



# Bronze Fish

## *Marine Resources and the Bronze Age Economy*

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### Abstract

The Bronze Age was a time of pivotal economic change when new long-distance trading networks became associated with a macro-regional division of labour and decentralised political complexity. These developments occurred against the background of a shifting mosaic of subsistence patterns, which included the east-west exchange of crops across Eurasia and (in some areas) greater use of secondary products. As Bronze Age economies became more specialised and diverse, it might be assumed that there was also an increased emphasis on the procurement and trade of fish and other marine resources. However, archaeological analyses of such resources are limited in contrast to land-based subsistence patterns and many questions remain. This essay aims to build a broad interpretive framework for analysing the role of marine resources in the Bronze Age. Our provisional results find that an increased emphasis on specialist systems of agropastoralism reduced the use of marine resources in many parts of Eurasia during this period. However, evidence from Japan and the eastern Mediterranean suggests that, at least in some regions, marine resources became commodities traded over long-distances by the late Bronze Age, though this requires further quantification. Island Southeast Asia displays a different pattern from other regions considered here in a greater continuity of marine resource use from the Neolithic into the historic era, perhaps due to a lower reliance on agropastoralism.

## Keywords

Bronze Age – Eurasia – fishing – commercialisation – agropastoralism – social status

The Bronze Age saw major changes in the political economy of Eurasia. Most Neolithic societies engaged in farming had expanded their area of settlement, but once established they found many of their resources locally. Flint and obsidian to make stone tools could be exchanged over long distances and certain prestige goods such as jade also travelled far (Bausch 2004; Cunliffe 2008:152–153; Fontijn 2020:68; Habu 2004:224–227; Kuzmin 2017; Pétrequin et al. 2012), yet the traditional understanding of Neolithic social complexity has been that it was regional and concentrated. In the Bronze Age, by contrast, the demand for metals—which could only be obtained through very long-distance trading networks—led to a macro-regional division of labour, resulting in a more decentralised political complexity (Childe 1930; Kristiansen 2018a, 2018b; Scott 2017). Kristiansen (2018a:2) argues that the fundamental socio-economic structures established in the Bronze Age—including international commodity trade and the rise of cities—dominated Eurasia until 1500, a claim made in more detail by social anthropologist Jack Goody (2006a, 2006b; cf. Feuchtwang & Rowlands 2019). The economic changes also had a cultural side. Vandkilde (2016) coined the term ‘bronzisation’ to capture how the metal trade had far-reaching transcultural impacts.

The new social and economic structures of the Bronze Age were associated with a shifting mosaic of subsistence patterns characterised by variable combinations of *diversity*, *specialisation* and *articulation* (Table 1). Neolithic economies had already been highly adaptable; as agriculture moved from the Middle East into Europe, for instance, new combinations of plants and animals were used across the different environments of the Neolithic sub-continent (Ethier et al. 2017; Ivanova et al. 2018; Shennan 2018). In the Bronze Age, however, the scale of change in agropastoral systems was different. If the resilience of earlier, Neolithic systems had often been low, due especially to their expansion into new ecological zones (Fuller and Lucas 2017; Ivanova 2020), by the Bronze Age, agriculture and agricultural landscapes had become more stable through a combination of local and ‘global’ components (Stevens and Fuller 2012; Liu et al. 2019). Crop diversity was encouraged by the east-west exchange of plants across Eurasia, a phenomenon recently discussed through the concept of ‘food globalisation’ (Jones et al. 2011; Liu et al. 2019; Long et al. 2017; Spengler 2019; Spengler et al. 2021), although earlier archaeologists had already noted the importance of trade in farming dispersals (Runnels & van Andel 1988; Sherratt 1999).

TABLE 1 Some Structural Features of the Bronze Age Economy

Feature	Summary	Examples
Diversity	New crops and animals, including non-local varieties transmitted through 'food globalisation'	Many cereals and domestic animals moved far beyond their initial centres of domestication
Specialisation	Spread of new production and preservation technologies; specialist animal herding; arboriculture. Risk was increasingly managed by supra-household structures.	Metals, wool and salt. Food technologies associated with dairying. Bone-working using bronze tools
Articulation	Ways in which components of the economy interacted	Commodification and trade; agropastoralism combined with marine production ('maritime mode of production')

While Sherratt's (1981) original concept of the 'secondary products revolution' has been revised (Greenfield 2010), the growing importance of dairying transformed some Bronze Age economies (Cramp et al. 2014; Cubas et al. 2020; Wilkin et al. 2020, 2021). Pastoralism in the Inner Eurasian steppe corridor was an important factor in the east-west exchange of crops (Long et al. 2017; Hermes et al. 2019). New crops were also carried via maritime movements, for example to Korea, Japan, and Southeast Asia (Higham 2019; Robbeets et al. 2021). Specialisation in Bronze Age economies involved a range of activities including the production of metals, textiles, salt, and foodstuffs such as fruit, olive oil, and wine (Harding 2021; Lucas & Fuller 2020; Sabatini & Bergerbrant 2020). Military specialists to protect trade can also be seen as a new profession since Bronze Age weapons required considerable training to master effectively (Molloy & Horn 2020). Specialisation in foodstuffs presupposes macro-regional buffering of agricultural risk. Neolithic resource buffering had often involved wild foods such as nuts that could be collected at a household level (Stevens et al. 2022). Fish could also serve as a major buffer food in regions where they could be easily caught and processed at a household level (see, e.g.,

Glavatskaya 2006:136–153).<sup>1</sup> Where fishing required more coordinated communal activity, it was perhaps less likely to serve as a household buffer food.

Several of the features in Table 1 overlap. Specialisation and a division of labour benefit, for instance, from subsistence diversity and from the close articulation of various economic pathways. With respect to articulation between farming and fishing groups, in Japanese archaeology it is widely assumed that Bronze and Iron Age peasant farmers produced a surplus to support political complexity and that, consequently, fishing villages were subordinate to farmers (cf. Hudson 2021a). In northern Europe, by contrast, recent research has attempted to model a fusion of agropastoral and maritime modes of production for the Bronze Age (Ling et al. 2018), an approach that has great potential for application to other regions.

Since the early work of V.G. Childe, the Bronze Age has been characterised as a time when long-distance trade developed in association with new shipbuilding technologies (Childe 1930; Berg 2013; van de Noort 2013). For Childe (1930:9), the sailing ship was a ‘herald’ of the age of metals. By the late second millennium BC, shipbuilding had advanced to such an extent that large naval battles are known from the Mediterranean (Paine 2013:74–78). The use of bronze woodworking tools in shipbuilding has been studied, and a particular link between bronze socketed gouges and sewn plank boats recognised (Clarke 2004; Lee 2019). However, bronze was not universal in shipbuilding; in Island Southeast Asia and the Pacific, metals were initially not used at all.<sup>2</sup> In other cases, the relationship between bronze and ships is unclear. The Japanese Islands, for instance, were settled by farmers from the Korean Peninsula around 1000 BC, yet the first evidence for metals in Japan dates to some five centuries later. Was the (very late) agricultural colonisation of Japan stimulated by new Bronze Age shipbuilding technologies or was the timing due to other factors?

