"A new technology era in the Adriatic Sea – Big data sharing and analytics for a circular sea economy"

D 3.2.2. Guidelines to promote blue careers

Final Version 15/06/2023

Deliverable Number D.3.2.2

Project Acronym	TECHERA
Project ID Number	10417714
Project Title	A new technology era in the Adriatic Sea – Big data sharing and analytics for a circular sea economy
Priority Axis	Blue innovation
Specific objective	1.1 - Enhance the framework conditions for innovation in the relevant sectors of the blue economy within the cooperation area
Work Package Number	3
Work Package Title	Clustering thematic activities
Activity Number	3.2
Activity Title	Guidelines to promote blue careers
Partner in Charge	PP7 and PP4
Partners involved	All Partners

Status	Final
Distribution	Public

„This document reflects the author's views; the Programme authorities are not liable for any use that may be made of the information contained therein. “

CONTENT

1. INTRODUCTION

One of the goals of the TECHERA project is the development and promotion of careers in the Blue sector through the cooperation of scientists, the administration and the sector itself, influencing the attractiveness and attraction of young personnel. Considering that Europe is the number one market in the world, Europe's goal is to achieve long-term self-sustainability in production and processing, so that demand and supply become self-sustainable and less dependent on the import of raw materials. This will contribute to the development of sustainable fisheries, which needs a whole spectrum of experts from different professions who will contribute to the sustainable development of fisheries with new ideas and innovative technologies. **The blue sector analysed here is mainly focused on fisheries and aquaculture sectors, but also consists of shipbuilding and ship repair, offshore oil and gas, cargo and passenger transport.**

The European Commission has identified five high-potential sectors in the Blue Growth strategy and set the goal of strengthening employment and the growth potential of European coasts and seas, namely:

- Ocean energy (renewable: wind, waves, tides, etc.)
- Marine biotechnology (medicines, industrial enzymes, etc.)
- Coastal and maritime tourism (coastal tourism, cruise tourism, yachting)
- Aquaculture (farming of fish, shellfish, marine plants)
- Seabed mining (mineral resources)

The blue sector represents approximately 5.5 million jobs (with related activities), with a turnover of approximately €660 billion. Europe's coasts and seas have the potential to provide growth and job creation in the coming years, and highly qualified and skilled professionals are needed to advance Blue Growth. The above 5 sectors of the Blue Economy have difficulties in finding employees with appropriate skills, and most sectors expect these difficulties to continue. The question arises, why young people are not directed to this essential and promising, fast- growing sector? According to the SUBMON organization, the main reasons affecting the difficulties in finding suitable personnel are:

- the skills gap between educational offers and labour market needs, especially in terms of technological development and innovation.
- lack of communication and cooperation between education and industry.
- lack of attractiveness and awareness of career opportunities in the blue economy, and
- lack of a culture of oceanic literacy.

(Source: SUBMON, Filling the gap: possible needs in terms of blue careers - SUBMON)

On the one hand, a certain, but not sufficient number of high schools have incorporated or are working on incorporating knowledge on the boundaries set by the EU and related to Blue Growth and Development, so it is possible to find a certain marinization of the curriculum, acquisition of skills, concepts and knowledge related to on-site ocean literacy.

The labour market, on the other hand, has a demand for basic competences, experience, field work, accreditations and certificates, sustainability criteria and harmonization of its activities with the goals of sustainable development and the European Maritime Strategy. For these reasons, the European Union has approved directives, strategies, plans, projects and funds for the inclusion of young people in the labour market.

The problem probably arose before the access to this labour market, since the universities did not fill the void of the secondary schools that started with such curricula. A review of the curricula of various universities offering degrees related to biology, environmental sciences, biotechnology, biochemistry, marine sciences, and master's specializations in aquaculture, biodiversity, microbiology, ecology, habitat management and restoration, oceanography, and others showed that in each of them, there is a **lack of specific training aimed at the emerging labor market** that Blue Growth is looking for, moreover, in many of them it is not even explained in which area of the Blue Sector the European Union has its basic direction for development and which it is already guided by. (Source: SUBMON, Filling the gap: possible needs in terms of blue careers - SUBMON).

According to the latest Blue Economy 2022 report, it is expected that the number of employees in the Blue sector could double by 2030. (Source: Blue Economy Report 2022., 2022-blue- economy-report en.pdf (europa.eu)). This means that 11 million employees are expected in this sector, or 5.5 million new jobs that need to be filled. Although the changes are imperceptible in the outflow of labour force, it should be emphasized that they occur within the sectorial disproportion. For example, job demands are growing in coastal tourism, while a large gap has emerged in the oil sector. It should be emphasized that new subsectors have also appeared, which distract the attention of young personnel from the former primary sectors of the Blue Economy, and it is necessary to maintain stability and long-term sustainability.

The purpose and goal of this guide is to use the available sources and data collected through workshops, study visits and analyses of fresh reports, to create direction and recommendations that will be used for the promotion and popularization of Blue Careers among young people who are just joining or are already involved in the labour market.

2. ANALYSIS OF THE STATE OF THE BLUE SECTOR

The blue sector includes a number of branches that include **resources of living organisms in the sea (fishes and other sea organisms), marine non-living resources (gas, oil, ores), renewable energy of the sea and marine conditions (wind, tides, waves), port activities, shipbuilding and ship repairs, maritime transport and coastal tourism.**

The perspective of this sector is great, because the synergy of unled activities enables a sustainable economy that Europe is constantly working on.

Seafood plays a key role in the diet of a growing world population that recently reached 8 billion. Since increasing the amount of fishery products derived from the catch is almost impossible, aquaculture remains the only branch that can provide enough fishery products for a continuously growing human population. For these reasons, the preservation of fish resources and healthy fish populations make seas and oceans healthy, so the resilience of marine ecosystems and coastal communities depends on the creation of sustainable fisheries. Fishery refers to an enterprise for growing or catching fish and other aquatic life, as well as the place where such an enterprise is set up. Commercial fishing includes both wild fishing and fish farming and/or other water organisms, of which approximately 90% is in the oceans and seas, and 10% is in freshwater waters. Fishing as a branch includes:

- Fishing (catching wild species)
- Aquaculture (breeding of aquatic species)
- Processing and marketing

Fishing, as authorized hunting, and collection of fish and/or other aquatic organisms is divided into:

- Economic sea fishery ,
- Small scale coastal fishery.
- Sports,
- Recreational,
- Fishing for scientific and scientific-teaching purposes,
- Fishing for the needs of aquariums open to the public, and
- Fishing tourism

Commercial fishing at sea is carried out by the holder of the privilege for commercial fishing (legal or natural person - tradesman) who is authorized to carry out fishing in accordance with the rights from the privilege. Small-scale coastal fishing is carried out by the holder of the privilege for small-scale coastal fishing (natural person) who is authorized to carry out fishing in accordance with the rights from the privilege for small-scale coastal fishing. The number of privileges for small-scale coastal fishing is limited to 3,500 authorized persons in a calendar year, and the right to carry out this category of fishing is non-transferable.

(Source: Law on Sea Fisheries, Zakon o morskom ribarstvu - Zakon.hr)

Aquaculture is the part of fisheries that deals with the cultivation of aquatic organisms, including fish, molluscs, crustaceans and seaweed. The breeding process implies a certain form of intervention (eg. artificial spawning, supplementary feeding, protection from predators) with the

aim of improving production. World fisheries are just reaching the peak of aquaculture development. Due to the increasing need for nutrients from marine and freshwater organisms, and the limited wild sources of them, aquaculture is one of the fastest growing activities in food production in the last few years, with an average annual growth rate of 6-8% per year. (Source: Blue Smart, Akvakultura | Blue Smart).

"Aquaculture" means the breeding or cultivation of aquatic organisms using techniques designed to increase the production of said organisms beyond the natural capacity of the environment, where the organisms remain owned by a natural or legal person during the rearing and production phase, up to and including the harvesting phase.

(Source: Aquaculture Act (NN 130/2017, 11/2018 and 144/2020)

Europe has become the world's leading market in terms of the value of consumption of fishery and aquaculture products, and this market is continuously growing - adding new types of products and new products every day, driven by increased consumption per capita, which is the main result of the **processing and marketing of fish products**.

This trend opens up a large number of opportunities for European manufacturers, provided they can meet the expectations of today's consumers. Innovation is a key aspect of activities related to the process of adding value as a permanent process required due to socio-cultural and economic changes in European society that are reflected in the needs and consumer behaviour, which is changing at an increasing speed. For this reason, the lifespan of a product is limited and manufacturers must always anticipate the decline in demand for their traditional products by improving and offering innovation. (Source: FARNET, European Commission, FARNET_HR_3.pdf (euribarstvo.hr)).

2.1. EUROPE

Europe is certainly the largest market for fish products on a global level, and the largest consumers are Portugal and Spain, while it ranks 6th in terms of production and landings (including the United Kingdom). According to the latest EUMOFA and FAO report, Europe reached a value of exports and imports of €26.6 billion in 2018. Fish is mainly caught in the distant seas of third countries, and the removal of only 43% compared to EU needs is a relatively low percentage, while the difference is compensated by imports, the abolition of import duties or the reduction of a certain number of fish products up to a certain annual amount of imports. Products can also be imported at zero or reduced duty rates, from countries with which the EU has a free trade agreement in force or from developing countries that can export to the EU under the GSP - Generalized System of Preferences.

The already mentioned EU plays a big role in fishing, but also in the import of fish products, it is the world's largest consumer of fish raw materials and products. This chapter will analyse: consumption, production and procurement of raw materials according to the available source: Marketing of and trade in fishery and aquaculture products in the EU (europa.eu).

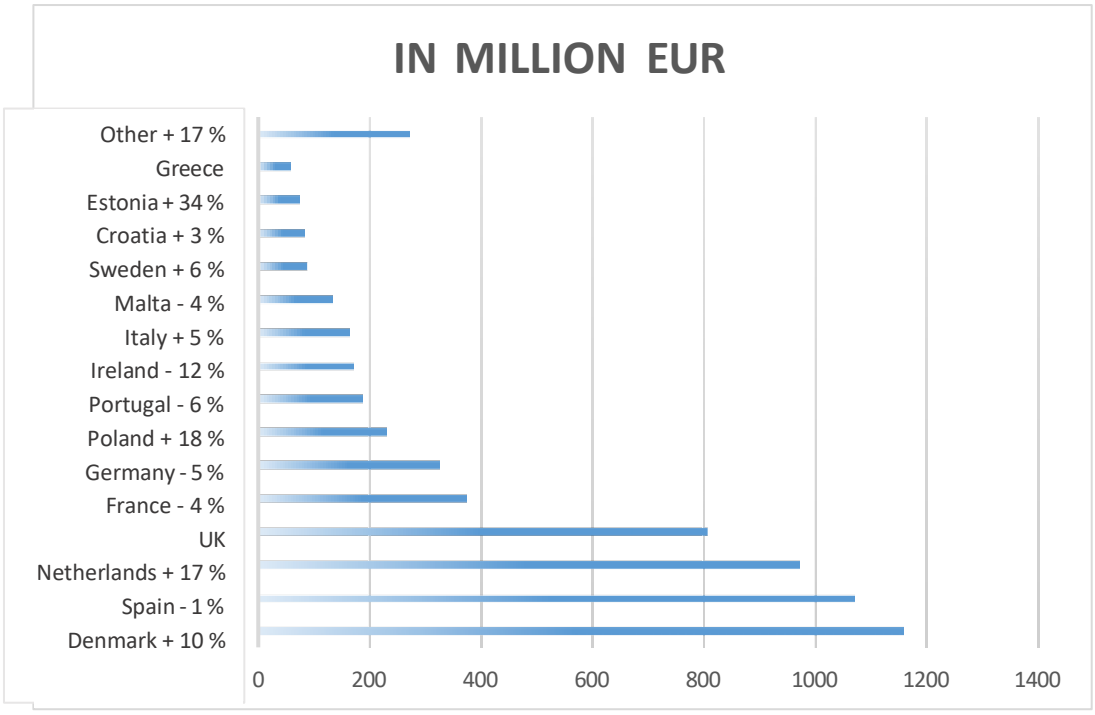
According to the data, it is evident that the EU is far from being self-sufficient in fishery and aquaculture products, which makes the EU highly dependent on imports. The EUMOFA 2019 report contains data on trade between member states and with third countries. However, the aggregated data for the EU in this report refers to the EU-28, which includes the United Kingdom. The trade deficit outside the EU in fishery and aquaculture products (the total value of EU-28 exports minus the total value of EU-28 imports) have been growing since 2013, and in 2018 it amounted to EUR 20.8 billion.

Data obtained from Eurostat's reference database on international trade in goods (Comext - Focus on Comext - International trade in goods - Eurostat (europa.eu)) allow a better understanding of trade flows outside and inside the EU. In a scenario using 2018 data but taking into account the UK as a third country, the trade deficit for the EU-27 is €18.9 billion − total imports of €25.9 billion minus total exports of €7.0 billion.

The Euro has (2018) strengthened against four currencies important to fish and seafood operators - the US Dollar (USD), the Icelandic Krona (ISK), the British Pound (GBP) and the Norwegian Krone (NOK). However, in 2019, the picture was mixed. The € weakened by 5% against the USD and 1% against the GBP. On the other hand, it strengthened by 3% and 5% compared to NOK and ISK. In the first three quarters of 2020, the € strengthened by a significant 10% against NOK and 11% against ISK, while its exchange rate with GBP and USD remained unchanged. The consumer price index for fish and seafood in the EU28 showed a slight upward trend in 2019. In the first half of 2020, it increased by 1.5% compared to the same period in 2019. This also meant a higher growth rate, with consumer prices of fish and seafood increasing by 0.9% in the first half of 2019. In 2019, the spot prices of crude oil, which is the main driver of marine fuel prices, remained stable, as did marine fuel prices in the EU. In 2020, the drop in crude oil prices, heavily influenced by the COVID-19 pandemic, resulted in lower fuel costs for the fishing fleet. In the first three quarters of 2020, the spot price of marine fuel was on average 30% lower than in the same period of 2019. (Source: THE EU FISH MARKET, EDITION 2020, Kontali Analyse, monthly seabass and seabream report, September 2020, EUMOFA macroeconomic dashboard, Ibidem, EN_The+EU+fish+market_2020.pdf (eumofa.eu), Pristupljeno: 02.12.2022.)

