AN ICONOGRAPHY OF TUNA TRAPS. ESSENTIAL INFORMATION FOR THE UNDERSTANDING OF THE TECHNOLOGICAL EVOLUTION OF THIS ANCIENT FISHERY

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SUMMARY

*Tuna traps used for catching the bluefin tuna (*Thunnus thynnus*) are not a single gear type, even if this is a common thought. Going through the very long history of this fishery it is possible to identify several types of traps, thanks to images or detailed descriptions. It is still difficult to precisely define the first type of traps, but starting from 16th century images is a great help. The importance of precisely identifying the main types (besides the individual technologica features of each trap) is fundamental to more specifically distinguish yields and effort by category, whenever a long historical series is analysed. This paper provides details on the iconography of tuna traps in the last five centuries in order to better define the various types and their evolution over the years.*

RÉSUMÉ

*Les madragues utilisées pour capturer le thon rouge (*Thunnus thynnus*) ne sont pas un type d'engin unique, même si c'est la croyance commune. Si l'on parcourt la très longue histoire de cette pêcherie, il est possible d'identifier plusieurs types de madragues, grâce aux images et aux descriptions détaillés. Il est encore difficile de définir avec précision le premier type de madragues, mais à partir du 16e siècle les images sont d'une grande aide. L'importance d'identifier avec précision les principaux types (au-delà des caractéristiques technologiques individuelles de chaque madrague) est fondamentale pour distinguer de manière plus spécifique les productions et l'effort par catégorie, lorsqu'une longue série historique est analysée. Le présent document fournit des informations détaillées sur l'iconographie des madragues thonières au cours des cinq derniers siècles afin de mieux définir les divers types et leur évolution au fil des ans.*

RESUMEN

*Las almadrabas de túnidos utilizadas para capturar atún rojo (*Thunnus thynnus*) no son un único tipo de arte, aunque esta es la creencia común. Observando la larga historia de esta pesquería es posible identificar diversos tipos de almadrabas gracias a imágenes o a descripciones detalladas. Sigue siendo difícil definir de forma precisa el primer tipo de almadraba, pero a partir del siglo XVI las imágenes son una gran ayuda. La importancia de identificar de forma precisa los principales tipos (además de las características tecnológicas individuales de cada almadraba) es fundamental para distinguir de forma más específica los rendimientos y los esfuerzos por categoría cuando se analiza una larga serie histórica, Este documento se realiza tanto para facilitar detalles acerca de la iconografía de las almadrabas de túnidos en los últimos cinco siglos como para definir mejor los diferentes tipos de almadrabas y su evolución a lo largo de los años.*

KEYWORS

trap fishery, ancient industry, bluefin tuna, Atlantic Ocean, Mediterranean Sea, Black Sea, gear technology, tuna traps, seine fishery.

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1. Foreword

The tuna fishery is one of the oldest organised fisheries in the world, and the bluefin tuna trap fishery is certainly the oldest industrial fishery as far as we know, dating back at least 26 centuries. Literature on the tuna fisheries is one of the most relevant among that of all fisheries, and papers describing the bluefin tuna fisheries are available since at least VII b.C. (Adams, 1883; Aeliano, II b.C.; Aristotelis, 1635; Athaeneus di Neucratis, II b.C.; Aubet, 1987, Azcoytia, 2007a, 2007b, 2007c, 2008, 2009, 2011; Bacci, 1982; Baskett, 1899; Bekker-Nielsen, 2005; Bekker-Nielsen & Casasola, 2010; Ben Lazreg *et al*., 1995; Bernard Casasola, 2009, 2011; Campos *et al*., 1999; Consolo, 1987; Corwin, 1929; Curtis, 1988, 1991, 2005; Del Rosso, 1905; Di Natale, 2012; Doumenge, 1998, 1999a; Dumont, 1976-1977, 1981; Edmondson, 1987, 1990; Eschilo, 472 b.C.; Esopo, 1592; Étienne & Mayet, 2002; Fernández-Duro, 1866; Fernandez Gómez *et al*., 2007; Fernández Pèrez, n.d.; García Vargas, 2001; García Vargas & Florido del Corral, 2010; Habibi, 2011; Herodotus, V b.C., Levine, 2006; Mastromarco, 1998; Merino, 1991; Mila y Pinell, 1902; Morales-Muñiz & Roselló-Izquierdo, 2007, 2008; Moreno Páramo & Abad Casal, 1972; Muñoz Vincente & de Frutos Reyes, 1999, 2004; Omerus, VII b.C.; Oppianus, 177 b.C.; Pepe, 2006; Pérez Gomez *et Al*., 2007; Philostratus de Lemnos, III b.C.; Plinius, 65 a.D.; Ponsich & Tarradel, 1965; Powell, 1996, Radclife, 1921; Smidth, 1876; Strabonis I b.C.; Theocritus, III b.C.; Vargas *et Al*., 2010; VV.AA., 2001, 2204, 2006). More ancient bluefin tuna fisheries are not documented, even though it is possible that the ancient Egyptians were able to fish this species.

According to archaeological findings, bluefin tuna (*Thunnus thynnus*, Linnaeus, 1758) was exploited in the Mediterranean Sea more than 11,200 years ago. The first known document on the bluefin tuna fishery is engraved on the rocky walls of Genovese's Cave on the isle of Levanzo (Egadi Islands, W. Sicily, Italy), dated about 9,200 years b.C. (**Figure 1**). It is evident that since these remote times, bluefin tuna was regularly a common food resource for the Mediterranean inhabitants and a basic component in their diet (Curtis, 1991; Dumont, 1981; Powell, 1996), at least for those living close to the coasts. Archaelogical evidences show that the bluefin tuna fishery was also present since IV b.C. in the Black Sea (Lebedev & Lapin, 1954; Morales *et Al*, 2007). Later images, like the scene of cutting a tuna painted on a Greek wine pitcher in the VI century b.C. (**Figure 2**), or the marvelous image of a tuna vendor on a "Siciliota" pottery from the IV century b.C. at the Mandralisca Museum in Cefalù (Sicily, Italy), show that trade of bluefin tuna, which was mostly marketed fresh at that time, was a common activity (**Figure 3**), while the presence of tunas on several ancient Ibero-Hispanic coins (from III b.C.) from various Moroccan, Spanish and Portuguese sites shows the economic important of this activity during Phoenician times (**Figure 4**).

Whilst the bluefin tuna fisheries are documented in several historical reports, it is still very difficult to understand the gears that were used in these fisheries. The fishery carried out by the Phoenicians in many places along the Mediterranean and the eastern Atlantic coast is perfectly documented in terms of factories and methods for preserving the tunas, but not at all about the fishing gears that were used at that time. The first attempt to describe the bluefin tuna fishery in the Greek period is from Oppianus (177 a.C.), since in its poem Halieutica the fishery is widely reported. According to Oppianus, the tunas were spotted from towers along the coast, and they used nets and up to five vessels to catch and kill the tunas. It is not clear if they used a set net or a boat seine or a combination of both, as several translations are able to fit all hypotheses. According to the first Italian translation made by Salvini in 1728, it seems that a set trap was used, because the description refers to "nets set like a town, with galleries, entrances and spaces", and possibly this is the first description of a bluefin tuna trap.

During Roman times, several marine fisheries were very well described by various authors, and the bluefin tuna fishery was mentioned in several texts, including Plinius (65 a.D.), however always without any acceptable description of the gear used at that time. Furthermore, many Roman fisheries are very well described in mosaics in several sites, but not one of them is really showing a bluefin tuna fishery. The only mosaic sometimes mentioned by a few historical reports on tuna fishery is that in the Bardo National Musem in Tunis, but the fishing representation, showing fishermen with harpoons and nets (and maybe also tunas but not as the target of the fishery) seems mostly related to bottom species. The famous mosaic depicting a seine fishery in Piazza Armerina (Sicily), where one person seems to be holding a swordfish, while other fish are close to the net, was not considered as an image of a trap or a seine fishing for bluefin tuna, although some scientists have doubts. The absence of any mosaics or wall paintings showing the bluefin tuna fisheries in Roman times is particularly strange, because these fisheries were extremely important at that time, mostly for the production of "*garum*" sauce. Several Roman villas close to areas where tuna factories were located do not have any mosaic or painting with tunas or tuna fishing activity, and this is still unexplained.

There is a long period of time without precise descriptions of bluefin tuna fisheries, at least until the X and the XI centuries. The famous Arab geographer Al-Idrisi (1154) reports the location of various tuna traps along the

coasts of Sicily, but the description of the fishery does not allow for better defining the type of gear. The only clear evidence we have up to the medium-age period is that in most of the places tunas were spotted from the top of coastal towers, also used for defense purposes, close to the tuna factories which were located in the fishing sites.

The purpose of this paper is to provide a synthetic overview of the most important images of "tuna traps", since their beginning and up to modern times, for a better understanding of the various types of "bluefin tuna trap fisheries" over the centuries and the modifications or development of each gear type, if any.

2. The beginning of the age of printing, etchins and engravings

When manuscripts were slowly substituted by printed books, after the diffusion in Europe of the technique which used mobile characters[2], the progressive diffusion of books increased in a considerable way. In several countries there was a flourishing production of books on several matters, mostly religious as before, but also concerning geography, literature, legal affairs, science and other subjects. The fishery was not usually considered an important activity, even if the tuna fishing industry was possibly the most relevant along the Mediterranean coasts, and then books on the fishery were not very common.

The very first printed image of a tuna trap was provided by the marvelous etchings of Georg (Joris) Hoefnagel, who engraved the views of many Spanish cities in the volumes of the world famous "*Civitates Orbis Terrarum"* (1572-1617), by George Braun and Franz Hogenberg. The first etching shows a beach seine fishery in Cadiz (published in the first volume in 1572) and the second clearly shows the bluefin tuna fishery in Conil (published in the second volume in 1575) (**Figure 5**). It is not clear if the beach seine in the first etching of Cadiz was used for bluefin tuna because, apparently, it is a common seine used for other smaller species and, furthermore, the position along the coast is different from the tuna trap factory position. Another larger etching, illustrating in a more detailed way the bluefin tuna fishery in Cadiz, was published in the same volumes, but it is not clear if it was included in some copies of the first volume (1572) or if it was added only to the second edition in 1598; this is the first available image including both the bluefin tuna fishery activity and the land-based factory activities (**Figure 6**). These images not only show the type of trap used at that time in Spain (a seine, set possibly by at least five vessels and then operated as a beach seine), but also the way of harvesting, manipulating and preparing the bluefin tuna for the market. It was clear that everything was used for various preparations: fresh meat, salty meat, smoked meat, tuna sausages, and even the bones were used for the fire! In this case, it was clear that the tuna trap was what the Spanish call "almadraba de tiro", based on the tuna spotting from land-based towers. The Cadiz engraving was copied and partly modified several times in the following centuries.

In about the same period, another image of the bluefin tuna fishery became available: it was etched by Adrian Colaert, on a subject by Jan Van der Straet (more commonly known as Johannes Stradanus), for the second edition of "*Venationes Ferarum, Avium, Piscium, pugnae bestiarorum et mutuae bestiarum*", published in Antwerp, Belgium, by Philipp Galle. The first edition (1578) had the same plates but without the progressive numbers, while the second edition was possibly published in 1584. This image shows the bluefin tuna fishery in Naples (Italy), with an atypical beach seine, where tunas are encircled by the net using small boats and then harpooned when they are kept inside the net close to the shore (**Figure 7**). It is possible that that etching was showing a small coastal tuna trap ("tonnarella") targeting juvenile bluefin tuna, a type of fishery active in the area south of Naples until about 1980. The artist based the etching on some historical description (Plinius is mentioned some times in the volume), but a personal artistic componet cannot be excluded.

Thanks to the development of printed images and the wide diffusion of books, finally it was possible to follow this important fishing activity, with clear images of many fishing gears from several places. It is also very clear that "tuna trap" was not a single gear, but several gears were included under this name. This is extremely important to better understand the historical series of CPUE data (Di Natale & Idrissi, 2012). At the same time, starting from the XVII century, the images of the fishing gears used for bluefin tuna showed more technical and technological details, providing the basis for a better understanding of the various activities.

It seems that the most diffused gear targeting bluefin tuna in the earliest times (at least in the western Mediterranean Sea and close to the Gibraltar area) was the seine, mostly operated by five vessels, encircling

[2] It is commonly accepted that Johann Gutemberg was the inventor of this important printing technique at the beginning of the XV century. In the reality, the printing technique is much more ancient (VII century in China), while the use of pottery mobile characters is documented in China since 1041; metal mobile characters were used in China and in Korea since the XIII century.

tunas at sea close to the shore or operated from the shore[3]. This was also evident from some painted documents held in the Archives of the Duque de Medina Sidonia (García García, 2012; López González & Ruiz, 2012), showing a beach seine in the XVI century (**Figure 8**). There is evidence that since classic times this beach seine fishery was an industrial one, with specific economic organisations, land-based factories and conflicts about the fishing rights.

Immediatelly after these first images, there is the image of a typical "mattanza"[4] in a set trap (Sarà, 1983, 1998) which was painted by an anonymous Sicilian artist in Trapani (Sicily) in the XVII century (**Figure 9**). This is a very interesting image, because it shows a lot of details about the final harvesting operation, which is carried out on a traditional set tuna trap. Furthermore, it provides not only two very well defined images of bluefin tunas but also three different predatory behaviours of bluefin tunas attacking shoals of small pelagic fish. The use of traditional set tuna traps in Sicily is confirmed by many documents (Di Natale, 2012), and also by several images. It is interesting to note that all documents from Sicily usually refer only to set traps. A descriptive figure, also in terms of clothes used by the tuna trap workers, is given in **Figure 10**, which shows another typical "mattanza", painted by an anonymous Sicilian artist in Trapani (Sicily) in the first part of the XVIII century on ceramic floor tiles (Sarà, 1983). The widespread use of the set traps for bluefin tuna in Italy is documented by various images from the XVIII century: one of the most known is an engraving by the priest Antonio Bova, showing a traditional set trap used in Trapani (**Figure 11**), but also a painting, again from Trapani, showing another type of set tuna trap (**Figure 12**), because each trap was organised in a different way, taking into account the local characteristics of the area and the incoming courses of bluefin tunas, even keeping the same concept of the net structure. One of the artists providing a lot of details about the tuna trap fishery in Sicily was Jean-Pierre Louis Laurent Houël, who included in the famous four volumes about his travels to Sicily, Malte and Lipari (carried out between 1769 to 1772 and published in 1782), four masterpiece etchings, derived from watercolours, on tuna traps in Trapani (**Figure 13**). These etchings show details about the way of making the ropes and cords for the trap, technical views of the trap and some gears for slaughtering the tunas, the closure of the "death chamber" and the "mattanza". The etchings provided by the Sardinian Jesuit and naturalist Francesco Cetti (1777) (**Figure 14**) confirmed that tuna set traps where the most common type of trap used for bluefin tuna in Italy since that time or even the only one.

The use of what is nowadays considered a traditional set trap for bluefin tuna was certainly diffused in several countries in the XVIII century. An ancient French map, made in 1714 (**Figure 15**), not only shows the several small tuna set traps, all of the same size, in the area close to Marseille, but it also reveals how they were set one after the other, logically fishing along the same migratory course (this possibly affected some yields). Joseph Vernet, in 1754, painted the world-famous oil on canvas (**Figure 16**), showing the harvesting of bluefin tuna in the set trap in the Gulf of Bandol (southern France, between Marseille and Toulon). Using this image, the famous engravers Charles-Nicolas Cochin and Jacques Philippe Le Bas made the largest etching available in the XVIII century on the tuna trap fishery (**Figure 17**), published in 1760, as one of the engravings in the series "Les Ports de France" (1760-1767). This famous image was published with small variations several times by other authors and engravers in the following decades. Others and more technical images of tuna traps in France were made available by the fundamental work on fishery and fish by Duhamel de Monceau (1769-1782), who, in the second volume (1772) included a description of the tuna trap fishery in France and two engravings of tuna set traps. The same description was provided by Charles Joseph Panckoucke (1792-1793), who had the permit to reprint and improve the famous monumental "Encyclopédie", originally edited by Denis Diderot and Jean le Rond D'Alembert between 1751 and 1782. Panckoucke (1793), in the separate volume of tables, also provided the same engravings made by Duhamel de Monceau, but mirror printed (**Figure 18**).

Further images of set traps, at least two types ("de buche"[5] or "de anclas"[6]) are held in the archives of Archives of the Duque de Medina Sidonia (López González & Ruiz, 2011), confirming the use of these traps also in Spain. The very important work by Sañez Reguart (1791), a fundamental illustrated dictionary of fishing gears, which was possibly inspired by the volumes by Duhamel de Monceau (1769-1782), also includes several detailed descriptions and figures about the Spanish bluefin tuna fishing activity**.** Sañez Reguart provided, for the

[3] The Spanish names for the tuna seines were "almadraba de vista" and "almadraba de tiro".

[4] "Matanza" is the correct Spanish word for defining the final harvesting or slaughtering of bluefin tuna in a trap, even if in the earliest times, the most used name was "la sacada". The Italian and Sicilian word for the same operation, clerly derived from the Spanish one, is "mattanza".

[5]This type of tuna trap was a mixset system, with a part of set nets arranged in chambers and one or more mobile nets, manouvered by small vessels close to the entrance, having the role of pushing the tuna school into the inner part of the trap. These nets are not used nowadays.

[6]This type of tuna trap, also called in Spanish "almadraba de monteleva", is comprised only of nets fixed to the seafloor, forming a complex of chambers; it is now commonly considered the "traditional tuna trap".

first time, a wide overview of the many types of bluefin tuna traps ("almadrabas" *sensu lato*) used in several Spanish sites, showing the diversity of gears included within the word "almadraba". Here there is a selection of various types of set tuna traps, from the most simple to the most complex one, including a "matanza" view (**Figures 19** to **Figure 22**).

The beach seine fishing was active, at least along the Spanish coasts until the XVIII century, and again two painted documents held in the Archives of the Duque de Medina Sidonia (García García, 2012, López González & Ruiz, 2012) show the details of this activity in southern Spain in the early part of the XVIII century (**Figure 23**), with two different ways of using these nets. Sañez Reguart (1791) also provided some interesting images of other seines used for bluefin tuna: **Figure 24** shows a tuna beach seine, which is a double seine used differently from those shown in **Figure 23**; **Figure 25** shows a typical tuna boat seine, operated by 5 vessels in coastal areas.

3. Images in more recent times

The XIX century is a key period both for the books on traps and for the iconography. In this century, finally, images and documents on traps are showing-up from several countries, documenting this important industrial activity. This is also the period when the diffusion of traps showed a considerable improvement, with many new traps in various areas (Algeria, Tunisia, Libya, Egypt and Turkey), possibly where they existed also in very ancient times. The philosophy behind the new traps was to try to further intercept the tuna movements along the coast, when they were travelling immediately before or after the spawning or even during the spawning period in a few areas.

Finally, it was possible to better understand the diversity of tuna traps used in the Mediterranean Sea, in the Atlantic Ocean close to Gibraltar, in the Marmara Sea and in the Black Sea, and this is really impressive. Of course, it is difficult to provide all images in one scientific paper, due to space constraints, but it is always possible to present a general overview of the various documents.

The bluefin tuna trap fishing activity in Italy in the XIX century and in the first part of the XX century is largely documented, because Italians were deeply involved in this industry, owning traps in several Mediterranean countries, and also having economic interests in some Atlantic traps (Manfrin *et Al*., 2012). This is the reason why the two most comprehensive books on the bluefin tuna trap fishery in that period were written by Pavesi (1889) and Parona (1919), who provided not only the first comprehensive map with the location of all tuna traps (active or inactive) in the Mediterranean, in the area close to Gibraltar, in the Marmara Sea and in the Black Sea, but also an extensive overview of the many types of traps used in various countries.