Cunliffe (2008) titles his chapter on Bronze Age Europe ‘Taking to the Sea’, a phrase which aptly summarises the new maritime focus of the era. Did this Bronze Age ‘taking to the sea’ involve an increased emphasis on fishing and other marine resources? Was there economic specialisation in marine resources? Were (preserved) marine products traded as commodities over large distances? These questions have relevance for our broader understanding of Eurasian economic history since it is often claimed that the long-distance trade in fish which developed in medieval Europe was one precursor

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- 1 The example cited here is from the Khanty people of northwestern Siberia who herded reindeer as well as hunting, fishing, and gathering. Yet fishing is described as a common buffer, especially for poorer families who did not possess reindeer (Glavatskaya 2006:137).
  - 2 Iron came into use in later centuries. For a detailed discussion of medieval (tenth to sixteenth centuries) boat building the Philippines, see Abrera 2017.

to what Jones (2003) calls the ‘European Miracle’. East Asia, by contrast, is said not to have had a long-distance trade in non-elite foodstuffs. According to Jones (2003:167–168), Asian fisheries were—with the exception of Japan—inferior to those that could be accessed by Europeans in the North Sea and Atlantic, meaning that there were fewer opportunities to develop experience with deep-sea navigation or commercial activities.

Unfortunately, these questions about Bronze Age fish use are not easy to answer. Several types of archaeological and historical evidence—discussed in more detail below—can be used to reconstruct ancient fishing practices (Table 2). Yet the archaeological literature contains remarkably little discussion of marine resources during the Bronze Age. One example is an important synthesis of Bronze Age economic strategies by Kneisel et al. (2015) which does not mention fish at all, though marine resources appear in their Figure 1 with reference to a chapter in the same book by van Amerongen (2015). Other studies express surprise that there is so little evidence for Bronze Age fishing, even given the maritime geography of islands like Britain, Japan and the Balearics (Roberts 2009:68; Sugiyama 2019:103; Ramis 2014:48). Studies such as Barrett et al. (1999), which presents long-term zooarchaeological data on fish use in

TABLE 2 Main categories of archaeological evidence related to fishing

Direct	Technological	Biological	Ethnohistoric
Fish bones (sometimes with shell-fish and marine mammal bones)	Fishing gear: nets, hooks, net sinkers, lures, harpoons, weirs, etc.	Stable isotopic reconstructions of human diet	Traditional methods of fish preservation (salting, drying, fermentation)
Artistic representations	Salt production	Isotope and DNA evidence for the source of fish remains	Fish products in culinary traditions
Historical texts	Boats and seafaring technologies	Reconstruction of fishing niches using marine biology	Non-dietary uses of fish products (e.g., fish skin clothing)  Religious ideas related to fish and water



FIGURE 1 Fisherman fresco from Akrotiri on the island of Thera (Santorini)  
 SOURCE: PHOTO IN PUBLIC DOMAIN.  
[HTTPS://COMMONS.WIKIMEDIA.ORG/WIKI/FILE:FRESCO\\_OF\\_A\\_FISHERMAN,\\_AKROTIRI,\\_GREECE.JPG](https://commons.wikimedia.org/wiki/File:Fresco_of_a_fisherman,_Akrotiri,_Greece.jpg)

northern Scotland from 3500 BC to AD 1500, are rare (see also Beech 2004; Campos 2013; Faulkner et al. 2021). The present essay aims to explore interpretive frameworks for analysing the role of marine resources in the Bronze Age, approached from a broad geographical perspective. In terms of periodisation, we follow Kristiansen (2015) in classifying the Bronze Age as a *world historical epoch*, a time when ‘communities, even when not directly connected to each

other, shared basic conditions that enabled and constrained their evolutionary potential.' The chronological time span considered is roughly 3300 BC to the last centuries of the first millennium BC. Further discussion of Bronze Age periodisation in eastern Eurasia can be found in Hudson (2022a).

### Marine Resources in the Bronze Age: Some Theoretical and Methodological Issues

The use of copper, bronze and then iron by human societies had an enormous impact on social and economic life. To what extent bronze itself transformed fishing activities is less clear. Many fishing methods, such as nets, weirs, baskets, harpoons and so on, were already known from the Neolithic or before and continue into later times (Brinkhuizen 1983). Clark (1948:65) claimed that a barb at the point of fishhooks opposing the shank first developed on metal hooks, and was then copied in bone or antler 'among poor marginal peoples.' This conclusion can no longer be supported as barbed point fishhooks are known from Neolithic sites in places as diverse as Sweden (Olson et al. 2008), Ukraine (Telegin 1987:319) and Japan (Watanabe 1966). Such sites include Boisman in the Russian Far East, where the Neolithic levels are dated to ca. 6300–4700 BP (Popov et al. 2022: 201). In Japan, this type of fishhook became common from the end of the Middle Jōmon phase in the mid third millennium BC (Watanabe 1966). While we have not made a detailed study of fishhook morphology for this paper, it seems probable that the 'barbed' type was invented in many different locations long before the Bronze Age. Nevertheless, metal fishhooks would have been easier to produce than bone, antler, or shell alternatives; bronze and then iron hooks quickly become the norm in the age of metals.

Another type of evidence for fishing is artistic representations. In the Aegean and eastern Mediterranean, images of fish and the sea on a variety of media have been discussed by Haysom (2011), Berg (2013), and Knapp (2018). One of the most famous examples is the seventeenth century BC fresco of a fisherman holding his catch from Akrotiri (Fig. 1). In southern Sweden, a number of rock art sites have figures with grid-like patterns that may be fishing nets (Oosterwijk 2020; Clark 1948:75).

Although there has been considerable discussion of long-distance trade in commodities during the Bronze Age, foodstuffs have received little attention in this respect and, as noted, bulk trade in foodstuffs is widely regarded as a feature of the *post-1500* modern world system, *pace* Wallerstein (1974). While cereals such as rice and wheat can be stored and moved long distances, the

transportation of such bulky goods was expensive. Trade in food staples raises the question ‘why move starchy cereals?’ (Lightfoot et al. 2013). Some domesticated animals, such as cattle and sheep, could be herded and moved ‘on the hoof’ as long as pasture was available. Fish are unlikely trade goods if they could be caught locally. However, technologies of fish preservation, including salt manufacture, would have given added value in local exchange networks. Otherwise, fish and most other marine products spoil very quickly and are not easily transported over distance. Around 50 km is probably the maximum distance that fresh fish could be traded inland in prehistory, although this depends on terrain and efficiency of transport (Van Neer et al. 2004:106; Van Neer & Ervynck 2004). Tel Bet Yerah on the Sea of Galilee, around 50 km from the Mediterranean, is the farthest inland site to have produced marine fish in the southern Levantine Early Bronze Age (Lernau et al. 2021). In the fourteenth century AD, fast deliveries of fish to Paris were being made over distances of up to almost 300 km using a special system integrating transport and sale at fish markets (Robert 2018). Yet this *chasse-marée* system seems to have been exceptional even in the medieval period. The movement of fish in larger quantities over around 50 km would have required processing and preservation.