EU trade in fisheries and aquaculture products, which includes both imports and exports with third countries, amounted to €33.37 billion and 8.55 million tons in 2019, making the EU the second largest trader of these products in the world after China. Imports, which make up about 80% of the total amount, amounted to €27.21 billion and 6.34 million tons.

Figure 1. Ratio of EU28 countries in exports, NOMINAL VALUE OF EXTRA-EU EXPORTS BY MEMBER STATES IN 2019 AND % VARIATION 2019/2018, Source: EUMOFA elaboration of EUROSTAT data - COMEXT (network data code: DS-016890)



In 2019, the Republic of Croatia exported €84 million, which is not far from the total production of fish products, compared to other EU members, and in relation to the geographical position and size of the market, it does not fare badly, where it also records a trade surplus. There are 15 other countries below Croatia, and it is evident that the Republic of Croatia is rationally using its fisheries strategy and operational programs, as it is making good progress in this sector.

2.2. CROATIA

One of the most important industrial branches of the Republic of Croatia are fishing and aquaculture, which complement each other in economic, social and environmental aspects. Even though the 5,000 km long coastline and 1,244 islands account for 1% of the GDP of the Republic of Croatia, the Croatian fishing sector is a year-round source of income for the population living in coastal settlements and on islands.

The National Island Development Plan 2021 - 2027 defines fishing and aquaculture (in addition to tourism and catering), seafaring, shipbuilding and fish processing as the dominant economic sectors on the islands. Agriculture and fishing have always been activities that ensured the survival of the island's inhabitants. After tourism, agriculture and fishing activities employ the largest percentage of the working population of the island, around 11%, which is significantly higher than the average of the entire primary sector of the Republic of Croatia (6%). The fishing sector (including the processing industry) participates to a significant extent in the export of food products of the Republic of Croatia and contributes to employment on the islands. Aquaculture is an extremely important and growing potential of fisheries on islands with a significant number and capacity of marine fish and shellfish farms, which make up the majority of farms in the Republic of Croatia. In addition to providing quality seafood throughout the year, this activity offers one of the rare opportunities for permanent employment of the island population. The limiting factors for the development of aquaculture on the islands are the lack of professional staff and general workforce in fisheries, the demise of the traditional crafts of fishermen and shipbuilders (small shipbuilding, netting, etc.) and an outdated fishing fleet. The most important development potentials are the development of ecological agriculture, product branding and licensing, the introduction and use of advanced technologies, the cultivation of indigenous varieties of agricultural crops that are less sensitive to lack of moisture, areas still rich in natural diversity, the possibility of exporting and increasing demand on the tourist market, the use all potentials of game, hunting and hunting tourism and connecting the agricultural, fishing, tourist and ICT sectors.

The fishing sector is closely related to tourism on the coast, as well as the production of fishing equipment. Tourism on the coast and islands represents an economically significant activity, especially with the seasonal opening of an additional market for various products, where fishery products play a significant role. In addition, fishing, in conjunction with tourism, provides added value to the tourist service. According to the national strategic determinants in the development of tourism, the goal is to develop the tourist offer in the direction of high-value services.

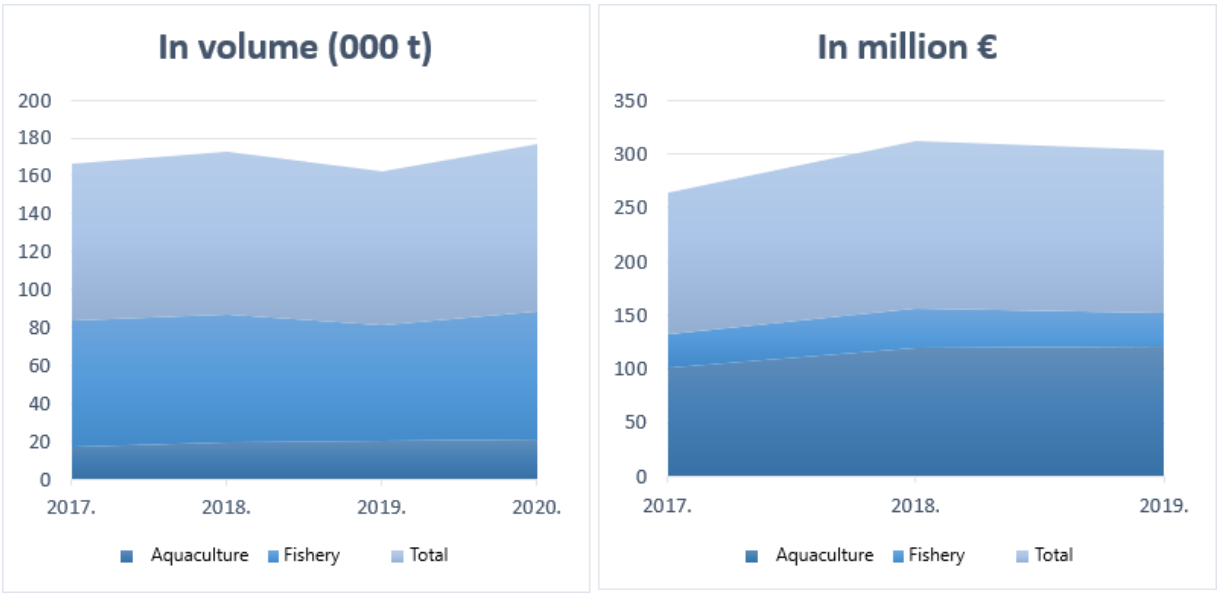
It is important to emphasize that the majority of breeding sites at sea are directly connected to the islands, and that they significantly affect the development and sustainability of sensitive island communities. Areas and communities that traditionally depend on fishing and that even today have the characteristic of "fishing places" in the Republic of Croatia, especially on the islands, also represent significant capital in terms of the development of the tourist offer as a whole. Also, in general, it can be stated that fishing is one of the most important economic sectors for the survival of sensitive island communities, which provides a basic or additional source of income throughout the year, in all its segments - catch, cultivation and processing. At the same time, fishing has significant cultural value and as such represents part of the identity of island populations. The sector of small scale fisheries (SSF) represents about 50% of the fishing fleet of the Republic of Italy and about 77% of the fishing fleet of the Republic of Croatia.

In 2021, the Croatian fishing fleet included 7,757 vessels, of which 6,235 were active. The number of vessels also includes 3,500 vessels that were included in the fleet register with the accession of the Republic of Croatia to the European Union, and were previously categorized as "for personal use" (belonging to the PGP segment). Most of the fishing fleet consists of vessels with a length overall (LoA) of less than 6 meters (4,379 vessels) and vessels with a length of between 6 and 12 meters (2,829 vessels), while only 549 vessels are over 12 meters long.

According to data from the European Market Observatory for Fisheries and Aquaculture Products (EUMOFA, 2019), the visible consumption of fishery and aquaculture products in the Republic of Croatia in 2017 was 18.7 kg per capita, which is an increase of 8.7% compared to 2016. In 2018, it was 19.19 kg per capita, which is an increase of 6% compared to the previous year, while in 2019 it was 20.02 kg per capita, which is still below the EU-28 average level (24.36 kg/year).

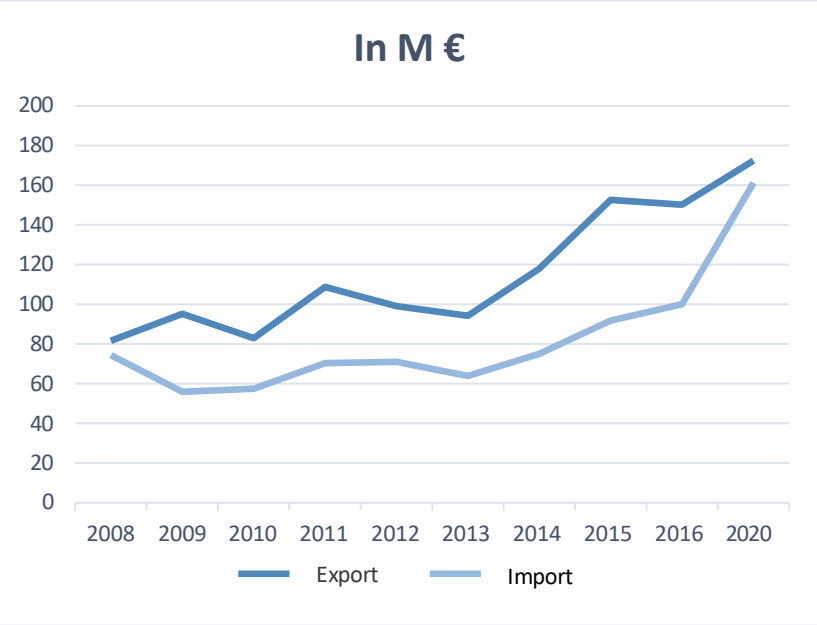
The net supply of live fishery products in 2018 was 86,637.78 tons, while in 2019 it was 81,387.11 tons, and in 2020 it was 88,546.26 tons worth HRK 1.4 billion, or €187 million. Between 20 and 22% of the total production comes from the aquaculture sector. It should be mentioned that the value of farmed seafood is much higher compared to the catch.

Figure 2. Value of production in volume (000 t, in M€), compiled according to available sources EUMOFA, DZS, MPS, EUROSTAT.



Croatia is a net exporter of fish and fish products, and represents one of the rare branches of the economy that creates a surplus. Between 2008 and 2020, exports increased by a total of 111%, while imports increased by 116%.

Figure 3. Value of export and import of fish and fish products, compiled on the basis of data DZS, EUMOFA i FAO



According to currently available data for 2018 (FAO)

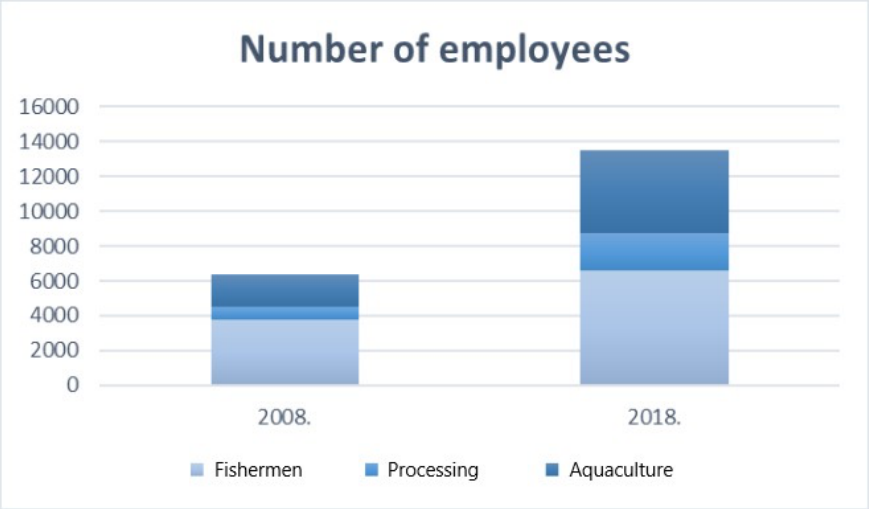
96 million tons
0.092 % of world production volume

81 million tons
0.022% of the volume of world production in aquaculture

According to the National Bureau of Statistics, in 2020, 6,582 fishermen were registered, through fishing trades or companies. Such data shows that in 2020, 175% more fishermen were registered in the Republic of Croatia compared to 2008. In 2018, the number of registered fishermen was 6,668, where a slight decrease of up to 2% can be noticed in a period of 2 years.

Preliminary data from the NBS for 2020 show that the number of vessels increased to 7,555 gross tonnage of 44,000 tons and a power of 348,455 kW by 203% compared to 2008, when 3,718 vessels were registered. The last official categorization of vessels by size according to available data comes from 2019.

Figure 4. Employees in fisheries sub-sectors, compiled on the basis of data DZS i STECF



The labour market in the fishing sector will certainly require intervention. It is necessary to interest the younger population early enough in this perspective branch, harmonizing trends in the fishing industry with education and enrolment quotas, which should be a key strategic factor in the new strategy of operational programs for subsidizing fisheries in 2021-2027. There is no clear and reliable data on employees in the fishing sector, except for fishermen who are often linked to trade statistics. It is assumed that this number with the fish processing sector is around 14,000, and in a broader sense and with seasonal work, up to 25,000. Considering the low natural increase in recent years and large emigration of young families, it is to be expected to replace the labour force with greater automation of production lines in processing, but also by stimulating young people for this industrial branch.