An interesting etching of the tuna traps in S. Giorgio (northern Sicilian coast) in the early XIX century (Di Santo, 1971; Salmeri, 2008), shows that two different types of tuna set traps were used in the same location, sometimes at the same time or one after the other during the fishing season. This image (**Figure 26**) shows three small set traps and one traditional set trap used along a small portion of the southern Tyrrhenian coast. It is one of the very few images that clearly informs about this practice which seems to have been used in several places in Sicily, at least between the end of the XVIII and in the XIX century. The use of two or more traps belonging to the same owner, in the same location, is rarely mentioned in the many books describing the bluefin tuna fisheries, while such use sometimes appears in the logbooks of the trap or in the sales notes of the trap material. **Figure 27** shows the main set trap of San Giorgio as it was at the beginning of the XX century (Gamberini, 1916).

The complexity of some traps since 1800 is well demonstrated by the scheme of the large bluefin tuna set trap of Magazzinazzi (sometimes reported also as Magazzinacci, the Italian version of the original Sicilian name), an important tuna trap located West of Trapany (South-western Sicily) (Parona, 1919; Sarà, 1983, 1998). Close to this trap, there was another famous large one, the tuna trap of Bonagia, which was active until the second part of the XX century (**Figure 28**) (Pavesi, 1898). These large trap nets, sometimes extented far from the coast, were very costly, due to the large number of ropes and anchors required, which implied a considerable number of workers to set the structure at sea. In these last two centuries, the iconography of Italian bluefin tuna traps was enriched by a lot of technical details, far better describing the gear components and the many names of the various parts, including the vessels (**Figures 29** to **Figure 32**). The small traps, usually called "tonnarella" (**Figure 33**) (Pavesi, 1898), were present in several places along the coast, but their distribution still needs further investigation; the last one is still active in Camogli, in the Ligurian Sea close to Genoa (Mariotti, 2003, 2005, 2007; Cattaneo Vietti & Bava, 2009).

A part of the iconography on traps was also related to some religious or folkloric aspects of this fishery. **Figure 34** shows an "*ex voto*" made in 1818 by a tuna fisherman after an accident in the tuna trap of Formica, near Trapani, West Sicily, one of the very few concerning the trap fishery. Several images were published by newspapers or popular publications in the second half of the XIX century. **Figure 35** shows a tuna trap and the manner of carryng the tunas, while **Figure 36** shows the popular celebrations in Palermo of the first tuna caught at the beginning of the season, which was carried around the downtown in a happy procession. At any rate, most of the images showed the slaughtery ("mattanza"), because this activity was able to catch the attention of the readers more than any other image of this fishery (**Figure 37**). At the same time, in the XIX century, some artists depicted high quality paintings of trap fishery in Sicily, either for the interesting scenography or for the impact of the images (**Figure 38**).

Of course, an extensive and good iconography was also available for the Spanish traps. The main reference paper is the important "Diccionario de Artes de Pesca de España y sus posesiones" (Rodriguez Santamaria, 1920, 1923). In this case, the iconography shows in a clear way, with all the details, the difference between the two main types of tuna traps ("almadraba de monteleva" and "almadraba de buche") (**Figures 39** to **Figure 41**), providing many technical details and a full description in the text. The slaughtery was only rarely depicted and the most known image is provided by the Spanish edition of Buffon (1839), but it was copied from the original French edition (**Figure 42**). Other images of the "matanza" extist but they are less clear; artistic images or paintings are not commonly available for the XIX century, while they became more common in the last part of the XX century and in more recent years.

The iconography of trap fishery in the same centuries in France is not as diffused as it was in the XVIII century. In this case, there are many replicas, with few variations, of the famous etching presented in **Figure 17**, while some other etchings were published in popular magazines or books (**Figures 43** to **Figure 45**). It seems that several paintings on the tuna trap fishery were produced by various artists in the XIX century and Farrugio (2012) prides some examples; **Figure 46** shows a very high-quality painting by the artist Felix Ziem, which provides evidence that tuna seine fishing was still active in the French Mediterranean coast at least until the end of the XIX century, as is also confirmed by Farrugio (2012).

It is very interesting that, finally, some images of traps used in the Ottoman Empire (the actual Turkey) were made available in a very few books (Deveriyan, 1915, 1926; Ninni, 1923), only very partly redrawn by Karakulak and Oray (2009). Due to the very difficult availability of these images and the many varieties of tuna traps used in the Turkish Mediterranean, in the Strait of Boshorous, in the Marmara Sea and in the western part of the Black sea, it is supposed that **Figure 47** provides a very interesting overview of tuna traps used in the Ottoman Empire, between the end of the XIX century and the beginning of the XX century. From these images, it is clear that traps between the eastern Mediterranean and the Black Sea were very different one from the other, with several small traps (as reported by Ninni, 1923) and a few large traps, but all able to catch good quantities of bluefin tuna, intercepting the movements in both directions before entering, along and after leaving the Bosphorous. From time to time a very few artistic images of the tuna fishery in the Turkish area become available. **Figure 48** shows two of these examples, possibly painted between the end of the XIX century and the first part of the XX century by an unknown Turkish artist, on pages of old Holy books. Both paintings show vessels with tuna nets and in one of the paintings there is a fisherman harpooning a tuna. It is not clear if the artist intended to represent a trap net (maybe the final harvesting) or a seine fishing.

The bluefin tuna fishery along the eastern coast of the Adriatic Sea was also very poor in terms of iconography in old times. There are sevreal maps showing the location of tuna traps and a few books where this fishery is described also in terms of images (De Marchesetti, 1882; de Loubeau, 1894; Krisch, 1900; Maggioli, 1937; Ninni, 1917; Volpi Lisjak, 1996), but usually these are very poorly known. As a matter of fact, the tuna trap fishery along the eastern Adriatic coast between the end of the XIX century and the beginning of the XX century was very peculiar, with small traps set along the coast, in various places mostly located in the actual Croatia; the tunas were spotted from the coast by spotters on rocks (**Figure 49**) or on the top of long ladders or pols, close to the entrance of the trap. The traps were partly made by a set net and partly by a mobile net operated from a small vessel, able to close the entrance when tunas entered (**Figure 50**). This fishery has not been practiced for many years.

Tuna trap images from North African, eastern Mediterranean countries, Greece or Malta do not seem to be available.

4. The age of photography and films: modern times

When photographic techniques became available in the XIX century, the history of all images underwent great change. After the development of portable photographic equipment, even pictures in remote places became slowly available, improving in a considerable way the need for documenting many activities. The tuna trap industry, with its fascinating structures and rituals, was one of the activities which had good photographic documents from many places, but mostly from the Sicilian tuna traps.

There are many modern photographic books on the trap fishery and some are particularly important from a documental point of view (Alliata di Villafranca, 1951; Aliffi et Al., 2007; Alongi *et Al*., 2008; Centola, 1999; Consolo, 1987; Conte, 1985; Corso, 1952; D'Anzuso & Zinna, 1987; De Paoli, 1988; Díaz Ortuño *et Al.*, 2010; Di Bella & Meo, 1988; Di Natale, 1988; Di Stefano, 1970, 1976; Doneddu, 1983; Drago et Al., 1999; Falla, 2001, Farina, 1986; Florido del Corral, 2003; La Duca, 1988; Lazzaro Danzuso & Zinna, 1987; Lentini, 2004, 2008; Li Greci *et Al*., 1991; Lippi Guidi, 1993; Lo Coco, 2006; Lo Curzio, 1992; Lo Curzio & Sisci, 1991; López Gonzales *et Al*., 2007; Manetti, 2001; Manzi-Giusi *et Al*., 1986; Mariotti, 2003; Martorana, 1995; Maurici & Vergara, 1991; Montesanti, 1994; Narbona Olivier, 1982; Qualecultura, 1991; Quatriglio, 1991; Quilici & Tamagnini, 2007; Racheli, 1986; Ravazza (2002, 2003a, 2003b, 2004, 2005a, 2005b; 2007; Regueira & Reguira, 1993; Ricotti, 1925; Ruiz-Acevedo & López–González, 2002; Salerno, 2009; Sarà, 1983, 1998; Silvestri, 2003; Siragusa, 1980, 1986; Sorbello, 2010; Torre, 1999; Various Authors, 1918, 1986, 1988, 1991, 1994; Vivona, 1999; Volpi Lisjak, 1996).

Of course, it is not the objective of this paper to present many photographic images of the trap fishery, particularly because many of them are related to the way of transporting or preparing the tunas or to the many workers engaged in this activity or even the land-based plants. However, the documents on fishing techniques are usually limited to the vessels, the structure of the death chamber or the slaughtery. Here it was decided to present two patchworks of images: a first one with black and white photos, just to show a sort of short history of the photographic images of some traps in the XIX century and in the first part of the XX century in Spain and Italy (**Figure 51**); and a second one with color photos, showing some recent tuna trap activities in Sicily and Sardinia, but also some building of land-based plants of tuna traps, for a better understanding of the relevance of this fishery also from an architectural point of view and for industrial archaeology.

Several videos and films have been made on the tuna trap fishery in the last century. The most documental are those by Alliata di Villafranca (2006), Hernández San Juan & Halffter (1956), Istituto Luce (1931), Quilici (1970), Ravazza (2001), but most of the recent videos are produced by several TV productions and they are very difficult to find.

Such photos and videos are finally creating a complete and insightful overview of the fishing activities of the few remaining tuna traps in the Mediterranean and in the eastern Atlantic Ocean.

5. Conclusion

One of the important objectives of the ICCAT-GBYP, among others, is the recovery of historical data sets on the tuna trap fishery, the only fishery which is able to provide extremely long historical data series. These will help us to understand some of the variables known to occur from time to time, which also affect the yields of bluefin tuna and which can also possibly help in the understanding of natural cycles in the bluefin tuna populations.

The iconography is a part of this historical recovery because it provides an insightful view of various important technological variables over the last centuries which are not usually considered when analysing bluefin tuna data originating from the trap fishery. This paper is a first attempt to assemble some examples, using only a minor part of extensive iconography that exists on this ancient fishery. Further work is necessary to attribute the individual technological characteristics to the many traps which were active between the Atlantic Ocean and the Black Sea in the last centuries, in order to better attribute yields to specific gears. This immense task will require time, funds and considerable effort over the next few years.

6. Bibliography

Adams W.M., 1883, A popular history of fisheries and fishermen in all countries, from the earliest times. Intern. Fish. Exib. Lit., Handbook 1, part 1: 18-19.

Aelianus C., II a.C., De Natura Animalium. Lib. 13 chap. 16, and Lib. 15 chap. 6.

Aliffi A., Malesani M., Gissara L., 2007, Pesca e pescatori nel Siracusano. Syrakosia Cons. Ass. Ed., Siracusa: 1-137.

Alliata di Villafranca e di Salaparuta F., 1951, Il tonno e la tonnara. *In*: Le vie d'Italia. Touring Club Italiano, Milano: 1025-1037.

Alliata di Villafranca F., 2006, Il cinema e le tonnare. www.cosedimare.com/tonnare/cinesub.php

Alongi R., Gini G., Lentini R. (edit.), 2008, Lo Stabilimento Florio di Favignana. Storia, iconografia, architettura. Soprintendenza BB.CC.AA., Trapani.

Aristotelis, 1635, De Animalibus. In: Stagiritae peripatetico rum. Principis de Historia Animalium. Ed. Theodoro Goza, Venezia: 1-843.

Athaeneus di Naucratis (Ateneo), II a.C., 1656 (repr.), Deumosophistae. Lib. 7, chap. 14, folio 301. Hugueton J.A. & Ravan M.A. : 1-812.

Aubet M.E., 1987, Tiro y las colonias fenicias de Occidente, Edicions Bellaterra, Barcelona: 1-323.

Azcoytia C., 2007ª, Historia de las almadrabas y salazones en el sur de España.
http://www.historiacocina.com/historia/garum/almadrabas.html

Azcoytia C., 2007b, Historia del atún en el Mediterráneo.
http://www.historiacocina.com/historia/garum/atun.html

Azcoytia C., 2007c, Historia y elaboración del Garum.
http://www.historiacocina.com/historia/articulos/garum.htm

Azcoytia C., 2008, Baelo Claudia (Cadiz), la mayor factoría de salazones y manifactura de garum de la Hispania Romana. http://www.historiacocina.com/paises/articulos/baelo/index.htm

Azcoytia C., 2009, Lixus (Larache, Marruecos), la mas alejada factoría de garum y salazones de Roma. http://www.historiacocina.com/historia/garum/lixus.htm

Azcoytia C., 2011, Historia de las almadrabas y los salazones en el sur y levante de España entre los siglos XIII y XX. http://www.historiacocina.com/historia/garum/salazonescervantes.htm

Bacci G.M., 1982, Antico insediamento per la pesca e la lavorazione del tonno presso Portopalo. Kokalos, F. Serra Ed., Roma, 28-29: 345-347.

Baskett J.N., 1899, The story of the fishes. New York: 1-268.

Bekker-Nielsen T. (ed.), 2005, Ancient fishing and fish processing in the Black Sea Region. Aarus University Press, Aarus.

Bekker-Nielsen T., Bernal Casasola D. (ed.), 2010, Ancient Nets and Fishing Gear. Proceedings of the International Workshop on "Nets and Fishing Gear in Classic Antiquity: a first approach". Univer. Cadiz, Serv. Publicaciones and Aarhus University Press, Cadiz, Nov. 15-17, 2007.

Ben Lazreg N., Bonifay M., Drine A., Trousset P., 1995, Production ed commercialisation des salsamenta de l'Afrique ancienne. Actes VI colloque Hist. Et Archéol., de l'Afrique (Pau, 25-29 Octobre 1993), CTHS, Paris : 103-142.

Bernard Casasola D., 2009, Arqueología de la pesca en el Estrecho de Gibraltar : de la prehistoria al fin del mundo antiguo. Universidad de cadiz, Serv. Publ., Cadiz.

Bernard Casasola D., 2011, Liquamina : pesquerías y garum en las almadrabas romanas del estrecho de Gibraltar. Los Pinos Distr., Algeciras, 1-232.

Braun G., Hogenberg F., 1572-1617, Civitates Orbis Terrarum. Colonia : 340 tabl.

Buffon Leclerc G.L.M., 1834, Obras completas de Buffon aumentadas con articulos suplementarios sobra diversos animales no conocidos de Buffon por Cuvier. Imp. A. Bergnes y C., Barcelona.

Campos J.M., Péres J.A., Vidal N., 1999, Las cetariae del litoral onubense en época romana. Publ. Diput. Prov. Cadiz., Huelva.

Cattaneo Vietti R., Bava S., 2009, La Tonnarella e la pesca tradizionale a Camogli. Le Mani Ed. Genova: 1-143.

Centola B., 1999, Le città del mare. Avagliano Edit., Ercolano: 1-168.

Cetti F., 1777, Storia naturale di Sardegna. III. Anfibi e Pesci. Tip. Giuseppe Piattoli, Cagliari: 1-208.

Cochin C.N., Le Bas J.F., 1760-1767, Les Ports de France, Paris.

Consolo V., 1987, La pesca del tonno in Sicilia. Sellerio Ed., Palermo: 1-203.

Conte G., 1985 – Addio amico tonno. Indagine sulle tonnare di Portopaglia, Portoscuso e Isola Piana dal XIV secolo ai giorni nostri. Edizioni della Torre, Cagliari: 1-135.

Corso N., 1952, Mattanza del Tonno, Trapani. EPT Trapani, Ed. Radio: 1-17.

Corwin G., 1929, A bibliography of the Tunas. Div. Fish and Game California, Fishery Bullettin n. 22: 1-103.

Curtis R., 1988, Spanish trade in salted fish products in the 1st and 2nd centuries AD. Intern. Journ. Naut. Arch. Underw. Explor., 17(3): 205-210.

Curtis R.I. 1991. Garum and Salsamenta. Production and commerce in Materia Medica. E.J. Brill, Leiden, Netherlands: 1-226.

Curtis R.I., 2005, Sources for production and trade of Greek and Roman processed fish. In: Ancient fishing and fish processing in the Black Sea Region. Aarus University Press, Aarus: 31-46.

D'Anzuso G.L., Zinna E., 1987, La Mattanza: il ritorno di Ulisse. Giuseppe Maimone Ed., Catania: 1:105.

De Loubeau P., 1894, La Méditerranée pittoresque. Ed. Armand Collin, Paris: 1-500.

Del Rosso R., 1905, Pesche e peschiere antiche e moderne nell'Etruria marittima. Poggi Ed., Firenze, 2 vol.: XXXI+1-764.

De Marchesetti C., 1882, La pesca lungo le coste orientali dell'Adriatico. Trieste: 91-94.

De Negri L., 1874, La pêche et la Societé de Pisciculture Italienne. Cortenbergen Ed., Paris: 1-56 + 6 tab.

De Paoli R., 1988, Tonnare di Sicilia, Calabria, Sardegna e Puglia: un piano di valorizzazione. Indagine preliminare. Italtekna, Roma: 1-226.

Deveriyan K., 1915, Balih ve Bahhçilik. Kafih Hakuk Muhlfin Hadur, Dumhadis, Istanbul (in Ottoman) : 1-440 + 60.

Deveryian K., 1926 – Pêche et Pêcheries en Turquie. Imprimerie de l'Administration de la Dette Publique Ottomane, Istanbul : 1-480.

Díaz Ortuño J., Díe Bañuls C., Álvarez-Ossorio Ramos I., 2010, Almadrabas: el milenario arte de la pesca del atún. Diputación de Alicante: 1-199.

Diderot D., le Rond D'Alembert J., 1751-1782. Encyclopédie ou Dictionnaire raisonné des Sciences, des Arts et des Métiers, par une Sociètè de gens de Lettres. Chez Briasson, David, Le Breton et Durand, Paris, 17 vol. + 11 vol. of tables.

Di Natale A, 1988, Miti e tradizioni fra Uomo e Pesci In: Mare Nostrum, Rainero Ed., Firenze: 61-85.

Di Natale A., 2012, Literature on the eastern Atlantic and Mediterranean tuna trap fishery. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier. Collect. Vol. Sci. Pap. ICCAT, 67(1) (in this volume).

Di Natale A., Idrissi M., 2012, Factors to be taken into account for a correct reading of tuna trap catch series. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier. Collect. Vol. Sci. Pap. ICCAT, 67(1) (in this volume).

Di Santo M., 1971, La tonnara di San Giorgio. Thesis. Facultà di Economia e Commercio, Università di Messina, Anno Acc. 1970-1971.

Di Stefano G., 1970, La pesca del tonno e le tonnare del Trapanese. Trapani, 1 : 1-16.

Di Stefano G., 1976, Le tonnare di Scopello e di Castellammare del Golfo. Facoltà di Lettere e Filosofia, Università di Palermo, AA 1975-1976, thesis.

Doneddu G., 1983, Le Tonnare in Sardegna (1500-1800). Società e Storia, Franco Angeli Edit. Milano, 6(21) : 535-563.

Doumenge F., 1953, La pêche au thon dans le golfe d'Aigues-Mortes. Vie et Milieu, 4(3) : 381-410.

Doumenge F., 1955 – L'évolution de la pêche à Saint-Jean-de-Luz. Centre Régional de la Productivité et des Etudes Economiques, Montpellier, Bull. Trimestr., 12 : 325-336.