The early history of fish processing presents us with an apparent contradiction of considerable relevance to this paper. On the one hand, the processing of marine products has a very deep antiquity. In East Asia, pottery was used to process aquatic products from the end of the Pleistocene (Craig 2021). In Egypt, the Upper Palaeolithic site of Makhadma is reported to have evidence of fish smoking at around 12,000 BP (Van Neer et al. 2000). Notwithstanding these and other precocious examples, however, the intensive processing and long-distance trade of marine products grew in importance from the Iron Age and later. In their historical overview, Pitcher & Lam (2015) argue that the first commoditisation of fisheries occurred under the Roman empire. In southern Iberia, fish ‘factories’ to produce salted meat (*salsamenta*) and *garum* and other fish sauces reached their peak in the Roman period based on roots in the earlier Iron Age (Morales-Muñiz & Roselló-Izquierdo 2008; Lowe 2017). An earthenware jar found on a Koryŏ dynasty (AD 918–1392) shipwreck in Korea contained a large quantity of ray (Rajidae) vertebrae and was likely used for the transport of *chŏtkal* salted fish (Kim & Moon 2011:137). While the preservation and commercialisation of fresh fish may be easier to achieve in colder climates (Van Neer et al. 2004:102), in northern Europe, a *large-scale* international trade in processed (dried or salted) fish only seems to have developed from the late medieval period (Barrett et al. 2004). However, the major expansion in the production of salt in the Bronze Age (Harding 2021) might have been expected to expand fish preservation technologies. Salt production dates



back to the Neolithic in Europe and Japan, with early sites known from the fifth and perhaps the sixth millennia BC. However, the Bronze Age saw a notable expansion of this industry (Harding 2021; Kawashima 2015).

Fermentation is another technology for preserving fish that likely has a great antiquity, yet is difficult to approach from the archaeological record. Boethius (2016) has reported an Early Mesolithic site from Sweden with evidence consistent with large-scale fish fermentation. In Northeast Asia, Craig (2021) and Shoda (2021) explore possible links between early pottery, fishing, and fermentation practices. However, the earliest direct evidence for fermented fish in that region is from the eighth century AD, when a wooden baggage label excavated from the Fujiwara palace site in Japan mentions a type of fermented carp (Shoda 2021). Modern *sushi* may have derived from earlier forms of fermented fish, especially carp (Rath 2021), but the use of cereals (mainly rice but also millets) in that process suggests a link with the spread of agriculture. Two wooden labels from the medieval Korean shipwreck mentioned above also included a term interpreted as meaning 'fermented fish' (Shoda 2021). Sibbesson (2022:118) raises the possibility that, in Britain, the Middle to Late Bronze Age saw a new reliance on 'labour-intensive, fuel-expensive, and time-consuming techniques like baking, cheese-making, and brewing ... in association with agricultural intensification.' Although Sibbesson does not develop this idea in detail, it would appear to be consistent with the socio-economic conditions of the time, notably growth in population and commercialisation of food resources. Another aspect requiring further research is the synergy between the food technologies employed in different contexts such as cheese or wine-making (Muñoz Fernández 2012).

An alternative to the immediate processing and preservation of fish is to keep them in some type of artificial pond or tank. These can be built on the coast and designed to catch fish at high tide, leaving them unable to escape at low tide. Such fish traps were already constructed by hunter-gatherers in several parts of the world, including Australia where they are thought to date back as early as 6600 years ago (McNiven et al. 2012). Roman fish tanks (*piscinae*) were built inland to keep fish that had been harvested (Higginbotham 1997). In the Middle Ages, fish tanks were commonly found in monasteries in Europe (Hoffmann 1996). Bronze Age examples are less common—though reported from Brittany as discussed below. Reese et al. (1986:83) suggest that Nile catfish may have been transported in containers of fresh water for later consumption, but the antiquity and extent of such a practice is unknown.

While preservation is an important issue, there is also a need to consider another fundamental question—the extent to which marine products might have actually contributed to Bronze Age diets. While this obviously depends

on the location, for the eastern Mediterranean an influential study by Gallant (1985) argued that the contribution of fish to the ancient economy was likely quite small because of the unreasonable quantities of both fish and salt to preserve them which would have been involved. Gallant's comparative analysis used Greek fisheries statistics from the 1930s and here we come to the difficult problem of 'shifting baselines' for historical fisheries (cf. Pauly 1995). It cannot be doubted that the fisheries of the Mediterranean are *in general* less rich than many other regions, a fact noted by classical and medieval writers, though the existence of geographic and seasonal variation must be stressed (Purcell 1995). Tetsurō Watsuji, a Japanese philosopher and reluctant traveller to Europe in 1927–28, wrote that 'It was no mere chance that the Mediterranean gave me this impression of desolation; you might call it a sea-desert, for the harvest of the sea here is indeed meagre. So it is natural in the extreme that there has been no development of either a fishing industry or of fish eating habits' (Watsuji 1961:65). Despite Watsuji's preconceptions—indeed prejudices—about Europe (see Hudson 2021b), it would obviously be wrong to argue that fishing has not been an important element in Mediterranean foodways. Nevertheless, many works continue to see fishing as a minor economic strategy in the Bronze Age.

With respect to the articulation of fishing with other aspects of the Bronze Age economy, the question of the social position of fishers has been debated in the literature from places as different as Japan and Greece. In most premodern societies, fishers were looked down upon. This was certainly true in the Confucian cultures of East Asia. In Chosŏn Korea, the court saw fishing as a type of punishment or tax that could be applied to outsiders who submitted to its control (Bohnet 2020:123, 133). Portuguese Jesuit Luís Fróis (1532–1597) observed that in Japan 'fishing is considered lowly and an activity for base individuals' (Danford et al. 2014:143). Japanese prejudice against fishers continued until the late twentieth century, as seen in the discrimination against fishing communities impacted by the Chisso company's pollution of the waters around Minamata in Kyushu (Aoyama & Hudson 2013). In the Classical Mediterranean, 'Dependence on the desolate world of the sea is a potent sign of need, and in both Greek and Roman thought the fisherman is a classic type of poverty' (Purcell 1995:135). The fisher was 'a shadowy figure, destitute, weatherworn, always at the margins of society' (Mylona 2008:67). This status of poverty and marginalisation continues to characterise many contemporary fishing groups (Béné & Friend 2011).

Given this background, early archaeologists such as Movijs (1942) sometimes saw Neolithic fishing in terms of Mesolithic 'survivors', an approach still common in writings on other Neolithic wild foods (see Stevens et al. 2022). This

view was already criticised by Clark (1948:63) who concluded that ‘The fisherman from Neolithic times onwards was as a rule a farmer’ and that ‘Fishing was dovetailed into the farming year like any other branch of the food-quest’. Clark’s work on the Mesolithic perhaps encouraged him in this positive view, not always followed by later scholars, many of whom see fishers as opportunistic ‘hungry farmers’ and assume that ‘fishermen possessed a basically land-bound farming mentality’ (Mylona 2008:67–68). Riley (1999:62) regarded the nudity of the fisherman in the Akrotiri fresco (Fig. 1) as an indication of low social status. The implication is that fishers were unable to engage in more advantageous agricultural activities. Fagan (2017:2) claims that ‘Fishers have always been anonymous folk, usually on the margins of society, far from pharaohs’ courts and teeming urban markets.’ Even in the medieval Mediterranean there is little textual evidence for fishermen (McCormick 2001:266). Yet ‘anonymous folk’ have usually attracted archaeologists as much as kings and pharaohs. While the sea and its denizens can be considered as liminal to mainstream society (Monroe 2011)—especially from the perspective of the state—Bronze Age society encouraged travels and transformations and the associated liminality has been an important focus of previous research, most notably by Kristiansen & Larsson (2005). Mylona (2008) argues that archaeological accounts of fishing groups rarely take proper consideration of their specialist skills, knowledge, and *mentalités*, and there has been little such work for the Bronze Age. It is worth noting the contrast here with animal pastoralism: herders are generally seen in a more favourable light than fishers by modern archaeologists (though not necessarily, of course, by ancient states).