2.3. ITALY

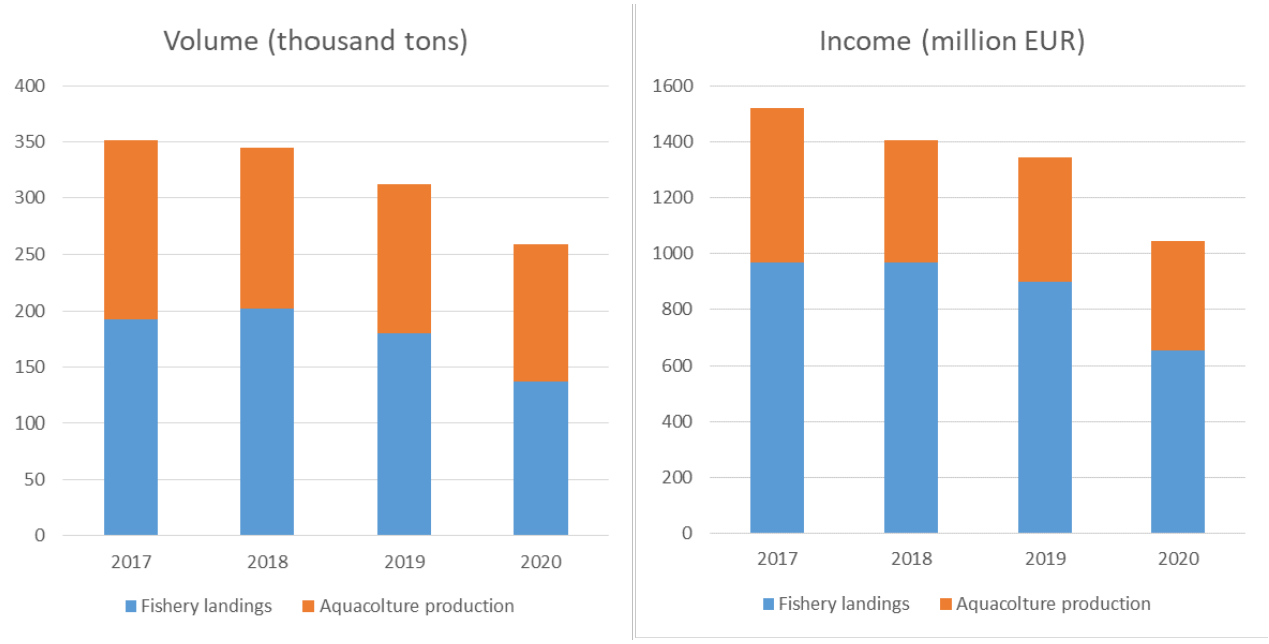
The fishery and aquaculture sector in Italy in 2020 generated a gross income of approximately 1050 million euros, contributing to less than 0.1% to the Italian GDP of 1 653 577 million euros, contributing to with 5% to the UE-27 production. The largest contribution is given by the fishery sector, who landed 136'000 tons in 2020, generating approximately 655 million euros in revenue. The aquaculture sector produced 122'000 tons of products and 390 million euros in revenue.

Italy has 325 registered fishing ports, where a fishing fleet of roughly 12 180 fishing vessels by the end of 2020 were hosted. The Italian fleet is having 146 600 gross tonnage and 939 050 kW of engine power in total. The largest part of the fishing fleet (71.9%) has a small size (length over all , LOA 0-11 m), while mid-sized vessels (LOA 12-23 m) contribute to a quarter of the total fleet (25.5 %), and the largest vessels (LOA 24-40 and above 40 m) to less than 3% (respectively 2.4 and 0.4 %). In terms of fishing gears, the number of vessels using, as first gear hooks and lines are the most abundant gear per vessel (40 %), followed by the trawling gears (20%), set nets (19 %), purse seines (15 %) and other gears (mainly dredges, 6%).

In 2020, the fishery sector had an estimated number of 13 200 employees, contributing to less than 0.1% to the approximately 25 million Italian workforce.

The Italian aquaculture is mainly done in marine and brackish waters (70 %), although a considerable amount of production is also coming from fresh water (30 %). The largest part of the production is done in the water column in marine and brackish waters (41 %), in enclosed basins or canals (28 %, mainly in fresh waters), at the sea bottom in marine and brackish waters (20 %), in cages in marine and brackish waters (6 %) and fresh water ponds (3 %).

Figure 5. Value of production in volume (000 t, in M€), compiled according to available sources (EUMOFA 2022).



In Italy, there are 49 producer organisations (PO) and 2 associations of POs. Their role is to contribute to the achieving the objectives of the Common Fishery Policy (CFP) and of the Common organisation of markets (CMO), through the management of the activities of their members. In the fishery sector are active 35 POs, while in the aquaculture 14, and both the associations of POs are active in the fishery sector.

According to Eurostat-SBS data, in 2020 the Italian seafood processing industry had 5.936 employees, and generating an added-value revenue of 492 million euros, equivalent to 2,1% of the added-value of the food manufacturing industry. The main sold products are the canned products of tuna like species and smoked fish products.

According to EUMOFA, in 2020 the average fish consumption was estimated at 30 kg per capita, a decrease of 4% compared to 2019. The most consumed species were: the yellow-fin tuna, squids, salmon, mussels, skipjack tuna and Nordic cod.

(Source: EUMOFA, Osservatorio europeo del mercato dei prodotti della pesca e dell'acquacoltura, Italia 2020, ISTAT, Conti economici nazionali - Anno 2020, ISTAT, Occupati e disoccupati dicembre 2020)

3. INTERACTIONS BETWEEN DIFFERENT ECONOMIC ACTIVITIES

The blue economy includes newly emerging innovative sectors such as Renewable marine energy (i.e. ocean and sea energy, floating solar power plants, and offshore hydrogen production), "blue" bio-economy and biotechnology, desalination, maritime defence, security and surveillance, research and infrastructure (undersea cables, robotics).

These fast-growing sectors offer significant potential for economic growth, sustainability transition, as well as job creation. However, these sectors distract attention in terms of employment from standard and established sectors of the blue economy such as fishing and aquaculture, as coastal tourism has been doing for many years, which has a negative effect in terms of employment. On the other hand, looking at the income side, without coastal tourism and hospitality, commercial fishing and aquaculture would have a hard time progressing. Fishing and aquaculture mostly coexist with tourism and transport.

The blue economy categorizes the blue economy into two categories:

• Marine-based activities: include activities undertaken in oceans, seas and coastal areas, such as marine living resources (fisheries and aquaculture), marine non-living resources, marine renewable energy, desalination, maritime transport and coastal tourism.

• Marine-related activities: activities that use products and/or produce products and services from the ocean, the sea or sea-based activities such as seafood processing, biotechnology, shipbuilding and repair, port activities, technology and equipment, digital services, etc.

The number of employees engaged in the production of the final good or service can be defined as direct employment. In an open economy that is not operating at full production capacity, changes in the demand for an industry's final goods and services tend to generate corresponding changes in the supply or output of that industry, and consequently its labour force. To maintain increased production, for example, manufacturers hire more workers. Conversely, a decrease in demand can lead to a decrease in production and work. Changes in demand and production also determine changes in the use of raw materials and intermediate inputs along the industry's supply chain. Producers of intermediate goods and services will hire more or fewer workers in response to changes in the demand of downstream economic activities. The number of employees employed by producers of intermediate products in the industry's supply chain can be defined as indirect employment. Direct and indirect employment generates household income throughout the economy. Part of that income will be spent on other goods and services in the wider economy. On the other hand, these expenses and consumption tend to create other jobs. This phenomenon is defined as induced employment.

Direct, indirect and induced employment also refers to the blue economy. According to some estimates, six maritime sectors account for approximately 99% of direct employment in the blue economy, namely:

• life resources (eg. fishing, aquaculture, processing, markets),

• non-living resources (eg. oil and gas, sand and gravel, salt),

• transportation (e.g. transportation of passengers and cargo),

• shipbuilding (including floating structures at sea and marine equipment),

• coastal tourism,

• renewable energy.

A study carried out for the European Commission, DG MARE showed that in 2014 the blue economy created a total of around 5.7 million jobs, of which 3.2 million through direct employment in established sectors and an additional 2.5 million created through their respective supply chains. chains65. The study showed that coastal tourism is by far the largest economic activity in terms of added value and jobs created (55%), considering the wide range of activities generated by tourism (eg. accommodation, food and restaurants, transport etc.).

Other studies have shown that the seaports of the European Union alone create about 2.5 million jobs (direct and indirect), of which only about half a million are covered by sector statistics. This is because ports generate employment and economic benefits in other sectors, such as logistics, maritime services in maritime transport, etc.

For fisheries, an estimated 59.5 million people were directly employed in the primary fisheries (65%) and aquaculture (35%) sectors in 2018 globally (including full-time, part-time and casual workers), and another 200 million people employed in the value chain from harvest to distribution.

A study by the Mediterranean Union estimates that fisheries employ approximately 200,000 direct and 500,000 indirect jobs. This phenomenon can also be observed in other sectors of the blue economy, such as shipbuilding, which is reported to generate approximately 576,000 direct jobs and an additional 500,000. In the renewable energy industry, indirect employment is estimated to range from 50% to 100% of total employment.

All the listed activities of the Blue Sector (less newly created, more attractive to young people) face the impact of demographic changes that may have implications in terms of feedback effects caused by the **aging of the workforce**, which may require targeted initiatives to further strengthen the blue economy that serves as an employer for millions of workers who adapt to this long-term change in the structure of the workforce for a longer period.

These established sectors, including the subsectors covered and their activities, directly employed

almost 4.45 million people in 2019. Although this figure is only 0.5% higher than in 2009, it means that the number of jobs in the EU's blue economy is higher today but before the economic crisis. The increase is largely caused by **coastal tourism, which employs 63% of total jobs in the EU's blue economy.**

Marine renewable energy (production and transmission), which is still in a phase of strong expansion considering that it is a relatively young sector, has seen an increase in the number of employees more than twenty-six times since 2009, from 384 people to more of 10,500 people in 2019.

Gross earnings per employee for the established sectors of the EU's blue economy have grown steadily since 2009, peaking in 2015 (€24,925 per employee) and falling slightly thereafter. However, with an average of slightly more than 24,737 euros per employee, the income of employees in 2019 was 17% higher than in 2009. Graph 5 below.

Figure 6. Employment (thousands of people), personal expenses (millions of €) and benefits (thousands of €) in the EU Blue Sector

Source: Own calculations based on Eurostat (SBS) and DCF data.

(Source: Blue Economy report 2022, 2022-blue-economy-report_en.pdf (europa.eu)).

The decline in average employee compensation can be largely attributed to a significant decline in employment in non-living resources (-71% compared to 2009), a well-paid sector that has been in decline for several years; while employment in coastal tourism has increased in recent years (43% compared to 2015), which is a poorly paid sector.

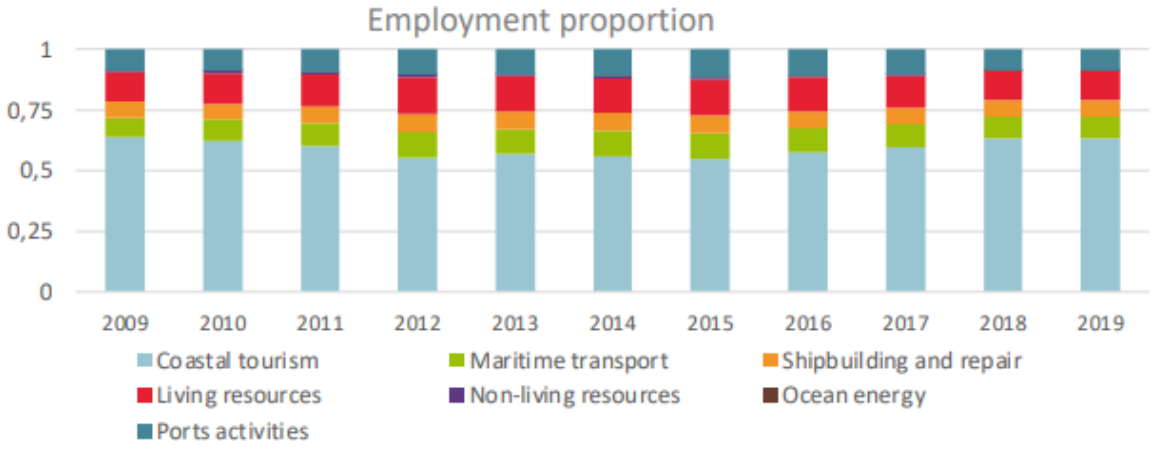
The marine living resources sector includes the harvesting of renewable biological resources (primary sector), their processing and distribution. Game fishery production has increased and may have the capacity for further growth, in part due to improved fish stock status and increased fishing opportunities, together with higher average market prices and reduced operating costs.

Economic performance is expected to continue to improve as fish stocks recover and capacity continues to adjust. However, these advantages have not yet been achieved in the Mediterranean basin, where most fisheries have not yet transitioned to sustainable fishing conditions. 93.9% of estimated fish and shellfish stocks commercially exploited in the Mediterranean Sea (2016 data) did not meet either of the two primary criteria defining the MSFD goal of good ecological status (GES), fishing mortality and reproductive capacity compatible with biomass levels populations above those that can produce maximum sustainable yield (MSY). The situation is only slightly better in the Black Sea (85.7%), while the EU average was 44.8%.

Aquaculture production in the EU has largely stagnated over recent decades, although its value has increased and continues to grow. The development of maritime spatial plans at the level of the Member States, as well as the revision of the Strategic Guidelines for the Sustainable Development of EU Aquaculture should provide an opportunity to boost EU aquaculture production, which is essential to supplement the demand for fish products of the EU market, and achieve independence and self-sufficiency in fish supply.

It is worth mentioning that there was no serious outflow of labor in this sector (Chart 6) at the European level, although there is a warning about the aging of the labor force, which will soon need to be replaced, and the promotion of fishing among young people is weak, and they consider it less attractive. sector than others in the Blue Economy category. (Source: Blue Economy report 2022., 2022-blue-economy-report_en.pdf (europa.eu)).