Doumenge F. 1998 – L'histoire des pêches thonières. Collect. Vol. Sci. Pap. ICCAT, 50(2): 753-802.

Doumenge F. 1999, La storia delle pesche tonniere. Biol. Mar. Medit., 6(2) : 107-148.

Drago D., Quilici F., Tomasino R., Finocchiaro G., 1999, Tonnare. L'EPOS edit., Palermo: 1-269.

Duhamel de Monceau H.L., 1769-1782, Traite général de Pêches et histoire des Poissons qu'elles fournissent, tant pour la subsistence des hommes que pour plusieurs autres usages qui ont rapport aux arts at au commerce (1st vol.). Saillant & Nyon/Desaint, Paris, 4 vol.

Dumont J., 1976-77, La pêche du thon à Byzance à l'epoque hellénistique. REA 78-79 : 96-119.

Dumont J., 1981 – Halieutika. Recherches sur la pêche dans l'antiquité greque. Doct. Let., Paris VI, Histoire, 4 vol.: 1-1298.

Edmondson J.C., 1987, Two industries in Roman Lusitania : mining and garum production. BAR Int. Ser., 362, Oxford.

Edmondson J.C., 1990, Le garum en Lusitanie urbaine et rurale. Hierarchies de demande et de production. In : Les villes de Lusitanie romaine : hiérachies et territories. Table Ronde du CNRS, Paris.

Eschilo, 472 b.C., Persiani. Athens: 422-428

Esopo F., 1592, Piscatorius. In : Aesopi Phrygis et Aliorum Fabulae. Elegantissimis Iconibus in gratiam studiose iuventutis illustrate, pluribusq. aucte, & diligentius quam ante hac emendata. Com Indice locupletissimo. Ioannen Fiorinam, Firenze: 282.

Étienne R., Mayet F., 2002, Salaisons et sauces de poissons Hispaniques. Ed. de Bochard, Paris: 1-67.

Falla M., 2001, Marzamemi, la Tonnara ed altre storie. Arnaldo Lombardi Editore, Siracusa: 1-103.

Farina A., 1986, Tonnare di Sicilia, indagine storico-geografica. Arti Grafiche Siciliane, Palermo.

Farrugio H., 2012, Données historiques sur les anciennes madragues françaises de Méditerranée. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier. Collect. Vol. Sci. Pap. ICCAT, 67(1) (in this volume).

Fernández-Duro C., 1866, Almadrabas. Reseña histórica de su empleo en las costas de España y reglamento para su régimen. Tip. Estrada, Díaz y López, Madrid: 1+108+3 tab.

Fernandez Gómez F., Yañez Polo M.A., Hurtado Rodriguez L., 2007, Las Almadrabas del Atún Rojo en Conil de la Frontera y Aguas Atlanticas del Estrecho desde la antigűedad hasta nuestros dias. UNESCO Proyecto Oceanus, Fundacion Toro Albalá, Còrdoba: 1-174.

Fernández Pérez J., n.d., Consideraciones sobre la pesca romana en España. 1-21. http://www.ucm.es/info/antilia/asignatura/piloto/material_adicional/pesca_roma.pdf

Florido del Corral D., 2003, La almadraba como sistema cultural de pesca. PH, Boletín del Instituto Andaluz del Patrimonio Historico, 44: 65-71.

García García P., 2012, Las almadrabas de la costa andaluza bajo el dominio de la casa ducal de Medina Sidonia. Su tipología, sus producciones et sus problemáticas. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier. Collect. Vol. Sci. Pap. ICCAT, 67(1) (in this volume).

García Vargas E., 2001, Pesca, sal y salazones en las ciudades fenicio-púnicas del sur de Iberia. J. Fenandez & B. Costa Eds., in: De la mar y de la tierra. Producciones y productos fenicio-púnicos. XV Jornadas de Arquelogía Fenicio-púnica, Ibiza, 2000. Trabajos del Museo arquelógico de Ibiza y Formentera, 47: 9-66.

García Vargas E., Florido del Corral D., 2010, The origin and development of tuna fishing nets (Almadrabas). In: Ancient Nets and Fishing Gear. Proceedings of the International Workshop on "Nets and Fishing Gear in Classic Antiquity: a first approach". Univer. Cadiz, Serv. Publicaciones and Aarhus University Press, Cadiz, Nov. 15-17, 2007: 205-228.

Habibi M., 2011, Les salaisons de salaison de poisson dans le Maroc antique. Presented at the ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier.

Hernández San Juan J.M., Halffter E., 1956, Costas del Sur (documental). Hermic Films, Arcadia Films S.A.

Herodotus, V b.C., Histroriae, lib.1 Ch. 62.

Houël J.-P. L.L., 1782, Voyage pittoresque des Isles de Sicile, de Malte et de Lipari, oú traitá des Antiquités qui si trouvent encore; des principaux phénomènes que la Nature y offre; du costume des Habitants, & de quelques usage. Imprimerie de Monsieur, Paris: 1-223.

Istituto Luce, 1931, La pesca del Tonno 1924-1931. Roma, video documentary.

Karakulak F.S., Oray I.K., 2009, Remarks on the fluctuation of bluefin tuna catches in Turkish waters. Collect. Vol. Sci. Pap. ICCAT, 63: 153-160.

Krisch A., 1900, Die Fischerei im Adriatischen Meere. Pola: 36-88.

La Duca R., 1988, La Tonnara di Scopello. Grifo Ed., Palermo: 1-137.

Lazzaro Danzuso G., Zinna E., 1987, La mattanza, Maimone edit., Catania.

Lentini R., 2007, Da Magazzinazzi a Cefalù: le tonnare palermitane tra storia e recupero. In: Gangemi M. (ed.), Pesca e patrimonio industriale. Tecniche, strutture e organizzazione (Sicilia, Puglia, Malta e Dalmazia tra XIX e XX secolo), Cacucci Edit., Bari: 91-124.

Lentini R., 2008, Favignana nell'800: architetture di un'economia. In: Lo Stabilimento Florio di Favignana. Storia, iconografia, architettura. Soprintendenza BB.CC.AA., Trapani: 15-257.

Levine D., 2006, Tuna in ancient Greece. University of Arkansas, American Institute of Wine and Food, New York: 9 p.

Li Greci F., Berdar A., Riccobono F., 1991, Mattanza. Le tonnare messinesi scomparse. Edizioni G.M.B., Messina.

Lippi Guidi A., 2004, La tonnara di Capo Passero, antica magione sul mare. Prospettive dellsa Provincia di Siracusa, dec.: 78-85.

Lo Coco N., 2006, L'ultima levata. La tonnara di Solanto dai fasti al declino. Falcone Ed. Palermo, 1-152

Lo Curzio M., 1992, L'architettura delle tonnare.EDAS ed., Messina: 1-143

Lo Curzio M., Sisci R., 1991, Tonnare e barche tradizionali in Sicilia. I resti di una cultura del mare. EDAS Ed., Messina: 1-193.

López Gonzalez J.A., Ruiz M.B., Mata V.C., Fernándaz Alonzo F.J., Martinez Feria F., Perez Marco A., Ruíz Acevedo J.M., Sánchez Quintana D., 2007, El Atún y la Alimentación Mediterranea. Associazion Amigos del Atún, Isla Cristina, Cons. Agric. Pesca: 1-93.

López González J.A., Ruiz J.M., 2011, Series históricas de capturas del atún rojo (*Thunnus thynnus*) en las almadrabas del golfo de Cádiz. Presented at the ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier.

Maggioli U., 1937, Tonnare dell'alto Adriatico. Illustr. Ital., Milano:579-585.

Manetti R., 2001, Tonnare Elbane. Alinea Ed., Firenze: 1-186.

Manfredi L.I., 1987, Melqart ed il tonno. In: Studi di Egittologia ed antichità puniche, Acquaro E. Pernigotti S. (eds.), Giardini Edit., Pisa: 1-105.

Manfrin G., Mangano A., Piccinetti C., Piccinetti R., 2012, Les données sur lac capture des thons par les madragues dan l'archive du Prof. Massimo Sella. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier. Collect. Vol. Sci. Pap. ICCAT, 67(1) (in this volume).

Manzi-Giusi E., Siragusa G., Farina A., Dispenza T., 1986, Tonnare di Sicilia: indagine storico-geografica. Istituto di Scienze Geografiche, Facoltà di Magistero, Università di Palermo, Arti Grafiche Siciliane, Palermo.

Mariotti A.L., 2003, Il Tonno. Le Tonnare che parlano Genovese. Feguagiskia Studios Ed., Genova: 1-159.

Mariotti A.L., 2005a, La tonnara di Camogli. http://www.cosedimare.it/tonnare/camogli.php

Mariotti A.L., 2007b, La tonnara di Camogli. http://www.isolapiana.com/cultura/lilla/latonnaradicamogli.htm

Martorana G., 1995, Tonnara. Sellerio Editore, Palermo: 1-138.

Mastromarco G., 1988, La pesca del Tonno nella Grecia antica: dalla realtà quotidiana alla metafora politica. Rivista di cultura classica e medioevale, 1-2: 229-236.

Maurici F., Vergara F., 1991, Per una storia delle tonnare siciliane: la tonnara dell'Ursa. Accademia Nazionale di Scienze, Lettere ed Arti, Regione Siciliana, Assessorato Beni Culturali ed Ambientali, Palermo, Quaderni B.C.A., 11-12: 1-58.

Mila y Pinell J., 1902, Memoria sobre la antigüedad de la pesca de los atúnes, importancía de esta industria y decadencia en que estuvo. La Coruña.

Montesanti A., 1994, Le Tonnare di Bivona. Associazione Turistica Pro Loco di Vibo Marina, Off. Grafiche Garrì, Vibo Valentia: 1-87.

Morales A., Antipina E., Antipina A., Roselló E., 2007, An ichthyoarchaelogical survey of the ancient fisheries from the Northern Black Sea coast. Archaeofauna, 16 : 117-172.

Morales-Muñiz A., Roselló-Izquierdo E., 2007, Los atunes de Baelo Claudia y Punta Camarinal (s. II a.C.). Apuntes preliminares. In : Las cetariae de Baelo Claudia. Avance de las investigacíones arqueológicas en el barrio industrial (2000-2004). Arqueología Monografías, Sevilla : 489-498.

Morales-Muñiz A., Roselló-Izquierdo E., 2008, Twenty thousand years of fishing in the Strait : the archeological marine fauna assemblages from southern Iberian. In : Human impacts on marine environments. University of California Press, Berkley : 243-278.

Moreno Páramo A., Abad Casal L., 1972, Aportaciones al estudio de la pesca en la antigüedad. Habis, 2 : 209-221.

Muñoz Vincente A., de Frutos Reyes G., 1999, La industria pesquera y conservera púnico-gaditana : balance de la investigación. Nuevas perspectivas. Actos II Congreso de Arquelogia Peninsular, Zamora, 1966 : 49-57.

Muñoz Vincente A., de Frutos Reyes G., 2004, El comercio de las salazones en época fenicio-púnica en la bahía de Cadiz. Estado actual de las investigaciones : los registros arqueologicos. In : XVI Encuentros de Historia y Arqueología de San fernando. Las industria alfareras fenicio-púnicas de la Bahía de Cadiz. (San Fernando, 13-15 diciembre de 2000), Córdoba : 131-167.

Narbona Oliver M., 1982, Almadrabas de la costa Alicantina. Universidad de Alicante, Servicio de Publicaciones, Alicante : 1-265.

Ninni E., 1917, La pesca nell'Adriatico. Ministero Industria, Comm. E Lavoro, Sez. Pesca, Roma.

Ninni E., 1923, Primo contributo allo studio dei pesci e della pesca nelle acque dell'Impero Ottomano. Miss. Ital. Esplor. Levante, 5: 1-53+15 tab.

Omerus, VII b.C., Odyssea. Lib. 12.

Oppianus, 177 b.C., Alieuticon. In: Salvini A.M., 1738, Della Caccia e della Pesca. Firenze : 1-510.

Panckoucke C.J., 1792-93, Dictionnaire de toutes les especes de Peches. Enciclopédie Metodique. Paris.

Panckoucke C.J., 1793, Planches de Pêche. Recueil de planches de l'Enciclopédie Methodique. Paris : 1-114.

Parona C., 1919, Il Tonno e la sua pesca. R. Comit. Talass. Ital., Venezia, Mem. LXVIII : 1-259.

Pavesi P., 1889, L'industria del Tonno. Relazione alla Commissione Reale per le Tonnare. Min. Agric. Indust. Comm., Roma, Tip. Eredi Botta: 1-254.

Pérez Gomez F., Yañez Polo M., Hurtado Rodiguez L., 2007, Las Almadrabas de Atún rojo en Conil de la Frontera y aguas Atlántica del Estrecho, desde la antigüedad hasta nuestros días. UNESCO, Prgetto Oceanus, Cordoba : 1-174.

Philostratus de Lemnos. III a.C., Imagines, 13.

Plinius C.S., 65 AD? (re-edited in 1553), Historia Mundi. Naturalis Historia. Ed. Antonio Vicentino, Ludguni: 1-882.

Ponsich M., Tarradel M., 1965, Garum et industries antiques antiques de salaison dans la Méditerranée occidentale. Bibl. Ec. Hist. Et. Hispan., PUF, Paris, 36: 1-36.

Ponsich M., Tarradel M., 1988, Aceite de oliva y salazones de pescado. Factores geoeconómicos de Bética y Lusitania. Universidad Complutense, Madrid: 1-253.

Powell, J. 1996, Fishing in the Prehistoric Aegean. Studies in Mediterranean Archaelogy and Literature, pocket book n. 136, Paul Åströms Förlag, Jonsered, Sweden: 1-266.

Qualecultura, 1991, Le tonnare di Pizzo: materiali, documenti, ricerche. Jaca Book, Qualecultura, Vibo Valentia: 1-111.

Quatriglio V., 1991, Diventa museo la Tonnara Florio: a Favignana un esempio di archeologia industriale. Kalos, Arte in Sicilia, Riv. Bim., 3 (3-4): 1-56.

Quilici F., 1970, La Tonnara di Favignana – Maggio-Giugno 1970. Il Mediterraneo. Coprod. RAI-RTF-TVE, film.

Quilici F., Tamagnini L., 2007, Il mare di Siracusa, da Ortigia a Capo Passero. Deaprinting Off. Graf., Novara: 1-160.

Racheli G., 1986, Egadi, mare e vita. Natura, storia, arte, turismo dell'arcipelago eguseo e delle isole dello Stagnone. U. Mursia Edit., Milano: 1-348.

Radclife W., 1921, Fishing from the earliest times. New York,: 1-250.

Ravazza N., 2001, La tonnara nascosta. Maurici, Trapani (video).

Ravazza N., 2002, Le tonnare di Cetaria. In: La Sicilia Ricercata. Bruno Leopardi Edit., Palermo.

Ravazza N., 2003°, Il tonno fatato. In: De Muro G., Doz N., Gente di Tonnara. Fondazione Banco di Sardegna, Sassari.

Ravazza N., 2003b, Uomini, tonni e tonnare. In: Uomini, storie e sapori sulle rotte del tonno. Iª Rassegna Girotonno, Carloforte.

Ravazza N., 2004, L'ultima Muciara. Storia della Tonnara di Bonagia. Giuseppe Maurici Ed., Trapani: 1-106.

Ravazza N., 2005a, Diario di Tonnara. Magenes Ed. Milano : 1-330.

Ravazza N., 2005b, San Vito lo Capo, Zingaro e Scopello. Anselmo edit., Trapani.

Ravazza N., 2007, Il sale ed il sangue. Storie di Uomini e Tonni. Addictions Magenes Ed., Milano: 1-233.

Regueira J., Regueira E., 1993, Túnidos y tunantes en las almadrabas de las costas gadidanas. Coll. El Castillo de Jimena, Algesiras : 1-191.

Ricotti C., 1925, Pesca del tonno in tonnara. In: La pesca nei mari e nelle acque interne d'Italia, Minist. Marin. Mercant., II: 1-300.

Rodriguez Santamaria B., 1920, Esplicación de las láminas que contienen los principales artes, aparejos e instrumentos que se emplean para la pesca marítima en las costs de España. Mateu, Madrid: 1-149+1-35 plt.

Rodriguez Santamaria B., 1923, Diccionario de Artes de Pesca de España y sus posesiones. Sucesores de Rivadeneyra, Madrid: 1-332.

Ruiz-Acevedo J., López-González J.A., 2002, La Almadraba de Nueva Umbría (El Rompido). Ayuntamiento de Cartaya y Caja de Ahorros de Granada.

Salerno F., 2009, Uomini, tonni e tonnare di Sicilia. Morrone Editore, Siracusa: 1-182.

Salmieri A., 2008, San Giorgio; Storia di un borgo e la sua Tonnara. Pungitopo Ed., Marina di Patti (ME): 1-149.

Sañez Reguart A., 1791, Diccionario Histórico de los Artes de la Pesca Nacional. Imp. Joaquim Ibarra, Madrid, t.1: 1-406.

Sarà R., 1983, Tonni e Tonnare, Una Civiltà, una Cultura. Libera Università di Trapani Ed., Trapani :1-128.

Sarà R., 1998, Dal mito all'aliscafo. Storie di Tonni e Tonnare. Banca Aegusea Ed., Favignana-Palermo: 1-271.

Silvestri G., 2003, La tonnara di Lacco Ameno ed altri mestieri di pesca dell'Isola d'Ischia. Imagaegenaria Ed., Lacco Ameno d'Ischia: 1-249.

Siragusa G., 1980, Una ricerca sulla decadenza delle tonnare in Sicilia. Boll. Soc. Geogr. Italiana, XI (1-6): 1-212.

Siragusa G., 1986, Tonnare di Sicilia: indagine storico geografica. Arti Grafiche Siciliane, Palermo.

Smidth J.K., 1876, Historical observations on the condition of fisheries among the ancient Greeks and Romans, and their mode of salting and pickling fish. Rep. U.S., Comm. Fish for 1873-1874 and 1874.1875: 15-16.

Sorbello S., 2010, La pesca del tonno nel capolinea del Sud: Vendicari/Marzamemi/Portopalo di Capo Passero. Emanuele Romeo editore, Siracusa: 1-119.

Theocritus, III b.C., Epigrams, XIII.

Thomazi A., 1947, Histoire de la pêche, des âges de la pierre à nos jours. Edit. Payot, Paris : 1-645.

Thuy-Anh N., 1966, Luoi Dang ou Madrague Vietnamienne dans la Region de Khanh-Hòa (Nha-Trang). Bull. Soc. Études Indochinoises, Saigon, n.s. tome XLI (3-4) : 1-290.

Torre S., 1999, Le magie del tonno. La lunga avventura del pesce che dal mare finì sott'olio. Marsilio Edit., 1-148.

Van der Straet J., 1584, Venationes Ferarum, Avium, Piscium, pugnae bestiarorum et mutuae bestiarum. Ill. by Adrian Colaert, Philipp Galle publ., Antwerp, Belgium, 2nd ed.: 1-120.

Vargas G., Alberto E., Florido del Corral D., 2010, The origin and development of tuna fishing nets (almadrabas). In: Proceedings of the International Workshop on "Ancient Nets and Fishing Gear in Classical Antiquity. A First Approach". Monographs of the Sagena Project 2. Aarhus University Press, Aarhus: 205-227.

Various Authors, 1928, Iglesias, le miniere e le tonnare sarde. Le cento città d'Italia illustrate. Sonzogno Edit., Milano: 1-16.

Various Authors, 1986, La pesca del tonno in Sicilia: Indagine storico-geografica. Palermo:1-28.