The low status afforded to fishers in many societies does not mean that fish themselves were necessarily low status food. In medieval al-Andalus, it was said that ‘The upper classes rarely ate fish, which was consumed on a regular basis by lower-class people in coastal places’ (Gutiérrez & Valor 2015: 86). In other places, fish—or at least certain types of fish—were associated with elite diets and feasting. In the Levant in the Late Bronze Age, Nile fish obtained through long-distance commercial networks seem to have served as luxury foods (Zohar & Artzy 2019). The use of fish in aristocratic banquets in Japan suggests that even as late as the medieval and early modern periods, the ability to obtain and consume luxury species was an opportunity to display wealth and status (von Verschuer 2017; Ōguchi 2021). Wild fowl were also eaten on such occasions, and status may have derived from the non-everyday nature of these foods. However, the association of fish with elite diets is potentially overstated and requires careful evaluation (Van Neer & Ervynck 2004). Marine products (such as abalone or sea cucumber) that had high status value as trade products were not necessarily widely consumed by local fishers.

Last but not least, there are numerous methodological issues surrounding fish bones in archaeology. While larger bones can sometimes be handpicked during excavations, a proper ichthyo-archaeological analysis requires sieving of deposits. Fish bone analysis is not only time consuming but involves complex issues of fish biology and taphonomy (Morales-Muñiz 2014). Stable isotope analysis of diet from human bones is one way of reconstructing use of aquatic resources (e.g., Tsutaya et al. 2022; Varalli et al. 2022). Zooarchaeology by Mass Spectrometry (ZooMS) provides a new approach to fish bone identification and is likely to become more widely used in the future (Richter et al. 2020). For fully agricultural societies such as those of the Bronze Age, however, fish remains are often not a priority. Furthermore, new applications of isotope and DNA analysis have shown that the origins of fish catches cannot necessarily be assumed based on local availability (Barrett et al. 2011; Oosting et al. 2019; Sisma-Ventura et al. 2018; Star et al. 2017).

### The Sea and Bronze Age Cash Crops

The Bronze Age can be considered as a transitional stage between household or village-level procurement and consumption of fish and greater market exchange of marine products. By the medieval period, both archaeological and documentary evidence show that fish were major commodities in the provisioning of urban centres. In fifteenth-century Japan, the *Hyōgo Kitaseki irifune nōchō*, a register of port taxes paid by boats entering a checkpoint in Settsu province, lists goods from western Japan designed for sale in the capital region. These included rice but also salt, *mugi* (barley or wheat), beans, sardines, sea cucumbers, dried and salted sea bream, shrimp, abalone, and seaweed, as well as textiles, iron, and ceramic pots (Sakurai 2018:46–47). While such documents provide a detailed picture of trade in marine products, in the absence of written records it is much harder to reconstruct earlier economies. Yet historical evidence enables us to propose a range of premodern patterns of fish consumption, some of which may have Bronze Age correlates (Table 3).

The use of marine products as commodities for exchange presupposes a market. Examples from later history show the complex relationships between economic and political forces that could be involved. In early modern East Asia, for instance, after the Qing dynasty lifted its maritime ban in 1684, trade with Japan became possible again but the Tokugawa shogunate wanted to limit its export of precious metals and chose dried marine products—in high

TABLE 3 Some premodern patterns of fish consumption with possible Bronze Age correlates

Type of fish consumption	Characteristics/ examples	Bronze Age correlates
Luxury food (elite banquets)	Use of larger or exotic species or fish perceived as culturally desirable	Late Bronze Age exotic species in the Levant (Zohar & Artzy 2019)
Secular consumption in private households	Use of smaller, local species or preserved fish. Frequency increases with market penetration	Likely widespread despite regional variation. May increase with urbanisation
Ritual use (offerings, food for fasting, etc)	The <i>Engishiki</i> (AD 927) provides examples of seafoods as ritual offerings in ancient Japan. Ritual might also involve the <i>non-use</i> of fish	Many Classical examples (Dölger 1922). A cylinder seal from Alalakh, Syria, shows an offering table with a fish before a seated god (Knapp 2018: 38). Extent of ritual use of fish in the Bronze Age is uncertain
Marine products as commodities for exchange or for tax/tribute	Long distance trade or tribute of preserved marine products	Examples from the eastern Mediterranean and Japan discussed in this study

demand in China—as an alternative. These products included sea cucumber, abalone, shark fins, scallops, squid, shrimp, and seaweeds, many deriving from waters around Hokkaido (Godefroy 2022: 382). Enormous quantities of these goods were sent to China. In 1771, it is estimated that 1.77 million tons of kelp were exported and in 1786 almost 40 tons of sea cucumber were obtained for trade (Godefroy 2022:383). The trade in these products derived from a particular set of circumstances involving their high demand in China and availability in Japan (see also Bowdler 2002; Fabinyi 2011; Schwerdtner Máñez & Ferse 2010). However, all of these products could have been traded much earlier and evidence from Bronze Age Japan and the eastern Mediterranean discussed below suggests that some were.

### Fishing Cycles: Bronze Age Subsistence over the *Longue Durée*

In order to evaluate the role of marine products in the Bronze Age economy, we have to take note of the fact that in many regions of Eurasia there had been a significant decline in fishing in the Neolithic. In western Europe, this decline seems to have lasted until the Roman period when fish use was stimulated primarily by elite consumption. After the fall of the Roman empire, fishing and the fish trade again became less conspicuous in many parts of Europe until around AD 1000 (Barrett 2019; Barrett et al. 2004). Coastal Mesolithic or pre-farming Neolithic societies such as the Jōmon made extensive use of marine resources. Many of the most socially complex hunter-gatherer adaptations were based on the sea (Rowley-Conwy 1984; Yesner 1980; Fitzhugh 2022). With the onset of farming, the reliance on fishing declined rather suddenly in several regions including Atlantic Europe, Greece, Korea, and Japan (Richards et al. 2003; Cramp et al. 2014; Berg 2013; Hudson 2021a, 2022b; Kim & Seong 2022). It is unclear to what extent this was a general trend across Eurasia. In some regions, the local unsuitability of agriculture, due to environmental or cultural factors, led to a renewed focus on fishing. Southeast Asia and Oceania are examples of the latter trend where fishing remained an important subsistence component.

One common interpretation of the decline in marine foods in the Neolithic has been that the new agropastoral products were *controllable* and could thus enhance access to prestigious exchange networks; wild foods, by contrast, were representative of the 'bygone age' of the Mesolithic (see Berg 2013:19–20). If the rejection of marine foods was a way of 'being Neolithic' (Thomas 2004:121), then that trend may have continued into the Bronze Age, though perhaps subject to new tensions as the economy became more commercialised. Nevertheless, such ideological constructs cannot escape the fact that human societies would have made various social arrangements to mediate or 'buffer' subsistence risk (Halstead & O'Shea 1989) and fish needs to be considered in that context.