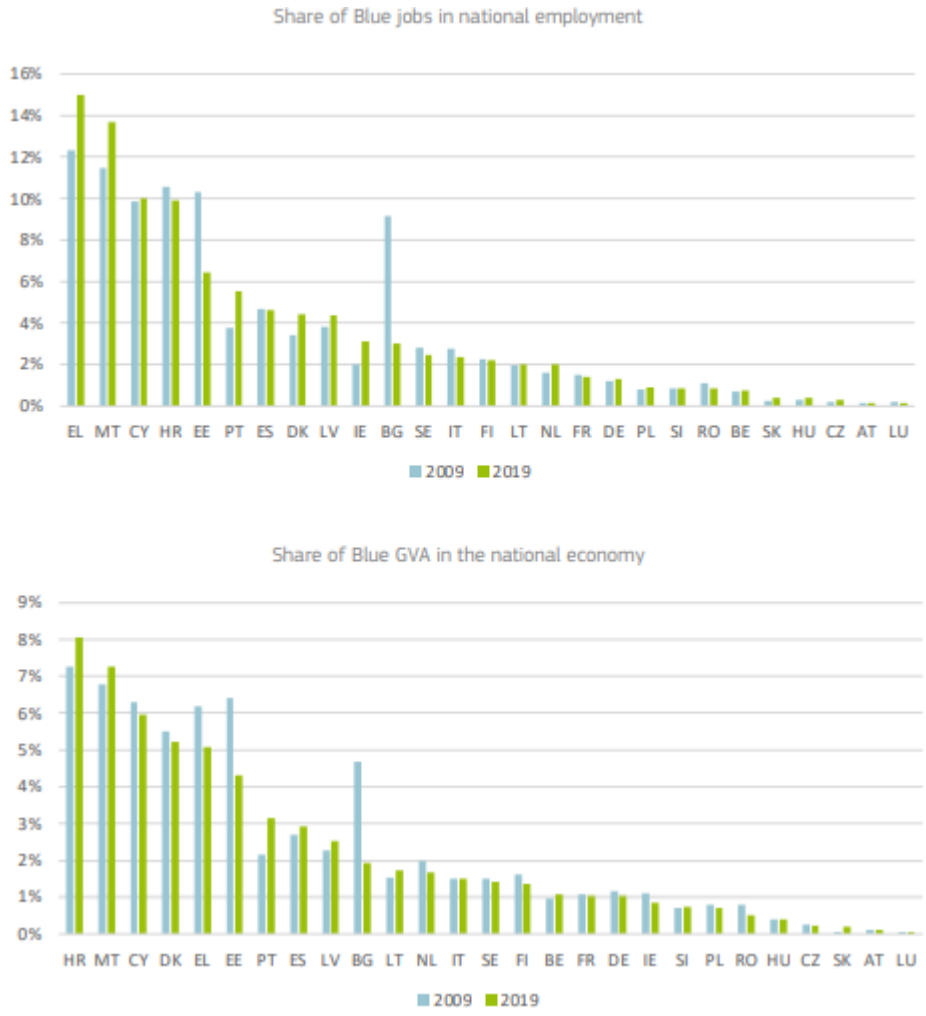
Figure 7. Evolution of employment in established sectors, 2009-2019



Production in the member states of the European Union (fishing and aquaculture) covers about 30% of the total needs for raw materials for the processing of fish products in the European Union. The **processing sector therefore depends on the global fish market**. The distribution of fish products is increasingly concentrated in the hands of a few players. Adding value can allow manufacturers to recover some of the product's value, which is usually created further down the chain. The Russian invasion of Ukraine resulted in an increase in oil prices, which threatened the economic viability of the EU fishing fleet.

Chart 7 below shows the share of the Blue sector in national employment and GVA of the EU member states, so it is evident that the Blue sector is crucial for sustainable development in terms of both parameters, and also represents a strategic economic branch. There is a slight decrease in employment compared to 2009, but also an increase in the share of GVA.

Figure 8. Relative size of the blue economy, percentage



4. ANALYSIS OF LABOR AVAILABILITY IN THE EU MARKET - BLUE SECTOR

The EU is the sixth largest producer of fishery and aquaculture products (behind China, Indonesia, India, Vietnam and Peru), covering about 3% of global production. However, total production has been fairly stable in recent decades. The EU has about 57,000 active vessels that land about 4 million tons of seafood worth 6.3 billion euros; **while the aquaculture sector reached a production of about 1.2 million tons worth 4 billion euros in 2019**.

The processing and distribution of marine products is highly dependent on the procurement of raw materials from the primary sector. High consumption and increased demand for marine products and stagnation in the primary sector make these activities increasingly dependent on imports from third countries. In fact, the EU is the largest importer of seafood in the world. Its self-sufficiency in meeting the growing demand for seafood from its own waters is about 30%;
i.e. EU citizens consumed more than three times more than they produced. On average, EU citizens eat around 24 kg of seafood and spend around €100 on seafood per year. The main products consumed are tuna (mainly canned), cod, salmon, Alaskan pollock, shrimp, mussels and herring.

Despite this general stagnation on the production side, the economic performance of the sector has increased over time. Thanks in part to an overall improvement in stocks in the Northeast Atlantic and low fuel prices for the primary sector; coupled with **high demand and consumer willingness to pay for high quality seafood for the processing and distribution sectors.**

Since March 2022, oil prices have risen sharply as a result of the Russian invasion of Ukraine, seriously affecting the performance of the entire sector, but especially threatening the sustainability of the EU fishing fleet, which is a sign that the European Union should also strive for energy independence.

Marine living resources consist of three sub-sectors, which are further broken down into the following activities:

• primary sector: hunting fisheries (small coastal, large and industrial fleets) and aquaculture (marine, freshwater and shellfish);

• processing of fish products: processing and preservation of fish, crustaceans and molluscs; ready meals and semi-ready meals, production of oils and fats and other food products;

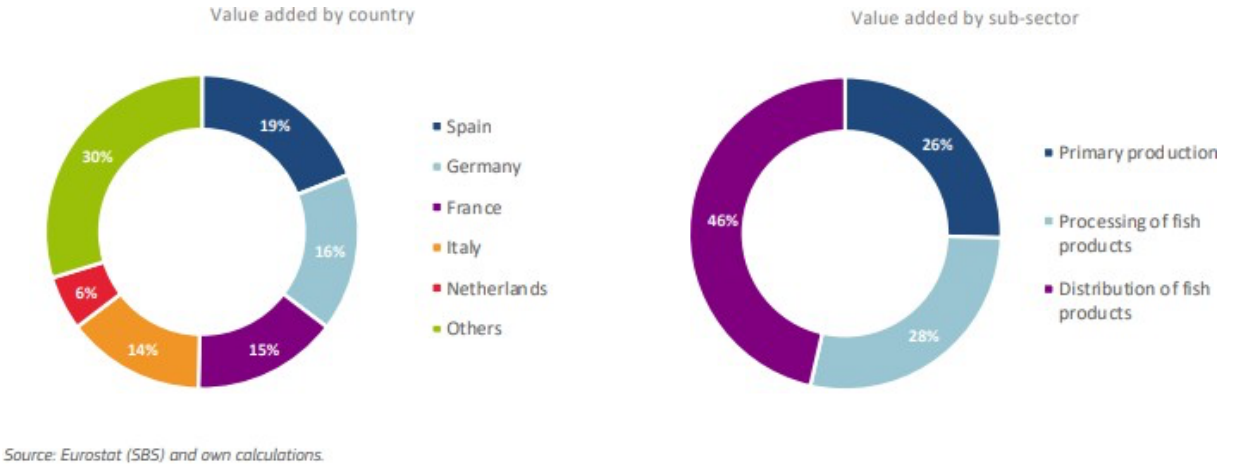
• distribution of fish products: retail trade in fish, crustaceans and molluscs in specialized stores and wholesale trade in other food, including fish, crustaceans and molluscs.

In a broader sense, these activities form an integral part of the EU Blue Bio-Economy, which includes any economic activity related to the use of renewable aquatic biological biomass, e.g. food additives, animal feed, medicines, cosmetics, energy, etc. Due to the limited availability of data and due to its nascent nature, the biotechnology and bioenergy industries are discussed in emerging sectors.

Overall, the contribution of marine living resources to the EU blue economy in 2019 was 12% in terms of jobs, 11% of GVA and 10% of profits. Overall, the economic performance of the sector has improved compared to 2009 and the sector does not appear to have been significantly affected by the COVID-19 pandemic. (Source: Blue Economy report 2022., 2022-blue-economy- report en.pdf (europa.eu)).

The primary sector employs 37%, the distribution sector 39%, and processing 24% of employees. Employment fell from 2009 to 2014 and has since recovered; **overall decreased by 2%:** processing and distribution recorded an increase of 9% and 6%, respectively, while the primary sector decreased by 6%.

Figure 9. Share of GVA generated by the marine living resources sector in the EU, 2019



(Source: Blue Economy report 2022., 2022-blue-economy-report_en.pdf (europa.eu)).

The greatest concern in the outflow of labour from the primary production of fish products is represented by the contrasts in the attractiveness of the newly created sectors of the Blue Economy, which are well promoted among young people, as well as the appearance of an imminent generational exchange.

5. ANALYSIS OF REQUIRED PERSONNEL BY JOB

The need for jobs in the Blue sector is growing, given that it is one of the most important strategic axes of Europe, in which it is planned to invest 372 billion euros of public and private investments through the EU budget guarantee of 26.2 billion euros until 2030, as it would be self-sufficient, but also sustainable in social, economic and environmental aspects, which represents a serious financial allocation and growth, which will require new employment.

Among other things, the goal is to protect biodiversity by at least 30% by the same period. At the same time, the EU has up to 14 million young people between the ages of 15 and 29 who are not in education, employment or training, and millions more who are at risk of entering this space due to early school leaving, difficulties entering the labour market or personal problems. (Source: Blue Generation Project, Blue Careers - The BlueGeneration Project Job Portal).

One of the goals of the guide is certainly to make the interest groups closer to what the jobs are, and it will be divided into 6 most important categories of activities with the common denominator of the Blue sector, with a special emphasis on fishing and aquaculture.

Coastal tourism

Tourism is a great resource for Europe and more than half of the total tourist accommodation in the EU is located in coastal areas. Coastal tourism accounted for 40% of gross value added (GVA), 61% of jobs and 42% of profits of the EU's total blue economy in 2016. This growth must be harnessed in a way that is sustainable and delivers strong economic development. Many sectors and services are offered.

For example, nautical tourism includes recreational boating, cruises, water sports, as well as maritime historical tourism, maritime tourism and many other land-based activities such as nautical museums and resorts. Tourists are less and less attracted to traditional "sun and beach" vacations and are instead opting for innovative activities such as coastal and marine archaeology, underwater tourism and culinary traditions. Operators in the industry adapt and always offer new solutions and ideas, such as exploiting the potential of digital platforms, providing an increasingly scalable and customized experience to the consumer, creating jobs and helping the social, economic and cultural development of their environments.

Coastal tourism encompasses a wide range of businesses related to: Hotels, accommodation and catering, water and beach sports, commercial ship management, maritime consulting, coast guard services, environmental protection services, recreational activity management, digital service providers (ICT), construction infrastructure, operators and logistics, agro and rural tourism, marinas and ports for nautical tourism, congress and event tourism and many others. (Source: The Blue generation Project, Coastal Tourism | Blue Career Guide (bluegeneration.guide)).

Renewable energy of the sea

Seas and oceans offer a huge source of renewable energy. **Offshore wind energy is the most established sector and the fastest growing activity in the blue economy**. The EU is responsible for 91% of global offshore wind power capacity. Offshore wind farms directly employ 160,000 people, and it is estimated that they will employ 244,000 people in the EU by 2030. **This already exceeds employment in fishing**. Most of the current capacity is installed in the North Sea. Ocean energy is also a huge source of potential energy and is less variable than other energy sources such as wind and solar.

It includes various types of energy production such as tides, waves, currents, osmosis and ocean heat energy conversion. It employs around 2,000 people across Europe. Because of its potential, numerous studies are being conducted in the EU with around 320 companies and organizations operating in this sector from different member states. Between 2007 and 2015, €2.6 billion was invested in this sector in the EU. In general, ocean energy means harnessing the power of the ocean to generate electricity. Oceans can produce two types of energy: thermal energy from the sun's heat and kinetic energy from tides and waves. Oceans cover more than 70% of the Earth's surface, which makes it one of the most important sources of energy production.

This can be done in several ways, but the resources that have immediate potential in terms of energy production are:

- waves: using wave energy converters to generate electricity.
- tides: use of tidal barrages, fences and turbines to produce electricity.

Many different fields offer jobs in ocean energy such as: entry-level mechanical work, marine engineering, supply industry, project development, operation and maintenance, navigation and transportation, research and science, and construction. Some of the sought-after occupations in this area are; masters and crew of wind farm service vessels, mechanics and maintenance workers, construction workers, electricians and technicians, ICT services, health and safety personnel, renewable energy project managers and personnel, designers, researchers and project operators, energy information consultants. (Source: The Blue Generation Project, Ocean Energy | Blue Career Guide (bluegeneration.guide))

Marine biotechnology

This sub-sector represents one of the most important areas **of key technology for the future of the EU's blue economy**. For biotechnology, the Organization for Economic Co-operation and Development (OECD) gives the following definition: "The application of science and technology to living organisms, as well as their parts, products and models, to change life or materials for the production of knowledge, goods and services." (Source: OECD, https://www.oecd.org/sti/42833898.pdf). Marine biotechnology, or also called Blue biotechnology, uses resources from aquatic living organisms (freshwater and marine) to develop new commercially viable products or applications. Since the oceans cover 70% of the planet's surface and contain 99% of the biosphere, there is unprecedented biodiversity in the oceans. It is estimated that up to 1 million eukaryotic species, such as micro-algae, seaweeds, fungi, fish, invertebrates such as starfish or molluscs, as well as hundreds of millions of prokaryotes such as bacteria, live in the oceans. **These organisms can be used as biomass or more importantly, to be used as producers of various end products or substances, such as pharmaceuticals, cosmetics, nutraceuticals, agrochemicals**. This subsector is very young and is currently being initiated and developed through national and EU projects that support and encourage this vital area of intensive research.

The comprehensive biotechnology sector is a successful umbrella sector of the EU market, with many market applications. In addition to marine biotechnology, other well-known subsectors are red biotechnology (pharma), white biotechnology (industrial), green biotechnology (food and agriculture). Marine biotechnology is a highly specialized field that requires extensive knowledge. There are not many blue/marine biotechnology programs in Europe.

General graduate and MSc courses offer specialization in blue biotechnology, while some full specialized MSc programs can be found in Europe.

Among the most promising sub-sectors of marine biotechnology are algae. The algae biomass sub-sector in the EU alone already (2018) employs more than 14,000 people and has a value of EUR 1.69 billion, which includes research and development, equipment manufacturing and jobs in the larger supply chain that depend on the results from the sector algae. In 2019, there were 126 companies producing microalgae and macroalgae in the EU, with a total of 144 production plants, and 15 production companies in other countries of the European Economic Area with one plant each.