Various Authors, 1988, Atlante dei beni culturali siciliani. Regione Siciliana, Ass. Beni Cult. Amb. Pubbl. Istruz., Palermo: 1-549.

Various Authors, 1991, La pesca del tonno in Sicilia. Assoturismo, Periodico Bimestrale di Turismo e Tempo Libero, Associazione Socialturismo, Palermo:1-50

Various Authors, 1994, Museo della tonnara. Il ricordo della memoria: Stintino. Assoc. Golfo dell'Asinara, La Celere Ed., Alghero.

Various Authors, 2001, Conservas, aceite y vino de la Bética en el Imperio Romano. Actas del Congreso Internacional, Écija y Servilla, 17-20 de diciembre de 1998, Écija.

Various Authors, 2004, Las Industrias alfareras y conservas fenicio-púnicas de la Bahía de Cádiz. XVI Encuentros de Historía y Arqueología de San Fernando, San Fernando. 13-15 de diciembre de 2000, Córdoba.

Various Authors, 2006, Historia de la pesca en el ambito del Estrecho. I Conferencia Internacíonal, Puerto de Santa María, 1-5 de junio de 2004, Consejería de Agricultura, Pesca y Alimentación, Junta de Andalucía, Sevilla.

Vivona A., 1999, Le tonnare del Trapanese nell'età moderna. Università degli Studi di Palermo, AA. 1999-2000, thesis.

Volpi Lisjak B., 1996, La spettacolare pesca del tonno attraverso i secoli nel Golfo di Trieste. Mladika Ed., Trieste.

Figure 1. The engravings and drawings of tuna and dolphins on the rocky walls of Genovese's Cave on the Isle of Levanzo (Egadi Islands, western Sicily, Italy), 9,200 B.C.

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Figure 2. (right). Cutting a bluefin tuna before a ceremony or a feast. Black figures painted on a reddish background and decorating a Greek wine pitcher of VI b.C. at the State Museum in Berlin (Germany).

Figure 3. (left). Image of a bluefin tuna vendor on a "Siciliota" pottery from the IV century B.C. at the Mandralisca Museum in Cefalù (Sicily, Italy).

Figure 4. Three ancient Hispano-Arabic coins from southern Spain, showing bluefin tuna on one side.

Figure 5. The very first images of the beach seine fishery in Cadiz (top) and the bluefin tuna preparation in Conil (bottom) engraved by Georg (Joris) Hoefnagel and included in "Civitates Orbis Terrarum" by Braun and Hogenberg (1572-1617).

Figure 6. The first complete image of the bluefin tuna beach seine fishery and the land-based factory activities in Cadiz, engraved by Georg (Joris) Hoefnagel and included in "Civitates Orbis Terrarum" by Braun and Hogenberg, surely included in the second edition in 1578, but which is also present in some copies of the first volume of the first edition in 1572.

Figure 7. Etching of the bluefin tuna fishery in a small tuna trap in Naples, by Adrian Colaert, on a subject by Jan Van der Straet (more commonly known as Johannes Stradanus), for the second edition of "Venationes Ferarum, Avium, Piscium, pugnae bestiarorum et mutuae bestiarum", published in Antwerp, Belgium, by Philipp Galle. The first edition (1578) had the same plates but without the progressive numbers, while the second was possibly published in 1584.

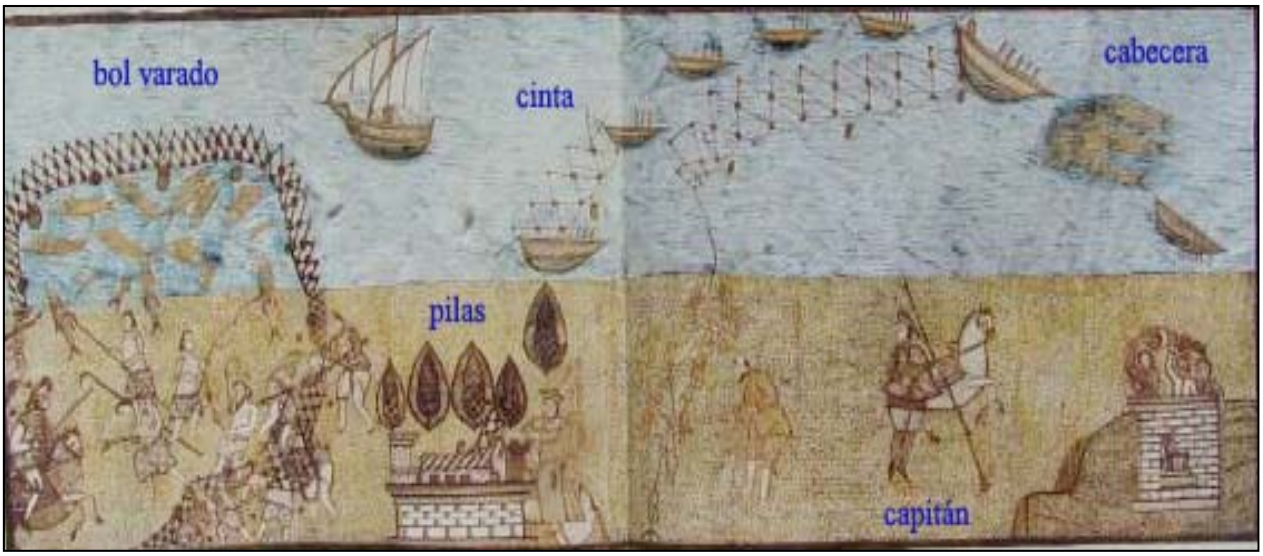

Figure 8. Painted document (with some modifications) made in the XVI century, from the archives of the Duque de Medina Sidonia, showing the bluefin tuna fishery by beach seine (from López González & Ruiz, 2012).

Figure 9. Image of a typical “mattanza”, painted by an anonymous Sicilian artist in Trapany (Sicily) in the XVII century. This image shows the details of the final harvesting operation, carried out on a traditional set tuna trap; furthermore, it provides two very well defined images of bluefin tunas and also three different predatory behaviours of bluefin tunas attacking shoals of small pelagic fish.

Figure 10. Image of another typical “mattanza”, painted by an anonymous Sicilian artist in Trapani (Sicily) in the first part of the XVIII century on ceramic floor tiles.

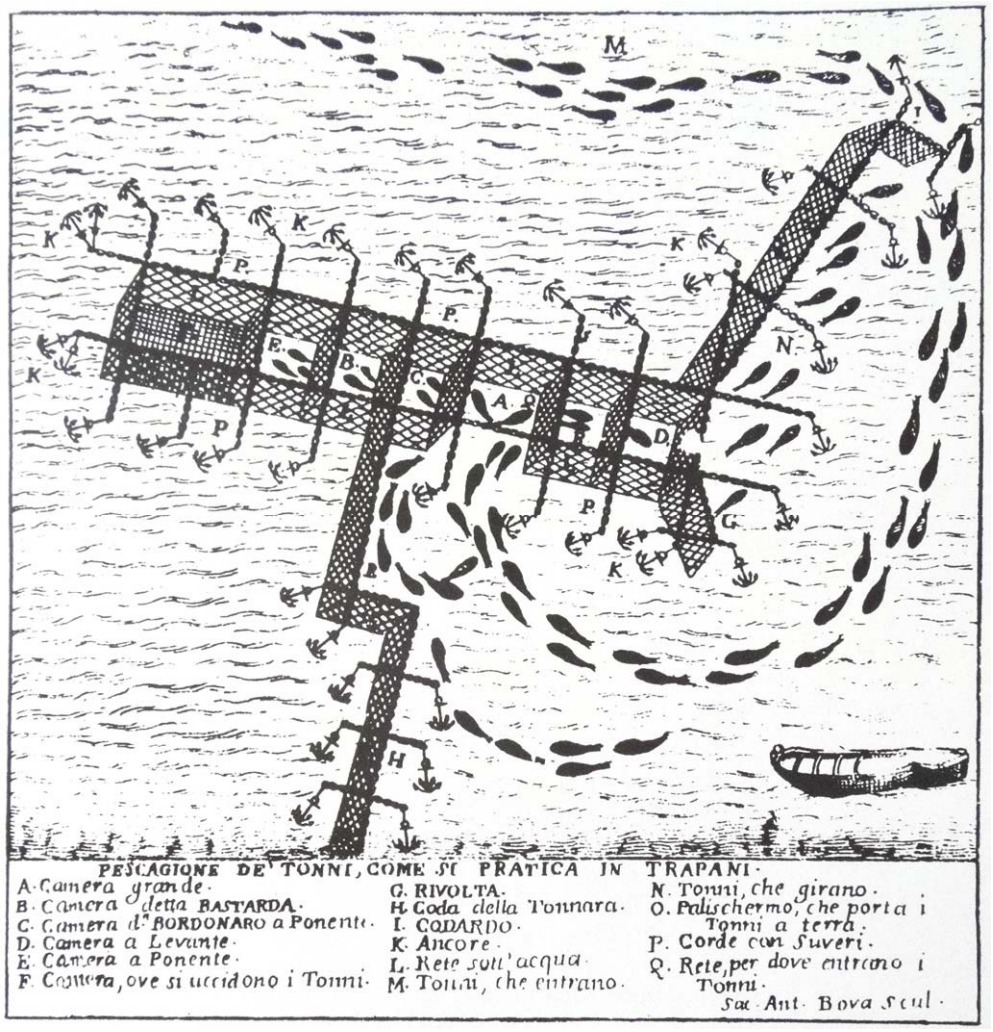

Figure 11. A traditional bluefin tuna set trap, used in Trapani at the beginning of the XVIII century (engraving by the priest Antonio Bova).

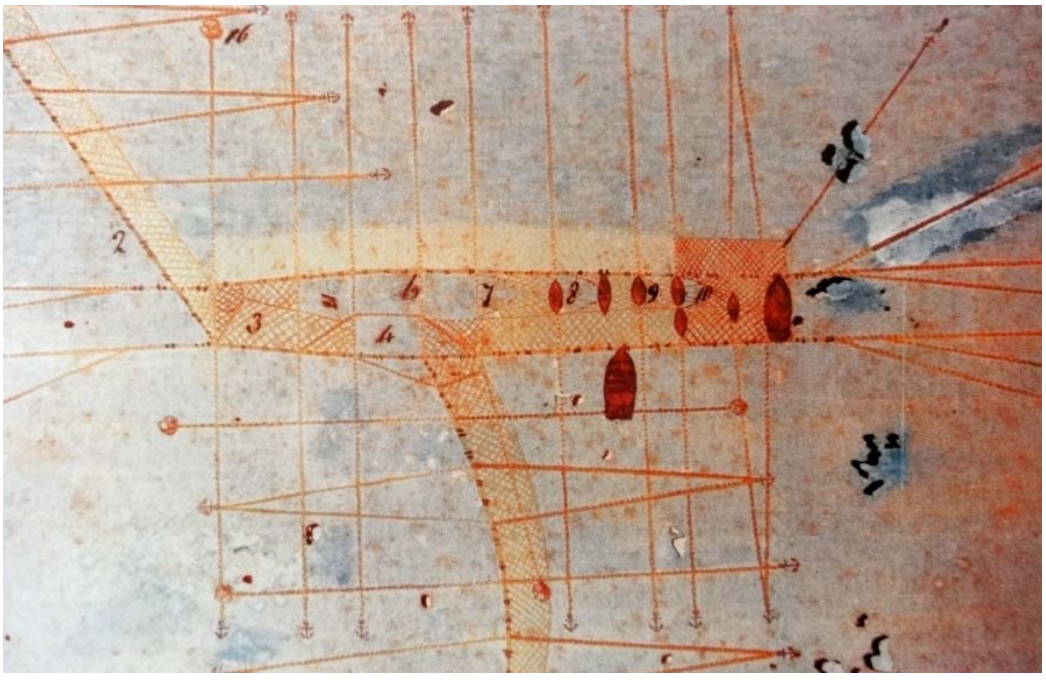

Figure 12. Another traditional bluefin tuna set trap, used in Trapani in the XVIII century.

Figure 13. Three out of four etchings published by Jean-Pierre Louis Laurent Houël (1782), showing many details of a bluefin tuna trap in Trapani (Sicily, Italy). The top image shows two views of a set trap and some gears, while the second and third images shows a "mattanza", with fishermen engaged in harvesting the tunas, while the trap owner and his rich hosts were watching the fishery.

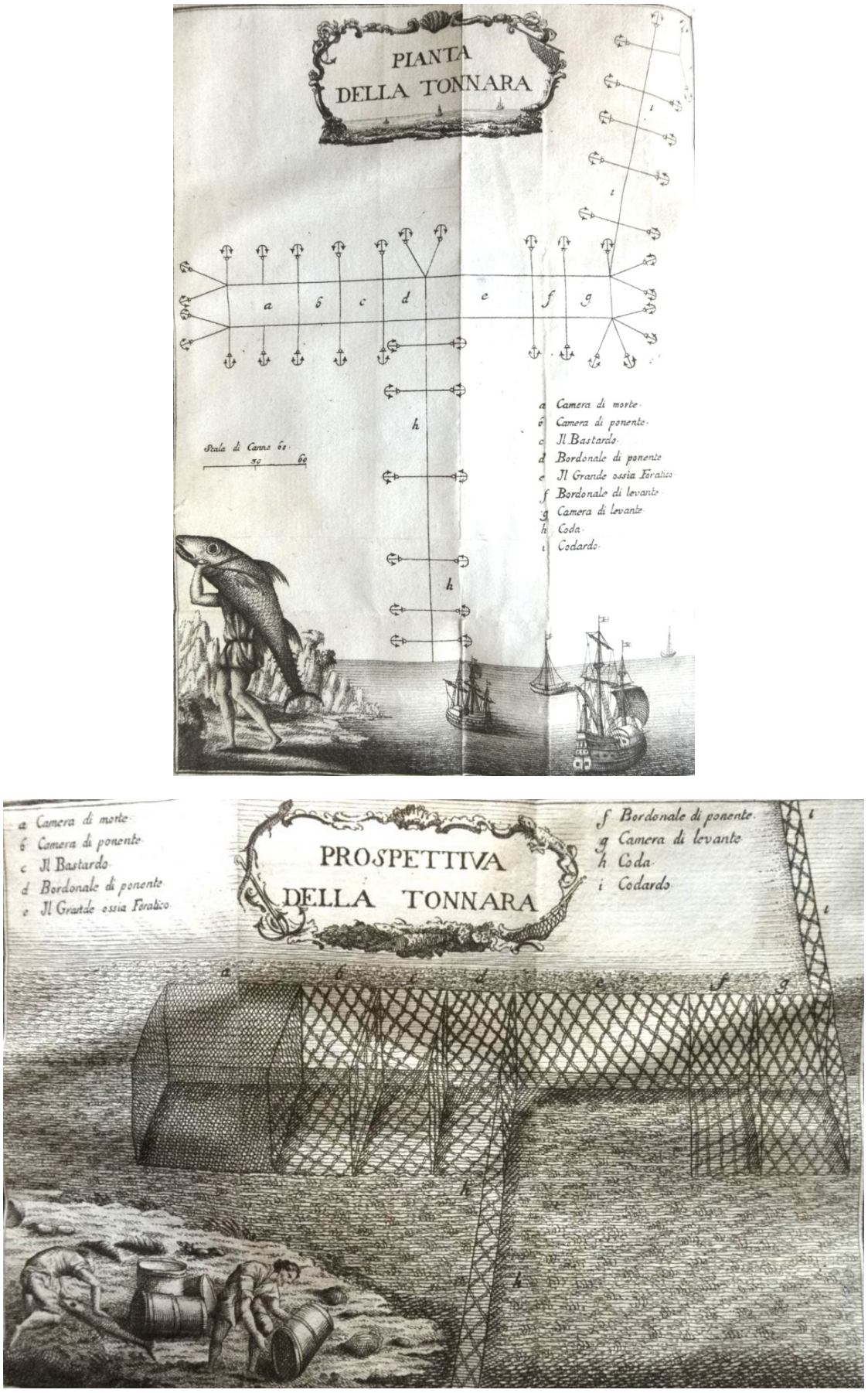

Figure 14. Plan and perspective of bluefin tuna traps in Sardinia (Italy) from Cetti (1777).

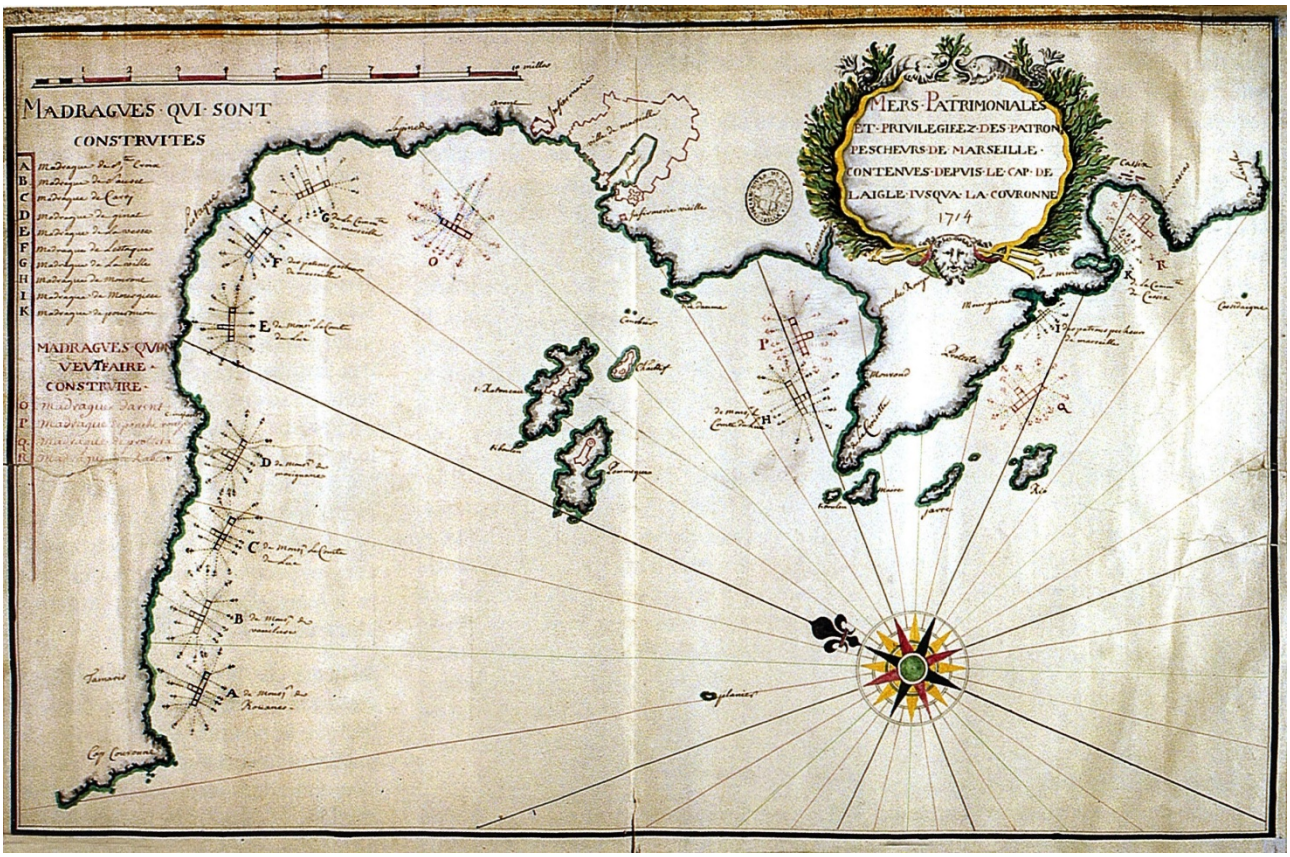

Figure 15. Map of the existing and planned tuna traps in the Gulf of Marseille (southern France, in the Mediterranean Sea) in 1714, showing the type of traps and their high density, mostly on the western side of the gulf.