The fact that an apparently similar decline in fishing can be identified in agricultural societies across a huge chronological and geographical span from Neolithic Europe to the medieval Ryukyu Islands might also suggest that ecological factors related to land-use played a role. In the Ryukyus, the introduction of agriculture between the tenth and thirteenth centuries AD (Jarosz et al. 2022) was associated with a reduced contribution of fishing in the economy of the archipelago (Toizumi 2018). Geomorphological evidence of increased land erosion on Okinawa Island from around AD 1000 (Yamada et al. 2014) suggests that agricultural land clearance had an impact on landscape ecology

(Takamiya & Hudson *in press*). Fitzpatrick & Giovas (2021) note that agricultural runoff on tropical islands can lead to sedimentation over coral reefs and a consequent reduction in fish catches. However, it is unlikely that land clearance and runoff were the main cause of the fishing decline in all cases. Furthermore, it has been suggested that intensive agriculture in medieval Europe damaged freshwater fish stocks and led to a consequent increase in *offshore* fishing (Hoffmann 1996).

Around the Classical Mediterranean, fish could be a symbol of death, and were sometimes offered in sacrifice given that potent function (Dölger 1922; Berg 2013:16–17). The scarce evidence for the consumption of fish in Iron Age Britain has been linked with a possible cultural taboo on eating species derived from sacred water (Hill 1995; Dobney & Ervynck 2007; but cf. Russ et al. 2012). Clark (1948:73) wondered if the ‘taking of eels was limited in ancient times, as it still is to-day in some areas, such as Scotland, by superstitious scruples.’ Purcell (1995) discusses taboos surrounding fish in Greek and Roman Antiquity. By contrast, Rainsford & Roberts (2013:42) suggest that ‘increasing societal attention on [cereal] agriculture and social possibilities afforded by domestic animals would have made fish a lower-value resource, in comparison to domestic crops of livestock.’ Although these arguments relate to the Iron Age and later, they may provide some hints for understanding the earlier Bronze Age (Scheibner 2015:165).

The Roman empire saw something of a revival in fish consumption (Marzano 2013). In areas of Europe outside the Roman empire, marine fish consumption remained low until the Middle Ages. In the Baltic, marine fish are reported to be absent from sites dating to 1000 BC to AD 1200 in Estonian and Finnish coastal areas and the Åland Islands; freshwater species were eaten but it was not until the thirteenth century that these regions were drawn into the long-distance trade in Atlantic fish. The move to increased fish consumption here seems to have been stimulated by external migration from German lands and by Christian fasting restrictions (Löugas & Bläuer 2021).

### Marine Resources in the Bronze Age: Some Regional Sketches

The following five sections provide brief summaries of marine resource use across Bronze Age Eurasia. The intention is not to be comprehensive but to sketch some of the parameters of the topic in question. The authors welcome further information and corrections on the material presented here.

### *Bohai Sea, Korean Peninsula and Japanese Archipelago*

The maritime dispersal of farming was an important element of Neolithic and Bronze Age economies in Northeast Asia. As the Lower Yangtze valley was an early centre of wet rice cultivation, it is often assumed that coastal farmers played a key role in the spread of agriculture into southern China and Southeast Asia as well as to Korea and Japan. However, Qin & Fuller (2019) argue that Lower Yangtze rice farmers themselves engaged in little marine activity. Freshwater wetlands were exploited for fishing, as for instance at the site of Tianluoshan (Zhang 2018), but there is very little evidence for marine fish. For these rice farmers, ‘marine and coastal resources clearly appear to have been the exception; a form of exotica set apart from the routine worlds of Neolithic inhabitants’ (Qin & Fuller 2019:167). In Northeast Asia, however, rice cultivation spread by sea and was initially associated with marine-based subsistence activities. Millet cultivation had reached Korea in the fourth millennium BC (Li et al. 2020), but during the Bronze Age rice, wheat, and barley were added to an agricultural package which then spread to Japan after 1000 BC (Robbeets et al. 2021; Miyamoto 2022).

Qin & Fuller (2019:179) propose that in the area around the Bohai Sea (i.e., the Shandong and Liaodong peninsulas) and in Korea and Japan, rice was initially a supplement or ‘add-on crop’ which was combined with existing maritime adaptations, thereby facilitating the maritime spread of rice cultivation. Lin et al. (2022) similarly suggest that the combination of rice cultivation with ‘accumulated maritime knowledge from collecting oysters and clams, might have facilitated the waves of spread of rice agriculture from eastern China to the Korean Peninsula and Japanese Archipelago’. Such descriptions fail to explain sufficiently the relationship between marine and rice-farming adaptations in these cultures. On Shandong, the Late Neolithic Dawenkou culture (ca. 4300–2600 BC) combined the cultivation of foxtail and broomcorn millet with rice, at least in sites in the southern peninsula. Pig and deer were the most abundant mammals and marine fish and shellfish were found at coastal sites (Dong et al. 2021). While molluscs such as razor clams (*Sinonovacula*) and oysters (*Ostrea*) were common, there appears to have been a much lower reliance on fishing (Lin et al. 2022).

The exploitation of marine resources was an important subsistence strategy during the Neolithic Chulmun period in Korea (Kim & Seong 2022). Close maritime connections were maintained with Jōmon Kyushu (Bausch 2017). At the beginning of the Bronze Age Mumun period around 1500 BC, there was a decline in the use of marine resources as the economy shifted to a dependence on cereal farming (Kim 2003; Kim & Seong 2022). It is suggested that during the Bronze Age and following Iron Age Proto-Three Kingdoms era, ‘maritime



activities were mostly related with long-distance exchange' (Kim & Seong 2022:43). A diverse sample of marine fish, including amberjack (*Seriola*), seabream (Sparidae), rockfish (*Sebasticus*), flatfish (Paralichthyidae), puffer fish (Tetraodontidae), and sharks (Carcharhinidae, Lamnidae and Squalidae), is reported from the Imdang site, dated to ca. 80 BC to AD 394 and located around 60 km from the coast. A recent study of this site suggests that marine foods may have been an elite dietary item (Choy et al. 2021).