Areas of interest are: research, marine environment, biomass production and processing, product innovation and differentiation, enabling technology and infrastructure. Possible occupations include: field researchers or laboratory research assistants, field scientists (marine biotechnology, bioengineering, biochemistry, marine biology), data scientists, environmental and aquaculture consultants, eg conservation, greenhouse gas emissions, circular economy, climate change, bioentrepreneurs, microbiologists, medical scientists (pharmacognosy, synthetic biology, bioinformatics), workers at a sea farm or industrial plant (e.g. for seaweed, mussels or microalgae), machine operators in industry, assistants for aquariums, Marine Park managers, marine planners, eco-tourism guides or wildlife educators in a marine conservation or eco- tourism center that combines production, e.g. of mussels and algae with tourism, animal keepers at "Sea Worlds" or similar aquariums or tourist attractions, professional divers, diving instructors or guides, instructors or scuba diving guides. In-demand occupations in this sector include: microbiologists, biomedical engineers, chemical technicians, medical scientists, aquaculture operations managers, marine farm workers, industrial machine operators, factory workers on production lines, genetic counselors and geneticists, zoologists and wildlife biologists , laboratory staff, laboratory workers. (Source: Blue Generation Project, Marine Biotechnology | Blue Career Guide (bluegeneration.guide)).

Marine monitoring and mapping

Monitoring marine systems also through mapping of habitats, species distribution and use of marine space is central in the EU directives for identification of health of marine systems, restoration, conservation, and management purposes.
Nature restoration will be a central element of the EU's recovery plan from the coronavirus pandemic, providing immediate business and investment opportunities for restoring the EU's economy. Biodiversity loss and ecosystem collapse is one of the biggest threats facing humanity in the next decade. The world already lost an stimated €3.5-18.5 trillion per year in ecosystem services from 1997 to 2011, and an estimated €5.5-10.5 trillion per year from land degradation. Biodiversity underpins EU and global food security. Biodiversity loss risks puts our food systems and nutrition at risk.
The benefits of biodiversity conservation for the economy are several: conserving marine stocks could increase annual profits of the seafood industry by more than €49 billion, while protecting coastal wetlands could save the insurance industry around €50 billion annually through reducing flood damage losses.

Enlarging protected areas is also an economic imperative both for conservation of nature and as a tool for managing exploited resources. For instance the General fisheries Commission of the Mediterranean Sea (GFCM) 2030 strategy largely includes the use of spatial measures for fisheries management and conservation of vulnerable marine ecosystems. These approaches needs monitoring and mapping resources and pressures for an appropriate identification of optimal sites. Studies on marine systems estimate that every euro invested in marine protected areas would generate a return of at least €3. Similarly, the Nature Fitness Check showed that the benefits of Natura 2000 are valued at between €200-300 billion per year. The investment needs of the network are expected to support as many as 500,000 additional jobs. The biodiversity plan aims to protect more nature for good of the environment and the economy, both land and sea. The objective related to the marine environment is to reach at least 30% the sea to be protected in the EU, a minimum of an extra 19% for sea areas as compared to today. The protected areas should be specific for very high biodiversity value or potential, since these are the most vulnerable to climate change and should be granted special care in the form of strict protection. In this spirit, at least one third of protected areas – representing 10% of EU sea – should be strictly protected (see also GFCM 2030 Strategy). As part of this focus on strict protection, it will be crucial to define, map, monitor and strictly protect marine habitats.

Achieving good environmental status of marine ecosystems, including through strictly protected areas, must involve the restoration of carbon-rich ecosystems as well as important fish spawning and nursery areas. Marine resources must be harvested sustainably and there must be zero-tolerance for illegal practices. In this regard, the full implementation of the EU's Common Fisheries Policy, the Marine Strategy Framework Directive and the Birds and Habitats Directives is essential. The application of an ecosystem-based management approach under EU legislation will reduce the adverse impacts of fishing, extraction and other human activities, especially on sensitive species and seabed habitats. Combining the pressures and impacts of different human actions on the sea requires careful evaluation that is conducted using marine spatial planning approaches.

Where necessary, measures will be introduced to limit the use of fishing gear most harmful to biodiversity, including on the seabed. The European Maritime and Fisheries Fund should also support the transition to more selective and less damaging fishing techniques that will require mapping of resource distribution and definition of the most opportune fishing grounds. Healthy fish stocks are key to the long-term prosperity of fishermen and the health of our oceans and biodiversity. This makes it all the more important to maintain or reduce fishing mortality at or under Maximum Sustainable Yield levels also through spatial measures and management done in order to reduce by-catch. In addition, fisheries co-management measures must be established in all marine protected areas according to clearly defined conservation objectives and on the basis of the best available scientific advice, but considering also participation of stakeholders (Source: EU Biodiversity Strategy for 2030, COM(2020) 380 final, Brussels, 20.5.2020).

The EU Biodiversity Strategy calls on Member States to carry out a mapping and assessment of ecosystems and their services (MAES). As such, an EU-wide ecosystem assessment was launched to provide harmonised information on the condition of ecosystems and biodiversity, and their capacity to provide ecosystem services. This mapping uses spatially explicit information, mostly based on the Copernicus service portfolios, the habitat classification of the European Nature Information System EUNIS (EEA, 2017) and other spatially referenced data sets. The work is also an essential input to the EU-level mapping and assessment of ecosystems and their services following the MAES analytical framework (Maes et al., 2018).
Marine ecosystems include the seabed and the water column. Of particular importance is the zone close to the surface, which receives light (the photic zone) and which contains most of the primary productivity that supports marine food webs, including those in the deeper parts of Europe's seas. Salinity is also an important physico-chemical factor for species and their habitats in transitional and coastal waters. For example, European Marine Observation and Data Network (EMODnet) provides seabed information, combined with bathymetry data, the measurements of the depth of water in oceans and the EUNIS classification defines the different marine habitats. Such maps will support the development of the knowledge base for the EU biodiversity strategy and provide the analytical framework to assess the ecosystem condition. More detailed information on ecosystem condition will become available through the combination with the information reported in the Habitats and Birds Directives, the Water Framework Directive and the Marine Strategy Framework Directive. The Copernicus program is providing detailed data with higher spatial and temporal resolutions and additional and more detailed thematic information layers. These will allow further enhancement of the ecosystem type map. In conjunction with the EUNIS classification. Within the Copernicus program, the Copernicus Marine Service is particularly important for the marine environment, providing free and open marine data and services to enable marine policy implementation, support Blue growth and scientific innovation. Its portfolio includes data products, reports, monitoring indicators and visualization of results.

In order to make good use of all the collected data, and be accessible to a large number of user, those should possibly follow some guidelines as the Data Management Plans (DMPs), which are a key element of good data management. A DMP describes the data management life cycle for the data to be collected, processed and/or generated within an activity. As part of making research data findable, accessible, interoperable and re-usable (FAIR), a DMP should include information on: handling the data; selection of collected, processed and/or generated data; methodologies and standards applied; choice of make them shared/open access; and how data will be curated and preserved. (Source: Guidelines on FAIR data management in Horizon 2020 projects)

The marine science is entering the digital age and the big data, providing opportunities to transform the way we study and understand the ocean through more complex and interdisciplinary analyses, and offers novel approaches for the data-driven management of marine resources and heir sustainable use. Moreover, big data find particular use in climate science and marine biogeochemistry, or to create high-resolution, multidisciplinary habitat maps for planning new marine protected areas.

A big source of data can come from marine biological observations including genetic sequences, imagery and hydro-acoustic data and globally connected networks of long-term biological observations for more complex interdisciplinary analyses using big data. Still, there is a lot of development and innovation to be done, and will involve collaborations of multidisciplinary working groups including marine scientists, computer scientists, data scientists and data managers and the confrontation with stakeholders and policy makers to design the needed results and indicators for an effective data-driven management. (Guidi et al., 2020)

Skills mostly required by this sector is high technological specialized expertise in mechatronics, electronics for the development and use of highly sophisticated instruments that can be used to monitoring, such as underwater automated vehicles, submergible drones etc.
Furthermore, giving the large amount of data that need to be treated for mapping and spatial analysis, expertise on big data treatment, data management, data analysis such as statistical and data analyst will be more and more required.

Shipbuilding and maintenance

Maritime technology is an innovative and advanced manufacturing sector that includes all phases from research and design to construction, maintenance and repair of ships and other maritime facilities. The sector includes shipyards, suppliers of systems, technology and equipment. European shipyards build the most modern and complex vessels on the global market: cruise ships, ferries, offshore vessels and platforms, fishing vessels, research vessels, mega-yachts, naval vessels, submarines, carriers aircraft etc. The construction of these types of ships is very complex since most of the ships built in Europe are unique prototypes designed according to the specific needs of the owners. The sector is actually characterized by long development phases and long production cycles (for example 12 – 24 months for merchant vessels, 24 – 36 months for passenger vessels). Therefore, every vessel is a new challenge.

European suppliers of marine equipment and systems develop the technologies necessary for the operation of each vessel: propulsion, navigation, cargo handling, drilling, monitoring equipment, etc. These companies also provide solutions for a wider range of maritime activities such as offshore energy production (marine energy, offshore wind, electrical substations, etc.). Some of the areas of interest: ship design, mechanics, structural construction, electrical systems, plumbing, painting/spray and gel coating specialists, marine surveying, welding and interior design.

Some of the main and most sought-after jobs are: naval architects-designers - assistants or trainees, naval architects or designers, interior designers, shipbuilding - material procurement - logistics, electrical and electronics engineers - assistants - trainees. Electricians plumbing engineers - assistants - trainees, plumbers and pipe fitters, electronics engineers - assistants - trainees, painters - gel coatings - sprays, etc., welders - metal construction - frames, insurance appraisers. (Source: Blue Generation Project, Ship Building and Maintenance | Blue Career Guide

(bluegeneration.guide)).

Marine transportation

By maritime transport we mean the transport of goods, people and the necessary infrastructure for that. **Maritime transport is the world's primary mode of movement of goods. In fact, 80% of all goods transported use this method**, which equates to 5.1 billion tons of goods per year. In passenger traffic, more than 400 million passengers board and disembark annually in European ports. Maritime transport also offers the lowest amount of greenhouse gases per transported unit. In Europe, 267,000 people work in ports, warehouses and other relevant workplaces, while 235,000 people work in the goods and passenger transport sector. The maritime sector offers many travel opportunities and the opportunity to work with people from different countries and cultures.

Diversity is the most attractive element and one of the most important strengths of maritime transport. The areas covered by maritime transport and in which it is possible to find employment are: passenger ship tourism on board or on land, navigation safety and passenger safety, cargo management, port management, ICT, ship sales and brokerage, charter carriers, Catering on cruises or yachts, and jobs for superyachts.

Occupations in demand are: ship captains or ship crew members, ship mechanics or repairmen, port operators, passenger tour operators, cargo or passenger transport managers, port or marina managers, mooring agents or brokers, ship or vessel brokers, online service providers and digitization, charter operators, forklift drivers, insurance representatives, marine managers, sales and marketing, crane operators, economic analysts, staff services (eg cooks, cleaners, bartenders, waiters). (Source: Blue Generation Project, Maritime Transport | Blue Career Guide (bluegeneration.guide)).

Fishing and aquaculture

The term fisheries usually refers to the entire industry of catching, processing and selling fish. In this chapter, we will consider fisheries as separate entities for the sake of easier structure and monitoring of the areas of activity and sought-after professions in both fishing and aquaculture.

Fishing includes activities such as catching, processing, storing, transporting, marketing the fish and fish products. To understand the fishing industry chain, we can divide the industry in two sectors:

• Commercial fishing, which includes commercial fishing at sea (fishing by vessels fishing with purse seines, bottom nets or passive fishing gear, defined by division according to fleet segments), processing of fish and other marine organisms to add value to primary products and, finally, marketing of fishery products.

• Non-economic fishing that is carried out for own needs under specially prescribed conditions

(small coastal fishing) and recreational and sport fishing that include the production and retail of various products and services for this industry (e.g. fishing boats, fishing services and products, clothing, rental in sector of experiential fishing tourism, fishing 'adventure', etc.)

The fisheries industry is a highly globalized and interconnected industry, directly linked to social and economic life in terms of employment, consumption, ecology and ecological health, as well as the sustainability of fishing communities and fish stocks (including issues of illegal fishing and overfishing). The European Union is the world's largest seafood market, while its fishing industry is among the world's 4 largest markets, supplying approximately 6.4 million tons of fish each year (80% of production comes from fisheries). On the other hand, fishing and fish processing employ more than 350,000 people.

Fisheries play a key role in employment and economic activity in several EU regions – in some European coastal communities, the fisheries sector accounts for as much as half of local employment. Employment in the fishing sector is mostly concentrated in a few countries. Spain, Denmark, the United Kingdom, France and the Netherlands are the five largest fisheries producers in the EU. These countries also have the highest consumption of fish products. Spain alone accounts for 25% of total employment, and the four countries with the highest employment levels – Spain, Greece, Italy and Portugal – account for around 73% (2015). They also have the largest fish markets for the main commercial species in the EU.

The fishing sector has a wide range of needs for certain types of occupations, from primary production (commercial fishing) to the processing of fish and other marine organisms, placing fishery products on the market, through non-commercial fishing, fisheries science to the management of this sector.

The following occupations are in demand in fishing: fishermen, captains of fishing boats or heads of fishing boats (responsible persons for carrying out commercial fishing at sea), fisheries experts, traders for placing fishery products on the market, processors, scientists, marine environmental economists, fish biologists , fish watchers, research chemists, processing plant technologists, fish processing plant managers, plant workforce, technicians, marketing and sales, quality controllers.

Fishing is done with fishing vessels, which can be fishing boats or fishing boats, as defined by maritime regulations. The activity of commercial fishing at sea in the Republic of Croatia is carried out by the holder of the privilege (trade or trading company). The person responsible for commercial fishing is a natural person, the owner of the business, if he himself carries out fishing and is professionally trained, or his employee. In the case of legal entities, the person responsible for fishing is a natural person who is an employee and is professionally trained. On a fishing boat, the person responsible for conducting fishing is the captain of the vessel, while on boats the responsible person is the boat manager, i.e. a natural person who carries out fishing.

The crew of a fishing boat consists of the captain, the first officer, the ship's captain, known as the deckboss on smaller ships, and workers known as deckhands. These crew members are needed to operate the fishing boat.

Master of a fishing vessel: responsible person in commercial fishing who manages the boat, organizes fishing, registers the catch and is responsible for the legal conduct of commercial fishing at sea. The captain supervises and coordinates all activities on the fishing vessel, including: fishing planning, deciding on the position and method of starting the fishing operation, the type and size of the catch, the catch, the length of the trip, the method and procedures for preserving the quality of the catch and delivery to fish processing facilities.