Figure 16. The original painting of the tuna trap in Bandon by Joseph Vernet in 1754. The trap owner and his well-dressed hosts are in the vessels behing those with fishers and workers around the death chamber of the trap.

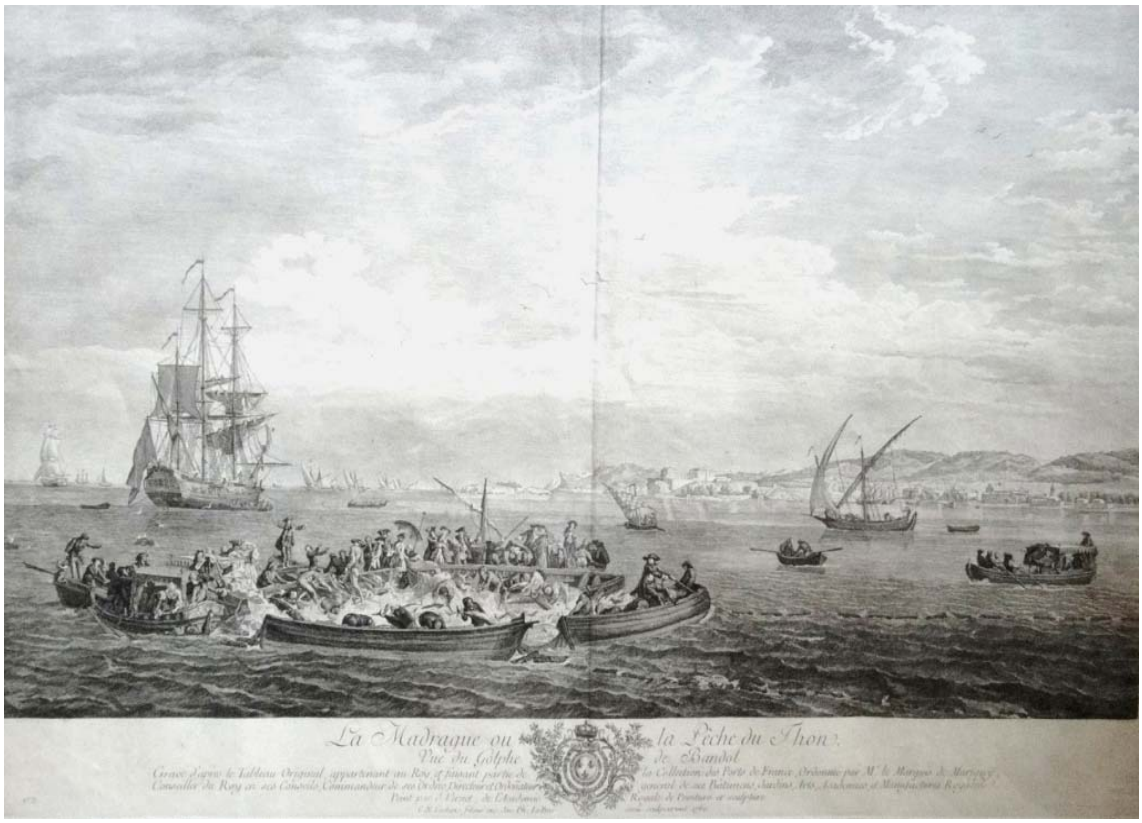

Figure 17. The largest engraving available in the XVIII century about the tuna trap fishery: the harvesting of bluefin tuna in the set trap in the Gulf of Bandol. This engraving was made in 1760, after the original painting by Joseph Vernet in 1754, by the famous engravers Charles-Nicolas Cochin and Jacques Philippe Le Bas and included in the series "Les Ports de France" (1760-1767).

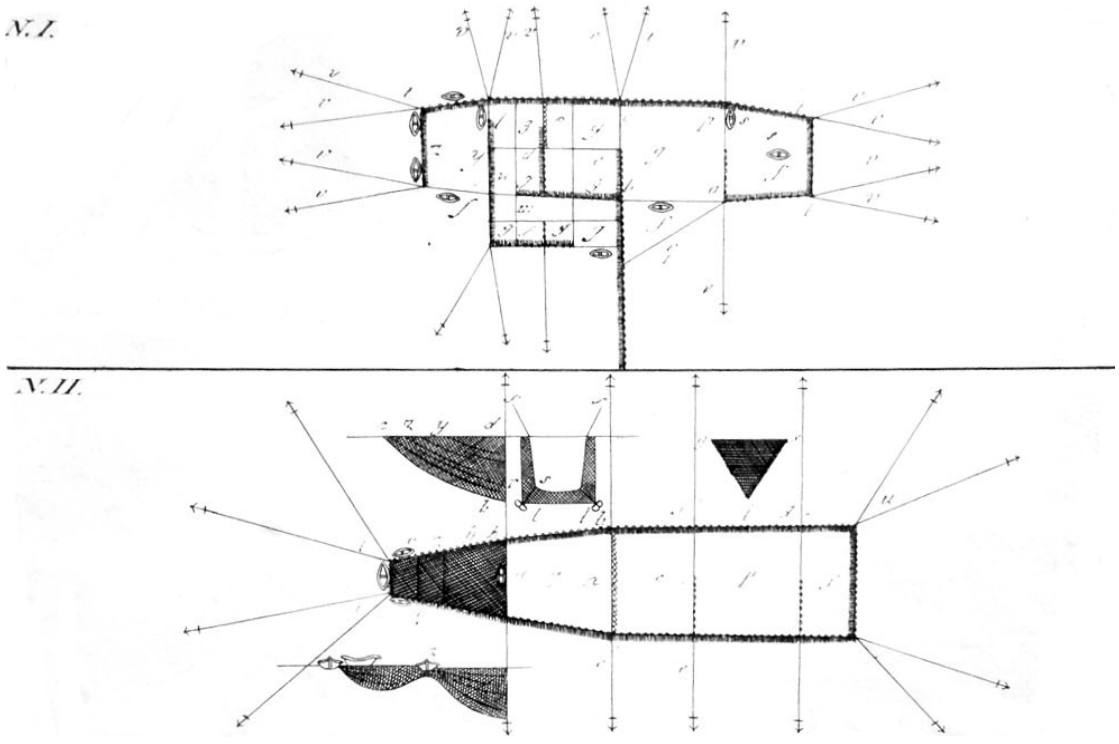

Figure 18. Two different types of set tuna traps used in Toulon (upper figure) and in Bandol (lower figure), along the Mediterranean coast of France in the XVIII century (Panckoucke, 1793).

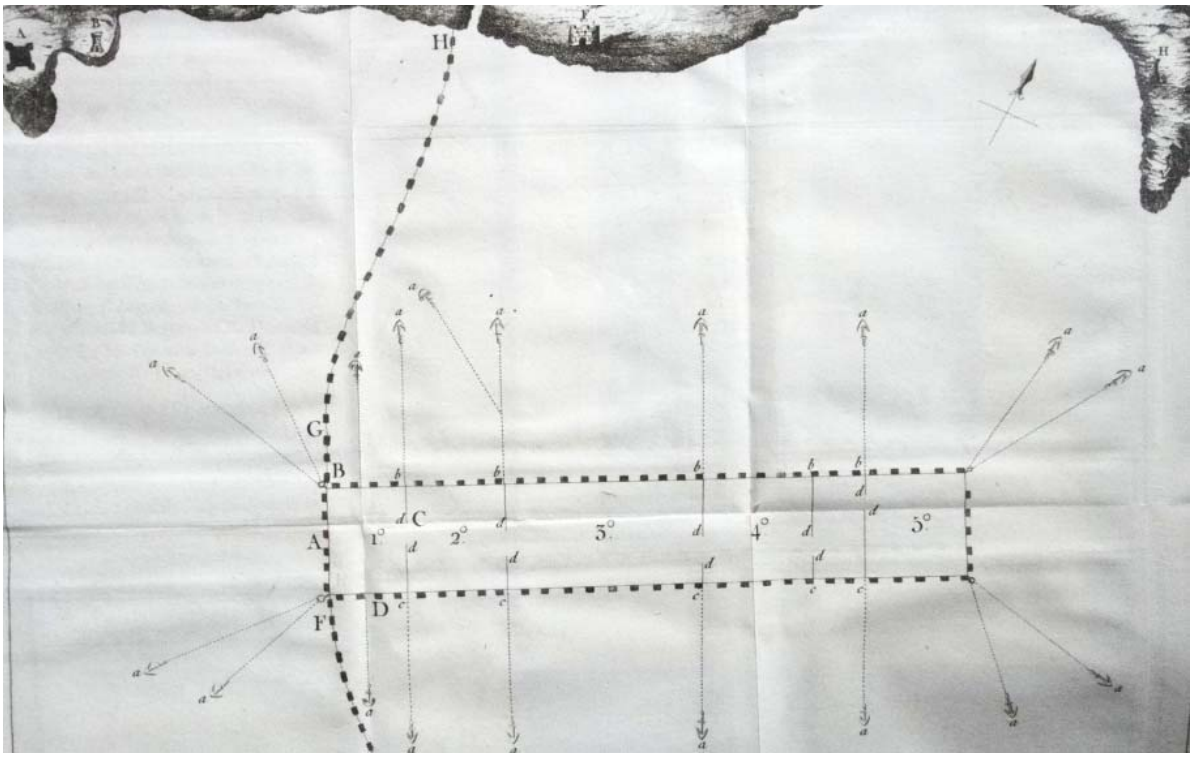

Figure 19. A simple type of set tuna trap for bluefin tuna used in Spain in the XVIII century (Sañez Reguart, 1781).

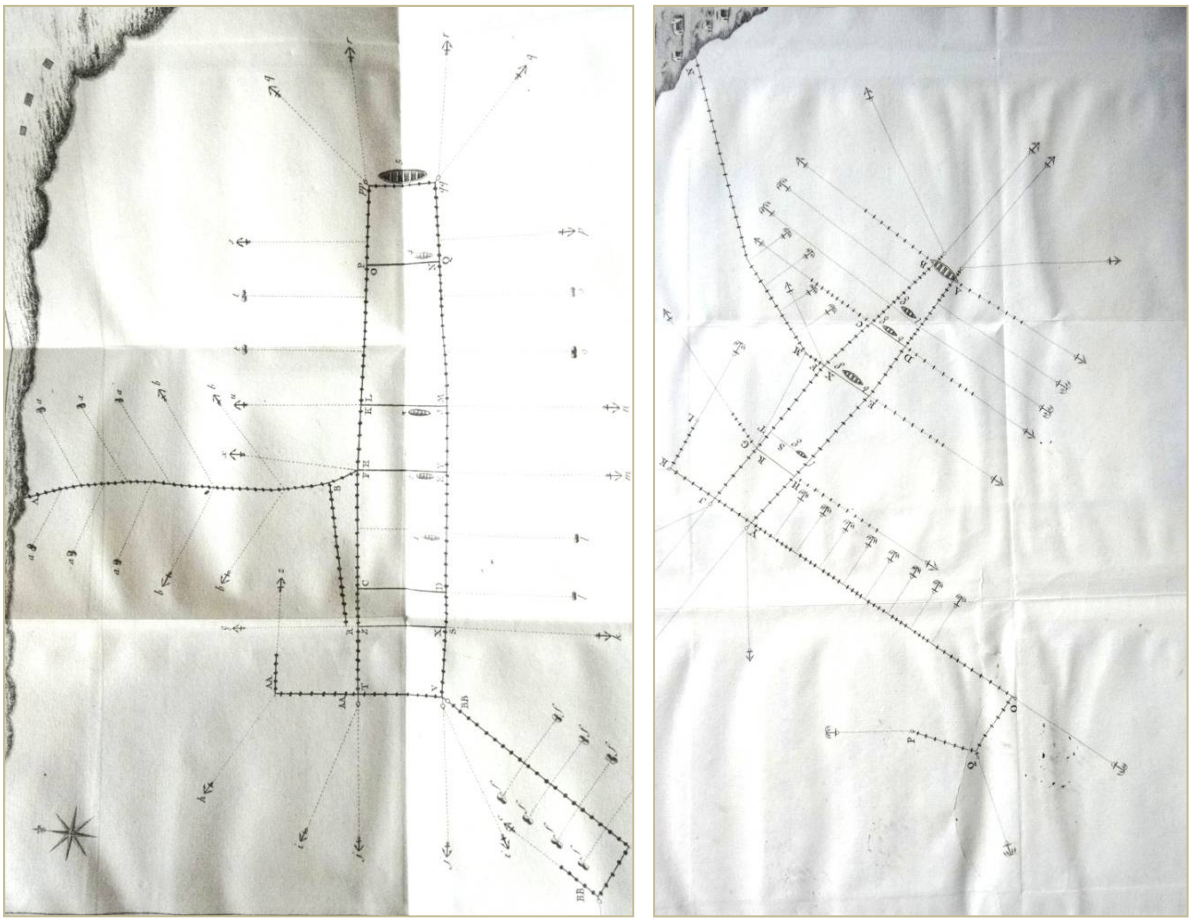

Figure 20. Two slightly more complex types of bluefin tuna set traps used in Spain in the XVIII century (Sañez Reguart, 1791).

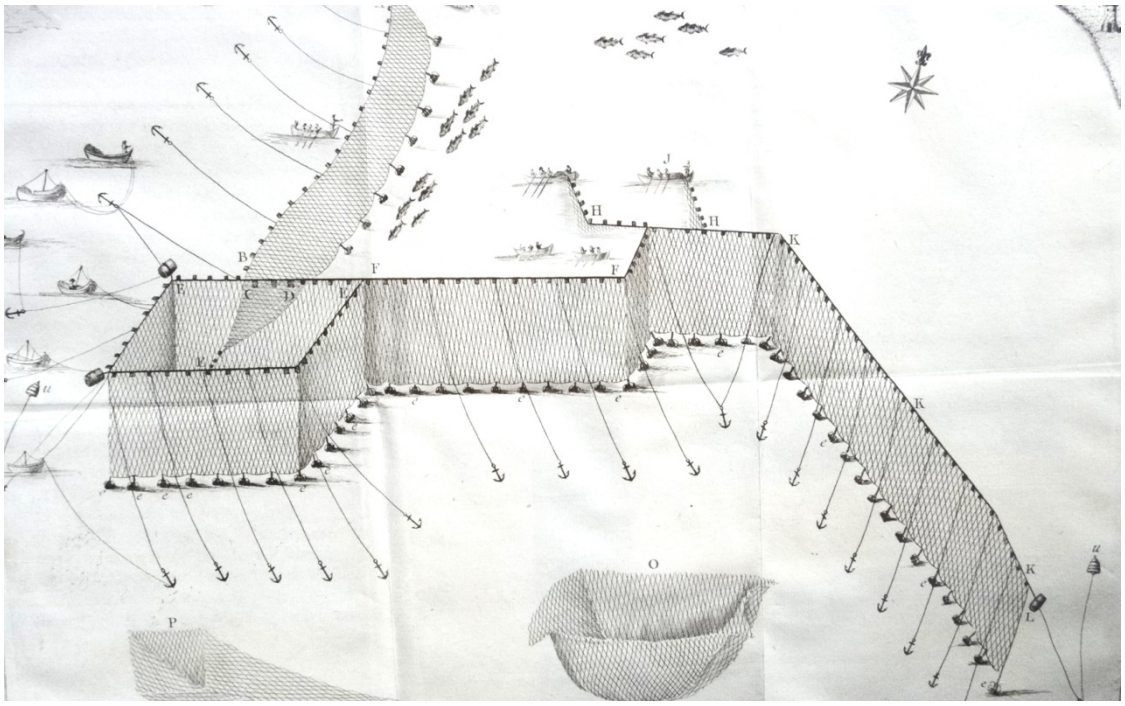

Figure 21. Another symple type of bluefin tuna trap, an “almadraba de buche”, because of the use of boats for closing the entrance (Sañez Reguart, 1791). This image is possibly a graphic modification of a coloured design hold in the Archives of Duque de Medina Sidonia (García García, 2012).

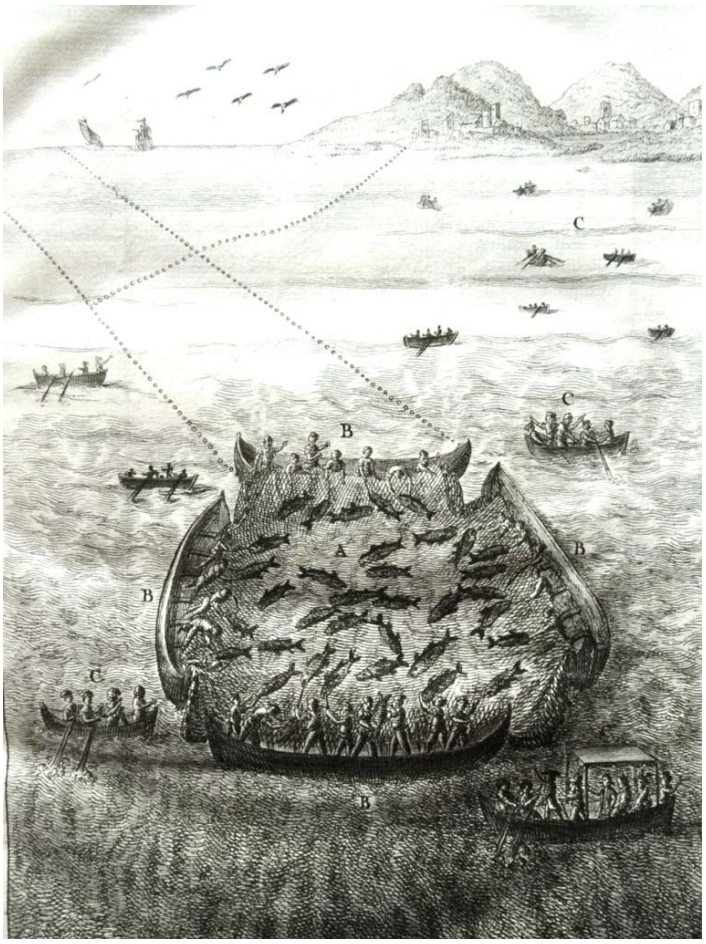

Figure 22. A “matanza” in a Spanish tuna set trap, in a nice engraving by Sañez Reguart (1791); the trap owner and his hosts are in the vessel with a tent (at the bottom right of the image).

