Introducing the fisheries system

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Chapter 1

Roots and tendencies of Italian fisheries

1.1 The multidimensionality of fisheries: a brief introduction

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A fishing area can be considered as a system characterised by interdependence among one or more fish stocks and a number of fishing companies involved in their exploitation. This relationship can vary in complexity, depending on the number of stocks involved, the size of the fleet, the technologies used, etc. A fishing area in which a single homogenous fleet operates, engaged in the exploitation of a monospecific stock, will undoubtedly have less complex features than another area in which fleets of various origins are involved in the exploitation of fish communities, using different fishing systems competing between one another, and in which several target fish populations coexist. Whatever the level of complexity, the management authority's objective is nevertheless to ensure a balanced relationship between the size of fish stocks and fishing activities, in order to ensure the sustainability of fisheries over time. This means ensuring economic success, without compromising the conservation of living resources for future use and respecting the right to life on Earth of other species.

It is therefore a question of addressing the same issue from two different perspectives: on the one hand, according to the traditional interpretative scheme, fish stocks, i.e. the natural capital of the system, and on the other, fishermen and the fishing fleet, defined in terms of labour and capital used in exploitation.

The stock, the size of which is measured as biomass, responds to variable natural dynamics linked to the structure and functions of the ecosystems to which populations belong, as components of plant and animal communities, and to the dynamics modified by fishing activities, which alter the demographic structure of target fish through capture. It is as if very strong upheavals were imposed by a single species, man, on the natural system, which is under the laws of biological evolution (natural evolutionary environment) which has led to species diversity and structured the ecosystem over time. The impact of anthropic activities determines new evolutionary pathways for the exploited species and communities (social evolutionary environment).

It is clear that in this perspective the need arises to integrate the ecological, economic and social dimensions which were traditionally structured on their own criteria and descriptors.

For example, in agriculture and animal husbandry, scholars can contextualise almost every issue within the so-called "social environment", even though they work with natural resources and

ecological dynamics. Human influence on natural dynamics is so strong that even "biological materials" are shaped to a great extent by human activities. All the selective pressures on living systems are oriented towards answering the issues that arise in the social and economic context to improve production both in terms of quantity and quality.
In a perspective aimed at sustaining human population, the planet's carrying capacity is based on the ability to control nature through agriculture and animal husbandry, which provide food for demographic growth. The varieties and breeds on which agriculture and livestock production is based are the product of selective breeding by man or, at least, of captivity, which exerts selective pressure on wild species.
While the timescale for processes in the biological evolutionary environment is measured in million, or even hundred million years, those for the dynamics connected with the social context, i.e. those due to human activities, relate to much shorter timescales, in the order of thousand years for agriculture and decades for fisheries.
Back to the evolution of the "agriculture system" as a "social environment", the timescale for interactions dates back to the origins of land ownership and species domestication. Sheep and goats, as animals, and wheat, peas and olives, as vegetables, are considered to have been "under human control" in the Near East since at least 8,500 BC; pigs, silkworms, rice and millet in China since at least 7,500 BC (Diamond, 1997).
Modern aquaculture has its own peculiar characteristics because it is still substantially based on the evolutionary context and therefore on natural selection. This is not just because it is a recent activity, but also because the diversification of species is based on natural biodiversity, with constant additions of new candidates to the list of cultured species from the wild biodiversity. Aquaculture concerns many animal and plant species; it exploits natural biodiversity to enhance the offer of products on a market that demands a great variety of species and to respond to the need for organisms capable of adapting to the various environmental conditions in which aquaculture activities are carried out. In animal husbandry on land most breeds derive from a few ancestral species, at times extinct; horse breeds, for instance, derive from the wild horse being extinct for long.
Fisheries, aquaculture included, are therefore still essentially linked to the natural evolutionary context and thus to the biodiversity resulting from natural selection and the "residues" of the natural world, in a system definitively affected by human activity.
These considerations, which might appear excessively academic, can be helpful in understanding the close integration between naturalists and economists in the attempt to create a credible approach to forecast the future of fisheries. They are also useful to understand the institutional path taken by fisheries and aquaculture, which are increasingly becoming the focus of environmental policies, yet which should not lose their economic significance.
Fisheries affect natural ecosystems, whereas aquaculture concerns organisms belonging to wild species still living in natural ecosystems, and this broadens the complex discussion regarding the impact of human activities on ecosystems, which is a central issue in future marine strategies. Examining fisheries in the framework of sustainability therefore means to study a human activity in its various aspects, from ecology to culture and economics. It requires knowledge of the dynamics of the natural system from which the resources of economic interest derive. It also requires knowledge of the natural dynamics directed by the pressure of human activities.
Multidimensionality therefore appears as an essential characteristic for dealing with fisheries, given that partial assessments could lead to erroneous diagnoses and prognoses.