A fisherman is a natural person who participates in commercial fishing at sea as a crew member or, in the case of his own trade, as an independent fisherman. Fishing on fishing boats is usually done by one fisherman alone or with the help of another fisherman. As part of the crew, the fisherman performs tasks related to the fishing operation, participates in fishing, hauling the catch onto the vessel, sorting, weighing and storing the catch.

Experts in the field of biotechnical, natural and medical sciences (inspectors, advisers, associates) in public law bodies: perform tasks related to education, information and supervision and control to prevent water pollution in order to protect the marine environment, including freshwater streams, with the aim of protecting public health and prevention of poisoning due to the consumption of toxic and / or bacteriologically contaminated fish and other marine organisms that can lead to serious health problems.

Fishery product traders: place fishery products on the market. Fishery products that come from fishing are placed on the market through the first sale, that is, through the registered first customer who participates in the distribution chain, from taking over the catch, through transport, weighing to the sale to the next customer.

The first customers must be on the list of approved or registered establishments, that is, they must be approved for catering activities by the competent authorities.

Processing plant worker: fish and other marine organism processing workers perform tasks in processing units and perform the following tasks: cleaning and/or filleting products, placing raw materials on belts, discarding defective products, operating machinery for moving seafood and ensuring cleanliness and workplace safety. A seafood processor should have the following skills: good practical skills, dexterity, knowledge of food safety standards, teamwork, time management and organization.

Master's degree in marine fisheries engineering: marine fisheries, as a theoretical and applied scientific discipline, includes the methods and activities of catching, growing, processing and trading fish and other marine organisms, as well as the methods and activities of managing, protecting and exploiting the living resources of the sea. They can play a significant role in local and national bodies, in fisheries inspection work and in companies that deal with catching, growing, processing and trading fish and other marine organisms, preserving them from spoilage and managing and protecting the living resources of the sea.

MSc Engineer in Marine Ecology and Protection: for work in the field of biological oceanography, which includes a wide range of biological research from the diversity of marine organisms to their distribution, characteristics, mutual relationships and interactions with the marine environment. Furthermore, due to the increasingly present problem of dumping a large number of harmful and dangerous substances into the sea and the irrational use of marine resources, special attention is paid to the protection of endangered species and ecologically endangered areas.

From all of the above, it is evident that work on ecology and marine protection, in addition to a good knowledge of biology, also requires knowledge in the fields of ecology, biotechnology, integral management of coastal zones, and the right to protect fishing and the marine environment. In order to understand the entire range of biological processes in the sea, a good knowledge of the functioning of the entire marine ecosystem is necessary, which is why this work requires an extremely high degree of multidisciplinarity, including work in the field, in an office environment or on a marine vessel such as a floating laboratory.

Marine Economist: The marine resource economist job falls under the broader career category of environmental economist; conducting economic analysis related to environmental protection and use of the natural environment, such as water, air, land and renewable energy sources. Evaluate and quantify the benefits, costs, incentives and effects of alternative options using economic principles and statistical techniques.

An authorized observer in fisheries is an independent expert in the field of natural sciences, who meets the prescribed conditions and is authorized for specific types of work. An authorized scientific observer in fisheries is an authorized observer who is in charge of collecting data within the framework of the implementation of the national plan for collecting data in fisheries in accordance with national regulations, while an authorized observer in charge of control in fisheries is an authorized observer in charge of monitoring fishing activities and activities in aquaculture, and are its activities aligned with International Commission for the Conservation of Atlantic Tunas (ICCAT) Recommendation 21-08 establishing a multi-annual conservation and management plan for bluefin tuna in the eastern Atlantic and Mediterranean Sea. The scientific observer performs his tasks in accordance with the prescribed methodology and protocols and is obliged to organize his work on the vessel or other sampling site in such a way as to interfere as little as possible with the crew of the vessel or employees at the sampling site in the performance of their duties.

Research Chemist: Research scientists are responsible for designing, conducting and analysing information from controlled laboratory research, experiments and tests. They mostly work for government laboratories, environmental organizations, specialized research organizations or universities.

Fish Processing Facility Manager: The Manager is responsible for safety, quality, production, sanitation, shipping, receiving and maintenance, as well as recruiting, motivating and retaining a multi-shift processing team. (Source: The Blue Generation Project, Fisheries | Blue Career Guide (bluegeneration.guide))

Aquaculture, also known as water farming, is the cultivation of fish, crustaceans, molluscs, aquatic plants, algae and other organisms. Aquaculture involves the cultivation of freshwater and saltwater populations under controlled conditions, and can be compared to commercial fishing, which is the harvesting of wild fish. This activity can take place in both coastal and inland areas including interventions in the cultivation process to increase production. **It is probably the fastest growing food production sector and now accounts for 50% of the world's fish used for food.** Therefore, there is a great need to develop sustainable options and ways of growing to meet the increasing demand for its products**.** This is clearly reflected in the aquaculture policies of many governments across Europe. In Europe, aquaculture accounts for about 20% of fish production and directly employs about 85,000 people. Aquaculture production in the EU is mainly concentrated in 5 countries: Spain, the United Kingdom, France, Italy and Greece with 75% of the value in the EU as a whole.

It covers a number of areas where employment can be found, namely: fish and seafood farming, breeding research centres, coast guard services, operational mechanics, communications, ICT, digitization and robotics, problem solving, health and safety, machinery maintenance and resource management. The following occupations are in demand: hatchery technician, hatchery manager, saltwater production manager, hatchery technician, hatchery manager, environmental and regulatory affairs manager, fish health technician, aquaculture engineer and many others.
The great potential that the industry has and the wide range of activities means that it has a range of opportunities as a wide range of knowledge and work activities must be applied in the aquaculture industry, making it attractive as a place to find meaningful work with opportunities to build a career from manual labor through work experience, training and education to advanced specialized functions in a wide range of fields, for example in biology, economics, technology, science, administration and commerce in different sectors or related to the aquaculture industry.

The commercial aquaculture industry has a wide variation in form and activity in different regions inland and around the coasts of many countries in Europe, as well as around the world. Its wide range varies widely, from the cultivation of algae (sea grass), through the collection and cultivation of shellfish such as mussels and oysters, fish such as tuna and their maintenance, control and production of the entire life cycle of fish species such as sea bass, bream, salmon,

sturgeon, trout; from the management and development of parent fish (often referred to as broodstock fish) for egg production, egg laying to the production and rearing of fry and adult fish to marketable size. In many cases, commercial activity also includes processing, primary (semi-finished products that are still raw materials for customers) and value-added (final consumer products), as well as distribution and marketing of the marketed product. Commercial aquaculture activities in Europe are numerous and diverse in many European countries. The countries with the largest industries in this area are Greece, Italy, Spain, Portugal, France, Great Britain, Scotland, Germany, Norway and Iceland.

The generally accepted view of the aquaculture sector in the future is that it has significant or even great growth potential due to the need for more food, the size of the untapped potential and the opportunities for sustainable and economic development. The industry is currently in a phase of rapid development, not only technologically and commercially, but also because of the great need to develop sustainable options and ways of growth to meet the ever-increasing demand for its products. This is clearly reflected in the aquaculture policies of many governments across Europe, especially in countries where there is already experience in the field and the continuous growth of aquaculture, which in all cases is encouraged by the authorities.

One clear example is Norway where recent governments, regardless of position on the political spectrum, have issued policies aimed at increasing current national aquaculture production from approximately 1.2 million metric tonnes per year to 5 million tonnes per year by 2050. Similar policies also apply to the UK , Faroe Islands, Iceland and several other countries in Europe. Sustainable innovative development is also encouraged by government policies that encourage innovation and start-ups in various areas of the aquaculture industry, manufacturing as well as related industries serving the aquaculture industry. (Source: The Blue generation Project, Aquaculture | Blue Career Guide (bluegeneration.guide))

6. PERSPECTIVES FOR YOUTH EMPLOYMENT IN THE FISHERIES SECTOR

The Ministry of Agriculture, Directorate of Fisheries, held an interactive workshop among students of the last grades of elementary school and high school students, who for this Guide represent a representative sample and empirical results about their career preferences in the Blue sector. The workshop entitled Career Promotion in the Blue Sector is part of the TECHERA project, financed by the Interreg Croatia Italy program.

The workshop was attended by 11 lecturers from the scientific community of the Republic of Croatia and Italy, the private sector and fisheries management bodies. Given that it is a cross-border cooperation between two EU member states that share a common sea (Adriatic), they informed the students about the current situation on the labour market, and the necessary skills for employment in various occupations in fishing and aquaculture. Since these two sub-sectors, in addition to coastal tourism, are the most represented sectors in the development of these

regions, the students received "first-hand" information about the possibilities for career development within these sectors.

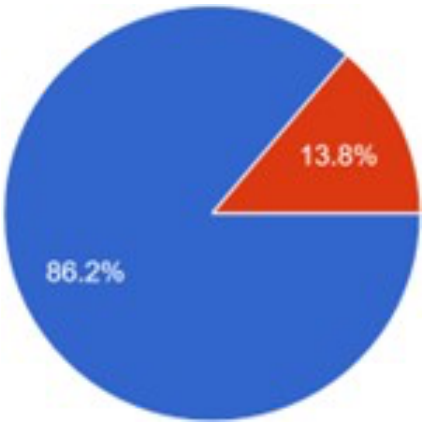
At the end of the workshop itself, an online survey was conducted, in which 58 students participated, who answered specific questions related to this sector. In addition to additional information through the survey, students were able to see for the first time what a complete questionnaire on preferences and employment opportunities in the Blue sector looks like in practice. We also gained an insight into how necessary these types of workshops are so that young people can be correctly guided around important decisions such as career paths, especially in coastal areas.

The results of the conducted survey

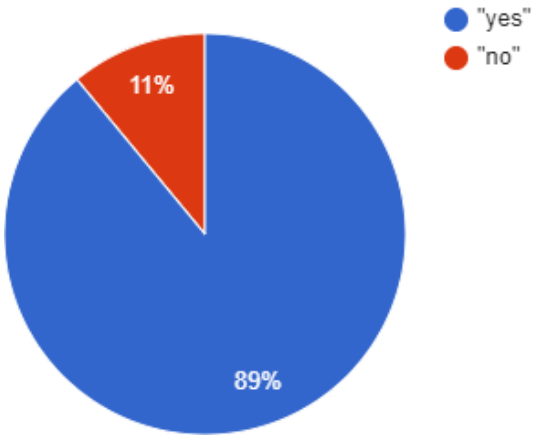
Below are the results of the survey, with the associated analyses. In Croatia there were 58 students surveyed, while in Italy 28 students.

1. Did you get any new information at this workshop related to continued education and employment in the area of Blue careers related to the fishing sector?

Croatia



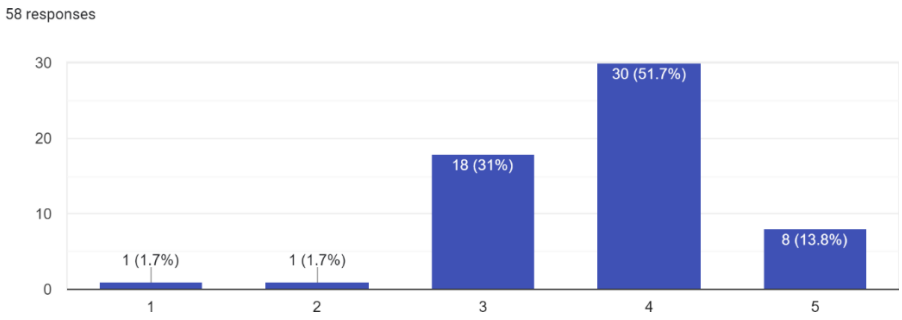
Italy



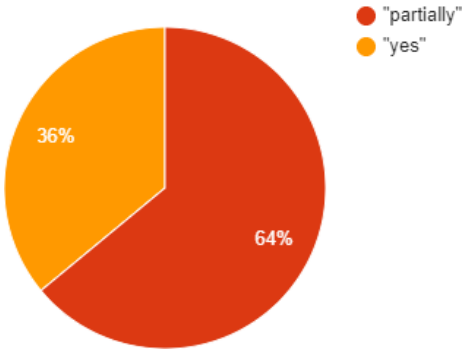
The majority of the students in Croatia and Italy think that the workshop is useful for informing about employability and future employment trends in the fishing sub-sector.

2. How much do you think fishing contributes to humanity in terms of providing food and employment?

Croatia



Italy



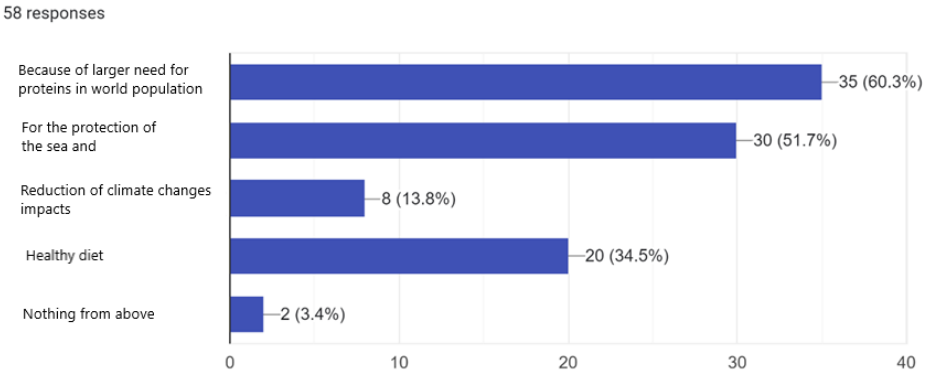
In Croatia the majority of students believe that fishing greatly contributes to humanity in terms of providing food and employment, scoring 4 and 5 (65.5% of them), 31% of them believe that such a thesis contributes to a good extent, and a small percentage that fishing not important for humanity and employment.

Similarly, in Italy the majority of students believe that fishing greatly contributes to humanity in terms of providing food and employment (64% of them), while the remaining believe that this contribution is only partial (36% of them).