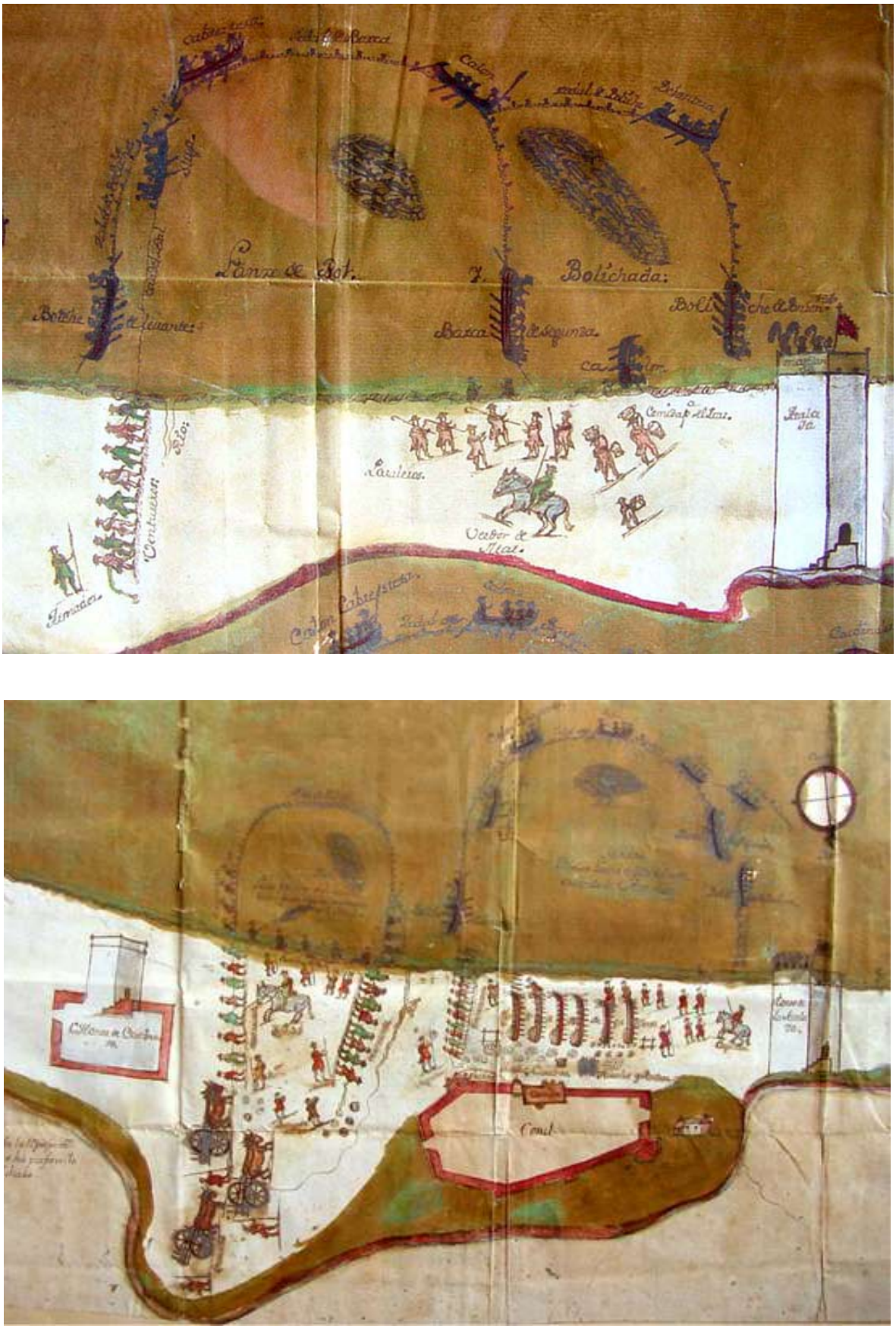

Figure 23. Two different types of beach seines used for bluefin tuna in the early XVIII century, from the archives of the Duque de Medina Sidonia (from López González & Ruiz, 2011).

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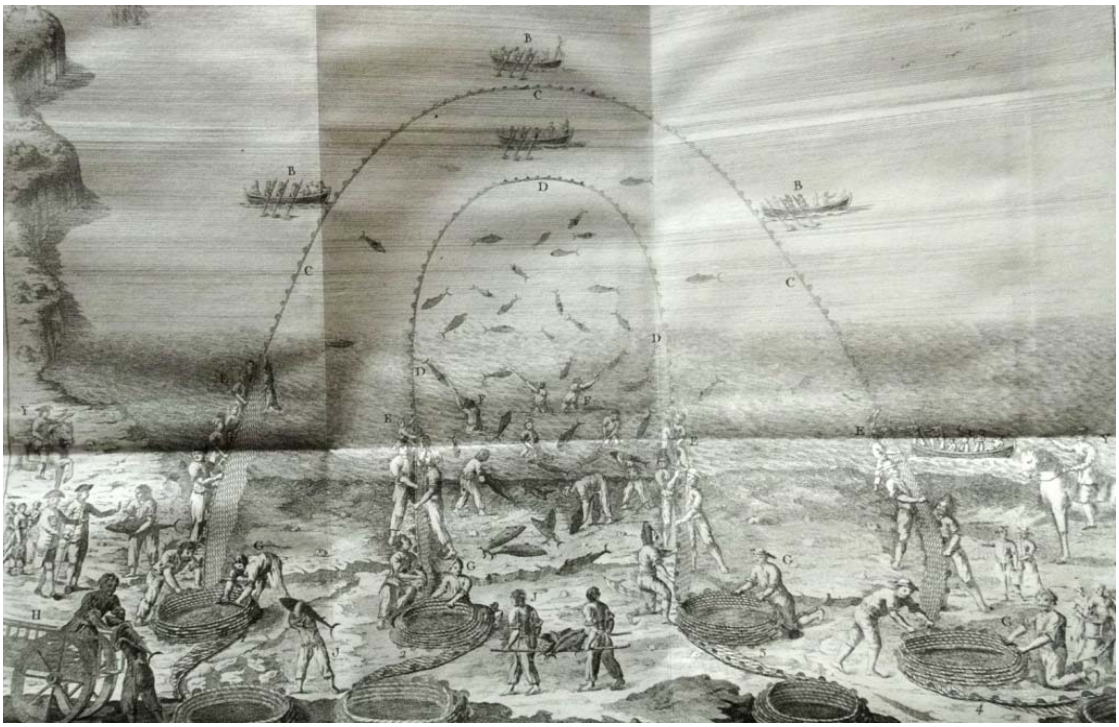

Figure 24. Another example of a tuna double beach seine used in Spain in the XVIII century, as reported by Sañez Reguart (1791).

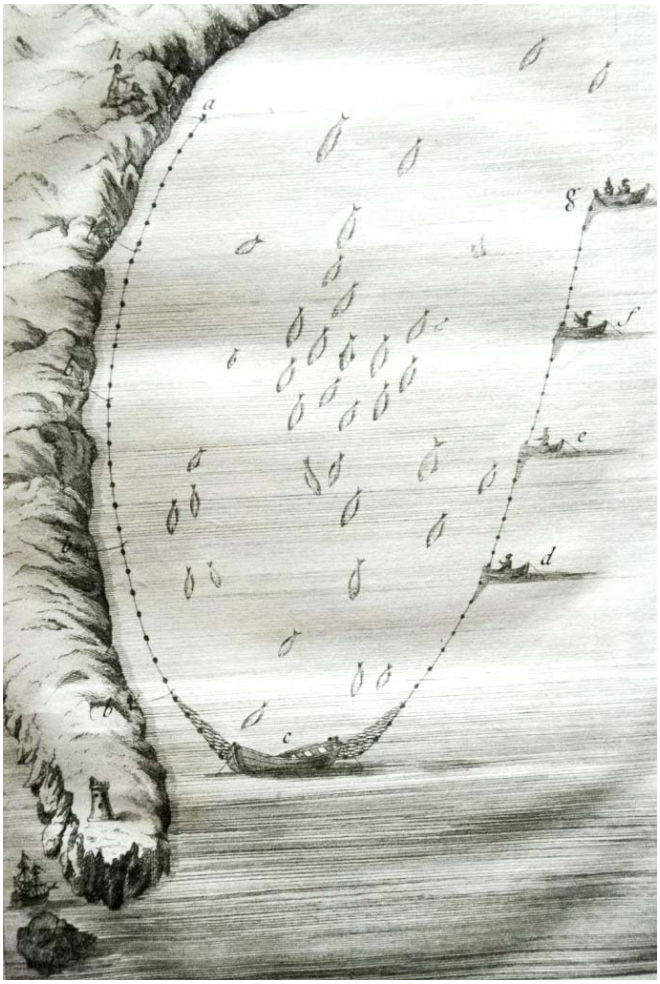

Figure 25. A Spanish tuna boat seine by Sañez Reguart (1791).

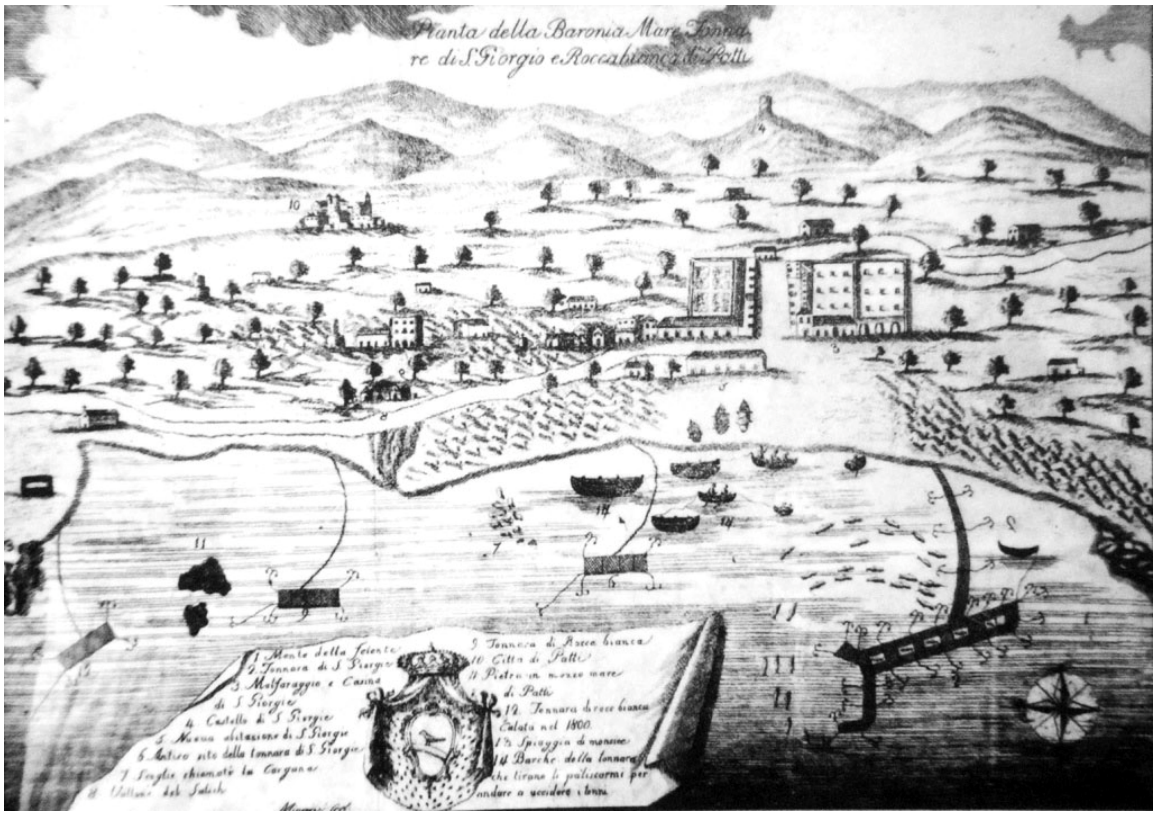

Figure 26. Two types of tuna set traps used in S. Giorgio (norther Sicily, Italy) in 1800; three small set traps and one normal set trap ("tonnara").

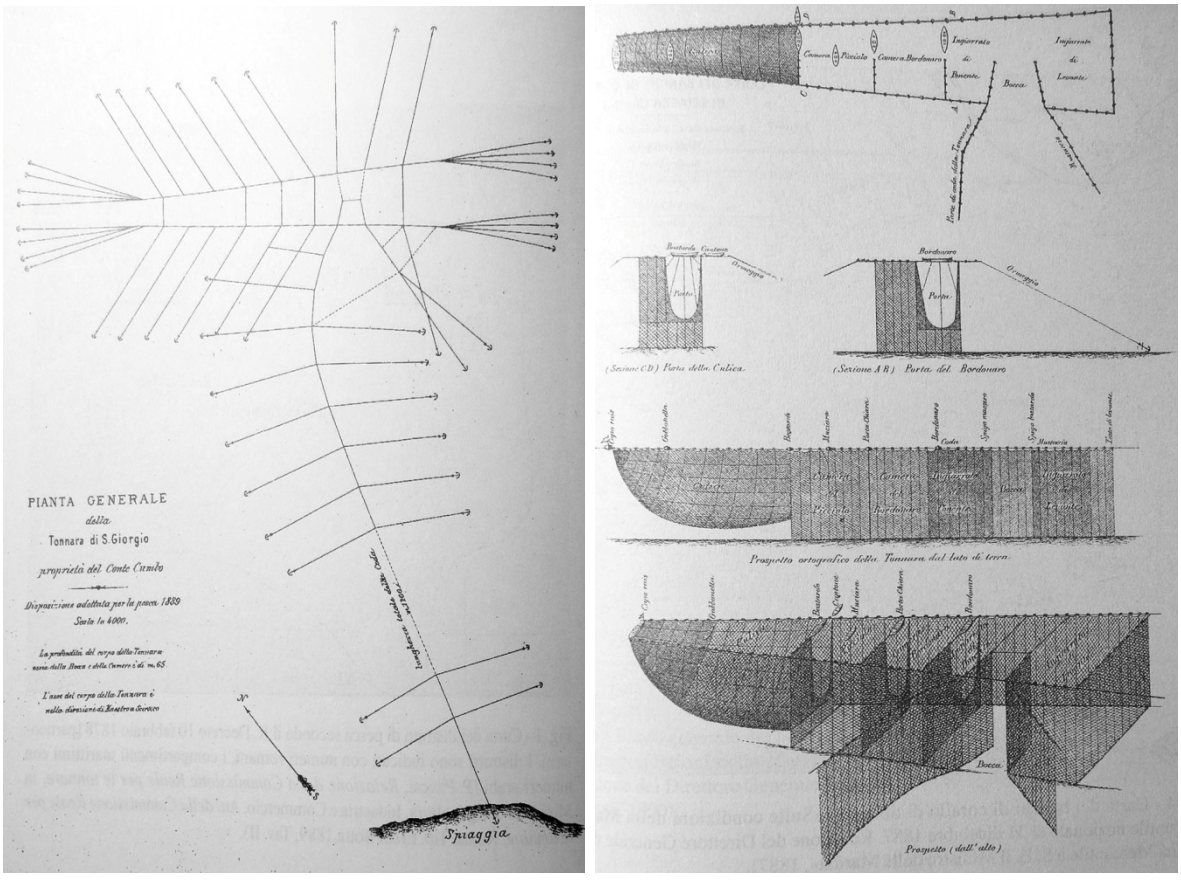

Figure 27. The main tuna set trap ("tonnara") of S. Giorgio (norther Sicily, Italy) in 1915: plan, lateral view and perspective view (Gamberini, 1916).

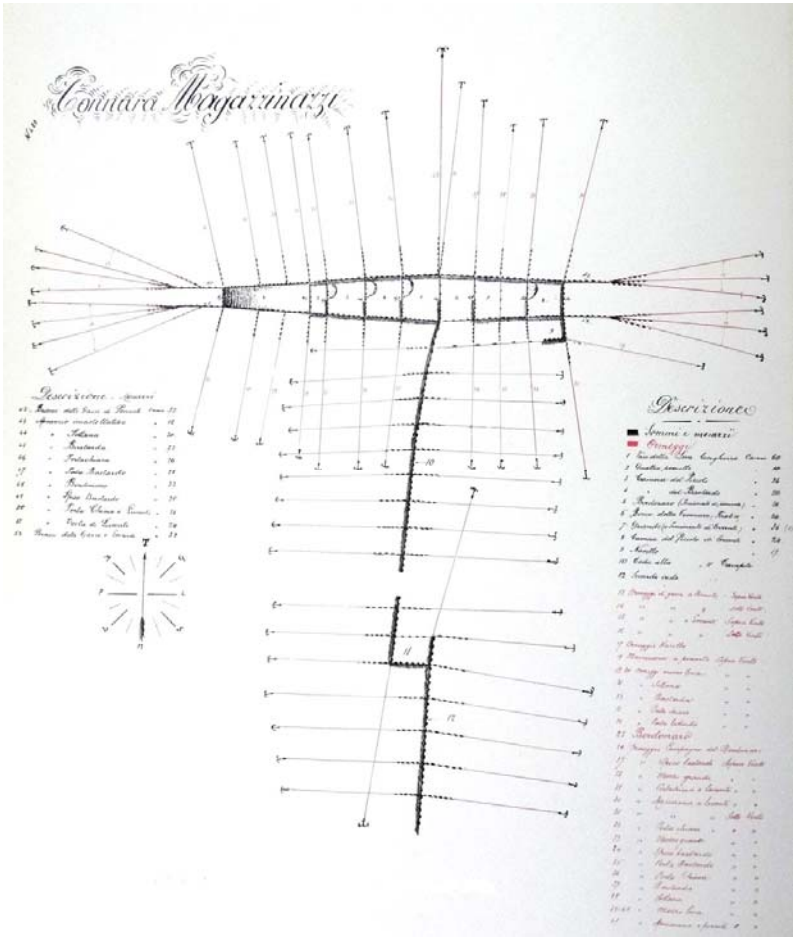

Figure 28. The structure of the large tuna set trap of Magazzinazzi (Sicily, Italy) in 1800, with all techinical details (design by V. Barrabino).

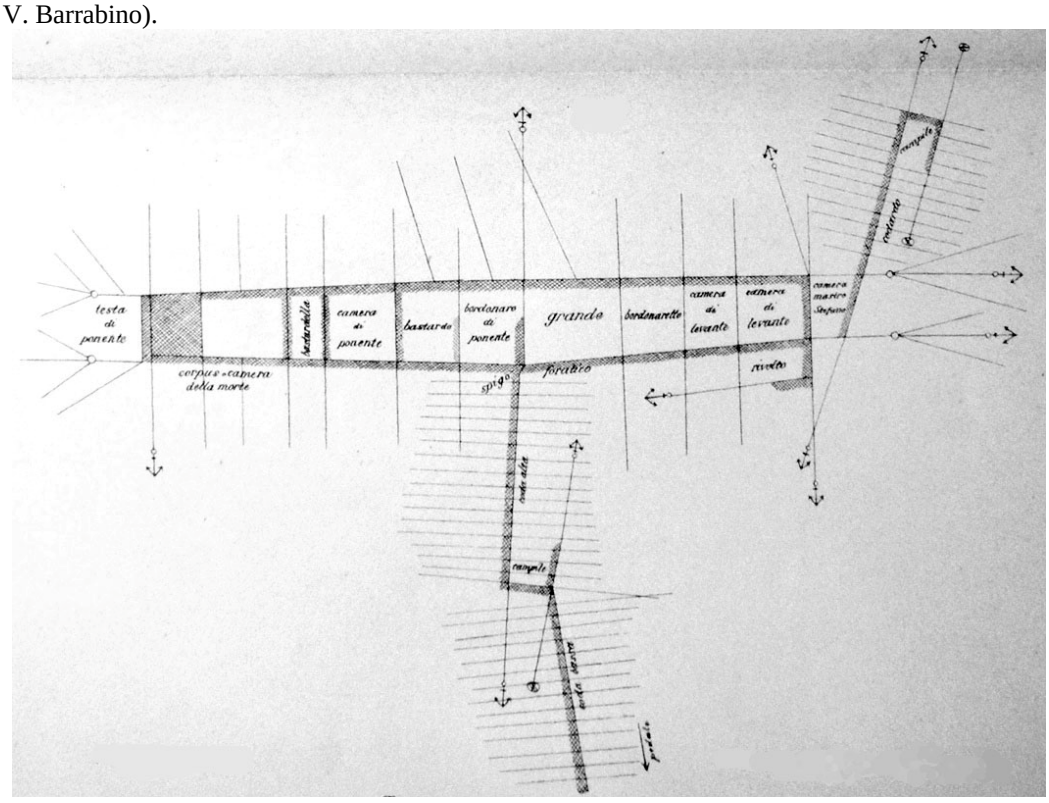

Figure 29. Plan of the big set trap of Bonagia (Trapani, W. Sicily) at the end of the XIX century with the various components (Pavesi, 1898).