Back to capture fisheries, the main theme of this book, it is conceivable that abundance variations observed by the first fishery scientists in the mid-19th century could be attributed mainly to natural fluctuations. Today, however, while fluctuations still remain "the essence of ecosystems" (Margalef, 1960), variations in the abundance of certain populations, with constant trends towards decline, could be the indicator of their risk of collapse. There is no other option then to intervene, for example, to reduce fish mortality. This issues is rather complex and concerns various human behaviour related to economic aspects, such as applying capital and labour to capture activities with variable intensity. All these aspects affect ecological dynamics and require experts in the various fields and an intense exchange of information and collaboration to be correctly understood.
The tendency today, with increasing knowledge of marine communities ecology, is to consider fisheries within ecosystems, with an interaction of the forces of the biological evolutionary context and those of the system modified by intensive human activities (the social environment). The outcome of this interaction requires inter-disciplinary evaluations from both the natural sciences and the social and economic sciences.
Biodiversity conservation does not simply mean to conserve species or the genetic resources underlying diversity: the conservation of related economic, cultural, scientific and recreational values is also an essential requirement for natural conservation to counteract extinction by man. The Convention on biodiversity, with its multiple sequels, was aimed at closing the divide between the needs to conserve the results of the biological evolutionary process and the speed at which they are being changed and/or eroded by the economic and social context.
Due to their interdisciplinary nature, fishery sciences assume an "independent" character, developed to evaluate the impacts of fisheries as a human activity on natural systems. The predator here is man, and its behaviour is studied in the context of anthropological, cultural, economic, social and legal sciences.
Without a system approach, it is impossible to manage fisheries in the perspective of policies aimed at sustainable development. For example, the size of the fleet can be measured as invested capital and is generally variable in relation to the economic gains from the exploitation activity. Obviously, when yields are high, fishermen tend to increase capital investments in that fishing area, whereas the opposite is true when incomes tend to decline or become negative. The production function in fisheries is the relationship between the landings (output) on the one hand and the production factors, capital and labour and the stock (s), on the other (input). This relationship tends to influence the decision making processes of fishing companies. Furthermore, the decisions by the companies may affect natural biodiversity. The scenario of various forces is obviously completed by market laws and by the national and international regulatory system, together with traditional rules applied in local areas. The awareness of the need for a multidimensional approach began with the growing scarcity of resources, which made the economic viability of fishery activities a central issue. Until the years following World War II, the availability of living resources exceeded the fishing fleets capacity and therefore awareness of the need to seek a sustainable management model was rather limited. Fisheries were analysed with a one-dimensional approach, mainly entailing evaluation of the populations size and of the behaviour of target species. Subsequently, while still remaining within natural sciences, biologists saw the need to formalise and communicate their findings and open themselves to collaboration beyond the close circle of natural sciences. Interaction among physicists, mathematicians and biologists opened new ways to deal with fisheries, based on the capacity to integrate different scientific languages. The interaction between the marine biologist Umberto D'Ancona and the

mathematician and physicist Vito Volterra from the 1920s in particular was an important move towards interdisciplinarity.
The example of the collaboration between Volterra and D'Ancona (Gatto, 2009) was a crowning achievement in Italian multidisciplinary research within exact sciences and a case study in the history of method that placed fishery sciences in a significant position as a source of complex issues and a stimulus for the search of original solutions.
D'Ancona, trained in the school of Giovan Battista Grassi at the Institute of Comparative Anatomy in Rome, carried out a survey on the composition of fish landings in the ports of Fiume, Venice and Trieste, analysing series of data from 1905 to 1923 (D'Ancona, 1926). In some sampling stations D'Ancona observed that the presence of cartilaginous fish (sharks and rays), which are predators, had increased during World War I, when the fishing effort was reduced. Reduction in the fishing mortality of predators had increased their numbers and put them in competition with man for the same resources. Through his acquaintance with Volterra, he was able to bring the problem to his attention. This was the stimulus that led the great scholar, at 65 years old, to study the relationships between predators and prey. This process resulted in the development of a famous model published by Volterra in 1926 (Volterra, 1926). This fundamental theoretical contribution is known as the Lotka-Volterra Model; since 1920 the demographer Alfred James Lotka had proposed a mathematical model leading to the same conclusions (Lotka, 1925). Volterra was not aware of this, but the convergence of results shows that it was time to create theoretical and formal bases for the interpretation of complex ecological relationships, thereby opening up a promising path towards modelling which was to be essential for the development of basic and applied sciences in later generations.