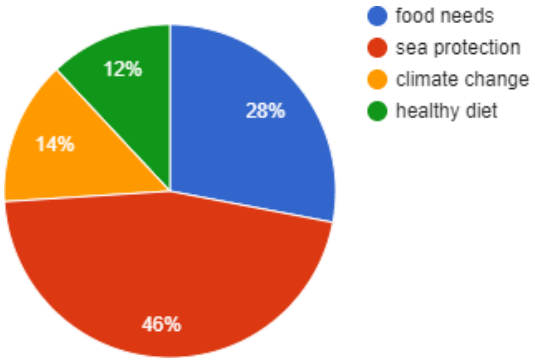
From this we can conclude that through the informative workshop and the school curriculum, they are well aware of the importance of fishing for humanity in terms of nutrition and sufficient resources for new generations, but also that this sector will grow and look for young workforce.

3. Why is it important to manage fishing and to have farming, processing and marketing of fish products?

Croatia



Italy



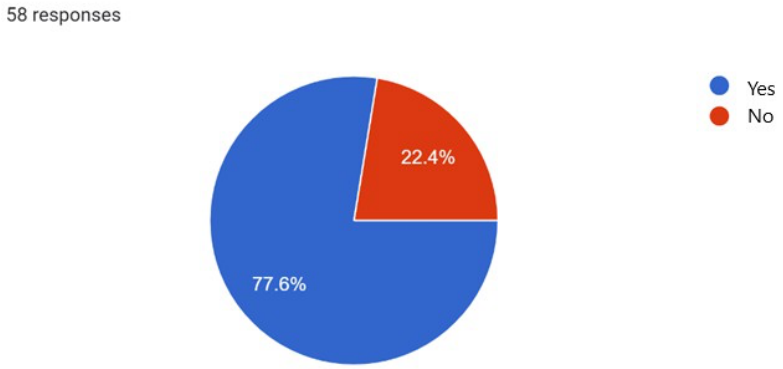
In Croatia, from the questions about how important it is, and for what reasons, to have sustainable fishing, cultivation and processing, we see that the students are very aware of how it is necessary for the sake of the growing number of the world's population, which demands an increasing intake of protein, that fish is at the top of the food pyramid chain, how sustainable fishing and aquaculture are essential components of the protection of the sea and ocean and its natural resources, and how climate change can also be influenced by smart management of this sub-sector.

In Italy the responses were a little bit different, the students view the management of sea related production activities mainly linked to the protection of sea (46%), and secondly for its food need for the human population (28%).

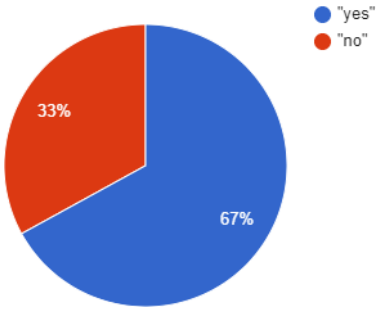
The least important aspect viewed by the students is related to fight the climate change (14%) and for the diversity of the human diet (12%). From the acquired answers it is encouraging that the new generation of the students sees the importance of the protection of the sea, both the marine environment and by extension its resources. The low perception of other aspects, such as climate change and dietary diversification, might be due to the complexity of the problem and difficulty to comprehend such broad concepts. On the other hand, environmental protection and food requirements are more simple concepts, benefiting of vast media coverage.

4. Can the provided information help you in making a decision about your further education?

Croatia

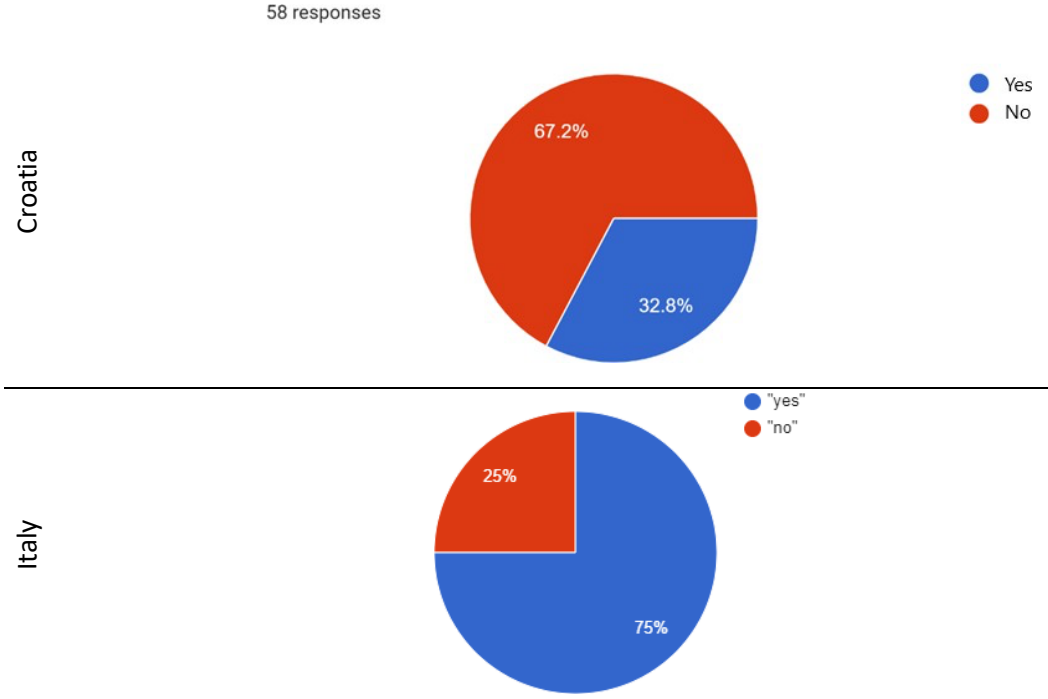


Italy



Both in Croatia (77.6% of respondents) and in Italy (67%) believe that the workshop contributed to an easier choice of decision in which direction to continue their education. It is possible that among the positive answers there are also those who know that they do not want to continue their career path in this sub-sector. However, the workshop itself was made attractive, with the aim of attracting young personnel to this sector, so such a claim is unlikely.

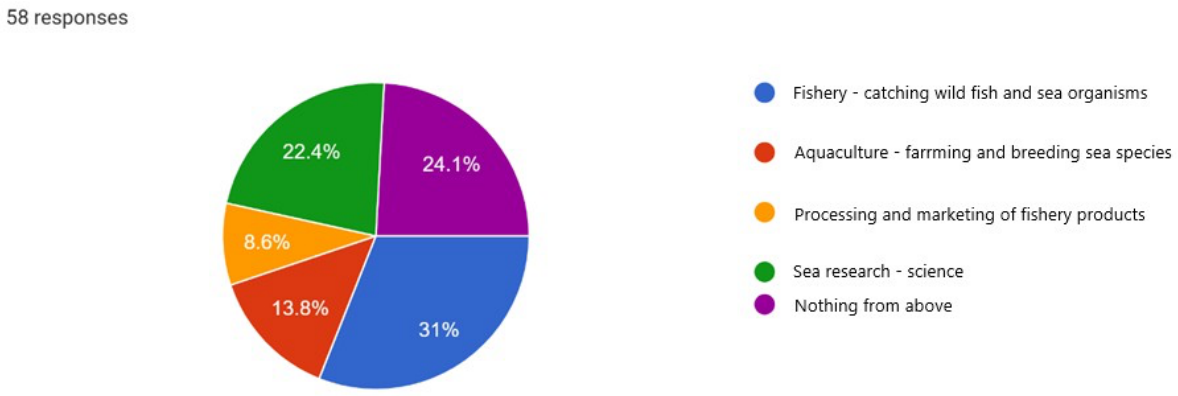
5. Can you see yourself as tomorrow's employee in the fishing sector?



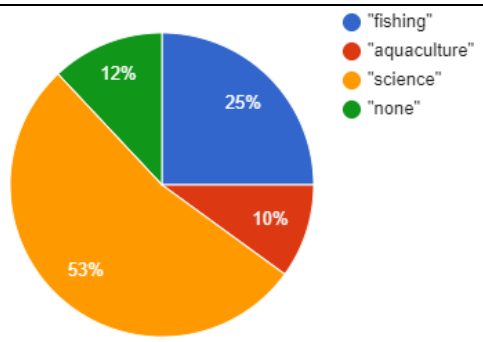
We see a big difference between the answers obtained in Croatia and Italy. In Croatia only 32.8% of students wish to continue their education in the area of this sub-sector, while the respondents in Italy said 75% could see themselves in the future employed in the fisheries sector. This figure is 32.8%. This is not a sufficient number compared to a representative sample, so there might be a need to invest much more effort in the promotion of employment in this sector.

6. Which part of fishing attracts you the most?

Croatia

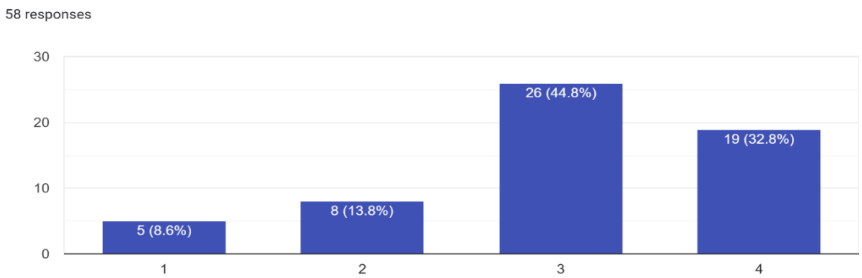


Italy



In Croatia most of the students are interested in the fishing sector (31%), followed by research of the sea through science (22.4%). In Italy the situation was opposite, where the majority of the students was interested in the scientific sector (53%) and followed by the fishing sector (15%). Given that a large part of the workforce will be concentrated in aquaculture in the future, it is clear that this sector needs strong promotion.

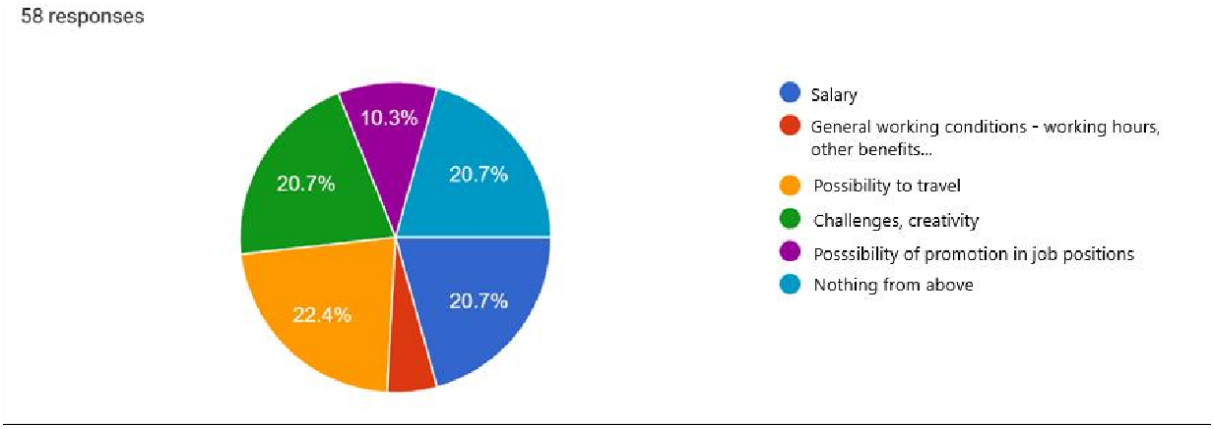
7. How important are the working conditions at your future employer?



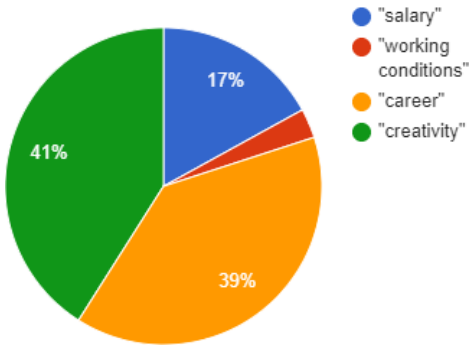
In Croatia, the respondents indicae that the working conditions at their future job are very important to them.

8. What would motivate you to work in the fishing sector?

Croatia



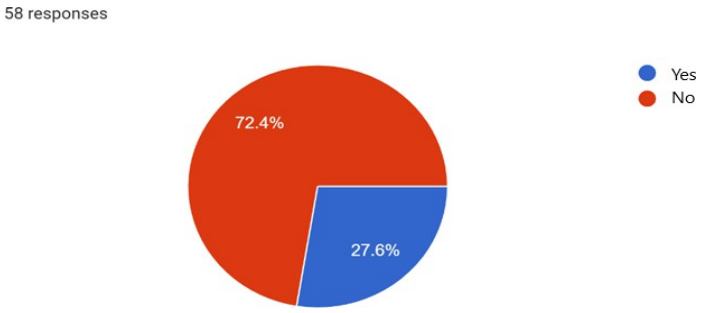
Italy



The majority of respondents consider that the working conditions of future employers are important to them. In Croatia the majority of students are most interested in the level of income, new challenges and creativity, and the possibility of travel. In Italy the majority of respondents consider that the opportunity to have a career and express their creativity are the major motivators for them in pursuing the employment in the fishery sector.

These areas should be used for future promotions of this sub-sector, because this is what young people expect from this industry.

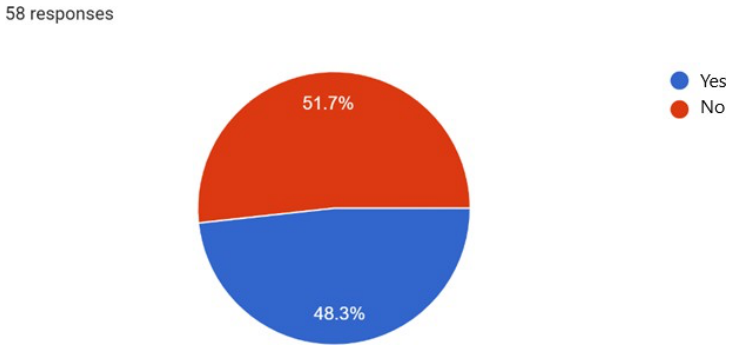
9. Are you interested in the possibility of employment in the breeding sector (aquaculture)?