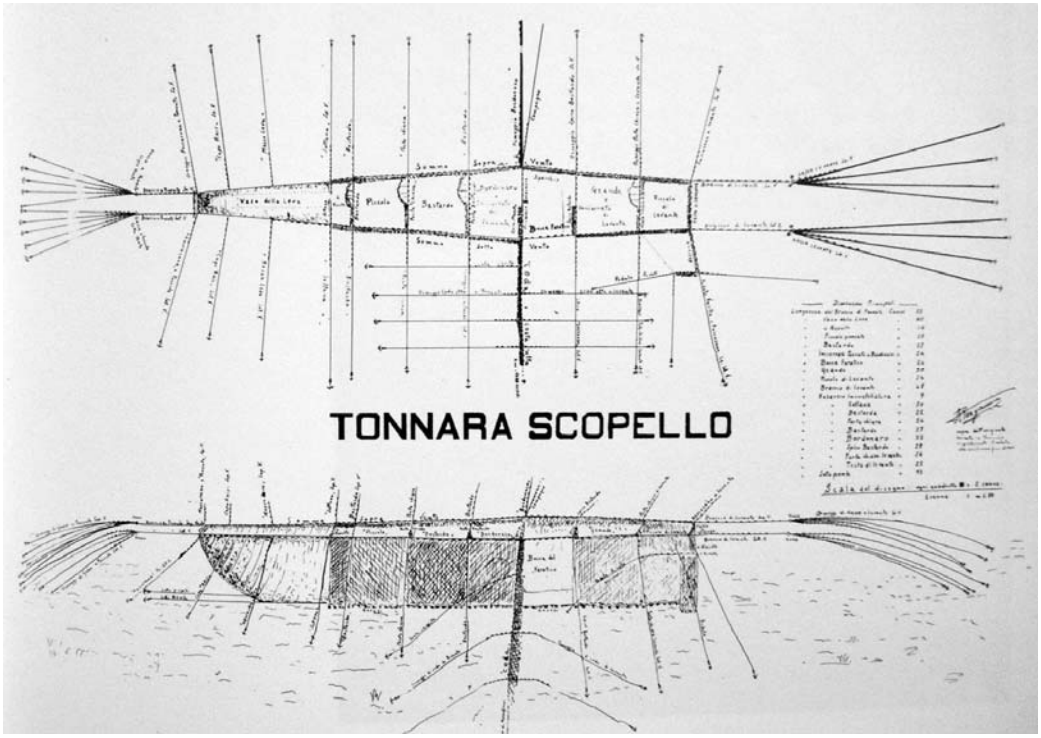

Figure 30. Plan of the tuna set trap of Scopello (W of Palermo, North Sicily) at the end of the XIX century, with a lot of details describing the various components (Sarà, 1983).

Figure 31. Technical details of the tuna trap of Sant'Elia (Palermo, North Sicily) in 1896, with a very detailed description of the various components and their technical details (Sarà, 1983).

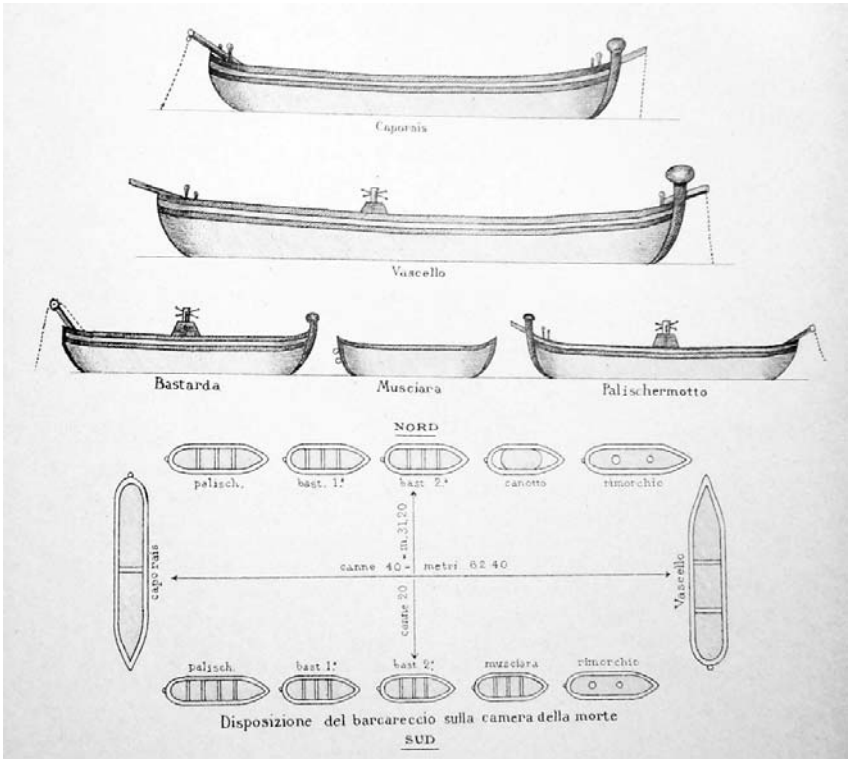

Figure 32. Details and names of the various vessels used in Italian tuna traps, with their distribution for the slaughter in the death chamber of the trap ("mattanza") (Parona, 1919) Technical details of the tuna trap of Sant'Elia (Palermo, North Sicily) in 1896, with a very detailed description of the various components and their technical details (Sarà, 1983).

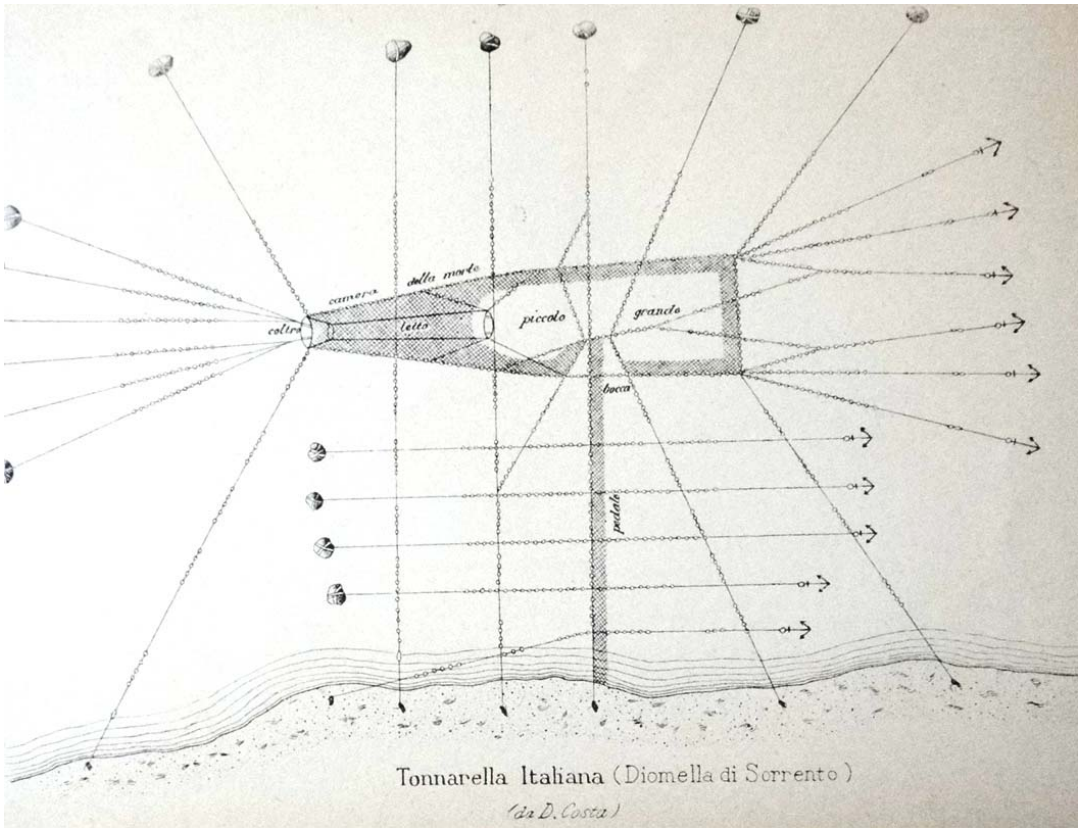

Figure 33. Plan of the small set trap of Sorrento (southern Tyrrhenian Sea) at the end of the XIX century (Pavesi, 1898, after a drawing by D. Costa).

Figure 34. "*Ex voto*" made by the tuna fishermen Francesco Manca in 1818, for acknowledging his lucky rescue after an accident occurred in the tuna trap of Formica (Egadi Isles, W. Sicily), hold in Pitre`s Museum in Palermo (Sarà, 1998).

Figure 35. Image of a tuna trap in the Egadi Isles, showing the transport of a tuna. Etching by M. Reinhardt (1852).

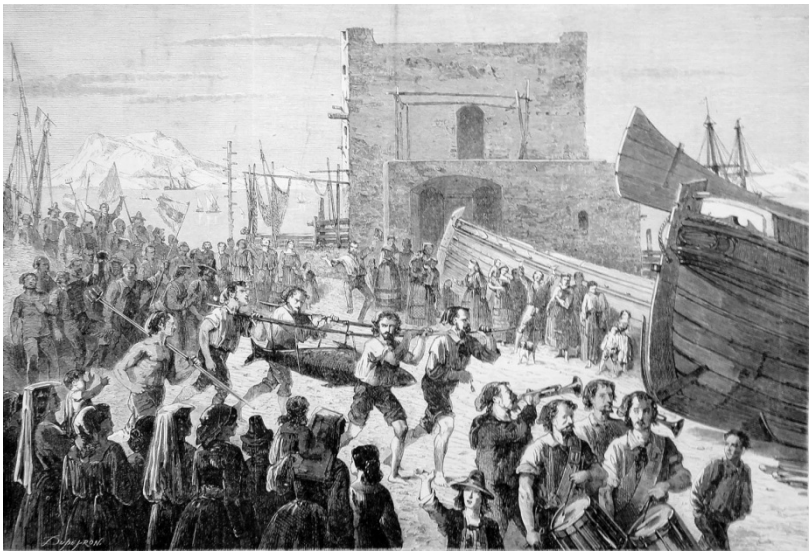

Figure 36. Image of the first bluefin tuna caught at the beginning of the fishing season (May) in Palermo and carried around the area close to the harbour in a procession (etching by M. Durand-Broger, Le Monde Illustrée, 1861).

Figure 37. Three popular images of the slaughtery (“mattanza”) in Sicilian tuna traps published on various magazines in the second half of the XIX century.

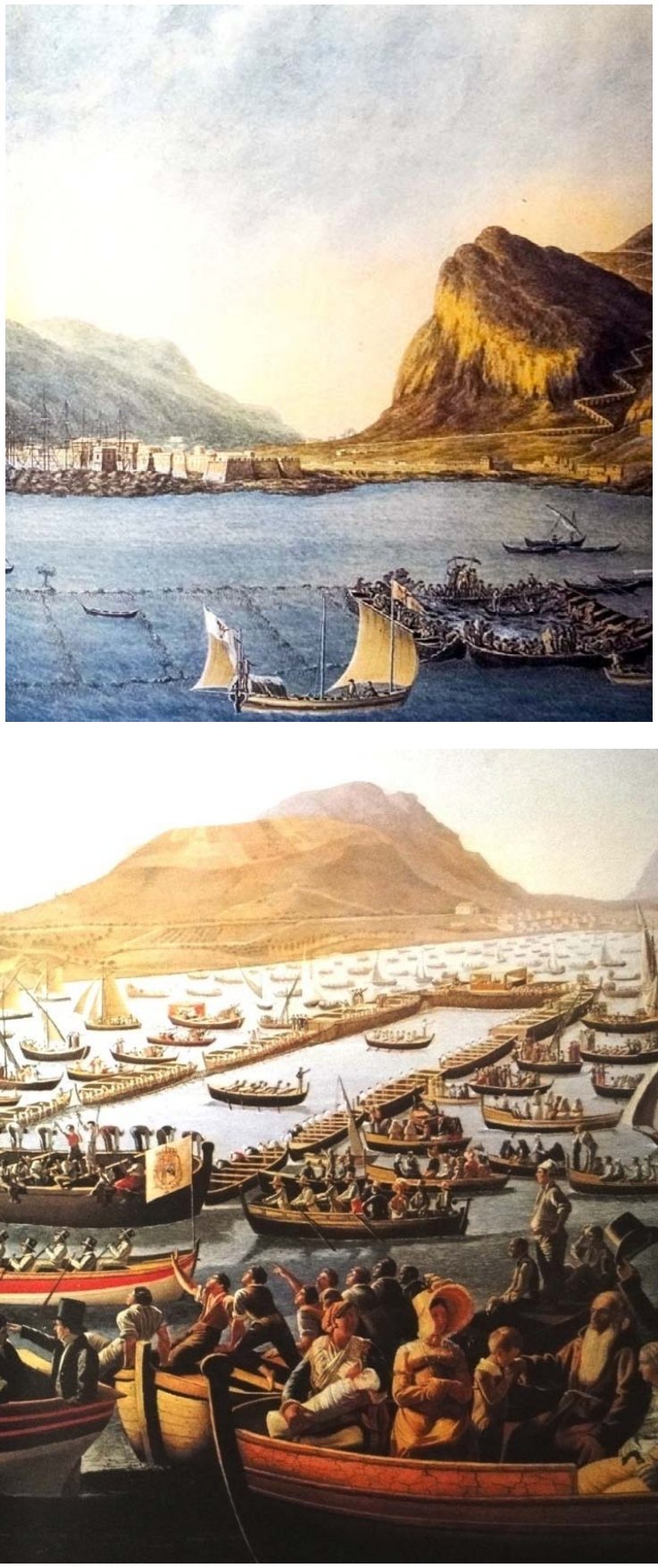

Figure 38. Two details of some paintings made by the artist Paolo de Albertis about the tuna trap fishery in the Gulf of Palermo (North Sicily) in the first part of the XIX century. The lower image shows the participation of King Ferdinand IV of Borbon in the fishery in the tuna trap of Solanto.

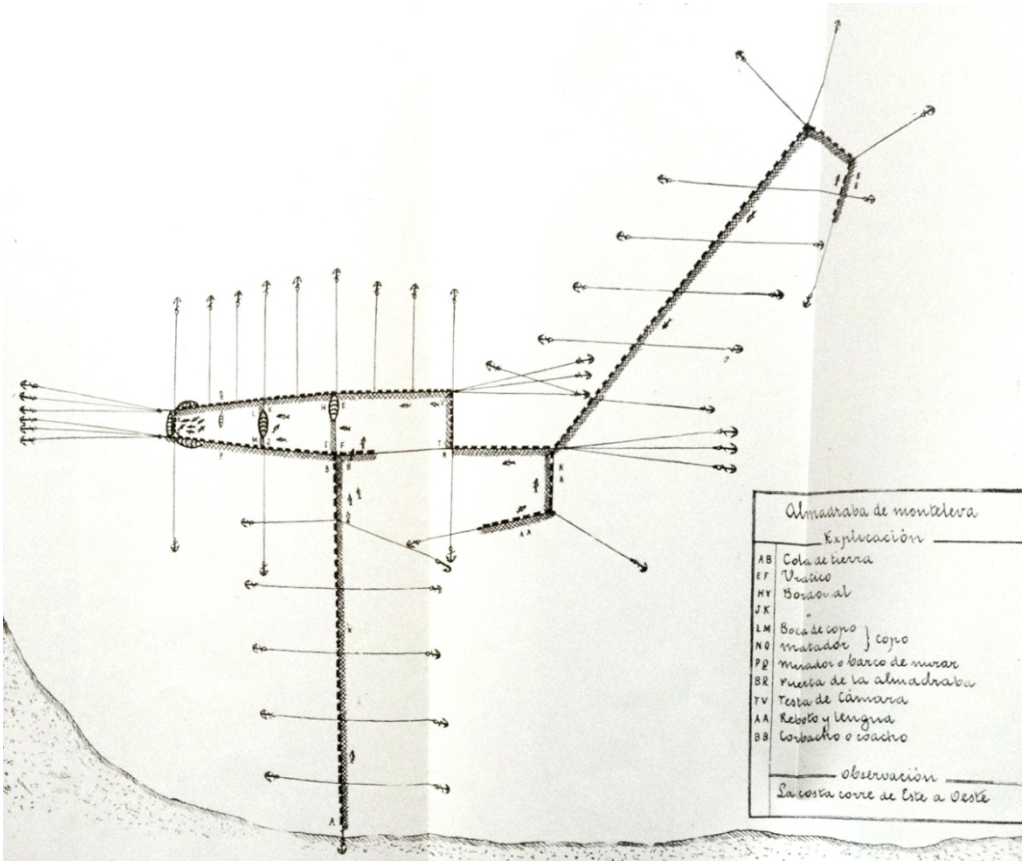

Figure 39. Plan and details of a bluefin tuna trap (type “Almadraba de monteleva”) used along the Spanish coast in the XIX and XX century (Rodriguez Santamaria, 1923).

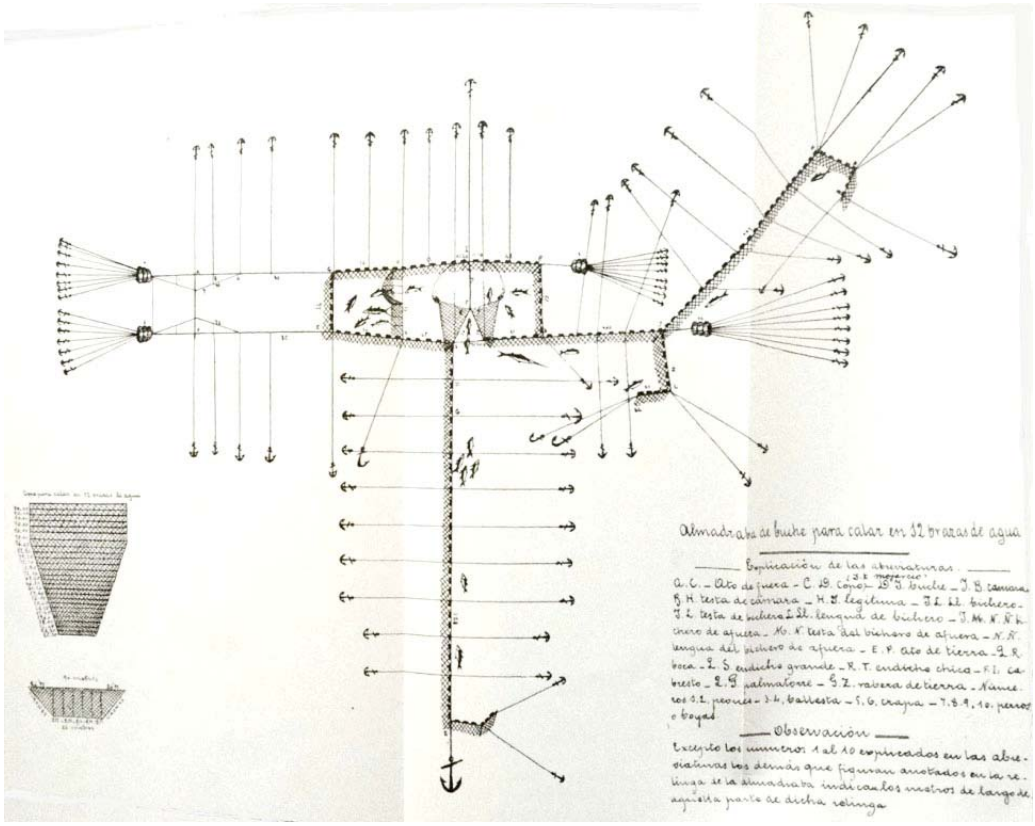

Figure 40. Plan and details of a bluefin tuna trap (type “almadraba de buche”) used along the Spanish coast in the XIX and XX century (Rodriguez Santamaria, 1923).