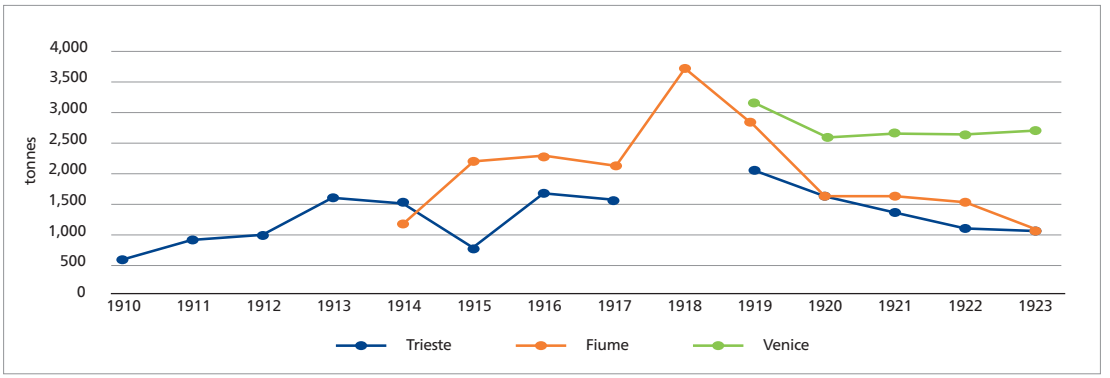

Figure 1.1 - Cartilaginous fish in catches during the pre-, inter- and post-WW I period in 3 main Northern Adriatic ports (Source: D'Ancona, 1926).

After World War II there was a great increase in both demand for fish products and technical innovations, which enabled fleets to expand considerably. As a consequence, there was a continuous and substantial increase in the capacity for exploiting fish resources. A significant trend reversal took place in this period, questioning the implicit axiom according to which fish resources would always exceed human capacity for capture. It was no coincidence that the first theoretical works on fishery economics were published in this period (Gordon, 1954; Schaefer, 1954), thereby adding a further analytical and interpretive dimension to the initial scheme. These contributions allowed the complex relationships between biological dynamics to be linked to the production and market aspects that characterise fisheries and determine its overexploitation.

From this moment on, despite inevitable difficulties, the analysis of fisheries acquired a clearly multidimensional approach and interest shifted to bio-economic aspects. The development of important bio-economic modelling is one of the most significant results associated with the new approach.
However the results of scientific contributions based on the new approach were only seldom incorporated into management measures. The various management authorities often preferred to pursue their objectives by means of "command and control", mainly through the introduction of technical measures. These measures in the non-Mediterranean European context, the reference area for EC regulations, were associated with limitations in outputs, particularly through the introduction of total allowable catches (TACs), based on biomass estimates for certain stocks. In this area, a one-dimensional biological approach still remained the only reference management system for long. Unlike Northern European areas, in the Mediterranean Sea the pronounced stock multi-specificity and the variety of fishing gear competing to catch the same species gave rise to management systems based on regulation of the fishing effort. This is a great difference among the two systems. Fishing effort – one of the main variables used to define the production function of fishing companies – is the product of two different components: fishing activity and capacity. Although the level of fishing effort is a decisive variable to achieve biological sustainability, fishing activity and capacity are also subject to economic evaluations, which are fundamental in the decision-making process of fishing companies.
Thus the Mediterranean situation has significant differences if compared to the Northern European management systems, particularly as far as the integration of biological and economic aspects is concerned. In this region, Italian fisheries management is no exception. Since the 1980s it has been based on fishing effort regulation measures defined through the synergetic contribution of biological and economic sciences. Unlike other areas of the European Union, in Italy close integration between the two aspects was developed. Results proved decisive for implementing the new fishery strategies and policies introduced since the beginning of the third millennium. The experience gained during the 1990s allowed Italy to play a positive role in the implementation of the so-called "Data Collection Regulation" (Regulation (EC) 1543/2000). The development of increasingly refined management systems has required access to information systems capable of supporting the new policies. This represents an important new development among the instruments provided by EC policies, both in financial terms and in regard to the scientific personnel mobilised to acquire the necessary biological and economic information. Basically, through the "Data Collection Regulation" Europe was given a compatible information structure in which details could be compared at a continental level. Thanks to the close integration of biological, economic and statistical components, Italy was able to provide an acceptable level of compliance with EU regulatory requirements.
The outcome was no different when the European Commission approved a new regulation on data collection in 2008 (Regulation (EC) 199/2008) to increase the quality and quantity of requested information and processing. Further information needs that had arisen in the meantime determined a marked increase in the information management spectrum, in particular to make it compatible with bio-economic modelling needs. Other aspects were also integrated with the initial scheme and here too Italy was able to provide a response to the new requirements, thanks to the increased level of coordination and collaboration between the various scientific disciplines applied to fisheries.
In recent years, however, EC regulatory innovations continued to affirm a new information model