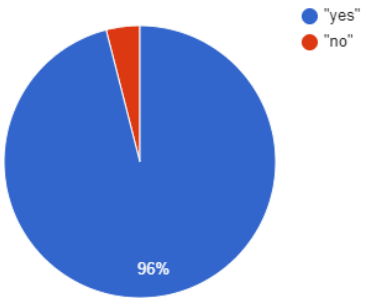
It is worrying to see the result in Croatia that speaks of the interest of employment in the breeding or aquaculture sector, 72.4% of them are not seen in this sub-sector, which is crucial for supplementing the growing demand for fish products on the European market and which is impossible to satisfy only with fishing. It is necessary to pay more attention to this area in future workshops.

10. Do you have a desire to learn more about marine biology and do research in that area?

Croatia



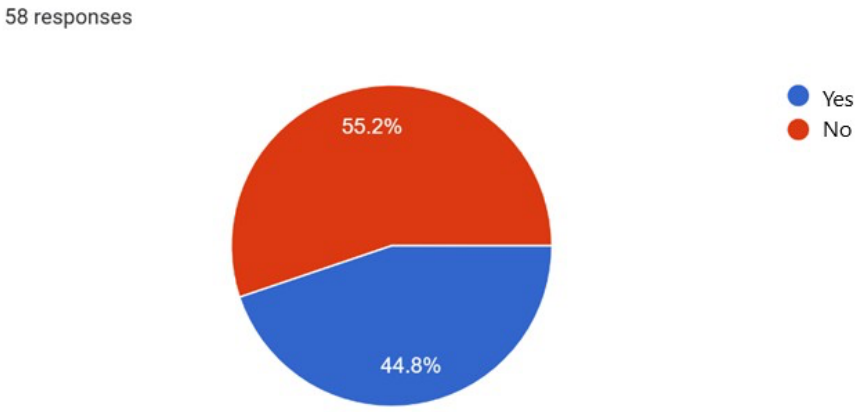
Italy



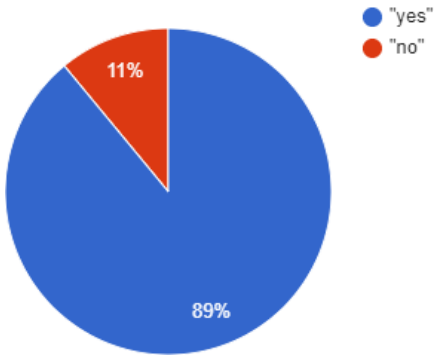
There is a contrast between respondents in Italy, where the majority expressed their interest in the marine biology, while in Croatia a little less than half expressed their desire to learn more about marine biology.

11. Are you interested in innovations, new technologies, informatics, robotics in the field of fishing?

Croatia



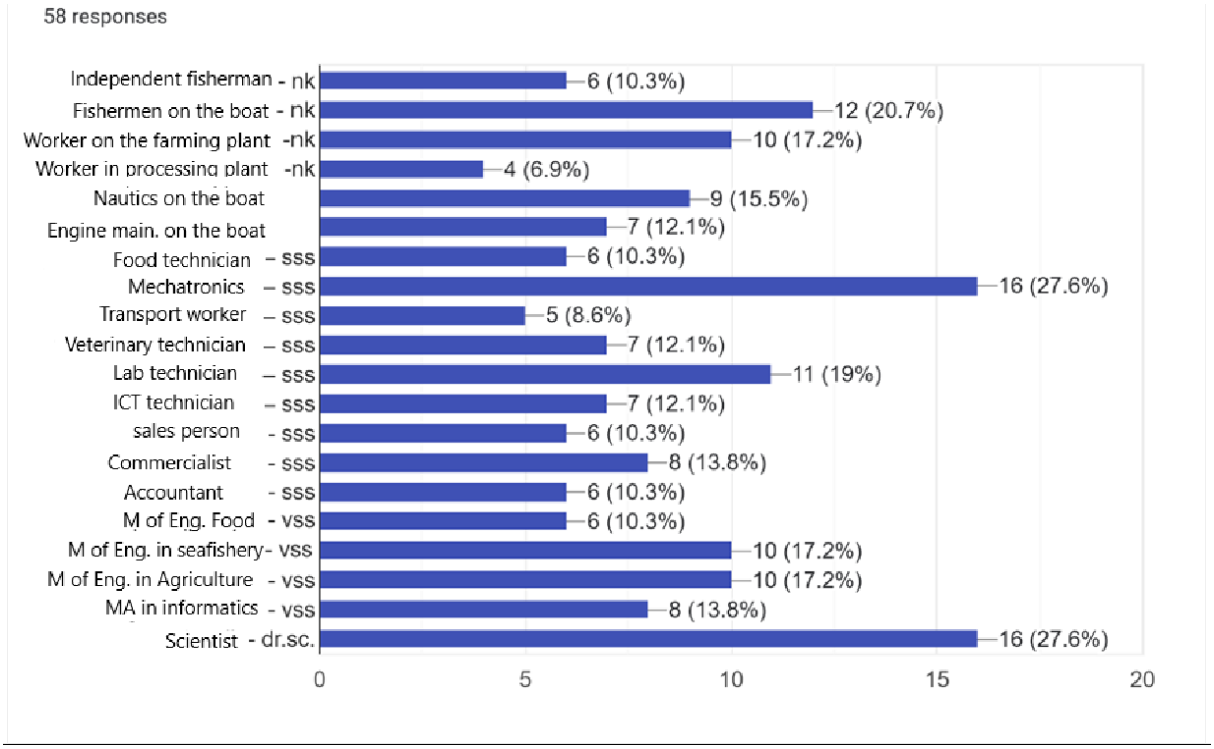
Italy



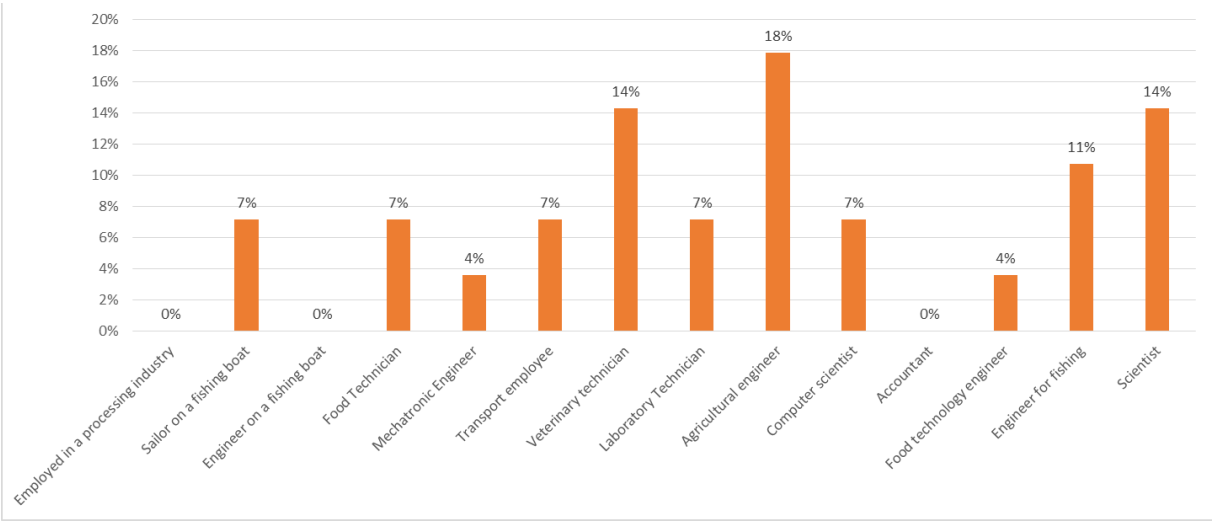
Similarly, to previous question, there is a more interest to innovations, new technologies, informatics and robotics in the field of fishing in Italy (89%) than in Croatia (45%). There might be a difference in education or the perception of the presented field between two respondents. Given that the younger generations are more computer literate, they have the opportunity to join robotics and automation programs already in the early stages of their education, the answers to the 9th and 10th questions should be looked at with special attention. Why are the new generations in Croatia not more interested in innovations, new technologies, research that has been made easier for them? It certainly remains as a suggestion for future workshops.

12. Which of the offered professions would you choose?

Croatia



Italy



The answer to the last question is interesting, how do young people see themselves as future scientists, mechatronics engineers, fishermen on a boat. One gets the impression that they are still not completely clear, which is understandable because they are in the adolescence phase which course to choose, which qualifications to focus on.

Most interested in Croatia are mechatronics and scientist (both 27.6%), while in Italy agricultural engineer (18%), veterinary technician (14%) and scientist (14%).

At the workshop, the employers presented all the benefits of working in this subsector, the reactions of the students were very positive. It is necessary to invest greater efforts in workshops and student encounters with the real sector, and even through visits to employers (processing factories, research laboratories, farms, etc.).

7. RECOMMENDATIONS FOR THE DEVELOPMENT OF INNOVATIVE CAREERS IN THE BLUE SECTOR

The results of the held workshop showed that it is necessary to hold workshops in this sub- sector, but also in other sub-sectors of the Blue Economy, in order to provide young people with fresh and adequate information from the market and to keep them constantly informed. This is a serious deficiency in the promotion of careers, because there are very few workshops, especially those aimed at students and the young working population who live in coastal areas where industrial opportunities are great.

Recommendations for the promotion of blue careers and the attraction of young staff should certainly include regular and continuous counselling and informing of students, connections with producers, involvement in events from the area of the Blue sector. Currently, there is no better instrument than the gathering of all stakeholders in one place, where it is possible for young people to interact with experts from all spheres of the Blue Sector. In addition to the workshops, it is necessary to start with organized lectures in schools, which would popularize this sector through short information about the news on the market, adapted to the ages. According to the expressed interest of the representatives of the sector, it is possible to connect schools and producers who are interested in organized visits of students to fish processing factories, farms, hatcheries, laboratories, in order to bring them closer to their possible future profession in a realistic way. Often, these approaches make the sector itself far more attractive than young staff imagine. Today, modern technologies, modern methods and approach to work are present in such plants, which is still a big unknown among young people.

The Blue careers fair is also recommended, which can bring together representatives of all interested producers to present employment opportunities and working conditions in their production facilities, farms, and vessels. In this way, it is possible to contribute to changing the perception of young people who, due to insufficient information, often choose "proven" professions and already outdated programs for further education.

8. CONCLUSION

The blue economy will need a large number of highly skilled and qualified professionals. However, today many sectors of the blue economy have difficulties in finding the right people, which hinders their growth. Blue careers projects focus on concrete actions to close the skills gap, tackle unemployment and increase the attractiveness of blue careers among students and young professionals.

The traditional sectors of the blue economy contribute about 1.5% of the GDP of the EU-27 and provide about 5 million direct jobs, i.e. 2.3% of the total employment in the EU-27. Innovative emerging blue economy sectors such as ocean renewable energy, blue biotechnology and algae production are adding new markets and creating jobs. The presented data are presented without calculating the indirect and induced effects on income and employment.

With such enormous potential, it is no wonder that the European Green Deal envisages a central role for the Blue Economy in alleviating the EU's multiple demands on land resources and addressing climate change. The sector can contribute by improving the use of water and marine resources, and by promoting the production and use of new protein sources that can reduce the pressure on agricultural lands.

The labour problem has become even worse after the COVID-19 pandemic, which has taken a devastating toll in terms of job losses in several sectors of the blue economy, and now there is also the problem of energy supplies due to the emerging war between Russia and the West in 2022. For these reasons, Over the past few years, the European Commission's Directorate- General for Maritime Affairs and Fisheries has been working to resolve this discrepancy, with the following objectives:

• reducing the skills gap between education supply and labour market needs

• improving communication and cooperation between education and industry

• improving attractiveness and awareness of career opportunities in the blue economy

• improving the perception of blue professions, starting with oceanic literacy, which is the basis of all this

The European Commission is increasing the number of calls for co-financing of programs aimed at the development of blue careers with the aim of supporting cooperation projects between companies and education, at the local level, the level of the regional sea basin or the transnational level. Such tenders and calls are aimed at concrete actions to close the skills gap, tackle unemployment and increase the attractiveness of blue-collar careers among students and young professionals.

9. LITERATURE

1. MARITIME FORUM, Cluster story: Blue Careers & Skills | Maritime Forum (europa.eu)

2. SUBMON, Filling the gap: possible needs in terms of blue careers - SUBMON

3. Blue Economy Report 2022., 2022-blue-economy-report_en.pdf (europa.eu)

4. Zakon o morskom ribarstvu, Zakon o morskom ribarstvu - Zakon.hr

5. Ministarstvo poljoprivrede, Uprava ribarstva, Rezultati radionice Promocija karijera u Plavom sektoru

6. FARNET, Europska Komisija, FARNET_HR_3.pdf (euribarstvo.hr)

7. Blue Smart, Akvakultura | Blue Smart

8. Europski Parlament, Marketing of and trade in fishery and aquaculture products in the EU (europa.eu)

9. National Development Strategy of the Republic of Croatia until 2030.

10. National Island Development Plan 2021-2027.

11. FAO. 2022. The State of Mediterranean and Black Sea Fisheries 2022. General Fisheries Commission for the Mediterranean. Rome. https://doi.org/10.4060/cc3370en

12. European Market Observatory for fisheries and aquaculture (EUMOFA). https://www.eumofa.eu/home

13. EU 2022. The EU Fish Market. Report year 2022. 118 pp.

14. ISTAT, Conti economici nazionali - Anno 2020, ISTAT, Occupati e disoccupati dicembre 2020

15. Guidi, L., Fernandez Guerra, A., Canchaya, C., Curry, E., Foglini, F., Irisson, J.-O., Malde, K., Marshall, C. T., Obst, M., Ribeiro, R. P., Tjiputra, J., Bakker, D. C. E. (2020) Big Data in Marine Science. Alexander, B., Heymans, J. J., Muñiz Piniella, A., Kellett, P., Coopman, J. [Eds.] Future Science Brief 6 of the European Marine Board, Ostend, Belgium.