Japan also saw an *overall* decline in the use of fish and other marine resources when cereal farming arrived in the Bronze Age Yayoi period (1000 BC – AD 250) (Hudson 2019, 2021a, 2022b). However, a rich archaeological record from the Japanese Islands enables us to separate out two economic patterns at this time. On the one hand, farming villages had a low dependence on aquatic resources, even though the settlement of coastal lowlands increased (Takesue 2018:7; Fujio 2021). Carp aquaculture has been identified at the Asahi site (Nakajima et al. 2019) and may have been common at other Yayoi sites where wet rice was grown, although the extent of this custom requires further analysis. Other new fishing technologies included ceramic octopus pots and tubular net weights, customs thought to have been introduced from the continent (Toizumi 2009:190). The second Yayoi pattern, focused more on coastal sites, suggests specialist exploitation of marine resources, most likely for the purpose of trade. This trend is known from the northern island of Hokkaido, which was outside the zone of Yayoi culture or cereal farming. Based on zooarchaeological studies, fishing became significantly more important in the Hokkaido economy during the period 600 BC to AD 200 (Takase 2019), a time frame that corresponds to the widespread use of bronze artefacts in the main islands of the Japanese archipelago. In the first part of this period, specialised fisheries in Hokkaido focused on benthic species, especially Pleuronectinae and the olive flounder *Paralichthys olivaceus*, as well as swordfish. Takase argues that these fish were probably not traded to Japan and that their targeting was related to status-building in Hokkaido hunter-gatherer societies; that status may nevertheless have been a way for individuals to participate in desirable trading networks with Bronze Age societies to the south. This proposal mirrors arguments made for the Bronze Age Mediterranean that control over food resources may have been a way to access prestigious trade networks (cf. Berg 2013:19). From the second century BC, there was a shift to salmon and Clupeidae exploitation in Hokkaido, probably an indication of direct trade with Japan, even though previous research has tended to emphasise the role of the later Satsumon culture (AD 700–1200) in the expansion of that trade (Ōnishi 2014).

Outside Hokkaido, specialised procurement of marine resources in Bronze Age Japan is suggested by archaeological evidence at a number of sites located

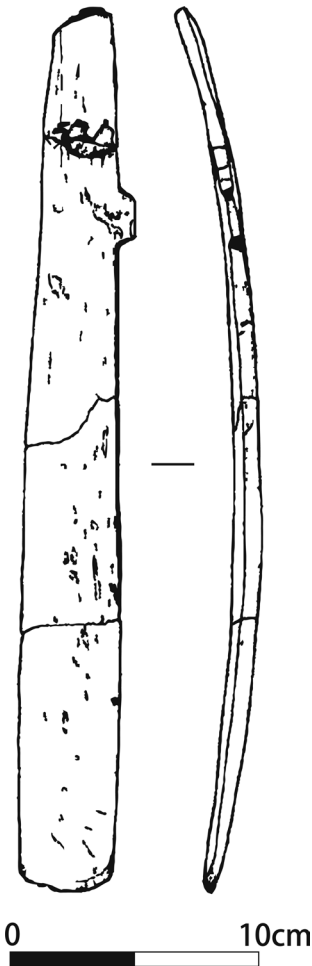


FIGURE 2

Whalebone abalone priser from the Hara-no-tsuji site, Iki Island. Middle to Late Yayoi.

SOURCE: REDRAWN FROM KOBAYASHI (2009) BY J. UCHIYAMA

down the Sea of Japan coast. These sites speak to maritime exchange between Yayoi Japan and the Korean peninsula (Takesue 2009, 2018). Finds of Yayoi pottery at sites in Korea date from the early first millennium BC (Initial Yayoi phase). By the first century BC (Middle Yayoi), the ceramic evidence suggests significant Yayoi settlement at a number of sites on the southern peninsula, most notably at Nūkto, an island which seems to have served as a trading emporium. Nūkto produced three 'abalone prisers', a type of tool known from many coastal Yayoi sites (Kobayashi 2009:172). Since the early work of Okazaki (1968), these artefacts have been understood as tools used to remove abalone from rocks and linked with the *Wei zhi*, a third-century Chinese history which records of northern Kyushu that "The people are fond of catching fish and

collecting abalone; regardless of shallow or deep water all go down to catch them' (Kidder 2007:12) (Fig. 2). Abalone prisers were made of bone, antler, and iron and have been found from as far north as the Hamanaka 2 site on Rebun Island, Hokkaido (Kobayashi 2009:171). Archaeological evidence of Chinese coins, iron artefacts, Korean pottery, and standardised weights and measures supports the interpretation that Yayoi coastal sites were involved in trading with the Korean peninsula (Takesue 2009, 2018). Some of these sites, including Nūkto, have produced inkstones, or more precisely objects interpreted as inkstones even though actual written texts have not yet been discovered from the Bronze Age in either Japan or Korea (Takesue 2018; Yanagita 2020).

Bronze and later iron were almost certainly the main commodities desired by traders from the Japanese archipelago during the Yayoi period. The Japanese literature has given little attention to the question of what may have been traded in exchange, but abalone was one possible commodity. A stable isotope study of the Nūkto site reported only a minor dietary reliance on marine foods (Choy & Richards 2009), perhaps consistent with the interpretation that seafoods were a luxury. Abalone from Yayoi Japan may have been traded on from Korea to China. Historical texts relate how the first emperor of the Han dynasty encountered abalone in the late third century BC (Clarke 2004:57), and we can assume that the shellfish was a desired item from at least that time. Further research, including zooarchaeological analyses, is needed but the hypothesis that marine products from Japan were traded for metals from the Korean peninsula appears consistent with the archaeological record from Bronze Age Northeast Asia.

### Southeast Asia

Notwithstanding the above-mentioned argument that wet-rice farmers in the Lower Yangtze lacked a maritime focus (Qin & Fuller 2019), farming spread to southern China and mainland Southeast Asia via both inland and coastal routes from the third millennium BC (Chi & Hung 2010; Stevens & Fuller 2017; Higham 2019). Farming populations then crossed from Taiwan to the northern Philippines around 2200 BC, beginning a huge maritime dispersal which eventually took Austronesian-speaking peoples and their changing food production systems across the Pacific (Bellwood 2005; Bulbeck 2008; Spriggs 2018). Metals only reached Mainland Southeast Asia at the end of the second millennium BC (Higham et al. 2011) and Taiwan around 400 BC (Hung and Chao 2016). Compared to Northeast Asia, there was a locally patchy adoption of cereal farming in Southeast Asia (Fuller et al. 2017). Fishing remained an important

component of the subsistence economy in many areas. The high-salinity found in Mainland Southeast Asian coastal environments was not favourable for rice and some groups switched back to a strong emphasis on hunter-gathering, including fishing. This process is perhaps best illustrated at the site of Khok Phanom Di in Thailand (Higham 2021). In Island Southeast Asia in particular, the role of farming as a driver of Late Neolithic/Bronze Age population dispersals has been debated. While Bellwood (e.g., 2005) has stressed agriculture as ultimately the key factor, others have countered that actual evidence for the spread of mainland Eurasian cereal farming is weak (Denham 2017). As an alternative, Bulbeck (2008:48) suggests an ‘advanced maritime capacity’ might explain Austronesian expansions. While Bulbeck’s study presents almost no concrete evidence for the role of fishing in early Austronesian subsistence economies, some excavations in Island Southeast Asia have produced fish remains from Metal Age deposits (Ono et al. 2018; Hawkins et al. 2020). There is also an extensive record of fishing from prehistoric Oceania, although bronze and iron are of course missing from this region (Kirch 1997:195–203; Kirch & Green 2001:131–141). More recently, Bellwood (2022:390) notes that the settlement of Oceania must have been based on a reliance on both maritime resources *and* lowland agriculture.