and created a very strong impulse towards more advanced management models, particularly following the failures associated with previous choices. Much stricter conservation measures were introduced with Regulation (EC) 2371/2002 and the first recovery and management plans were launched. Other regulations introduced obligations relating to management plans, such as, for example, the "Mediterranean Regulation" (Regulation (EC) 1967/2006) and the Regulation on the European Fisheries Fund (EFF) (Regulation (EC) 1198/2006). As described in details in another chapter of the book, the preparation of management plans for various levels and objectives reaffirmed the need for a multidimensional scientific structure capable of providing adequate responses to the complexity of the issues, which have grown in the meantime and to which the new EU legislation seeks to provide an answer. More sophisticated mathematical, statistical and information management tools are integrated into the fishery system. This process requires the establishment of new scientific aggregations in order to guarantee an adequate capacity to respond to the new challenges related to environmental, economic and social sustainability. Management systems centred on the introduction of technical measures and TACs necessarily lead to the use of one-dimensional tools. It is not surprising that most resource management plans prepared for the Northern European areas are aimed at the formulation of rules for catches control (harvest control rule, HCR). The Mediterranean management system, on the contrary, requires the adoption of highly multidimensional instruments capable of providing answers for the conservation and recovery of living resources, but also to economic and social issues within a single management scheme.

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1.2 The history of fisheries in the Mediterranean Sea

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The study of fishery activities in the first centuries of modern era enables to reconstruct a specific history of the Mediterranean Sea, in which the 16th century was a transition time from old to new fishing methods. The sources examined provide a fairly complete picture of the world of marine fisheries, in which, together with fishing methods practised *ab immemorabili*, new techniques were being tested. These new techniques were to have a significant effect on fish production, which was still almost exclusively based on the exploitation of ponds, coastal lagoons and marshes. The continuity of the fishing systems that were used in the ancient world is particularly evident, above all in coastal settlements that developed near coastal lagoons and ponds where, due to the presence of salt water and suitable biological conditions for fish reproduction, highly ingenious devices had been developed and perfected to catch various species of fish, and continued to be used.

Coastal lagoons created a symbiotic relationship between fish and salt that proved very important for fish production and trade since salting was also one of the most reliable ancient preservation methods. The description of these habitats, which were genuine fish reserves distributed along the coasts of the Mediterranean Sea, is vividly presented in the documentation we possess, which indicates the main fishing areas, the natural sites best suited to provide shelter for the various species or the right conditions for biological replenishment and the growth of juveniles, as well as the fish production centres and trade flows for preserved fish. The fish reserves along the Mediterranean coastline are always referred to as “fishponds”, which should not be confused with the artificial fishponds connected with farms, which are documented in medieval and modern agronomical treatises. “Marine” fishponds are actually natural refuges shaped by the geomorphology of the Mediterranean coastline, such as those that can be seen, for example, along the coast of Istria.

Here – according to a ministerial report from 1929 – the name “fishponds” refers to “the bays, sea coves and calmer gulf and channel areas where, due to favourable conditions in terms of food and shelter, certain quantities of adult fish are known to congregate, uniting in a compact mass during the breeding period to defend themselves from pursuing predators and thereby ensure the propagation of the species”. The activity of fishermen is therefore concentrated in this environment at least until the 17th century, using tools that had been developed in antiquity (set lines, troll lines, *brancaruole*) to which fishing with hooks (long lines) further offshore was added. To these methods the use of the dragnet or seine net, i.e. trawl fishing, was added, still in use until recent times, for example in the Dalmatian islands, as well as in lagoon waters and along sandy coastlines.

