oppian describes in the case of young tunny (4.566-582, trans. A.W. Mair):³²

The fishers set up very light nets of buoyant flax and wheel in a circle round about while they violently strike the surface of the sea with their oars and make a din with sweeping blow of poles. At the flashing of the swift oars and the noise the fishes bound in terror and rush into the bosom of the net which stands at rest, thinking it to be a shelter; foolish fishes which, frightened by a

noise, enter the gates of doom. Then the fishers on either side hasten with the ropes to draw the net ashore. And when they see the moving rope, the fish, in vain terror, huddle and cower together and are coiled in a mass. Then would the fisher offer many prayers to the gods of hunting that nothing may leap out of the net nor anything make a move and show the way; for if the pelamyds [tunny³³] see such a thing, speedily they all bound over the light net into the deep and leave the fishing fruitless.

Among ancient fishing techniques, one of the most productive was to catch migrating tunny in semi-permanent nets or traps. Oppian describes the “tunny-watcher” (*thynnoskopos*) on a high hill, keeping a lookout for the approaching shoals, and the fish streaming into the stationary nets “like soldiers by the phalanx” (*Hal.* 6.637-648). In the Black Sea region, Kyzikos and Byzantion were, among others, renowned for tunny fishing. In the Mediterranean, Oppian singles out three waters as especially notable for their tunny fisheries: the Iberian Sea, the Golfe de Lion and the Sicilian Channel (3.623-627). Significantly, these three regions were also known for their *garum* production.

6. Conclusions

Gallant assumed that ancient net fishing did not take place from boats, and that other techniques (such as fishing with hook and line, or net fishing from shore) were inefficient. As can be seen even from this short survey of the available evidence, neither of these assumptions is tenable. Simple technologies such as lines with multiple hooks or casting-nets used from shore are capable of producing substantial catches, and nets were clearly used from boats, at least from the early Empire onwards.

In fact, the most important technological constraint on the development of Graeco-Roman fisheries was not the inefficiency of the fishing gear, but the inability to preserve fish after the catch. This limited the range of the fishing boats, since going far out of port entailed a correspondingly long return journey, by which time the catch would be spoiled. It also limited the size of boats and crews, since a larger boat would take longer to fill before it could commence the return trip.

Oppian describes seines and boats overflowing with fish as one might find on a good fishing day, but there would be other days when the catch was poor or fishing altogether impossible due to the weather. Even with advanced modern-day technology, catches remain variable and unpredictable. Catching table fish was probably never very remunerative for a fisher based in a small city (a category that includes most of the settlements along the Black Sea coast). On the few days of the year when the fisher had a windfall catch, there would be too few buyers in the local market – and the fish could not be held over until the next day. They could, however, be preserved (by drying,

pickling or salting) or processed into *garum*. Compared with other strategies for obtaining food, ancient fishing technology was neither inefficient nor unproductive, and it may in fact have been overproductive in relation to potential consumption – leading in turn to the development of technologies for preservation and long-term storage of fish and fish products.

Notes

- 1 Ørsted 1998, 14-17.
- 2 Cf. that in Rostovtzeff 1957, nearly all references to “fishing” and “fish” are to freshwater fishing.
- 3 For the date, see *Hal.* 1.3; 2.683.
- 4 Published by Isabella Gualandri (1967).
- 5 Indeed, one may well doubt that Oppian ever went to sea in a small fishing boat. While the *Halieutica* teems with literary descriptions of the roaring waves, the rushing currents etc. there is no attempt to describe the motion of the boat itself. At the beginning of book 3, Oppian dwells on the physical stamina required of a fisherman: strength, endurance, etc. but there is no mention of seasickness; *Hal.* 3.29-40.
- 6 Cf. the discussion in Ørsted 2000, 19-20. The tradition that the emperor commissioned the poem from Oppian is late and dubious.
- 7 Cf. *Hal.* 3.7-8.
- 8 Gallant 1985, 25.
- 9 Personal communication, 23 February 2002.
- 10 E.g., Xenophon, *Hell.* 5.1.23
- 11 E.g., Hesiod, *Shield*, 213-214.
- 12 Bekker-Nielsen 2002b, 218-223.
- 13 The story of how Caesar finds the boat on the beach and wakes its master in his simple house of reeds and seaweed clearly imply that the boat-owner is a fisherman.
- 14 Barnes 1998, 193.
- 15 *Hal.* 1.57-63. Perhaps it was on such a pleasure fishing expedition that Oppian saw fishers enticing sea bream towards their lines by throwing food in the water, as described in *Hal.* 3.462-474. Cf. also 3.221-260.
- 16 Duval 1949; Bekker-Nielsen 2002b, No. 22; 30.
- 17 Blanchard-Lemée 1975, pl. 1, Bekker-Nielsen 2002b, No. 29.
- 18 Poinssot 1965, 224; Bekker-Nielsen 2002b, No. 18.
- 19 Bekker-Nielsen 2002b, No. 9.
- 20 In *Hal.* 3.66, Oppian explicitly advises the fisherman to set his sail when he has a favourable wind. Greek triremes similarly had a sail and mast that could be taken down when not in use.
- 21 Galen, *On the properties of foodstuffs* 3.34 = 6.713 Kühn; see also Wilkins, above p. 24-25.
- 22 This and other information on fish preservation is taken from Hans Otto Sørensen’s paper (not included in this volume) on the biochemistry of fish processing.
- 23 Bekker-Nielsen 2002b, Nos. 1-4.
- 24 Kadeev 1970, 16. See also Bode 2002, 13-15.
- 25 Gallant 1985, 25.
- 26 Kadeev 1970, 8.

- 27 For the use of cork floats, cf. *Hal.* 3.103.
- 28 The translations are those of A.W. Mair (English) and F. Fajen (German).
- 29 For a more detailed discussion of the different net types and their use, see Bekker-Nielsen 2002b; for a general survey of fishing in antiquity, see Donati and Pasini (ed.) 1997.
- 30 E.g., Bekker-Nielsen 2002b, No. 7; 11; 13.
- 31 *Hal.* 3.103, *peismata phellôn*, lit. “cork ropes”, presumably cylindrical cork floats strung on a cord. Among the members of a fishing-guild at Parion on the Hellespont, one is identified as *phell[lo]chalastôn*, “loosening (?) the cork floats” (IK 25.6).
- 32 In this passage, the net is only described in general terms as *linos* (“flaxen”) and *diktyon* (“webbed”) but judging from the description of its use, it corresponds to the *sagênê* or the *skolios panagros*.
- 33 Greek *pêlamys* signifies “young tunny”. The modern word “pelamyd”, which Mair uses here, denotes various species of mackerel, so called from their resemblance to small tunny.