In both Mainland and Island Southeast Asia, fishing (hunter-gathering) and farming are sometimes seen as opposing economic strategies in the Neolithic and Bronze (Metal) Age and there is little discussion of how the two strategies might have inter-related or been combined. Two shark vertebrae beads from inland Samrong Sen, Cambodia, confirm the existence of trading networks with the coast in the Late Neolithic/Bronze Age (Boulanger et al. 2021). The extent to which (preserved) fish were traded at this time remains unknown. Though dating from a later period than that considered here, long-distance transmission of fishing technology can be inferred from the discovery of clay net sinkers at the Leang Buida site on Kabaruan in the Talaud Islands. These artefacts are dated stratigraphically to around AD 1000–1600 and are apparently the first such net sinkers excavated in Island Southeast Asia (Ono et al. 2018:250). Though the context of the development of these sinkers in the Talaud Islands is unclear, they appear to mirror the widespread use of clay net sinkers in East Asia from the Bronze Age (cf. Li 2002; Toizumi 2009).

An influential argument in Southeast Asian history is that the fifteenth to seventeenth centuries AD saw a dramatic rise in commerce with China and then the European colonial powers (Reid 1988, 1993). In this view, trade and exchange—including that of foodstuffs—were stimulated by outside contacts

and not inherent to the early economies of the region. A large ethnohistoric literature on forager-farmer interactions shows that forest hunter-gatherers played an important role in such trade (Morrison & Junker 2002). Historical records tell us that salted fish was one commodity exported from Japan to Manila in the late sixteenth century (Tremml-Werner 2015:158). However, the deeper antiquity of traded fish in Southeast Asian waters is unclear.

### Eastern Mediterranean

A recent study by Knapp (2018) has brought together a wealth of information on Bronze Age seafaring in the eastern Mediterranean. His book includes discussion of material, documentary and iconographic remains related to fishing, showing that fishing activities were widespread, despite an archaeological record that is inconsistent over space and time. Knapp emphasises the close link between seafaring and fishing and concludes that 'Fish and other marine resources undoubtedly made an important contribution to the mixed economies that formed the basis of most Bronze Age Mediterranean societies' (Knapp 2018:195).

Scientific archaeology is beginning to extend our knowledge of this marine resource use. Guy et al. (2018) analysed phosphate oxygen isotope compositions ( $\delta^{18}\text{O}_{\text{PO}_4}$ ) of seabream (*Sparus aurata*) teeth excavated from the southern Levant. From the Late Bronze Age (1500–1200 BC) onwards, *S. aurata* with hypersaline  $\delta^{18}\text{O}_{\text{PO}_4}$  signatures from the Bardawil lagoon off the Nile delta almost entirely replaced locally caught seabream discovered at sites in the southern Levant. The authors of the study interpret this as evidence for extensive commercial trade in likely dried *S. aurata* from Egypt to Canaan beginning in the Late Bronze Age and continuing through the Iron Age at least until the Byzantine period (Sisma-Ventura et al. 2018). The Late Bronze Age also saw an increase in exotic Nile fish such as perch (*Lates niloticus*) and catfish (*Bagrus* sp.) in the southern Levant (Van Neer et al. 2004). A Late Bronze Age assemblage of fish bones from Tell Abu Hawam (Haifa) shows that a range of fish species were both caught locally and imported from Egypt and perhaps the Aegean (Zohar & Artzy 2019). Documentary evidence from Ugarit in Syria supports the growing commercialisation of fish in the Bronze Age. The text RS 34.167 + 175 records a request from Tyre for oil, silver shekels, and copper, in return for which it was proposed to send purple-dyed wool and dried fish (Knapp 2018:110).

## Iberia

As in many other regions, analyses of fish fauna have been very scarce in Spanish archaeology until recently, with only a few sites studied in detail: Cueva de Nerja (Jordá et al. 2003; Sanchidrián & Simón 1998), Cerro del Villar (Rodríguez 1999), or the bay of Gadir where, in addition to a plethora of studies on Phoenician and Ibero-Punic fisheries and fish consumption (for example, those carried out by Morales & Roselló 1994, 2012, or those on Gadir's Phoenician and Punic necropolis by Niveau-de-Villedary 2006 and Sáez 2016), salt production is inferred by some archaeologists to be practiced on local marshes prior to Phoenician times (Sáez 2012:260). Medieval fishing is also less well understood compared to northern Europe (but see Llorente-Rodríguez et al. 2022). In the absence of fish fauna remains, the presence of Bronze Age coastal settlements, for example around the Bay of Biscay, has been used to infer networks of fishing societies (e.g., Coles & Harding 1979:234). Stable isotope studies have generally failed to show a significant role for aquatic resources in Bronze Age Spain (Molina-González et al. 2019). On the other hand, the lack of ichthyofaunal analyses is compensated by an abundance of studies about fishing gear and fish salting production (Vargas 2020, 2021; Bernal 2012; Lagóstena et al. 2005)

Iberian Bronze Age sites with remains related to marine resources are mostly coastal, including Areeias Altas in northwest Portugal, where the excavation of dozens of net weights suggests fishing was an important activity. At this site, dated to 1800–1500 BC, there is no evidence of agriculture but the production of salt from seawater is suggested by the excavators (Luz 2021). At the inland site of Camino de las Yeseras, located in the Madrid region, seven vertebrae from a large anadromous allis shad (*Alosa alosa*) were discovered with an adult female burial, a finding consistent with stable isotope analyses suggesting the consumption of aquatic resources at the site (Liesau 2017:120–121). In the Balearic Islands, it is reported that there is a 'complete absence of evidence for fish consumption' in the Bronze Age (Ramis 2014:48). The exception here is the small (83 km<sup>2</sup>) island of Formentera, from where the site of Cova des Riuets, dated to ca. 2000 BC, produced a faunal assemblage including 852 fish remains (Marlasca 2008; Ramis 2014:50). The difficulty of conducting agriculture on such a small island may have contributed to the greater reliance on fishing.

During the transition from the end of the Neolithic to the Bronze Age, there was a sudden abandonment of lowland settlements and many upland sites were established, most with defensive structures, apparently as a result of increased violence and social tensions, especially in Western and Southern Iberia (Lull et al. 2014:12–131). This change in settlement patterns can be assumed to have reduced the exploitation of marine resources. Nevertheless,

it is important to take into account fishing in inland rivers and lakes. Some of the few sites with evidence of fishing are, indeed, related to freshwater (Liesau 2017; Bueno et al. 2005).

Prior to the arrival of the Phoenicians in the ninth century BC, the Iberian Peninsula was divided into several Bronze Age cultures with comparatively little interaction between them, except in border areas and with an exception for some technologies and luxury materials, such as ivory (Schuhmacher & Banerjee 2012). Commercial networks and mass production appear to have been limited, so fishing may have been primarily oriented to local consumption. With the Phoenicians, some researchers talk about an agricultural colonisation as the first Phoenician settlements are located in areas of high agricultural and maritime production. Some of the earliest Phoenician temples, such as Melkart in Gadir (ancient Cádiz), were probably linked to fish factories in the area. The new navigation technologies introduced to Iberia by the Phoenicians (Mederos et al. 2005) may have affected the kind of fish species taken.