In terms of fishery practices, up to the 16th century the Mediterranean Sea has all the characteristics of an ancient sea in which trading activities in *schienali*, *morone* and *caviari*, i.e. processed products derived from sturgeon fishing, are still active, although in a period of decline, being transported via Constantinople from the Black Sea to the Gulf of Venice. Several references describe to the preservation systems used in Dalmatia, particularly for oily fish, and to the production and trade of salted fish from Dalmatia and Brulle (the Nile Delta), as well as to significant imports of herrings,

cod and stockfish from Northern European seas, mainly to feed the masses. From Mediterranean Spain to the marshy areas of Provence, and from the coral fishing grounds of Sardinia to the *Mar Piccolo* and *Mar Grande* of Taranto and Gargano, the Comacchio valleys and the Venetian lagoon, despite the new experimental trials that were carried out more or less everywhere, the traditional fishing techniques mentioned above remained predominant, together with night fishing with lamps (*lampadare*), already mentioned in the classic treatises (Oppian of Cilicia), practised both from boats and fixed positions (piers and *trabucchi*, also known as "*lucerne"*, i.e. lanterns, in some regions).

Coastal lagoons, valli and coastal ponds provided a wealth of experience, beginning with knowledge of the environment and observation of the behaviour of the fish species and their seasonal migrations. This was initially of use for subsistence fishing, but later, in specific historical moments, they became a sort of workshop for innovative technologies that gradually permitted the conquest of the open sea. The fishermen of the Catalonian and Provençal valleys, and those of the Venetian lagoons and the Ionian islands and archipelago (Aegean Sea) can be credited with the technical developments and investments in aquaculture, which in the 18th century, aided by favourable circumstances, finally allowed fisheries to be ranked among market economy items worthy of government attention.

Thanks to centuries of trials with certain fishing methods and an age-old transmission of knowledge, a process of transformation and improvement of traditional catching techniques began during the modern era, stimulated by previously unknown external demand, through the initiative of certain groups of fishermen, with the aim of increasing their production capacity by transferring their equipment from coastal waters to the high seas. Essentially there was a change from solitary fisheries, with a few isolated vessels, to more organised practices requiring not just boats and equipment but also experienced men and capital; in short, a well-structured fishing fleet, similar to that of their seafaring colleagues who had been operating in the Atlantic Ocean since medieval times, as the organic result of collective development.

The increase in Mediterranean fishery activities and the development of "new fishing methods" was most probably provoked by the growing demand for fish observed from the second half of the 16th century. Thanks both to the population growth recorded throughout Europe and the increased demand for fish due to the fast days prescribed in the new Church calendar following the Council of Trent (1563), communities already based on "sea economies" tended to become more competitive and transfer their work offshore, adapting equipment already successfully used in *valli* and along the coast to the different weather conditions and wave motion of the open sea with the help of improved technologies and original solutions.

It should, however, be borne in mind that for any invention to be accepted, take root to then spread like a chain reaction to other areas, right favourable conditions and circumstances, such as economic and social changes, are needed. High seas were finally conquered, despite the persistence of a whole series of unresolved difficulties, not least the threat of pirates and corsairs. During these centuries the Mediterranean Sea never provided long periods or extensive areas in which the seas could be sailed without encountering ambushes or snares, even outside times of real conflict.

This is perhaps also why fishery practices, aside from particular exceptions, were carried out almost exclusively along the shores until the end of the 16th century. Coastal waters thus required supervision, with access regulated by municipal statutes in order to avoid situations of overcrowding and depletion of reserves. The limited areas of water in which fishermen could work

obliged the authorities in many coastal locations, such as Noli, Gaeta and Lissa, to make an equal division of operative zones with a system of rotating shifts, allowing nominal use of the various "posts" located in the respective jurisdictions at specific times, assigned according to rankings. Essentially a sort of "competition" developed, also described by Paolo Giovio in his work on Roman fish (1523), which both controlled free fishing, limiting it to the high season, and helped to prevent the development of potential controversies. Conflicts arose among fishermen, however, once the open sea had been conquered (17th-18th century), when more enterprising groups ventured beyond their own geographic areas, invading the territorial spaces of other communities with seasonal sea migrations in pursuit of catches and to reach mid-sea and high sea fishing grounds. There is frequent mention in the history of fisheries of conflicts caused by both to the exploitation of local fish resources with well-tried and established traditional techniques, as well as to the custom of itinerant fisheries involving seasonal migrations of groups of fishermen, driven from one place to another in pursuit of moving shoals of fish and in search of more plentiful fishing grounds.