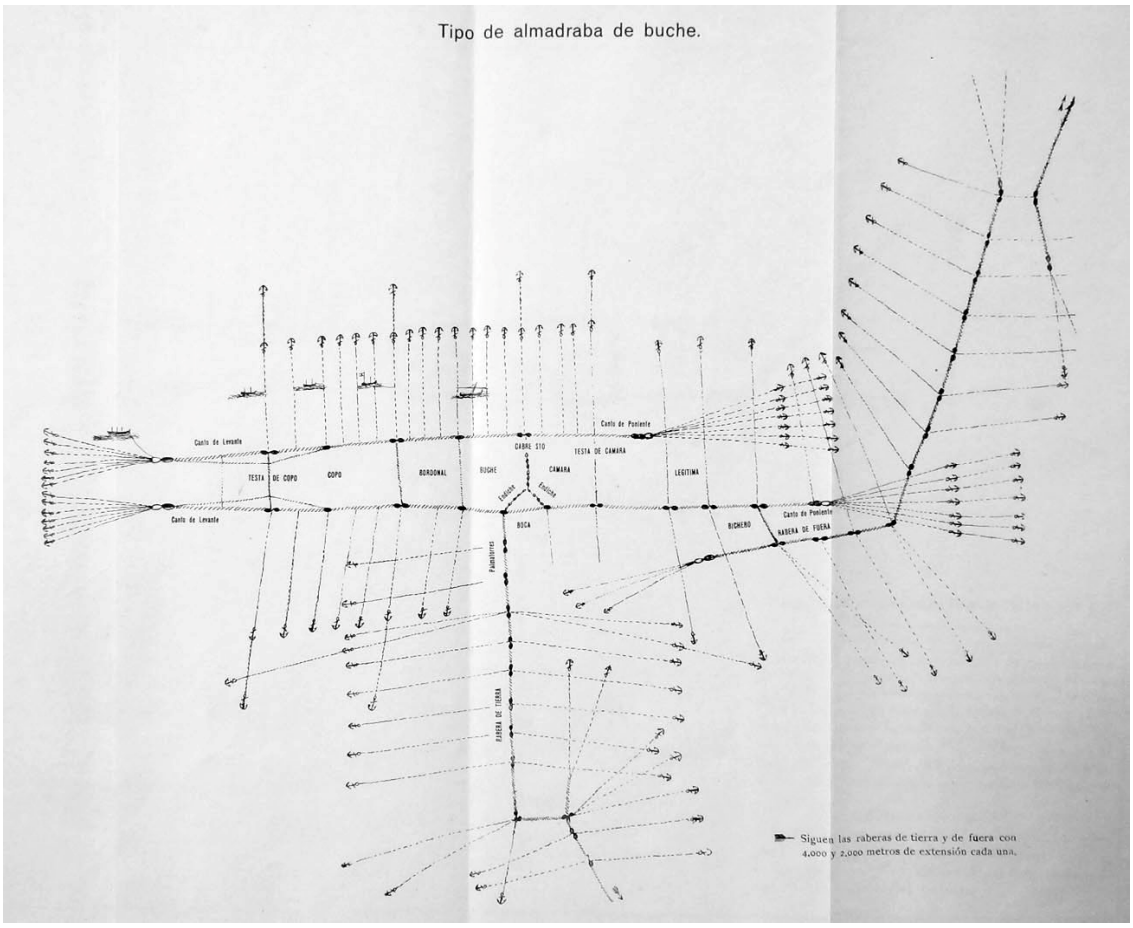

Figure 41. Plan and details of another bluefin tuna trap (type “almadraba de buche”) used along the Spanish coast in the XX century (Rodriguez Santamaria, 1923).

Figure 42. The slaughtery (“matanza”) of bluefin tuna, as illustrated by Buffon (1834); this image is from the Spanish edition, but it was the same as that in the original French edition.

Figure 43. The tuna fishery at the trap of Sausset (South France). Sketch by Ch. Roux, engraved by Fuchon (L'Univers Illustré, June 21, 1865).

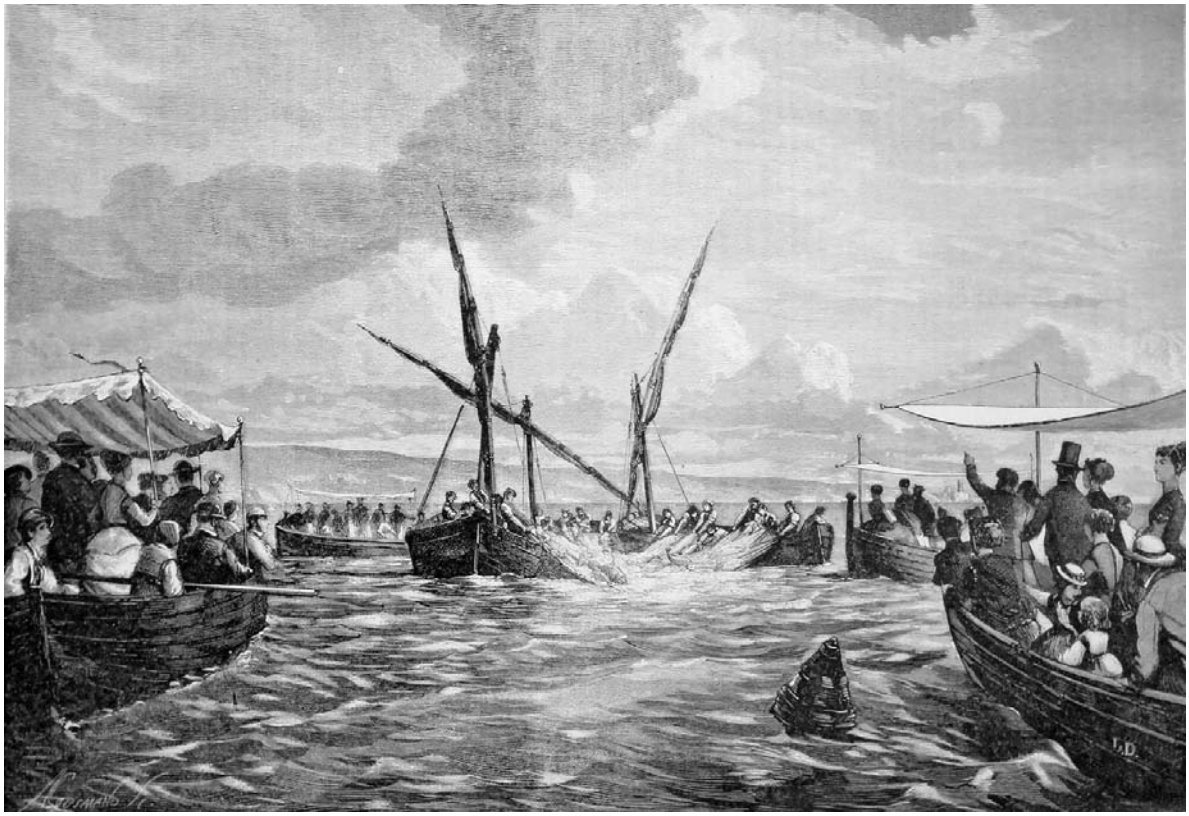

Figure 44. The tuna fishery in the French Mediterranean. Sketch by N. Cosmand (La Chasse Illustrée, XIX century).

Figure 45. The tuna harvesting in a tuna trap in the French Mediterranean (L'Illustration, July 10, 1897).

Figure 46. Tuna harvesting in a tuna seine trap in the Bay of Marseille, painted by Feliz Zeim around 1880 (Collection Fondation Regards de Provence).

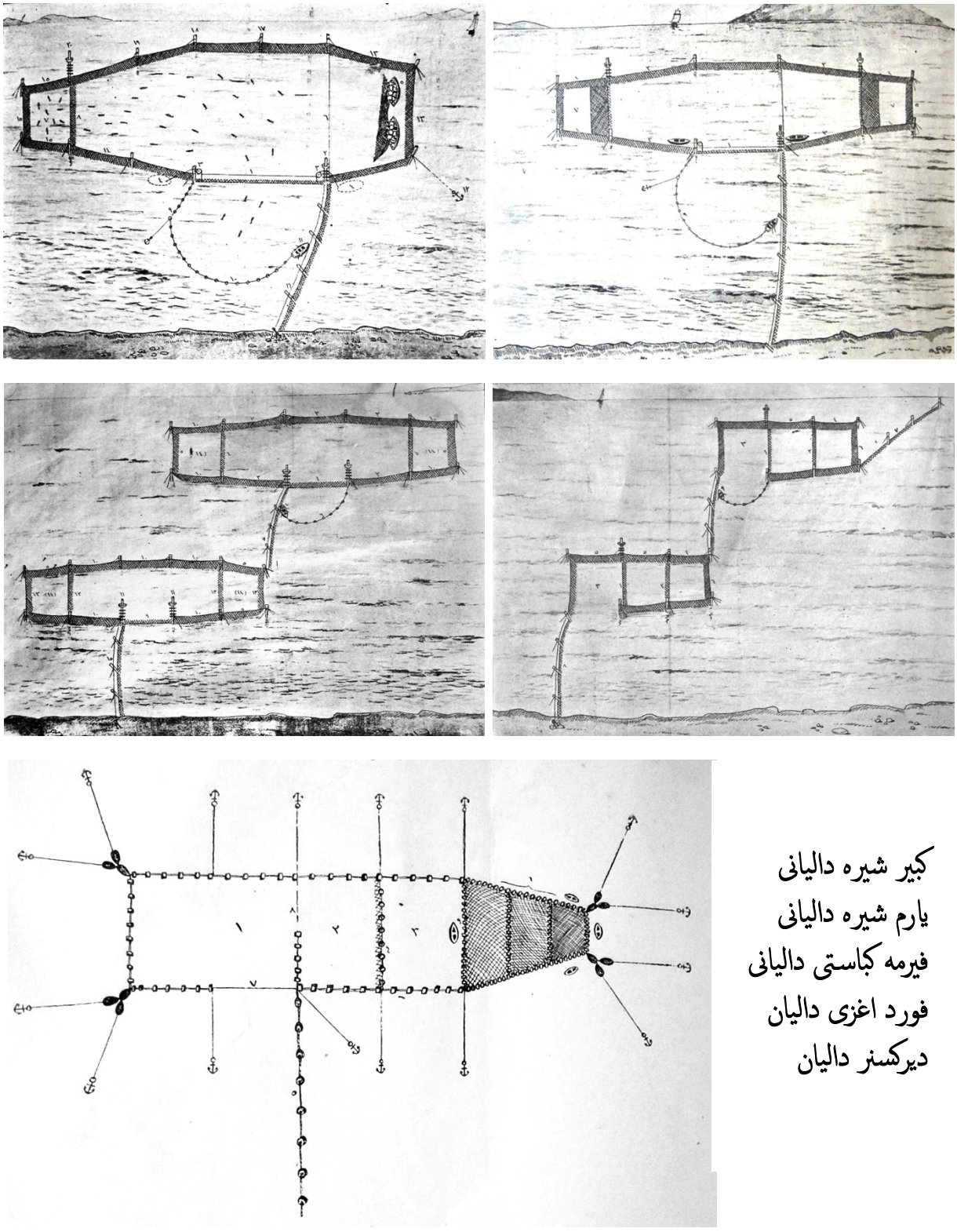

Figure 47. Five different types of tuna set traps used in the Ottoman Empire between the end of the XIX century and the beginning of the XX century, mostly in area of the Marmara Sea and the Strait of Boshorous. The names on the bottom right are the transcription in modern Arabic language of the original names in Ottoman (the order of the names is related to the figures from the top left to the lower one) (Deveriyan, 1915, 1926).

Figure 48. Images of Turkish paintings showing bluefin tuna fishery in Turkish area, made by unknown artists. The paintings are made in tempera colours, possibly done between the last part of the XIX century and the first part of XX century, on older pages, both possibly coming from a Holy books. The image on the left shows a fisherman harpooning the tunas. Due to the artistic component of these images, it is not sure if they are related to tuna seine fishing, maybe the same type of “traps” used in ancient times, or if they show a normal “set trap fishery”, as suggested by the presence of several vessels around the net in the right image.

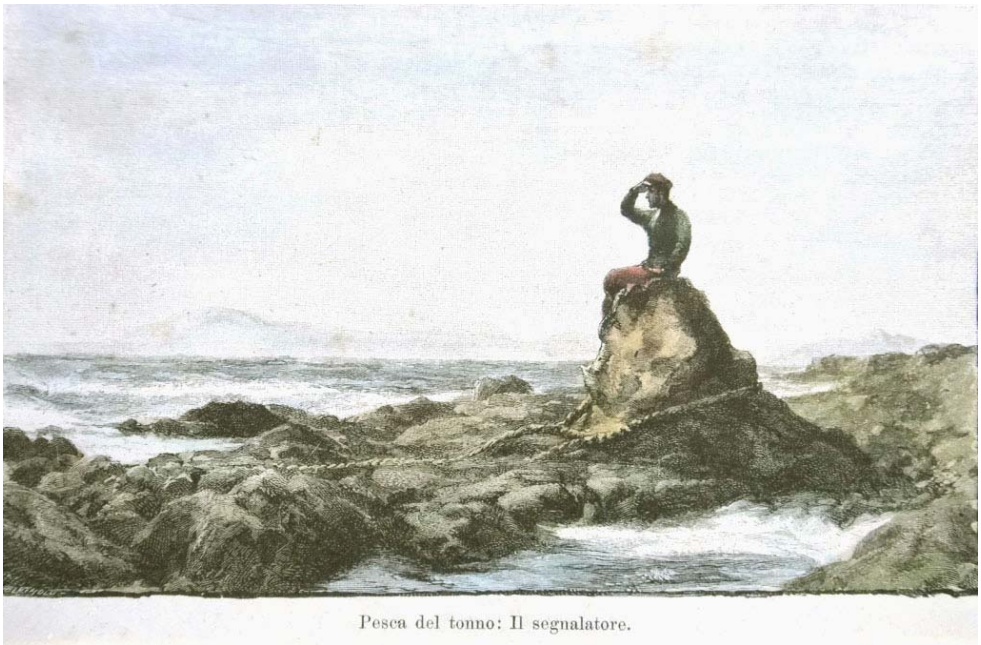

Figure 49. A tuna spotter in a coastal trap along the north-eastern Adriatic Sea (de Loubeau, 1894).

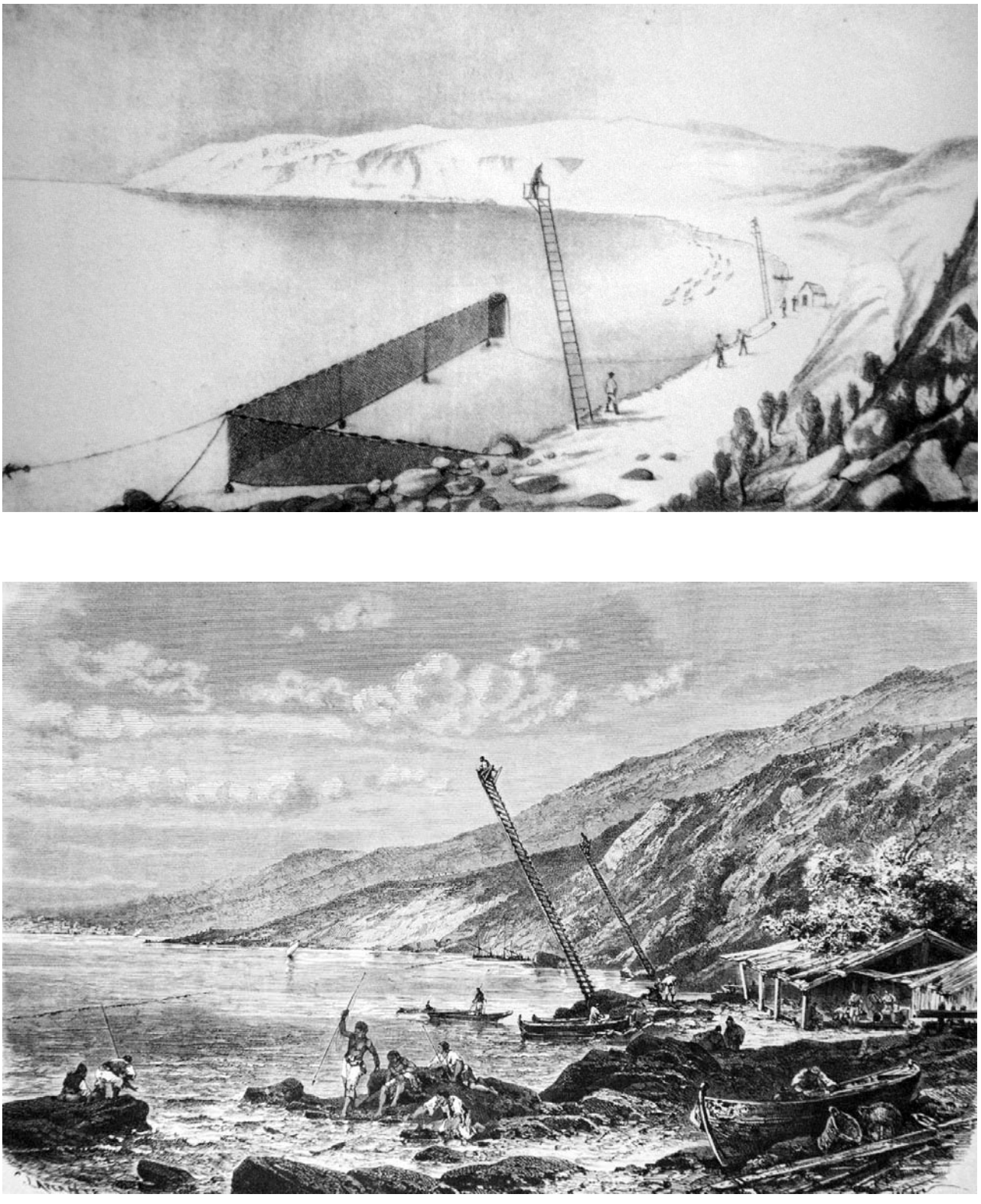

Figure 50. The coastal tuna trap fishery as it was carried out along the north-eastern Adriatic Sea between the second part of the XIX century and the first part of the XX century (Krisch, 1900). Tunas were spotted from the top of a long ladder or poles and the trap was partly set and partly mobile and operated by small boats.

Figure 51. Patchwork of various photographic images of tuna trap activities in the Mediterranean Sea in the XIX century and in the first part of the XX century, from Spain, Sicily and Sardinia (Rodiguez santamaria, 1923; Consolo, 1987; various magazines and newspapers).

Figure 52. Patchwork of various photographic color images of tuna trap activities and old tuna trap buildings and anchors in Sicily and Sardinia in recent times.