Even when they began with a discrete role of food production, the Phoenician fish factories evolved into colonial settlements oriented to high production centres within a wide commercial network linked, as in the example of Gadir, with the 'Silver Route' (Almagro-Gorbea 2011:70)—the ancient way connecting the Iberian Southwest and Northwest, whose origins lay in ancient, pre-Bronze Age drover's roads (Almagro-Gorbea 2008). Waterproofing and structural technologies used in Iberian fisheries mirror those used in wine-making and are exactly the same as those used in other Phoenician sites across the Mediterranean (Sáez & Bernal 2006). Phoenician fish factories in Iberia date to the Iron Age and Roman periods. Yet the importance of fishing in the Phoenician colonisation of Iberia did not appear out of nowhere; it must have had roots in the Bronze Age in terms of an understanding of the potential of marine resources for commerce. This could be the case of the Chalcolithic rock shelter of Laja Alta, in Cádiz province, whose depictions of ships show different fishing operations such as tuna shoals or enclosing manoeuvres (Martín & Martín 2011).

### Northwest Europe: Brittany and the Netherlands

In Brittany, a Bronze Age site with important evidence for fishing is Beg ar Loued on Molène Island (Finistère) (Pailler et al. 2019; Dréano 2019). Today, Molène is located about 12 km west of mainland France. Excavations at Beg ar Loued between 2003 and 2011 produced two superimposed dry-stone

houses with radiocarbon dates between 2150 and 1750 cal BC. The Bronze Age islanders practiced agriculture and animal husbandry, growing barley, emmer, wheat, broad beans, and peas, and raising cattle, pigs, and caprines. They also caught fish, collected shellfish, and hunted birds. The fish remains recovered from Beg ar Loued were mainly inshore species such as sea bass (*Dicentrarchus labrax*) and seabream (*Sparus aurata*); only a few offshore species were recovered. Five stone weirs on Molène Island are believed to have been used as the main method to catch fish during the Early Bronze Age, a custom which existed in the Molène archipelago since the Early Neolithic (Stéphan et al. 2019). While it might be assumed that the isolated location of Molène, which was only marginally suited to agriculture, forced the islanders to exploit all available resources, the remains from the Beg ar Loued site show that the island was in contact with the outside world. The particular type of stone house found at the site has links with southern Europe, but also with Shetland and the Hebrides.

Moving east from Brittany, a study by van Amerongen (2015) analysed fishing in the Bronze Age Netherlands, a stage dated locally to around 2000–800 BC. Eel, pike, perch, bream and Cyprinidae were some of the main species taken. Atlantic cod (*Gadus morhua*), likely taken offshore, was also found at one site. Inshore fishing used weirs and *fyke* bag nets. Based on fish biology, van Amerongen managed to reconstruct different seasons for fishing at the sites she analysed.

## Conclusions

Research on fishing has lagged behind other aspects of the Bronze Age economy and the archaeological record relating to Bronze Age marine resource use remains sketchy. Nevertheless, even though this paper has made no attempt to review the literature from all across Eurasia in a consistent fashion, we have presented examples of how fishing occupied an important role in many Bronze Age economies. The problem is how to bring such case studies together to generate a more synthetic picture. Table 4 lists common fishery strategies known from the Neolithic onwards. These should not be understood in a typological fashion; rather, different strategies were combined depending on social and ecological circumstances. All of the strategies listed can also be analysed in terms of a continuum between different patterns of scale and investment. There is evidence for all of these strategies in the Bronze Age.



TABLE 4 Common fishery strategies with Bronze Age correlates discussed in this paper

Type of fishery	Historic/contemporary examples	Bronze Age examples	Comments
Subsistence fishing by groups with low reliance on agropastoralism	– Jōmon Japan – Indigenous Arctic groups	Island Southeast Asia	Subsistence fishing could also be impacted by the <i>social</i> demands of trading systems (Takase 2019)
Small-scale or opportunistic fishing by farmers	– Mekong Basin (Voeun 2003; Béné & Friend 2011)	Beg ar Loued site (Brittany)	Historically, sometimes seen as a last resort for 'hungry farmers'
Fish farming by agricultural societies	– Widespread freshwater fish farming in medieval Europe (Hoffmann 1996; Deligne 2009).	Carp aquaculture in East Asia (Nakajima et al. 2019), though its Bronze Age extent is unclear	Early fish farming mostly involved management of freshwater ecosystems
Inshore/offshore fishing for subsistence and trade with farmers	– Widespread strategy in premodern times	Seabream fisheries in the Nile delta	Vulnerable to over-exploitation of inshore niches
Commercial, long-distance 'predatory' procurement of marine resources for trade (continuum from small- to large-scale)	– Small-scale: Macassan trepang fishers in northern Australia (Bowdler 2002) – Large-scale: medieval European cod and herring fisheries (Barrett & Orton 2016)	Yayoi harvesting of abalone from islands in the Sea of Japan	Often seasonal in premodern times. Men primarily involved in the catch, but women played a key role in onshore activities, including trade (de Wit 2019)

Fishing continued as a subsistence activity in combination with agropastoralism at Bronze Age sites such as Beg ar Loued in Brittany. In other regions, the Bronze Age saw an increase in the commercial exploitation of fish and other

marine resources, which were traded and associated with emerging urbanisation. This pattern seems to have been especially associated with the latter part of the Bronze Age and continued into the following Iron Age. The eastern Mediterranean and the Japanese Islands were discussed here as examples of such trade, with Iberia following in the Iron Age. In Southeast Asia and Oceania, the role of fishing increased—or more likely was maintained—as expanding populations ‘escaped’ the Bronze Age, not just through a low reliance on metallurgy, but also by reduced dependence on the complex agropastoral systems that had come to characterise East Asia by the second millennium BC.

Perhaps not unsurprisingly, fishing was common at many small island sites discussed here, including Formentera, Iki, Molène, Nūkto, and Rebut. Yet, evidence for Bronze Age fishing was found in a range of environments, insular, coastal, and inland. The commercial exploitation of fish fits well with broader expectations regarding the structure of the Bronze Age economy and new maritime connectivities. A reasonable hypothesis would be that the commodification of fisheries increased in places where other Bronze Age trading arrangements were more developed. The evidence considered here from the eastern Mediterranean and Japan appears to be consistent with that interpretation, but further research is required. The decentralised nature of the Bronze Age world might be considered as favourable to fishing groups—in contrast to later periods when strong states such as Ming China could enact extreme policies of coastal depopulation in order to control fishermen and pirates (cf. Hang 2015). However, to the extent that trading relations over-determined the Bronze Age economy, demand for other products may have been given greater priority than the fruits of the sea. Classical, Confucian, and indeed modern prejudices against fishing groups have impacted the way these people have been studied in archaeology. Kristiansen & Larsson (2005:22–23) have protested that historical views of the medieval immobile peasant have adversely impacted our understanding of the Bronze Age. With regard to fishing, the same point can certainly be made for Japan, where, from the Bronze Age onwards, fishers are invariably seen as subordinate to rice farmers.

A ‘big data’ approach is one key to future research on Bronze Age fishing. While numerous zooarchaeological reports exist in the regional literature, and some comparative analyses have been made (e.g., Dréano 2019), there is a need for further synthetic integration into a broader model of the use of the sea and marine products in the Bronze Age. At the same time, this paper has also attempted to demonstrate the importance of qualitative syntheses of regional sequences. While we currently lack an overall analysis of the decline in fishing in early farming societies, the Bronze Age is a key period for understanding

how long-term trajectories of fishing began to articulate with new patterns of commercialisation.

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