Fig. 1.2 - Return of the fishing boats, late 19th century (Photo M. Filippini collection).

If, on the one hand, the mobility of the more evolved fishing fleets increased concerns of a protectionist nature, on the other it contributed at times improve supplies to markets in port towns that had no professional fishermen. Awareness of technically superior equipment, different from that normally used, encouraged local fishermen to try alternative fishing strategies by adapting "foreign" practices, which also allowed them to attempt a qualitative leap. Two important moments of change are observed in the history of fisheries in the Mediterranean Sea, due precisely to such contacts. The evolutionary process of two different "fishing methods", which were to characterise the respective historical periods in which they became established, allows the definition of periods in the history of Mediterranean fisheries. Their adoption was not limited to particular geographical areas, but ranged from the western to the eastern sector, causing a rapid and radical upheaval in centuries-old fishing systems, with extremely important implications not only on the level of marine enterprise organisation, but also in terms of production, both for internal consumption within the same state as well as for export.

The introduction of a fishing technique capable of considerably increasing catch volumes also obliged communities based on a production economy to adapt their fleets to the new sailing and fishing equipment in order to keep pace and withstand competition. Research has clearly highlighted the phenomenon, which is seen to be a true "fishing revolution", fuelled by exchanges of experience between maritime communities with the longest fishing traditions and marked by two distinct phases: the first, from the early 17th century, is characterised by the introduction and subsequent establishment of "tartana" fishing (trawl fishing using a single-mast boat with the net extended from two long poles, known as *spontieri*, protruding fore and aft, to which the lines of a large trawl net were fixed); the second, despite opposition from the very start, with prohibitions aimed at the protection of juvenile fish and territorial waters, appeared in the early 18th century, emphatically established itself from the middle of the century, and was based on "pair trawling", a technique that allowed considerable commercial development of the fresh fish trade and remained substantially unchanged until the decline of sail power. The first change, with the appearance of the so-called "*tartana*" technique, of French or Catalan origin, involved the adoption of a particular form of sailing requiring a series of modifications to the hull and the use of a lateen sail, with the support of additional small sails to facilitate the dragging of a net known, as was mentioned, by the term "*tartana*". The Pontifical Adriatic coastline has proven to be an interesting observatory, particularly for focussing on the technique assimilation process. The stages of the change, which was quite rapid, can be traced through the monitoring of certain localities (Ancona and Pesaro).
The arrival of *tartanas* from Provence (Martigues) in the Adriatic Sea, and together with the new fishing method, led to the complete replacement of boats and equipment within five years, and the definitive abandonment of the previous "*a bragoccio*" fishing technique, which had been developed in the Venetian lagoon area (and was to some extent a forerunner of the 18th century "pair trawling"), carried out with two small boats at the short distance from the shore, with far lower yields than with the "*tartana*" system. Fishermen were very adaptable in welcoming and assimilating the innovative idea, proving to be capable of making changes to suit various individual needs.
The first agreements concerning the second, more problematic, fishing revolution centred on large-scale adoption of "pair trawling" are documented in the western Mediterranean Sea (the Gulf of Lyons). The new fishing method then spread along the neighbouring basins until it reached the Gulf of Venice and definitively established in the late 18th century. The spread of "*tartana*" fishing did not create significant problems regarding the invasion of territorial spaces – except in Cetara, where an open conflict is mentioned between the Cetarese fisherman, who practiced the traditional methods used along the coast, and those from the island of Procida, who were already practising "tartana" trawl fishing. The introduction of "pair trawling", however, due to the destructive impact on sea beds attributed to it, provoked initial rejection, both from those engaged in fishing and from the various central and peripheral state authorities, who were forced to issue an entire series of fishing bans. Upon realisation of its profitability, however, they began to issue occasional access permits, confined to sea areas with very deep beds, or even piloted liberalisation, with fleet activities limited to a restricted number. In short, public authorities, while desiring to act in defence of the marine environment and protect the resources under their jurisdiction, became inclined, particularly during times of slump, to grant certain exemptions to ensure the fishermen's association the possibility of survival for themselves and their families through their trade.
The transformation of fisheries brought about by the two fishing revolutions also required investments for the fitting out of new vessels, with different hull and sail designs from the previous

types of craft, for the use of nets that were woven differently, with a different mesh size, for the adoption of hitherto unfamiliar sailing techniques, for the social organisation of the fishing enterprise, with the definition of specific work duties for crewmembers, both on board and on land, for the construction of special buildings, stores or ice houses suitable for keeping fish fresh, and for the creation of an efficient distribution network, with the mediation of a body of forwarders and correspondents engaged in continuous pendular movements between landing ports and the inland towns. The starting point in the fisheries enterprise was naturally the purchase of the means of production, i.e. the operating capital represented by boats and equipment. This obvious fact, however, was often the start of a process that ended up penalising the main player in the production chain, namely the fisherman–ship owner.

The problems that were still evident in 1869 in Chioggia, undisputedly the most representative Adriatic fishing society, can be considered typical of a situation caused by the persistence of age-old habits and generally relevant to other Mediterranean maritime divisions. What is seen in Chioggia is that, "there is no ship or fishery owner that at the same time is not also the skipper of his own wood". After the unification of Italy, the ministerial survey on fishermen provides very interesting data on the working enterprises. One of the first figures to create a credit-based relationship with fishermen was in fact the shipwright, or *protocalafato*. His acceptance of the payment due to him in instalments, which at first glance could appear as easier financial terms for the customer, became over time a straightjacket solution for the fisherman, who was forced to make continuous and almost usurious payments. The cost of a fully equipped boat actually ended up being "more than twice its real value", since "with the necessary repairs" the debt was prolonged almost perpetually. Regarding the initial credit commitment, the possibility of paying off the debt became increasingly remote due to the need for subsequent repair works, and it was made even more burdensome by to the addition of other necessary expenses.

A second figure involved in the product marketing phase was the *parcenevole*, a "trustee" to whom the sale of the catch was entrusted, with a guaranteed "5% commission on the gross sale price", which also significantly reduced the profits. Squeezed in a vice between the *protocalafato* and the *parcenevole*, debt could become chronic over time for the fisherman. The tasks entrusted to the fish vendor made him, to all purposes, the financial administrator of the fishing enterprise, since he was responsible for the calculation of both landed catch quantities and sales, which he conducted in the public fish market "all'orecchio", i.e. through a sort of auction which he held starting from a base price. Most fishermen were therefore in a condition of extreme precariousness, from which the shipwright and the fish vendor in particular gained profit, together with other tradesmen, such as the blacksmith and the rope maker, who were engaged in activities of support to the fishing enterprise. These were basically "four vampires", to express it with the metaphorical succinctness of Domenico Andrea Renier, drafter of the government enquiry. With no government incentives, the fisherman, who was always short of available finances, since numerous forces severely limited the accumulation of savings, had no other option except recourse to loans to continue the work he had begun. Earnings, when made, could only be accumulated gradually, and so, in order to have boats fit for sailing the high seas and the necessary working equipment, fishermen exposed themselves to risk in the attempt to increase their production capacities, accumulating debts not only with shipwrights, but also with caulkers, sail makers, mast makers, rope makers and others tradesmen associated with fisheries.

External financing therefore became essential, and burdensome levels of interest were assumed in order to gain immediate access to it, usually equal to a share, or even fractions of a share, to

be paid periodically with the division of the profits from fish sales. The increase in production and the growth of fisheries during the 19th century did not really help fishermen as a class to emerge from a state of poverty. Due to the observance of ancient "habits and customs", they remained in a situation of subjection to the boat owners, fish sellers and moneylenders, from which it was not easy to escape and for which a solution was only provided much later, in the early 20th century. From the late 16th century, however, despite many social and organisational problems, a transformation began in the fish trade, which over two centuries led to the eclipse of traditional commerce in fish, together with eating habits established in the Middle Ages, with the progressive development of deliveries of the fresh product, even over long distances, to the detriment of preserved fish.

Many topics still need adequate examination and archival research could certainly provide further important information on the phenomenal growth of Mediterranean fish production between the 17th and the 20th centuries and the evolution of fisheries and fresh fish trade, in other words, on those economic micro-functions interwoven into the daily life of sea workers.

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